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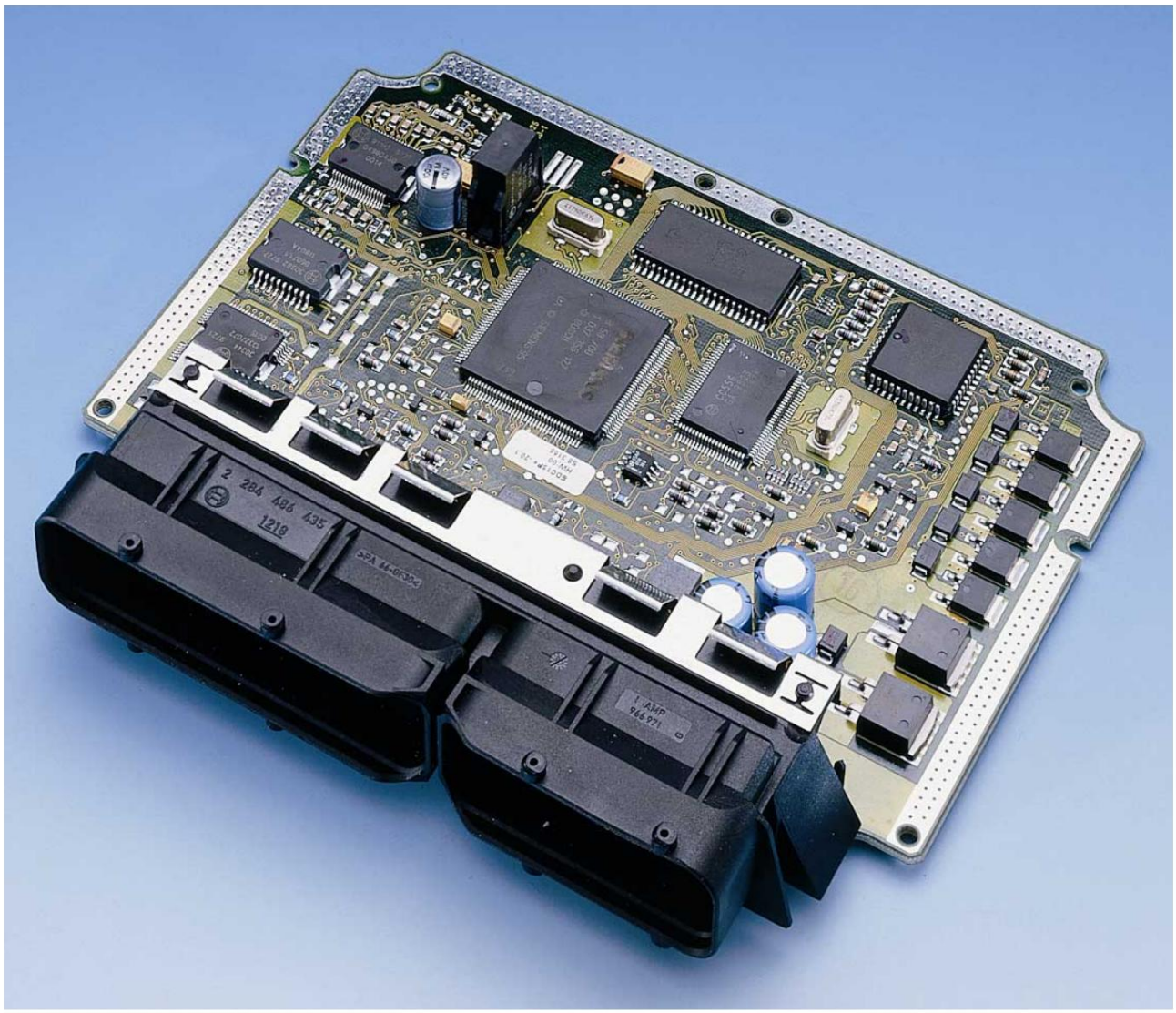
functional description
EDC15+
P127-PEA



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1 overview

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1.1 Notes on construction and use

The modularization of the EDC15 software is function-oriented in function groups. Each function group has a function group designation and a 2-character abbreviation. The 2-character abbreviation forms the first 2 characters of all names (symbols) used in text and drawings. The overview images of the individual functions are given in block letters.

Monitoring concept (including self-diagnosis (ed)) / error handling (fb) configuration (co) Control engineering functions (rf)		
Input signals: digital inputs (di) analog inputs (on) Speed sensor (dz) Secondary speed sensor (dz) Driving speed sensor (fg)	Quantity calculation (mr) and Quantity metering (zm) Start of injection control (sb) or Control start (ab) with CR or start of delivery calculation (fn) with PDE exhaust gas recirculation (ar) Boost pressure control (ld) Glow time control (gs) Air conditioning compressor (kl) Cooling water heating (kh) Coolant thermostat control (km) Ecomatic (ec) Radiator fan control (ku) Misfire detection (mr) bottle Service interval display (si) diagnosis (xc) CAN (approx)	Output signals: exhaust gas recirculation actuator boost pressure adjuster . . . . . . TD signals TQ signal MUX signal (pb)

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1.2 Explanation of terms

expression	Explanation	Depiction
Entry	-	on the left edge one drawing
Exit	-	on the right edge one drawing
messages	embassy to information exchange between SG functions	-
OLDA	is used to output intermediate results -	
record	all changeable by an adjustment system Data (fixed value, characteristics, maps)	-
..	represent placeholders for letters and digits shown, their meaning in the respective chapter is explained	-
fixed value	Single value or software switch	-
Software switch is used to	configure each SW functions	-
DAMOS - Switches Subset	of software switches, only allowed be changed by DAMOS run	-

1.3 Naming Conventions

All names used within text and drawings are after the following Schema built:

jjtXXXXXXX(maximum 10 characters)

jj 2-character abbreviation of the function group (lower case)

t Name type from the following list (lower case)

- ÿ b bit variable
- ÿ c Byte (character) variable
- ÿ e Equate or Set constant
- ÿ m message
- ÿ o OLDA address
- ÿ w Word variable / fixed value

XXXXXXX 1 to 7 characters freely assignable (uppercase or lowercase)

Examples:

- ÿ noteWTF Message (m) Water temperature (WTF) of the analog value processing (on)
- ÿ dzmNmit Message (m) Speed (Nmit) of the speed measurement (dz)
- ÿ fboSDZG OLDA Address (o) of the speed encoder path (SDZG) of error handling (fb)
- ÿ fbwHAEUF_I data word (w) frequency counter initial value (HAEUF_I) of error handling (fb)

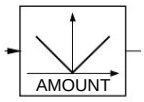
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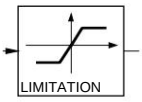
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1.4 Icons

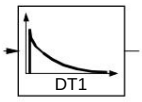
The consistent Bosch K5 symbols are listed below:



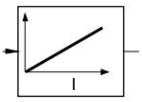
absolute amount



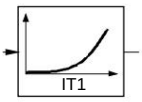
limitation



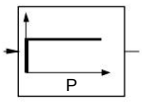
DT1 element



I element



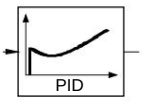
IT1 element



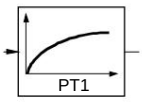
P element



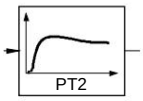
PI element



PID item



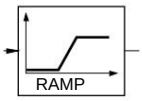
PT1 element



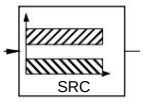
PT2 element



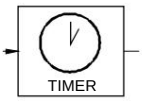
ramp



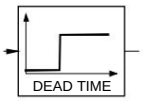
ramp, rising



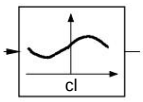
signal range Check



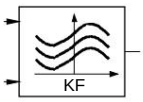
timer



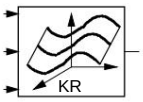
dead time



curve



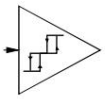
map



identification space


Hysteresis, falling


Hysteresis, rising

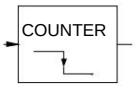

Hysteresis, 3-fold



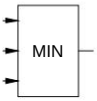
Minimum, 2 entrances



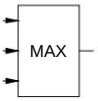
Maximum, 2 entrances



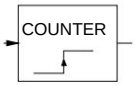
counters, falling flank



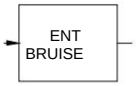
Minimum, 3 entrances



Maximum, 3 entrances



counters, rising edge



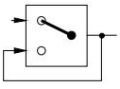
debouncing


switch, 2 inputs, 1 exit


switch, 2 inputs, 1 exit


switch, 1 input, 2 exits

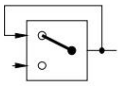

switch, 1 input, 2 exits

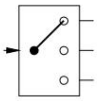

short circuit switch

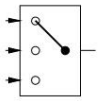
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short circuit switch


switch, 1 input,
3 exits


switch, 3 inputs,
1 exit



comparator



comparison to same



comparison on smaller



comparison on larger



comparison on smaller
or the same



comparison on larger
or the same



bit position



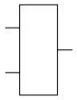
addition



subtraction


division


multiplication

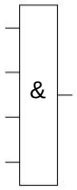

Empty gate



AND, 2 entrances



AND, 3 inputs



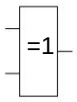
AND, 4 inputs



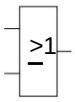
AND, 5 inputs



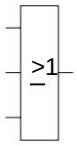
AND, 6 inputs



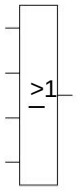
XOR, 2 inputs



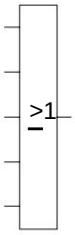
OR, 2 inputs



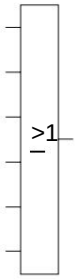
OR, 3 inputs



OR, 4 inputs



OR, 5 inputs

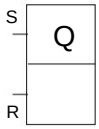


OR, 6 inputs



inverters

inversion

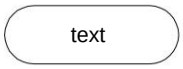


RS flip-flop

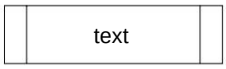
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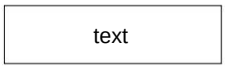
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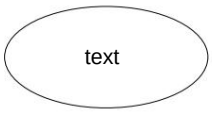
Block start/end



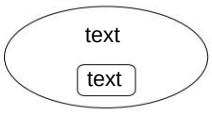
function call



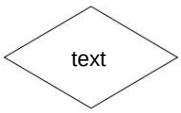
statements



statements



Statement with number



decision



connectors

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1.5 Identification Space

The calculation algorithm of a characteristic space is explained here in general.

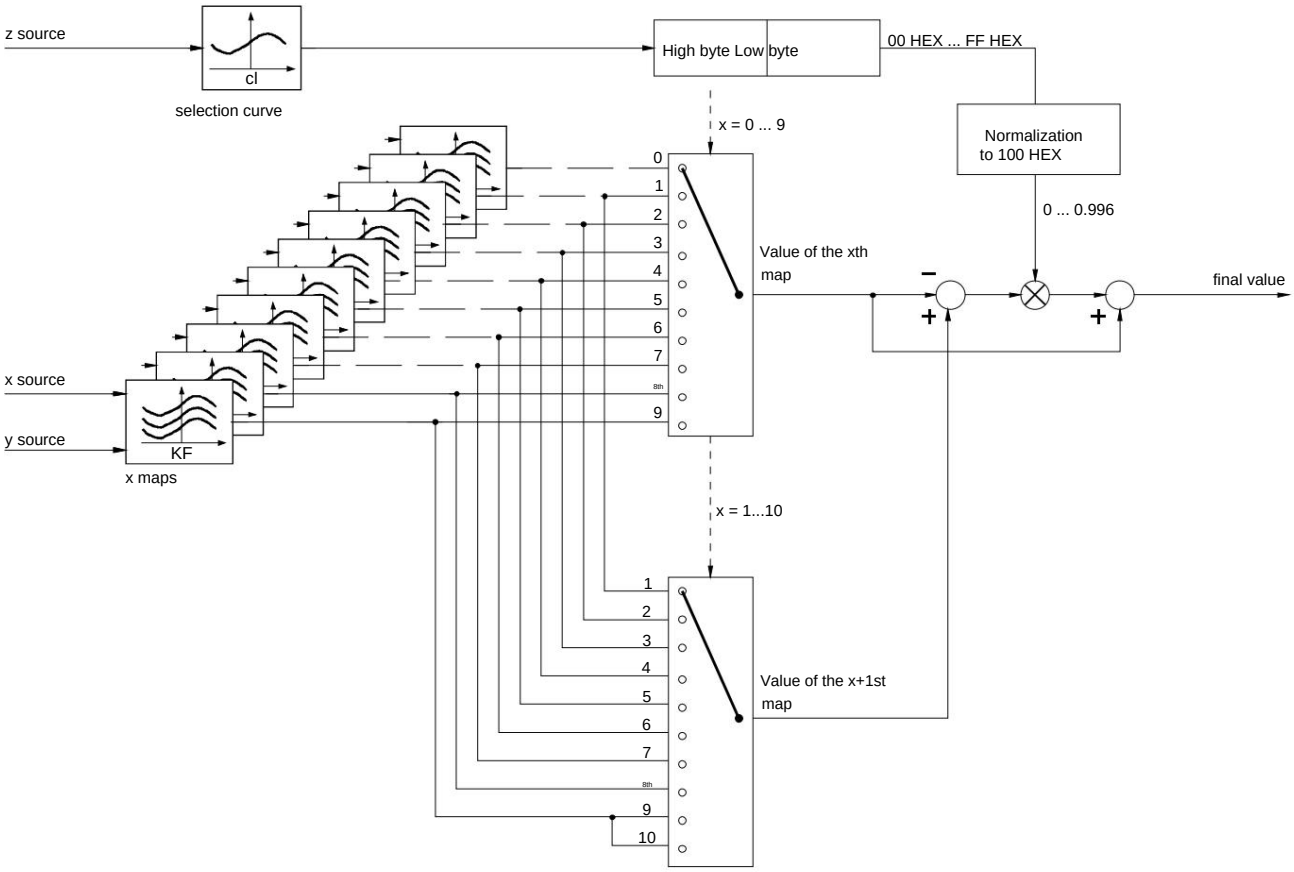


Figure: IDENTIFICATION ROOM

The end value is formed from a 4-dimensional interpolation. The 4-dimensional interpolation is simulated by linear interpolation between the output values of two maps. Depending on the third input variable (z-source), a pair of switches is actuated with the help of the selection characteristic (the conversion must have SBK_EKF) (initial value 00 00 HEX xx 00 HEX). The lower switch is always one step further than the upper switch. ...

The pair of switches selects a pair of characteristics from each x characteristics with the input variables x-source and y-source. The selection from the x maps is made by the "high byte" of the selection characteristic value (0ÿxÿn). A linear interpolation takes place between the output values of the characteristics maps KF(x) and KF(x+1). To do this, the difference between the above output values is multiplied by the normalized "low byte" of the selection characteristic and added to the result of the characteristic diagram KF(x). This results in the final output value.

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1.6 Abbreviations

ADC	Analog to digital converter
ADF	atmospheric pressure sensor
AG4	Automatic transmission (4-speed)
ARD	Active judder damping
ARF	exhaust gas recirculation
ASR	Drive slip control
GDP	Beginning of Injection Period
BRE	brake contact
BRK	redundant brake contact
CAN	controller area network
SLIDE	diagnosis
DCS	throttle actuator
DPRAM	Dual port RAM
DZG	speed sensor
I/O	input/output signals
EDC	Electronic Diesel Control
EEPROM	Electrical Eraseable Programmable Read only memory
EPW	Electropneumatic pressure converter
FB	start of funding
FBR	Start of funding regulation
FGG	vehicle speed sensor
GAZ	glow indicator
GF	memory factor
GRA	cruise control system
GRL	glow relay
GSK	glow plug
GZS	Glow time control/device
HFM	Hot film air mass meter
IWZ	Incremental angle-time system
KF	map
cl	curve
CLI	air conditioning compressor
KS	short circuit
KTF	fuel temperature sensor
KUP	coupling
week	Crankshaft / crank angle
LDF	boost pressure sensor
LDR	boost pressure control
LDS	boost pressure adjuster
LGS	idle switch
LL	Neutral
LLR	idle controller
LMM	air flow meter
LRR	smooth-running regulator
LTF	air temperature sensor
md	moment
MSA	Amount, start of injection and emission control
MSG	engine control unit
MV	magnetic valve
M_L	air mass
M_E	Crowd
N	rotational speed
commercial vehicle	commercial vehicle
NW	camshaft
N_LL	idle speed
obd	On board diagnostics
OLDA	On-line data analysis
PWM	pulse width modulation
PID	parameter identification
car	passenger cars

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PSG	pump controller
PWG	pedal sensor
PWM	pulse width modulation
P_ATM	atmospheric pressure
P_L	boost pressure
R.A.M.	Random access memory
ROME	Read only memory
RP	in-line pump
SG	control unit
SNYC	sync pulse
t	time
T0	sampling time
T_K	fuel temperature
T_L	air temperature
T_S	intake manifold temperature
T_W	water temperature
TDS	speed signal
tv	duty cycle
TQS	crowd signal
U_BATT	battery voltage
V	speed
VP	distribution pump
VSO	Adjustment system 100 (real-time application system)
VTG	Variable turbine geometry
VAG	VW diagnostic tester
WTF	water temperature sensor
Z	number of cylinders
DMF	Dual mass flywheel system

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1.7 RCOS - operating states

The operating system differentiates between 3 system states. At one point in time, the system assumes exactly one of these states:

1.7.1 Initialization

An *initialization* takes place after a power-up or a K15 level change from low to high and can also be triggered by the operating system (after several recoveries have occurred, see below). The initialization is used to set the processor core to a defined state and is carried out when it is assumed that the processor is in an undefined state with regard to the application. The duration of the initialization is typically in the range of 200 ms.

1.7.2 Recovery

A *recovery* takes place under the assumption that an error condition has occurred in the system, which can be converted to an error-free condition by a restart (= reset + processing of the recovery functions). The aim of a recovery is to restart the service and application programs during operation without the driving operation being noticeably affected. In the case of recovery, it is assumed that the overall system is in a partially defined state. The recovery time is of the order of 1 ms. The occurrence of recoveries is time-monitored, too frequent recoveries lead to an initialization.

1.7.3 Operational

This is the "normal" operating state of the control unit. The *Operational* state is reached after initialization or recovery is complete. The functions required for driving are only carried out in this state.

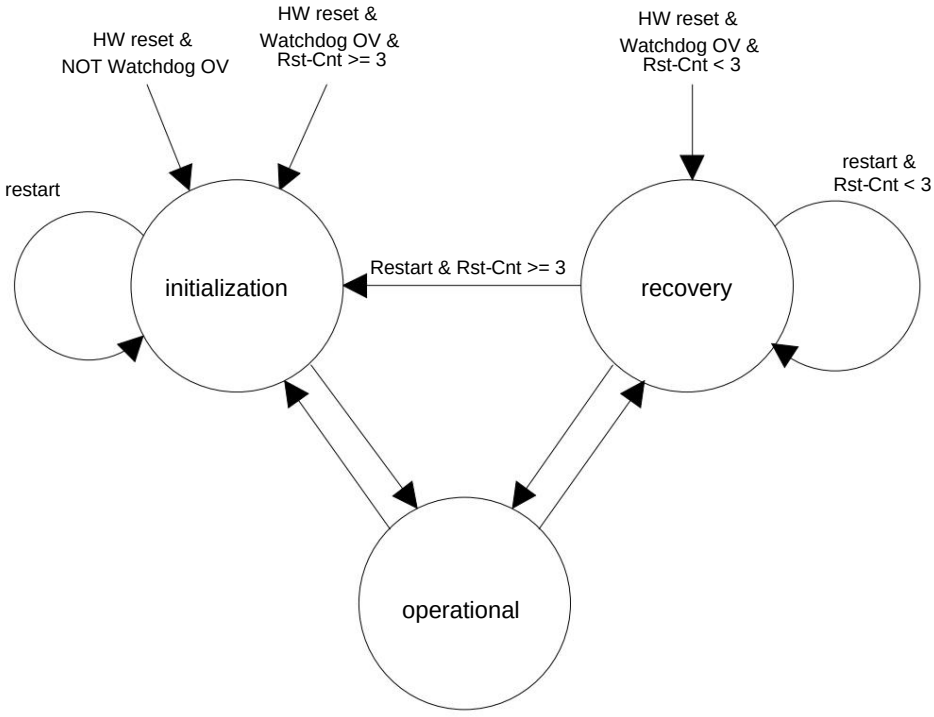


Figure OPMODES: operating states

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1.7.4 Restart - Treatment

If the operating system detects a critical malfunction, it triggers a restart. Through this process, the system is brought into the recovery state. The recovery routines of each Tasks can read the restart cause and take appropriate measures. the respective The cause of the error is displayed in the *low byte of the message edoRSTCD :*

Value (hex)	Cause of **error**
00	Hardware initialization (no error)
01	Timeout during initialization (1st task)
02	Timeout during recovery (1st task)
03	External RAM test failed
04	Initialization timeout (miscellaneous task)
05	Timeout on recovery (miscellaneous task)
06	Incorrect system table version in EPROM
07	Error reading the bit pattern in the EPROM
08	Error reading bit pattern in external RAM
09	EPROM checksum incorrect
0A	Invalid restart entry
0B	Watchdog expired during operational
0C	Null job not active
0D	Task deadline exceeded
0E	Inconsistent valid_bits (int. RAM)
0F	Resource deadline exceeded
10	Illegal interrupt after PEC 0
11	Illegal interrupt according to PEC 1
12	Illegal interrupt after PEC 2 *)
13	Illegal PEC 3 interrupt
14	Illegal PEC 4 interrupt
15	Illegal PEC 5 interrupt
16	Illegal PEC 6 interrupt
17	Illegal PEC 7 interrupt
18	Invalid trap or interrupt entry
19	Stack not empty at end of task
1A	Stack overflow
1B	Stack underflow
1C	Undefined opcode
1D	protection violation

*) possible cause: extreme overfrequency on FGG-1

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Value (hex)	Cause of **error**
1E	Illegal word operand access
1F	Illegal instruction access
20	Access to unconfigured bus
21	Illegal class B HW trap
22	Illegal NMI interrupt
23	Detuning in overrun mode
24	Index in dzmDZGPER has overflowed
25	User stack overflow
26	User stack underflow
27	A/D channel number out of step
28	Eprom checksum (rest) incorrect
29	Series control unit with application data set
2A	CAN module blocks ready line
2 B	different Number of power stage modules - number of power stages used
2C	Measurement series stands although started
2D	Main relay stuck
2E	Internal ROM checksum incorrect
2F	Deadline of a 100ms task exceeded
30	incorrect number of CS lines
31	Incorrect mask ID in EPROM
32	XBUS RAM test failed
33	Wrong number of address lines
34	Critical IWZ implausibility (e.g. no GA)
35	Request GateArray identification error
36	Activate flash programming via restart
37	Data bus test error
38	Software compatibility test not OK
39	wrong mask identification in flash
3A	Master/slave communication disrupted
3B	RAM connectivity test failed
3C	CS agility test failed
3D	Address bus test error
3E	faulty CC215 data bus connection
3F	no APP-SG/Checksum Err detected
40	MV energization: minimum duration for HS-UBat monitoring fallen below

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Value (hex)	Cause of **error**
41	MV energization: A/D conversion time for HS-UBat monitoring fallen below
42	MV energization: A/D conversion time for HS-IMV monitoring fallen below
43	CAN module B blocked

High byte of the edmRSTCD message:

00h ... during initialization / recovery

10h ... during operational with previous initialization

30h ... during operational with previous recovery

The high byte of the restart code has been extended by one more position. With restart code 80XXh the control unit jumped into high-level flash programming. The numbers in Low bytes then have other meanings (namely the error numbers of the self-diagnosis). can be found in the following table.

VALUE (hex)	**Cause of error**
19	EPROM checksum error Page 36
1A	faulty ext. R.A.M.
1F	EPROM checksum error (Page 37-62)
24	Error in SW compatibility test
27	Incorrect mask identification in EPROM (Page 36)
50 - 61	Incorrect bit pattern in EPROM
7F	High-level flash programming entry (via recovery)

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2 quantity calculation

2.1 Overview

The quantity calculation is divided into three sub-tasks due to the different required reaction times. Characteristic maps and characteristic curves are essentially calculated synchronously. The dynamic reaction to the engine behavior requires a speed-synchronous calculation for some parts, while the position control of the quantity metering takes place with a high repetition rate.
The speed-synchronous tasks are generally linked to the speed interrupt, but are activated at least every 32 ms (math limit for speed-synchronous controllers) and not more often than every 6 ms (computer load) or 1.3 ms (with CR).

Functionally, the quantity calculation is made up as follows:

- ÿ start -up process
- ÿ Driving operation

The driving operation is further subdivided into:

- ÿ Limited quantity
- ÿ idle controller
- ÿ Desired quantity
- ÿ Active judder damper
- ÿ Smooth running controller

The functions specific to the injection system are described in the chapter on quantity metering.

An overview can be found in the figures MERE01 (quantity calculation) and MERE02 (driving operation).

The speed-synchronous part of the quantity control is calculated from the current driving or
Engine condition and the calculated speed, the amount of fuel required to reach or maintain the desired operating point.

The desired quantity of the idle controller mrmM_ELLR and the desired quantity mrmM_EWUN determined synchronously are accepted after the start shedding as the current injection quantity mrmM_EAKT. If the sum exceeds the value of the limit quantity mrmM_EBEGR, only the correspondingly reduced part (desired target quantity mrmM_EWUSO) is accepted from the time-synchronous desired quantity. This part is included in the system as a variable that changes the operating point via the quantity input of the active judder damper. Any ARD amounts are ignored during overrun after the time mrwSCHTIxG (gear dependent).

After the addition of the speed-synchronous partial results of the LLR, ARD and LRR, the desired quantity is implemented in the quantity metering chapter.

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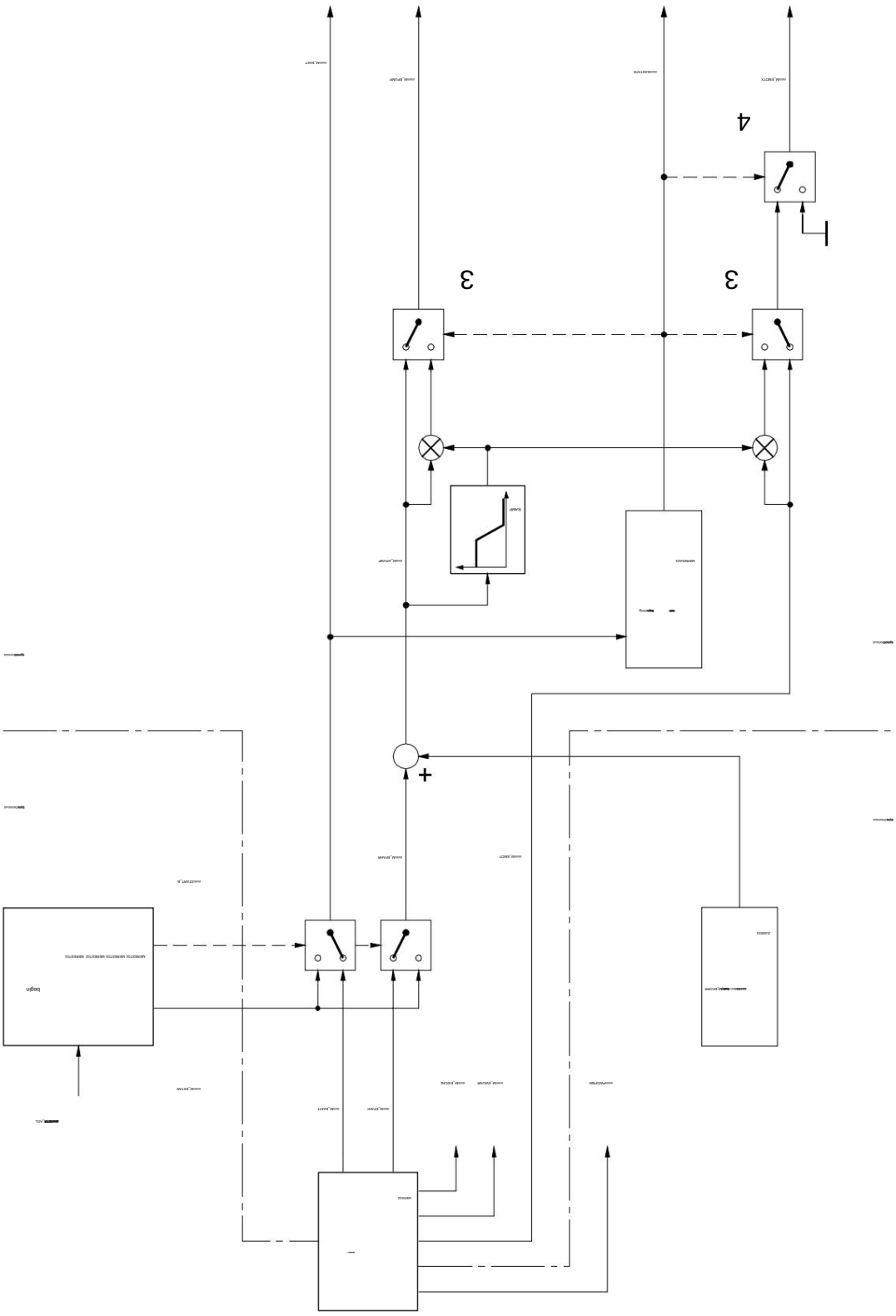


Figure MERE01: Quantity calculation

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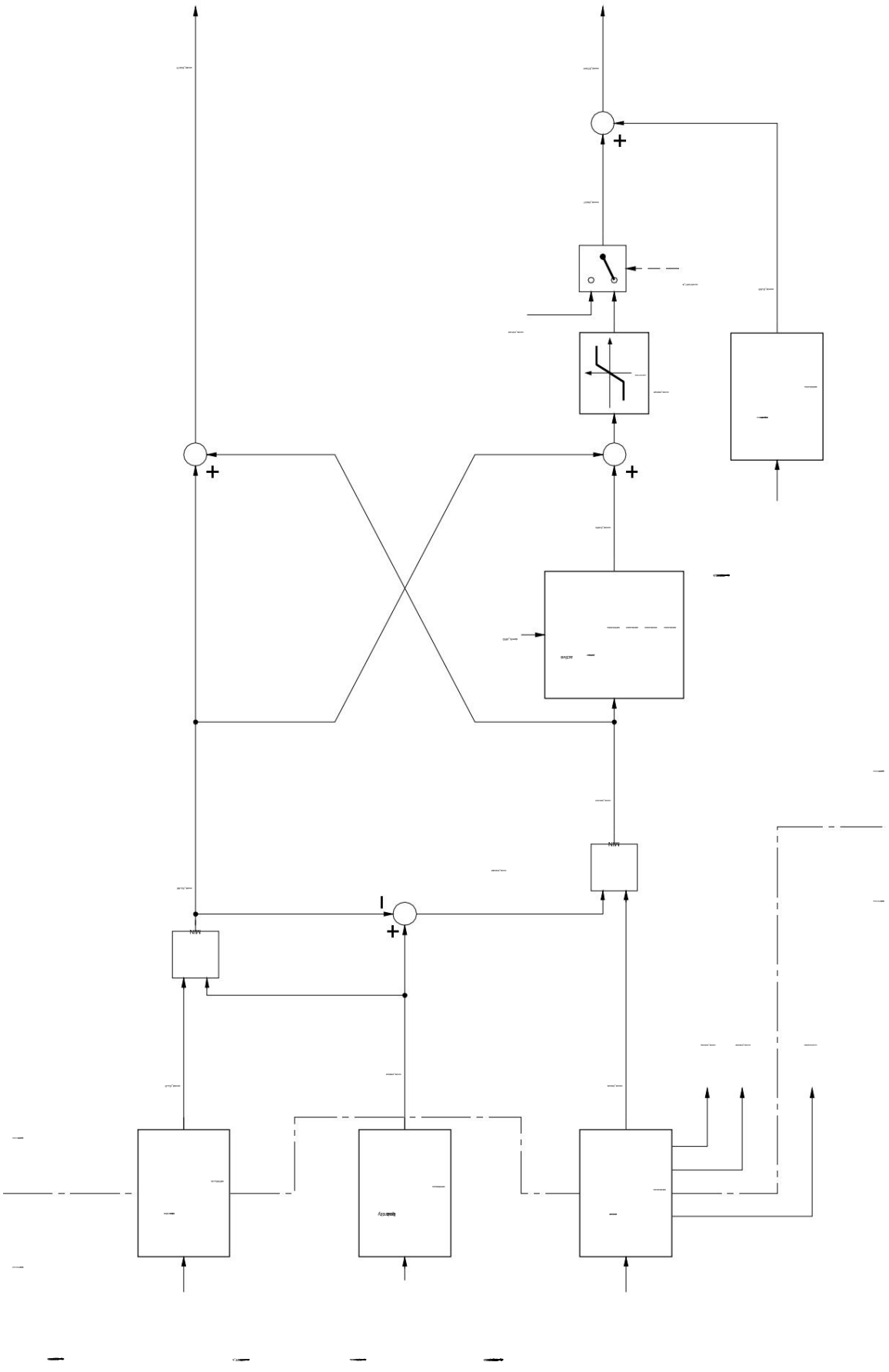


Figure MERE02: driving operation

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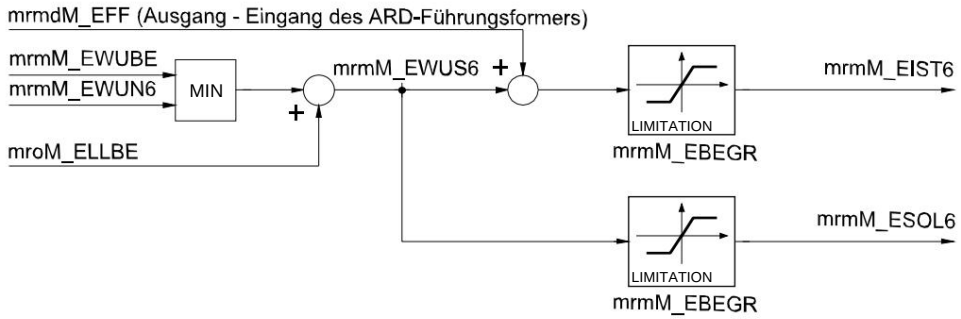


Figure MERE03: Quantity calculation for Motor6 message

The EGS uses engine intervention to reduce excessive acceleration and requires the actual torque for hydraulic control. The target torque is required for the push/pull detection and for controlling the converter clutch.

For the output of the indicated engine torque via CAN (Motor6 message) the "actual injection quantity" mrmM_EIST6 for Motor6-actual torque and the "target injection quantity" mrmM_ESOL6 for Motor6 target torque are calculated in addition to the actual quantity calculation. However, the influences of the ARD disturbance controller, the LL controller and the EGS intervention are not mapped to these two quantities, which requires a certain "parallel calculation". Both quantities are not used for the actual injection, but are only used for the CAN outputs of the Motor6 message after conversion into moments. These moments are evaluated in the gearbox SG. The "target injection quantity" mrmM_ESOL6 also does not contain the influence of the ARD guide shaper, with which a "leading injection quantity" can be determined, which can be evaluated in the transmission SG before the actual injection.

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2.2 Startup Procedure

The starting process is divided into a starting quantity calculation and a starting quantity control.
The starting quantity calculation is based on a static base quantity mroM_ESTIP, adds a value that can be set via VAG tester mrmSTA_AGL and a time-dependent correction value. The starting quantity control releases the starting quantity and switches it off again.

2.2.1 Starting Quantity Calculation

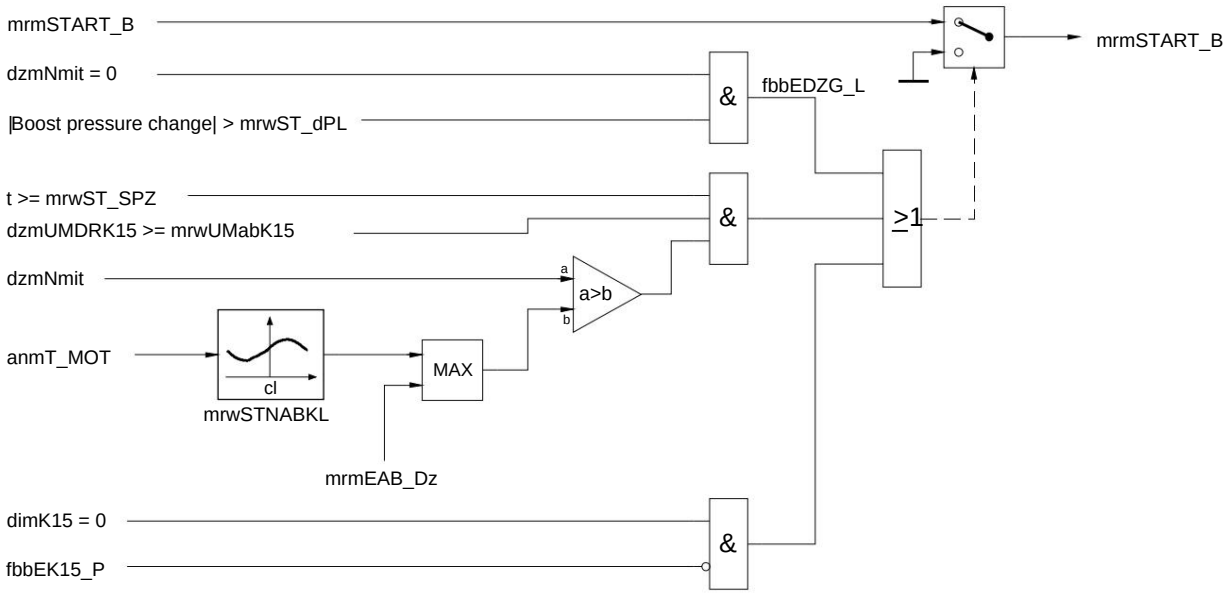


Figure MEREST01: Starting set

base amount:

The lower the engine temperature, the higher the starting quantity must be in order to enable a good cold start; the speed dependency is intended to prevent the engine from generating unnecessary smoke.
The base value mroM_ESTIP is specified by the starting quantity map depending on the engine temperature anmT_MOT and the speed dzmNmit.

Before recognizing a real positive edge at dimK50 (transition initialization - driving SW is not considered an edge), the starting quantity map mrwSTMGRKF is used. The first positive edge at dimK50 (= starter input tracks OLDA mro_ZMsta.4 = 1) is stored in an RS flip-flop and causes switching to the start quantity map mrwSTMGxKF.

In the event of a faulty terminal X (e.g. fuse failure) or starting without a starter (e.g
Pushing) is only started with the starting quantity map mrwSTMGRKF.

Application note:

The starting quantity map must be applied in such a way that no quantity is output in the event of an error in overrun mode (fbbERUC_S), ie the quantity must be zero above the speed threshold mrwUW_SNGR.

The map mrwSTMGxKF contains quantities even at low speeds and high engine temperatures in order to achieve short start times.

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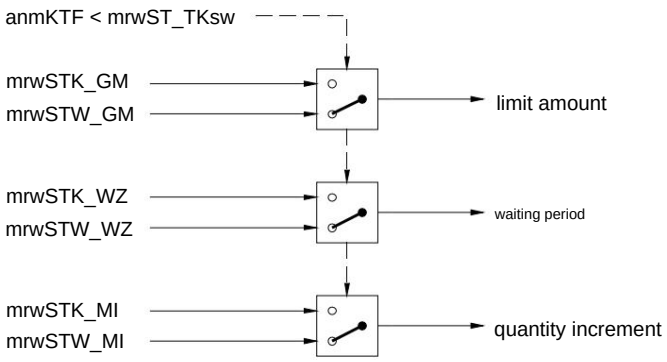


Figure MEREST02: Selection of fuel temperature dependent parameters

Start quantity comparison:

The starting quantity adjustment value mrmSTA_AGL (initialized with cowAGL_STA) is limited to the maximum adjustment value mrwSTA_MAX and the minimum adjustment value 0. Above the adjustment end speed mrwSTA_END, the starting amount is no longer corrected.

Starting quantity increase:

The increase in starting quantity depends on the fuel temperature and is used to ensure a safe cold start. At speeds <mrwSTNMIN1 there is no start quantity increase (integrator = 0).
After exceeding the speed mrwSTNMIN1 is initially carried out for a temperature-dependent waiting time mrwSTW_WZ or mrwSTK_WZ no increase in quantity. After this time, the starting quantity mroM_ESTER is ramped up with the temperature-dependent quantity increment mrwSTW_MI or mrwSTK_MI. The starting quantity increase is frozen when the resulting starting quantity mrmM_ESTAR reaches or exceeds the temperature-dependent limit mrwSTW_GM or mrwSTK_GM or the speed threshold mrwSTNMIN2. The selection of the fuel temperature-dependent parameters is done once at "ignition on" after a delay over the temperature threshold mrwST_TKsw.

This delay (mrwWTCNTKT * 20ms) is to be applied in such a way that a valid fuel temperature is already present when the fuel temperature-dependent parameters are selected. When receiving the fuel temperature via CAN, the time until the first reception must be taken into account.

Deactivation of the starting amount during an applicable time to improve the cold start

The starting quantity can be switched off for an applicable time, determined from anmT_MOT via the characteristic curve mrwSTMFRKL. The timer is started as soon as a speed is determined for the first time (dzmNmit greater than 0).

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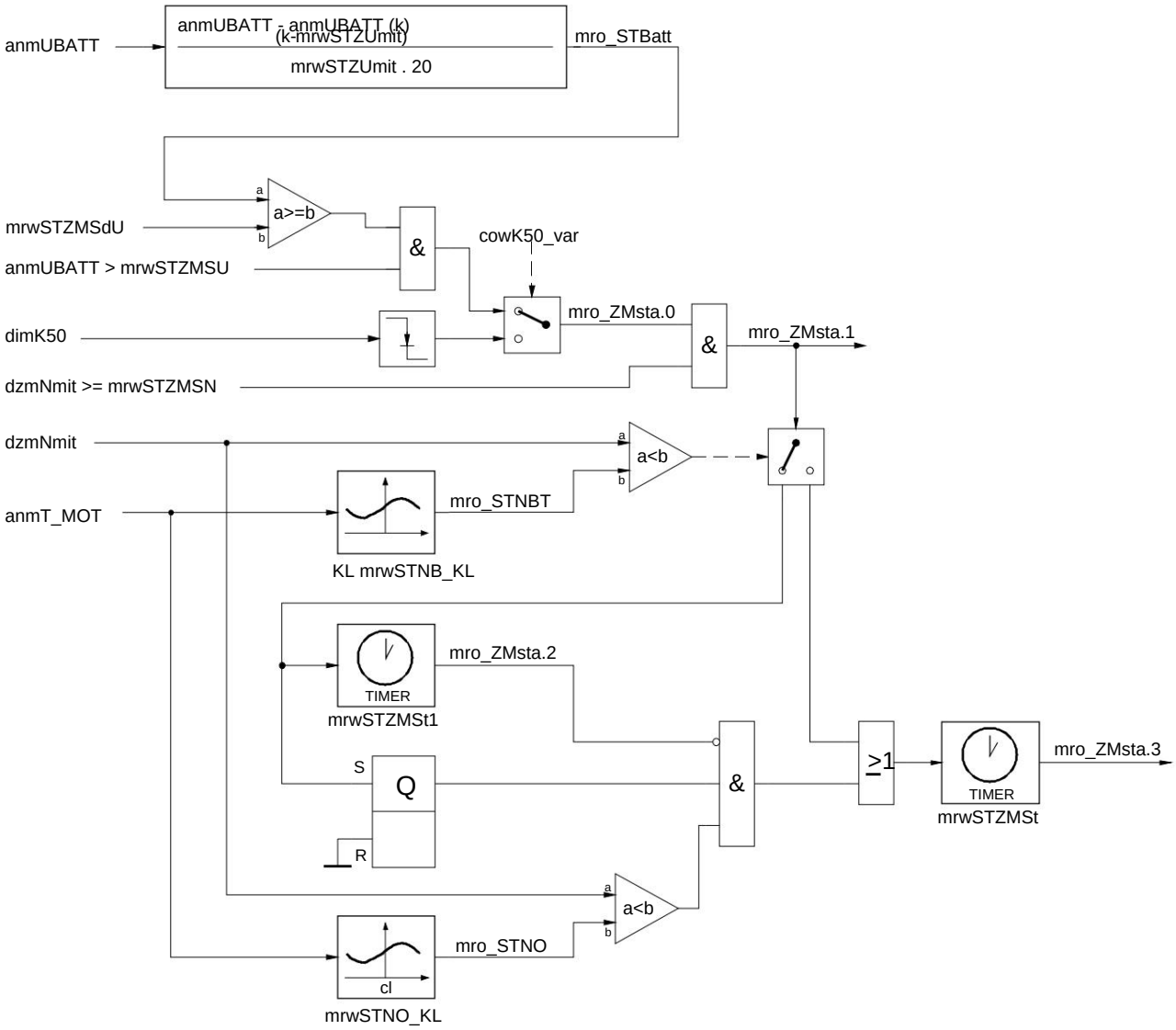


Figure MEREST1A: Starting quantity cut-off for dual mass flywheel

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Shutdown of the starting amount to avoid resonances of the dual mass flywheel

If the starter is decoupled from the engine when starting, the battery voltage curve shows a positive voltage swing. Exceeds this positive gradient of the battery voltage mro_STBatt, calculated from the average difference in battery voltages between the last mrwSTZUmit program periods, the value mrwSTZMSdU, and at this point the battery voltage is greater mrwSTZMSU, a condition for a start abort is met. Alternatively, the starter disengagement can be detected via the variant switch cowK50_var applicable via the falling edge of dimK50 (starter). In order to enable reliable detection of the starter disengagement, the starter disengagement at speeds greater than or equal to the applicative speed threshold mrwSTZMSN is accepted. Is at this point in time with a rising edge (mro_ZMsta.1) the speed dzmNmit less than a motor temperature-dependent threshold mro_STNBT (determined from the characteristic curve mrwSTNB_KL) so the starting quantity mroM_ESTER is turned off for the time mrwSTZMSt. Otherwise, a time mrwSTZMSt1 is started. If after this time the speed threshold mro_STNO (determined from the characteristic curve mrwSTNO_KL) is not reached, the starting amount mroM_ESTER is also turned off for the time mrwSTZMSt. These shutdowns can only occur once per driving cycle.

This measure excludes the speed range that is critical for a start resonance and permits maximum time mrwSTZMSt1 to remain in a resonance.

The number of main program periods for averaging the voltage increase mrwSTZUmit is also limited to the values 1 to 10. The application date is therefore only accepted during initialization. Furthermore, the conditions are only calculated and the OLDAs updated as long as the start bit is set.

