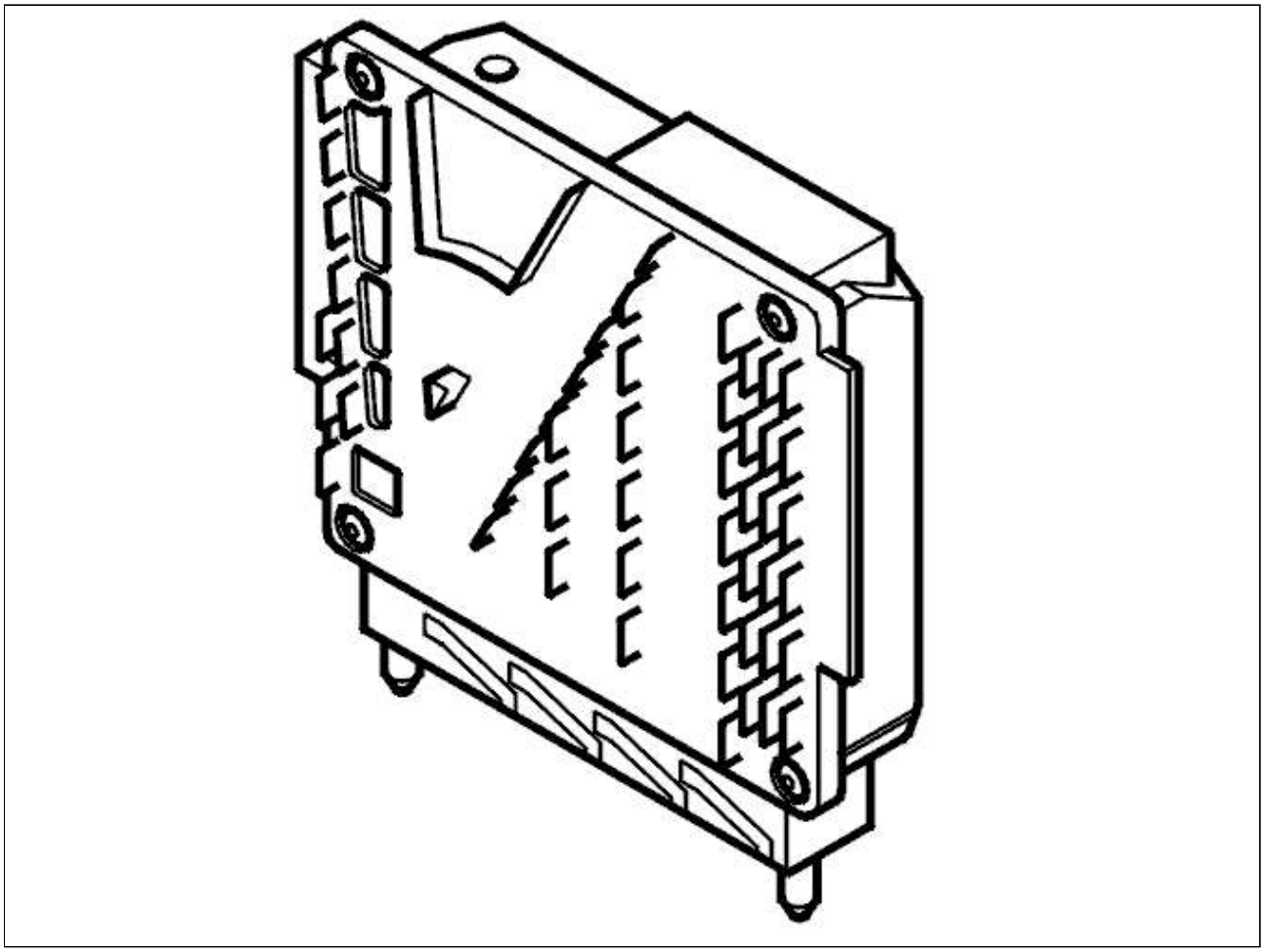
YMMS: 2001 Volvo S80 Base
Engine: 2.9L Eng
VIN:

Mar 30, 2022
License:
Odometer:

Bosch ME 7 Engine Control Module (ECM)

Fig 1: Identifying Engine Control Module



Courtesy of VOLVO CARS OF NORTH AMERICA.

Integrated atmospheric pressure sensor

Signal Specification (5 Cylinder Turbocharged Engines 2002)

General
All values given below are between the terminals stated in column 1 and breakout box terminal in the control module) and terminal B3 in column 2 (terminal in the breakout box) unless otherwise indicated in column 6 (Miscellaneous).

NOTE: *It is important to connect the breakout box and check the ground terminals before taking readings.*

U=	DC voltage in volts (V)	U_{AC} =	AC voltage in volts (V)
U_{bat} =	Battery voltage (V)	f =	Frequency in Hertz (Hz)
U_{low} =	Voltage approximately 0 V	% duty =	Duty cycle (pulse ratio) as a percentage (%)
t =	Time in milliseconds (ms)	I =	Current in amperes (A)

Control module terminal	**Breakout box terminal**	**Signal type**	**Ignition on**	**Engine idling**	**Other**
#A1	#A1	Throttle unit signal, potentiometer 1 (circuit 1)	U ≈ 0.4 -4 V	-	The voltage varies depending on the position of the throttle. U increases with throttle opening.
#A2	#A2	-	-	-	
#A3	#A3	-	-	-	
#A4	#A4	Signal (+) engine coolant temperature (ECT) sensor	-	(+30°C) U=1.22 V (+80°C) U = 0.29 V (+100°C) U = 0.17 V	
#A5	#A5	Signal (+) Intake air temperature (IAT) sensor	-	(+20°C) U = 3.50 V (+30°C) U = 3.00 V (+40°C) U = 2.50 V	
#A6	#A6	Control signal, rear heated oxygen sensor (HO2S) preheating	U = Ubat	Preheating off: U = U_{bat} Preheating on U=U_{low}	
#A7	#A7	Engine cooling fan (FC) control signal	Pulse width modulation (PWM) signal U_{high} at least 70% of U_{bat} U_{low} =1.2V f = 100 Hz Pulse ratio = 10-95%	-	
#A8	#A8	-	-		
#A9	#A9	Control signal, canister purge (CP) valve	U = U_{bat}		PWM signal during activation of the canister

					purge (CP) valve
#A10	#A10	-	-	-	
#A11	#A11	-	-	-	
#A12	#A12	-	-	-	
#A13	#A13	-	-	-	
#A14	#A14	Injector no. 5 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A15	#A15	Injector no. 3 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A16	#A16	Injector no. 1 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A17	#A17	Power supply	$U = U_{bat}$	-	Supplied via the system relay
#A18	#A18	Control signal, front heated oxygen sensor (HO2S) preheating	$U = U_{bat}$	Preheating off: $U = U_{bat}$ Preheating on: $U=U_{low}$	
#A19	#A19	Signal ground, throttle unit, potentiometers 1 and 2	$U=U_{low}$	-	
#A20	#A20	Throttle unit signal, potentiometer 2 (circuit 2)	$U \approx 4$ -0.4 V	-	The voltage varies depending on the position of the throttle. U decreases with increasing throttle opening.
#A21	#A21	Exhaust camshaft reset valve control signal (turbocharged engines only)	-	Pulse width modulation (PWM) signal $U_{top} = U_{bat}$ f=250 Hz (+-12.5 Hz) Pulse ratio 20-95%	The pulse ratio governs control of the camshaft
#A22	#A22	Mass air flow (MAF) sensor signal	U = 1 V	U = 1.7 V	U increases with increasing air mass
#A23	#A23	Boost pressure sensor signal (turbocharged engines only)	U = 1.96 V	-	U increases with increasing boost pressure
#A24	#A24	Front heated oxygen sensor (HO2S), pump current	-	-	Pulsed current supply, not measured

#A25	#A25	-	-	-	
#A26	#A26	Oil pressure switch signal	$U=U_{low}$	$U = U_{bat}$	
#A27	#A27	Signal (+), camshaft position (CMP) sensor exhaust camshaft	U =5 V	U = Pulsed signal U_{top} =5 V U_{offset} = 2.5V	The frequency varies according to engine speed (RPM)
#A28	#A28	Front heated oxygen sensor (HO2S), calibration current	-	-	Not measured
#A29	#A29	Power supply, 5 V camshaft position (CMP) sensor	U =5 V		
#A30	#A30	Ignition coil no. 2 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A31	#A31	Ignition coil no. 1 control signal	$U=U_{low}$	U=2.5 V t_{high} =2.5 ms	The frequency varies according to engine speed (RPM)
#A32	#A32	-	-	-	
#A33	#A33	Injector no. 4 control signal	$U = U_{bat}$	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A34	#A34	Injector no. 2 control signal	$U = U_{bat}$	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A35	#A35	Control signal (+) damper motor for the throttle unit	-	PWM signal U_{top} =U_{bat}	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A36 (breakout box terminal #A36)
#A36	#A36	Control signal (-) damper motor for the throttle unit	-	PWM signal U_{top} =U_{bat}	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A35 (breakout box terminal #A35)
#A37	#A37	-	-	-	
#A38	#A38	Control signal for the turbocharger (TC) control valve (turbocharged engines only)	$U = U_{bat}$	-	During turbocharger (TC) control: PWM signal f = 32 Hz

#A39	#A39	Power supply 5 V, boost pressure sensor, A/C pressure sensor, mass air flow (MAF) sensor	U =5 V	-	
#A40	#A40	-	-	-	
#A41	#A41	Signal (+), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A42	#A42	Signal (-), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A43	#A43	-	-	-	
#A44	#A44	-	-	-	
#A45	#A45	Signal (+), rear knock sensor (KS)	$U=U_{low}$	-	
#A46	#A46	Signal (+) front knock sensor (KS)	$U=U_{low}$	-	
#A47	#A47	-	-	-	
#A48	#A48	Signal (+), flywheel sensor	U=2.5 V	U= sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A66 (terminal #B6 on the breakout box) The frequency increases with engine speed (RPM)
#A49	#A49	-	-	-	
#A50	#A50	Ignition coil no. 3 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A51	#A51	Ignition coil no. 5 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A52	#A52	Ignition coil no. 4 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A53	#A53	Power ground 3	U_{low}	-	
#A54	#A54	Power ground 2	U_{low}	-	
#A55	#A55	-	-	-	
#A56	#A56	-	-	-	
#A57	#A57	-	-	-	
#A58	#A58	Signal ground, mass air flow (MAF) sensor	$U=U_{low}$	-	
#A59	#A59	Power supply 5 V throttle	U =5 V	-	

		unit, potentiometers 1 and 2			
#A60	#A60	Signal ground, intake air temperature (IAT) sensor, air conditioning (A/C) pressure sensor, boost pressure sensor, engine coolant temperature (ECT) sensor	$U=U_{low}$	-	
#A61	#B1	Signal (+), rear heated oxygen sensor (HO2S)	U≈0.50 V	Above 0.6 V or below 0.3 V	
#A62	#B2	Signal (-), rear heated oxygen sensor (HO2S)	$U=U_{low}$	$U=U_{low}$	
#A63	#B3	Signal ground body	$U=U_{low}$	-	
#A64	#B4	Signal (-) front knock sensor (KS)	$U=U_{low}$	$U=U_{low}$	
#A65	#B5	Camshaft position (CMP) sensor signal ground	$U=U_{low}$	-	
#A66	#B6	Signal (-) flywheel sensor	U=2.5 V	U = sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A48 (terminal #A48 on the breakout box) The frequency increases with engine speed (RPM)
#A67	#B7	Signal (-) rear knock sensor (KS)	$U=U_{low}$	$U=U_{low}$	
#A68	#B8	Air conditioning (A/C) pressure sensor signal	U=0.9 V (at approximately 20°C)	-	U increases with pressure in the air conditioning (A/C) system
#A69	#B9	-	-	-	
#A70	#B10	-	-	-	