2.2.2 Start quantity control

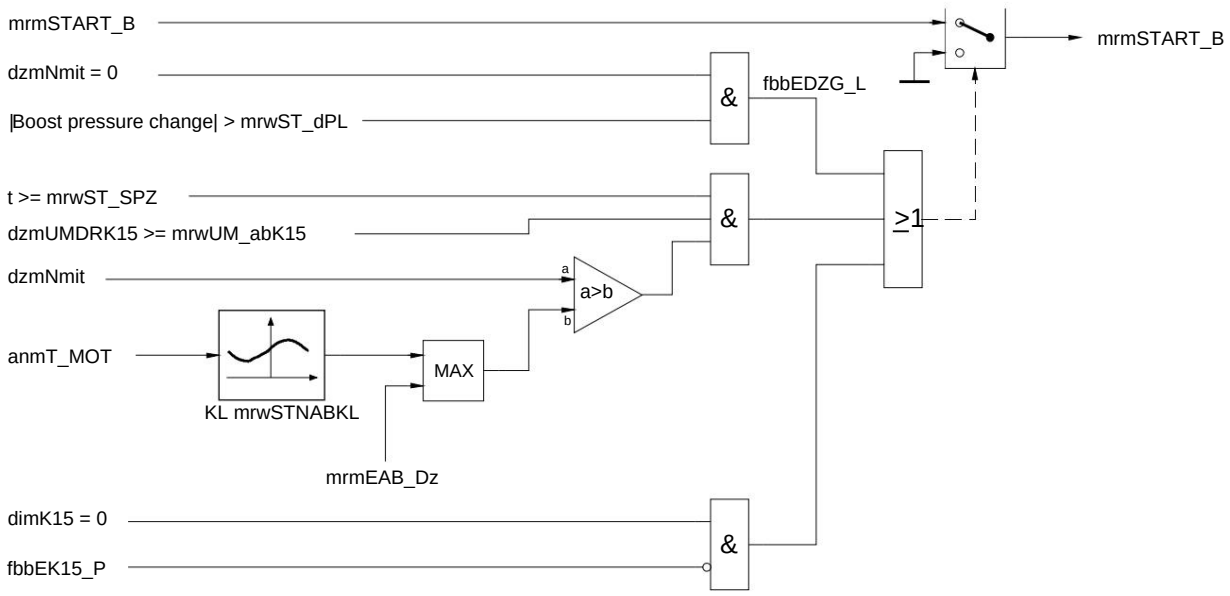


Figure MEREST03: launch drop

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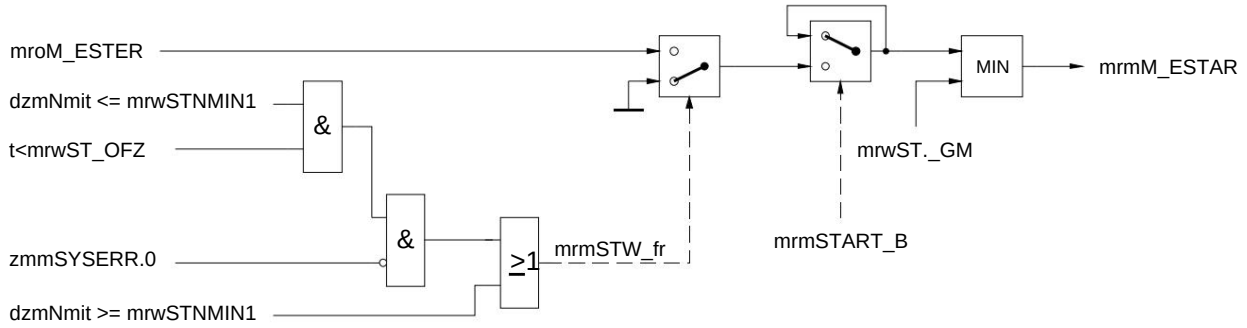


Figure MEREST04: Quantity metering and ELAB release

Normal case:

The set after the control unit initialization start bit mrmSTART_B is deleted when a motor temperature-dependent start shedding speed is exceeded. The start shedding speed is determined from the characteristic mrwSTNABKL as a function of the engine temperature anmT_MOT. With monitoring concept-functioning "summarized system the supply voltage of the control unit, the starting speed is set to zero, see mrmM_ESTAR and in systems with ELAB switching ELAB at zero speed (dzoNmit = 0) release.

Range of values mrmSTART_B (bit-coded):

ÿ 0 = launch drop ÿ 1

= start condition ÿ 16

= transition from aborted after-run to start condition

ÿ 32 = restart by Ecomatic

Engine speed sensor - monitoring when starting (see monitoring concept): The

engine speed sensors are monitored via the change in boost pressure anmLDF. Changes the pressure at the speed dzoNmit = 0 by more than the pressure delta threshold mrwST_dPL an error fbbEDZG_L is reported and the start bit is deleted.

Terminal 15 - monitoring during start:

If the driver requests "ignition off" during the starting process (dimK15 = 0) and there is no error in the terminal 15 evaluation circuit (fbbEK15_P), the start bit is also deleted. When the start bit mrmSTART_B is deleted, the start quantity mrmM_ESTAR remains frozen.

Glitch suppression:

Due to interference from the starter, the observation of the speed for a start shedding blocking time mrwST_SPZ is suppressed after the start of the startup process. A fade out is also done until a minimum number (mrwUM_abK15) of engine revolutions since K15 On (dzmUMDRK15) is reached. If the starting process is triggered by the ECOMATIC, then the start shedding blocking time mrwST_SPZ is suppressed at speed dzmNmit ÿ 0.

No starter actuation:

If after the beginning of the glow start minimum speed mrwSTNMIN1 is not exceeded within the shutdown mrwST_OFZ + preheating time or only one speed sensor is defective, the quantity metering and the ELAB will be blocked again.

Start with ELAB test (see monitoring concept):

The ELAB is tested at certain intervals during the start process. see also

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Operating hours counter (monitoring concept)

2.3 Limit Quantity

The limiting quantity consists of the parts smoke, torque limitation and
Correction options together:

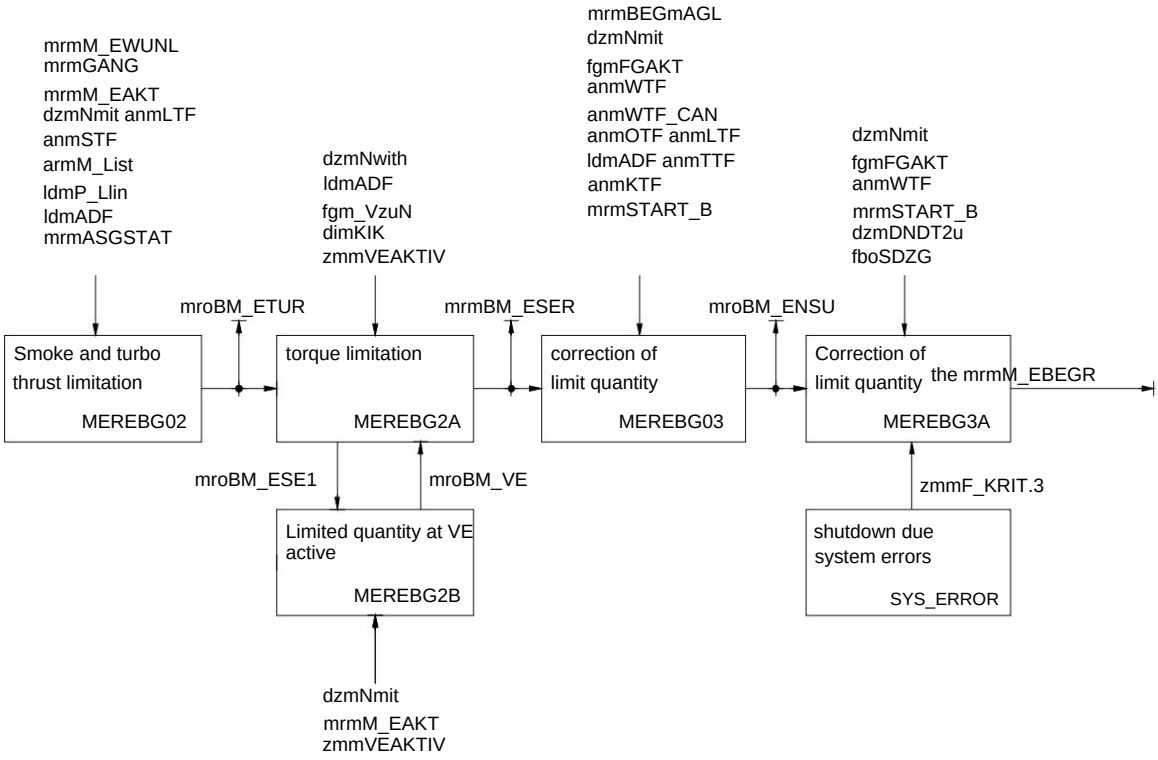


Figure MEREBG01: Limit quantity

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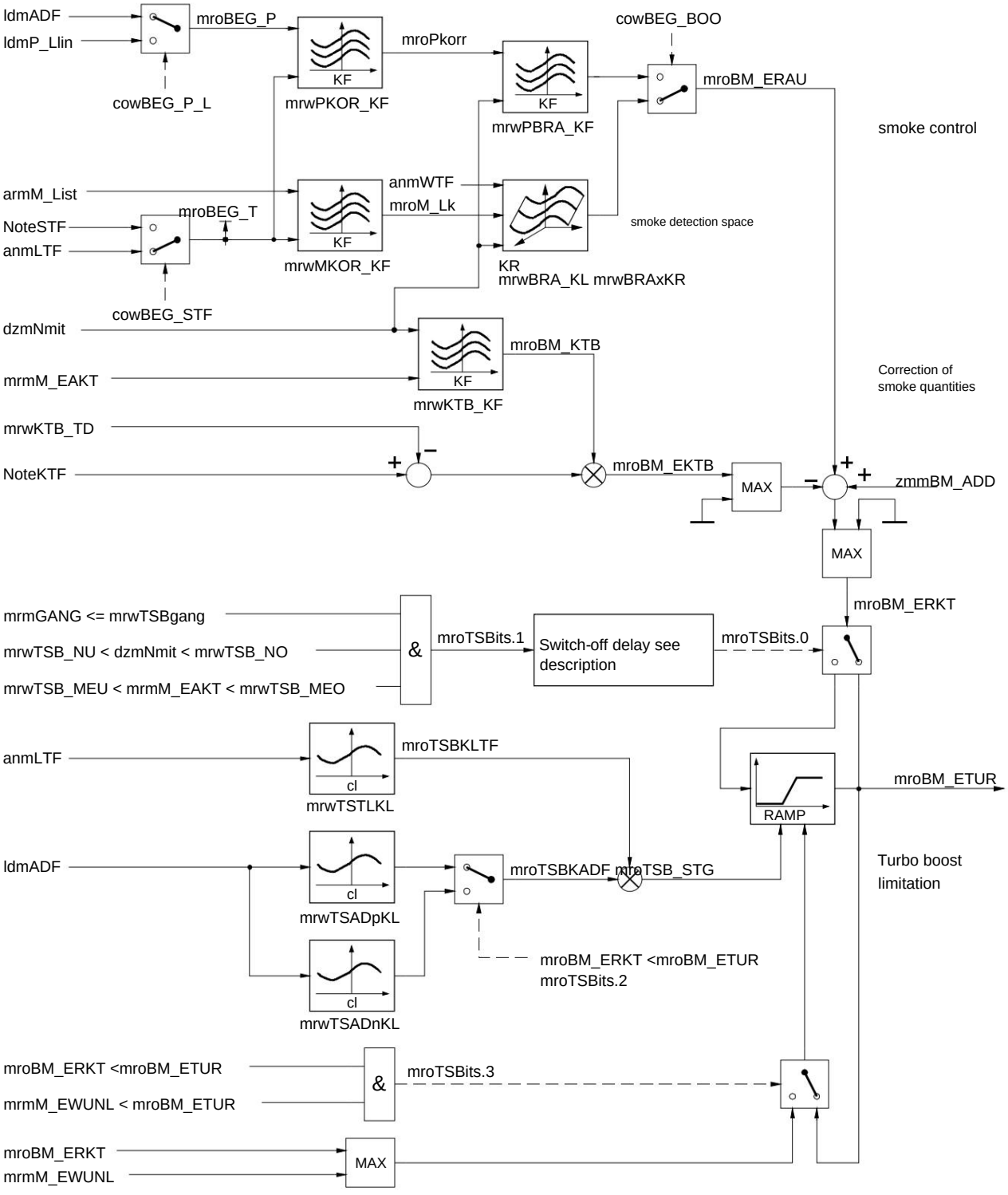


Figure MEREBG02: smoke limitation + turbo boost limitation

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Smoke Limitation:

The permissible amount of fuel (amount of smoke) is determined from a smoke limitation map in order to avoid excessive smoke development. The cowBEG_BOO switch defines whether the smoke limitation is calculated with air mass or with intake manifold pressure. When cowBEG_BOO = 0, the smoke limitation is calculated with mrwBRAxKR as a function of the corrected air mass mroM_Lk and the speed dzmNmit. The corrected air mass mroM_Lk is calculated with mrwMKOR_KF from air mass armM_List and temperature. When cowBEG_BOO = 1, the smoke limitation is calculated with mrwPBRA_KF as a function of the corrected intake manifold pressure mroPkorr and the speed dzmNmit. The corrected intake manifold pressure mroPkorr is calculated with mrwPKOR_KF from pressure and temperature. The cowBEG_P_L switch is used to select whether atmospheric pressure ldmADF or boost pressure ldmP_Llin is used. The cowBEG_STF switch is used to select whether anmLTF (cowBEG_STF = 0) or anmSTF (cowBEG_STF = 1) should be corrected.

System-specific smoke quantity correction:

With zmmBM_ADD an injection system-dependent additive correction of the smoke limitation can be made.

Smoke amount correction as a function of fuel temperature:

At high fuel temperatures, the amount calculated from the smoke map should be corrected to compensate for the softer injection of the pump due to temperature-dependent leakage losses. Smoke development can thus be avoided. The correction acts but only subtractively on the amount of smoke map mroBM_ERAU. About the correction map mrwKTB_KF with the input variables mrmM_EAKT and dzmNmit, the normalized amount mroBM_KTB for 100 ° C above the reference

temperature mrwKTB_TD is calculated. The amount of smoke correction mroBM_EKTB is limited to positive values and subtracted from the amount of smoke, ie at fuel temperatures below mrwKTB_TD no correction is made. The result mroBM_ERKT is also limited to positive values.

Turbo Thrust Limit:

The sudden increase in engine torque when the turbocharger kicks in is to be reduced by the Extended Turbo Boost Limitation (TSB). As soon as the activation conditions

mrmGANG <= mrwTSBgang **AND**

mrwTSB_NU < dzmNmit < mrwTSB_NO **AND**

mrwTSB_MEU < mroM_EAKT < mrwTSB_MEO

are met, the rate of increase of the output quantity of the smoke map (amount of smoke mroBM_ERAU) is limited by a ramp to the maximum gradient mroTSB_STG and formed the turbo quantity mroBM_ETUR. The maximum gradient results, depending on the sign, from two ADF - dependent characteristics mrwTSADpKL and mrwTSADnKL, which are still corrected by an LTF - dependent characteristic mrwTSTLKL. If the desired amount mrmM_EWUNL is smaller than the turbo amount mroBM_ETUR with falling TSB ramp, the TSB ramp is initialized to the maximum of desired amount mrmM_EWUNL and amount of smoke mroBM_ERKT.

Turbo boost limit switch-off delay:

In order to avoid noticeable jumps in quantity when the TSB is switched off, the TSB remains after it has ceased to exist

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of the activation conditions remains active until the turbo quantity has reached the value of the smoke quantity or the torque limiter intervenes.

Ramp-shaped limiting quantity for pre-injection:

With active pre-injection (zmmVEAKTIV = 1) and current. Amount (mrmM_EAKT) greater threshold value mroBM_Verp, the current amount should only increase with the WTF-dependent ramp slope from the characteristic curve mrwVEBsLKL in order to stay in the area of the pre-injection for as long as possible.

The switch-off delay (mroVEB_STA.0=1) is intended to prevent jumps in quantity when the function is switched off. After the elimination of the switch-on condition (mroVEB_STA.1=0), mroBM_VE is incremented with the slope mrwVEBstgS until mroBM_ESE1 is reached regardless of mrmM_EAKT.

If mrmM_EAKT is larger mroBM_VERp and smaller mroBM_VE, the limit amount mroBM_VE is initialized with mrmM_EAKT (mroVEB_STA.3=0).

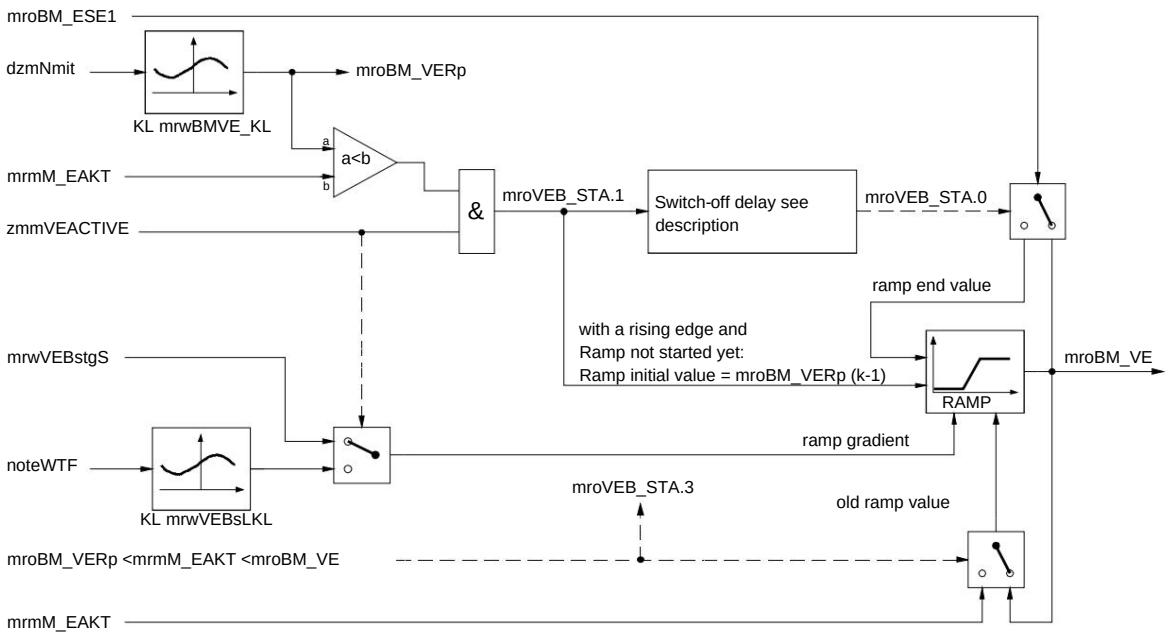


Figure MEREBG2B: Ramp-shaped limit quantity with VE active

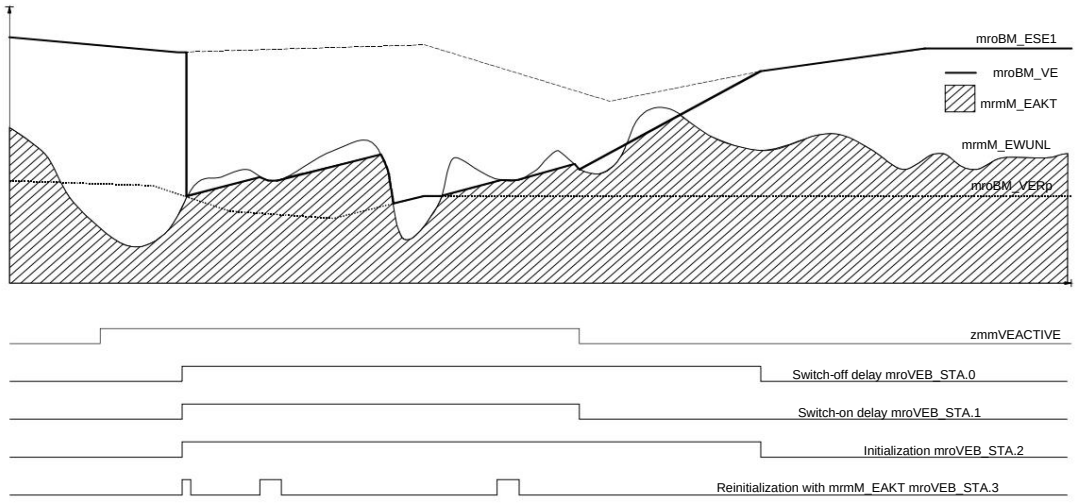


Figure MEREBG2C: typical limiting quantity curve with VE active

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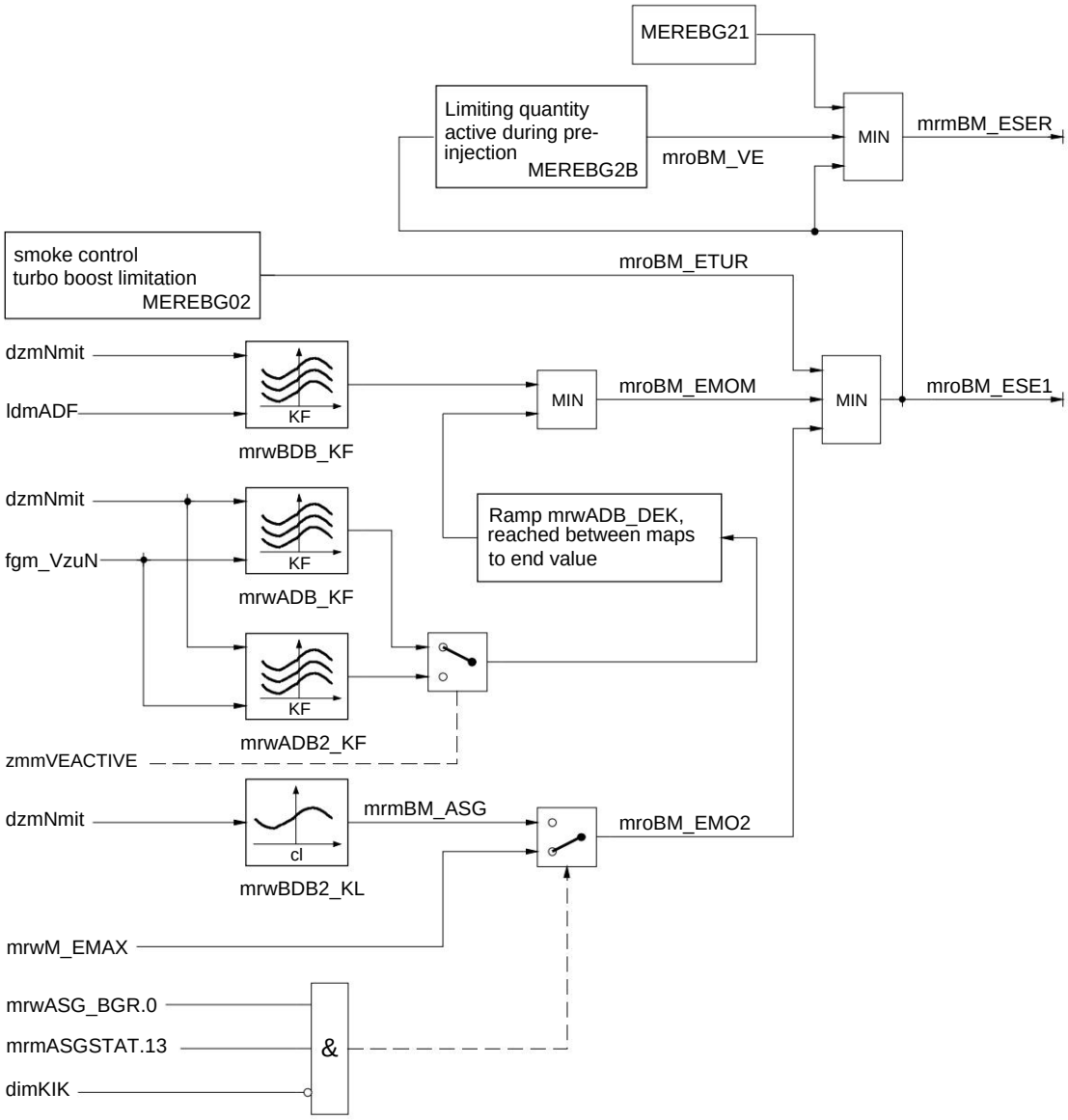


Figure MEREBG2A: Torque limitation

Torque limitation:

The torque limitation quantity mroBM_EMOM is formed from the minimum of the maps mrwBDB_KF (dzmNmit, ldmADF) and mrwADB_KF (dzmNmit, fgm_VzuN) or mrwADB2_KF (dzmNmit, fgm_VzuN and zmmVEAKTIV = 1).

In order to avoid quantity jumps, the switchover between the maps mrwADB_KF and mrwADB2_KF is realized via a ramp with the maximum gradient mrwADB_DEK. The ramp is calculated until the current quantity has reached the desired value from the map. ie after the switchover has been completed, the map intervenes unfiltered in the generation of the minimum torque.

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Torque limitation in ASG-ECO mode:

For the ASG ECO mode is a second torque limit amount mrmBM_ASG determined from the map mrwBDB2_KL available.

This can be activated via the label mrwASG_BGR.0. If the ASG ECO mode is now enabled (mrmASGSTAT.13 = 1) and Kik-Down is not actuated (dimKIK = 0), the calculated torque limit mroBM_EMO2 is included in the minimum selection.

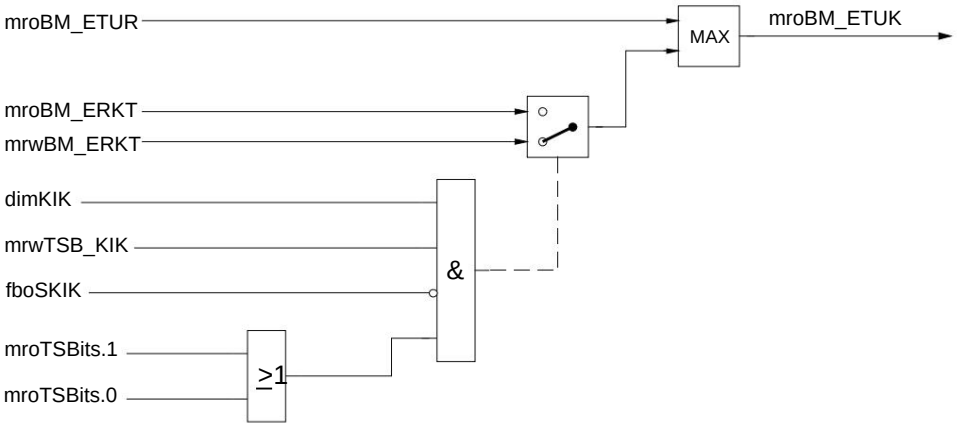


Figure MEREBG21: TSB bypass by kick-down

Switching off turbo boost limitation on kick-down:

In order for the driver to be able to call up the full engine power despite the turbo boost limitation, it can be switched off during kick-down. For this purpose, a maximum selection between smoke quantity correction and turbo boost quantity is formed and output on mroBM_ETUK with an applied kick-down (dimKIK = 1) and active turbo boost limitation (mroTSBits.0 = 1 OR mroTSBits.1 = 1). This function can be switched off via the label mrwTSB_KIK. If there is no kick-down, the label mrwBM_ERKT is included in the maximum selection. For runtime reasons, the OLDA mroBM_ETUK is issued 20ms after mroBM_ETUR.

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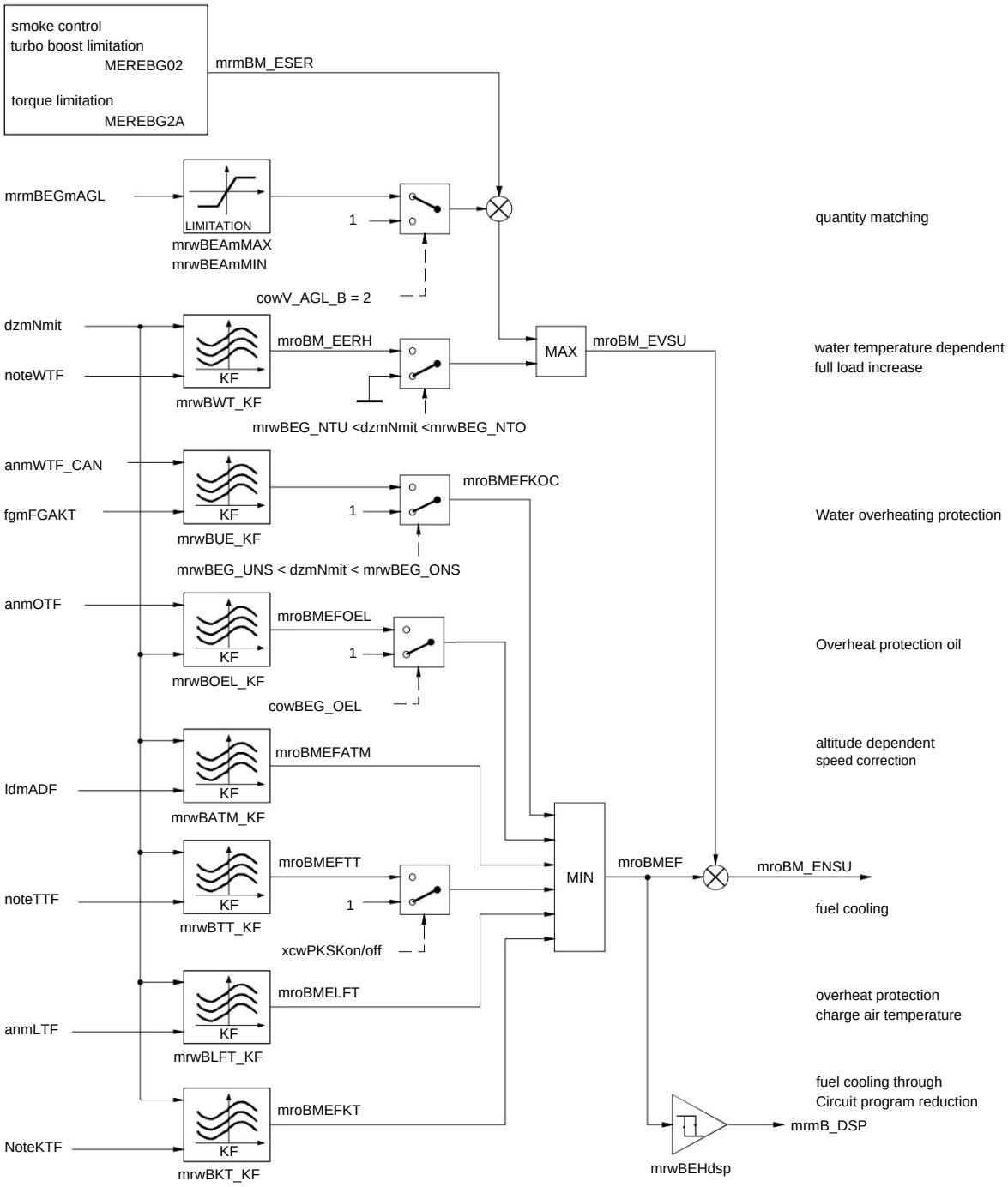


Figure MEREBG03: Boundary quantity corrections

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Service quantity comparison via VAG tester:

The software switch cowV_AGL_B defines whether the quantity comparison should be multiplicative on the limit quantity or additive in the quantity metering

Description of the software switch cowV_AGL_B:

Bit position	decimal value	comment see
0	1	multiplicative quantity comparison of the limit
1	2	quantity mrmBM_ESER with mrmBEGmAGL (substitute value cowAGLmBEG). The comparison value is limited between mrwBEAmMIN and mrwBEAmMAX.

Water temperature dependent full load increase:

Between the speed threshold mrwBEG_NTU and the speed threshold mrwBEG_NTO, an increase amount mroBM_EERH is determined from the map mrwBWT_KF as a function of the water temperature anmWTF and the speed dzmNmit to enable a better starting when the engine is cold. The maximum of limit amount mrmBM_ESER and increase amount mroBM_EERH is summarized and processed to limit amount mroBM_EVSU.

Overheating protection on the water temperature: The

cooking protection quantity factor mroBMEFKOC is determined from the overheating protection map mrwBUE_KF as a function of the water temperature via CAN anmWTF_CAN and the driving speed fgmFGAKT. However, this function is only active within the speed limits mrwBEG_UNS and mrwBEG_ONS. Overheating protection on the oil temperature: The mroBMEFOEL limiting quantity factor is calculated using the map mrwBOEL_KF with the current

speed dzmNmit and the oil temperature anmOTF. With the software switch cowBEG_OEL the quantity limitation

depending on the oil temperature is switched on (=1) or off (=0). Overheating protection on the charge air temperature: About the map mrwBLFT_KF is calculated with the current speed dzmNmit and the charge air temperature anmLTF the limiting quantity factor mroBMELFT.

Altitude-dependent speed correction: The

mroBMEFATM limiting quantity factor is calculated using the mrwBATM_KF map with the current speed dzmNmit and the atmospheric pressure ldmADF.

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Fuel temperature-dependent speed correction and fuel cooling:

About the map mrwBKT_KF is calculated with the current speed dzmNmit and the fuel temperature anmKTF the limiting quantity factor mroBMEFKT. About the map mrwBTT_KF is calculated with the current speed dzmNmit and the tank inlet temperature anmTTF the limiting quantity factor mroBMEFTT. This limitation can be switched on via the diagnostic password xcwPKSKon and switched off via xcwPKSKoff.

Fuel cooling by lowering the switching point: From the

minimum of overheating protection water, - oil, - fuel, - tank inlet temperature and - charge air temperature, the factor mroBMEF is formed, with which the limiting quantity is reduced to mroBM_ENSU. If the factor mroBMEF also falls below the value mrwBEHdspU, a switching program is selected with mrmB_DSP via CAN on the transmission, in which upshifts take place at lower speeds. If mroBMEF exceeds the value mrwBEHdspO, the original switching program is selected again.

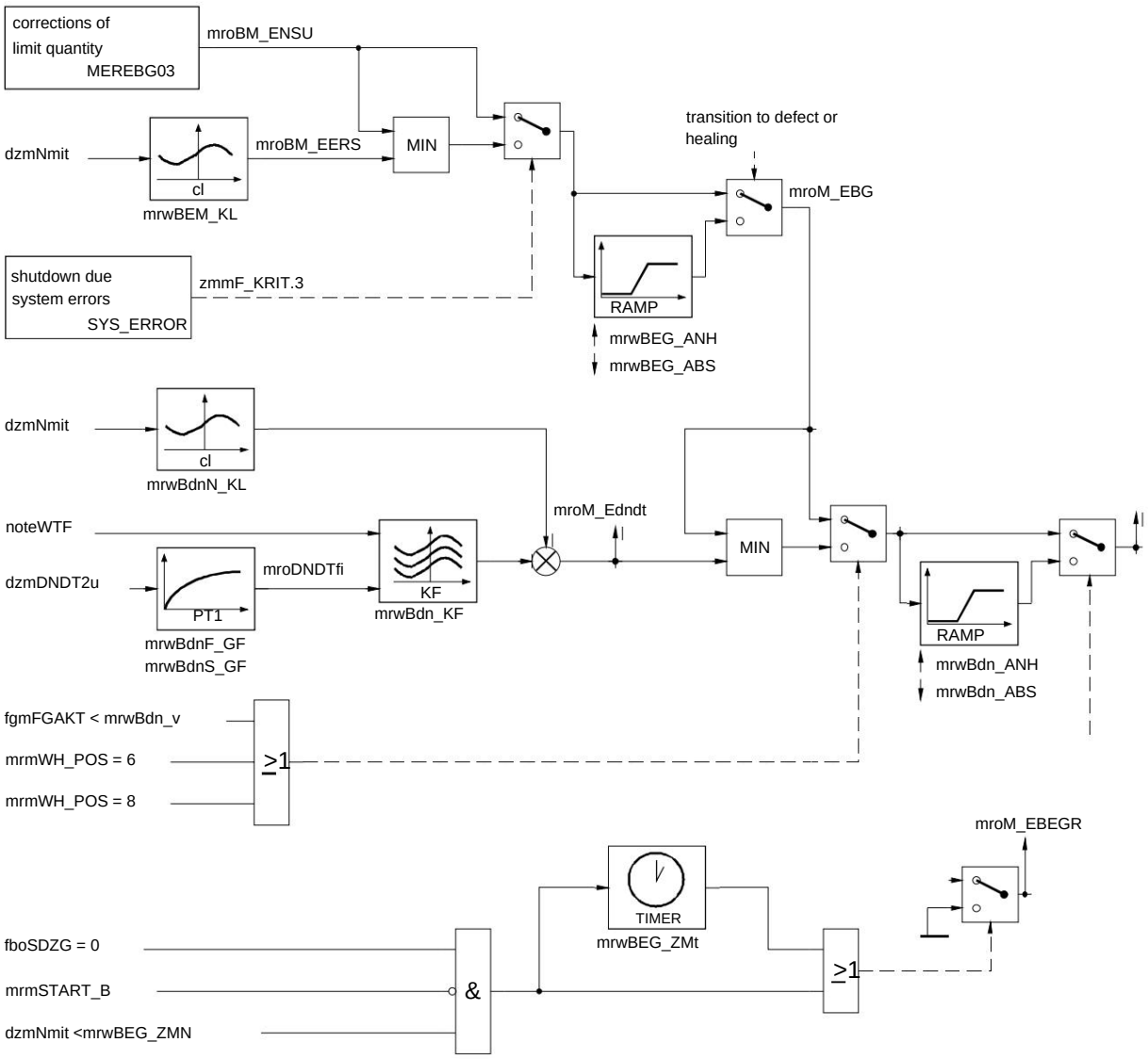


Figure MEREBG3A: Boundary quantity corrections

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Quantity limitation in the event of a system error:

With the software switches cowFMEBEG1, cowFMEBEG2, cowFMEBEG3 and cowFMEBEG4 is applied, which system errors should be limited to a speed-dependent replacement amount. (See monitoring concept: shutdown due to system errors) The speed-dependent replacement quantity mroBM_EERS is formed from the replacement quantity characteristic mrwBEM_KL as a function of the speed dzmNmit.

When a system error occurs (zmmF_KRIT.3=1), the amount mroM_EBG is introduced via the ramp mrwBEG_ABS to the minimum of the speed-dependent replacement amount mroBM_EERS and the limiting amount mroBM_ENSU.

When healing the system error, the amount mroM_EBG is introduced to the amount mroBM_ENSU via the ramp mrwBEG_ANH.

Limitation depending on the speed acceleration:

The speed acceleration of the last two revolutions dzmDNDT2u is filtered with falling acceleration with mrwBdnF_GF, filtered with increasing acceleration with mrwBdnS_GF. With the map mrwBdn_KF and the characteristic mrwBdnN_KL is determined depending on this filtered acceleration, the water temperature and the speed of a limiting amount mroM_Ednt. This controls a limitation of the acceleration, the inputs for water temperature and speed have the purpose that the acceleration limitation can be reduced or switched off at certain water temperatures and at certain speed ranges. With a switch, the acceleration limitation can be switched on at speeds below mrwBdn_v or at selector lever position mrmWH_POS 6 or 8. The minimum of the amounts mroM_Ednt and mroM_EBG is passed on mroM_EBGvo when acceleration limitation is active. When exiting the acceleration limitation, the ramp mrwBdn_ANH or mrwBdn_ABS acts to avoid quantity jumps.

Quantity shut-off to avoid resonances from the dual-mass flywheel:

If while driving (mrmSTART_B = 0) the speed falls below the threshold mrwBEG_ZMN by braking and there is no error in the DZG path (fboSDZG = 0), then the limiting amount mroM_EBEGR is switched to 0, and the time mrwBEG_ZMt started. If the condition is no longer met, the amount is released again after the time mrwBEG_ZMt. If the condition changes while the time mrwBEG_ZMt is running, the time is restarted with each change from not fulfilled to fulfilled.

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2.4 Idle Control

A PI controller is used for idle control. To optimize speed-synchronous processing, various parameter sets are selected and made available synchronously. The target idling speed is switched depending on the operating status of the vehicle.

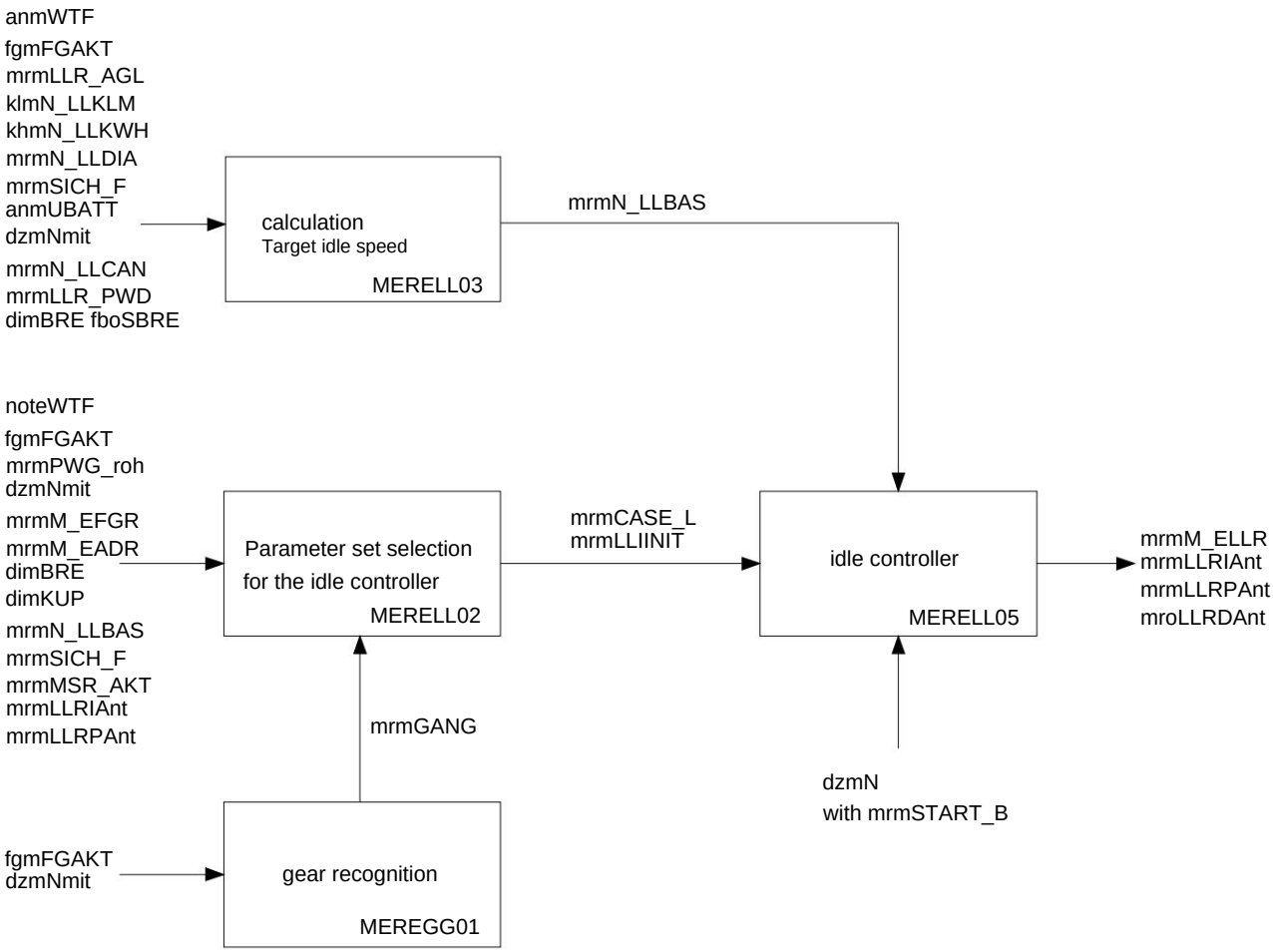


Figure MERELL01: Overview idle controller

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2.4.1 Aisle detection

The gear recognition determines the engaged gear for the parameter selection of the idle controller and the active judder damper.

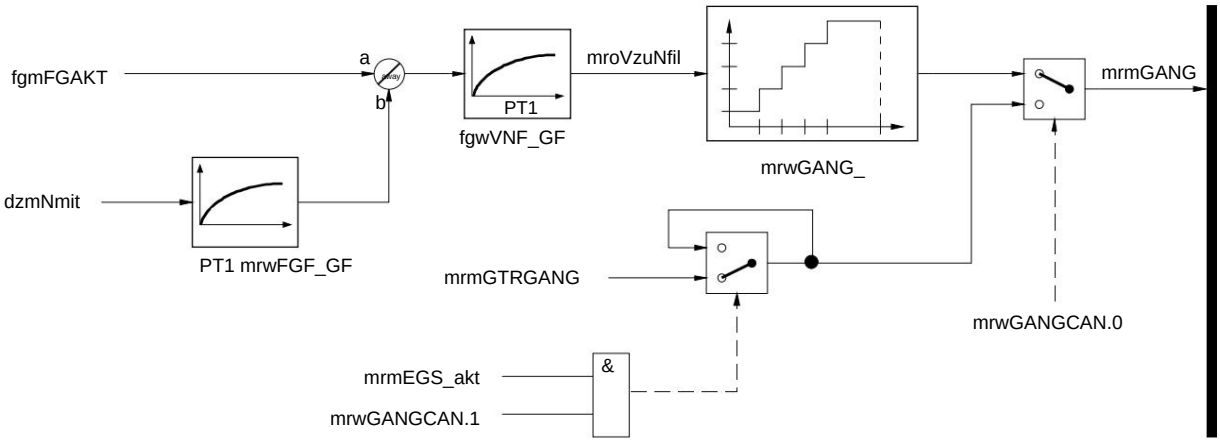


Figure MEREGG01: Aisle detection

It is possible to determine the gear information from the driving speed and engine speed or to take it from the CAN message gearbox 1. The selection is made via mrwGANGCAN.

Description of the software switch mrwGANGCAN:

bit pos.	decimal value	comment
0	1	0: gear information from driving speed and speed 1: gear information via CAN only effective at mrwGANGCAN.0 = 1 0: take gear
1	2	information directly from mrmGTRGANG 1: evaluation including the "circuit active" bits.

Gear information from driving speed and engine speed:

In order to adapt the speed dzmNmit to the dynamics of the driving speed fgmFGAKT, there is a PT1 filtering via mrwFGF_GF. The ratio of the driving speed to the filtered engine speed is formed and smoothed using a further PT1 element. The result is a filtered value for the v/n ratio mroVzuNfil. The gear selection mrmGANG is then done via the application data mrwGANG_.

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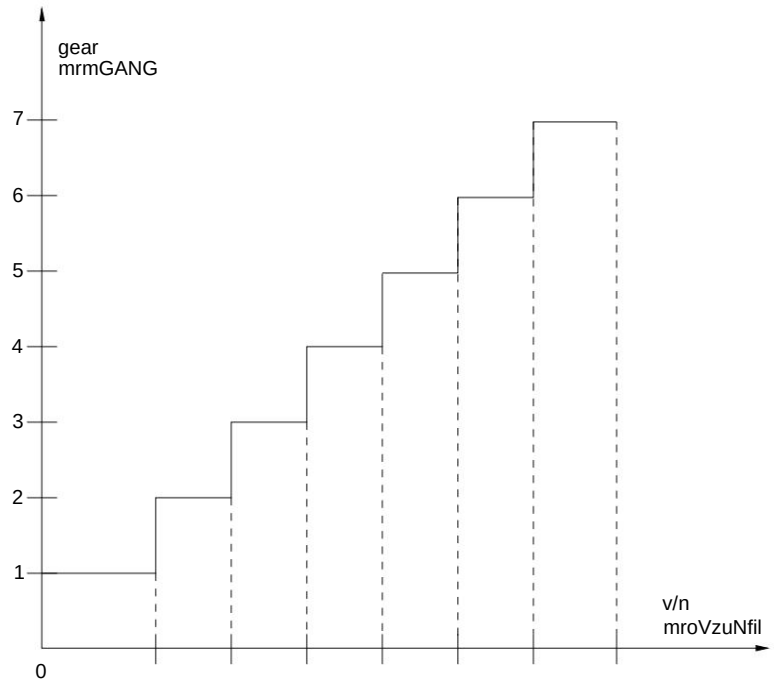


Figure MEREAR02: Gear detection for the parameter definition ARD and LLR

Gear information via CAN:

If the bit mrwGANGCAN.1 is not set, then the target gear information from the transmission mrmGTRGANG taken directly.

When the mrwGANGCAN.1 bit is set, the value of mrmGTRGANG is only accepted if mrmEGS_akt (S_SG - "Active circuit" from gear 1) is 0. This has the purpose that a newly engaged gear is only recognized after the shift has been completed. The Only change target gear information in transmission 1 if S_SG is already set.

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2.4.2 Parameter set selection

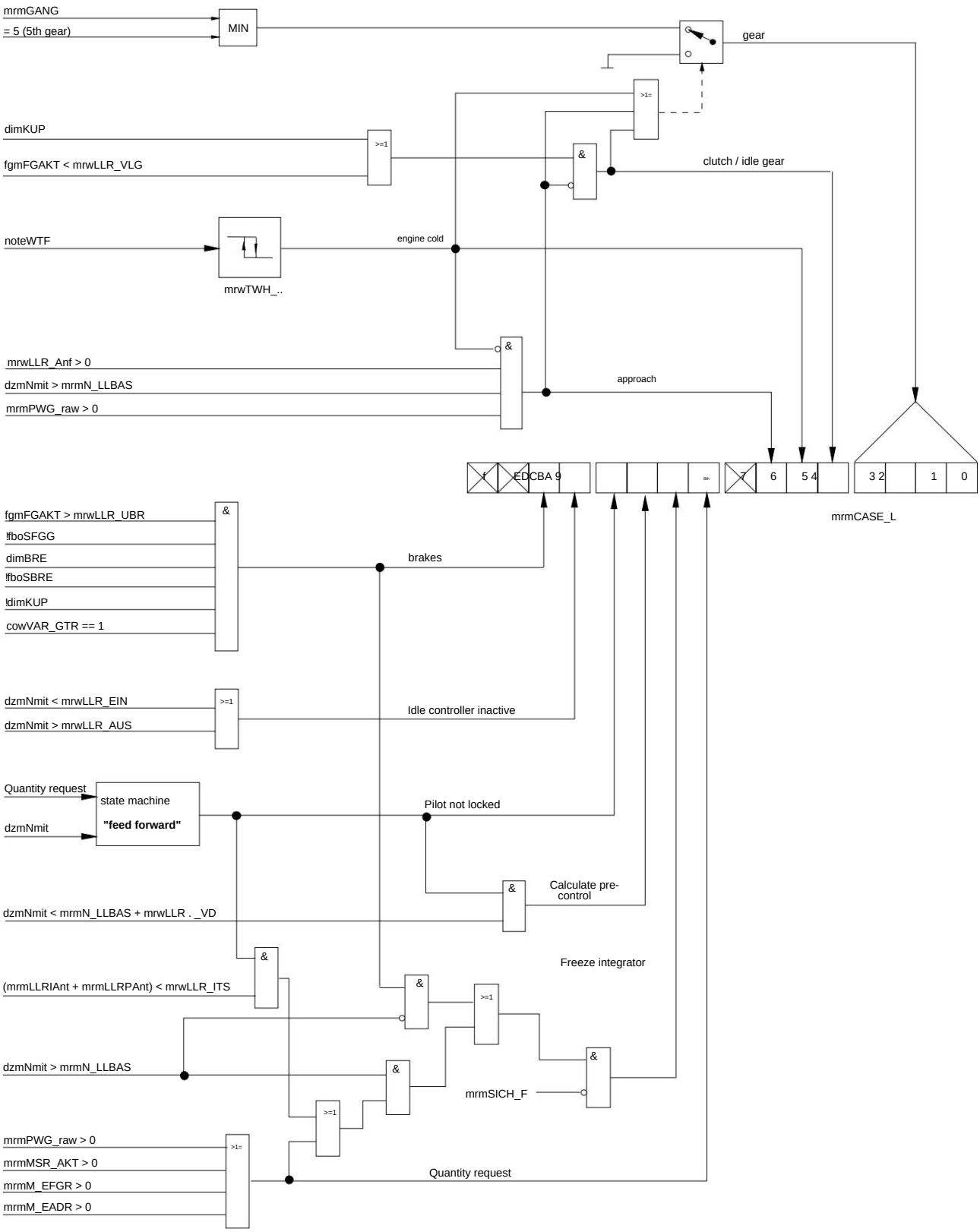


Figure MERELL02: Parameter selection for the idle controller

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This subtask selects the parameters for the idle speed controller (LLR) from the input variables Water temperature anmWTF and ratio of driving speed to speed mroVzuNfil. the Switching between the states cold / warm takes place with hysteresis. Standing in the "cold" state two sets of parameters are available, one each for the decoupled and coupled drive train. When the engine is cold, there is no gear-specific parameter changeover. For driving in the Five parameter sets are provided for gears with a warm engine. Through the minor Differences in the parameters in the higher gears are from the 5th gear (mrmGANG>=5) the 5th gear parameters used. Furthermore, to optimize the speed-synchronous Processing of the following operating states summarized in control bits and with the message "State of the LLR" mrmCASE_L sent:

ÿ "Approach - conditions":

mrwLLR_Anf > 0	AND
Speed dzmNmit> target idle speed mrmN_LLBAS	AND
PWG raw value mrmPWG_roh > 0	AND
engine warm	

ÿ "Brakes - Conditions":

Current driving speed fgmFGAKT > threshold speed at Brakes mrwLLR_UBR Road	AND
speed sensor path fboSFGG not defective Brake actuated	AND
dimBRE = 1 Brake signal path fboSBRE not defective Clutch	AND
not actuated dimKUP = 0 Transmission type is manual	AND
(cowVAR_GTR = 1).	AND

ÿ "Idle controller inactive - conditions":

Speed dzmNmit <speed limit LLR a mrwLLR_EIN speed dzmNmit>	OR
speed limit LLR from mrwLLR_AUS.	
In this case, the speed-synchronous LLR calculation is omitted.	

- "Precontrol not blocked - conditions:"

Realized by a two-state state machine; Pre-control blocked / not blocked (initial value). The pre-control is switched from blocked to not blocked when at least one of the following cases is fulfilled:
(Speed dzmNmit> target speed mrmN_LLBAS + area window mrwLLR_DNV) AND desired quantity OR
Speed dzmNmit> target speed mrmN_LLBAS + pre-control offset mrwLLRK_VD or mrwLLRW_VD
In the "locked" state is switched when the target idle speed mrmN_LLBAS is undercut or reached.

- "Calculate pre-control - conditions"

Pilot not locked speed dzmNmit	AND
<set speed mrmN_LLBAS + offset mrwLLRK_VD or mrwLLRW_VD	

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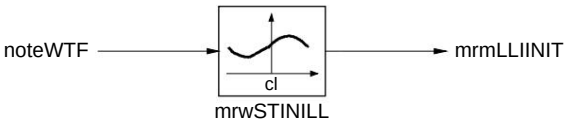
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- "Freeze Integrator - Conditions"

no security case mrmSICH_F	AND
((Speed dzmNmit> target speed mrmN_LLBAS	AND
(Quantity request	OR
LLR I component + P component < exchange barrier	
AND	
Pre-control active))	OR
(Brakes	AND
dzmNmit <= mrmN_LLBAS))	

- "Quantity request - Conditions"

PWG raw value mrmPWG_roh > 0	OR
MSR quantity intervention active, mrmMSR_AKT > 0	OR
Desired amount of GRA mrmM_EFGR > 0	OR
Desired amount of ADR mrmM_EADR > 0	



MERELL06: Initial value for the integrator

With the characteristic mrwSTINILL as a function of the water temperature anmWTF is the Initial value for the LLR integrator in the message mrmLLIINIT provided.

Description of the message mrmCASE_L:

valueHEX	decimal value	comment
0001H	1	1st gear is engaged
0002H	2	The 2nd gear is engaged
0003H	3	The 3rd gear is engaged
0004H	4	The 4th gear is engaged
0005H		The 5th gear is engaged
0010H	5	Clutch engaged or neutral gear active
0020H	16 32	The engine is cold
0040H	64	approach
0100H	256	There is a quantity request
0200H	512	Freeze the idle controller integrator
0400H	1024	The pilot control (D element) is calculated
0800H	2048	Feedforward state not locked
1000H	4096	The idle controller is not active
2000H	8192	State braking is active

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2.4.3 Idle Target Speed Calculation

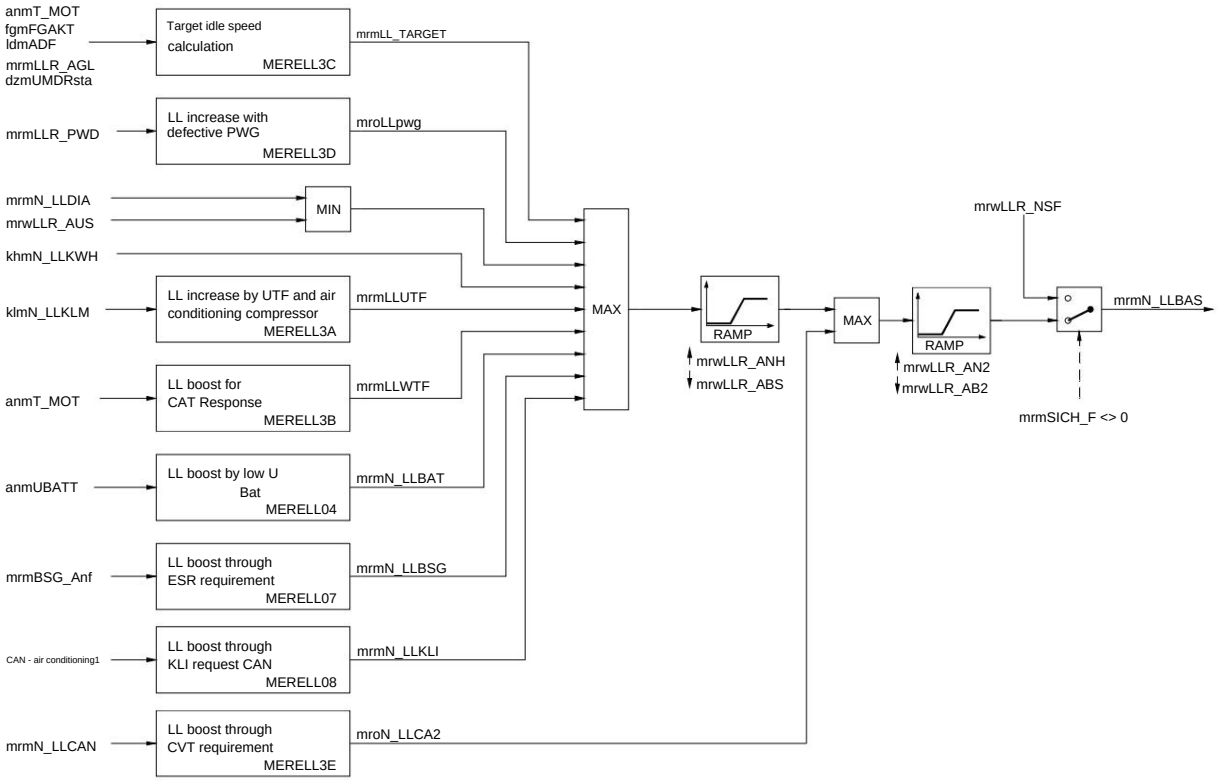


Figure MERELL03: Calculation of target idle speed

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If a discrepancy between the current effective target idle speed mrmN_LLBAS and the desired new target idle speed is detected, the target idle speed is increased via a ramp with the increment mrwLLR_ANH, or a reduction with the increment mrwLLR_ABS. Excluded from this is the occurrence of a security case.

The increase is made in leaps and bounds. The lowering is also done via a ramp with the increment mrwLLR_ABS. The target idling speed increase is switched between different default values, characteristic curves and calibration values depending on the operating condition of the vehicle:

In the initialization phase, the target idle speed is preassigned with the maximum value from the maps mrwWTAD_KF, mrwLLW_KL and mrwLTW_KL.

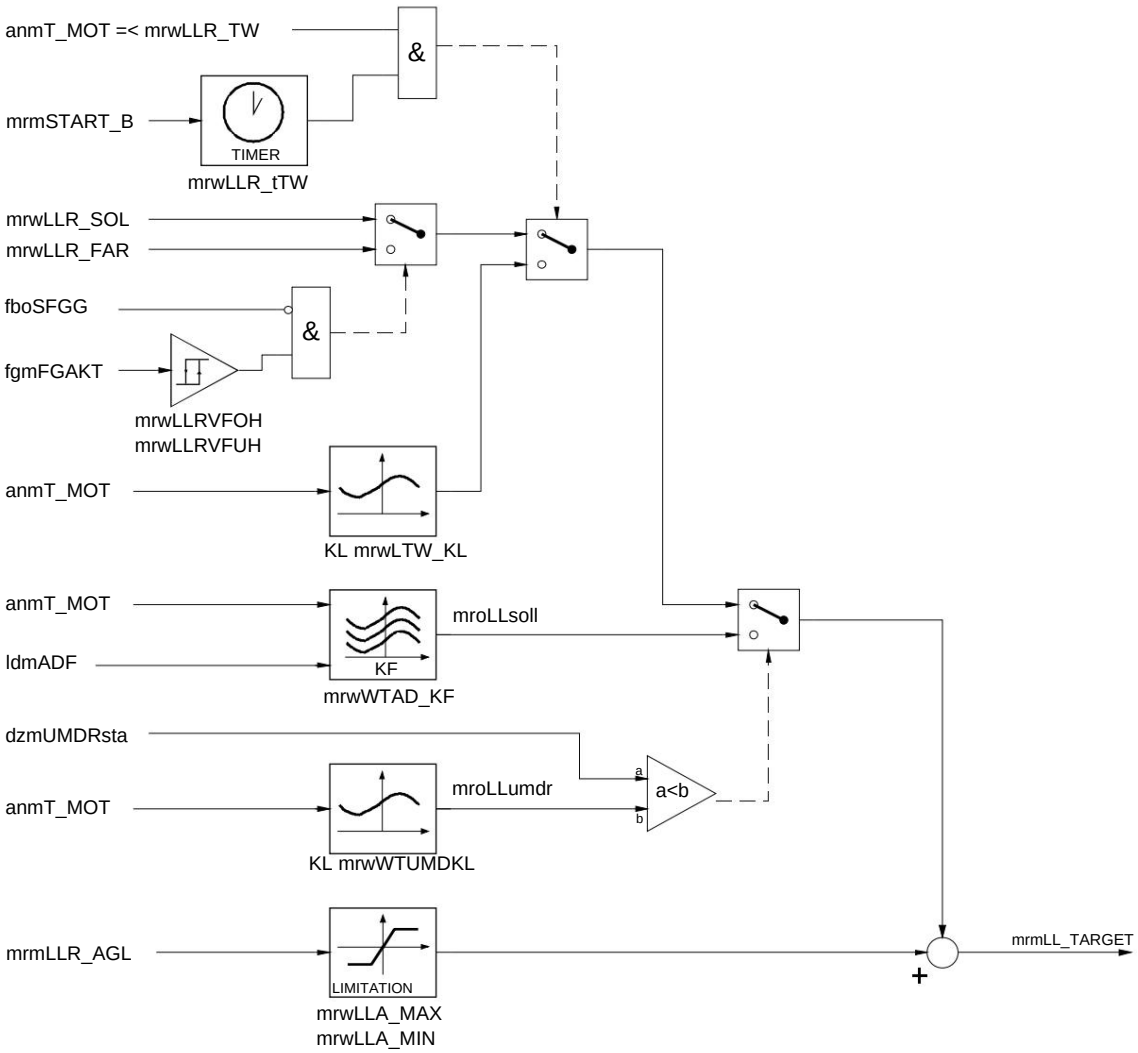


Figure MERELL3C: Target idle speed calculation

Motor temperature dependent increase:

As long as the number of revolutions after start shedding dzmUMDRsta is less than a calculated number of mroLLumdr revolutions after start shedding (from the characteristic curve mrwWTUMDKL as a function of anmT_MOT), the target idle speed results in mroLLsoll, a function defined by the map mrwWTAD_KF of ldmADF and anmWTF.

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For the time mrwLLR_tTW after the start, the target idle speed mrmN_LLBAS results from the characteristic curve mrwLTW_KL as a function of the engine temperature anmT_MOT. If during this time the motor temperature rises anmT_MOT above the applicative threshold mrwLLR_TW, a speed-dependent value is used immediately.

Speed-dependent increase or reduction:

Below the applicable hysteresis threshold mrwLLRVFOH the target idle speed is assigned the value mrwLLR_SOL, above this hysteresis threshold is switched to mrwLLR_FAR. This only happens if there is no FGG error.

Increase using VAG tester:

The target idle speed can be additively adjusted via the diagnostic interface with the adjustment value mrmLLR_AGL (initialized with cowAGL_LLR). Before that, mrmLLR_AGL is limited to the maximum adjustment value mrwLLA_MAX in the positive direction and to the minimum adjustment value mrwLLA_MIN in the negative direction.

Increase due to defective PWG:

In a plausibility error PWG - brake mrmSICH_F is switched to the safety idle speed mrwLLR_NSF.

If the PWG detection via potentiometer/switch (cowVAR_PWG=0), the idle speed mroLLpwg is raised to the value mrwLLR_PWD with a defective PWG (fbbEPWG_H, fbbEPWG_L or fbbEPWP_A).

In PWG detection with a double-analog PWG (cowVAR_PWG = 1) with a defective PWG (mrmLLR_PWD = 1), the idle speed mroLLpwg with the brake actuated (dimBRE = 1) or with a defective path fboSBRE to the value mrwLLR_PWB, otherwise set to mrwLLR_PWD.

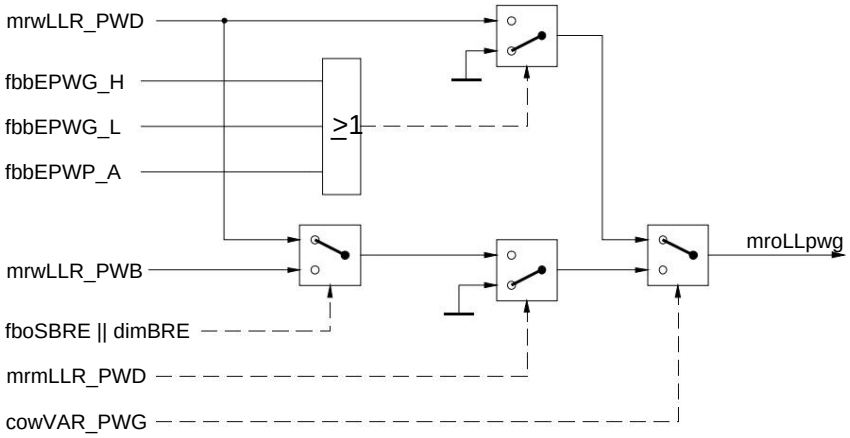


Figure MERELL3D: LL increase due to defective PWG

Increase at basic setting:

The target idle speed of the diagnosis mrmN_LLDIA can influence the target idle speed up to the calculation limit of the LLR mrwLLR_AUS increasing.

Increase through cooling water heating:

When the cooling water heater is active, the idle speed is increased to the value khmN_LLKWH.

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Stationary vehicle detection as condition for idle speed increase

For the release of the idling target speed increases, the condition that the vehicle is stationary should be recognized, ie the driving speed is 0 and there is no error in the error path FGG. In vehicles with an automatic transmission, the system also queries whether the transmission is in park or neutral, the transmission is not active and whether the selector lever is in park or neutral. The condition can be switched on and off by the software switch cowFUN_LLA. (cowFUN_LLA = 1 .. Stationary vehicle as a condition for idle target speed increases; cowFUN_LLA = 0 no release condition stationary vehicle, so no speed increase for functions that have stationary vehicle mrmLLN_ANH = 1 as a condition)

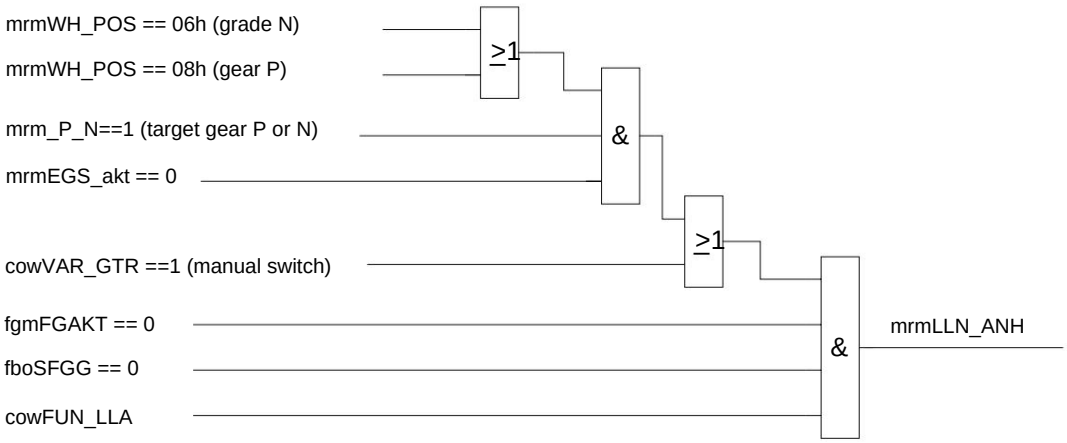


Figure MERELL09: Stationary vehicle as a condition for idling speed increase

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Battery voltage dependent increase:

If the battery voltage anmUBATT at a speed greater mrwNBATEIN longer than the time mrwTBATEIN below the threshold mrwUBATEIN, the target idle speed is raised to at least mrwN_LLBAT. The target idle speed is at a standstill (condition stationary vehicle mrmLLN_ANH = 1) or at a speed dzoNmit> mrwN_LLBAT + mrwDN_EIN and start shedding (mrmSTART_B = 0 debounced with mrwTBATSTA) raised and released for maximum formation. If the battery voltage rises anmUBATT over mrwUBATAUS and the increased idle speed is reached, the target idle speed of mrmN_LLBAT is taken back after the time mrwTBATAUS. The withdrawal of the target idle speed is only at a speed dzoNmit> mrmN_LLBAS + mrwDN_EIN.

Application note: mrwUBATEIN must be smaller than mrwUBATAUS.

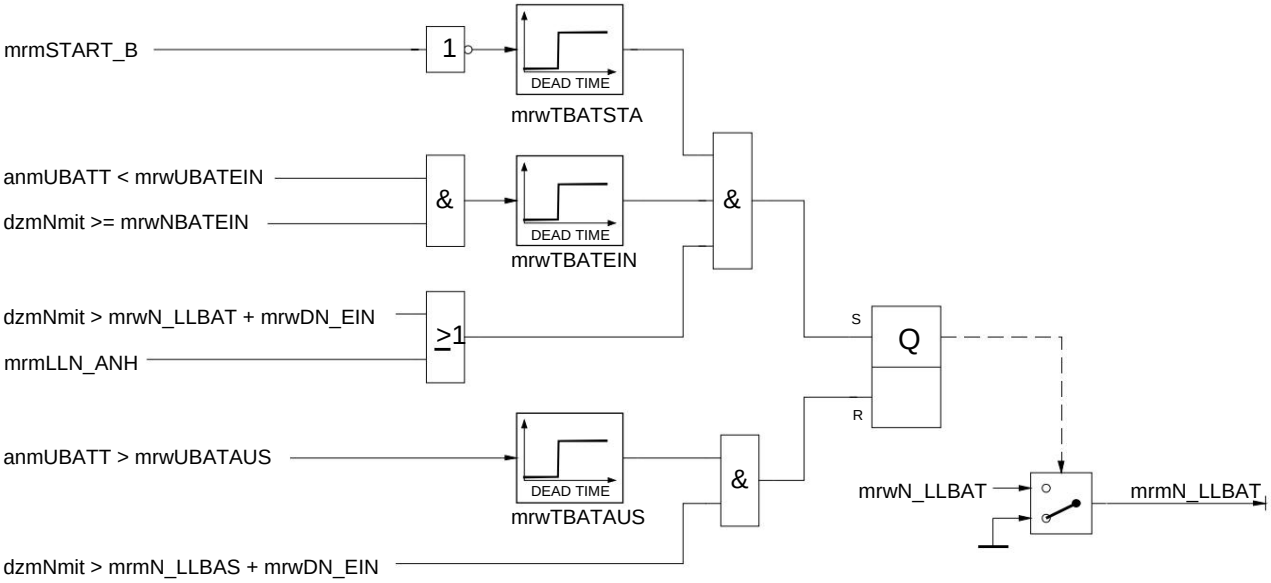


Figure MERELL04: Idle speed increase as a function of battery voltage

Increase due to request from the on-board power supply control unit

BSG: The on-board power supply control unit can request an idle target speed increase via BSG_Last message bit 1.0. If an increase is requested, then at a speed dzmNmit> mrwN_LLBSG + mrwDN_EIN2 or at standstill (condition stationary vehicle mrmLLN_ANH = 1) released the increased target idle speed mrwN_LLBSG for maximum formation in the target idle speed calculation.

If the requirement expires, the increased idle speed mrwN_LLBSG is withdrawn again. The redemption is only at a speed dzmNmit> mrmN_LLBAS + mrwDN_EIN2.

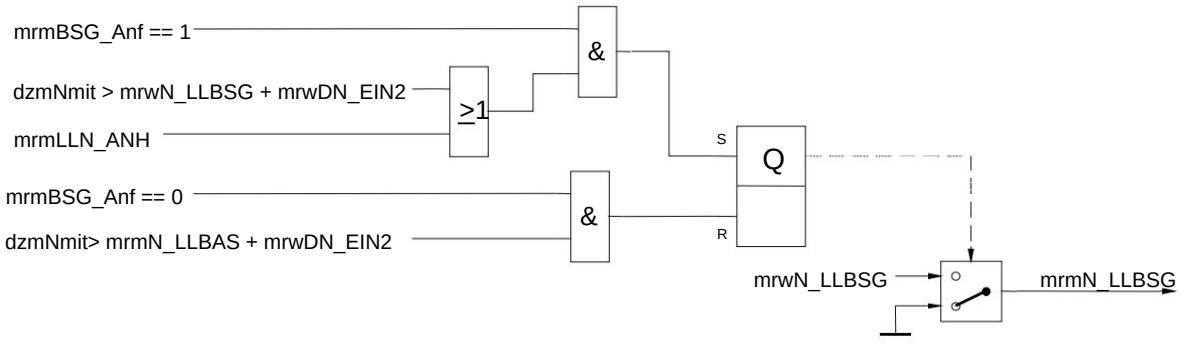


Figure MERELL07: Idle speed increase due to BSG requirement

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Increase due to request from the climate control unit via CAN message Clima1:

Via Clima1 message bit 1.0 (S_KLB) and bit 1.4 (S_KPZ), the air conditioning control unit can request an increase in the target idling speed. If an increase is requested, the vehicle is stationary (mrmLLN_ANH = 1) or at a speed dzmNmit> mrwN_LLKLI + mrwDN_EIN3 released the increased target idle speed mrwN_LLKLI for maximum formation in the target idle speed calculation. The bit S_KPZ of the message Clima1 can be hidden with the software switch cowFUN_KPZ = 0 as a condition for a speed increase. Note: In the event that both inputs of the flip-flop are at 1 applies mrmN_LLKLI = 0.

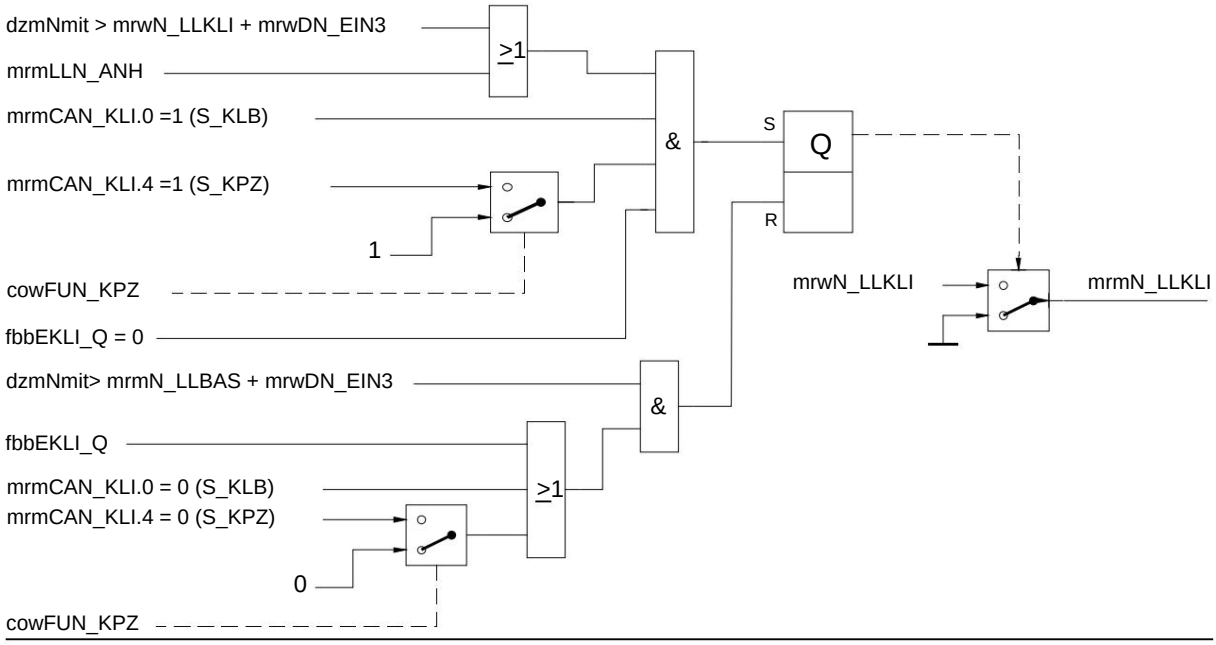


Figure MERELL08: Idle speed increase request by CAN message Clima1

Increase by Transmission2 message:

In the Transmission2 message, the VL30 transmission can request a target idle speed.
This is limited to the maximum value mrwCVTNLLM and then transmitted by the CAN receiving task as mrmN_LLCAN the LL target speed calculation. If the VL30 requirement is disabled (cowFUN_CVT = 0), mrmN_LLCAN is always sent zero, thus preventing intervention in the N_LL calculation. See also chapter Monitoring and CAN.

The requirement to increase the idle speed is met by the engine control unit when the required speed mrmN_LLCAN is not greater than the sum of engine speed dzmNmit and a tolerated increase in speed mrwCVTNtol. In this case, mrmN_LLCAN goes directly into the maximum formation of the target speed calculation. If the maximum tolerated idle speed increase is exceeded by the requested LL speed, the value mroN_LLCA1 (mrwCVTNtol + dzmNmit) is frozen and fed into the maximum formation of the target speed calculation. Only when the speed dzmNmit exceeds the value of mrmN_LLCAN, the increase in idle speed is allowed on mrmN_LLCAN and the frozen speed value is thawed. To meet the requirement for a rapid increase in idle speed, the ramp mrwLLR_AN2 becomes effective as soon as the approved target speed mroN_LLCA2 is greater as the current idle speed mrmN_LLBAS. If the current idle speed is greater than mroN_LLCA2, it is ramped down to mroN_LLCA2 using mrwLLR_AB2. mrwLLR_AN2

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or -_AB2 are only used if all other target idle speed specifications are smaller than mroN_LLCA2. MrwLLR_AN2 and mrwLLR_AB2 must be applied faster than mrwLLR_ANH or mrwLLR_ABS.

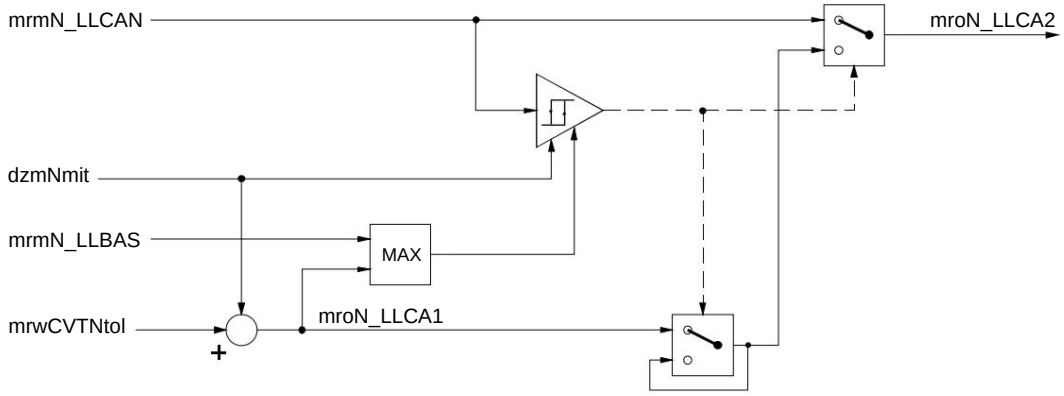


Figure MERELL3E: Idle speed increase by Transmission2 message

Increase via UTF and air conditioning compressor:

An idle speed increase takes place when

o) the line KLI-E is activated (dimKLI = 1) AND o) the ambient temperature anmUTF is greater than the hysteresis mrwUTF1_UH.

The target idle speed mrmLLUTF is set to mrwHOT_NLL when

o) the line KLI-E is activated (dimKLI = 1) AND o) the ambient temperature anmUTF is greater than the hysteresis mrwUTF2_UH AND o) the UTF evaluation is not faulty (anmUTF_STA = FALSE) o) the transmission in P - or N - Position is (mrm_P_N received via CAN) OR
if no automatic transmission is available.

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If one of the above conditions is not met, the target idle speed mrmLLUTF is raised to the value klmN_LLKLM. The P - or N - position of the automatic transmission is recognized by the message mrm_P_N (see chapter "CAN") is queried. The query on mrm_P_N (1 = gear selector lever of the CAN - automatic transmission to P or N - position) causes that in a gear selection that moves the vehicle, this speed increase can not take place for safety reasons. The transmission type (manual or automatic without CAN or automatic with CAN) is recognized by the function switch cowVAR_C5.

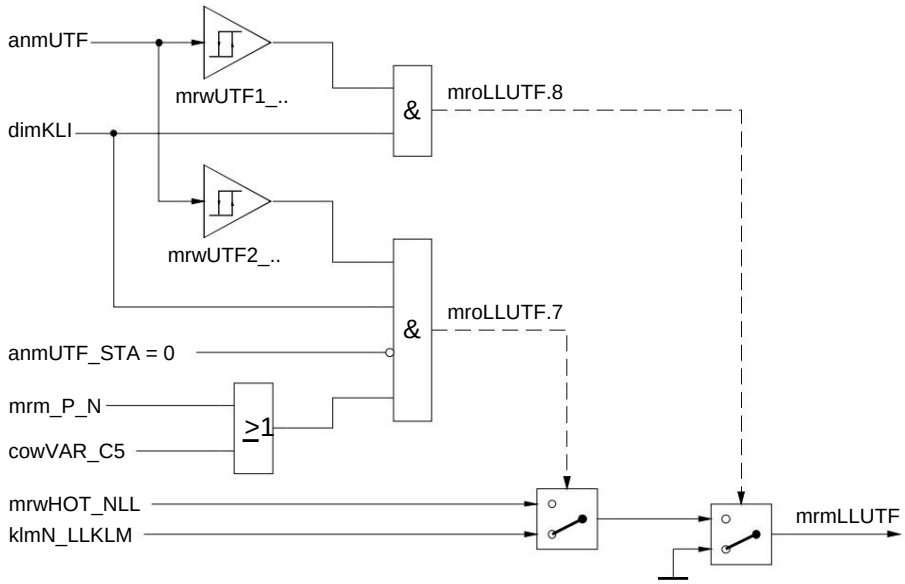


Figure MERELL3A: Idle increase via UTF and air conditioning compressor

The increased idle speed is made available in the message mrmLLUTF of the setpoint calculation. Please also note the application notes in chapter "Input and output signals" regarding ambient temperature anmUTF!

Increase after start:

In order to improve the KAT response after starting, the idle speed is increased after resetting the start bit mrmSTART_B. The increase is only effective once within a driving cycle. The engine temperature-dependent idle - starting speed mrmLLWTF is taken from the map mrwLLW_KL. It becomes ineffective when the speed dzoNmit exceeds the threshold mrw_nWTF or when the time mrw_tWTF has elapsed since the start bit was reset.

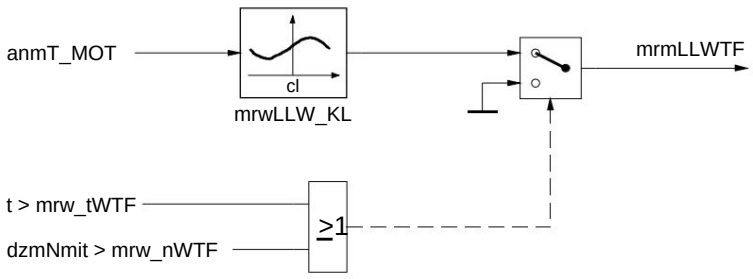


Figure MERELL3B: Idle increase after start

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2.4.4 Control Algorithm

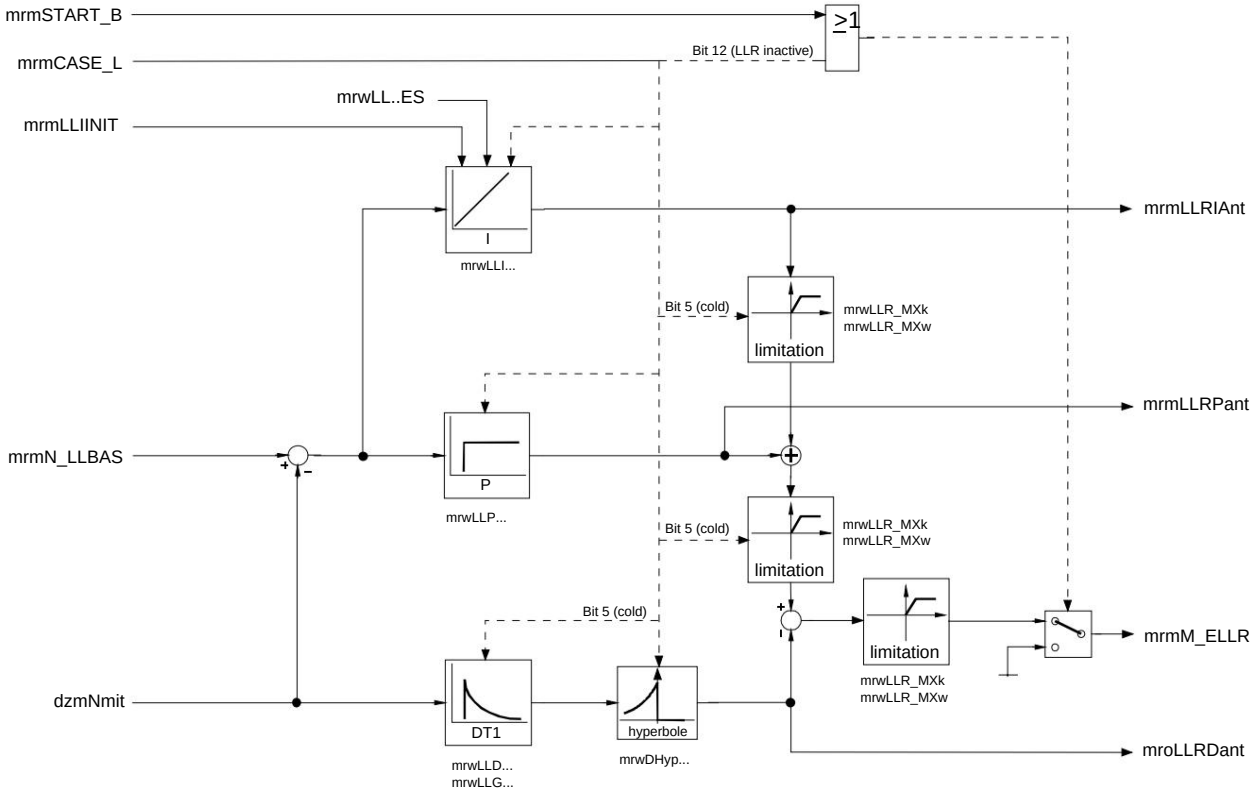


Figure MERELL05: idle controller

A PI controller is used for idle control. Against the undershooting of the speed under the target idle speed mrmN_LLBAS after the start or at crash gas is a pilot logic (DT1 element) installed. It should be noted that when driving in the idle speed range, the controller is expanded to a PID2T2 structure by the ARD.

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For the program flow control or for the selection of the control parameters for P, I - controller and DT1 - Member is the synchronously determined operating state in the message mrmCASE_L (see Parameter set selection idle controller).

If the "LLR inactive" control bit is reset, the controller calculation is started with a of the intended parameter sets are carried out in this order:

Condition	mroCASE_LL	P share I share D share			GF	single-step quantity
Error in mrmCASE_L	10000000 00000000 mrwLLPWK_ mrwLLIWK_ mrwLLDWK_ mrwLLGWK_ mrwLLWK_ES					
brakes	00100000 xxxxxxxx mrwLLPBr_ mrwLLIBr_ mrwLLDBr_ mrwLLGBr_ mrwLLBr_ES					
Idling/KUP+engine warm	00000000 00010000 mrwLLPWK_ mrwLLIWK_ mrwLLDWK_ mrwLLGWK_ mrwLLWK_ES					
Idle/KUP + engine cold 00000000 00110000 mrwLLPKK_ mrwLLIKK_ mrwLLDKK_ mrwLLGKK_ mrwLLKK_ES						
engine cold	00000000 00100000 mrwLLPKG_ mrwLLIKG_ mrwLLDKG_ mrwLLGKG_ mrwLLKG_ES					
approach	00000000 01000000 mrwLLPAF_		x	mrwLLDAF_ mrwLLGAF_		x
5th gear	00000000 00000101 mrwLLP5G_ mrwLLI5G_ mrwLLD5G_ mrwLLG5G_ mrwLL5G_ES					
4th gear	00000000 00000100 mrwLLP4G_ mrwLLI4G_ mrwLLD4G_ mrwLLG4G_ mrwLL4G_ES					
3rd gear	00000000 00000011 mrwLLP3G_ mrwLLI3G_ mrwLLD3G_ mrwLLG3G_ mrwLL3G_ES					
2nd gear	00000000 00000010 mrwLLP2G_ mrwLLI2G_ mrwLLD2G_ mrwLLG2G_ mrwLL2G_ES					
1st gear	00000000 00000001 mrwLLP1G_ mrwLLI1G_ mrwLLD1G_ mrwLLG1G_ mrwLL1G_ES					

In the case of take-off, the integrator is initialized with the value from the LLR - Integrator - message mrmLLIINIT preassigned.

The differentiator has the task after take-off and falling speed in the Speed window mrwLLRK_VD and mrwLLRW_VD on the idle speed Influencing the speed curve in such a way that the actual idle speed is reached Idle control can be included using PI controller.

The D component is not continuously engaged. He will only be activated if he increasing idle amount and other speed conditions and LLR states are fulfilled. Furthermore, the connection of the differential component is weighted, in Dependence of the difference between the current speed and the target idling speed. This soft Activation causes an asymptotic approach to the specified setpoint speed. the The differential quantity component is applied after multiplication with the function value a hyperbola, where the independent variable of the hyperbolic function is the difference between Idle base and current speed is. The equation of the intrusion function is:

$$\frac{mrwDHyp\ Z \cdot _}{mrwDHyp\ N\ mrmN + LLBAS\ dzmNmit}$$

The D component should only be activated when the gas falls to avoid undercutting the prevent target speed. The activation of the D component is done in the parameter selection decided.

When the idle speed is reached, the I component with the maximum from the last calculated quantity of the idle controller and the integrator quantity initialized.

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There is also the possibility of defining the parameter set-dependent one-step quantity mrwLL.._ES, which the idle integrator may not fall below each time the idle speed is reached (minus the current time-synchronous desired quantity mrmM_EWUN). The logic is exceeded with the speed threshold target idle speed mrmN_LLBAS + I - controller - small signal window width mrwLL .. I_F released.

The calculated subsets (integrator, PI - share) and the total amount PI + DT1 - share are each limited to zero and maximum LLR - amount. The result is sent as a quantity of idle controller mrmM_ELLR.

The maximum amount is when the engine is cold (bit 5 of mrmCASE_L) mrwLLR_MXk. If the hysteresis switches to a warm engine, the maximum amount is guided to the value mrwLLR_MXw, with this value only being reached when the limited amount falls below this value for the first time. If the hysteresis switches back to a cold engine, the maximum amount is assigned the value mrwLLR_MXk.

The integrator is therefore not integrated up if the maximum set is exceeded, but it is still allowed to integrate down. This avoids jumps and long reaction times.

Application note: The
value for the cold maximum amount mrwLLR_MXk must be above the warm maximum amount mrwLLR_MXw.