Control module terminal	**Breakout box terminal**	**Signal type**	**Ignition on**	**Engine idling**	**Other**
#B1	#B11	Control modules communication cable (CAN L)	-	-	
#B2	#B12	-	-	-	
#B3	#B13	-	-	-	
#B4	#B14	Signal ground, intake air temperature	$U=U_{low}$		

		(IAT) sensor, clutch pedal sensor			
#B5	#B15	Signal ground, accelerator pedal (AP) position sensor	$U=U_{low}$		
#B6	#B16	-	-	-	
#B7	#B17	Control signal, leak diagnostic unit, pump	Pump motor running: $U=U_{low}$ Pump motor not running: $U = U_{bat}$	-	
#B8	#B18	Signal (+), coolant level sensor	$U=U_{low}$	Low engine coolant level: $U = U_{bat}$ Normal engine coolant level: U = Ulow	
#B9	#B19	Power supply, 5 V accelerator pedal (AP) position sensor	U =5 V	-	
#B10	#B20	-	-	-	
#B11	#B21	30-supply (Power supply from the battery)	$U = U_{bat}$	$U = U_{bat}$	Ignition off: $U = U_{bat}$
#B12	#B22	-	-	-	
#B13	#B23	Control module communication cable (CAN H)	-	-	
#B14	#B24	-	-	-	
#B15	#B25	Clutch pedal sensor signal	Unaffected: U=3.3 V Fully depressed: 100mm U = 2.2 V		U varies depending on the position of the clutch pedal
#B16	#B26	-	-	-	
#B17	#B27	Signal, accelerator pedal (AP) position sensor	U = 0.4 0.1 V with unaffected accelerator pedal (AP) U=2.5-4.4 V = the accelerator pedal (AP) fully depressed		U varies depending on the position of the accelerator pedal (AP)

			On certain vehicles the accelerator pedal (AP) will be at the limit position before the signal reaches 4.4 V.		
#B18	#B28	-	-	-	
#B19	#B29	-	-	-	
#B20	#B30	-	-	-	
#B21	#B31	-	-	-	
#B22	#B32	Diagnostic lead C-link	U=90% of U_{bat}	-	Other values apply if a generic fault-tracing instrument is connected to the data link connector (DLC)
#B23	#B33	Signal (+) crank, 50-supply	U=U_{low}	U=U_{low}	At crank: U = U_{bat}
#B24	#B34	-	-	-	
#B25	#B35	Signal (+), accelerator pedal (AP) position sensor	U_{top} =12 V t = 4 ms pulse ratio=8% 2% with unaffected accelerator pedal (AP) and 50% - 90% with fully depressed accelerator pedal (AP) On certain vehicles the accelerator pedal (AP) will be at the limit before the signal reaches 90%.	-	Pulse width modulation (PWM) signal from the accelerator pedal (AP) position sensor to the engine control module (ECM)
#B26	#B36	Signal (+), stop lamp switch	When the brake pedal is depressed: U = U_{bat} When the brake pedal is not depressed U=U_{low}	-	
#B27	#B37	-	-	-	
#B28	#B38	-	-	-	
#B29	#B39	Signal, outside temperature sensor	(0° C) U=2.92 V (+10° C) U=2.40V (+20° C) U=1.90 V (+30°C) U = 1.46 V		Temperature range: -40 to +30°C
#B30	#B40	-	-	-	
#B31	#B41	-	-	-	
#B32	#B42	-	-	-	
#B33	#B43	-	-	-	

#B34	#B44	-	-	-	
#B35	#B45	-	-	-	
#B36	#B46	-	-	-	
#B37	#B47	Signal, ignition on, 15-supply	U = U_{bat}	U = U_{bat}	Ignition off: U=U_{low}
#B38	#B48	System relay, control signal	-	U=U_{low}	Relay activated: U=U_{low} Relay not activated: U = U_{bat} The system relay runs on (2-5 minutes)
#B39	#B49	-	-	-	
#B40	#B50	Control signal, leak diagnostic unit, valve	-		Valve activated: U = Ulow Valve not activated: U = Ubat
#B41	#B51	-	-	-	
#B42	#B52	-	-	-	
#B43	#B53	-	-	-	
#B44	#B54	Control signal, air conditioning (A/C) relay	-	-	Air conditioning (A/C) relay activated: U=U_{low} Air conditioning (A/C) relay not activated: U = U_{bat}
#B45	#B55	Fuel pump (FP) activation control signal			PWM signal to the central electronic module (CEM) to control the fuel pump (FP) relay
#B46	#B56	Malfunction indicator lamp (MIL) control signal	U=U_{low}	Not activated U=U_{bat} Activated: U=U_{low}	
#B47	#B57	-	-	-	
#B48	#B58	Control signal, engine cooling fan (FC), control modules	-	Not activated U=U_{bat} Activated: U=U_{low}	The engine cooling fan (FC) is controlled by the engine control module (ECM)
#B49	#B59	-	-	-	
#B50	#B60	-	-	-	

Signal Specification (5-Cylinder Naturally Aspirated Engines)

General

All values given below are between the terminals stated in column 1 and breakout box terminal #B2. Control module terminals #A1-#A60 correspond to terminals #A1-#A60 on the breakout box, terminals #A61-#A70 correspond to terminals #B1-#B10 on the breakout box and terminals #B1-#B50 correspond to terminals #B10-#B60 on the breakout box.

> **NOTE:** *It is important to connect the breakout box and check the ground terminals before taking readings.*

HINT: If the numbering of the connector is different from the numbering on the breakout box, the connector number is given first, terminal #A61, followed by the breakout box number in brackets, (terminal #B1). Example: #A61 (#B1).

U=	DC voltage in volts (V)	U A/C =	AC voltage in volts (V)
U_{bat} =	Battery voltage in volts (V)	f =	Frequency in Hertz (Hz)
U_{low} =	Voltage approximately 0 V	%pulse =	Pulse ratio (%)
t =	Time in milliseconds (ms)		

Connector terminals #A1-#A70

Terminal	Breakout box	Signal type	Ignition on	Idle	Other
#A1	(#A1)	-	-	-	-
#A2	(#A2)	Control signal Canister purge (CP) valve	U = Ubat	-	Pulse width modulation (PWM) signal during activation of the EVAP canister shut-off valve
#A3	(#A3)	-	-	-	-
#A4	(#A4)	Signal (+) intake temperature sensor, integrated in the mass air flow (MAF) sensor	-	(+10°C) U=2.01 V (+20°C) U=2.62 V (+30°C) U=3.21 V	-
#A5	(#A5)	-	-	-	-
#A6	(#A6)	-	-	-	-
#A7	(#A7)	Control signal to the engine cooling fan control module	Pulse width modulation (PWM) signal Ulow = 1.5 V pulse ratio = 10 %-90 %	- Uhigh = Ubat -1.5 V f=100Hz	-
#A8	(#A8)	-	-	-	-

#A9	(#A9)	-	-	-	-
#A10	(#A10)	-	-	-	-
#A11	(#A11)	Control signal preheating rear heated oxygen sensor (HO2S)	U = Ubat	Preheating OFF U = Ubat Preheating ON U = Ulow	-
#A12	(#A12)	Reset valve camshaft	Pulse width modulation (PWM) signal Utop = Ubat t = 0.6 ms pulse ratio = 14 %	Pulse width modulation (PWM) signal Utop = Ubat -1 V t=2 ms pulse ratio = 50 %	The pulse ratio changes with engine speed (RPM)
#A13	(#A13)	-	-	-	-
#A14	(#A14)	Control signal injector 5	U = Ubat	t = 2-3 ms	t increases with engine speed (RPM) and load
#A15	(#A15)	Control signal injector 3	U = Ubat	tlow = 2-3 ms	t increases with engine speed (RPM) and load
#A16	(#A16)	Control signal injector 1	U = Ubat	tlow = 2-3 ms	t increases with engine speed (RPM) and load
#A17	(#A17)	-	-	-	-
#A18	(#A18)	Control signal preheating front heated oxygen sensor (HO2S)	U = Ubat	Preheating OFF U = Ubat Preheating ON U = Ubat	-
#A19	(#A19)	-	-	-	-
#A20	(#A20)	-	-	-	-
#A21	(#A21)	Signal A/C pressure sensor	U=0.9 V (at approximately 20°C)	-	U increases with increased pressure in the system
#A22	(#A22)	Mass air flow (MAF) sensor signal	U = 0.58 V	U = 1.33 V Unloaded, engine at operating temperature	U increases with increasing air mass
#A23	(#A23)	Signal manifold absolute pressure (MAP) sensor	U = 1.64 V atmospheric pressure at sea level	-	U increases with increasing pressure in the intake manifold

#A24	(#A24)	Signal (+) front heated oxygen sensor (HO2S) signal (+)	-	λ=0.95 V>700 mV λ=1.10 V<200 mV	-
#A25	(#A25)	-	-	-	-
#A26	(#A26)	-	-	-	-
#A27	(#A27)	-	-	-	-
#A28	(#A28)	Signal ignition discharge module (IDM) check, ignition coils	-	-	-
#A29	(#A29)	Control signal ignition coil no. 3	U = Ulow	U = 2.5 volt thigh = 2 ms	The frequency varies according to engine speed (RPM)
#A30	(#A30)	Control signal ignition coil no. 2	U = Ulow	U = 2.5 volt thigh = 2 ms	The frequency varies according to engine speed (RPM)
#A31	(#A31)	Control signal ignition coil no. 1	U = Ulow	U = 2.5 volt thigh = 2.5 ms	The frequency varies according to engine speed (RPM)
#A32	(#A32)	-	-	-	-
#A33	(#A33)	Control signal injector 4	U = Ubat	tlow = 2-3 ms	t increases with engine speed (RPM) and load
#A34	(#A34)	Control signal injector 2	U = Ubat	tlow = 2-3 ms	t increases with engine speed (RPM) and load
#A35	(#A35)	-	-	-	-
#A36	(#A36)	Power ground preheating, front heated oxygen sensor (HO2S)	U = Ulow	-	-
#A37	(#A37)	Communication cable control modules (CAN H)	-	-	Between the engine control module (ECM) and the throttle unit
#A38	(#A38)	Control signal stop lamp switch	U = Ulow (not activated) U = Uhigh (activated)	-	Between the engine control module (ECM) and the throttle unit
#A39	(#A39)	Oil pressure switch	U = Ulow (no oil pressure)	U = Ubat	-
#A40	(#A40)	Signal (+) engine coolant temperature (ECT) sensor	-	(+20°C) U = 3.1 V (+30°C) U = 2.6 V	-