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2.5 Desired Quantity

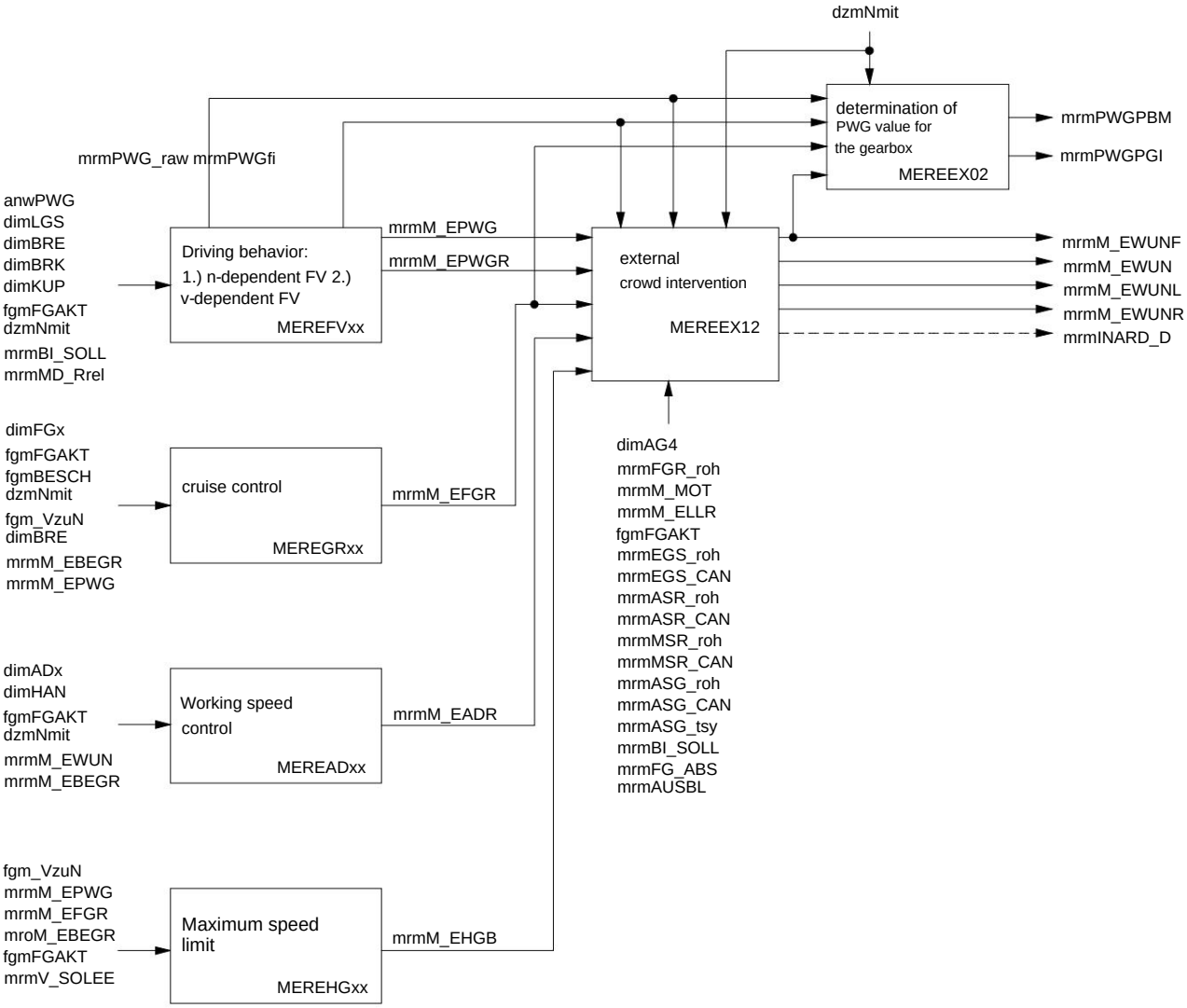


Figure MEREWU01: Requested quantity

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2.6 PWG filter and driving behavior

The influence of the accelerator pedal (= driver's request) and a
motor or vehicle-specific size in a PWG - driver request quantity mrmM_EPWG
pictured. Depending on the position of the DAMOS - switch cowFUN_FVH, it is possible
engine speed-dependent driving behavior map with the direct determination of mrmM_EPWG
to be selected (cowFUN_FVH=0), or to use a vehicle speed-dependent output torque map with subsequent
correction through the transmission/axle ratio
(cowFUN_FVH=1). A PWG -
Driver's desired quantity "raw" mrmM_EPWGR determined in order to also make the quantity value available
to be able to ask the unfiltered PWG - value corresponds to mrmPWG_roh.

For PWG with potentiometer/switch, the message anmPWG is copied into the message mrmPWG_lwo; is
configured a double analog PWG corresponds to mrmPWG_lwo the empty path-optimized PWG position (anmPWG
+ mroPW_OFFS).

2.6.1 Dual analog PWG

2.6.1.1 Optimizing idle travel with double-analog PWG

The greater idle travel of a double analogue, which is required with regard to a safe application
PWGs compared to a PWG with a pot/switch is minimized using this learning function.
In exceptional cases (transient fields, high resistance, changed PWG) a specified
larger free travel used.

This function is configured via cowFUN_DPG:

decimal value	comment
0	No learning
2	learning activated

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The structure of the empty path optimization is shown in figure MERELW01:

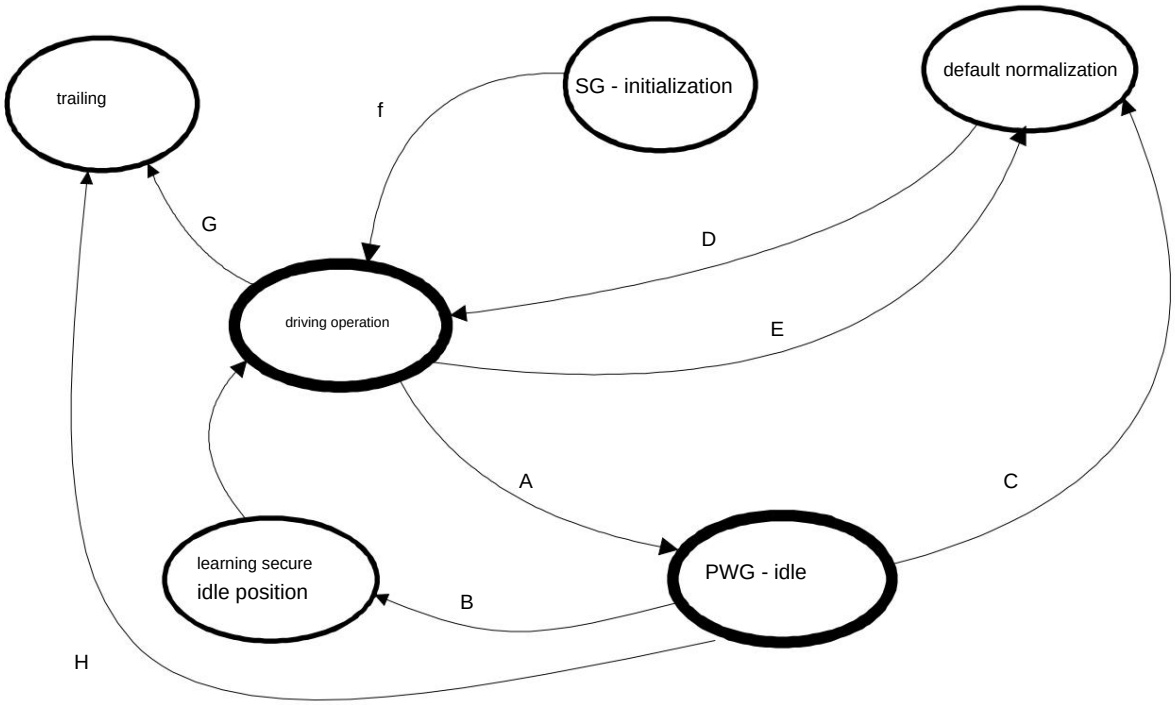


Figure MERELW01: States idle path optimization

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Labels and fixed values:

Surname	Meaning
mrwPWc1min electr. Limit lower tolerance range detection idle position PWG [mv] mrwPWc1max electr. Limit upper tolerance range detection idle position PWG [mV] mrwPWc2max electr. Limit upper tolerance range detection idle position PGS [mV] mrwPW_Tol tolerance range for learning function. internal monitoring; default normalization group [mV] mrwPW_dp allowed synchronization difference in the idle range [mV] mrwPWdUmax maximum allowed synchronization error detection PWG/PGS [mV] mrwPW1_max limit for dPW/dt component change [us] mrwPW1_fiH filter constant "rising" [1] mrwPW1_fiL filter constant "falling" [1] anmU_PWG analog value PWG [mV] anmU_PGS analog value PGS [mV] mroU_PGSx2 factor 2-corrected analog value PGS [mV] mroPW_cmax measured idle position [mV] mroPW_dp measured synchronization difference [mV] mrmPW_cmax learned idle position [mV] mrmPW_dp learned Synchronization difference [mV] edmPW_cmax Stored idle position [mV] edmPW_dp Stored synchronization difference [mV] mroPWLLPos Secured idle position PWG [mV] mroPW_MAX maximum allowed offset PWG [%] mrmPW_OFFS current offset PWG [%] mroPW_Stat status transfer conditions [1] mroPW_Hist states passed through [1]	

During SG initialization, the learned values are taken from the EEPROM (learned electrical idle position edmPW_cmax, learned plausibility window edmPW_dp). The idle position is calculated with mroPWLLPos = edmPW_cmax + edmPW_dp + mrwPW_Tol (tolerance value). Then (transition "F") in the status "driving" (mroPW_Stat.3) changed.

If the vehicle is in "PWG idle", the current position of PWG and PGS is measured. If the idling is left (transition "B"), this position is learned and the "driving mode" status is recognized.

If an implausibility or an error occurs in the DA-PWG acquisition, the system switches to the "Default normalization" status and a larger idle path is permitted.

The learned values are stored in the E2PROM in the "after-run".

The currently valid state is output in the Statusolda mroPW_Stat, the currently passed states appear in the Olda mroPW_Hist, transition conditions in the Olda mroPW_DAbd.

The encoder voltage anmU_PGS, increased by a factor of 2, is output on the Olda mroU_PGSx2.

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Meaning of the condition Solda mroPW_DAbd:

bit pos.	destination condition	
0	default norm. Error *path* fboSPWG set	
1	default norm. Error *path* fboSPGS set	
2	default norm. synchronization error:	ÿ|*anmU PWG mroU PGSx* _ 2| > ÿ with *mrwPW_diMX* according to ÿ*mrmPW dp_mrwPW Tol* _ ÿ
3	default norm. synchronization error:	Change timer> *mrwPW_Tmax* and *mroPWGmin* > *mrmPW_cmax*
4	Idle *anmU_PWG* > *mrwPWc1min*	
5	Idle *anmU*	_ *PWG* ÿ *mrwPWc1max* OR *mroU* _ *PGSx2* ÿ *mrwPWc2max*
6	Neutral	dzmNakt = 0 OR mrmSTART_B = 0
7	Neutral	*d anmU German* _ *PWG mrwPWdU* max <
8th	Idle *anmU*	_ *PWG* ÿ *mrwPWc1max*
9	idle *mroU*	_ *PGSx2* ÿ *mrwPWc2max*
10	Driving *anmU_PWG*> *mrwPWc1max*	
11	Driving *mroU_PGSx2*> *mrwPWc2max*	
12		
13		

Meaning of the Olda mroPW_Hist, mroPW_Stat:

Bit position	decimal value	comment
0	1	learning ban
1	2	synchronization error
2	4	PWG idle
		driving operation
3 4	8	trailing
	16	default normalization
5 6	32 64	Determination of filtered measured values
7	128	Learning safe neutral

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2.6.1.2 "Driving" mroPW_Stat.3 = 1

In this state, it is monitored whether a PWG error occurs (consequence: default normalization), is switched to idle (idle travel is learned), run-on is active or while driving should stay put.

Transition "E":



If an error occurs in the paths fboSPWG (mroPW_DAbd.0) or fboSPGS (mroPW_DAbd.1), so mroPW_Hist.0 is set and switched to the status "default normalization".
Transition "G": If the overrun is active (dimK15=0), there is a change to the "overrun" status.

Transition "A":



Is the encoder voltage PWG anmU_PWG <= mrwPWc1max (mroPW_DAbd.8) or is it Sensor voltage PGS mroU_PGSx2 <= mrwPWc2max (mroPW_DAbd.9), the idle learning area is reached and it is changed to the status "PWG idle". This change takes place not take place when "learning ban" is present (mroPW_Hist.0 = 1).

2.6.1.3 "PWG idle" mroPW_Stat.2 = 1

Upon entering this state, the alternation timer is restarted. This is used below for the detection of synchronization errors is required.

The idle range is measured in this state: There are no relevant error conditions on, the current position of the PWG and the deviation from the PGS are filtered via a low-pass filter determined.

Furthermore, it is monitored whether a PWG error occurs (consequence: default normalization), in the Driving mode is changed, run-on is active or should remain idle.

Transition "C":



If an error occurs in the paths fboSPWG (mroPW_DAbd.0) or fboSPGS (mroPW_DAbd.1), so mroPW_Hist.0 is set and switched to the status "default normalization".
Furthermore, mroPW_Hist.1 is set under the following conditions and in the status "Default normalization" changed:

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1.) synchronization errors:

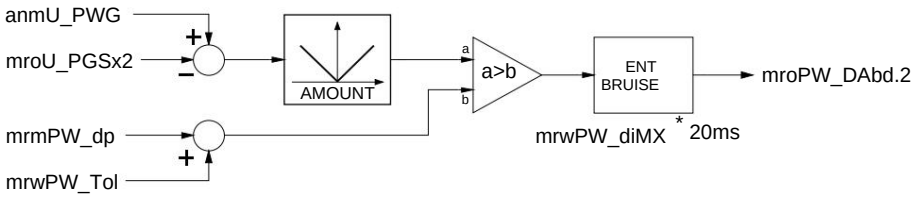


Figure MERELW03: synchronization error

The absolute deviation |anmU_PWG - mroU_PGSx2 | is at least mrwPW_diMX*20ms greater than the tolerance value mrwPW_Tol increased learned plausibility window mrmPW_dp (mroPW_DAbd.2) or

2.) Detection of component changes

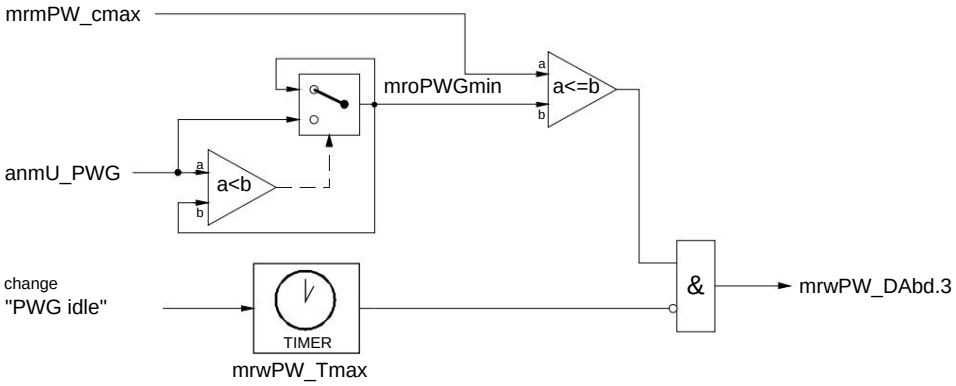


Figure MERELW04: Component change

The change timer has reached a value greater than mrwPW_Tmax and the minimum value of anmU_PWG (= mroPWGmin) reached since K15-A is greater than the learned electrical idle position mrmPW_cmax (mroPW_DAbd.3). *Transition “B”:*



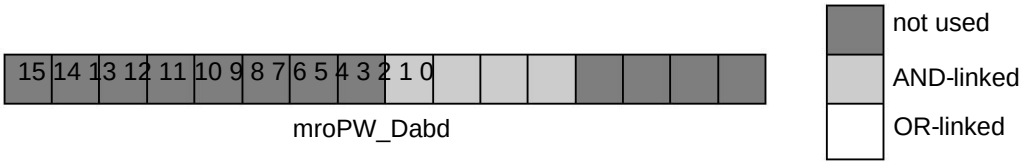
If the idle area left (anmU_PWG> mrwPWc1max (mroPW_DAbd.10) and mroU_PGSx2> mrwPWc2max (mroPW_DAbd.11)) and there is neither a learning ban nor a synchronization error (mroPW_Hist.0=0 and mroPW_Hist.1=0), it is in the status “Learn Safe Neutral” changed. *Transition ”H”:* If the run-on is active (dimK15=0), the status changes to “run-on”.

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Actions in the “PWG Idle” state:



Are there neither learning prohibition nor synchronization error (mroPW_Hist.0=0 and mroPW_Hist.1=0),

and is not recognized for high resistance (anmU_PWG> mrwPWc1min, (mroPW_DAbd.4))

and the idle area is not left (anmU_PWG <= mrwPWc1max or mroU_PGSx2 <= mrwPWc2max, (mroPW_DAbd.5))

and there are no disturbances caused by the starter (dzmNakt=0 or mrmSTART_B=0), mroPW_DAbd.6 **and** the PWG change d(anmU_PWG)/dt is smaller mrwPWdUmax (mroPW_DAbd.7) **then** the filtered measured values are determined (mroPW_Hist. 6 = 1):

Measured value idle position:

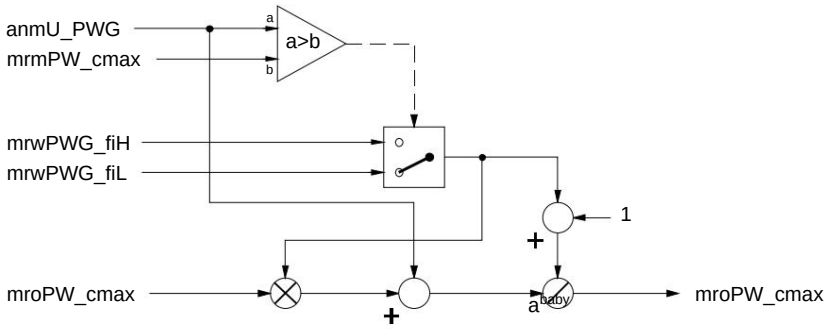


Figure MERELW05: measured value mroPW_cmax

mroPW_cmax | n = (mroPW_cmax | n-1 * Const + anmU_PWG) / (Const + 1)

The following applies to "Const": If the measured value anmU_PWG is greater than the stored learning value mrmPW_cmax, the value mrwPW1_fiH is used for "Const", otherwise the value mrwPW1_fiL.

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Measured value plausibility window:

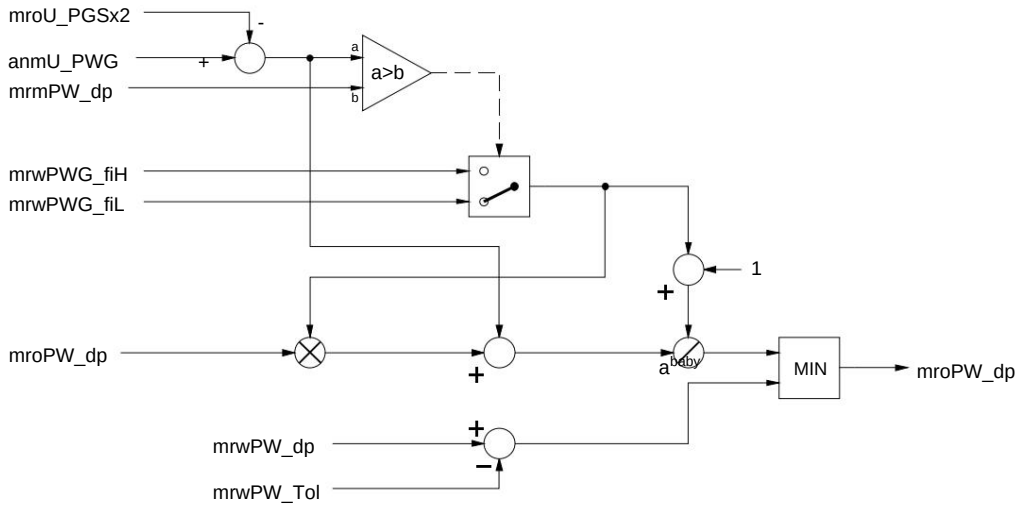


Figure MERELW06: measured value mroPW_dp

mroPW_dp | n = (mroPW_dp | n-1 * Const + | anmU_PWG - mroU_PGSx2 |) / (Const + 1), limited to a maximum of mrwPW_dp - mrwPW_Tol.

The following applies to "Const": Is the measured value |anmU_PWG - mroU_PGSx2| greater than the stored learning value mrmPW_dp, the value mrwPW1_fiH is used for “Const”, otherwise the value mrwPW1_fiL.

"Learn safe neutral position" mroPW_Hist.7 = 1

Here the measured values mroPW_dp and mrmPW_cmax are weighted to determine the learning values mrmPW_dp and mrmPW_cmax used.

Learning value idle position:

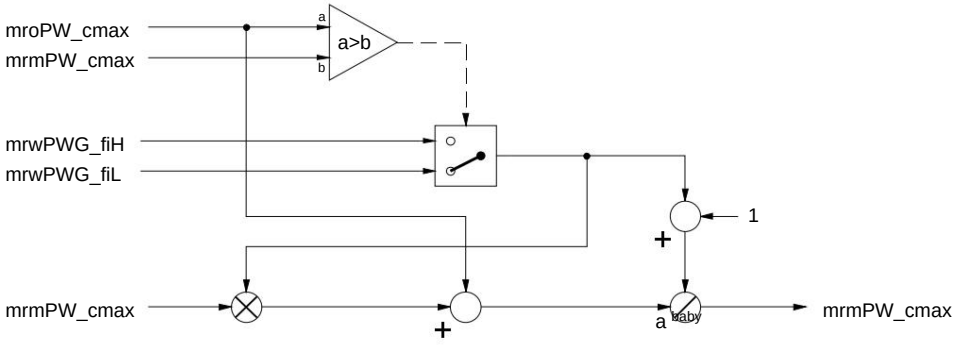


Figure MERELW07: learning value mrwPW_cmax

mrmPW_cmax|n=(mrmPW_cmax|n-1 * Const + mroPW_cmax)/(Const+1)

The following applies to "Const": If the measured value mroPW_cmax is greater than the stored learning value mrmPW_cmax, the value mrwPW1_fiH is used for "Const", otherwise the value mrwPW1_fiL.

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Learning value plausibility window:

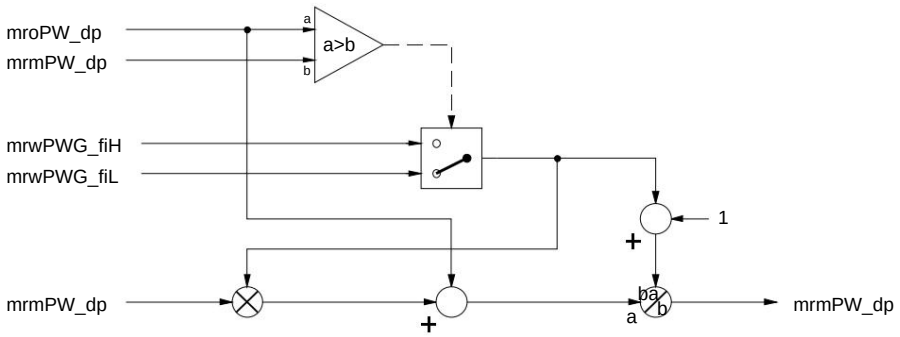


Figure MERELW08: Synchronization error learned value

mrmPW_dp|n=(mrmPW_dp|n-1 * Const + mroPW_dp)/(Const+1).

The following applies to "Const": If the measured value mroPW_dp is greater than the stored learning value mrmPW_dp, the value mrwPW1_fiH is used for "Const", otherwise the value mrwPW1_fiL. The idle position mroPWLLPos results in mrmPW_cmax + mrmPW_dp + mrwPW_Tol.

Then the status changes to “driving operation”.

2.6.1.4 "Default normalization" mroPW_Stat.5 = 1

All values are reset to the “safe default values”:
Learning value idle position mrmPW_cmax = mrwPWc1max,
Learning value plausibility window mrmPW_dp = mrwPW_dp,
Measured value idle mroPW_cmax = mrwPWc1max,
Measured value plausibility window mroPW_dp=mrwPW_dp
Then switch to “driving operation” status

2.6.1.5 "Lag" mroPW_Stat.4 = 1

The values mrmPW_cmax and mrmPW_dp are stored in the EEPROM (edwPW_cmax or edwPW_dp)

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Calculation of the idle position:

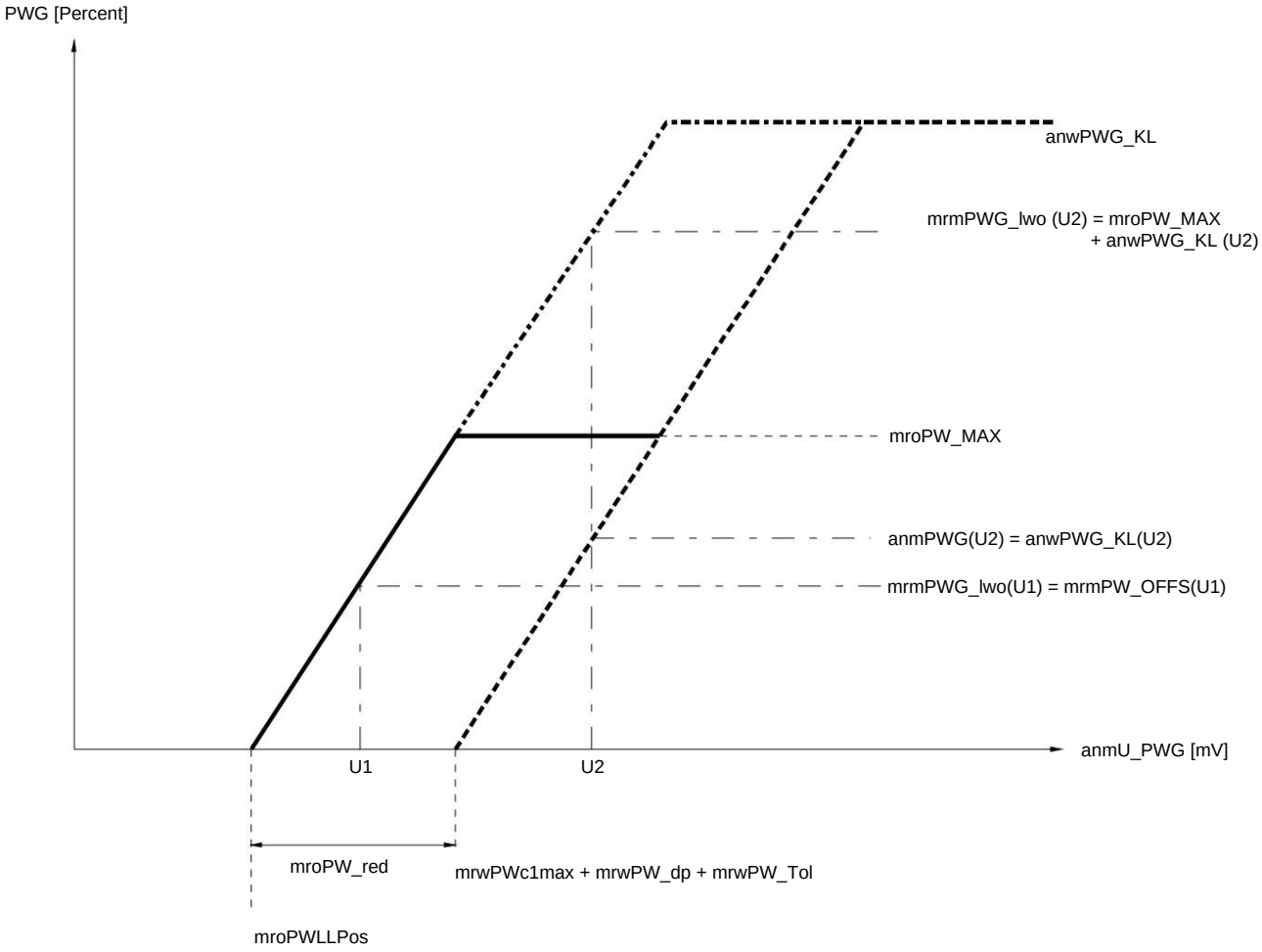


Figure MERELW02: Calculation empty path optimization

Application note: The characteristic anwPWG_KL must be applied in such a way that the 0% point is at mrwPWc1max + mrwPW_dp + mrwPW_Tol.

With the help of the idle path reduction, it is now possible to release a PWG value >0% from mroPWLLPos (= mrmPW_cmax + mrmPW_dp + mrwPW_Tol).

The electric idle travel reduction mroPW_red achieved in this way results in mrwPWc1max + mrwPW_dp + mrwPW_Tol - mroPWLLPos.

The maximum offset to be added to anmPWG is mroPW_MAX = anwPWG_KL (at mrwPWc1max + mrwPW_dp + mrwPW_Tol + mroPW_red).

The current offset to be added to anmPWG is MIN (mroPW_MAX, anwPWG_KL (anmU_PWG + mroPW_red).

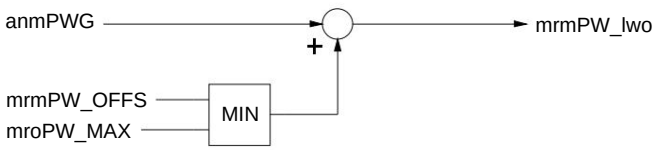


Figure MERELW09: Calculation of the empty path-optimized PWG position

The PWG request is then mrmPWG_lwo = anmPWG + mrmPW_OFFS (limited to 100%).

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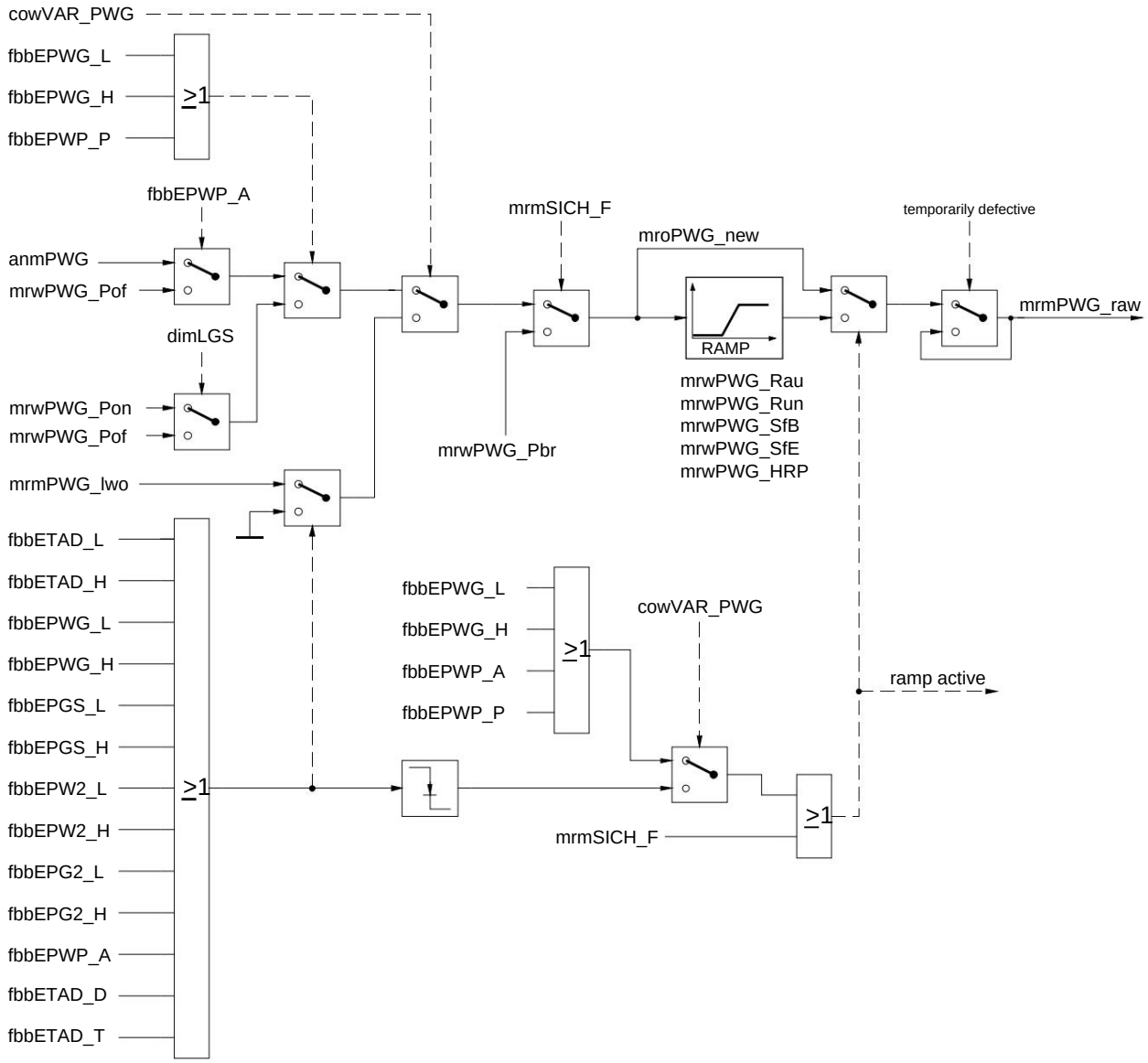


Figure MEREFV01: Evaluation of the pedal value sensor

Behavior with cowVAR_PWG=0 (potentiometer/switch):

The PWG value anmPWG is checked for SRC and checked for plausibility against the empty throttle switch (dimLGS). When the brake is actuated, safety cases (mrmSICH_F) can also be detected. If an implausible value is detected, the PWG raw value ramps up to a default value. A more detailed description of this can be found in the Monitoring function chapter.

Behavior with cowVAR_PWG=1 (double analogue PWG): Checking the PWG value, see chapter Monitoring function. When the brake is actuated, safety cases (mrmSICH_F) can also be detected

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2.6.2 Speed-dependent driving behavior

In the driving behavior map mrwFVH_KF a desired amount PWG mrmM_EPWG is determined as a function of speed and filtered PWG - position mrmPWGfi. The operating point in the driving behavior map changes when shifting gears. The resulting different moment must be compensated for by the driver in order to maintain the previous vehicle state.

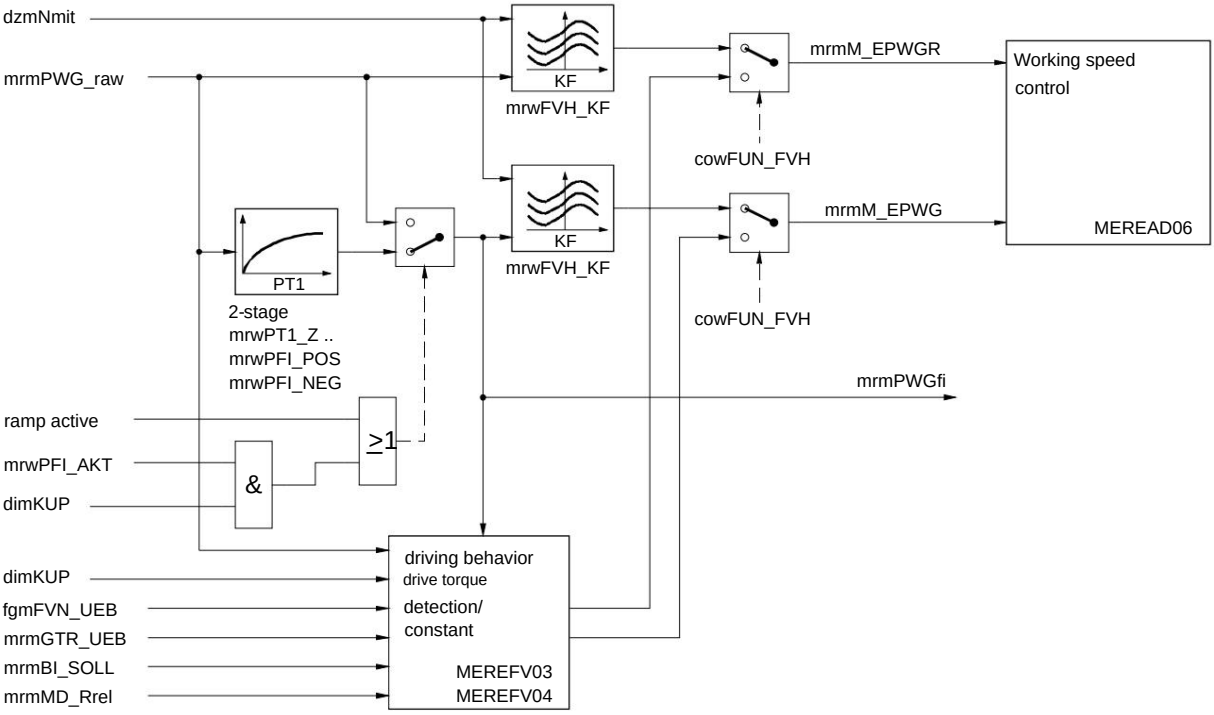


Figure MEREFV02: Filtering of the pedal sensor

The raw Pedalwertgeberposition mrmPWG_roh is in a two-stage filter PT1 - filtered. Depending on the direction of movement, one of four time constants is selected above or below threshold values PWG increase threshold value mrwPFI_POS, PWG drop threshold value mrwPFI_NEG. PT1 filter positive above mrwPT1_ZPO, PT1 filter positive below mrwPT1_ZPU, PT1 filter negative above mrwPT1_ZNO and PT1 filter negative below mrwPT1_ZNU. Bypassing the filtering when the clutch is activated can be switched off (mrwPFI_AKT). The filtering is also not performed while a default value is ramped or when a double-analog PWG (cowVAR_PWG=1) has a definitive defective error (mroFPM_ZAK=4).

2.6.3 Driving behavior dependent on driving speed

This form of determining the driver's wishes is primarily intended for automatic transmissions. The driver sets a propulsion request (output torque) with the accelerator pedal, regardless of the current engine status. The operating point in the driving behavior map does not change when shifting gears. Here it is possible to set a different PWG behavior depending on the driving speed (e.g. low torque increase for speed in the local area - easy operating point setting when driving in convoy. Consideration of the driving resistance at high speed - low free travel).

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2.6.3.1 Determination of the currently valid transfer function

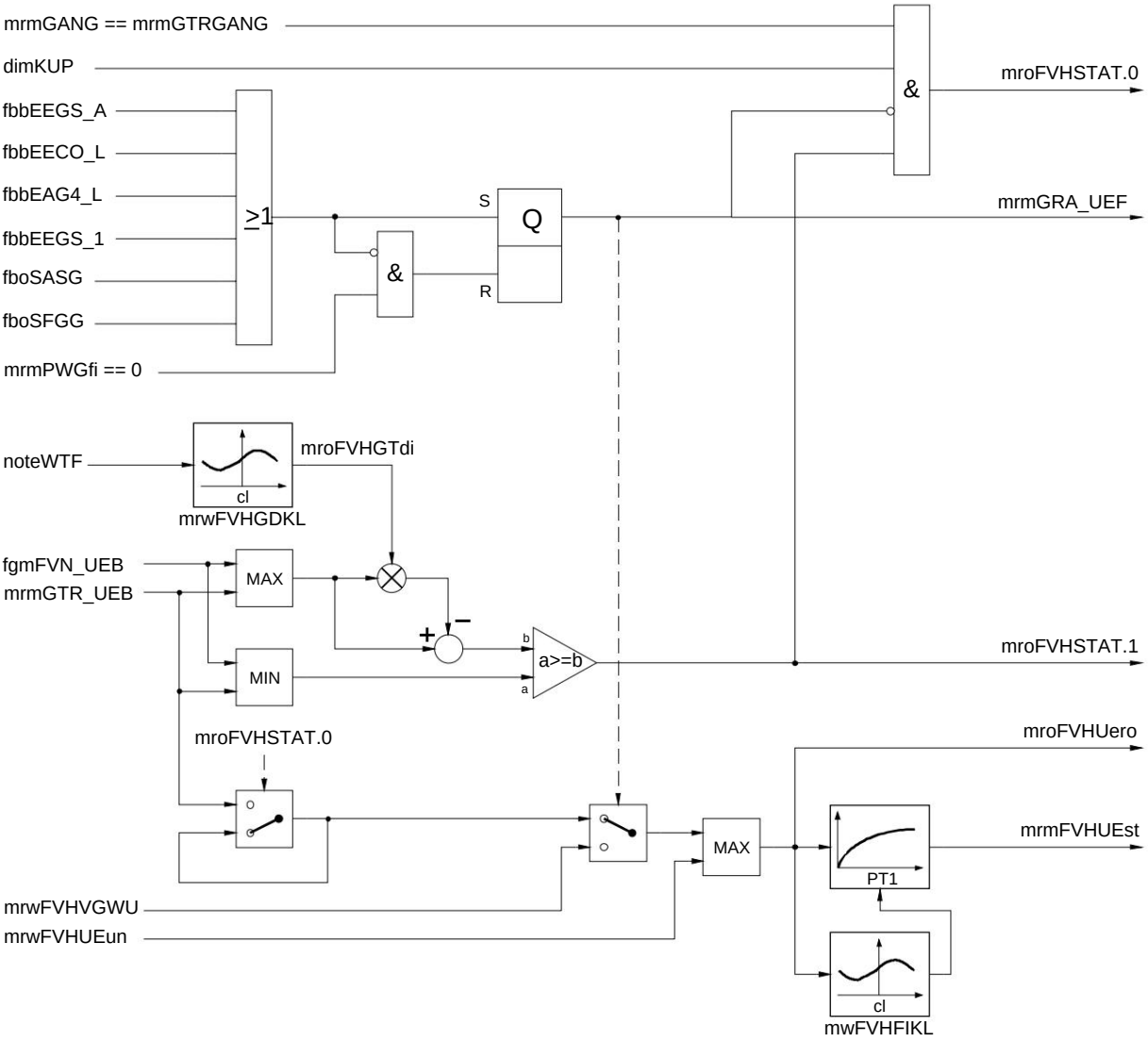


Figure MEREFV03: Determination of the translation to be used

This function is only executed if EGS is applied via CAN. From the gear then a. a powertrain unit via CAN and transmission function to the engine control (MRad/MKurbelwelle=IGetriebe*IAchs) and the engaged gear are transmitted. These are made available to the system by the CAN interpreter as mrmGTR_UEB and mrmGTRGANG. When the clutch dimKUP is actuated (contains the converter clutch status bits "open" - dimKUP=1 / "regulated" - dimKUP=0 / "closed" - dimKUP=0 for automatic transmissions, the converter clutch can be selected according to the application) under the following conditions, the translation currently used is mroFVHUEro via a translation-dependent PT1 - filter characteristic mrwFVHFIKL taken over in the size relevant to the driving behavior mroFVHUEst:

- No errors in the paths fboSEXM (evaluation transmission communication message transmission_1), fboSASG (evaluation transmission communication message transmission_2) and fboSFGG (vehicle speed measurement) or after the occurrence of an error and

mrmPWGfi = 0 - The deviation between mrmGTR_UEB and fgmFVN_UEB (translation, SG internally determined from ratio driving speed / engine speed fgm_VzuN) is smaller than the factor

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mroFVHGTdi (from the characteristic mrwFVHGDKL depending on anmWTF) * the maximum of mrmGTR_UEB and fgmFVN_UEB.

- Current gear mrmGANG = transition from CAN mrmGTRGANG (transmission control unit).

At the same time, a corresponding filter time constant is also selected depending on the transfer function mroFVHUEro from the characteristic mrwFVHFIKL. If there is a translation difference greater than mroFVHGTdi for the debouncing time fbwEASG_UA, the transmission is not idling (mrm_P_N = 0), the clutch is not actuated (dimKUP = 0) and there is no SRC error transmission ratio (fbbEASG_L), the error fbbEASG_U is set . If the translation deviation for the time fbwEASG_UB continuously smaller than mroFVHGTdi, the error fbbEASG_U is healed.

As a replacement function for errors in the paths fboSEXM, fboSASG and fboSFGG, the value mrwFVHVGWU is selected for mroFVHUEst. These values are also used in the SG initialization. The current status of the translation determination is shown in the OLDA mroFVHSTAT.

Description of the OLDA "Status of the driving behavior evaluation" mroFVHSTAT:

Bit position	Decimal value	Comment
0		Transfer ratio and gear active 1 2
1		The deviation between mrmGTR_UEB and fgmFVN_UEB (translation, SG internally determined from the ratio Driving speed / engine speed fgm_VzuN) is less than the Factor mroFVHGTdi * the maximum of mrmGTR_UEB and fgmFVN_UEB cowFUN_FVH = 1, speed-dependent driving behavior
7	128	

If no EGS is applied via CAN, only bit 7 (image of cowFUN_FVH) is mapped in mroFVHSTAT. In this case, the transfer function is assigned the default value mrwFVHVGWU.

2.6.3.1.1 GRA off at default value for the transmission ratio If an error

occurs regarding the interface engine - transmission (all relevant error conditions are OR linked)

fbbEEGS_A: message failure ASG
fbbEECO_L: Ecomatic switching signal message
fbbEAG4_L: AG4 switching signal timeout
fbbEEGS_1: message timeout gear 1 or message inconsistency gear 1 fboSASG:
automatic manual transmission fboSFGG: speed signal, then the gear ratio is set to a
default value under certain conditions. The GRA desired quantity could thus be
changed by leaps and bounds. The GRA is deactivated so that the driver does not notice the change in the desired quantity.

The message mrmGRA_UEF can enable or prohibit the cruise control (GRA). mrmGRA_UEF = TRUE GRA is deactivated mrmGRA_UEF = FALSE GRA remains activated

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2.6.3.2 Calculation of the PWG - driver's desired quantity

In order to keep the output torque set in each case constant during gear shifts, gear/axle ratio mroFVHUEst and the current friction torque mrmMD_Rrel (without idle controller component) are included in the determination of the PWG - driver's desired quantity.

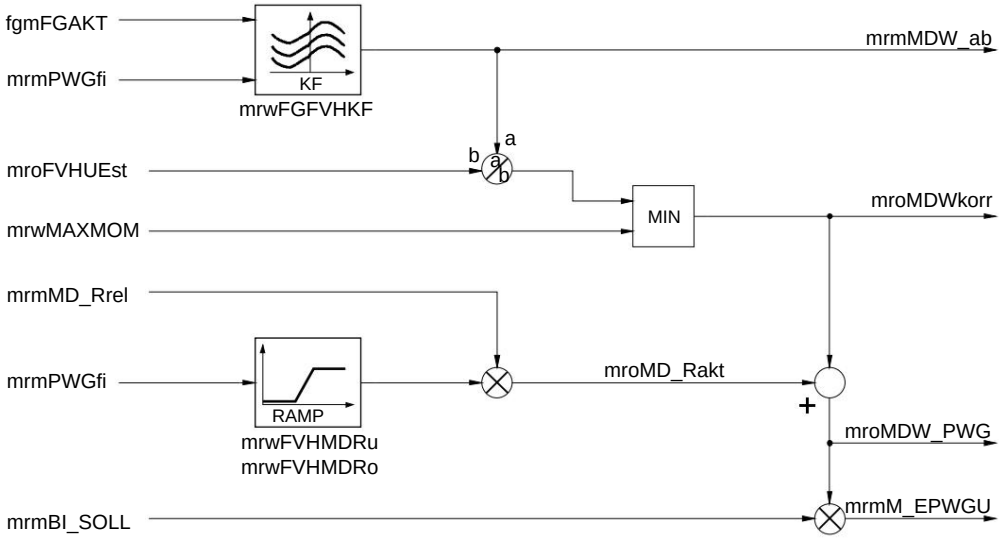


Figure MEREFV04: PWG - quantity determination

From the accelerator pedal position mrmPWGfi and the driving speed fgmFGAKT the desired output torque mrmMDW_ab is determined. Dividing by the stored translation mroFVHUEst results in the moment mroMDWkorr valid for the current gear.
This is limited to mrwMAXMOM before further processing. In order to compensate for the speed-dependent influence of the frictional torque in the engine, the traction torque (above the PWG threshold mrwFVHMDRu) is added at this moment to the portion of the idle controller reduced, frictional torque mroMD_Rakt. In order to create a smooth transition during the transition from overrun to traction operation, mroMD_Rakt is thereby calculated from the actual reduced friction torque mrmMD_Rrel, rated with a factor between 0 (at mrwFVHMDRu) and 1 (mrwFVHMDRo). This is in compliance with mrwFVHMDRo> mrwFVHMDRu> mrwPWG_OPS no impairment of the safety concept (quantity release at mrwPWG_OPS, redundant thrust monitoring) given.