				(+80°C) U = 0.9 V (+100°C) U = 0.5 V	
#A41	(#A41)	Signal (-) front heated oxygen sensor (HO2S)	-	λ=1 when the current is approximately +0.2 mA	Negative current when the fuel air mixture is rich. Range: [-12 mA, +12 mA]
#A42	(#A42)	Signal (+) front heated oxygen sensor (HO2S)	-	λ= 1 when the current is approximately +0.2 mA	Positive current when the fuel air mixture is lean. Range: [-12 mA, +12 mA]
#A43	(#A43)	-	-	-	-
#A44	(#A44)	-	-	-	-
#A45	(#A45)	-	-	-	-
#A46	(#A46)	Signal (+) knock sensor (KS)	-	-	-
#A47	(#A47)	Signal (+) camshaft position (CMP) sensor	U≈5 V or U=Ulow	f≈35 Hz U≈2.5 V	The frequency increases with engine speed (RPM)
#A48	(#A48)	Signal (+) flywheel sensor	U=2.5 V	U = sine wave voltage Utop = 3.5 V Uoffset = 2.5 V	-
#A49	(#A49)	-	-	-	-
#A50	(#A50)	Control signal ignition coil no. 5	U = Ulow	U = 2.5 volt thigh = 2 ms	The frequency varies according to engine speed (RPM)
#A51	(#A51)	Control signal ignition coil no. 4	U = Ulow	U = 2.5 volt thigh = 2 ms	The frequency varies according to engine speed (RPM)
#A52	(#A52)	Control signal Air assisted control valve (AACV)	-	-	-
#A53	(#A53)	Power ground 3	Ulow	-	-
#A54	(#A54)	Power ground 2	Ulow	-	-
#A55	(#A55)	Communication cable control modules (CAN L)	-	-	Between the engine control module (ECM) and the throttle unit
#A56	(#A56)	Control signal accelerator pedal (AP) position sensor, pulse	Utop = 12 V t = 4 ms	-	Between the engine control module (ECM) and the throttle unit

		width modulation (PWM) signal	pulse ratio = 8 %-88 %		
#A57	(#A57)	Power supply, camshaft position (CMP) sensor	U =5 V	-	-
#A58	(#A58)	Power supply, manifold absolute pressure (MAP) sensor A/C pressure sensor	U =5 V	-	-
#A59	(#A59)	-	-	-	-
#A60	(#A60)	Signal ground mass air flow (MAF) sensor	U = Ulow	-	-
#A61	(#B1)	Signal ground intake temperature engine coolant temperature (ECT) sensor rear heated oxygen sensor (HO2S)	U = Ulow	-	-
#A62	(#B2)	Power ground 1	U = Ulow	-	-
#A63	(#B3)	-	-	-	-
#A64	(#B4)	Signal (-) knock sensor (KS)	-	-	-
#A65	(#B5)	Signal ground camshaft position (CMP) sensor	U = Ulow	-	-
#A66	(#B6)	Signal ground flywheel sensor	U = Ulow	-	-
#A67	(#B7)	-	-	-	-
#A68	(#B8)	-	-	-	-
#A69	(#B9)	Control signal preheating front heated oxygen sensor (HO2S)	U = Ubat	Preheating off U = Ubat Preheating U = Ubat	B+ from the system relay
#A70	(#B10)	Power supply	U = Ubat	-	B+ from the system relay

Connector terminals #B1-#B50

Terminal	Breakout box	Signal type	Ignition on	Engine idling	Other
#B1	(#B11)	Communication cable	-	-	Between the engine control module (ECM)

		control modules (CAN L)			and the transmission control module (TCM)
#B2	(#B12)	-	-		-
#B3	(#B13)	-	-	-	-
#B4	(#B14)	Signal ground intake manifold air temperature sensor fuel tank pressure sensor clutch pedal sensor brake pedal sensor	U = Ulow	-	-
#B5	(#B15)	Signal ground accelerator pedal (AP) position sensor	U = Ulow	-	-
#B6	(#B16)	-	-	-	-
#B7	(#B17)	-	-	-	-
#B8	(#B18)	Coolant level sensor	U = Ulow	-	-
#B9	(#B19)	Power supply accelerator pedal (AP) position sensor, analog sensor	U =5 V	-	-
#B10	(#B20)	Power supply fuel tank pressure sensor	U =5 V	-	-
#B11	(#B21)	30-supply (Power supply from the battery)	U = Ubat	-	-
#B12	(#B22)	-	-	-	-
#B13	(#B23)	Control modules communication cable (CAN H)	-	-	Between the engine control module (ECM) and the transmission control module (TCM)
#B14	(#B24)	-	-	-	-
#B15	(#B25)	Signal clutch pedal sensor	U=3.3 V (unaffected) U = 2.2 V (fully	-	Varies depending on the position of the clutch pedal

			depressed, 100 mm)		
#B16	(#B26)	Signal brake sensor	U = 4.4 V (unaffected) U = 3.9 V (25 mm depressed)	-	Varies depending on the position of the brake pedal
#B17	(#B27)	Signal accelerator pedal (AP) position sensor, analog signal	U=0.4 V (idle) U=4.4 V (wide open throttle (WOT))	-	Varies depending on the position of the accelerator pedal (AP)
#B18	(#B28)	-	-	-	-
#B19	(#B29)	-	-	-	-
#B20	(#B30)	-	-	-	-
#B21	(#B31)	-	-	-	-
#B22	(#B32)	Diagnostic lead C-link	U=90 % of Ubat	Other values apply if a generic fault-tracing instrument is connected to the data link connector (DLC)	-
#B23	(#B33)	Signal (+) crank, +50 supply	U = Ulow	U = Ulow	U = Ubat at crank
#B24	(#B34)	-	-	-	-
#B25	(#B35)	Signal (+) accelerator pedal (AP) position sensor, Pulse width modulated (PWM) signal	Utop = Ubat t = 4 ms pulse ratio = 8-88%	-	Between the accelerator pedal (AP) position sensor and the engine control module (ECM)
#B26	(#B36	Signal (+) stop lamp switch	U = Ubat when the brake pedal is depressed U = Ulow when the brake pedal is not depressed	-	-
#B27	(#B37)	-	-	-	-
#B28	(#B38)	-	-	-	-
#B29	(#B39)	Signal outside	(0°C) U = 3.99 V (+10°C) U =	-	Temperature range: -50°C to +120°C

		temperature sensor	3.53 V (+20°C) U = 3.01 V (+30°C) U = 2.47 V		
#B30	(#B40)	-	-	-	-
#B31	(#B41)	Signal fuel tank pressure sensor	U = 2.5 V at 1 kPa negative pressure U=3.3 V at atmospheric pressure (0 kPa overpressure) U=4.1 V at 1 kPa overpressure	-	-
#B32	(#B42)	-	-	-	-
#B33	(#B43)	-	-	-	-
#B34	(#B44)	-	-	-	-
#B35	(#B45)	-	-	-	-
#B36	(#B46)	-	-	-	-
#B37	(#B47)	Signal ignition ON signal, +15 supply	U = Ubat	-	-
#B38	(#B48)	System relay control signal	U = Ulow	U = Ulow	Relay activated: U = Ulow Relay not activated: U = Ubat The system relay runs on (2-5 minutes)
#B39	(#B49)	-	-	-	-
#B40	(#B50)	Control signal EVAP canister shut-off valve	U=3.82 V	-	-
#B41	(#B51)	-	-	-	-
#B42	(#B52)	-	-	-	-
#B43	(#B53)	-	-	-	-
#B44	(#B54)	Control signal A/C activation	U = Ubat (not activated) U = Ulow (activated)	-	-
#B45	(#B55)	Control signal	Pulse width	-	Control signal to the

		fuel pump (FP) activation	modulation (PWM) signal		central electronic module (CEM) to control the fuel pump (FP)
#B46	(#B56)	Control signal malfunction indicator lamp (MIL)	U = Ulow	U = Ubat (not activated) U = Ulow (activated)	-
#B47	(#B57)	-	-	-	-
#B48	(#B58)	Control signal engine start inhibiting	U = Ulow (activated) U = Uhigh (not activated)	-	Certain markets only. The engine can only be started with the clutch pedal depressed (U=Ulow)
#B49	(#B59)	-	-	-	-
#B50	(#B60)	-	-	-	-

Signal Specification (B5204T5; B5234T3; B5234T7; B5244T3; -2004)

General
All values listed below should be measured between the respective terminal in column 1 (control module terminal) and terminal #B3 unless stated otherwise in column 6 (Other). Control module terminals #A1-#A70 correspond to terminals #A1-#B10 on the breakout box, terminals #B1-#B50 correspond to #B11 - #B60 on the breakout box.

> **NOTE:** *It is important to connect the breakout box and check the ground terminals before taking readings.*

HINT: If the numbering of the connector is different from the numbering on the breakout box, the connector number is given first, terminal #A61, followed by the breakout box number in brackets, (#B1). Example: #A61 (#B1).

U=	DC voltage in volts (V)	U_{AC} =	AC voltage in volts (V)
U_{bat} =	Battery voltage (V)	f =	Frequency in Hertz (Hz)
U_{low} =	Voltage approximately 0 V	% duty =	Duty cycle (pulse ratio) as a percentage (%)
t =	Time in milliseconds (ms)	I =	Current in amperes (A)

Control module terminal	Breakout box terminal	Signal type	Ignition on	Engine idling	Other
#A1	#A1	Throttle unit signal, potentiometer 1 (circuit 1)	U ≈ 0.4 -4 V	-	The voltage varies depending on the position of the throttle. U increases with throttle opening.

#A2	#A2	-	-	-	
#A3	#A3	-	-	-	
#A4	#A4	Engine coolant temperature (ECT) sensor signal	-	(+30°C) U=1.22 V (+80°C) U = 0.29 V (+100°C) U = 0.17 V	
#A5	#A5	Signal intake air temperature (IAT) sensor	-	(+20°C) U = 3.50 V (+30°C) U = 3.00 V (+40°C) U = 2.50 V	The intake air temperature (IAT) sensor is integrated in the boost pressure sensor
#A6	#A6	Control signal, rear heated oxygen sensor (HO2S) preheating	U = Ubat	Preheating off: U = U_{bat} Preheating on U=U_{low}	
#A7	#A7	Engine cooling fan (FC) control signal	Pulse width modulation (PWM) signal U_{high} at least 70% of U_{bat} U_{low} =1.2V f = 100 Hz Pulse ratio = 10-95%	-	
#A8	#A8	-	-		
#A9	#A9	Control signal, canister purge (CP) valve	U = U_{bat}		PWM signal during activation of the canister purge (CP) valve
#A10	#A10	-	-	-	
#A11	#A11	-	-	-	
#A12	#A12	-	-	-	
#A13	#A13	-	-	-	
#A14	#A14	Injector no. 5 control signal	U = U_{bat}	t= 2-3 ms	t increases with engine speed (RPM) and load
#A15	#A15	Injector no. 3 control signal	U = U_{bat}	t= 2-3 ms	t increases with engine speed (RPM) and load
#A16	#A16	Injector no. 1 control signal	U = U_{bat}	t= 2-3 ms	t increases with engine speed (RPM) and load
#A17	#A17	Power supply	U = U_{bat}	-	Supplied via the system relay

#A18	#A18	Control signal, front heated oxygen sensor (HO2S) preheating	U = U_{bat}	Preheating off: U = U_{bat} Preheating on: U=U_{low}	
#A19	#A19	Signal ground, throttle unit, potentiometers 1 and 2	U=U_{low}	-	
#A20	#A20	Throttle unit signal, potentiometer 2 (circuit 2)	U ≈ 4 -0.4 V	-	The voltage varies depending on the position of the throttle. U decreases with increasing throttle opening.
#A21	#A21	Exhaust camshaft reset valve control signal	-	Pulse width modulation (PWM) signal U_{top} =U_{bat} f=250 Hz (+-12.5 Hz) Pulse ratio 20-95%	The pulse ratio governs control of the camshaft
#A22	#A22	Mass air flow (MAF) sensor signal	U = 1 V	U = 1.7 V	U increases with increasing air mass
#A23	#A23	Boost pressure sensor signal (turbocharged engines only)	U = 1.96 V	-	U increases with increasing boost pressure
#A24	#A24	Front heated oxygen sensor (HO2S), pump current	-	-	Pulsed current supply, not measured
#A25	#A25	-	-	-	
#A26	#A26	Oil pressure switch signal	U=U_{low}	U = U_{bat}	
#A27	#A27	Signal camshaft position (CMP) sensor 2 exhaust camshaft	U =5 V	U = Pulsed signal U_{top} =5 V U_{offset} = 2.5V	The frequency varies according to engine speed (RPM)
#A28	#A28	Front heated oxygen sensor (HO2S), calibration current	-	-	Not measured
#A29	#A29	Power supply, 5 V camshaft position (CMP) sensor	U =5 V		
#A30	#A30	Ignition coil no. 2 control	U=U_{low}	U=2.5 V	The frequency varies

		signal		t_{high} =2 ms	according to engine speed (RPM)
#A31	#A31	Ignition coil no. 1 control signal	U=U_{low}	U=2.5 V t_{high} =2.5 ms	The frequency varies according to engine speed (RPM)
#A32	#A32	-	-	-	
#A33	#A33	Injector no. 4 control signal	U = U_{bat}	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A34	#A34	Injector no. 2 control signal	U = U_{bat}	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A35	#A35	Control signal (+) damper motor for the throttle unit	-	PWM signal U_{top} =U_{bat}	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A36 (breakout box #A36)
#A36	#A36	Control signal (-) damper motor for the throttle unit	-	PWM signal U_{top} =U_{bat}	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A35 (breakout box #A35)
#A37	#A37	-	-	-	
#A38	#A38	Control signal for the turbocharger (TC) control valve (turbocharged engines only)	U = U_{bat}	-	During turbocharger (TC) control: Pulse width modulation (PWM) signal f = 32 Hz
#A39	#A39	Power supply 5 V, boost pressure sensor, A/C pressure sensor, mass air flow (MAF) sensor	U =5 V	-	
#A40	#A40	-	-	-	
#A41	#A41	Signal (+), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A42	#A42	Signal (-), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A43	#A43	-	-	-	
#A44	#A44	-	-	-	
#A45	#A45	Signal (+), rear knock sensor (KS)	U=U_{low}	-	