The corresponding injection quantity mrmM_EPWG is determined from the PWG determined in this way - desired torque for the engine via the specifically indicated consumption mrmBI_SOLL.

The desired amount raw mrmM_EPWGR is determined in the same way. It is only used instead of the filtered, the unfiltered PWG value mrmPWG_roh as an input variable for the driving behavior map mrwFGFVHKF. The other input sizes are identical to those used to determine mrmM_EPWG, but there are no OLDA issues.

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2.6.4 Torque gradient limitation

When requested via the Transmission2 message, this function limits the increase in the driver's desired torque according to the torque gradient limitation transmitted in Transmission2 Byte3. This is therefore a temporary slew rate limitation of the driver's desired quantity, which ensures a variable maximum increase. In the operating states in which no such limitation is required (indicated by Byte3=FFh or Byte1-Bit2=0) there is no limitation of the driver's desired torque.

2.6.4.1 Justification

This function can be used to limit the speed of torque build-up, particularly when driving off from a standstill with a partial load with the VL30 (CVT) transmission or with the stationary decoupling function with the 5HP19 (multi-stage automatic) transmission. In this way, jerk-free starting can also be ensured at (consumption-optimum) low speeds, since after a gas burst, a high "torque burst" is not immediately fed into the drive train, to which the transmission can no longer react.

2.6.4.2 Functional description

This function can be activated via the function switch cowFUN_MGB = 1. In this case, mrmM_EPWG (driver's desired quantity) is limited with respect to the highest possible positive increase (slew rate limit upwards). i.e. there is an additional MIN formation active from the previously calculated unlimited driver request quantity - now renamed to mroM_EPWGU - and the sum of mrmM_EPWG (t-1) and mrodM_EMGB (maximum quantity gradient). This maximum quantity gradient mrodM_EMGB is transmitted from the CAN max.
Torque gradient calculated from Getriebe2-Byte3 mrmdMD_MGB. In this conversion, the target quantity consumption mrmBI_SOLL, the processing period (20 ms main program period) and an additional applicable evaluation factor for the MGB mrwMGBFAKT is taken into account. Furthermore, mrmdMD_MGB is limited downwards by a MAX formation with the application date mrwdMGBMIN in order to allow a minimum increase in any case.
If an impermissibly small torque gradient is actually requested via CAN, the error fbbEMGB_P (error path fboSASG) is reported - mrmdMD_MGB then gets the value mrwdMGBMIN.

The following switch-off conditions exist for the torque gradient limitation:

- Max. torque gradient from Gear2-Byte3 = FFh
- faulty transmission 2 message (message counter or timeout)

If one (or more) of these switch-off conditions occurs, the torque gradient limitation is switched off in that mrodM_EMGB is set to dM_EMAX (largest possible internally representable value) or the applicable default value mrwdMGBAUS. The default value mrwdMGBAUS is used if the torque gradient limitation is currently active (mroM_EPWGU> mrodM_EMGB + mrmM_EPWG(t-1)) - this avoids a sudden increase in any case. If a switch-off condition occurs during the active intervention, a switch-off ramp with the increase mrwdMGBAUS is executed.

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In the system, the torque gradient limitation acts on mrmM_EPWG and, if necessary, on sizes derived from it - but not on mrmMDW_ab (output torque on driving behavior map - is used by the FGR) and mrmM_EPWGR (desired quantity raw - is used by ARF and boost pressure control). The EGS intervention (as well as FGR, ADR, etc.) does not have a slew rate limitation, since this acts on the quantity path after the torque gradient limitation.

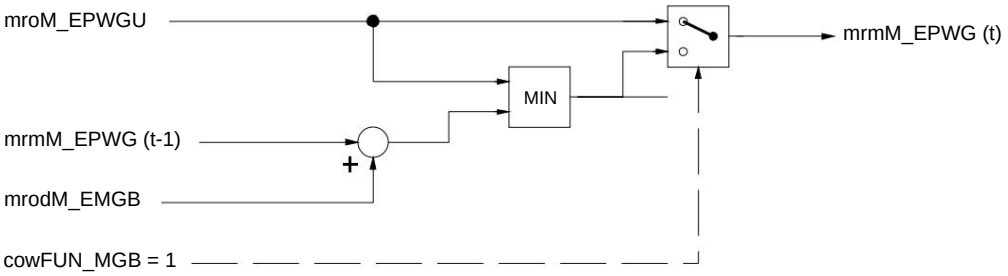


Figure MEREMGB1: Slewrate limitation of mrmM_EPWG

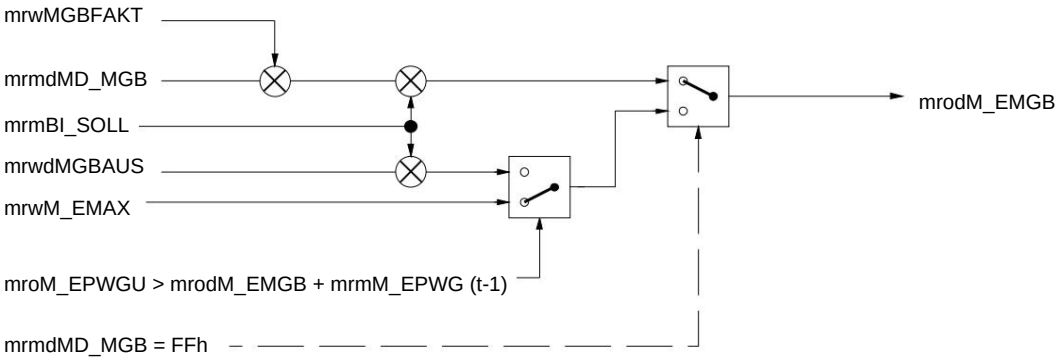


Figure MEREMGB2: Determination of the maximum volume gradient mrodM_EMGB

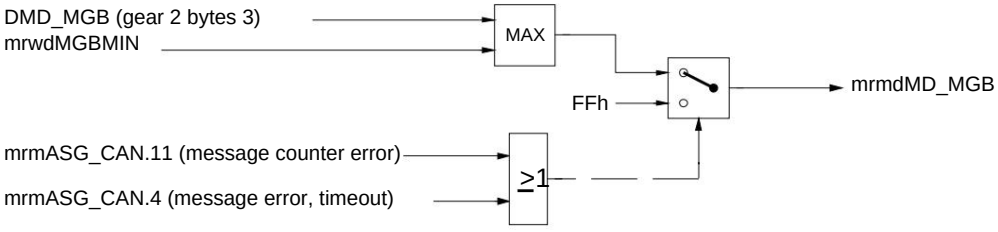


Figure MEREMGB3: Determination of the maximum moment gradient mrmdMD_MGB

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In the event of errors in the associated gearbox 2 message (message counter or timeout), the substitute value FFh is forwarded in order to safely deactivate the torque gradient limitation.

If an impermissibly small torque gradient is requested via CAN, the error fbbEMGB_P (error path fboSASG) is reported - mrmdMD_MGB then gets the value mrwdMGBMIN via the built-in MAX formation. If the error fbbEMGB_P is finally defective, this currently has no direct system impact. This error only serves to store the error that the gearbox control unit has requested an impermissibly low torque gradient.

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2.7 Fuel cut-off

The shutdown of the injection in the overrun is forced by the shutdown of the *metering zmmMVS_ANS* = 6 (see chapter pump control). The operating state thrust is when *mrmM_EAKT* = 0 is. In order to minimize the thrust bucking, gear-dependent (x=1..5) for the time *mrwSCHTIxG* the overrun cut-off of the ARD can be delayed. After this time, the remaining amount of pumps *mrmM_EPUMP* and the amount of engine torque for the CAN transmission *mrmM_EMOTX* is lowered to zero by increasing damping (gear-dependent with the factor *mrwSA_BExG) .* After falling below the quantity threshold mrwSA_OFF or exceeding the time *mrwARD_TIM ,* the metering is switched off and the amounts *mrmM_EMOTX* and *zmmM_EKORR* = 0 set.

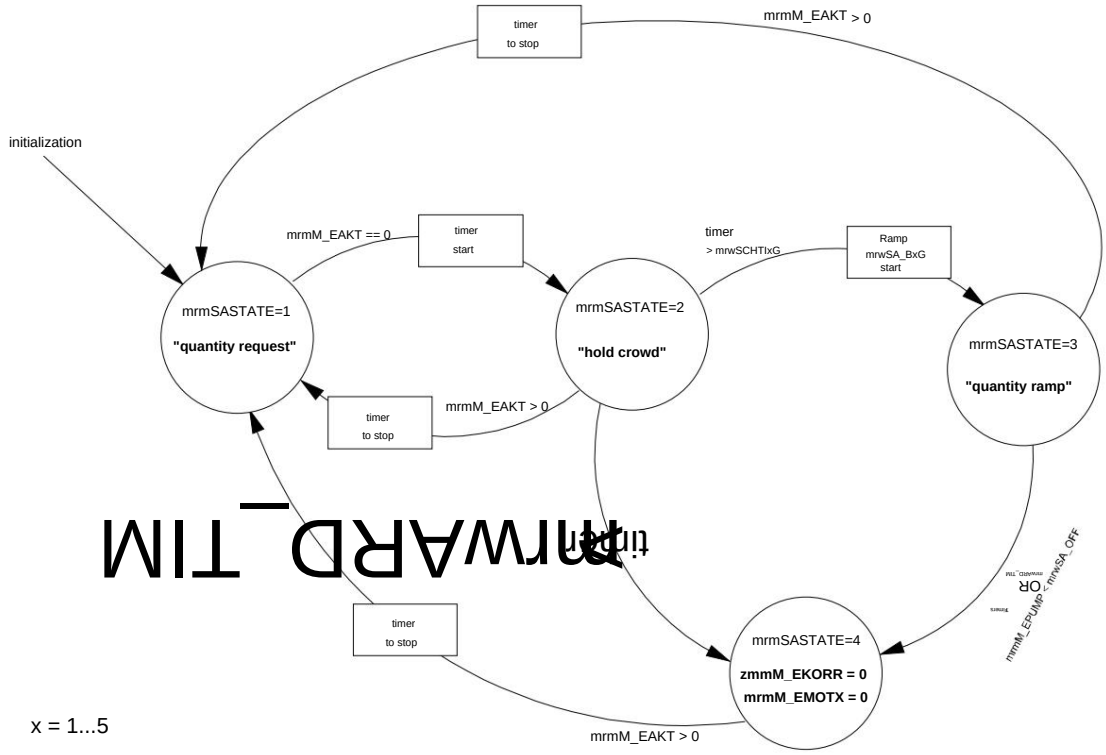


Figure MERESA01: State diagram of the overrun cut-off

The size mrmSASTATE represents the state of fuel cutoff.

mrmSASTATE = 1: There is a quantity request, thrust is not active.

mrmSASTATE = 2: boost active, the residence time mrwSCHTIxG has not yet expired. ARD interventions are possible.

mrmSASTATE = 3: Ramp reduction of mrmM_EPUMP to zero. For this purpose, the currently calculated amount mroM_APUMP is multiplied by an evaluation factor.
At the same time, the amount mrmM_EMOTX is ramped out with the same evaluation factor down to zero (multiplication of the evaluation factor with mrmM_EMOT). The evaluation factor is initialized with 1 and goes to zero with the increment mrwSA_BExG. If the amount of pumps falls below the applicable barrier mrwSA_OFF, the ramp is canceled and switched to the state mrmSASTATE=4.

mrmSASTATE = 4: The maximum overrun switch-off time mrwARD_TIM has expired or the pump volume mrmM_EPUMP is less than the barrier mrwSA_OFF. The solenoid valves are not activated.

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2.8 Cruise Control

The driving speed control (GRA) consists of three different subtasks
together: the evaluation of the control panel, the check of the switch-off conditions and the execution
the selected function. The control panel evaluation recognizes the function request to the
Driving speed control via the control panel and checks their plausibility and
functionality. When checking the shutdown conditions, the various conditions that
can cause a shutdown, recognized and disabled the GRA. In the subtask
"Execute the selected function" the function request is executed by the control panel. the
Digital inputs for the individual buttons and contacts are already defined in the Digital inputs module
debounced. Only the logical states are processed by the GRA.

Description of the software switch cowFUN_FGR:

decimal value	comment
0	No driving speed control (cannot be activated by diagnosis either!)
1	-
2	reserved
3	GRA function according to VW / AUDI (can be switched on and off by diagnosis)
4	-
	-
5 6	GRA function according to LT2 (can be switched on and off by diagnosis)
7	ADR with variable working speed (can be switched on and off by diagnosis)
8	ADR with fixed working speed (can be switched on and off by diagnosis)
9	ACC Adaptive Cruise Control

The message comFGR_opt contains the value of cowFUN_FGR if GRA is not deactivated via EEPROM switch (see Login Request) or GRA is applied via CAN.

Decimal value	Meaning comFGR_opt
0	disabled (via login or cowFUN_FGR=0)
	-
1 2	FGR over CAN (cowFUN_FGR = 3 AND mrwMULINF0 = 6, 9 or 11)
	FGR via digital input
3 4	-
5	-
6	FGR with MB control panel (LT2)
7	variable ADR
8	fixed ADR
9	Acc

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Transmission and reception conditions of the CAN message GRA:

cowFUN_FGR CAN	message GRA
0	send
2	GRA activated via EEPROM switch: received(comFGR_opt = 2) GRA disabled via EEPROM switch: - (comFGR_opt = 0)
	send
3 6	-
7	-
8th	-
9	send

Control unit evaluation:

Using the function switch cowFUN_FGR (0 = no GRA, 3 = VW / AUDI, 6 = LT2) can
between LT2 control panel and VW control panel can be selected:

LT2 control panel:

The following digital inputs are available:

ÿ dimFGA ÿ	= keyed OFF
dimFGW ÿ	= resume (WA)
dimFGP ÿ	= Accelerate (ON+) or Tip Up
dimFGM ÿ	= Deceleration (ON-) or Tip Down
dimFGV	= control contact

The control contact is used for a plausibility check. Except the contact OFF becomes a contact only
accepted together with a rising edge of the control contact. When changing from one
The neutral position must have been recognized in the meantime for the function request for the next one.
The acceptance condition for the contact EIN+ is tightened: it is only accepted together with
accepted by the control contact. Were the control and ON+ contacts activated and
then the control contact is deactivated, so there is no change to the “neutral” position for a
further acceleration necessary; it is sufficient to press the control contact again.

VW control panel:

This GRA version supports the digital control panel variant with the contacts ON+, WA,
OFF and latched OFF (N.O. contact). The extinguishing contact is mechanically designed as the main switch of the
GRA - control panel executed. If the clearing contact is actuated, the GRA -
Target speed set to zero. The following control panel variants are available:

Standard GRA:

ÿ dimFGL ÿ	= latched OFF (break contact)
dimFGA ÿ	= keyed OFF
dimFGP ÿ	= Set (SET) / Accelerate (ON+)
dimFGW	= resume (WA)

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VW control panel via CAN, message GRA/GRA_Neu:

It is possible to read in the GRA keypad status via CAN. To do this, mrwMULINFO0 must applied that one of the CAN messages GRA or GRA_Neu is received (see version the CAN data specification). In addition, GRA function according to VW / AUDI (cowFUN_FGR = 3) be applied. If these conditions are met, instead of the digital inputs dimFGx the Information from the CAN message is used as follows:

- ÿ dimFGL plausibility checked with “GRA/ADR - main switch”
- ÿ instead of dimFGA “GRA/ADR - Tip switch 'Off'” - inverted
- ÿ instead of dimFGP “GRA/ADR - tip switch 'set/decelerate'”
- ÿ instead of dimFGW “GRA/ADR - tip switch 'Resume / Accelerate'”

The bit "GRA / ADR control unit error" causes the shutdown of the GRA (mroFGR_ABN = 21).

Attention: The names of the signals in the GRA message are only correct in “ON” simulation (see below) agree with their meaning.

The bits "GRA/ADR delay" and "GRA/ADR accelerate" from the message GRA or GRA_Neu are not used.

The information of the contact “latched on-off” at the digital input (dimFGL) of the Control unit is with the redundant information GRA / ADR main switch of the GRA message checked for plausibility. If an error occurs in this context, it is reported via fbbEFGC_P (time-debounced) reported. This error leads to a shutdown of the GRA.

Description of the message mrmGRA (on receipt of GRA or GRA_Neu by Motor-SG):

Bit	comment GRA/ADR 4 position control panel	Comment GRA/ADR 6 position control panel	designation in the CAN message	correspondence
	Main switch 0	main switch	S_MAIN	dimFGL (plaus.)
1	off	Out of	T_OFF	dimFGA
2	Set/Delay	Delay	T_VER	dimFGP
3	resume/accelerate some	Accelerate	T_BES	dimFGW
4	-	Put	T_SET	
5	-	resumption	T_WA	
	Control panel error	Control panel error	F_BTL	mroFGR_ABN=21
6 7-		-	-	

When using the 6-position control panel, the inputs are linked via CAN and checked for plausibility and presented as mrmGRApl (bit positions identical to mrmGRA).

If the message GRA_Neu is received by the motor SG, the information “Sender Coding" as follows with mrwMULINF0 plausibility checked:

mrwMULINF0 transmitter coding	
9	00b
11	01b

If the transmitter coding is implausible, the error fbbEFGC_S is reported.

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The GRA message contains a message counter that is continuously incremented by the
to ensure that the message is up-to-date. The error fbbEFGC_B is reported when the
Difference in message counters of two consecutive messages greater than
mrwGRA_Bmx was. This error is also reported if the message counter exceeds more
has remained unchanged as mrwGRA_Bmn main program periods. The error fbbEFGC_B
causes the GRA to shut down.

The message content is monitored by a checksum byte. If the checksum as
recognized correctly, an error counter is decremented to 0. In the event of an error, the counter is
upper limit mrwGRA_Cog incremented. If the counter exceeds the value mrwGRA_Cmx
the error fbbEFGC_C is reported. This error causes the GRA to shut down.

If the checksum is recognized as defective or the message counter is defective, the signals dimFGA,
dimFGP and dimFGW not updated.

The information as to whether the checksum or message counter was detected as defective is in the
Message sent mrmGRACoff and used as a shutdown condition for GRA.

Description of the message mrmGRACoff:

Bit position	decimal value	comment
0		Defective checksum detected
1	1 2	Message counter defective detected

If the message times out or if the CAN handler detects inconsistencies
the errors fbbEFGC_Q and fbbEFGC_Y (no hiding and no error memory entry)
reported, which also cause a shutdown of the GRA. Here the substitute value is used
last valid value continues to be used until one of the errors is finally defective.

The debounce times for defect detection with errors fbbEFGC_B, fbbEFGC_C must be 0
to ensure that the CAN message is evaluated in accordance with the specifications.

As an alternative to the GRA, the function switch cowFUN_FGR (7 = ADR with variable
working speed, 8 = ADR with fixed working speed) the function of the working speed control can also be
specified (see working speed control).

With the configuration variable mrwALL_DEF, among other things, the ON simulation
switched on. In this mode, the digital inputs are defined as follows:

GRA with deceleration (on simulation):

ÿ dimFGL ÿ = latched OFF (break contact)
dimFGA ÿ = keyed OFF
dimFGP ÿ = set (SET) / delay (EIN-)
dimFGW = Resume (WA) / Accelerate (A+)

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Definition of the control panel states ON+, WA, SET and ON- with ON- simulation:

Control panel state ON+ (accelerate):

- Target speed is zero dimFGW AND
  (WA button) pressed longer than mrwALL_SPZ - dimFGW OR
(WA button) pressed AND
  Target speed greater than zero AND
  GRA active AND
  Control unit status WA not active

Control panel status WA:

ÿ dimFGW (WA button) pressed AND
  Target speed greater than zero AND
  GRA not active OR
ÿ dimFGW (WA button) pressed AND
  Target speed greater than zero AND
  GRA active in the resume state (WA) dimFGW AND
  (WA button) already actuated.

Control panel state SET (set):

ÿ dimFGP operated shorter than mrwALL_SPZ AND
  GRA is not active - OR
dimFGP operated shorter than mrwALL_TPZ AND
  GRA is active AND

  Deviation |VSoll -Vact | > mrwALL_BER

Keypad state ON- (decelerate):

ÿ dimFGP operated longer than mrwALL_TPZ

(control unit monitoring see monitoring concept)

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2.8.1 Examination of the switch-off conditions

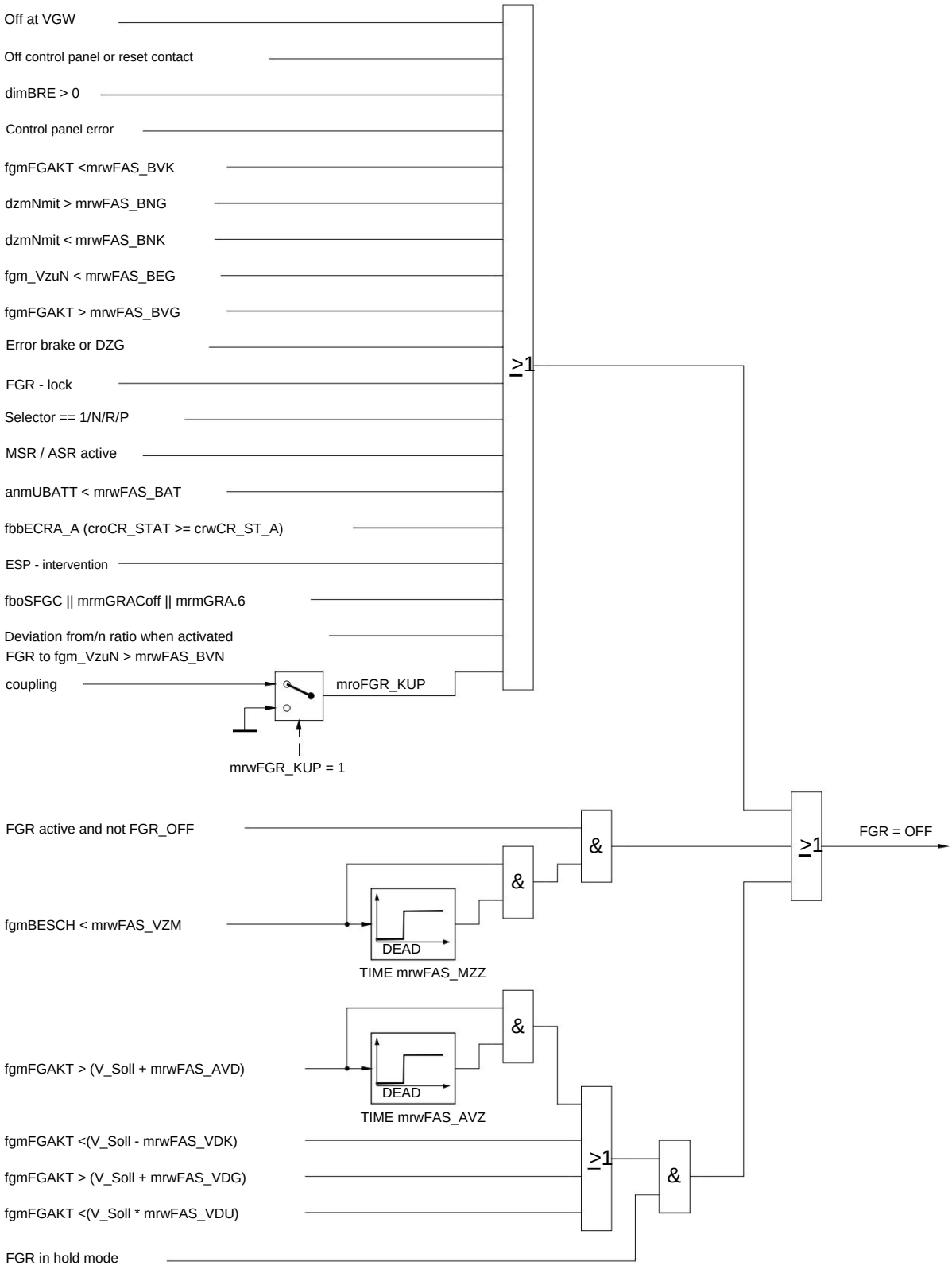


Figure MEREGR01: switch-off conditions

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The GRA is deactivated under the following conditions, with the cause of the shutdown being visible on the OLDA mroFGR_ABN:

ÿ OFF from the control panel (mroFGR_ABN = 1) +)
(If OFF by means of a reset contact - latched OFF, the target speed is deleted)
ÿ Brake contact or redundant brake contact active (mroFGR_ABN = 2) ++)
- Clutch actuation, provided mrwFGR_KUP = 0; no shutdown
mrwFGR_KUP = 1 (mroFGR_ABN = 3) +++)
- Occurrence of a control unit error (mroFGR_ABN = 4) +++) - the
vehicle deceleration is greater than the maximum value during the time mrwFAS_MZZ
mrwFAS_VZM (input via neg. Acceleration, mroFGR_ABN = 5) ++) Note: even when deactivating the GRA via the software switch cowFUN_FGR, or via the diagnosis is mroFGR_ABN = 5.

ÿ Driving speed below the minimum value mrwFAS_BVK, or above the maximum value
mrwFAS_BVG (mroFGR_ABN = 6) +)
ÿ Speed greater than the maximum value mrwFAS_BNG (mroFGR_ABN = 7) +)
ÿ speed less than the min. value mrwFAS_BNK (mroFGR_ABN = 8) +) ÿ current. v/n
- ratio less than min. Value mrwFAS_BEG (mroFGR_ABN = 9) +)
ÿ Deviation of the current v/n ratio from the v/n ratio when activating the GRA operation greater than
the maximum value mrwFAS_BVN (mroFGR_ABN = 10) +)
ÿ Occurrence of an error in the brake (fboSBRE) or speed sensor (fboSZG)
(mroFGR_ABN = 14) ++)
- Waiting for the neutral position of the control panel after cancellation (mroFGR_ABN = 15) +)
ÿ Selector lever of the automatic transmission in position 1, P, N or R (mroFGR_ABN = 16) +)
- ASR or MSR intervention longer than the time mrwALL_ASR active occurs when
mrmMSRSTAT bit 0 set or mrmASRSTAT bit 0 set (mroFGR_ABN = 17) +)
- Battery voltage anmUBATT longer than the time mrwFASBATt less than the threshold mrwFAS_BAT
(mroFGR_ABN = 18) +)
ÿ The crash level croCR_STAT is greater than or equal to the applicative threshold crwCR_ST_A
(mroFGR_ABN = 19) +++)
ÿ ESP intervention mrmFDR_CAN.0 is longer than the time mrwALL_FDR (mroFGR_ABN =
20) +)
ÿ One of the errors in the error path fboSFGC (FGR via CAN) is finally defective or if a message GRA control panel error is reported. Likewise, if mrmGRACoff shutdown due to CAN message error is required. (mroFGR_ABN = 21) +)
ÿ Error in determining the valid transfer function (after the RS flip-flop there is an error. This is transmitted to the FGR via mrmGRA_UEF). (mroFGR_ABN = 22) +)

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In the GRA - state HOLD, the following termination conditions also apply:

- ÿ Positive deviation of the current driving speed from the GRA - target speed during the time mrwFAS_AVZ greater than the maximum value mrwFAS_AVD (mroFGR_ABN = 11) +)
- ÿ Positive deviation of the current driving speed from the GRA - target speed greater than the value mrwFAS_VDG (mroFGR_ABN = 12) +)
- ÿ Negative deviation of the current driving speed from the GRA - Target speed: fgmFGAKT < VSoll mrwFAS_VDU or negative deviation of current driving speed of the GRA target speed: fgmFGAKT < VSoll - mrwFAS_VDK (mroFGR_ABN = 13) +)

Abort behavior:

- ÿ +) Reduction of the GRA - amount by a proportionality factor mrwFAS_RAS, then Quantity ramp with the slope mrwFAS_SRA to 0.
- ÿ ++) Reduction of the GRA - amount by a proportionality factor mrwFAS_RSB, then the amount is reduced to 0 via a ramp within the time mrwFAS_RAB.
- ÿ +++) Reduction of the GRA amount immediately to 0.

If aborted while the ON+ / ON- button is pressed (accelerate/decelerate), the target speed is deleted (0).

When the GRA is activated, the plausibility of the driving speed fbbEFGG_P is checked (see monitoring concept). If the FGG is defective (error in the fboSFGG path), the brake is simulated and the GRA operation is canceled under the resulting conditions (ramp gradient).

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2.8.2 GRA over wheel torque

With the function *switch cowFGR_RMo* (1 ... GRA over wheel torque, 0 ... GRA over quantity) it is decided whether the control structure of the GRA should calculate with the wheel torque or with the quantity.

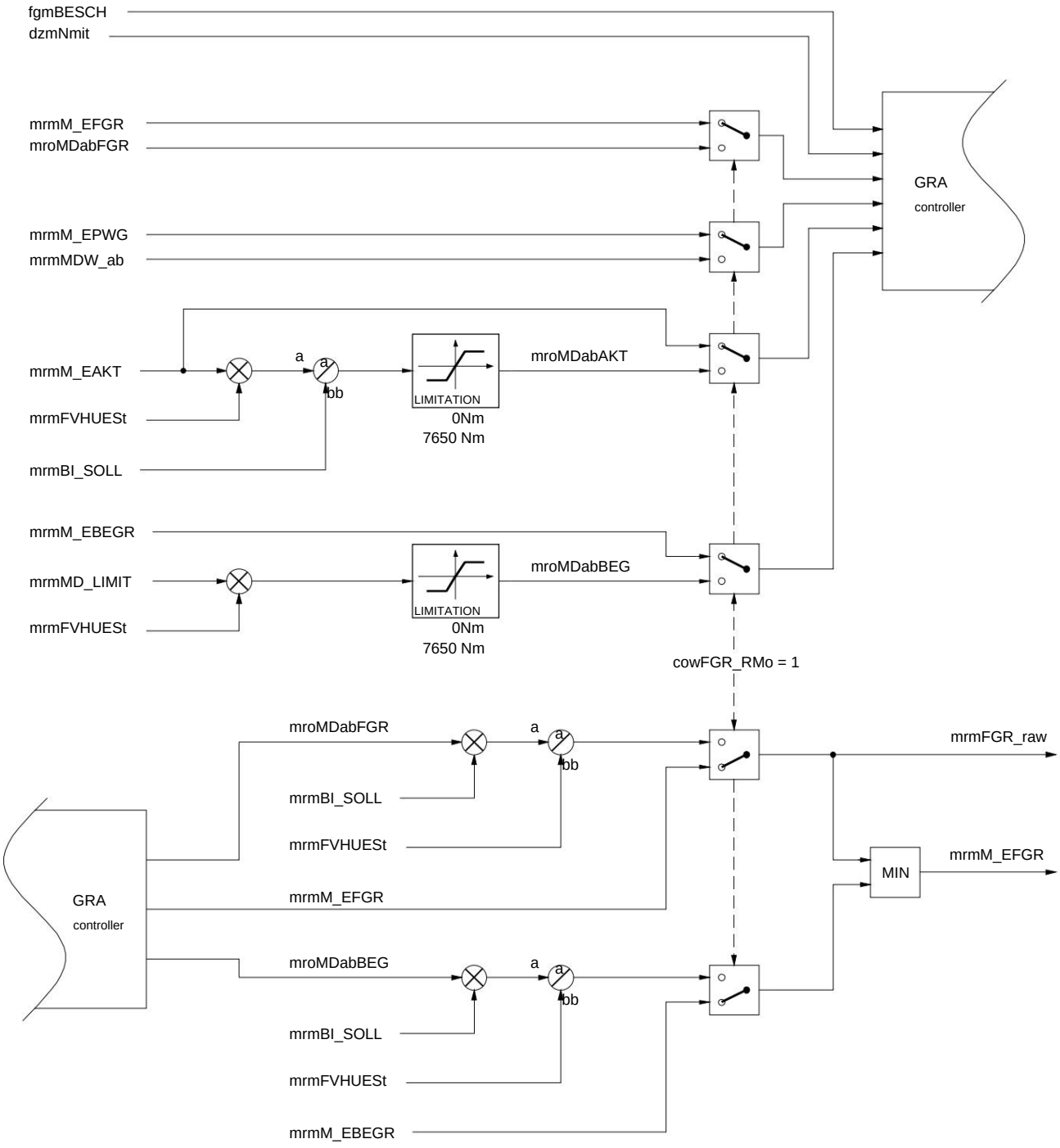


Figure MEREGR10: GRA wheel torque

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The input variables for the GRA controller block for "GRA via wheel torque" are set together as follows:

- *mroMDabFGR* [Nm (output torque)]... Result of the last controller run
- *mroMDabBEG ...* The "limiting wheel torque" is calculated from "limiting wheel torque" times "Transfer function powertrain after filtering"

$$\text{mroMDabBEG [Nm (output torque)]} = \text{mrmMD_BEGR}\ [\text{Nm (engine torque)}] \bullet \text{mrmFVHUEst}\ [-]$$

- *mroMDabAKT ...* The "ACTUAL wheel torque without ARD" is calculated from the "Current Injection quantity" by the "target quantity consumption" times "drive train transfer function after filtering"

$$\text{mroMDabAKT [Nm (output torque)]} = \frac{\text{mrmM_EAKT}\ [\text{mg/stroke}]}{\text{mrmBI_SOLL}\left[\frac{\text{mg/stroke}}{\text{Nm (engine torque)}}\right]} \bullet \text{mrmFVHUEst}\ [-]$$

- *mrmMDW_ab* [Nm (output torque)]... Torque from the driving behavior map mrwFGFVHKF
- fgmACC [m/s²]... Acceleration
- dzmNmit [1/min]... speed

The output variables for the GRA controller block for "GRA via wheel torque" have the following Units:

- mrmM_EFGR [mg/Hub]...Desired amount GRA
- mrmFGR_roh [mg/Hub]... Desired quantity GRA unlimited

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2.8.3 Execution of the selected function

Execution of the selected function in the standard GRA:

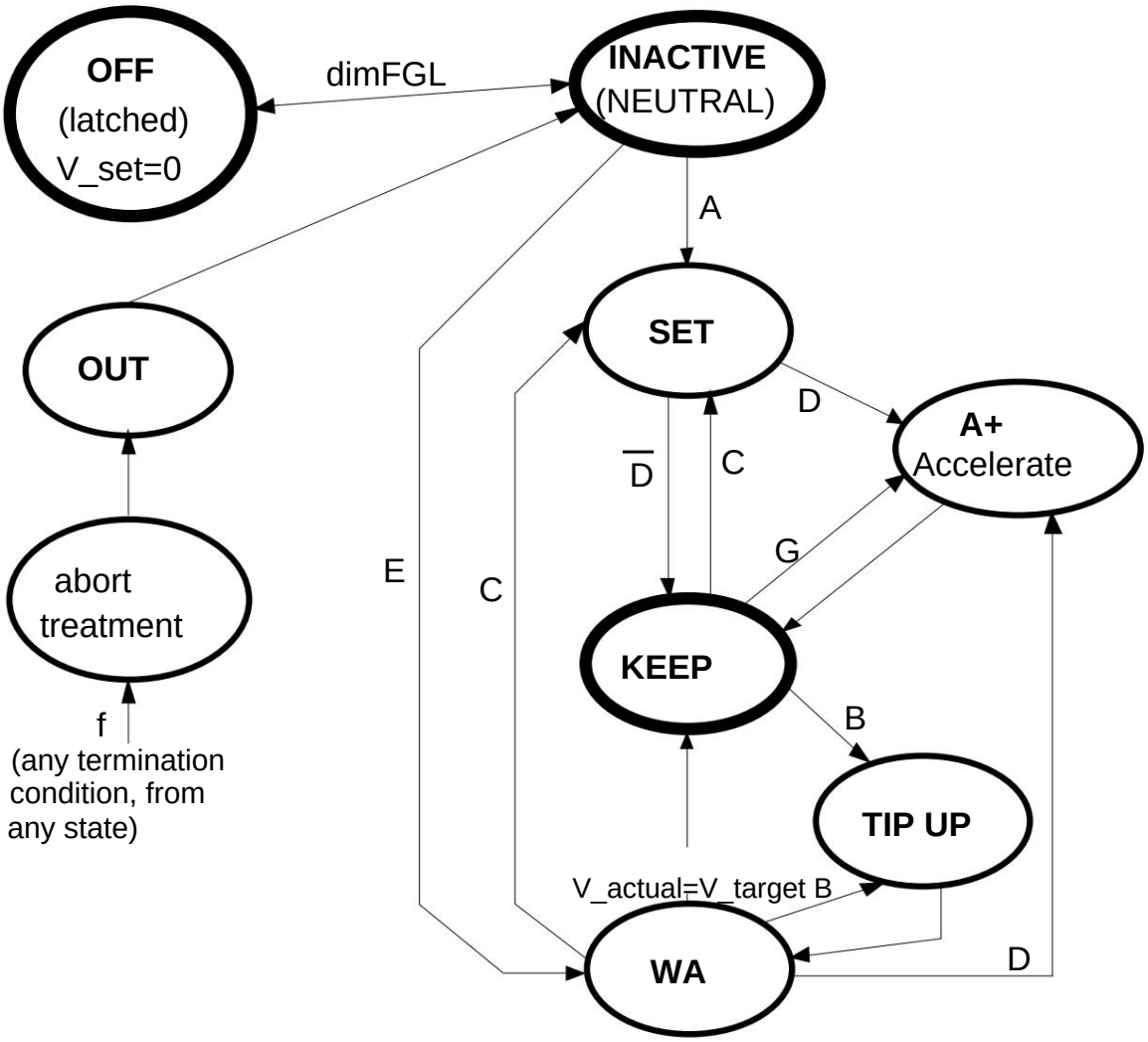


Figure MEREGR02: Overview of the GRA functions in the standard GRA

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The functions selected by the control panel are executed in this subtask. The GRA - operation assumes the following GRA - states according to the desired function:

A control panel state ON + recognized shorter than mrwALL_SPZ and GRA - NEUTRAL state: -> GRA - state is SET

B control panel state ON + recognized shorter than mrwALL_TPZ and GRA - state HOLD or WA and deviation from target speed to current driving speed <= mrwALL_BER: -> GRA - state is TIP-UP

C control panel state ON + recognized shorter than mrwALL_TPZ and GRA - state HOLD or WA and deviation from target speed to current driving speed > mrwALL_BER: -> GRA - state is SET

D control panel state ON + equal to or longer than mrwALL_SPZ recognized: -> GRA - state is _ ON+ (Accelerate)

D control panel state ON + recognized shorter than mrwALL_SPZ and GRA - state is SET: -> GRA state is HOLD

E Control unit status WA recognized and the current driving speed is higher than the last one driven GRA - target speed -> GRA - state is WA from above

WA recognized and the current driving speed is less than or equal to the last driven GRA - target speed -> GRA - state is WA from below

F Control panel status OFF from control panel, or other abort condition detected -> GRA - State is OFF

G control panel state ON + equal to or longer than mrwALL_TPZ recognized: -> GRA - state is ON+ (Accelerate)

The GRA - state HOLD is the target state of the states ON+, WA from above and WA from below, as well as the target state of the state TIP-UP (over WA).

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Execution of the selected function in ON simulation:

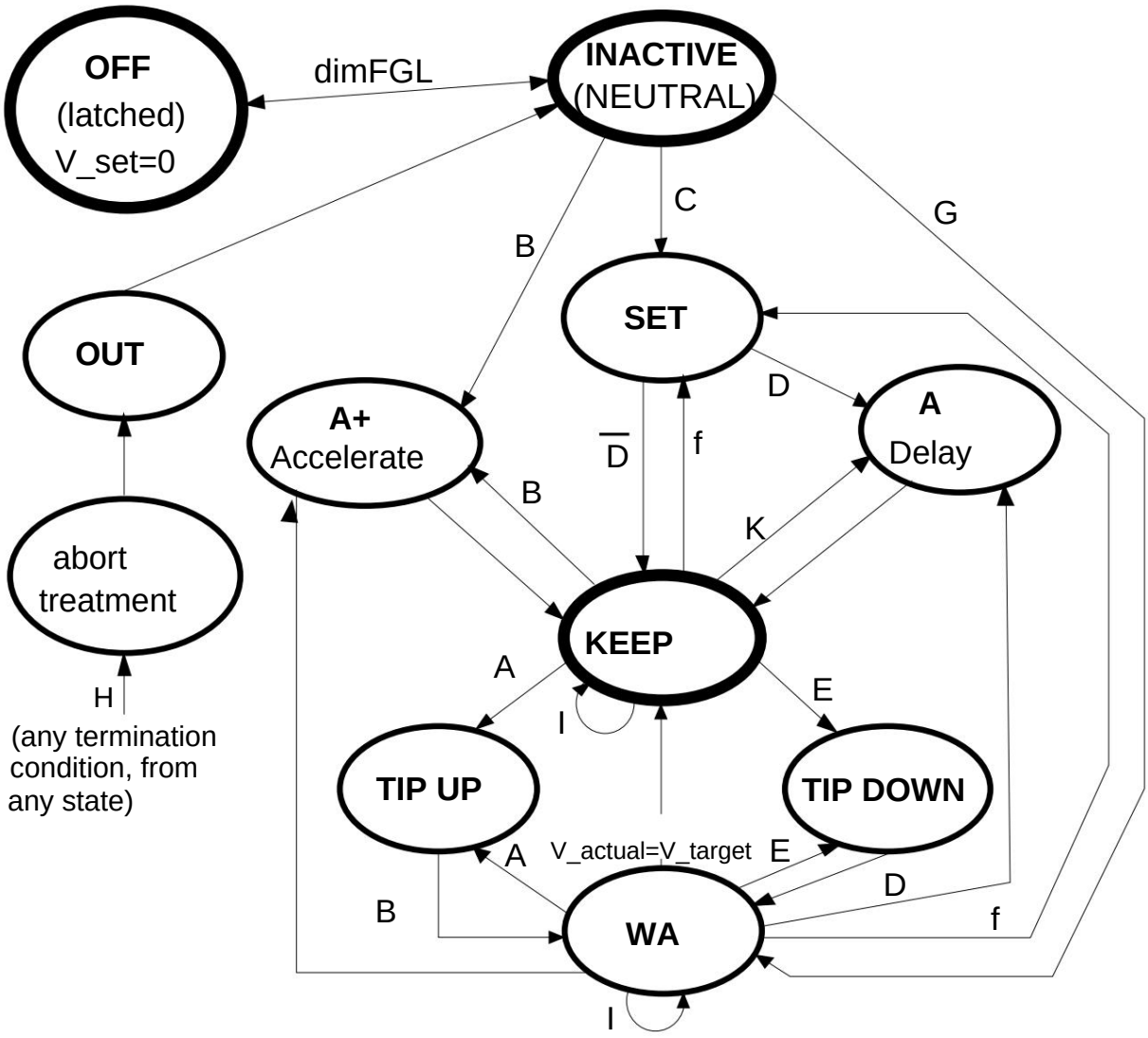


Figure MEREGR03: Overview of the GRA functions with ON simulation

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The functions selected by the control panel are executed in this subtask. The GRA - operation assumes the following GRA - states according to the desired function:

A control panel state ON + shorter than mrwALL_TPZ recognized and GRA - state HOLD or WA and deviation from target speed to current driving speed <= mrwALL_BER: -> GRA - state is TIP-UP B control panel state ON + longer than mrwALL_SPZ recognized: -> GRA - state is ON + (Accelerate).
This state change can be carried out at any target speed mroV_SOLL.

C control panel status ON- recognized shorter than mrwALL_SPZ and GRA - status inactive: -> GRA - state is SET

D control panel status ON- recognized equal to or longer than mrwALL_SPZ: -> GRA - status is _ ON- (decelerate)

D control panel state ON- recognized shorter than mrwALL_SPZ and GRA - state is SET: -> GRA - state is HOLD

E control panel state ON- recognized shorter than mrwALL_TPZ and GRA - HOLD and state Deviation from target speed to current driving speed <= mrwALL_BER: - > GRA - state is TIP-DOWN

F control panel state ON- recognized shorter than mrwALL_TPZ and GRA - HOLD and state Deviation from target speed to current driving speed > mrwALL_BER: -> GRA - state is SET

G Control unit status WA recognized and the current driving speed is higher than the last one driven GRA - target speed -> GRA - state is WA from above
WA recognized and the current driving speed is less than or equal to the last driven GRA - target speed -> GRA - state is WA from below

H Control panel status OFF detected by control panel or other abort condition -> GRA - State is OFF

I control panel state ON + recognized shorter than mrwALL_TPZ and GRA - state HOLD or WA and deviation from target speed to current driving speed> mrwALL_BER: -> GRA - state is unchanged.

K control panel status ON-identified equal to or longer than mrwALL_TPZ: -> GRA - status is ON- (decelerate)

The GRA - state HOLD is the target state of the states ON+, ON-, WA from above and WA from below, as well as the target state of the states TIP-UP and TIP DOWN (over WA).

The current GRA - target speed is visible on the OLDA mrmFG_SOLL, the value of the integrator on the OLDA mroI_AKT and the current GRA - desired amount on the OLDA mrmM_EFGR.

For the output of the inverse PWG - signal (information on automatic transmission) is a GRA desired quantity mrmFGR_roh sent. In mrmFGR_roh the P shares are not limited in the states "HOLD", "ON+" and "WA from below".

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2.8.4 Description of the GRA states

GRA - state SET:

In the SET state, after releasing the pressed button, the current driving speed is set to the target speed and the state is HOLD, with the current amount mrmM_EAKT in the integrator of the PI - controller for the state HOLD being accepted. If the button is pressed for a longer period of time, the current driving speed is set to the set speed and, based on this set speed, the next state (ON+ / ON-) is changed.

GRA - state TIP-UP:

If the GRA - state HOLD ON + is pressed shorter than mrwALL_TPZ and the deviation from the target speed to the current driving speed is ÿ mrwALL_BER, the GRA - state TIP-UP is activated. The target speed is when the GRA - desired amount has not yet reached the full load, set to the current driving speed increased by mrwALL_TPV, and it is in the GRA - state WA from below. When the full load is reached, the setpoint speed is not increased any further, but the HOLD state is entered via the WA state.

GRA - state TIP-DOWN:

If the GRA - state HOLD ON- pressed shorter than mrwALL_TPZ and the deviation from the target speed to the current driving speed is ÿ mrwALL_BER, the GRA - state TIP-DOWN is activated. The target speed is when the GRA - desired amount is greater than zero, to the lowered by mrwALL_TPV (lower limit is zero) current driving speed, and it is in the GRA - state WA from above. If the GRA - desired amount is equal to zero, the target speed is not further reduced.

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GRA - state ON+:

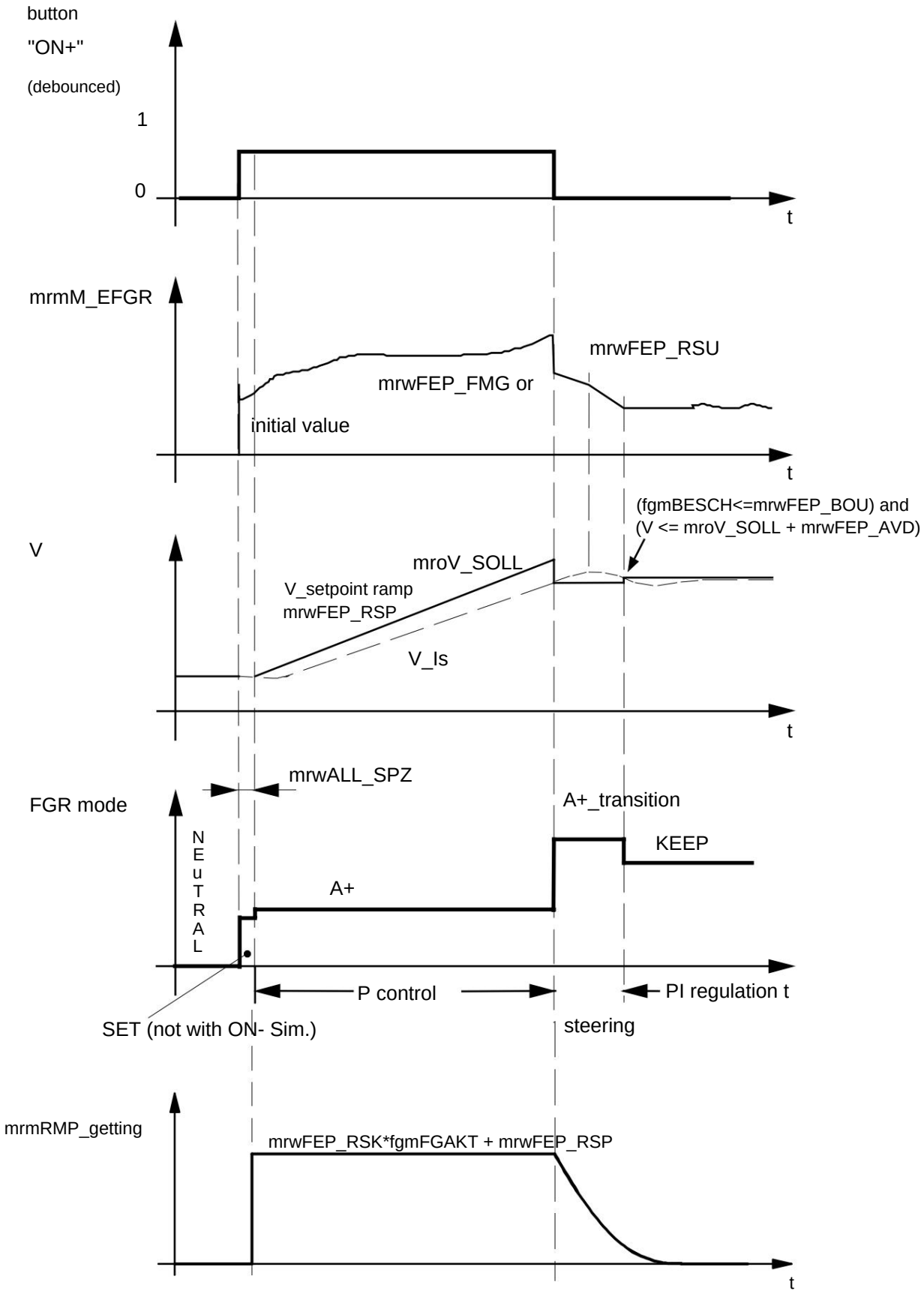


Figure MEREGR04: EIN+ function history

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After activation of the GRA - status ON+, a GRA - desired quantity initial value is calculated. This initial value is a maximum of the following quantities:

ÿ GRA - Desired quantity proportional to the current driving speed with the Proportionality factor mrwFEP_PAW
- current injection quantity mrmM_EAKT
- GRA - desired quantity mrmM_EFGR, if the GRA - condition ON + from the GRA - condition HOLD off has been activated

The setpoint speed is then increased using a speed ramp. The initial value of the ramp is the current driving speed at the time of activation of the GRA - state ON +, the ramp slope is (mrwFEP_RSK * fgmFGAKT + mrwFEP_RSP). By means of P - controller (limitation mrmof FGR_roh only to the integer - value range, limitation of mrmM_EFGR to [0, limiting amount mroM_EBEGR]) with the control parameters mrwFRP_ .. the current driving speed is regulated to the ramp speed. If the GRA - desired amount determined in this way is greater than or equal to the full load amount, the ramp speed is no longer changed. The ramp rate is increased as long as the ON+ contact is detected as actuated. After releasing the ON+ contact, the current driving speed becomes the new GRA target speed.

If the acceleration of the vehicle is less than or equal to mrwFEP_BOU, there is a transition to the GRA - HOLD state, with the current GRA desired quantity mrmM_EFGR in the integrator of the PI controller for the GRA - HOLD state is accepted.

Otherwise, the current GRA - desired quantity mrmM_EFGR at the time of letting go, if the current desired quantity is greater than the quantity threshold mrwFEP_MMP, reduced by the proportional factor mrwFEP_FMG. If the GRA - desired amount is less than or equal to the threshold, the proportional factor is mrwFEP_FMK. This new GRA - desired quantity is reduced by means of a ramp with the ramp gradient mrwFEP_RSU. If the current driving speed is greater than or equal to the GRA target speed, the ramp gradient is doubled. If the vehicle acceleration is less than or equal to mrwFEP_BOU and the current driving speed is less than or equal to the target speed, increased by the offset mrwFEP_AVD, the GRA - state ON + in the GRA - HOLD state, the current driving speed is set to the target speed. The GRA - desired amount mrmM_EFGR is in the integrator of the PI controller for the GRA - adopted state HOLD.

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GRA - status ON-:

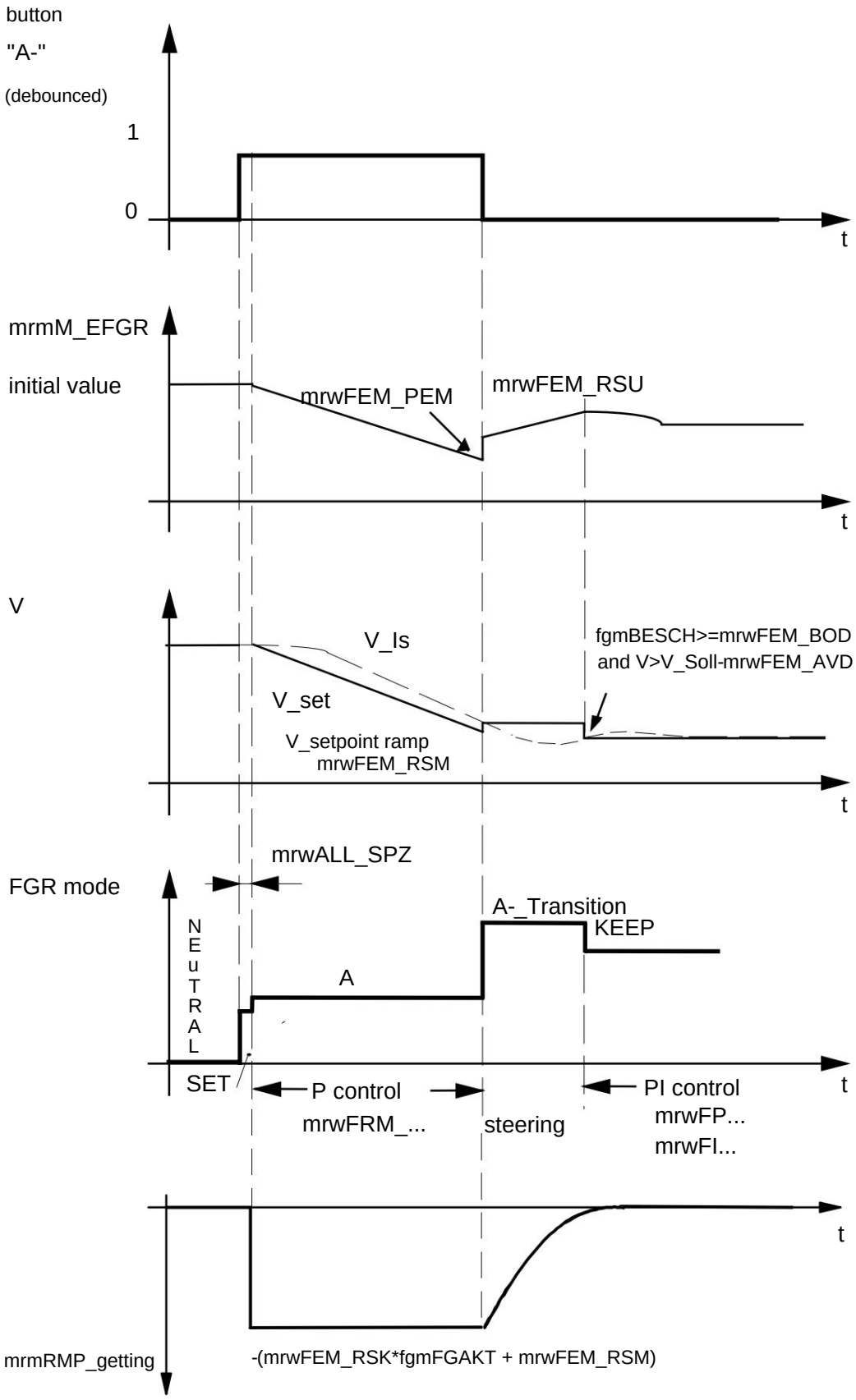


Figure MEREGR05: ON function history

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After activation of the GRA - status ON, a GRA - desired quantity initial value is calculated. This initial value is a maximum of the following quantities:

- Current injection quantity mrmM_EAKT
ÿ GRA - desired quantity mrmM_EFGR

The setpoint speed is subsequently reduced using a speed ramp.
The initial value of the ramp is the current driving speed at the time of activation of the GRA - state ON, the ramp slope is (mrwFEM_RSK * fgmFGAKT + mrwFEM_RSM). By means of a P - controller with the control parameters mrwFRM_.. the current driving speed is controlled at the ramp speed. If the GRA - desired quantity determined in this way is less than or equal to zero, the ramp speed is no longer changed. The GRA - desired amount mrmM_EFGR is limited to [0, limit amount mroM_EBEGR].
The ramp speed is reduced as long as the ON contact is recognized as actuated.
After releasing the ON contact, the current driving speed becomes the new GRA target speed.

If the deceleration of the vehicle is less mrwFEM_BOD (application as a negative acceleration), it is in the GRA - state HOLD passed, with the current GRA desired amount mrmM_EFGR in the integrator of the PI controller for the GRA - state HOLD is accepted.

Otherwise, the current GRA - desired quantity mrmM_EFGR at the time of release by the proportional factor mrwFEM_PEM increases proportional to the current driving speed (mrmM_EFGR = mrmM_EFGR + fgmFGAKT * mrwFEM_PEM). This means that a desired amount increases ramp gradient mrwFEM_RSU. If the current driving speed is lower than the GRA - target speed, the ramp gradient is doubled. If the vehicle acceleration is greater than or equal to mrwFEM_BOD and the current driving speed is greater than the GRA - target speed, reduced by the offset mrwFEM_AVD, is from the GRA - state ON in the GRA - HOLD state, the current driving speed is set to the target speed. The GRA - desired amount is taken over in the integrator of the PI controller for the GRA - state HOLD.

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GRA - state WA from above:

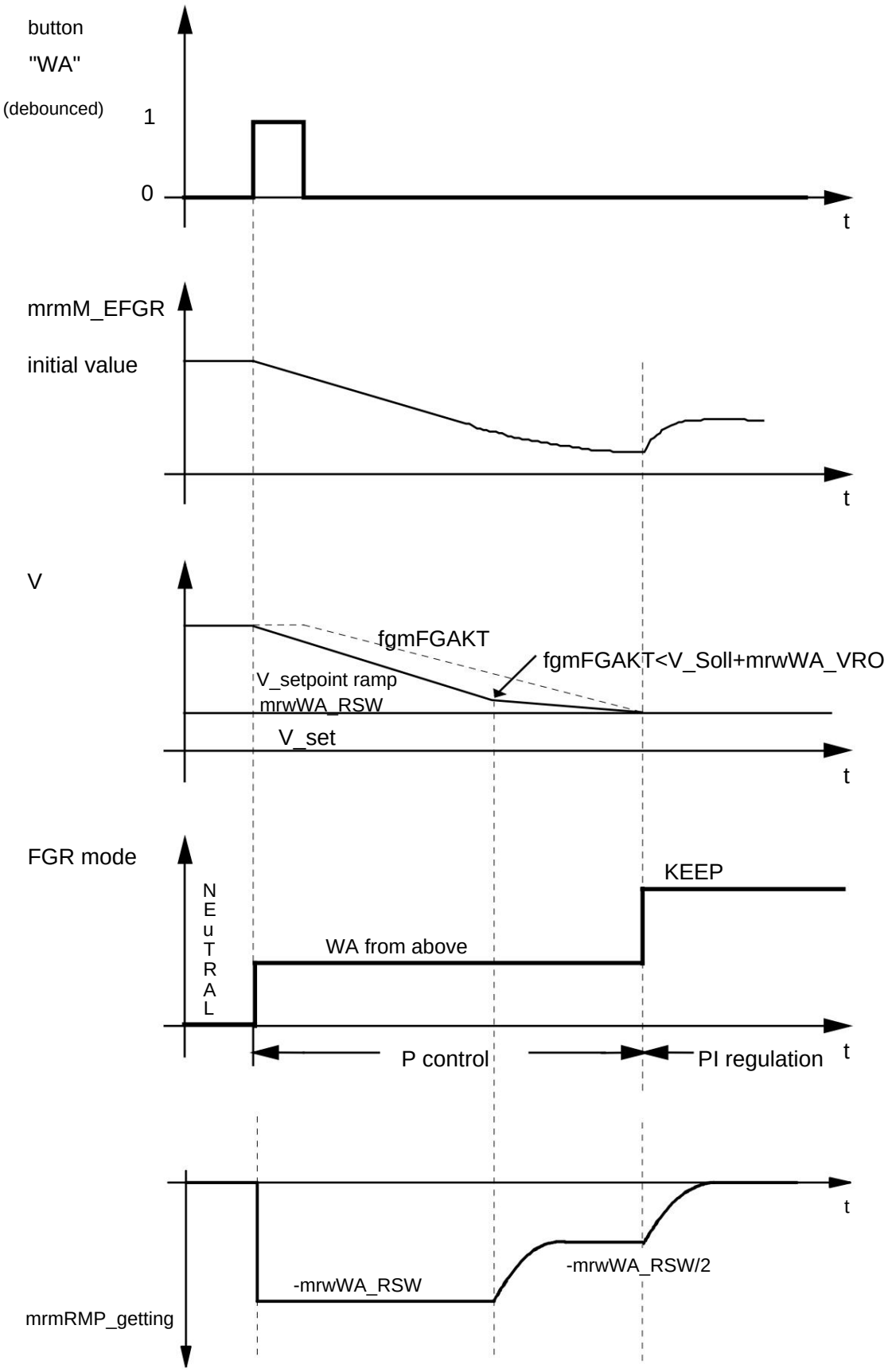


Figure MEREGR06: WA from above function curve

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After pressing the WA contact, the current amount is reduced to the percentage factor mrwWA_PAV and the new GRA - desired amount. The driving speed is subsequently reduced using a speed ramp mroV_RAMP. The initial value of the ramp is the current driving speed at the time of activation of the GRA - state WA from above, the ramp gradient is mrwWA_RSW. By means of P - controller with the control parameters mrwF1W_ .. the current driving speed is controlled at the ramp speed. The GRA desired amount mrmM_EFGR is limited to [0, mroM_EBEGR]. If the current driving speed is less than the GRA - target speed plus mrwWA_VRO, the ramp gradient is halved. If the current driving speed is less than or equal to the GRA - target speed, is in the GRA - HOLD state, the GRA - requested quantity mrmM_EFGR in the integrator of the PI controller of the GRA - HOLD state is taken over.

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GRA - state WA from below:

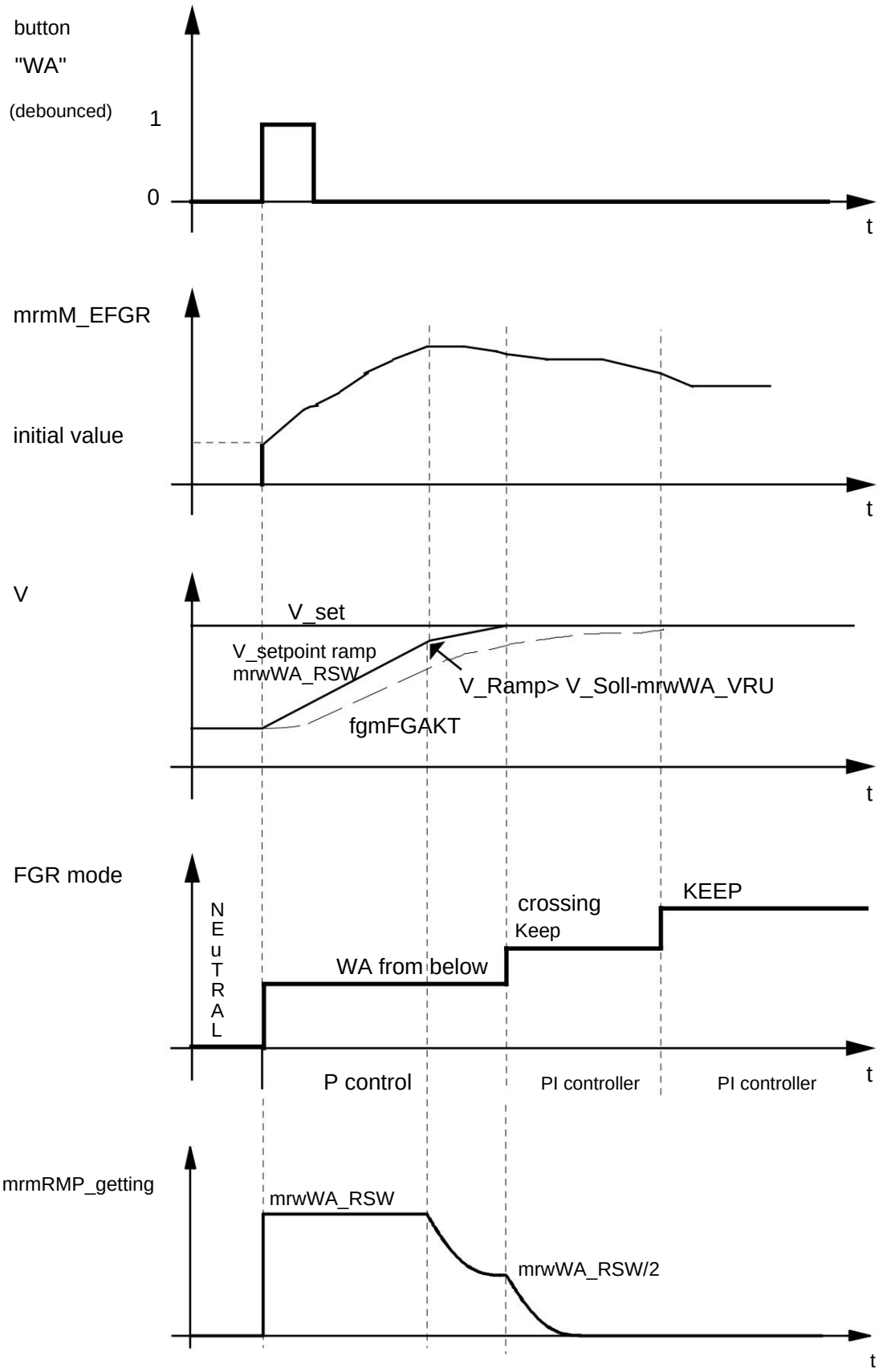


Figure MEREGR07: WA from below Function curve

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After pressing the WA contact is the initial value of the GRA - desired amount is the maximum of the current amount mrmM_EAKT and a value proportional to the current driving speed with the factor mrwFEP_PAW. The driving speed is subsequently increased using a speed ramp mroV_RAMP. The initial value of the ramp is the current driving speed at the time of activation of the GRA - state WA from below, the ramp gradient is mrwWA_RSW. By means of P - controller (limitation of mrmFGR_roh only to the integer - value range, mrmM_EFGR is limited to [0, limiting quantity mroM_EBEGR]) with the control parameters mrwF1W_ .. the current driving speed is regulated to the ramp speed.

If the ramp speed is greater than the GRA - target speed minus mrwWA_VRU, the ramp rate is halved. If the GRA determined in this way - desired quantity is greater than the full load quantity, the speed ramp is stopped. If the ramp speed is greater than or equal to the GRA target speed, the GRA changes to the TRANSITION HOLD state. If the current driving speed is greater than or equal to the GRA - target speed, the GRA - status HOLD is changed. As long as the current driving speed is less than the GRA - target speed, the driving speed using PI controller with the parameters mrwF2W_ .. for the P - portion and mrwFIW_ .. for the I - portion of the GRA - target speed introduced.

For the calculation of mrmFGR_roh, the P portion is limited only to the integer number range, while the I portion is limited to [0, limiting quantity mroM_EBEGR]. The GRA request amount mrmM_EFGR is limited to [0, limit amount mroM_EBEGR]. The integrator of the GRA - state HOLD is preloaded with the transition with the last value of the GRA - desired quantity.

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GRA - state OFF:

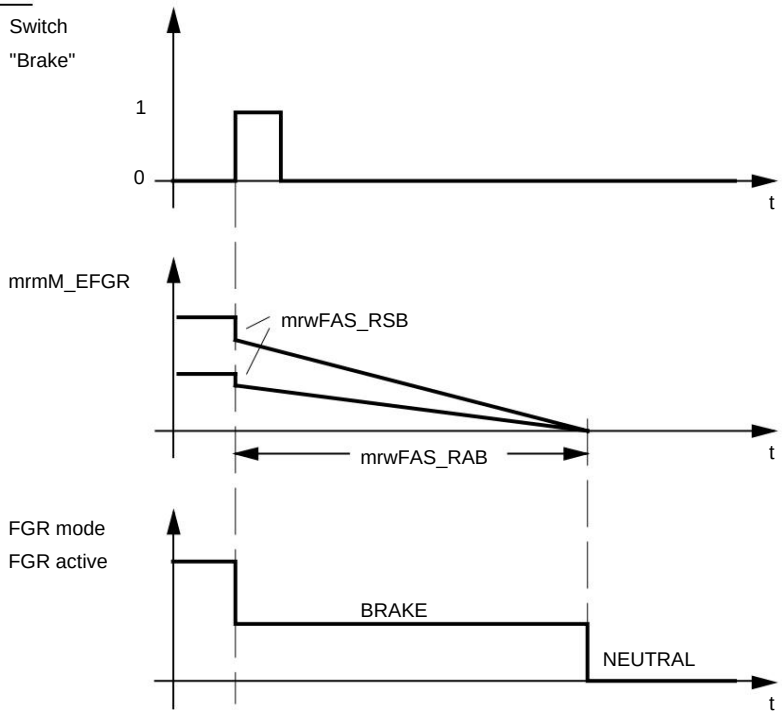


Figure MEREGR08: Brake actuation function curve

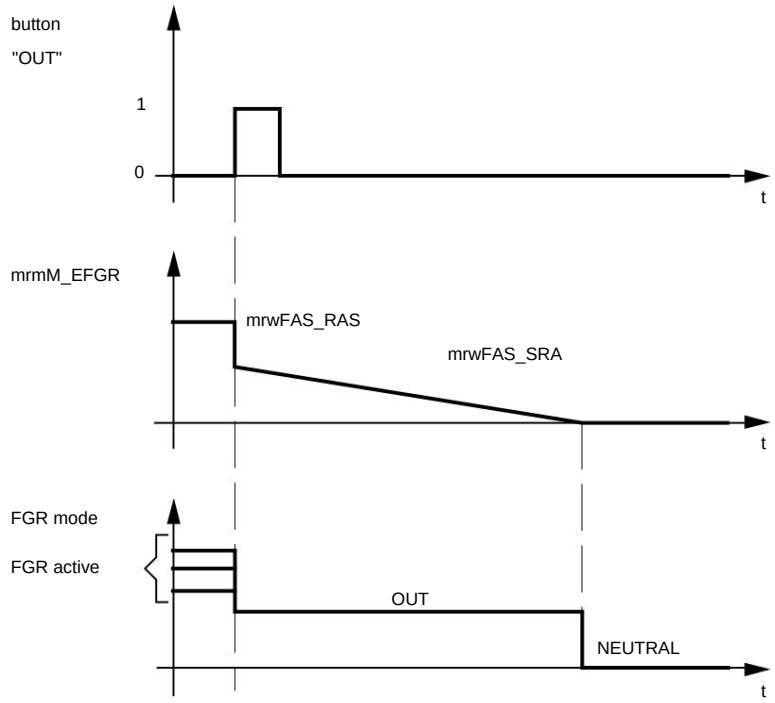


Figure MEREGR09: OFF function history

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The GRA - state OFF is activated when OFF is detected by the control panel or another switch-off condition.

If the GRA - state OFF by brake actuation, delay threshold mrwFAS_VZM or system error (brake, DZG) has been initiated, there is a proportional reduction of the GRA - desired quantity at the beginning of the GRA - state OFF with the reduction factor mrwFAS_RSB.
Furthermore, the current GRA - reduced desired amount within the time mrwFAS_RAB to zero.

If the cancellation is caused by clutch actuation or by the occurrence of a control panel error, the GRA - desired quantity is immediately zero.

In all other cases there is a proportional reduction of the GRA - desired quantity at the beginning of the GRA - state OFF with the reduction factor mrwFAS_RAS and subsequently a reduction of the GRA - desired quantity by means of a quantity ramp with the ramp slope mrwFAS_SRA to zero. If the GRA - desired quantity is zero, the GRA - state NEUTRAL is passed. The last target speed is deleted if the GRA - state OFF was caused by the clearing contact dimFGL or the cancellation occurred during the active state ON+/ON- (accelerate/decelerate).

GRA - STATE NEUTRAL:

In the GRA - NEUTRAL state, the GRA - desired quantity is set to zero.

GRA - HOLD status:

In the GRA - HOLD state, the current driving speed is controlled by the PI controller to the value of the GRA - target speed mroV_SOLL. The control parameters used are mrwFP2_ .. for the P - share and mrwFI2_ .. for the I - share. For the determination of mrmFGR_roh the I - part of the controller is limited to [0, full load quantity mroM_EBEGR], while the P - part is limited only to the integer - limits. The GRA - desired quantity mrmM_EFGR is limited to [0, full load quantity mroM_EBEGR]. If the GRA desired quantity mrmM_EFGR is suppressed by means of the accelerator pedal, the integrator of the PI controller is stopped.
After the end of this state and if the current driving speed is less than the GRA - target speed plus mrwALL_IAV, the integrator is released again.

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2.8.5 GRA target acceleration

The GRA target acceleration mrmRMPSLOP is calculated as follows:

GRA state mrmRMPSLOP		Condition
A+	(mrwFEP_RSK * fgmFGAKT) + mrwFEP_RSP	
A+		mrmM_EFGR >= mrmM_EBEGR
A-	0 -((mrwFEM_RSK * fgmFGAKT) + mrwFEM_RSM)	
A-	0	mrmM_EFGR = 0
WA from below mrwWA_RSW		mroV_RAMP <= mroV_SOLL - mrwWA_VRU
WA from below mrwWA_RSW / 2		mroV_RAMP> mroV_SOLL - mrwWA_VRU
WA from below 0		mroV_RAMP >= mroV_SOLL
WA from below 0		fgmFGAKT >= mroV_SOLL
WA from below 0		mrmM_EFGR >= mrmM_EBEGR
WA from above -mrwWA_RSW		fgmFGAKT>= mroV_SOLL + mrwWA_VOR
WA from above -mrwWA_RSW / 2		fgmFGAKT <mroV_SOLL + mrwWA_VOR
WA from above 0	0	fgmFGAKT <= mroV_SOLL
otherwise		

The GRA target acceleration is PT1-filtered with the memory factor mrwPT1_bes. to Filtering is suspended at the beginning of EIN+, EIN- and WA (see Fig. MEREGR04-07), since otherwise the transmission would react too slowly. The filtered target acceleration is in mrmRMP_gef displayed.

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2.8.6 Adaptive Cruise Control (ACC)

overview

In order to implement the function of the adaptive cruise control (adaptive distance control - ADR), the CAN message ADR1 is received in the control unit. The torque requirement contained in this message is converted into a corresponding desired quantity. The debounced and plausibility-checked signals are made available to the ACC via the CAN message GRA.

activation

The activation of the ACC function is still through the application of cowFUN_FGR (9 - ACC operation). In addition, the evaluation of the CAN message ADR1 must be activated via the software switch cowVAR_ADR.

Description of the software switch cowVAR_ADR:

Bit position	decimal value	comment 2
1		Evaluation of the message ADR1 active

termination conditions

The ACC is switched off under the following conditions:

irreversible (by applying the error debounce time accordingly):

ÿ Message counter error (fbbEACC_B) ÿ
incorrect checksum of the ADR1 message (fbbEACC_C)
ÿ Flag “ADR defective” set in ADR1 message (fbbEACC_D)
ÿ Error ID detected in the requested moment in ADR1 message (fbbEACC_F)
- ACC requirement below the v-threshold mrwFAS_BVK (fbbEACC_V) - one of
the following error paths defective: fboSPWG, fboSFGG, fboSBRE, fboSDZG, fboSCAN
ÿ Message timeout error fbbEACC_Q debounced defective
ÿ Plausible ACC torque request during OFF signal from control panel or
Driver braking (fbbEACC_P)
OFF signal: dimFGA or dimFGL equal to 0
Driver braking: dimBRE or dimBRK not equal to 0
ÿ General plausibility error (fbbEACC_A)

reversible:

ÿ Message timeout ADR1 expired
ÿ Request bit “Release torque request” not set in message ADR1
ÿ Status ADR in ADR1 message not “ADR active” ÿ
zmmSYSERR, bit 5 set
- GRA shutdown condition met and not hidden by mrwACCAUSx
mrwACCAUS1: If bit x is set, then GRA shutdown condition (mroFGR_ABN)
Number x to switch off the ACC
mrwACCAUS2: If bit x is set, then GRA switch-off condition (mroFGR_ABN)
Number (x+16) to switch off the ACC
ÿ Error path fboSFGA defective

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In principle, the requested torque is accepted after one of the inputs dimFGP or dimFGW a positive edge was detected. If the ACC operation is interrupted again waits for the above edge before the torque intervention is permitted. For the shutdown over driving speed threshold mrwFAS_BVK, this behavior over mrwALL_DEF (s. u.) be deactivated.

If one of the termination conditions described is detected, the amount is over mrmM_EFGR a ramp with the slope mrwACC_RAMP reduced to 0.

Description of the message mrmACC_SAT:

Bit position	decimal value	comment
0	1	"Release torque request" not set OR ADR status not equal to “ADR active”
1	2	Error detection in torque request
2	4	Message timeout or inconsistency
3	8th	Message counter not correct
4	16	Checksum not correct
5	32	Flag "ADR defective" set
6	64	Momentary request during OFF from keypad or driver braking
7	128	Torque request during fgmFGAKT below threshold mrwFAS_BVK

moment requirement

The requested moment is about the normalization moment mrwMULINF3 and the specific indexed consumption mrmBI_SOLL converted into a corresponding amount and over mrmM_EFGR made available to the system. The amount mrmM_EFGR is limited to mrmM_EBEGR, the unlimited value contains the message mrmFGR_roh.

CAN

The ACC function works with the following CAN messages:

• received message ADR1:

The following information from the ADR1 message - apart from the calculation of Checksum - processed by the engine control unit:

- Torque request ACC

- Message counter

The message counter is evaluated analogously to the received message GRA (see above). (Record labels: mrwACC_Bmn, mrwACC_Bmx)

- defect ADR,
set leads to ACC deactivation

- Status ADR

The status ADR must be 01 - "ADR active" so that torque intervention is permitted

- Enable torque request
not set leads to ACC deactivation

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• sent message GRA:

The debounced FGR control unit signals are made available via the message GRA. the
The signals are processed in the same way as the FGR function with on-simulation.

The digital inputs are mapped to the GRA message items as follows:
dimFGL "GRA/ADR - main switch"
dimFGA inverted to "GRA/ADR - tip switch OFF"
dimFGP "GRA/ADR - tip switch set / delay"
dimFGW "GRA/ADR - tip switch resume / accelerate"

The information "GRA / ADR delay" or "GRA / ADR accelerate" are set when
the signals dimFGP or dimFGW are present continuously for the time mrwALL_TPZ.

• message sent motor2:
With ACC operation, the GRA status in the Motor2 message has the following meaning, with in
In this case, mrmACCDDE2 is equal to S_GRA:

S_GRA.1	S_GRA.0	Comment
0	0	error fbbEACC_D, ADR - defect from ADR1 message Error fbbEACC_F, error code 0xFFH at the requested moment Error in path fboSFGA (keypad) all reversible termination conditions (see above)
0		"ADR active" set and flag mroACC_OFF not set
1	1 0	"ADR active" and driver request quantity mrmM_EPWG> ACC Request mrmM_EFGR
1	1	all irreversible shutdowns (see above)

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2.8.7 Status display, switch-off conditions and application notes

2.8.7.1 Status display

Description of the OLDA GRA status mroFGR_SAT:

valueHEX	decimal value	comment
0000H	0	GRA Mode NEUTRAL
0010H	16	GRA Mode TIP UP
0020H	32	GRA Mode TIP DOWN
0030H	48	GRA mode ON+ (or SET)
0040H	64	GRA mode ON (or SET)
0050H	80	GRA mode WA from above
0060H	96	GRA mode WA from below
0070H	112	GRA mode OFF
0080H	128	GRA Mode HOLD
0090H	144	GRA Mode ACC operation

Description of the GRA status in the TIP UP/TIP DOWN mode (decimal value is the value for TIP UP / TIP DOWN):

ValueHEX	decimal value	comment
0010H or 0020H	0	Wait for TIP time
0011H or 0021H	1	Calculating the target speed

Description of the GRA status in the mode EIN+/EIN- (decimal value is related to the value for EIN+ / EIN- add):

ValueHEX	decimal value	comment
0030H or 0040H	0	Waiting SET - time
0031H or 0041H	1	Calculate initial value
0032H or 0042H	2	ramp treatment
0033H or 0043H	3	transition hold

Description of the GRA status in the WA-up/WA-down mode (decimal value is to be added to the value for WA up / WA-down):

ValueHEX	decimal value	comment
0050H or 0060H	0	Calculate initial value
0051H or 0061H	1	ramp treatment
0052H or 0062H	2	transition hold

Description of the GRA status in OFF mode (decimal value is to be added to the value for OFF):

valueHEX	decimal value	comment
0070H	0	Calculate initial value
0072H	2	ramp treatment
0073H	3	Ramp treatment brake

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Description of the GRA status in HOLD mode (decimal value is for the value for HOLD add):

valueHEX	decimal value comment	
0081H	1	Initialize integrator with mrmM_EAKT

2.8.7.2 Shutdown Conditions

Description of the OLDA GRA switch-off conditions mroFGR_ABN:

decimal value comment	
0	No shutdown condition
1	From control panel
2	Off brake
3	From clutch
4	From control panel error
5	Off via -B - threshold (reduced brake detection), or GRA deactivated (cowFUN_FGR, diagnosis)
6	From V too large/V too small
7	From N too big
8	From N too small
9	Gear (F/N) too small
10	Gear change (F/N) - deviation
11	Remaining positive control deviation
12	Positive control deviation
13	Negative control deviation
14	Error brake or DZG
15	Waiting for the end of the keypad operation
16	Automatic transmission selector lever in position 1, N, R or P
17	ASR or MSR intervention
18	Battery voltage too low
19	crash
20	ESP intervention
21	fbbEFGC_B, fbbEFGC_C, fbbEFGC_P or fbbEFGC_Q finally defective
22	Error regarding the engine - transmission interface

(Conditions 11, 12 and 13 are only checked in the GRA - state HOLD.)

The switch-off conditions are bit-coded in the OLDA's mroFGR_AB1 and mroFGR_AB2 shown.

OLDA mroFGR_AB1: Bit n set means switch-off condition n is present.
OLDA mroFGR_AB2: Bit n set means switch-off condition n+16 is present.

Description of the message mrmGRACoff: GRA shutdown due to CAN message errors

decimal value comment	
1	wrong checksum
2	message error counter error

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2.8.7.2.1 GRA from the default value for the gear ratio In the application "GRA over wheel torque" (cowFGR_Rmo = 1), the GRA is deactivated in the event of an error relating to the interface engine - transmission and mroFGR_ABN has the value 22. See also chapter "Determining the currently valid transfer function, GRA off at default value for the transmission ratio".

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2.8.7.3 Application notes

Description of the software switch GRA control element mrwALL_DEF:

Bit position	decimal value	comment
0	1	OFF contact available (0: OFF contact not available (dimFGA OR dimFGL))
1	2	dimFGW and dimFGA is error (0: dimFGW and dimFGA is not an error)
2	4	dimFGP and dimFGA is error (0: dimFGP and dimFGA is not an error)
3	8th	dimFGA is a KWH control element (0: dimFGA is not a KWH control element)
4	16	On- simulation (GRA with delay) (0: no ON simulation (standard GRA))
5	32	dimFGP and dimFGW is error (0: dimFGP and dimFGW is not an error)
6	64	dimFGL = 0 and dimFGA, dimFGP or dimFGW is error (0: dimFGL = 0 and dimFGx is not an error)
7	128	1: ACC: When switching off above driving speed below threshold, will not respond to a positive edge for resume dimFGP or dimFGW maintained.

Notes on the application:

This GRA corresponds to the VW/AUDI group specification of November 7th, 1994, but can be changed per Application to be kept compatible with the previous GRA. The following values must be included must be complied with.

Data record parameters	GRA Spec. 7.11.1994 0	For previous GRA
mrwALL_MIN		0
mrwALL_MAX	VMAX	VMAX
mrwALL_BER	5 km/h, or any > 0	VMAX
mrwALL_SPZ		0 *)
mrwFEM_RSK	0	0
mrwFEP_RSK	0	0
mrwFAS_BVG	VMAX	VMAX
mrwFAS_VDU		0
mrwFAS_VDK	0.75VMAX _	25

*) This also defines that in ON simulation there is no setting or acceleration at Vsetpoint = 0 is possible.

Explanation of the VW/AUDI group specification of November 7th, 1994:

Operating unit error: does not appear in the specification, is evaluated as before (configurable, Quantity reduction immediately to 0 without a ramp).

If the button is aborted (accelerate/decelerate), Vsetpoint is deleted (is saved in the last version of the GRA spec. no longer mentioned).

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2.9 Working speed control

2.9.1 Overview

The working speed control (ADR) uses the to control the individual functions
Digital inputs of the GRA. This means that GRA operation is not possible in a vehicle with ADR
is!

Entry:

(switch) dimADR	digital Input ADR active => dimDIGprel.6
(button) dimADP	digital Input ADR+ => dimDIGprel.0
(button) dimADM	digital Input ADR- => dimDIGprel.2
(button) dimADW	digital Input ADR-WA => dimDIGprel.C
(switch) dimHAN	digital Handbrake input => dimDIGprel.3

dzmNmit	rotational speed
fgmFGAKT	current driving speed
mrmM_EWUN	time-synchronous desired quantity
mrmM_EPWG	Desired quantity PWG
mroM_EBEGR	full load amount
nlmNLact	run-on active
anmPWG	pedal sensor
mrmSICH_F	security case
mrmSTART_B	start bit
mrmT_SOLEE	Run-up time (of diagnostics)
mrmADR_Neo	upper speed threshold (from diagnosis)
mrmADR_Nfe	fixed speed (from diagnosis)

Exit:

mrmM_EADR	Desired quantity ADR
ehmFML2	ADR indicator lamp (when ADR is active, the Control lamp controlled via ehmFML2.)

Two types of ADR are implemented. The first possibility represents the variable ADR, the second represents the fixed ADR. Both functions never occur simultaneously. The distinction is made via the function *switch cowFUN_FGR.*

Description of the function switch cowFUN_FGR:

decimal value	comment
3	GRA with VW/AUDI control panel (see FGR)
6	GRA with LT2 control panel (see FGR)
7	ADR with variable working speed
8th	ADR with fixed working speed

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2.9.1.1 States of the working speed control

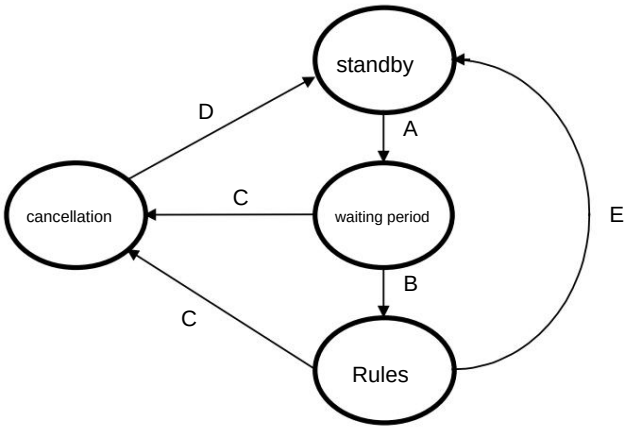


Figure MEREAD01: States of the ADR

The following state transitions of the ADR apply both to the variable and to the fixed ADR. The ADR is initially in the "standby" state.

A To activate the ADR, the engine speed dzmNmit must be greater than the lower ADR speed switch-on threshold mrwADR_Neu and smaller than the upper ADR speed switch-on threshold mrwADR_Neo and FGAKT smaller than the activation threshold mrwADR_VAK. Furthermore, the start drop must have taken place (mrmSTART_B = 0), the handbrake must be tightened (dimHAN = 1) and then the switch for ADR must be pressed once (dimADR = 1, rising edge). When changing to the "Waiting time" state, the target speed is initialized with the current actual speed.

B After the time mrwADR_t_f (status "waiting time"), the ADR is switched to the status "rules". The current actual speed is used as the setpoint.

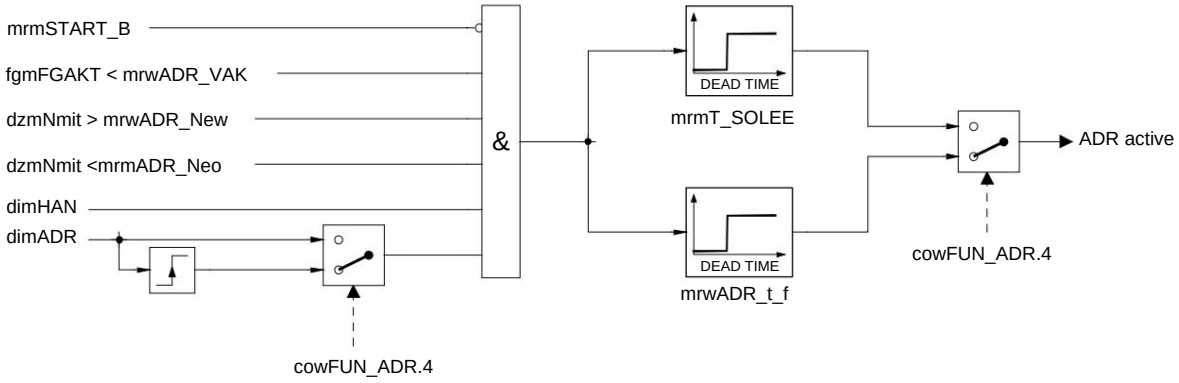


Figure MEREAD02: switch-on conditions of the ADR

C If the controller is aborted by an abort condition (see below), it goes to the "Abort" state.

D Only when there are no longer any termination conditions does the controller return to the status switched to "standby".

E If the controller ends by releasing the handbrake or switching off via dimADR, the target speed is reduced via a ramp to the speed mrwADR_Nau. When this speed is reached, the ADR goes into the "standby" state.

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With the software switch cowFUN_ADR/Bit 4, the delayed start-up operation of the ADR be set (after the start bit has been deleted), ie after a diagnostics / channel 27 (in Steps of a second) applicable time mrmT_SOLEE starts the run-up.
First initialization value for EEPROM: cowAGL_ADT;
Default value with defective EEPROM: edwINI_ADT

The status of the ADR is visible in the message mrmADR_SAT:

valueHEX decimal value comment		
0001H	1	The ADR is in the "standby" state
0002H	2	The ADR is in the "Waiting" state
0003H	3	The ADR is in the "Rules" state
0004H	4	ADR operation aborted
00FFH	255	ADR is blocked

2.9.2 Variable working speed control

The variable ADR consists of various tasks: "Working speed controller Operation", "Working speed controller increase/decrease", "Working speed controller PI controller", "Working speed controller OFF", "Working speed controller abort". the tasks "Working speed controller increase/decrease" and "Working speed controller OFF" lead the User request ADR+/ADR- and OFF through. The task "Working speed controller PI controller" regulates the engine speed to the target speed. The task "Work speed controller abort" monitors all conditions that require a termination of the ADR.

2.9.2.1 Working speed controller operation

Depending on the activated contacts of the working speed controller (dimADP and dimADM) and / or via PWG is the ADR target speed mrmADR_SOL, and the initial value of the integrator the PI controller mroADR_I_A determined.

The contacts dimADP and dimADM, as well as the contacts for the handbrake dimHAN and ADR active dimADR are debounced in the processing of the digital inputs.

Description of the function switch mrwADR_SOL:

Bit position decimal value comment		
0		Setpoint specification via keys (dimADP/dimADM)
1	1 2	Setpoint specification via PWG

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2.9.2.2 Working speed controller increase/decrease

If the requirements for the ADR are met and the waiting time mrwADR_t_f has expired, it can be activated by means of ADR+ contact dimADP or ADR contact dimADM. The ADR target speed mrmADR_SOL is occupied by pressing ADR + (dimADP) or ADR (dimADM) with the current engine speed dzmNmit.