#A46	#A46	Signal (+) front knock sensor (KS)	$U=U_{low}$	-	
#A47	#A47	-	-	-	
#A48	#A48	Signal (+), flywheel sensor	U=2.5 V	U= sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A66 (terminal #B6 on the breakout box) The frequency increases with engine speed (RPM)
#A49	#A49	-	-	-	
#A50	#A50	Ignition coil no. 3 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A51	#A51	Ignition coil no. 5 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A52	#A52	Ignition coil no. 4 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A53	#A53	Power ground 3	U_{low}	-	Ground terminal connected to the chassis
#A54	#A54	Power ground 2	U_{low}	-	Ground terminal connected to the chassis
#A55	#A55	-	-	-	
#A56	#A56	-	-	-	
#A57	#A57	-	-	-	
#A58	#A58	Signal ground, mass air flow (MAF) sensor	$U=U_{low}$	-	
#A59	#A59	Power supply 5 V throttle unit, potentiometers 1 and 2	U =5 V	-	
#A60	#A60	Signal ground, Air conditioning (A/C) pressure sensor, boost pressure sensor, engine coolant temperature (ECT) sensor	$U=U_{low}$	-	
#A61	#B1	Signal (+), rear heated oxygen sensor (HO2S)	U≈0.50 V	Above 0.6 V or below 0.3 V	
#A62	#B2	Signal (-) rear heated oxygen sensor (HO2S)	$U=U_{low}$	$U=U_{low}$	

#A63	#B3	Signal ground	$U=U_{low}$	-	Ground terminal connected to the chassis
#A64	#B4	Signal (-) front knock sensor (KS)	$U=U_{low}$	$U=U_{low}$	
#A65	#B5	Camshaft position (CMP) sensor signal ground	$U=U_{low}$	-	
#A66	#B6	Signal (-) flywheel sensor	U=2.5 V	U = sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A48 (terminal #A48 on the breakout box) The frequency increases with engine speed (RPM)
#A67	#B7	Signal (-) rear knock sensor (KS)	$U=U_{low}$	$U=U_{low}$	
#A68	#B8	Signal air conditioning (A/C) pressure sensor	U=0.9 V (at approximately 20°C)	-	U increases with pressure in the air conditioning (A/C) system
#A69	#B9	-	-	-	
#A70	#B10	-	-	-	

Control module terminal	**Breakout box terminal**	**Signal type**	**Ignition on**	**Engine idling**	**Other**
#B1	#B11	Control modules communication cable (CAN L)	-	-	
#B2	#B12	-	-	-	
#B3	#B13	-	-	-	
#B4	#B14	Signal ground, clutch pedal position sensor, outside temperature sensor	$U=U_{low}$		
#B5	#B15	Signal ground, accelerator pedal (AP) position sensor	$U=U_{low}$		
#B6	#B16	-	-	-	
#B7	#B17	Control signal, leak diagnostic unit, pump	Pump motor running: $U=U_{low}$ Pump motor not running: $U = U_{bat}$	-	

#B8	#B18	Signal, coolant level sensor	$U=U_{low}$	Low engine coolant level: $U = U_{bat}$ Normal engine coolant level: U = Ulow	
#B9	#B19	Power supply, 5 V accelerator pedal (AP) position sensor	U =5 V	-	
#B10	#B20	-	-	-	
#B11	#B21	30-supply (Power supply from the battery)	$U = U_{bat}$	$U = U_{bat}$	Ignition off: $U = U_{bat}$
#B12	#B22	-	-	-	
#B13	#B23	Control module communication cable (CAN H)	-	-	
#B14	#B24	-	-	-	
#B15	#B25	Clutch pedal sensor signal	Unaffected: U=3.3 V Fully depressed: 100 mm U=2.2 V		U varies depending on the position of the clutch pedal
#B16	#B26	-	-	-	
#B17	#B27	Signal, accelerator pedal (AP) position sensor	U = 0.4 0.1 V with unaffected accelerator pedal (AP) U=2.5-4.4 V = the accelerator pedal (AP) fully depressed On certain vehicles the accelerator pedal (AP) will be at the limit position before the signal reaches 4.4 V.		U varies depending on the position of the accelerator pedal (AP)
#B18	#B28	-	-	-	
#B19	#B29	-	-	-	
#B20	#B30	-	-	-	
#B21	#B31	-	-	-	
#B22	#B32	Diagnostic lead	U=90% of U_{bat}	-	Other values apply if a

		C-link			generic fault-tracing instrument is connected to the data link connector (DLC)
#B23	#B33	Signal crank, 50-supply	$U=U_{low}$	$U=U_{low}$	At crank: $U = U_{bat}$
#B24	#B34	-	-	-	
#B25	#B35	Signal, accelerator pedal (AP) position sensor	U_{top} =12 V t = 4 ms pulse ratio=8% 2% with unaffected accelerator pedal (AP) and 50% - 90% with fully depressed accelerator pedal (AP) On certain vehicles the accelerator pedal (AP) will be at the limit before the signal reaches 90%.	-	Pulse width modulation (PWM) signal from the accelerator pedal (AP) position sensor to the engine control module (ECM)
#B26	#B36	Stop lamp switch signal	When the brake pedal is depressed: $U = U_{bat}$ When the brake pedal is not depressed $U=U_{low}$	-	
#B27	#B37	-	-	-	
#B28	#B38	-	-	-	
#B29	#B39	Signal, outside temperature sensor	(0° C) U=2.92 V (+10° C) U=2.40V (+20° C) U=1.90 V (+30°C) U = 1.46 V		Temperature range: -40 to +30°C
#B30	#B40	-	-	-	
#B31	#B41	-	-	-	
#B32	#B42	-	-	-	
#B33	#B43	-	-	-	
#B34	#B44	-	-	-	
#B35	#B45	-	-	-	
#B36	#B46	-	-	-	
#B37	#B47	Signal, ignition on, 15-supply	$U = U_{bat}$	$U = U_{bat}$	Ignition off: $U=U_{low}$
#B38	#B48	System relay, control signal	-	$U=U_{low}$	Relay activated: $U=U_{low}$ Relay not activated: $U = U_{bat}$ The system relay runs on (2-5 minutes)

#B39	#B49	-	-	-	
#B40	#B50	Control signal, leak diagnostic unit, valve	-		Valve activated: U = Ulow Valve not activated: U = Ubat
#B41	#B51	-	-	-	
#B42	#B52	-	-	-	
#B43	#B53	-	-	-	
#B44	#B54	Control signal, air conditioning (A/C) relay	-	-	Air conditioning (A/C) relay activated: U=U_{low} Air conditioning (A/C) relay not activated: U = U_{bat}
#B45	#B55	Fuel pump (FP) activation control signal			PWM signal to the central electronic module (CEM) to control the fuel pump (FP) relay
#B46	#B56	Malfunction indicator lamp (MIL) control signal	U=U_{low}	Not activated U=U_{bat} Activated: U=U_{low}	
#B47	#B57	-	-	-	
#B48	#B58	Control signal, engine cooling fan (FC), control modules	-	Not activated U=U_{bat} Activated: U=U_{low}	The engine cooling fan (FC) is controlled by the engine control module (ECM)
#B49	#B59	-	-	-	
#B50	#B60	-	-	-	

Signal Specification (B5254T4 2004)

General
All values given below are between the terminals stated in column 1 and breakout box terminal in the Control unit) and breakout box terminal #B3 unless otherwise indicated in column 6 (Miscellaneous). Control module terminals #A1-#A70 correspond to terminals #A1-#B10 on the breakout box, terminals #B1-#B50 correspond to #B11 - #B60 on the breakout box.

> **NOTE:** *It is important to connect the breakout box and check the ground terminals before taking readings.*

HINT: If the numbering of the connector is different from the numbering on the breakout box, the connector number is given first, terminal #A61, followed by the breakout box number in brackets, (#B1). Example: #A61 (#B1).

U=	DC voltage in volts (V)	U_{AC} =	AC voltage in volts (V)
U_{bat} =	Battery voltage (V)	f =	Frequency in Hertz (Hz)
U_{low} =	Voltage approximately 0 V	% duty =	Duty cycle (pulse ratio) as a percentage (%)
t =	Time in milliseconds (ms)	I =	Current in amperes (A)

Control module terminal	**Breakout box terminal**	**Signal type**	**Ignition on**	**Engine idling**	**Other**
#A1	#A1	Throttle unit signal, potentiometer 1 (circuit 1)	U ≈ 0.4 -4 V	-	The voltage varies depending on the position of the throttle. U increases with throttle opening.
#A2	#A2	Fuel pressure sensor signal	-	350 - 400 kPa (absolute pressure) U=1.8-2 V	The voltage increases with increased fuel pressure.
#A3	#A3	Fuel temperature sensor signal	-	U≈ 0.5 V- 4.5 V	The voltage falls with increased fuel temperature. The fuel temperature sensor is integrated in the fuel pressure sensor.
#A4	#A4	Engine coolant temperature (ECT) sensor signal	-	(+30°C) U=1.22 V (+80°C) U = 0.29 V (+100°C) U = 0.17 V	
#A5	#A5	Intake air temperature (IAT) sensor signal	-	(+20°C) U = 3.50 V (+30°C) U = 3.00 V (+40°C) U = 2.50 V	The intake air temperature (IAT) sensor is integrated in the boost pressure sensor.
#A6	#A6	Control signal, rear heated oxygen sensor (HO2S) preheating	U = U_{bat}	Preheating off: U = U_{bat} Preheating on U=U_{low}	
#A7	#A7	Engine cooling fan (FC) control signal	Pulse width modulation (PWM) signal U_{high} at least 70% of U_{bat} U_{low} = 1.2 V f = 100 Hz		

			Pulse ratio = 10-95%		
#A8	#A8	-	-	-	
#A9	#A9	Control signal, canister purge (CP) valve	$U = U_{bat}$	-	PWM signal during activation of the canister purge (CP) valve
#A10	#A10	-	-	-	
#A11	#A11	-	-	-	
#A12	#A12	-	-	-	
#A13	#A13	Control signal, intake camshaft reset valve	-	Pulse width modulation (PWM) signal $U_{top} = U_{bat}$ f=250 Hz (12.5 Hz) Pulse ratio 20-95%	The pulse ratio governs control of the camshaft
#A14	#A14	Injector no. 5 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A15	#A15	Injector no. 3 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A16	#A16	Injector no. 1 control signal	$U = U_{bat}$	t= 2-3 ms	t increases with engine speed (RPM) and load
#A17	#A17	Power supply	$U = U_{bat}$	-	Supplied via the system relay
#A18	#A18	Control signal, front heated oxygen sensor (HO2S) preheating	$U = U_{bat}$	Preheating off: $U = U_{bat}$ Preheating on: $U=U_{low}$	
#A19	#A19	Signal ground, throttle unit, potentiometers 1 and 2	$U=U_{low}$	-	
#A20	#A20	Throttle unit signal, potentiometer 2 (circuit 2)	$U \approx 4$ -0.4 V	-	The voltage varies depending on the position of the throttle. U decreases with increasing throttle opening.
#A21	#A21	Exhaust camshaft reset valve control signal	-	Pulse width modulation (PWM) signal $U_{top} = U_{bat}$ f=250 Hz (12.5 Hz)	The pulse ratio governs control of the camshaft