If the current engine speed is less than the threshold speed (dzmNmit <mrwADR_Nsc_) the target speed mrmADR_SOL is raised at "ADR active" via a ramp with the slope mrwADR_dNP to the threshold speed mrwADR_Nsc. While the ramp is active, the speed cannot be changed via the contacts ADR+ (dimADP) or ADR- (dimADM). After reaching the ramp end value, the target speed mrmADR_SOL is limited by mrwADR_Nsc to a minimum.

As long as the ADR + (dimADP) or ADR (dimADM) contact is actuated, the ADR target speed mrmADR_TSO is increased or decreased within the speed limits mrwADR_Neu and mrmADR_Neo on the ADR ramp slope mrwADR_dNP or mrwADR_dNM.
If both buttons are pressed at the same time, the ADR button has higher priority and the setpoint speed is reduced.
If bit 0 of the function switch mrwADR_SOL is set, the target speed is used via button mroADR_TSA to form the maximum target speed.

The setpoint specification via PWG is done using the characteristic mrwADR_KL, which allows an implementation PWG (in percent) in speed. This speed mroADR_PSO is only filtered through a PT1 member mrwADR_GF if no error (fbbEPW2_L, fbbEPW2_H, fbbEPWG_L, fbbEPWG_H or mrmSICH_F) is set. If bit 1 of mrwADR_SOL is set, the filtered speed mroADR_PWG is allowed to form the maximum of the target speed.

After each working speed controller increase / decrease on the keys or on PWG the ADR target speed mrmADR_SOL with the current engine speed dzmNmit and the integrator of the PI controller mroADR_I_A with the current desired amount mrmM_EWUN is pre-assigned. The status of the ADR when increasing or decreasing is the "rules" status.

With an active speed specification of the ADR via PWG (cowFUN_FV2 = 1 and mroADR_PGW> 0), the quantities dependent on the driving behavior-KF (mrmM_EPWG and mrmM_EPWGR see Chapter 2.6.2 speed-dependent driving behavior) are set to 0. So that when you turn on the ADR no jump in quantity of the driver's desired quantity arises, the I proportion of the PI controller (mtoADR_I_A) is initialized with the current driver's desired quantity mrmM_EWUN before the driving behavior KF is switched off.

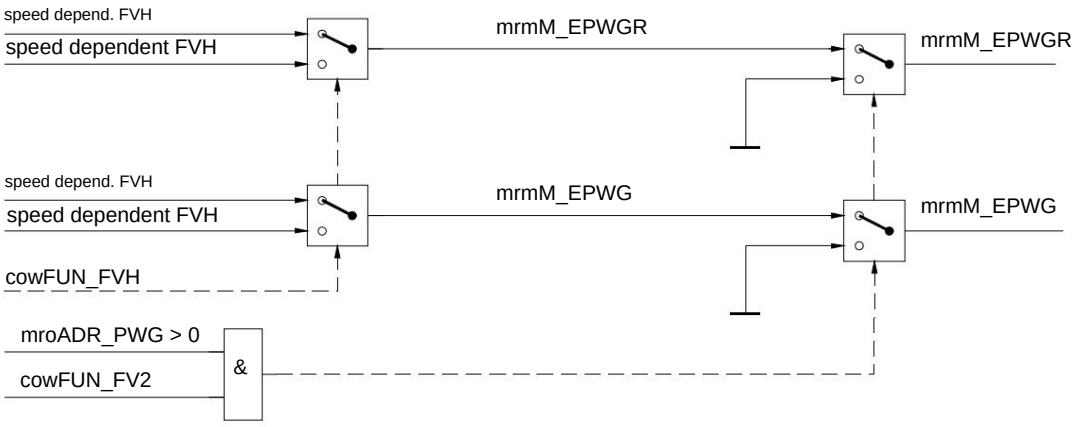


Figure MEREAD06: ADR via PW6

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Description of the function switch cowFUN_FV2:

decimal value	comment
0	Do not switch off driving behavior map when ADR is active
1	Switch off driving behavior map with ADR speed specification via PWG

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2.9.2.3 Working speed controller PI controller

The PI controller of the ADR regulates the engine speed dzmNmit to the ADR target speed mrmADR_SOL with the parameters mrwADP_... and mrwADI_... . The control parameters are differentiated separately for the P and I components according to small signal and large signal. In the event of a transition, for example from increase/ decrease to the "Control" status, there must not be a quantity jump at the controller output. The initial quantity of the PI controller mrmM_EADR is limited by the full load quantity mroM_EBEGR. The ADR target speed is visible in mrmADR_SOL, the I component of the PI controller on the OLDA mroADR_I_A and the P component on the OLDA mroADR_P_A. The state of the ADR is the "rules" state. The maximum speed mrmADR_Neo can be set via the adjustment channel 28 via the diagnostic interface with login (lower/upper limit: mrwADR_vmn or mrwADR_vmx).

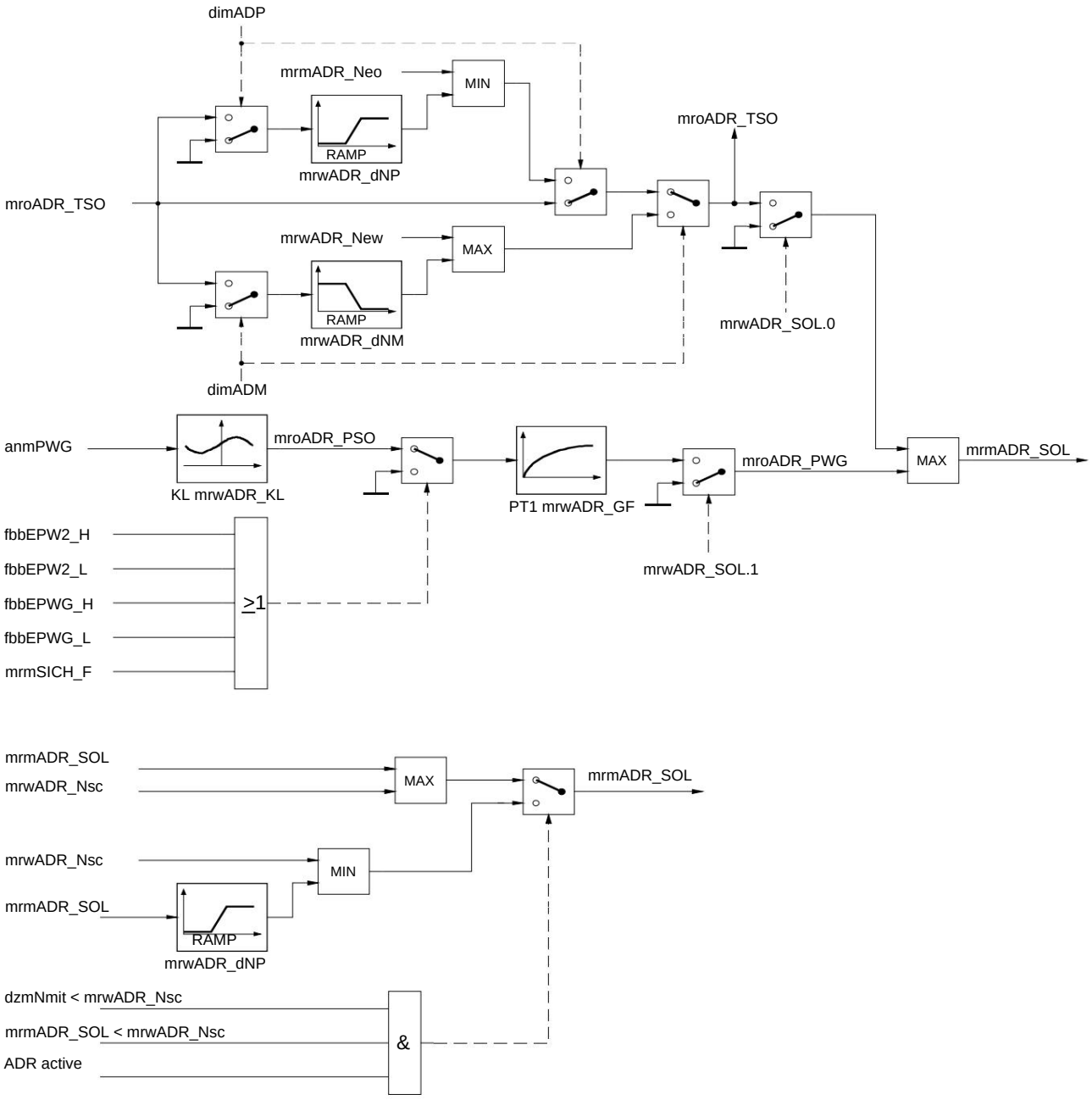


Figure MEREAD03: Target speed determination of the ADR

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For mrmADR_Neo is initial initialization value for EEPROM: cowAGL_ADV;

Default value with defective EEPROM: edwINI_ADV

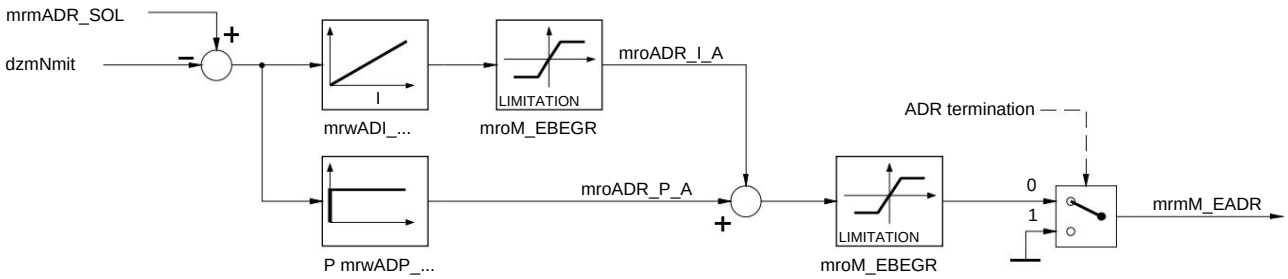


Figure MEREAD05: Controller structure of the ADR

2.9.2.4 Working speed governor resume

The activation of the WA is only possible in the states of stand-by and waiting time, and when applying a setpoint specification via a button. From the stand-by and waiting states, the setpoint speed is occupied in the state rules with the WA speed mroADR_SET after the waiting time has expired. If the setpoint speed changes, the WA speed is assigned the current setpoint speed.

The control panel status WA is recognized when

- dimADW (WA button pressed) AND
- dzmNmit > mrwADR_New AND
- dzmNmit <mrmADR_Neo AND
- mroADR_SET <> 0 AND
  - ADR in stand-by OR
  - ADR in waiting state.

If the control panel state WA detected and the current speed> mroADR_SET, then the new state of mroWA_Stat WA is from above, the current speed is <mroADR_SET so is the new state of mroWA_Stat WA from below.

If more than one of the dimADW, dimADM and dimADP keys is pressed simultaneously, the function is executed according to the dimADM, dimADP, dimADW priority list.

If dimADW and dimADM are pressed simultaneously in the stand-by state, the WA speed mroADR_SET is assigned 0.

resume from above:

When transitioning from waiting time to rules, the target speed is occupied with dzmNmit, and subsequently introduced using a speed ramp with the gradient mrwADR_dWM to mroADR_SET.

Resume from below:

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When transitioning from waiting time to rules, the setpoint speed is occupied with dzmNmit, and as a result introduced using a speed ramp with the slope mrwADR_dWP to mroADR_SET. is the determined ADR desired amount is greater than the full load amount, so the speed ramp stopped.

ADR status = rules and WA recognized

When transitioning from waiting time to rules, the integrator of the PI controller with the current Desired quantity preassigned. During the rules, the ADR amount is mrmM_EADR on [0, mroM_EBEGR] limited. If the current speed = mroADR_SET then the state WA deleted and the I share mroADR_I_A again with the current desired amount mrmM_EWUN preassigned.

The current setpoint speed is used at WA in the Oldas for influencing the speed via buttons mroADR_TSO, mroADR_TAS shown.

The resume type is visible in the OLDA mroWA_STAT:

Bit position	decimal value	comment
0	1	resume from above
1	2	resume from below

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2.9.2.5 Working speed controller OFF

With "working speed controller OFF" the ADR target speed is reduced over the ADR ramp mrwADR_dNA to the speed mrwADR_Nau. As soon as the ADR target speed reaches the switch-off threshold mrwADR_Nau, the controller output is switched to zero (mrmM_EADR = 0) and only the idle controller remains active. Only the handbrake is not actuated (dimHAN = 0) or the ADR switch is not actuated (dimADR = 0) or the start drop (mrmSTART_B = 0) is not yet applied as switch-off conditions.

The switch-off condition is visible in the OLDA mroADR_AUS:

Bit position	Decimal value	Comment 1
0		OFF via ADR switch dimADR = 0
1	2	OFF via handbrake dimHAN = 0
2	4	Delay by start shedding mrmSTART_B = 1

2.9.2.6 Working speed controller abort

The ADR will be canceled under the following conditions. The termination condition is visible in the OLDA mroADR_ABB:

o) Driving speed fgmFGAKT greater mrwADR_VAK (mroADR_ABB = 1),

o) speed dzmNmit greater mrwADR_Nao (mroADR_ABB = 2),

o) speed dzmNmit smaller mrwADR_Nau (mroADR_ABB = 4),

o) with a positive control deviation fbbEADRpR: speed difference in the "rules" state greater than the threshold mrwADR_pRA for a time fbwEADRpRA termination of the ADR and entry of the error ADR positive control deviation in the error memory (mroADR_ABB = 8), o) with a negative control deviation fbbEADRnR without

overpressing through the PWG :
Speed difference in the "rules" state less than threshold mrwADR_nRA for a time fbwEADRnRA and desired amount of ADR greater than or equal to the desired amount by the
PWG (mrmM_EADR ÿ mrmM_EPWG) termination of the ADR and entry of the error ADR negative deviation in the error memory (mroADR_ABB = 16), o) negative deviation fbbEADRnR with overpressures by the PWG:

Speed difference in the "rules" state less than threshold mrwADR_nRA for a time mrwADR_t_R and desired amount of ADR less than desired amount by the PWG (mrmM_EADR <mrmM_EPWG) termination of ADR without error entry (mroADR_ABB = 32),

At Klemme15 or DZG defective (fboSDZG <> 0), the regular operation is also canceled, but there is no output on mroADR_ABB. In the event of cancellation, the controller output is immediately switched to zero (mrmM_EADR = 0) and the normal idle control becomes active again.

The status of the ADR is the "Abort" status. If none of these termination conditions are present and either dimADR or dimHAN becomes 0 again, the ADR is switched to the "standby" state. After renewed activation (dimADR = 1 and dimHAN = 1), the ADR is released again after the time mrwADR_t_f (status "waiting time").

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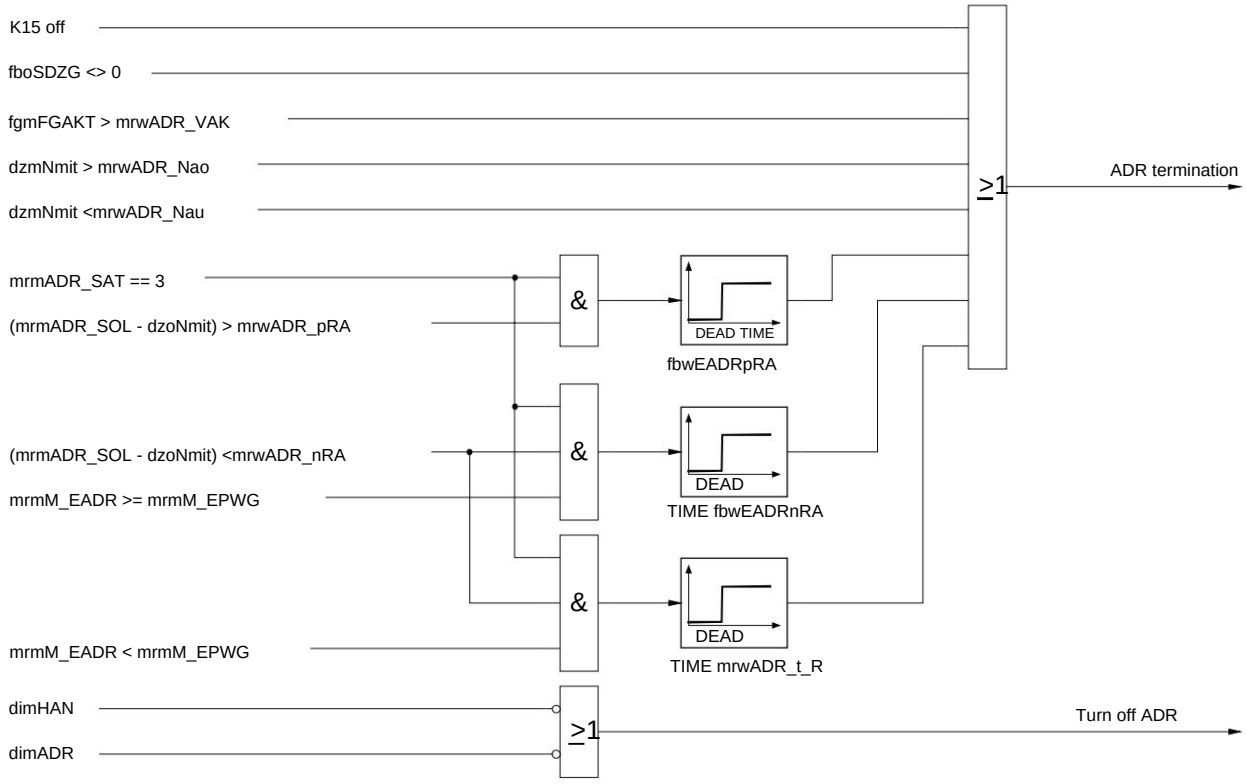


Figure MEREAD04: termination conditions of the ADR

If the working speed controller is active, terminal 15 is detected, the ADR desired quantity mrmM_EADR and the ADR target speed mrmADR_SOL are immediately set to zero.

2.9.2.7 Lamp test

After ignition on, the ADR lamp is driven for the time mrwADR_t_L.

2.9.2.8 Configuration

The intervention of the ADR on other functions can be configured via cowFUN_ADR. If cowFUN_ADR.0 is set, the error FGG plausibility with speed and quantity is not reported when the handbrake is pulled (see FGG monitoring concept). With cowFUN_ADR.1 is selected whether the ADR influences the parameter set selection of the active bucking damper. If cowFUN_ADR.1 is set, cowFUN_ADR.2 can be used to select which parameter sets are used by the active judder damper (see Active jerky damper, parameter set selection). If cowFUN_ADR.3 is set and the working speed control is in the "Rules" state (mrmADR_SAT = 3), the exhaust gas recirculation is switched off. The automatic startup can be set via cowFUN_ADR.4 (see Chapter 2.9.1.1.).

The remaining bits of cowFUN_ADR are not used.

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2.9.3 Fixed working speed control

2.9.3.1 Functionality

In contrast to the variable ADR, the fixed ADR is the target value with a fixed value (fixed working speed mrmADR_Nfe), which can be adjusted via the adaptation channel 29 via diagnostic interface with login (lower / upper limit: mrwADR_fmn or mrwADR_fmx).

First initialization value for EEPROM: cowAGL_ADE;

Default value with defective EEPROM: edwINI_ADE

If the conditions for activating the ADR are given (dimADR=1, dimHAN=1 and there are no termination conditions), then after a waiting period mrwADR_t_f (see also "Variable ADR"), the ADR target speed mrmADR_SOL by means of a ramp mrwADR_dNP to the fixed working speed mrmADR_Nfe introduced. The waiting time must be observed before each activation.

If the ADR is switched off via the ADR-Active switch or the handbrake, the target speed is reduced via the ADR ramp mrwADR_dNA and the speed is set according to the desired amount (without ADR). All other termination conditions result in the ADR controller shutting down the volume immediately (see also "ADR variable").

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2.10 Maximum Speed Limit

The maximum speed limit (HGB) must regulate the amount of fuel depending on the current average driving speed fgmFGAKT. The amount calculated by the maximum speed limit mrmM_EHGB limits the desired amount mrmM_EWUNF (see chapter "External quantity intervention").

The maximum speed limit is made up of four sub-tasks: evaluating the request via the CAN messages Level1 and Allrad1, target value tracking, controller parameter selection and regulation.

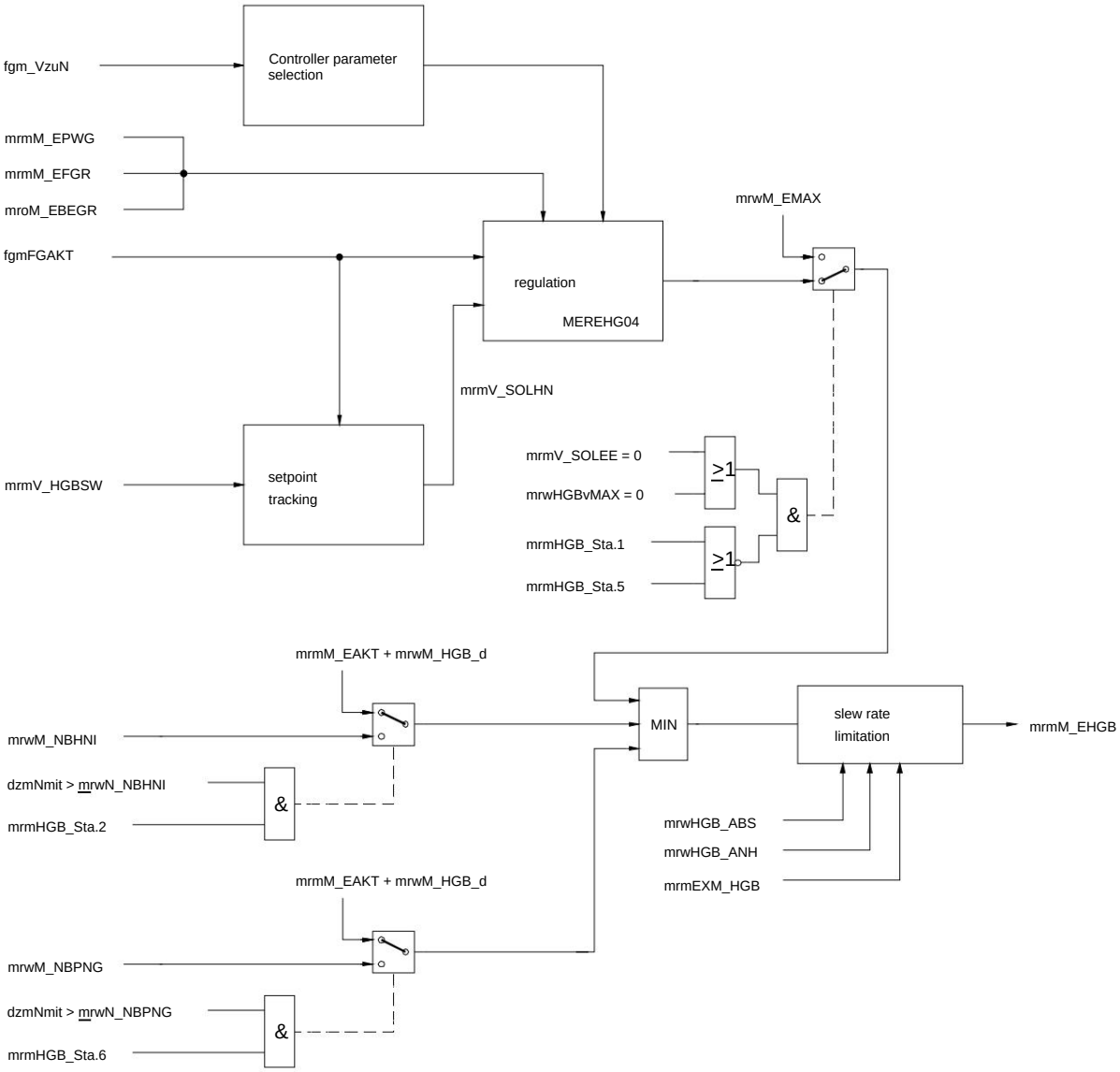


Figure MEREHG01: Structure of the HGB

fgm_VzuN Ratio of driving speed to speed
mroM_EBEGR limiting amount mrmM_EPWG requested
amount_PWG mrmM_EFGR requested amount_FGR
fgmFGAKT Current driving speed mrmV_HGBSW Currently
valid maximum speed

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The message mrmV_SOLEE is the maximum speed set via EEPROM. The maximum speed is set via EEPROM using the adjustment function of the diagnosis (see also chapter diagnosis), measured value channel 18. The maximum speed can be selected within the limits mrwHGBvMIN minimum and maximum value mrwHGBvMAX. Each time the adjustment is saved, the current value is used as the maximum value for the next adjustments. The HGB can only be deactivated and the maximum value reset using the login function and the password xcwPHGBOff.

If the HGB is deactivated, the values are mrmV_SOLEE (maximum speed) and mrmV_SOLHN (tracked speed) = 0. When activated, a tracked speed is set depending on the driving speed and the operating point.

The current maximum speed mrmV_HGBSW is the minimum of all active requirements

ÿ Limitation in the high level: mrmHGB_Sta.1 = 1 means mrwHGBvHNI influences the maximum speed.

ÿ Limitation of reduction by planetary gear: mrmHGB_Sta.5 means mrwHGBvPNG influences the top speed.

- otherwise: maximum speed corresponds to the value from the EEPROM: mrmV_SOLEE.

Application note: a value of mrmV_HGBSW = 0 means 'no limit' for the control. Due to the minimum formation described above, values of mrwHGBvHNI or mrwHGBvPNG = 0 mean that no limitation is carried out even if mrmV_SOLEE is not equal to 0.

The message mrmEXM_HGB indicates whether the HGB quantity mrmM_EHGB has an influence on the desired quantity mrmM_EWUNF.

The slew rate limit prevents volume jumps that can occur when the speed limit is deactivated or the rpm limit is activated (see below). The parameters mrwHGB_ABS or mrwHGB_ANH indicate the maximum amount change for lowering or raising. The slew rate limitation is only effective if the amount is actively limited (mrmEXM_HGB = 1) since the effectiveness of the limitation from the disabled state would otherwise be delayed (speed overshoot).

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Secure deactivation of HGB by EPROM (mrmV_SOLEE):

mrwHGBvMIN = 0; mrwHGBvMAX = 0;
First initialization value for EEPROM edwINI_HGB = 0;
Default value for defective EEPROM cowAGL_HGB = 0;

2.10.1 Evaluation of the request via level 1 and all-wheel drive 1

The requirements of the speed limit via level1 and all-wheel drive1 are in the Message mrmHGB_Anf summarized.

Description of HGB_Anf:

Bit position	Decimal value	Meaning
0	1	Request for a speed limit at high level Level1, Byte2, Bit7 'MSG constraint'
1	2	Installation coding - engine installed in the Hunter Level1, Byte5, Bit4 'Vehicle type Level'
2	4	free
3	8	free
4	16	Reduction speed limit request through PNG Allrad1, Byte1, Bit6 'Speed limit'

If there is an implausibility between the internal status 'Motor installed in Hunter' cowFUN_HUN and the installation coding mrmHGB_Anf.1 diagnosed, the error fbbENIV_P reported.

The status of the maximum speed limit is summarized in mrmHGB_Sta.

Description of HGB_Sta:

Bit position	Decimal value	Meaning
0		HGB for HNI – can be activated
1	1 2	HGB for HNI – active
2	4	HGB for HNI - Error while active
3	8th	reserved
4	16	HGB for PNG – can be activated
5	32	HGB for PNG – active
6	64	HGB for PNG - error while active
7	128	reserved

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Delete GRA setpoint

The target value of the GRA is deleted under the following conditions (mroV_SOLL = 0)

- At the time a speed limit was activated by external intervention (positive edge at mrmHGB_Sta.2 or mrmHGB_Sta.5), the GRA state was neutral (mroFGR_SAT = 0)

- The requested maximum speed (mrmV_HGBSW) is greater than the GRA target value (mroV_SOLL)

ÿ The resume contact is actuated when the GRA can be activated. Can be activated: mroFGR_AB1 and mroFGR_AB2 masked (logical AND) with mrwHGB_AB1 and mrwHGB_AB2 are equal to 0.

If the GRA target value is changed by Set while the speed is being limited, it will no longer be deleted as a result.

Evaluation of the request via level1

The following conditions must be met for limitation at the high level to be possible:

ÿ the data record label cowFUN_HUN (engine installed in the Hunter) is set to 1 ÿ there are no errors that prohibit a speed limit (fboSFGG, fboSPWG)

- The driving speed is less than mrwHGBvHNI - mrwHGBdHNI If all conditions are met, the bit mrmHGB_Sta.0 is set, otherwise deleted.

If the bit mrmHGB_Sta.0 is set, the limit in the high level can be activated with the bit 'MSG restriction' (level1, byte2, bit7 = mrmHGB_Anf.0). In this case, the mrmHGB_Sta.1 bit is set and the speed is limited to mrwHGBvHNI.

The limitation is deactivated by withdrawing the request via the 'MSG limitation' bit. If at this point the speed is actively limited (mrmEXM_HGB = 1), the limitation is only deactivated when mrmPWGfi was smaller mrwHGB_PWG for the time mrwT_HGBLL. As long as the limit is maintained, mroHGBLLho is set by the switch-off delay, otherwise deleted. The mrmHGB_Sta.1 bit is reset when deactivated.

Occur during the limitation (mrmHGB_Sta.1 = 1) errors that prohibit a speed limit is in the state 'Error while active' (mrmHGB_Anf.2 = 1) transition. Now the speed (dzmNmit) is limited: Above the speed mrwN_NBHNI the default value mrwM_NBHNI is used. Below the limit speed mrmM_EHGB is equal to mrmM_EAKT + mrwM_HGB_d (HGB amount corresponds to the current amount plus cushion, since the two amounts have different calculation frequencies). The speed limitation is deactivated by withdrawing the request via the 'MSG limitation' bit.

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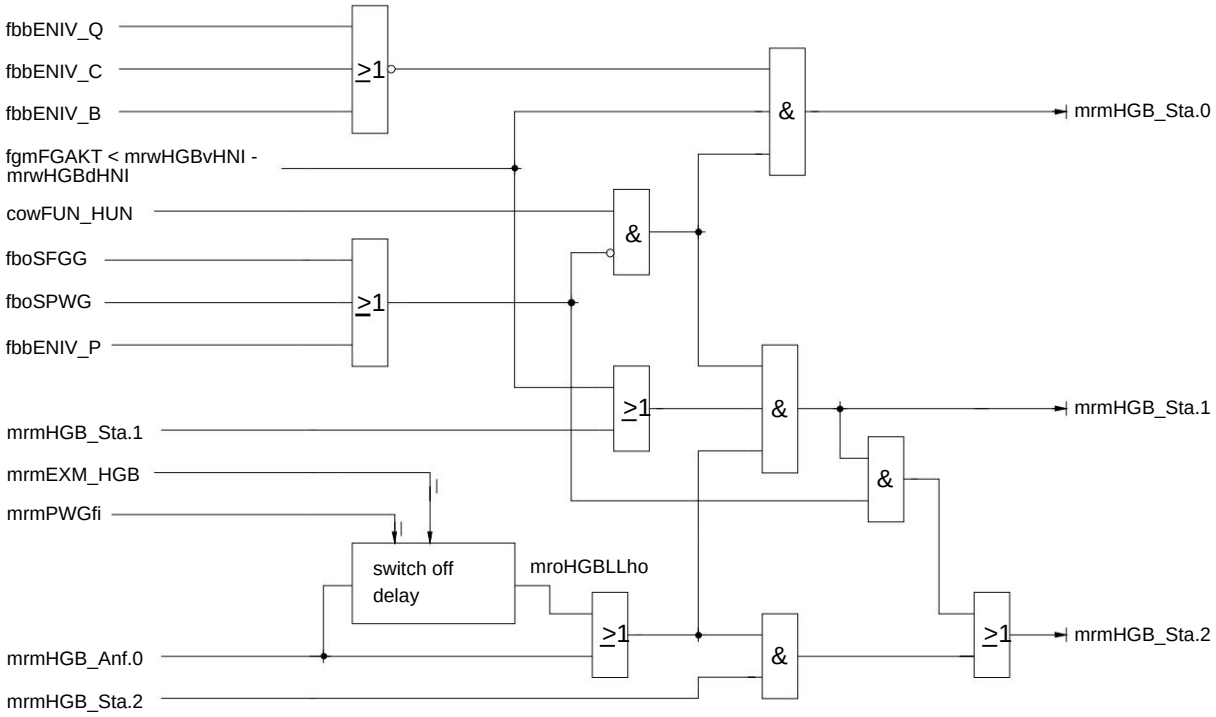


Figure MEREHG05: Request at high level

The status of the speed limit at high level is sent via the CAN message Motor7:

signal name	bytes	bit	RCOS message
Speed limit can be activated	1	1	mrmHGB_Sta.0
Speed limit active	1	2	mrmHGB_Sta.1

Evaluation of the request via all-wheel drive1

The following conditions must be met in order for limitation to be possible with PNG reduction:

ÿ the data record labels cowFUN_HUN (engine installed in the Hunter) and cowFUN_HAQ (Hand switch Quattro) are on 1 -
there are no errors that prohibit a speed limit (fboSFGG) - the driving speed is less than mrwHGBvPNG + mrwHGBdPNG If all conditions are met, the bit mrmHGB_Sta.4 is set, otherwise deleted.

If the bit mrmHGB_Sta.4 is set, the limit can be activated for reduction by PNG with the bit 'speed limit' (Allrad1, Byte1, Bit6 = mrmHGB_Anf.4). In this case, the mrmHGB_Sta.5 bit is set and the speed is limited to mrwHGBvPNG.

The limitation is deactivated by withdrawing the request via the 'speed limitation' bit. The bit mrmHGB_Sta.5 is reset when deactivated.

If errors occur during the limitation (mrmHGB_Sta.5 = 1) that prohibit a speed limitation, the status is 'Error while active'

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(mrmHGB_Anf.6 = 1) passed. Now the speed (dzmNmit) is limited: Above the speed mrwN_NBPNG the default value mrwM_NBPNG is used. Below the limit speed mrmM_EHGB is equal to mrmM_EAKT + mreM_HGB_d (HGB amount corresponds to the current amount plus cushion, since the two amounts have different calculation frequencies).

The speed limitation is deactivated by withdrawing the request via the 'Speed limitation' bit.

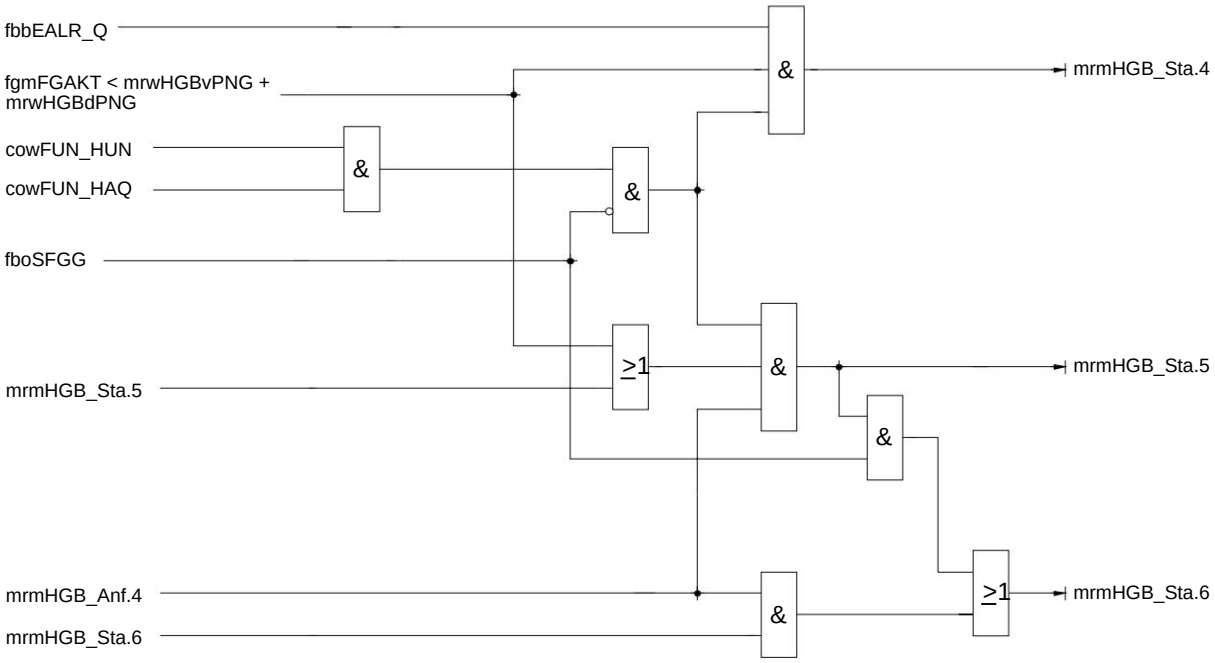


Figure MEREHG06: Request for reduction by PNG

2.10.2 setpoint tracking

The speed setpoint mrmV_HGBSW for the maximum speed limit is not output directly as a controller setpoint to the controller, but previously manipulated via the so-called setpoint tracking. The purpose of this function is to prevent the filtered driving speed from undershooting or overshooting in relation to the fixed speed setpoint after driving downhill or uphill.

The setpoint tracking brings the setpoint for the controller "slowly" (via a PT1 element) from the current actual speed value to the setpoint or target value.

The setpoint tracking can assume three states (display in OLDA mroAKT_SWN):

1 ... setpoint tracking enabled 2 ...
setpoint tracking switched on 3 ...
Setpoint tracking switched off

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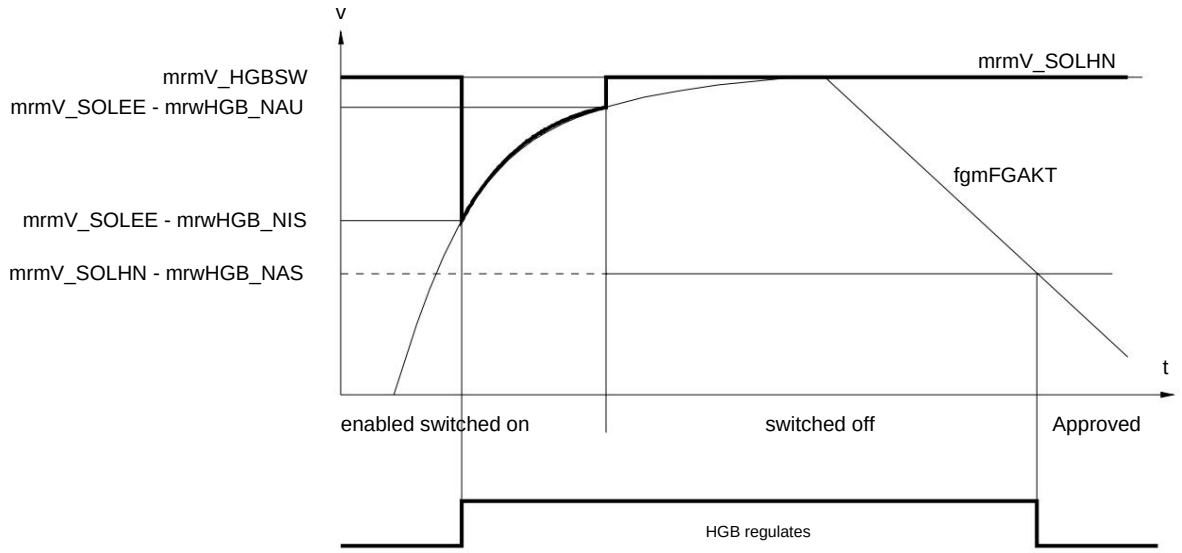


Figure MEREHG02: setpoint tracking

- Setpoint tracking enabled:

  The target value tracking is enabled when the difference between the target value and the driving speed is greater than an applicative threshold.

  (mrmV_SOLHN - fgmFGAKT> mrwHGB_NAS --> setpoint tracking released)

  The tracked target value mrmV_SOLHN is set to the target value mrmV_HGBSW.

Application note:

The applicative threshold mrwHGB_NAS must be chosen to be greater than mrwHGB_NIS, otherwise the status “setpoint tracking released” is no longer reached.

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- setpoint tracking switched on:

  The setpoint tracking is switched on when the difference between the tracked setpoint and the driving speed is less than or equal to an application threshold.

  (mrmV_SOLHN - fgmFGAKT <= mrwHGB_NIS--> setpoint tracking switched on)

  The tracked target value mrmV_SOLHN, starting with the current driving speed fgmFGAKT is introduced via a PT1 element to the driving speed target value mrmV_HGBSW. The PT1 member mrwPT1_HGB is running independent of transition. The initial amount mrmM_EHGB is limited to mroHGmax.

- setpoint tracking switched off:

  The setpoint tracking is switched off when the difference between the speed limit mrmV_HGBSW set in the EEPROM and the tracked setpoint is less than or equal to an applicative threshold

  (mrmV_HGBSW - mrmV_SOLHN <= mrwHGB_NAU)

  or the controller limitation becomes smaller than an applicative threshold.

  (mroHGmax < mrwHGB_MAU)

  The tracked setpoint mrmV_SOLHN receives the value mrmV_HGBSW and the setpoint tracking is turned off. The initial amount mrmM_EHGB is limited to mroHGmax.

  If the difference between mrmV_SOLHN - mrmV_HGBSW > mrwHGB_NAS, the state of the setpoint tracking changes from switched off to released, or switched on to released.

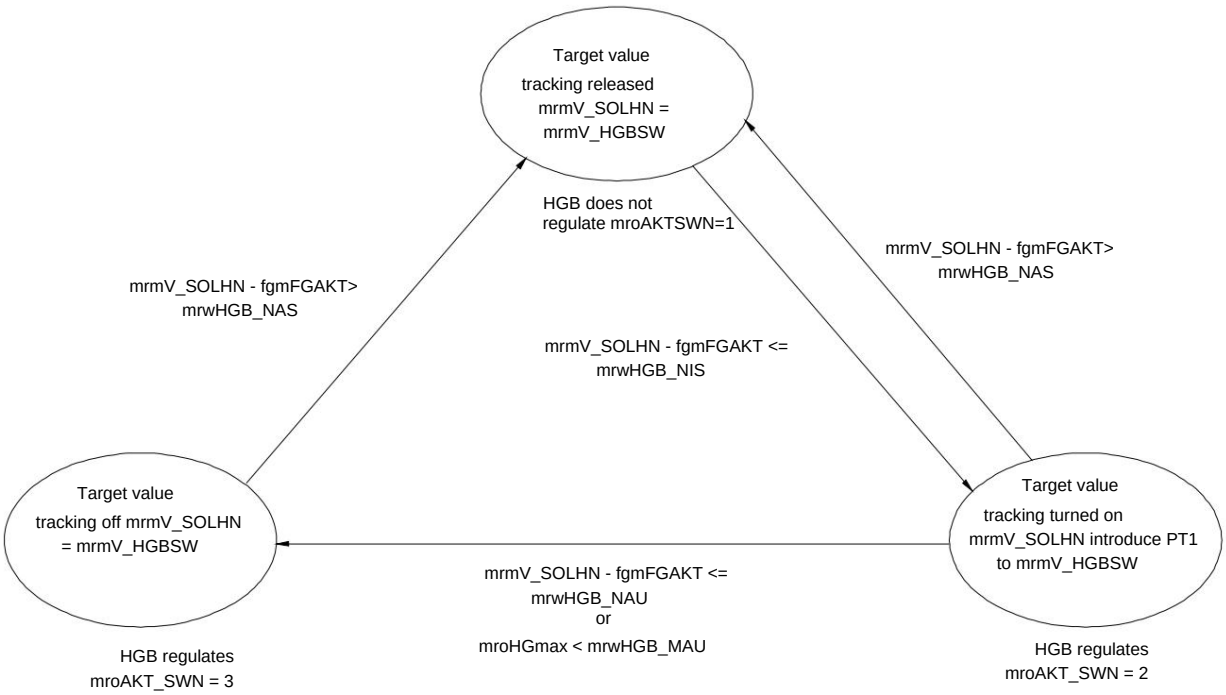


Figure MEREHG03: States of setpoint tracking

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2.10.3 Setpoint initialization

The tracked target value is initialized with the EEPROM value mrmV_SOLEE.

2.10.4 Controller parameter selection

Above the V/N threshold mrwHGB_VZN, the parameter sets mrwHP4_..., mrwHI4_... (for gears <= 4th gear) or mrwHP5_..., mrwHI5_... (for the 5th gear) selected.

2.10.5 HGB PI controller

The maximum speed controller continuously calculates the permissible injection quantity in order not to exceed the maximum speed.

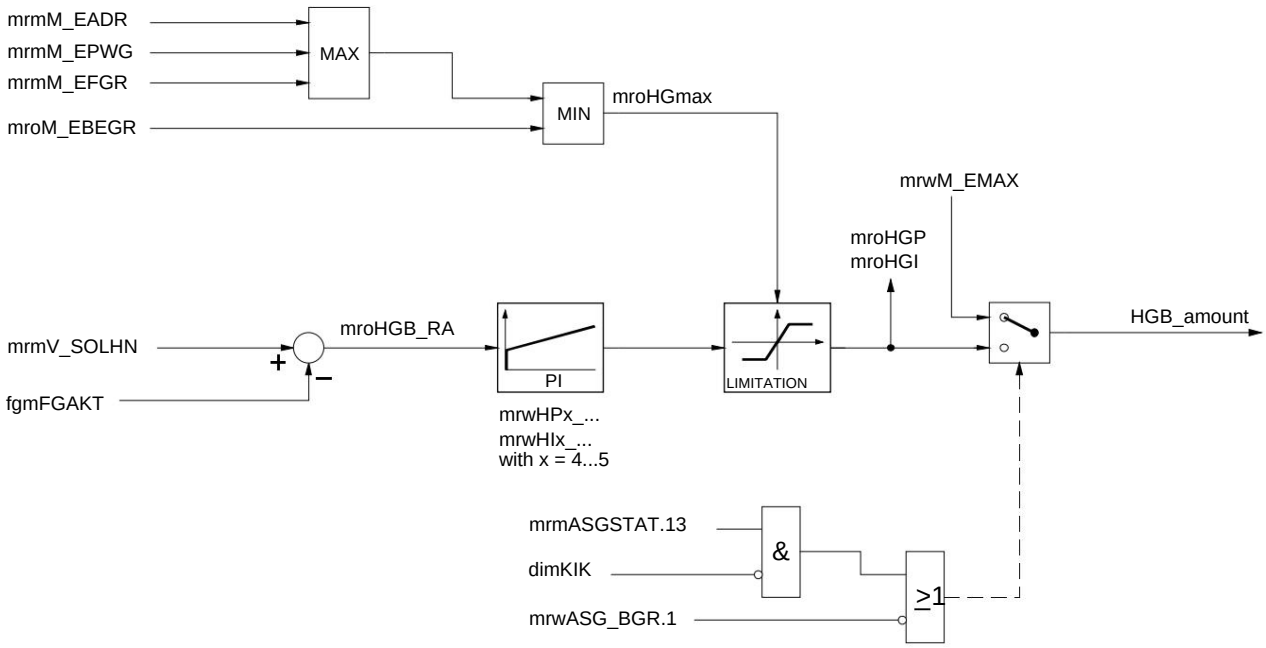


Figure MEREHG04: Regulation HGB

ASG ECO mode:

Basically, the HGB must be activated for this function (mrwHGBvMAX not equal to 0 and mrmV_SOLEE not equal to 0 or mrmHGB_Sta.1 equal to 1 or mrmHGB_Sta.5 equal to 1), see also secure deactivation of the HGB.