				Pulse ratio 20-95%	
#A22	#A22	Mass air flow (MAF) sensor signal	U = 1 V	U = 1.7 V	U increases with increasing air mass
#A23	#A23	Boost pressure sensor signal	U = 1.96 V	-	U increases with increasing boost pressure.
#A24	#A24	Front heated oxygen sensor (HO2S), pump current	-	-	Pulsed current supply, not measured
#A25	#A25	-	-	-	
#A26	#A26	Oil pressure switch signal	$U=U_{low}$	$U = U_{bat}$	
#A27	#A27	Signal camshaft position (CMP) sensor 2, exhaust camshaft	U =5 V	U = Pulsed signal U_{top} =5 V U_{offset} = 2.5 V	The frequency varies according to engine speed (RPM)
#A28	#A28	Front heated oxygen sensor (HO2S), calibration current	-	-	Not measured
#A29	#A29	Power supply, 5 V camshaft position (CMP) sensor	U =5 V	-	
#A30	#A30	Ignition coil no. 2 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A31	#A31	Ignition coil no. 1 control signal	$U=U_{low}$	U=2.5 V t_{high} =2.5 ms	The frequency varies according to engine speed (RPM)
#A32	#A32	-	-	-	
#A33	#A33	Injector no. 4 control signal	$U = U_{bat}$	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A34	#A34	Injector no. 2 control signal	$U = U_{bat}$	t_{low} =2-3 ms	t increases with engine speed (RPM) and load
#A35	#A35	Control signal (+) damper motor for the throttle unit	-	Pulse width modulation (PWM) signal U_{top} =U_{bat} Pulse ratio 0-100% The polarity of the control signal changes when the	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A36 (#A36)

				damper motor is deployed against the direction of rotation.	
#A36	#A36	Control signal (-) damper motor for the throttle unit	-	Pulse width modulation (PWM) signal U_{top} =U_{bat} Pulse ratio 0-100% The polarity of the control signal changes when the damper motor is deployed against the direction of rotation.	The damper motor is controlled using a pulse width modulation (PWM) signal from the integrated power stage in the engine control module (ECM) measured to terminal #A35 (#A35)
#A37	#A37	-	-	-	
#A38	#A38	Turbocharger (TC) control valve control signal	U = U_{bat}	-	During turbocharger (TC) control: Pulse width modulation (PWM) signal f = 32 Hz
#A39	#A39	Power supply 5 V boost pressure sensor, air conditioning (A/C) pressure sensor, mass air flow (MAF) sensor, oil level sensor, fuel pressure sensor	U =5 V	-	
#A40	#A40	Oil level sensor	-	Pulse width modulation (PWM) signal U_{top} =5 V Pulse ratio 17-83% T=120 ms Pulse train with three pulses, then pause for 1.2 seconds. Pulse no. 1= oil temperature. Pulse no. 2= oil level. Pulse no. 3= oil grade. The pulse ratio	The PWM signal is generated by the oil level sensor.

				for each pulse changes depending on the present: - oil temperature - oil level - oil grade.	
#A41	#A41	Signal (+), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A42	#A42	Signal (-), front heated oxygen sensor (HO2S)	-	-	Pulsed current signal, not measured
#A43	#A43	-	-	-	
#A44	#A44	-	-	-	
#A45	#A45	Signal (+), rear knock sensor (KS)	$U=U_{low}$	-	
#A46	#A46	Signal (+) front knock sensor (KS)	$U=U_{low}$	-	
#A47	#A47	Signal camshaft position (CMP) sensor 1, intake camshaft	U =5 V	U = Pulsed signal U_{top} =5 V U_{offset} = 2.5V	The frequency varies according to engine speed (RPM)
#A48	#A48	Signal (+), flywheel sensor	U=2.5 V	U= sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A66 #B6) The frequency increases with engine speed (RPM)
#A49	#A49	-	-	-	
#A50	#A50	Ignition coil no. 3 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A51	#A51	Ignition coil no. 5 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A52	#A52	Ignition coil no. 4 control signal	$U=U_{low}$	U=2.5 V t_{high} =2 ms	The frequency varies according to engine speed (RPM)
#A53	#A53	Power ground 3	U_{low}	-	Ground terminal, connected to the chassis
#A54	#A54	Power ground 2	U_{low}	-	Ground terminal, connected to the chassis
#A55	#A55	-	-	-	
#A56	#A56	-	-	-	

#A57	#A57	-	-	-	
#A58	#A58	Signal ground, mass air flow (MAF) sensor	$U=U_{low}$	-	
#A59	#A59	Power supply 5 V throttle unit, potentiometers 1 and 2	U =5 V	-	
#A60	#A60	Signal ground Air conditioning (A/C) pressure sensor, boost pressure sensor, engine coolant temperature (ECT) sensor, fuel pressure sensor, oil level sensor	$U=U_{low}$	-	
#A61	#B1	Signal (+), rear heated oxygen sensor (HO2S)	U≈0.50 V	Above 0.6 V or below 0.3 V	
#A62	#B2	Signal (-), rear heated oxygen sensor (HO2S)	$U=U_{low}$	$U=U_{low}$	
#A63	#B3	Signal ground	$U=U_{low}$	-	Ground terminal, connected to the chassis
#A64	#B4	Signal (-) front knock sensor (KS)	$U=U_{low}$	-	
#A65	#B5	Camshaft position (CMP) sensor signal ground	$U=U_{low}$	-	
#A66	#B6	Signal (-) flywheel sensor	U=2.5 V	U = sine wave voltage U_{top} =5 V U_{offset} = 2.5 V	Measured to terminal #A48 (#A48) The frequency increases with engine speed (RPM)
#A67	#B7	Signal (-) rear knock sensor (KS)	$U=U_{low}$	-	
#A68	#B8	Signal air conditioning (A/C) pressure sensor	U=0.9 V (at approximately 20°C)	-	U increases with pressure in the air conditioning (A/C) system
#A69	#B9	-	-	-	
#A70	#B10	-	-	-	

Control module terminal	**Breakout box terminal**	**Signal type**	**Ignition on**	**Engine idling**	**Other**
#B1	#B11	Control modules communication cable (CAN L)	-	-	

#B2	#B12	-	-	-	
#B3	#B13	-	-	-	
#B4	#B14	Signal ground clutch pedal sensor, outside temperature sensor	$U=U_{low}$	-	
#B5	#B15	Signal ground, accelerator pedal (AP) position sensor	$U=U_{low}$	-	
#B6	#B16	-	-	-	
#B7	#B17	Control signal, leak diagnostic unit, pump	Pump motor running: $U=U_{low}$ Pump motor not running: $U = U_{bat}$	-	
#B8	#B18	Signal, coolant level sensor	$U=U_{low}$	Low engine coolant level: $U = U_{bat}$ Normal engine coolant level: U = Ulow	
#B9	#B19	Power supply, 5 V accelerator pedal (AP) position sensor	U =5 V	-	
#B10	#B20	-	-	-	
#B11	#B21	30-supply (Power supply from the battery)	$U = U_{bat}$	$U = U_{bat}$	Ignition off: $U = U_{bat}$
#B12	#B22	-	-	-	
#B13	#B23	Control module communication cable (CAN H)	-	-	
#B14	#B24	-	-	-	
#B15	#B25	Clutch pedal sensor signal	Unaffected: U=3.3 V Fully depressed: 100mm U = 2.2 V	-	U varies depending on the position of the clutch pedal
#B16	#B26	-	-	-	
#B17	#B27	Signal, accelerator	U = 0.4 0.1 V with unaffected accelerator	-	U varies depending on the position of the accelerator

		pedal (AP) position sensor	pedal (AP) U=2.5-4.4 V = the accelerator pedal (AP) fully depressed On certain vehicles the accelerator pedal (AP) will be at the limit position before the signal reaches 4.4 V.		pedal (AP)
#B18	#B28	-	-	-	
#B19	#B29	-	-	-	
#B20	#B30	-	-	-	
#B21	#B31	-	-	-	
#B22	#B32	Diagnostic lead C-link	U=90% of U_{bat}	-	Other values apply if a generic fault-tracing instrument is connected to the data link connector (DLC)
#B23	#B33	Signal crank, 50-supply	$U=U_{low}$	$U=U_{low}$	At crank: $U = U_{bat}$
#B24	#B34	-	-	-	
#B25	#B35	Signal, accelerator pedal (AP) position sensor	U_{top} =12 V t = 4 ms pulse ratio=8% 2% with unaffected accelerator pedal (AP) and 50% - 90% with fully depressed accelerator pedal (AP) On certain vehicles the accelerator pedal (AP) will be at the limit before the signal reaches 90%.	-	Pulse width modulation (PWM) signal from the accelerator pedal (AP) position sensor to the engine control module (ECM)
#B26	#B36	Stop lamp switch signal	When the brake pedal is depressed: $U = U_{bat}$ When the brake pedal is not depressed $U=U_{low}$	-	
#B27	#B37	-	-	-	
#B28	#B38	-	-	-	
#B29	#B39	Signal, outside temperature sensor	(0° C) U=2.92 V (+10° C) U=2.40V (+20° C) U=1.90 V (+30°C) U = 1.46 V	-	Temperature range: -40 to +30°C
#B30	#B40	-	-	-	

#B31	#B41	-	-	-	
#B32	#B42	-	-	-	
#B33	#B43	-	-	-	
#B34	#B44	-	-	-	
#B35	#B45	-	-	-	
#B36	#B46	-	-	-	
#B37	#B47	Signal, ignition on, 15-supply	$U = U_{bat}$	$U = U_{bat}$	Ignition off: $U=U_{low}$
#B38	#B48	System relay control signal	-	$U=U_{low}$	Relay activated: $U=U_{low}$ Relay not activated: $U = U_{bat}$ The system relay runs on (2-5 minutes)
#B39	#B49	-	-	-	
#B40	#B50	Control signal, leak diagnostic unit, valve	-	-	Valve activated: U = Ulow Valve not activated: U = Ubat
#B41	#B51	-	-	-	
#B42	#B52	-	-	-	
#B43	#B53	-	-	-	
#B44	#B54	Control signal, air conditioning (A/C) relay	-	-	Air conditioning (A/C) relay activated: $U=U_{low}$ Air conditioning (A/C) relay not activated: $U = U_{bat}$
#B45	#B55	Fuel pump (FP) control signal, activation	-	-	PWM signal to the central electronic module (CEM) to control the fuel pump (FP) relay
#B46	#B56	Malfunction indicator lamp (MIL) control signal	$U=U_{low}$	Not activated $U=U_{bat}$ Activated: $U=U_{low}$	
#B47	#B57	Control signal, fuel pump (FP) control module	-	PWM signal pulse ratio 35% (+/-5%) engine at operating temperature	PWM signal transmitted by the engine control module (ECM) to the fuel pump (FP) control module. The pulse ratio varies with the requested fuel pressure.
#B48	#B58	Control signal, engine cooling fan (FC),	-	Not activated $U=U_{bat}$	The engine cooling fan (FC) is controlled by the engine control module (ECM)

		control modules		Activated: $U=U_{low}$	
#B49	#B59	-	-	-	
#B50	#B60	-	-	-	

Signal Specification [SIGNAL DESCRIPTION (4T65EV; 1999-2005)]

All the values listed below are between the terminal in column 1 and terminal #A53 (signal ground), unless otherwise indicated in brackets.

> **NOTE:** *Connect the breakout box and check the ground connections before starting to measure.*

U =	DC voltage in volts (V)	U_{AC} =	AC voltage in volts (V)
U_{bat} =	battery voltage	F =	frequency in Hertz (Hz)
U_{low} =	voltage approximately 0 V	% duty =	duty cycle (pulse ratio) in percent (%)
t =	time in milliseconds (ms)		

Connector A terminals #A35 - #A70

Breakout box terminal	Control module terminal	Signal type	Ignition on	Engine idling	Miscellaneous
#A35	#A35	Power supply	U_{bat}		Model year dependent: Up to and incl. 2004 Supply from CEM relay CMI21(2/101) From and incl. 2005 Supply from connection #B20 on Central electronic module (CEM)
#A37	#A37	Signal, oil temperature sensor	Cold gearbox (+20°C): U=2.4 V Hot gearbox (+100°C): U=0.3-0.5 V		U decreases with increasing temperature
#A39	#A39	Signal, gearbox output speed sensor signal	Tooth against sensor: 14 mA Cover against sensor: 7 mA		The sensor generates a pulsed signal (quadratic wave) with fixed pulse ratio when the pulse wheel rotates. Frequency increases with speed
#A41	#A41	Signal, gearbox input speed sensor	Tooth against sensor: 14 mA Cover against sensor: 7 mA		The sensor generates a pulsed signal (quadratic wave) with fixed pulse ratio when the pulse wheel rotates. Frequency increases with speed
#A44	#A44	Signal (-) from	Gear-shift selector in		Start immobilizer. The signal is

		gear position sensor via Transmission Control Module (TCM) to Central Electronic Module (CEM)	position P = U_{low} In all other positions U_{bat}	grounded when the gear selector is in position P and N, which makes engine start possible.
#A45	#A45	Signal, gear-shift position sensor C	Gear selector positions D, 3, L: U=0-0.5 V Other positions: U=0-2 V below U_{bat}	The signal is grounded in positions D, 3, L
#A46	#A46	Signal, gear-shift position sensor A	Gear selector position P, R, 3, L: U=0-0.5 V Other positions: U=0-2 V below U_{bat}	Signal is grounded in positions N, D
#A50	#A50	Control signal, shift solenoid S1	Activated: U=0-2 V below Ubat Not activated: U_{low}	The solenoid receives voltage when activated by the control module in 1st and 4th gears
#A51	#A51	Control signal, lock-up solenoid SL	Activated: U=0-2 V below U_{bat} Not activated: U_{low}	The solenoid is supplied with voltage when it is activated by the control module
#A52	#A52	Control signal, line pressure solenoid STH	U=1.6 V	Voltage decreases with increasing throttle opening
#A53	#A53	Signal ground	U_{low}	-
#A54	#A54	Signal ground for the gear selector module (GSM)	U_{low}	From and incl. 2001 Connection #A6 on the gear selector module (GSM)
#A55	#A55	Signal ground oil temperature sensor	U_{low}	Ground
#A57	#A57	Power supply, vehicle speed sensor (VSS)	U≈1 V	N/A
#A59	#A59	Power supply, engine speed (RPM) sensor	U≈1 V	N/A
#B3	#A63	Signal, gear-shift position sensor PA	Gear selector positions P, N, 3: U=0-0.5 V Other positions: U=0-2 V below U_{bat}	The signal is grounded in positions P, N, 3
#B4	#A64	Signal, gear-shift position sensor B	Gear selector position R, N, D, 3,	Signal grounded in positions R, N, D, 3

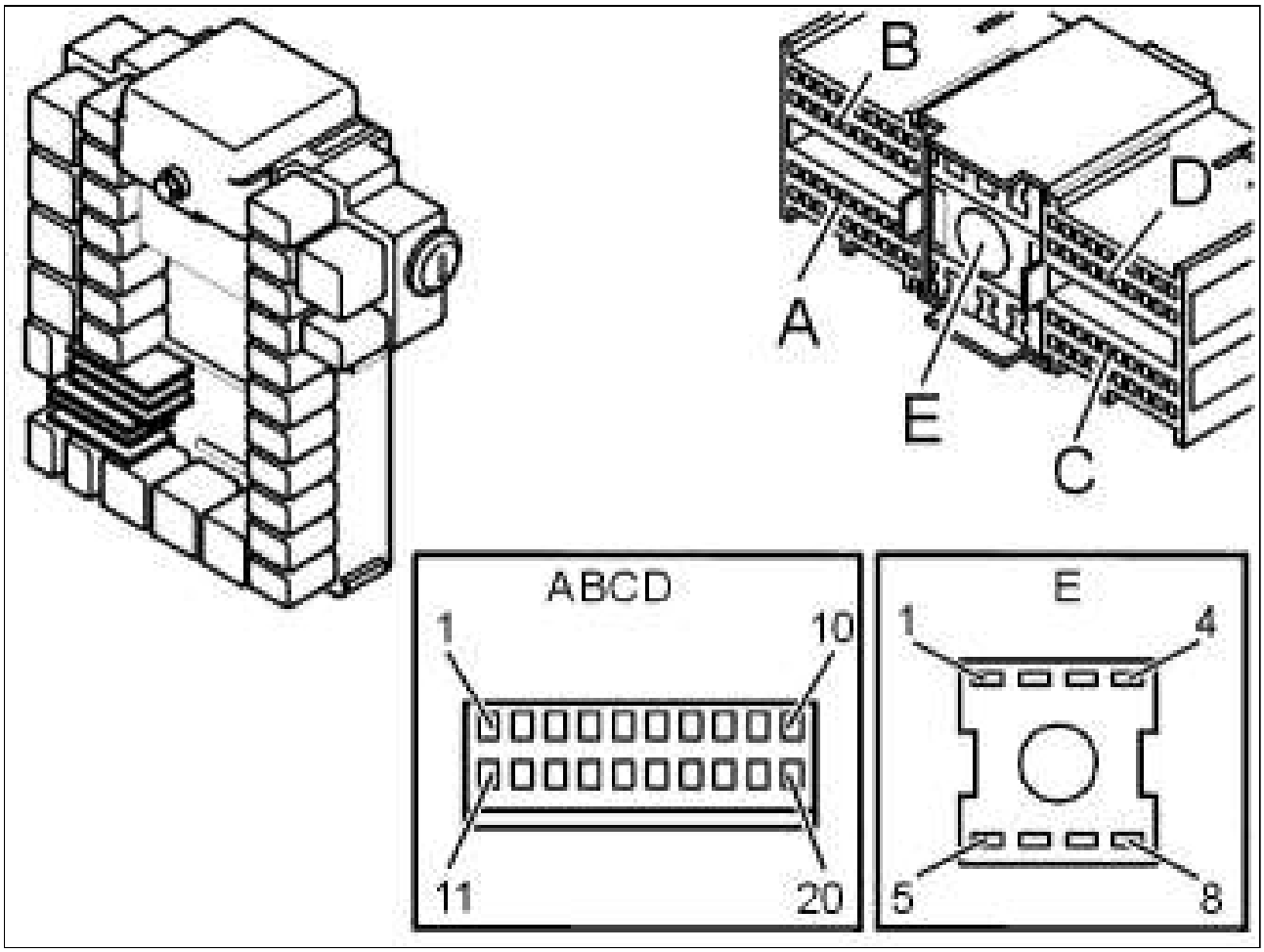
			L: U=0-0.5 V Other positions: U=0-2 V below U_{bat}	
#B5	#A65	Pressure sensor signal PS4	Active = U_{bat} , Not active = 0 V	Pressure sensor PS4 is usually closed. It transmits a signal to the control module indicating the position of solenoid SL. When lock-up is requested, the pressure sensor must be **Not active** . When there is no lock-up, the pressure sensor must be **Active** .
#B8	#A68	Control signal, shift solenoid S2	Activated: U=0-2 V below Ubat Not activated: U_{low}	The solenoid receives voltage when activated by the control module in 1st and 2nd gears
#B10	#A70	Signal ground, line pressure solenoid STH	F=300 Hz Frequency is constant, irrespective of driving conditions. The signal duty cycle is modified when the line pressure is adapted	N/A

Connector B terminals #B1 - #B22

Breakout box terminal	Control module terminal	Signal type	Ignition on	Engine idling	Miscellaneous
#B11	#B1	Communication cable for the control modules (CAN)	2-3 V		Between the transmission control module (TCM) and the engine control module (ECM)
#B12	#B2	Communication cable for the control modules (CAN)	2-3 V		Between the transmission control module (TCM) and the anti-lock brake system module (ABS) as well as the central electronic module (CEM)
#B23	#B13	Communication cable for the control modules (CAN)	2-3 V		Between the transmission control module (TCM) and the engine control module (ECM)
#B24	#B14	Communication cable for the control modules (CAN)	2-3 V		Between the transmission control module (TCM) and the anti-lock brake system module (ABS) as well as the central electronic module (CEM)
#B31	#B21	VOLCANO lite communication cable	8-11 V		Between the transmission control module (TCM) and the gear selector module (GSM)

Signal Specification [SIGNAL DESCRIPTION, CENTRAL ELECTRONIC MODULE (CEM) (1999-2004)]

Fig 2: Ground Terminals



Courtesy of VOLVO CARS OF NORTH AMERICA.

NOTE: *It is important to connect the breakout box and check the ground terminals before taking readings.*

Other information

- To connect the breakout box, see Connecting the breakout box
- To check ground terminals, see Checking the ground terminal .

U=	DC voltage in volts (V)	U_{AC} =	AC voltage in volts (V)
U_{bat} =	Battery voltage (V)	f =	Frequency in Hertz (Hz)
U_{low} =	Voltage approximately 0 V	% duty =	Duty cycle (pulse ratio) as a percentage (%)
t =	Time in milliseconds (ms)	-	-

Connector A, terminals #A1-#A20

The following values are measured between the relevant terminal in column 1 and terminal #E1 (power ground) unless otherwise stated.

> **NOTE:** *Check the ground terminals before starting to take readings with the breakout box.*

U = DC in volts (V)
Ubat = battery voltage in volts (V)
Ulow = Voltage close to 0 V

Breakout box terminal	Terminal in connector	Signal type	Ignition off		Ignition on		Other
-	-	-	Activated	Not activated	Activated	Not activated	-
#A1	#A1	Signal (-) back-up (reversing) lamp	Ulow	Ubat	Ulow	Ubat	-
#A2	#A2	Signal, for fault-tracing the actuator motor for the left-hand xenon lamp	Ulow	Ulow	Ulow-Ubat if active, Ulow otherwise in pulse ratio (% duty) = 0-100%		A fault is detected at 65%> pulse ratio (% duty) > 90%
#A3	#A3	Control signal, starter motor relay	-		0 V	0 V	Activated with key in position III
#A4	#A4	Signal, Hood switch	Ulow with the hood closed Ulow-Ubat with the hood open				Pulsed signal, f=100 Hz
#A5	#A5	Signal (-) L-signal	Ulow	Ulow	Ubat	U~0.3-0.7*Ubat	-
#A6	#A6	Stepper motor speed related power steering (channel B)	Ulow		Ulow-Ubat	Ulow	signal for 12 ms
#A7	#A7	Stepper motor speed related power steering (channel A)	Ulow		Ulow-Ubat	Ulow	signal for 12 ms
#A8	#A8	Reference voltage,	Ulow		Ubat		Model years prior to 2000

		beam adjustment unit				
#A9	#A9	Pulse width modulated signal (+) to beam adjustment unit	Ulow	Ulow-Ubat if active, Ulow otherwise Pulse ratio (% duty) > 0%		Pulse ratio increases with increased beam width
#A10	#A10	Reference ground, beam adjustment unit	Ulow			Model years prior to 2000
#A11	#A11	Stepper motor speed related power steering (channel B)	Ulow	Ulow-Ubat	Ulow	signal for 12 ms
#A12	#A12	Stepper motor speed related power steering (channel A)	Ulow	Ulow-Ubat	Ulow	signal for 12 ms
#A13	#A13	Control signal, windshield wiper relay off/on	Ubat	Ulow	Ubat	-
#A14	#A14	Control signal, windshield wiper high speed relay	Ubat	Ulow	Ubat	-
#A15	#A15	Glass breakage loop, pulsed signal	0-12 V	Ulow	Ulow	0-12 V periodically when the car is alarmed
#A16	#A16	Control signal, front washer motor relay	Ubat	Ulow	Ubat	-
#A17	#A17	Control signal, rear washer motor relay	Ubat	Ulow	Ubat	(5 DRS)
#A18	#A18	Volcano Lite	The voltage is 0 V - Ubat during communication			Serial

							communication
#A19	#A19	Control signal, horn relay	Ulow	Ubat	Ulow	Ubat	-
#A20	#A20	Signal (-), starter motor relay	Ulow		Ubat	Ulow	-

Connector B, terminals #B1 - #B20
The following values are measured between the relevant terminal in column 1 and terminal #E1 (power ground) unless otherwise stated.

> **NOTE:** *Check the ground terminals before starting to take readings with the breakout box.*

U = DC in volts (V)
Ubat = battery voltage in volts (V)
Ulow = Voltage close to 0 V

Breakout box terminal	Terminal in connector	Signal type	Ignition off		Ignition on		Other
-	-	-	Activated	Not activated	Activated	Not activated	-
#A21	#B1	S-supply (Power supply from ignition switch)	Ulow (Key out), Ubat (key in)				-
#A22	#B2	X-supply (Power supply from the ignition switch)	Ubat (Key in positions I and II); Ulow otherwise				-
#A23	#B3	15-supply (Power supply from ignition switch)	Ubat (Key in positions II and III); Ulow otherwise				-
#A24	#B4	Stop lamp switch signal	Ubat	Ulow	Ubat	Ulow	-
#A25	#B5	Supply upper stop lamp (4 door)	Ubat	6 V	Ubat	6 V	-
#A26	#B6	Supply to stop lamp relay in the rear electronic module (REM)	Ulow	Ubat	Ulow	Ubat	-
#A27	#B7	Diagnostic communication (CAN	The voltage is 2.0-3.5 V during communication				-

		H) for the high speed network					
#A28	#B8	Diagnostic communication (CAN_L) for the high speed network	The voltage is 1.5-2.5 V during communication				-
#A29	#B9	Signal (-) sensor for the front left seat belt buckle	Ulow		0-5 V	0-5 V	-
#A30	#B10	Reference voltage (+) for X-supply to the left seat belt buckle	Ulow		Ubat		-
#A31	#B11	Serial communication the left heated seat	Ulow		During communication voltage is ~Ubat		-
#A32	#B12	Signal (-) contact breaker (left rear door open)	Ulow-Ubat if the door is open, Ulow otherwise				Pulsed signal, f=100 Hz.
#A33	#B13	Signal (-) contact breaker (left rear door locked)	Ulow if the door is locked, Ubat otherwise				-
#A34	#B14	Frequency signal (-) from the engine control module (ECM) for the fuel pump (FP) relay	Ulow		Frequency signal U=Ulow-Ubat		f=50 HZ
#A35	#B15	Signal (-) from the windshield washer reservoir level sensor	Ubat if the tank is not empty, Ulow if under 1 liter.				-
#A36	#B16	Signal (-) from the windshield wiper motor	Ulow	Ubat	Ulow	Ubat	Ulow if the engine is running
#A37	#B17	Communication CAN_H high speed network	The voltage is 2.0-3.5 V during communication				-
#A38	#B18	Communication CAN_L high speed network	The voltage is 1.5-2.5 V during communication				-
#A39	#B19	Diagnostic communication	The voltage is 2.0-3.5 V during communication				-

		(CAN_H) for the low speed network		
#A40	#B20	Diagnostic communication (CAN_L) for the low speed network	The voltage is 1.5-2.5 V during communication	-

Connector C, terminals #C1-#C20
The following values are measured between the relevant terminal in column 1 and terminal #E1 (power ground) unless otherwise stated.

> **NOTE:** *Check the ground terminals before starting to take readings with the breakout box.*

U = DC in volts (V)
Ubat = battery voltage in volts (V)
Ulow = Voltage close to 0 V

Breakout box terminal	Terminal in connector	Signal type	Ignition off		Ignition on		Other
-	-	-	**Activated**	**Not activated**	**Activated**	**Not activated**	-
#A41	#C1	Reference voltage (+) for X-supply to the right seat belt buckle	Ulow		Ubat		-
#A42	#C2	Signal (-) sensor for the front right seat belt buckle	Ulow		0-5 V	0-5 V	-
#A43	#C3	Signal (-) contact breaker (right rear door locked)	Ulow if the door is locked, Ubat otherwise			-	-
#A44	#C4	Serial communication right heated seat	Ulow		During communication voltage is ~Ubat	-	-
#A45	#C5	Signal (-) Lock unit trunk lid	Ulow-Ubat if the tailgate is open, Ulow otherwise			-	Pulsed signal, f=100Hz.
#A46	#C6	Control signal,	-	Ubat	Ulow	Ubat	-

		auxiliary lamp relay					
#A47	#C7	-	-	-	-	-	-
#A48	#C8	-	-	-	-	-	-
#A49	#C9	-	-	-	-	-	-
#A50	#C10	-	-	-	-	-	-
#A51	#C11	-	-	-	-	-	-
#A52	#C12	-	-	-	-	-	-
#A53	#C13	-	-	-	-	-	-
#A54	#C14	Signal (-) fuel pump (FP) relay switch	-	Ulow	Ubat	Ulow	-
#A55	#C15	-	-	-	-	-	-
#A56	#C16	-	-	-	-	-	-
#A57	#C17	-	-	-	-	-	-
#A58	#C18	Signal (-) contact breaker (right rear door open)	Ulow-Ubat if the door is open, Ulow otherwise				Pulsed signal, f=100 Hz.
#A59	#C19	-	-	-	-	-	-
#A60	#C20	Reserve (-)	-	-	-	-	-

Connector D, terminals #D1-#D20
The following values are measured between the relevant terminal in column 1 and terminal #E1 (power ground) unless otherwise stated.

> **NOTE:** *Check the ground terminals before starting to take readings with the breakout box.*

U = DC in volts (V)
Ubat = battery voltage in volts (V)
Ulow = Voltage close to 0 V

Breakout box terminal	Terminal in connector	Signal type	Ignition off		Ignition on		Other
-	-	-	Activated	Not activated	Activated	Not activated	-
#B1	#D1	Control signal	-		Ubat	Ulow	-

		automatic Gear selector module (GSM), switch to ground					
#B2	#D2	Communication CAN L low speed network	The voltage is 1.5-2.5 V during communication				-
#B3	#D3	Communication CAN_H low speed network	The voltage is 2-3.5 V during communication				-
#B4	#D4	Signal (-) from control stalks (Limp Home)	Ubat	Ulow	Ubat	Ulow	-
#B5	#D5	Signal (-) from the SRS-control module (airbag OK)	Ubat for 200 ms if the airbag is triggered, Ulow if the airbag is not triggered.				-
#B6	#D6	Serial communication (K-line), diagnostic	The voltage is 0 V - Ubat during communication				-
#B7	#D7	Signal (-) contact breaker (left front door open)	Ulow-Ubat if the door is open, Ulow otherwise.				Pulsed signal, f=100 Hz.
#B8	#D8	Signal (-) contact breaker (right front door open)	Ulow-Ubat if the door is open, Ulow otherwise.				Pulsed signal, f=100Hz.
#B9	#D9	Signal (-) from the gear-shift position sensor (locked in P/N)	Ulow	Ulow	Ulow	Ubat	Ulow in P and N position
#B10	#D10	Signal (+), speed (frequency signal)	Ulow		Ulow-Ubat		Frequency signal increases with speed
#B11	#D11	Signal, for fault-tracing the actuator motor for the right-hand xenon lamp	Ulow	Ulow	Ulow-Ubat if active, Ulow otherwise in pulse ratio (% duty)=0-100%		A fault is detected at 65%>pulse ratio (%duty)>90%
#B12	#D12	Signal (-) from horn switch	Ulow	Ubat	Ulow	Ubat	-

#B13	#D13	Signal (+) data Immobilizer	Ulow		Ubat		-
#B14	#D14	Signal (+) Immobilizer	Ulow		Ubat		-
#B15	#D15	-	-	-	-	-	-
#B16	#D16	Signal (-) switch for the hazard warning signal flasher	Ulow if the button is held in, Ubat otherwise				-
#B17	#D17	Pulse width modulated signal (+) lamp in button for hazard warning signal flasher	Ulow-Ubat if active, Ulow otherwise Pulse ratio (% duty) > 0 %				-
#B18	#D18	Signal (+) glove compartment lighting	Ubat				30 minutes after ignition off, Ulow
#B19	#D19	Signal (+) ignition switch illumination	Ubat	Ulow	Ubat	Ulow	-
#B20	#D20	Signal (+) Alarm indicator LED	Ulow or 0.7 V		Ulow		0.7 V if the LED is active

Connector E, terminals #E1-#E8
The following values are measured between the relevant terminal in column 1 and terminal #E1 (power ground) unless otherwise stated.

> **NOTE:** *Check the ground terminals before starting to take readings with the breakout box.*

U = DC in volts (V)
Ubat = battery voltage in volts (V)
Ulow = Voltage close to 0 V

Breakout box terminal	Terminal in connector	Signal type	Ignition off		Ignition on		Other
-	-	-	**Activated**	**Not activated**	**Activated**	**Not activated**	-
#B21	#E1	Power ground	Ulow				-
#B22	#E2	Pulse width	Ulow-Ubat if active, Ulow otherwise			-	-

		modulated signal (+) courtesy lighting					
#B23	#E3	30-supply to turn signal lamps and hazard warning signal flasher	Ubat			-	-
#B24	#E4	-	-	-	-	-	-
#B25	#E5	-	-	-	-	-	-
#B26	#E6	30-supply to the central electronic module (CEM)	Ubat				-
#B27	#E7	-	-	-	-	-	-
#B28	#E8	Pulse width modulated signal (+) to rheostat	Ulow-Ubat if active, Ulow otherwise			-	-

Signal Specification, Engine Control Module (ECM)

All values below are measured between the relevant terminal in column 2 and #Axx (#Axx on the breakout box). (Stated in brackets after the table entry if not).
Connector A (96-pin) corresponds to terminals #A1 - #B36 on the breakout box.
Connector B (58-pin engine side) corresponds to terminals #C1 - #58 on the breakout box.

> **NOTE:** *Connect the breakout box and check the ground terminals before taking readings.*

Connector A

Breakout box terminal	Control module terminal	Signal type	Ignition on	Engine idling	Other
#A1	#A1	Injector no. 1, control signal high	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A2	#A2	Injector no. 4, control signal high	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A3	#A3	Injector no. 3, control signal high	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A4	#A4	Swirl throttle motor, signal (-)	U=U low	-	Control signal, H-bridge, .
#A5	#A5	Swirl throttle motor, signal (+)	U=U low	-	Control signal, H-bridge, .
#A6	#A6	Heated oxygen sensor,	U= approx.	U=approx. 3 V	

		current regulation	3 V		
#A7	#A7	Camshaft position sensor, power supply 5 V	U=5 V	U=5 V	
#A8	#A8	Temperature sensor, particle trap, signal ground	U=U low	U=U low	GND
#A9	#A9	Turbo regulator motor (VNT), signal ground	U=U low	U=U low	GND
#A10	#A10	Camshaft position (CMP) sensor, signal ground	U=U low	U=U low	GND
#A11	#A11	Throttle position sensor, signal	U=U low	U=approx. 0-5 V	Analog input (feedback).
#A12	#A12	-	-	-	
#A13	#A13	-	-	-	
#A14	#A14	-	-	-	
#A15	#A15	Intake temperature and pressure sensor (TMAP), power supply 5 V	U=5 V	U=5 V	.
#A16	#A16	-	-	-	
#A17	#A17	-	-	-	
#A18	#A18	Throttle position sensor (throttle unit), power supply 5 V	U=5 V	U=5 V	
#A19	#A19	Fuel pressure sensor, power supply 5 V	U=5 V	U=5 V	
#A20	#A20	-	-	-	
#A21	#A21	Turbo regulator motor (VNT), signal	PWM (0-12 V)	PWM (0-12 V)	Digital output, PWM
#A22	#A22	-	-	-	
#A23	#A23	Fuel pressure control valve (DRV2), power supply 12 V	U = U bat	U = U bat	
#A24	#A24	Throttle motor, intake, control signal (-)	U=U low	-	Digital output.
#A25	#A25	Injector no. 2, control signal high	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A26	#A26	Injector no. 5, control signal high	U=approx. 0.5-22 V	-	t increases with engine speed and load.

#A27	#A27	-	-	-	
#A28	#A28	EGR control, signal ground	U=U low	U=U low	GND
#A29	#A29	Mass air flow (MAF) sensor, signal ground	U=U low	U=U low	GND,
#A30	#A30	-	-	-	
#A31	#A31	Heated oxygen sensor, signal	Saw tooth shaped (U=approx. 2-4 V)	Saw tooth shaped (U=approx. 2-4 V)	Analog input
#A32	#A32	Glow plug control, signal	U=0-12 V	U=0-12 V	Digital output.
#A33	#A33	Camshaft position sensor, signal	U=5 V	Square wave (U=0-5 V), approx. 5.8 Hz when idling.	Digital input. Frequency increases as engine speed increases.
#A34	#A34	Oil level/temperature sensor, signal	PWM (0-5 V)	PWM (0-5 V)	
#A35	#A35	-	-	-	
#A36	#A36	Oil level/temperature sensor, signal ground	U=U low	U=U low	GND
#A37	#A37	Glow plug control, signal ground	U=U low	U=U low	GND
#A38	#A38	-	-	-	
#A39	#A39	-	-	-	
#A40	#A40	Swirl throttle position sensor, power supply 5 V	U=5 V	U=5 V	
#A41	#A41	Differential pressure sensor, particle trap, power supply 5 V	U=5 V	U=5 V	
#A42	#A42	Oil level/temperature sensor, power supply 5 V	U=5 V	U=5 V	
#A43	#A43	AC high pressure sensor, power supply 5 V	U=5 V	U=5 V	
#A44	#A44	Differential pressure sensor, particle trap, signal	U=0-5 V	U=0-5 V	Analog input
#A45	#A45	-	-	-	
#A46	#A46	Vacuum valves, engine	U=U low	U=0-12 V	Digital output.

		mounting, signal			
#A47	#A47	Fuel flow control valve (MPROP), power supply 12 V	U = U bat	U = U bat	
#A48	#A48	Heated oxygen sensor, signal	U = U bat	PWM (0-12 V)	Digital output
#A49	#A49	Injector no. 5, control signal low	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A50	#A50	Injector no. 1, control signal low	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#A51	#A51	-	-	-	
#A52	#A52	Position sensor, swirl throttle, signal ground	U=U low	U=U low	
#A53	#A53	Impulse sensor, signal (-)	U= approx. 2.5 V	U= sinus voltage (approx. 0.1-100 V)	Digital input. Voltage and frequency increase as engine speed increases.
#A54	#A54	-	-	-	
#A55	#A55	-	-	-	
#A56	#A56	Coolant temperature sensor (engine temperature sensor), signal ground	U=U low	U=U low	GND
#A57	#A57	Heated oxygen sensor, virtual ground, signal ground	U= approx. 2.5 V	U= approx. 2.5 V	
#A58	#A58	Temperature sensor particle trap, signal	U=U low	U=0-5 V	Analog input
#A59	#A59	Air temperature sensor in mass air flow (MAF) sensor, signal	PWM (0-5 V)	PWM (0-5 V)	Digital input
#A60	#A60	Coolant temperature sensor (engine temperature sensor), signal	U=0-5 V	U=0-5 V	Analog input
#B1	#A61	Fuel temperature sensor, signal	U=0-5 V	U=0-5 V	Analog input
#B2	#A62	Temperature sensor, catalytic converter, signal ground	U=U low	U=U low	GND
#B3	#A63	Differential pressure sensor, particle trap, signal ground	U=U low	U=U low	GND

#B4	#A64	Fuel pressure sensor, signal ground	U=U low	U=U low	GND
#B5	#A65	Fuel pressure sensor, signal	U= approx. 0.5 V	U=0.5-5 V	Analog input
#B6	#A66	EGR valve position sensor, signal	PWM (0-5 V)	PWM (0-5 V)	Digital input (feedback)
#B7	#A67	Throttle position sensor, signal ground	U=U low	U=U low	GND
#B8	#A68	-	-	-	
#B9	#A69	-	-	-	
#B10	#A70	-	-	-	
#B11	#A71	EGR control, signal	PWM (0-12 V)	PWM (0-12 V)	Digital output
#B12	#A72	Throttle unit motor, signal	PWM (0-12 V)	PWM (0-12 V)	H-bridge
#B13	#A73	Injector no. 4, control signal low	U=approx. 0.5-22 V	-	t increases with engine speed and load. Bank 1
#B14	#A74	Injector no. 3, control signal low	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#B15	#A75	Injector no. 2, control signal low	U=approx. 0.5-22 V	-	t increases with engine speed and load.
#B16	#A76	AC high pressure sensor, signal ground	U=U low	U=U low	GND
#B17	#A77	Impulse sensor, signal (+)	U=2.5 V	U= sinus voltage (approx. 0.1-100 V)	Digital input. Voltage and frequency increase as engine speed increases.
#B18	#A78	Fuel temperature sensor, signal ground	U=U low	U=U low	GND
#B19	#A79	AC high pressure sensor, signal	U=0-5 V	U=0-5 V	Analog input
#B20	#A80	Heated oxygen sensor, flow pump	U=approx. 3 V	U=approx. 3 V	Analog input
#B21	#A81	Position sensor, swirl throttle, signal	U= approx. 0.5-4.5 V	U= approx. 0.5-4.5 V	Analog input
#B22	#A82	Boost pressure sensor (TMAP), signal	U=0-5 V	U=0-5 V	Analog input
#B23	#A83	-	-	-	
#B24	#A84	Temperature sensor, catalytic converter, signal	U= approx. 0.5-2.5 V	U= approx. 0.5-2.5 V	Analog input

#B25	#A85	Intake air temperature sensor (TMAP), signal	U= approx. 0.5-4.5 V	U= approx. 0.5-4.5 V	Analog input
#B26	#A86	Mass air flow (MAF) sensor, signal	Square wave (0-5 V)	Square wave (0-5 V)	Digital input. Frequency varies based on air mass.
#B27	#A87	Boost pressure sensor (TMAP), signal ground	U=U low	U=U low	GND
#B28	#A88	LIN bus	0-12 V	0-12 V	Digital communication
#B29	#A89	-	-	-	
#B30	#A90	Glow plug relay, diagnostic signal	U=approx. 9 V	U=0-12 V	Digital input
#B31	#A91	-	-	-	
#B32	#A92	Bypass valve, EGR cooling, signal	U=U low	PWM (0-5 V)	Digital output. Certain variants only.
#B33	#A93	Fuel pressure control valve (DRV2), signal	PWM (0-12 V)	PWM (0-12 V)	Digital output
#B34	#A94	Fuel flow control valve (MPROP), signal	PWM (0-12 V)	PWM (0-12 V)	Digital output
#B35	#A95	-	-	-	
#B36	#A96	-	-	-	

Connector B

Breakout box terminal	Control module terminal	Signal type	Ignition on	Idling	Other
#C1	#B1	Power supply from system relay 12 V	U = U bat	U = U bat	Power supply from system relay (Mprop, DRV2 and swirl).
#C2	#B2	Power ground 1	U=U low	U=U low	GND
#C3	#B3	Power supply from system relay 12 V	U = U bat	U = U bat	Power supply from system relay (throttle motor and freewheel diodes).
#C4	#B4	Power ground 2	U=U low	U=U low	GND
#C5	#B5	Power supply downstream of system relay 12 V	U = U bat	U = U bat	Power supply downstream of system relay (Engine Control Module (ECM) and injector).
#C6	#B6	Power ground 3	U=U low	U=U low	GND
#C7	#B7	Accelerator pedal	U=U	U=U	GND

		position sensor, signal ground	low	low	
#C8	#B8	-	-	-	
#C9	#B9	-	-	-	
#C10	#B10	-	-	-	
#C11	#B11	-	-	-	
#C12	#B12	Clutch pedal position sensor, signal	U=0-5 V	U=0-5 V	Analog input.
#C13	#B13	-	-	-	
#C14	#B14	-	-	-	
#C15	#B15	Accelerator pedal position sensor, power supply 5 V	U=5 V	U=5 V	
#C16	#B16	-	-	-	
#C17	#B17	-	-	-	
#C18	#B18	-	-	-	
#C19	#B19	-	-	-	
#C20	#B20	-	-	-	
#C21	#B21	-	-	-	
#C22	#B22	HS-CAN high	U=2.5-3.75 V	U=2.5-3.75 V	Digital communication
#C23	#B23	HS-CAN low	U=1.25-2.5 V	U=1.25-2.5 V	Digital communication
#C24	#B24	Accelerator pedal position sensor, analog signal	U=0-5 V	U=0-5 V	Analog input. The value increases upon accelerator pedal actuation.
#C25	#B25	-	-	-	
#C26	#B26	-	-	-	
#C27	#B27	-	-	-	
#C28	#B28	-	-	-	
#C29	#B29	Starter relay	U = U bat	U = U bat	Digital output
#C30	#B30	-	-	-	
#C31	#B31	-	-	-	
#C32	#B32	AC relay, signal	U = U bat	U=0-12 V	Digital output.
#C33	#B33	Start signal from	U=U	U=U	Digital input

		ignition switch (50)	low	low	
#C34	#B34	Gear position sensor (P/N), signal	U=U low	U=U low	Digital input. The value increases in gear position P/N.
#C35	#B35	Engine coolant level sensor, signal	U=0-12 V	U=0-12 V	Digital input. U=0 V when coolant level is normal.
#C36	#B36	-	-	-	
#C37	#B37		U=0-5 V	U=0-5 V	Digital output.
#C38	#B38	signal	U = U bat	U = U bat	Digital input
#C39	#B39	-	-	-	
#C40	#B40	Clutch pedal position sensor, signal ground	U=U low	U=U low	GND
#C41	#B41	15-feed from ignition switch	U = U bat	U = U bat	
#C42	#B42	System relay, signal	U=U low	U=U low	Digital output
#C43	#B43	-	-	-	
#C44	#B44	Starter relay	U = U bat	U = U bat	Digital output
#C45	#B45	-	-	-	
#C46	#B46	-	-	-	
#C47	#B47	Accelerator pedal position sensor, signal	PWM (0-12 V)	PWM (0-12 V)	Digital input, PWM
#C48	#B48	Stop lamp switch	U=0-12 V	U=0-12 V	Digital input. U=0 V if brake pedal is not actuated.
#C49	#B49	-	-	-	
#C50	#B50	-	-	-	
#C51	#B51	-	-	-	
#C52	#B52	-	-	-	
#C53	#B53	-	-	-	
#C54	#B54	-	-	-	
#C55	#B55	-	-	-	
#C56	#B56	-	-	-	
#C57	#B57	-	-	-	
#C58	#B58	Engine cooling fan (FC), control signal	PWM (0-12 V)	PWM (0-12 V)	PWM, digital output

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Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

Fault-Tracing Information

See Fault-tracing information

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ECM-980A: TORQUE-LIMITING. INFORMATION (B6304S3; 1999) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

Fault-Tracing Information

See Fault-tracing information

ECM-980A: TORQUE-LIMITING. INFORMATION (B6304S3; 1999) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

Fault-Tracing Information

See Fault-tracing information

ECM-981A: TORQUE. TOO HIGH TORQUE (B6294S; 2000-2001) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Too-High: Torque

See Too high torque

Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

ECM-981A: TORQUE. TOO HIGH TORQUE (B6294S; 2000-2001) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Too-High: Torque

See Too high torque

Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

ECM-981A: TORQUE. TOO HIGH TORQUE (B6304S3; 1999) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Too-High: Torque

See Too high torque

Diagnostic Trouble Code (DTC) Information

See Diagnostic trouble code (DTC) information

ECM-981A: TORQUE. TOO HIGH TORQUE (B6304S3; 1999) [ENGINE CONTROL MODULE (ECM) & ELECTRONIC FUEL INJECTION (EFI) DIAGNOSTIC TROUBLE CODES - 1 OF 11]

Too-High: Torque

See Too high torque

Diagnostic Trouble Code (DTC) Information

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