In ASG-ECO mode, the HGB can be used to reduce consumption. This function is activated via bit 1 of mrwASG_BGR (mrwASG_BGR.1 = 1).
If the ASG ECO mode is released (mrmASGSTAT.13 = 1) and Kik-Down is not actuated (dimKIK = 0), it is switched to the amount mrmM_EHGB calculated via the HGB.

If dimKIK = 1 or mrmASGSTAT.13 = 0 it is switched to the default amount mrwM_EMAX.

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2.11 External Crowd Intervention

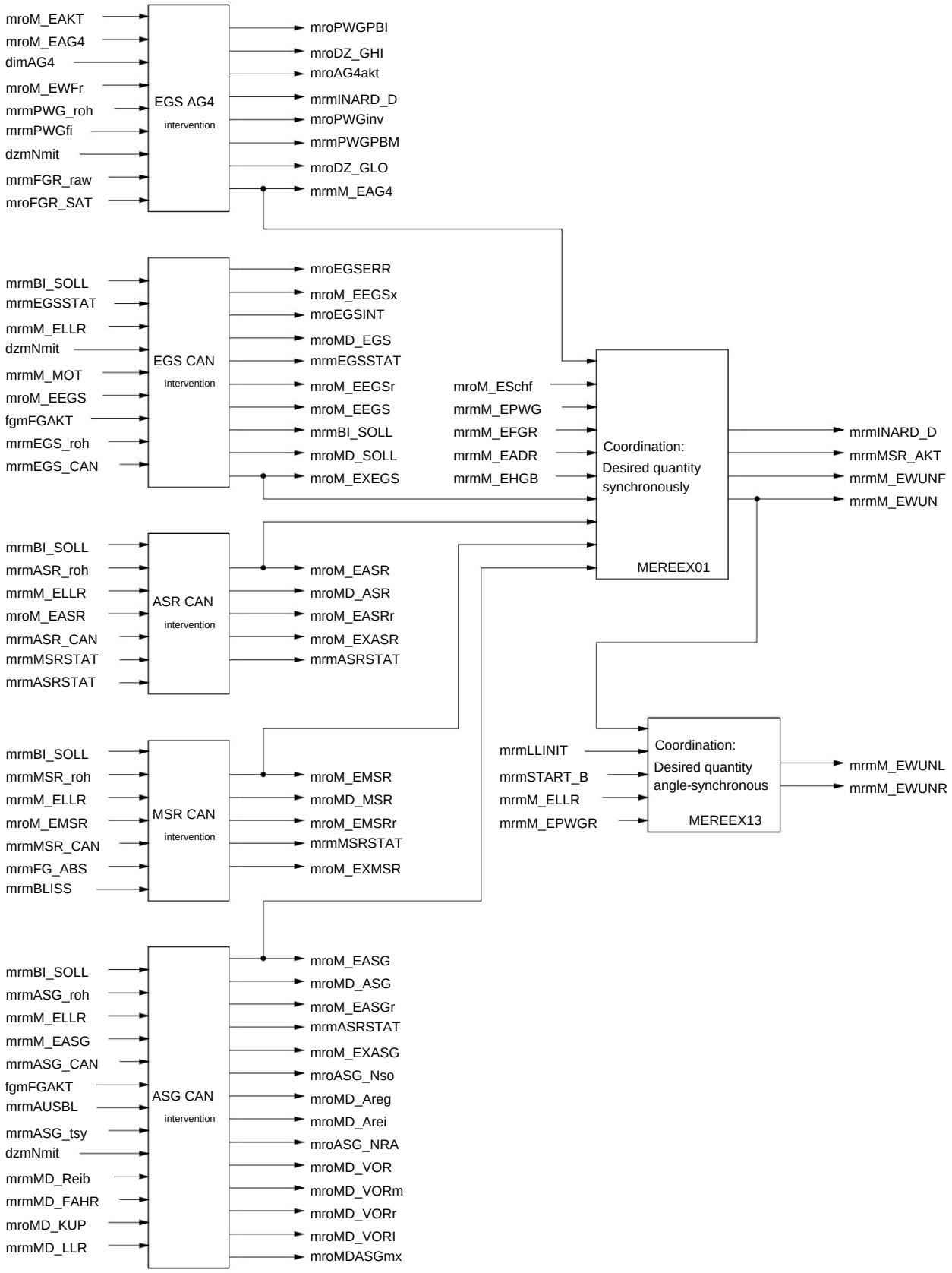


Figure MEREEX12: External crowd intervention

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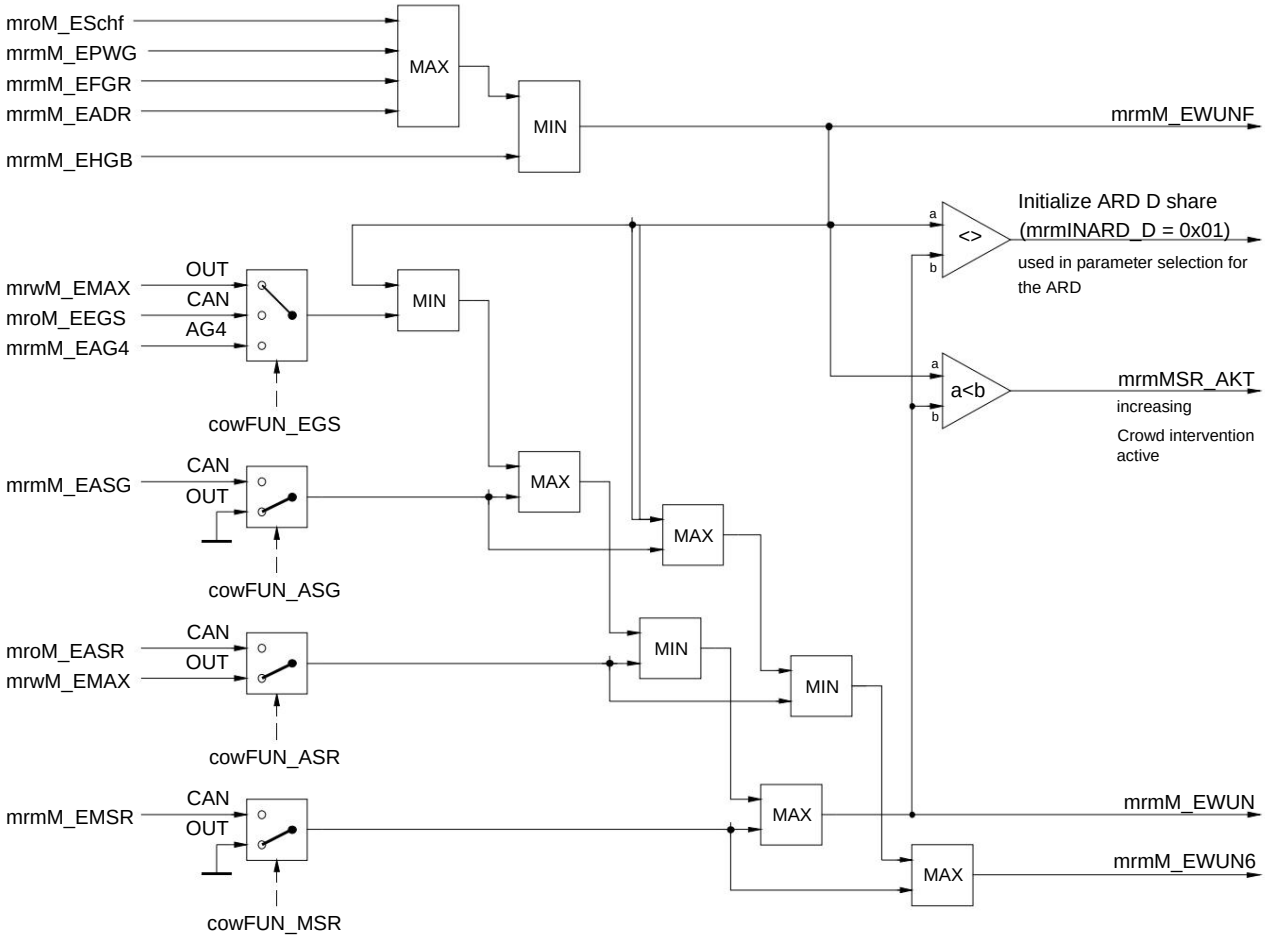


Figure MEREEX01: Requested quantity synchronously

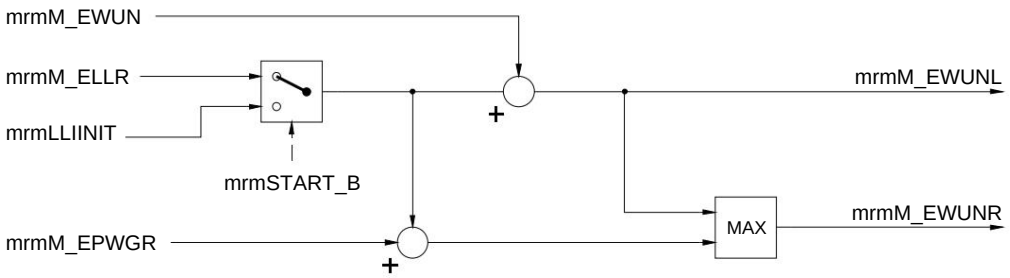


Figure MEREEX13: Desired quantity angle-synchronous

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The external volume intervention forms the maximum of the driver's request via PWG mrmM_EPWG, driver's request via the cruise control system GRA mrmM_EFGR and driver's request via the working speed control ADR mrmM_EADR and the PT1-filtered drag amount mroM_ESchf. This maximum is the amount of maximum speed limit mrmM_EHGB and after the start depending on the oil pressure. The limited by this minimum the driver's desired quantity is With mrmM_EWUNF (for the output of the inverse PWG - value on the map mrwIFV_KF is a driver's desired quantity raw mroM_EWFr, from the maximum of mrmM_EPWG and unlimited GRA desired quantity mrmFGR_roh formed).

The bit mrmMSR_AKT (information on redundant thrust monitoring) is set when an increasing amount of intervention actually increases the amount.

Description of the OLDA status of the MSR - quantity intervention by mrmMSR_AKT:

Bit position	decimal value	comment 0
0		no increasing quantity intervention active
0	1	increasing quantity intervention active (causes increase of mrmM_EWUN)

mrmM_EWUN6 is the desired amount for the target and actual moments of the Motor6 message and corresponds in principle to mrmM_EWUN, but the EGS intervention is not taken into account.

2.11.1 Drag torque limitation for CVT transmissions

The drag torque is to be limited by an injection quantity in overrun mode below a speed threshold, which results implicitly from the map mrwSchmxKF (1400 1/min).

The difference in the friction torque without idling torque mrmMD_Rrel and the target thrust torque mroMDSchSO results in the control deviation mroMDSchRA. The deviation is converted with the specific consumption mrmBI_SOLL in a quantity mroM_ESchu and then PT1-filtered. Depending on the direction of the change in quantity, one of two time constants (mrwPT1SchP or mrwPT1SchN) is selected. The PT1-filtered quantity is multiplied by a speed-dependent factor and results in the drag quantity mroM_ESchf. Multiplication by a speed-dependent factor is necessary to prevent a sudden jump in quantity to zero. Furthermore, the function is switched off when the system-specific error zmmF_KRIT.0 = 1 (inaccurate torque specification).

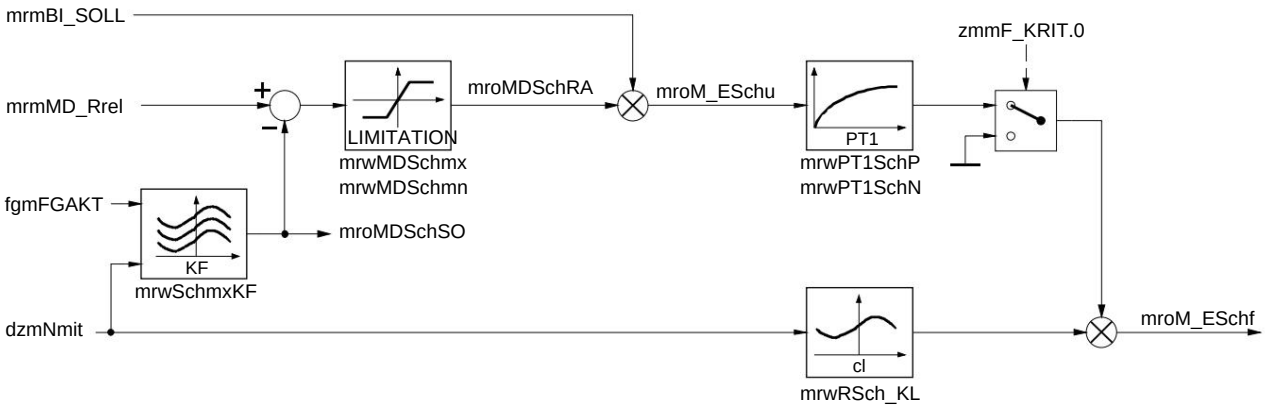


Figure MEREEX18: Drag torque limitation

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2.11.2 External control unit intervention

This driver's desired quantity can now be obtained from an external control device in several ways to be influenced:

- ÿ External quantity intervention by EGS (either AG4 or CAN)
- ÿ External quantity intervention by ASR (via CAN)
- ÿ External volume intervention by MSR (via CAN)
- ÿ External quantity intervention by ASG (via CAN)

The type of crowd intervention is via the software switch cowFUN_EGS, cowFUN_ASR, cowFUN_MSR and cowFUN_ASG defined.

Description of the software switch external quantity intervention type EGS cowFUN_EGS (OLDA comM_E_EGS):

decimal value	comment
0	no EGS - quantity intervention
2	Quantity intervention by EGS via CAN
3	Quantity intervention by EGS via AG4

Description of the software switch external quantity intervention type ASR cowFUN_ASR (OLDA comM_E_ASR):

decimal value	comment
0	no ASR - quantity intervention
2	Quantity intervention by ASR via CAN

Description of the software switch external quantity intervention type MSR cowFUN_MSR (OLDA comM_E_MSR):

decimal value	comment
0	no MSR - quantity intervention
2	Quantity intervention by MSR via CAN

Description of the software switch external quantity intervention type ASG cowFUN_ASG (OLDA mroASG_sel):

decimal value	comment
0	no ASG - quantity intervention
2	Quantity intervention by ASG via CAN

If no bulk intervention is desired or no bulk intervention is currently active, the Driver request amount mrmM_EWUNF as time-synchronous request amount mrmM_EWUN to the speed-synchronous quantity calculation passed on.

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The intervention quantity of EGS can reduce the driver's desired quantity mrmM_EWUNF, where the ASG intervention amount can subsequently increase again. The highest priority ASR/MSR intervention independently of the other two interventions, decreasing and increasing can work (as long as the clutch is engaged). The resulting set of interventions is called time-synchronous Request quantity mrmM_EWUN for processing in the speed-synchronous quantity calculation passed on.

During the duration of a valid quantity intervention, one and active (mrmM_EWUN<> mrmM_EWUNF) is the D - component of the active judder damper initialized mrmINARD_D (treatment in the parameter selection for the ARD).

The message mrmMSR_AKT serves as information whether an increasing amount of intervention is active.

For further processing in other tasks, the sum of the desired quantity is used mrmM_EWUN and the amount of idle controller mrmM_ELLR, or before the start shedding Initialisation quantity of the idle controller integrator mrmLLIINIT, as a message mrmM_EWUNL shipped. Furthermore, the maximum from mrmM_EWUNL and the sum of PWG - Desired amount raw mrmM_EPWGR and the limited amount of idle controller mrmM_ELLR, or before the start shedding of the initialization amount of the idle controller integrator mrmLLIINIT, a speed-synchronous desired amount determined raw mrmM_EWUNR.

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2.11.3 EGS intervention

EGS intervention via AG4:

When switching the AG4, the injection quantity should be reduced. During these switching processes, the control unit receives a switching signal, which is processed as a digital input AG4-E and internally handled via the message dimAG4. A speed signal (TD signal) and a PWM signal, which corresponds to the current accelerator pedal position, are made available to the AG4.

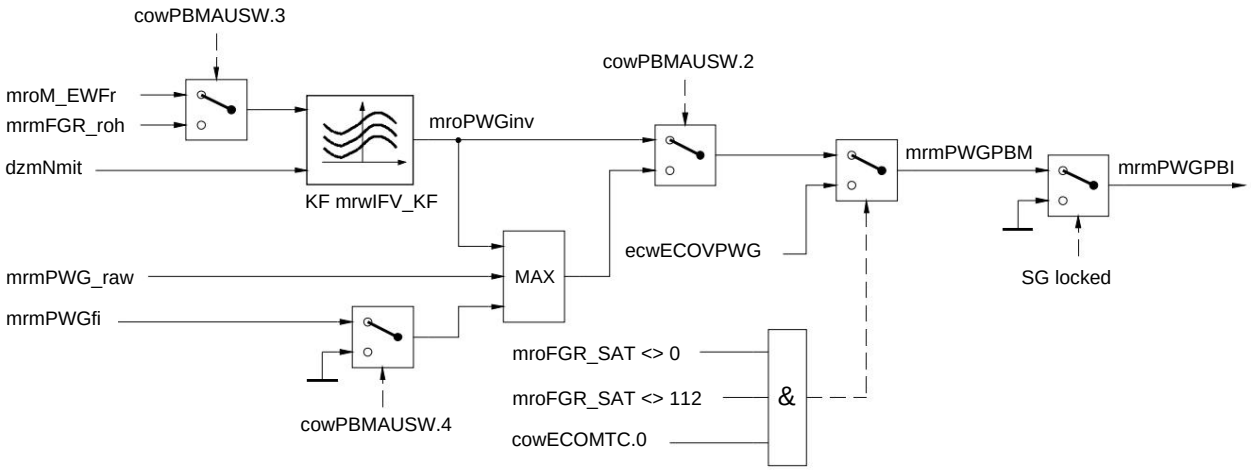


Figure MEREEX02: Determination of the PWG value for the AG4

In order to send a meaningful value for the accelerator pedal position even while the cruise control system GRA is active, a back-calculated PWG value mroPWGinv is determined via the inverse driving behavior map mrwIFV_KF. As an input variable for the inverse driving behavior map, the driver's desired quantity can be raw mroM_EWFr or the unlimited GRA - desired quantity mrmFGR_roh can be selected. Depending on the position of the DAMOS - switch cowPBMAUSW either the maximum from mroPWGinv, the PWG value mrmPWG_roh and the filtered PWG mrmPWGfi or only the recalculated PWG - value mroPWGinv as mrmPWGPBM via PBM to the AG4 or sent to the Ecomatik. The output of the message mrmPWGPBM as PBM - signal must be applied to the data of the MUX - handlers separately on the message number for mrmPWGPBM. It must also be specified there whether an error signal should be output for a defective PWG (fboSPWG or fboSPGS) (continuous wave low). For systems with Ecomatic, the PWG substitute value ecwECOVPWG should be sent when the GRA is active. This prevents the Ecomatic receiving mrmPWGPBM = 0% during overrun and active GRA.

Description of the DAMOS switch PBM output type cowPBMAUSW (IFVKF = inverse Driving behavior map):

Bit position	decimal value	comment 4
2		PBM for AG4 = MAX (PWG from IFVKF mroPWGinv, mrmPWG_roh, mrmPWGfi) (0: PBM for AG4 = PWG from IFVKF mroPWGinv)
3	8th	Input of the IFVKF = (dzoNmit, mrmFGR_roh) (0: input of the IFVKF = (dzoNmit, mroM_EWFr))
4	16	PWG input = mrmPWG_roh (0: PWG input = MAX (mrmPWG_roh, mrmPWGfi)

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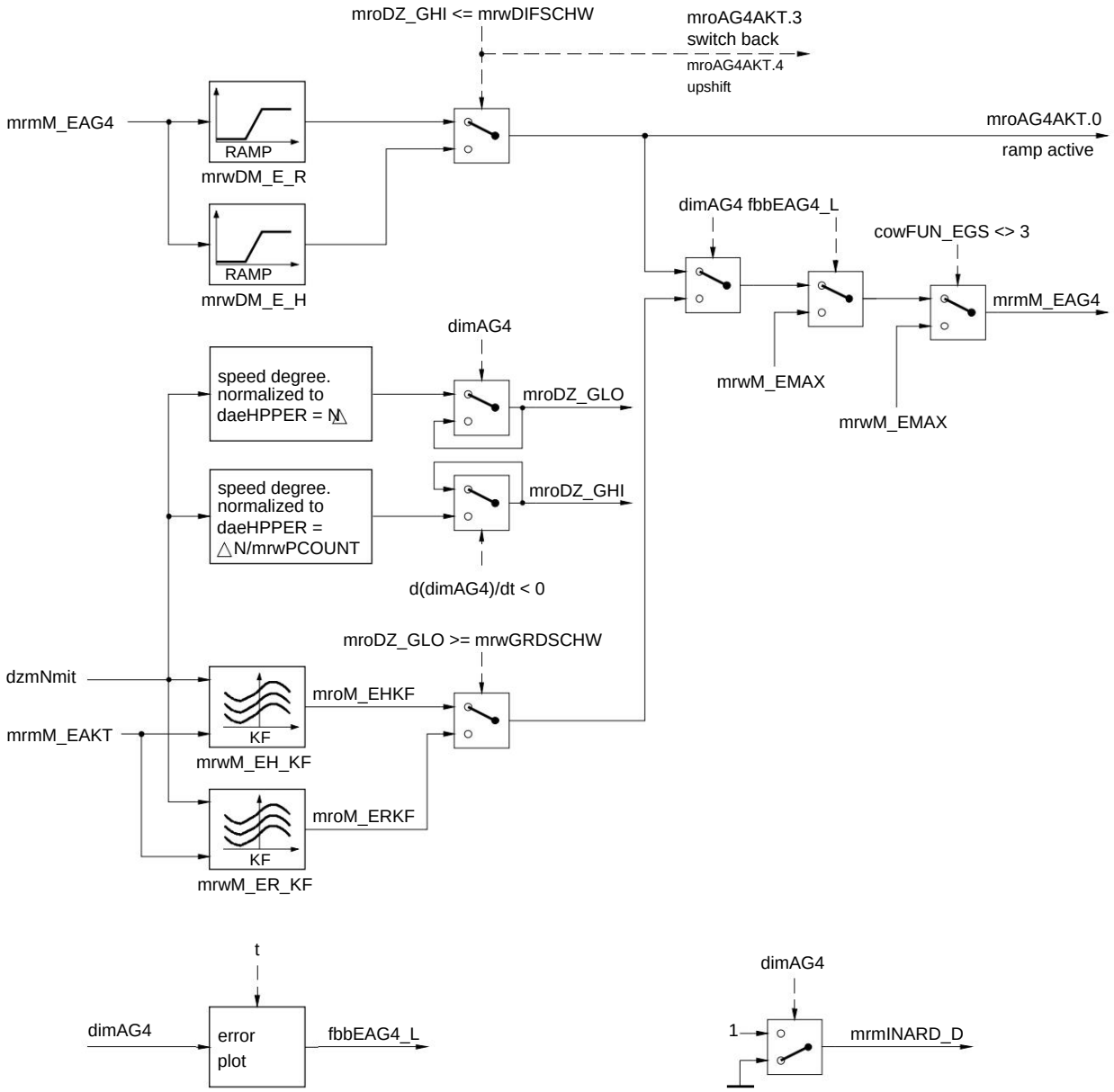


Figure MEREEX03: External quantity intervention by the AG4

If the AG4 is not active, a speed gradient mroDZ_GLO is continuously calculated in the synchronous part of the quantity calculation and compared with the threshold mrwGRDSCHW. If the speed gradient is greater than or equal to this threshold, there would be a downshift if the AG4 shifted. If it is smaller, the AG4 would upshift. Depending on the result of this comparison is from the map mrwM_EH_KF or mrwM_ER_KF (high or downshift map) an AG4 intervention amount mrmM_EAG4, depending on the current speed dzmNmit and the amount mrmM_EAKT determined.

Upon detection of an activity signal dimAG4 of the AG4 in the time-synchronous part of the quantity calculation, the switching sense determined is frozen and an intervention quantity mrmM_EAG4 is calculated. This amount of intervention is now continuously updated during the activity phase of the AG4 according to the speed dzmNmit. While dimAG4 is active, the D portion of the ARD is initialized (mrmINARD_D).

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After resetting the switching signal by the AG4, a new speed gradient mroDZ_GHI is determined from the speed at the beginning, the last speed before the end of the activity phase (negative edge of dimAG4) and the number of program runs in the activity phase and the AG4 intervention amount mrmM_EAG4 increases in a ramp . The ramp is only started when mrmM_EWUNF ÿ 0 or> 0. The slope of this ramp is determined from the comparison of the speed gradient mroDZ_GHI with the threshold mrwDIFSCHW. If the speed gradient mroDZ_GHI is greater than the threshold mrwDIFSCHW, the ramp slope mrwDM_E_R is used for downshifting. If the speed gradient is less than or equal to this threshold, the ramp slope mrwDM_E_H is used for upshifting.

Upon detection of an activity signal of the AG4 in the speed-synchronous part of the quantity calculation, a minimum of the current desired quantity mrmM_EWUN and AG4 intervention quantity mrmM_EAG4 is immediately formed and processed as a desired quantity.

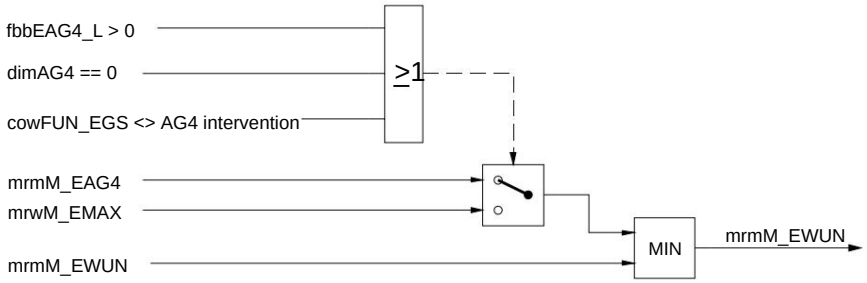


Figure MEREEX04: Speed-synchronous switching signal reaction

This additional processing in the speed-synchronous part is necessary in order to keep the required reaction time of the quantity intervention on the switching signal as short as possible (maximum 40 ms).

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Representation of the switching signal reaction:

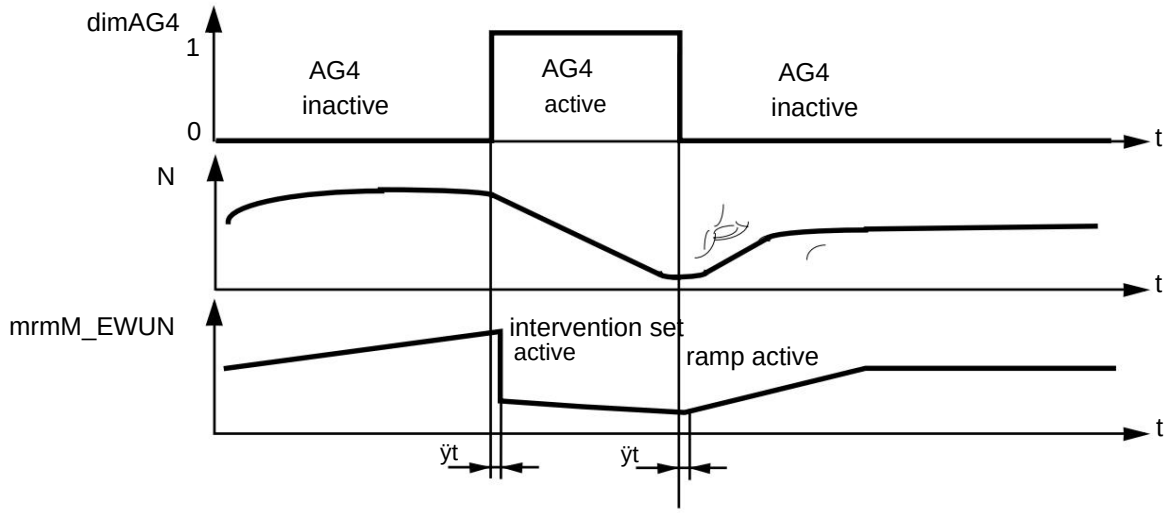


Figure MEREEX05: AG4 switching signal reaction

ÿt ... reaction time of the quantity intervention to the switching signal (max. 40 ms).

The maximum permitted duration during which an AG4 switching intervention can be active is determined by the Debounce time of the error bit fbbEAG4_L determined and thus implicitly through the error handling monitored (see monitoring concept).

Detailed information on the status of quantity intervention by the AG4 automatic transmission are summarized in the OLDA mroAG4AKT.

Description of the OLDA status of the AG4 quantity intervention mroAG4AKT:

Bit position	decimal value	comment
0	1	Ramp active after valid switching signal
1	2	AG4 switching signal active (dimAG4 = high)
2	4	AG4 switching signal timeout error
		the last shift was a downshift
3 4	8 16	last shift was upshift

Effect of the AG4 quantity intervention on the desired quantity mrmM_EWUN:

An output of AG4 intervention amount mrmM_EAG4 is only a valid AG4 shift intervention. A valid switching intervention occurs when the input signal is active and the error bit fbbEAG4_L is not set, or if the AG4 intervention quantity mrmM_EAG4 after a valid switching signal is within the ramp and the condition mrmM_EAG4 < mrmM_EWUNF is met. The ramp is only started at mrmM_EWUNF> 0. Next will with a valid AG4 intervention via the message mrmINARD_D the D - share of the active Jerk damper initialized (manipulated variable D - component = 0).

If the AG4 intervention is valid and the calculated AG4 - intervention amount mrmM_EAG4 smaller than that Value of the local copy of the desired quantity mrmM_EWUN, the intervention quantity in the local copy of the requested quantity.

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EGS intervention via CAN:

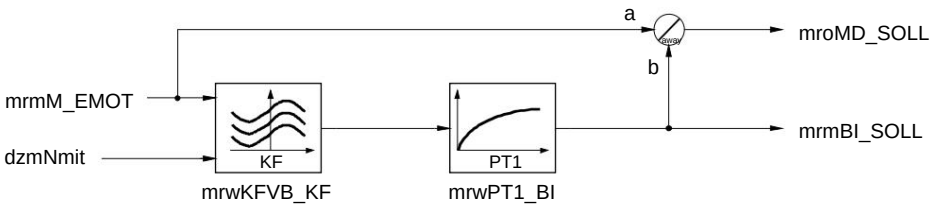


Figure MEREEX14: Calculation spec. ind. consumption

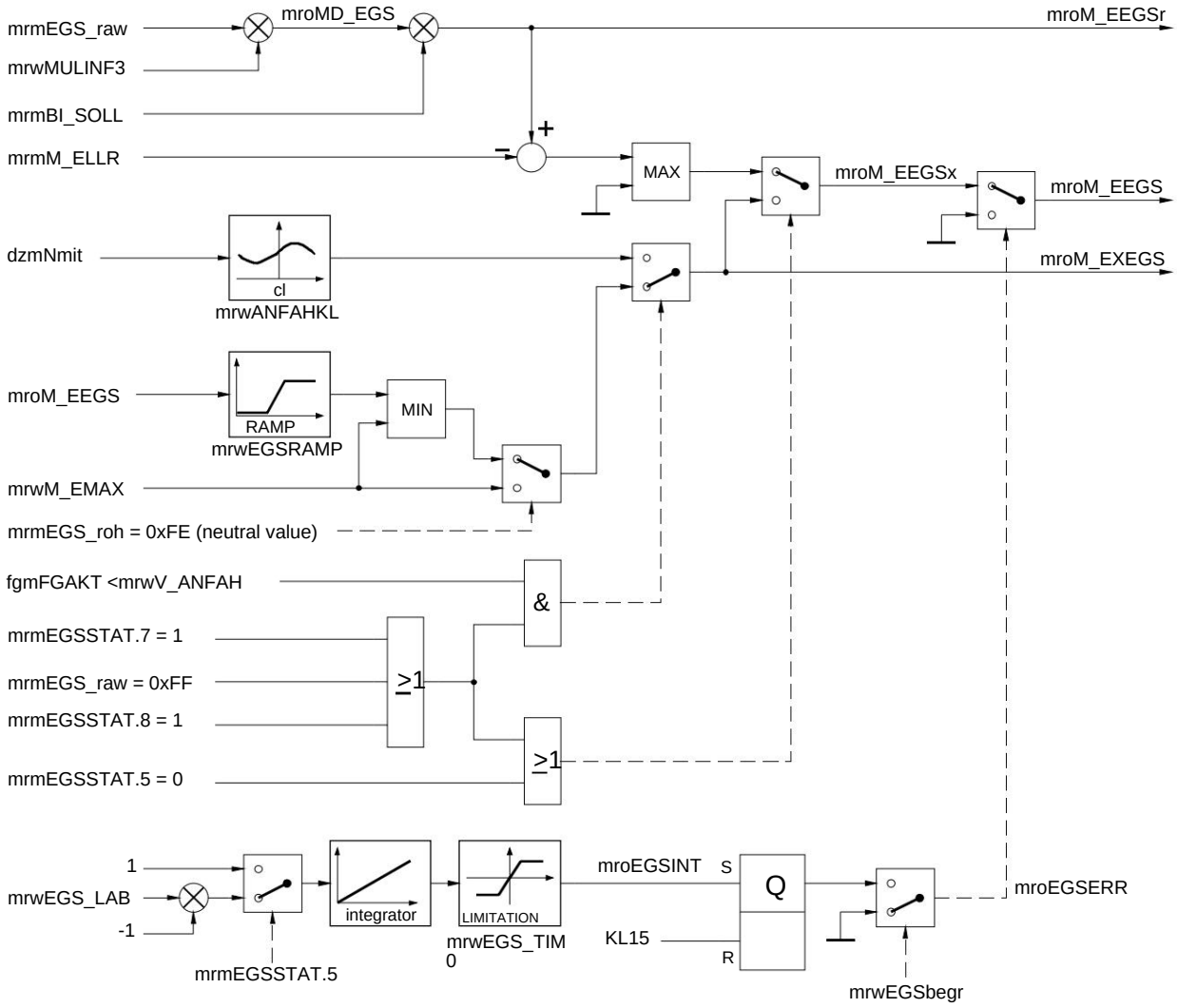


Figure MEREEX08: External quantity intervention by the EGS via CAN

Bits 4-8 from mrmEGS_CAN are directly transferred to the same bits of mrmEGSSTAT.

With CAN communication, standardization to torques is required. Torques are over the specific indexed consumption mrmBI_SOLL [(mg/hub)/Nm], which is determined from the consumption map mrwKFVB_KF with the speed dzmNmit and the engine torque quantity mrmM_EMOT, converted into quantities. Quantities are about the spec. ind.

Consumption mroBI_FAHR or mroBI_REIB, which are determined from the consumption map with the speed dzmNmit and the amount mrmM_EWUNF or mroM_EREIB, converted into torques.

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Calculation of intervention amount:

When EGS is set - request bit mrmEGSSTAT.5 the torque signal mrmEGS_roh (converted physical value is mrmMD_EGS) is multiplied by mrmBI_SOLL from the consumption map mrwKFVB_KF. From this amount of intervention mroM_EEGSr the current amount of idle controller mrmM_ELLR is deducted and the result is limited to 0 below, resulting in the amount relevant for determining the desired amount mroM_EEGS results.

Message error transmission (mrmEGSSTAT.4 = 1):

In the case of a CAN error (set bit mrmEGS_CAN.4), the status bit mrmEGSSTAT.4 is set. Subsequently, the replacement set mroM_EXEGS is activated. The error is not reported during active CAN blanking.

On this replacement amount mroM_EXEGS is not set EGS - request bit mrmEGSSTAT.5, gesetzem bit mrmEGS_CAN.7), transmission - control unit in emergency mode (mrmEGS_CAN.8 = 1) or in the intervention torque - error code mrmEGS_roh = 0xFF switched (see also monitoring concept) .

Determination of the information "Intervention cannot be carried out or cannot be carried out completely":

- If the amount of intervention mroM_EEGSr is less than the current amount of the idle controller mrmM_ELLR reduced by the tolerance value mrwM_E_ToG, the bit mrmEGSSTAT.7 is set (flag - intervention request can not, or not fully met). Increases the amount of intervention mroM_EEGSr on the current amount of idle controller mrmM_ELLR, this bit is reset. The bit is also set when bit mrmEGS_CAN.7 is set or when the EGS intervention is deactivated via the application (cowFUN_EGSÿ2). The same applies to quantity metering errors zmmSYSERR.2 (see monitoring concept "summarized system errors"). The status of the bit is also displayed in the OLDA mroHYSSTAT.0.

replacement amount:

The calculation of the replacement amount mroM_EXEGS depends on the current driving speed fgmFGAKT. If fgmFGAKT <mrwV_ANFAH, the replacement quantity mroM_EEGS is calculated with the starting characteristic mrwANFAHKL and the speed dzoNmit. If the current driving speed fgmFGAKT>= mrwV_ANFAH, the replacement amount is increased to the maximum mrwM_EMAX with an increment of mrwEGSRAMP ((mg/hub)/s) (status information: mrmEGSSTAT). As a special case, if the EGS is not set - request bit mrmEGSSTAT.5 and simultaneous neutral value at the moment of intervention (mrmEGS_roh=0xFE), the intervention ends immediately without a ramp (mroM_EXEGS = mrwM_EMAX).

Time limit: The EGS

intervention time can be monitored via the mrwEGSbegr label. This runs with active EGS intervention mrmEGSSTAT.5 an integrator up to the applicable limit mrwEGS_TIM. If the integrator exceeds the set value mrwEGS_TIM, mrmEGSERR is set, the amount of intervention mroM_EEGS of the EGS intervention is set to 0, the **ASG intervention** is canceled as implausible and the error bit fbbEEGS_A is set. If there is no active intervention, a negative input value mrwEGS_LAB is switched to the integrator. The integrator is limited to 0 below.

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Impact:

The gear intervention has a quantity-reducing effect, ie the quantity is from the electronically controlled Transmission mroM_EEGS smaller than the driver's request mrmM_EWUNF, so goes the amount mroM_EEGS in the quantity request mrmM_EWUN.

Description of the OLDA mrmEGSSTAT - status of the EGS quantity intervention:
(Bits 4-6 and 8 from mrmEGSSTAT correspond to those of mrmEGS_CAN).

Bit position	decimal value	comment
0	1	Quantity intervention by EGS active
1	2	Quantity intervention by EGS via ramp
2	4	no quantity intervention by EGS (ramp final value reached)
3	8th	Quantity intervention by EGS via start-KL
4	16	Message error EGS (timeout or message data inconsistent)
5	32	EGS request bit (intervention moment thus becomes valid)
6	64	Hiding of the CAN monitoring
7	128	mrmEGS_CAN: CAN errors or message errors mrmEGSSTAT: CAN error or message error or EGS intervention request cannot be fulfilled or not completely fulfilled (see assessment of the intervention above, as well as monitoring concept). Note: with simultaneous MSR intervention (takes precedence over EGS intervention) this bit is also set when the MSR intervention torque is greater than the EGS intervention torque.
8th	256	Transmission SG is in emergency mode (see CAN: Transmission 1)

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2.11.4 ASR intervention

ASR intervention via CAN:

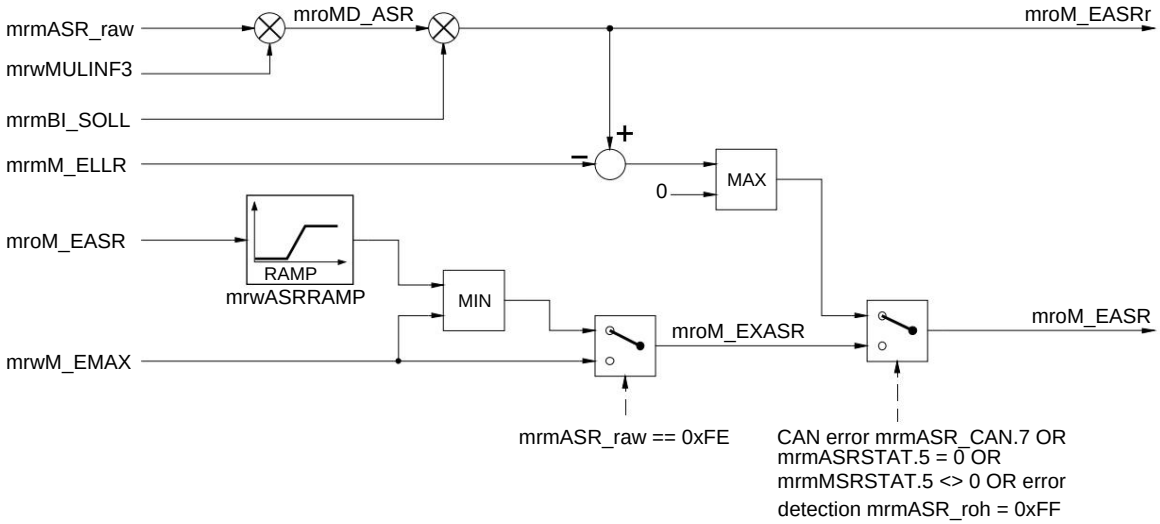


Figure MEREEX09: ASR intervention

The bits mrmASRSTAT.4 to mrmASRSTAT.B are taken directly from the bits mrmASR_CAN.4 to mrmASR_CAN.B.

Calculation of intervention quantity:

The ASR intervention torque mrmASR_roh (the converted physical value is output in mrmMD_ASR) is transmitted from the ASR/MSR control unit via CAN. This moment is set ASR request bit mrmASRSTAT.5 (at the same time must be mrmMSRSTAT.5 = 0) with the specifically indexed fuel consumption (mrmBI_SOLL) multiplied. From this amount of intervention mroM_EASRr the current amount of idle controller mrmM_ELLR is subtracted and the result is limited to 0 below, resulting in the relevant for determining the desired amount mroM_EASR amount.

Determination of the information "Intervention cannot be carried out or cannot be carried out completely":

If the amount of intervention mroM_EASRr is less than the current amount of the idle controller mrmM_ELLR reduced by the tolerance value mrwM_E_ToB, the bit mrmASRSTAT.7 is set (flag - intervention request can not, or not fully met). If the amount of intervention mroM_EASRr rises above or on the current amount of the idle controller mrmM_ELLR, this bit is reset. The bit is also set when mrmASR_CAN.7, or when the error fbbEMSR_P is finally defective, or when the ASR - intervention via the application is disabled (cowFUN_ASR > 2), set. The status of the bit is also displayed in the OLDA mroHYSSTAT.1 when ASR intervention is active.

Message error brake (mrmASRSTAT.4 = 1):

When the bit mrmASR_CAN.4 is set, the status bits mrmASRSTAT.4 and mrmMSRSTAT.4 are set.

This replacement amount is also not set ASR - request bit mrmASRSTAT.5, set MSR - request bit mrmASRSTAT.5, set bit mrmASR_CAN.7, message counter error (mrmASR_CAN.11) and the intervention moment - error code mrmASR_roh = 0xFF switched (see also monitoring concept).

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replacement amount:

When switching to the replacement amount mroM_EXASR, the ASR intervention amount mroM_EASR ramped up to the neutral value mrwM_EMAX increased (status information: mrmASRSTAT).
As a special case, if the ASR is not set - request bit mrmASRSTAT.5 and simultaneous neutral value in the moment of intervention (mrmASR_roh = 0xFE) the intervention immediately without Ramp finished (mroM_EXASR = mrwM_EMAX).

Impact:

The ASR - intervention has a quantity-reducing effect, ie the quantity mroM_EASR is smaller than that Driver request mrmM_EWUNF, so goes the amount mroM_EASR in the quantity request mrmM_EWUN a.

Description of the OLDA status of the ASR - quantity intervention by mrmASRSTAT:
(Bits 4-6 and B from mrmASRSTAT correspond to those of mrmASR_CAN).

Bit position	decimal value	comment
0	1	Quantities - Intervention by ASR active
1	2	Quantities - Intervention by ASR via ramp
2	4	no quantities - intervention by ASR (ramp end value reached)
4	16	Message error ASR/MSR (timeout or inconsistent embassy data)
5	32	ASR - request bit (intervention moment becomes valid)
6	64	Hiding of the CAN monitoring
7	128	mrmASR_CAN: CAN error or message error mrmASRSTAT: CAN error or message error or ASR - request for intervention cannot be fulfilled or not completely fulfilled (see assessment of the intervention above, as well as monitoring concept).
B	2048	see description mrmMSRSTAT.B or mrmMSR_CAN

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2.11.5 MSR intervention

MSR intervention via CAN:

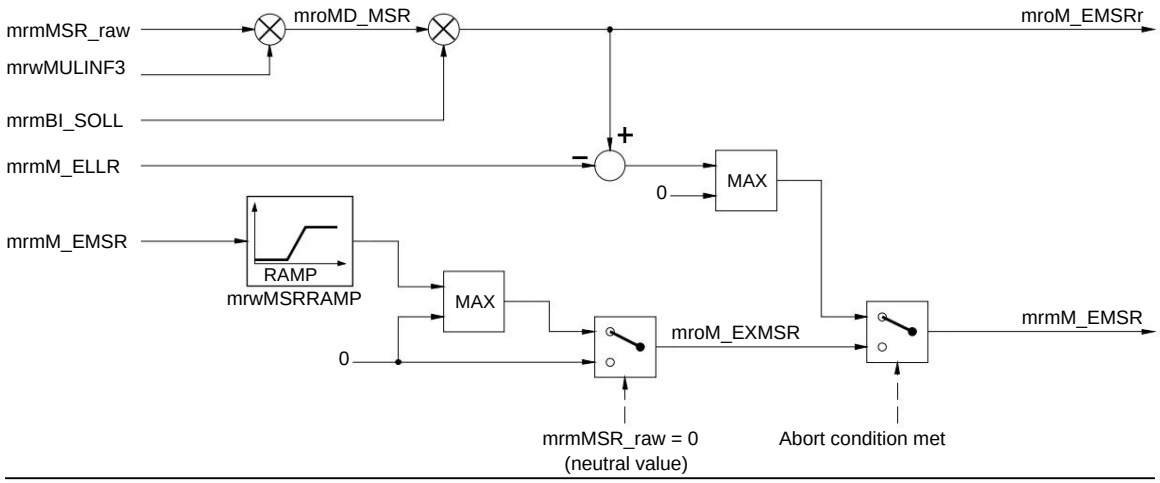


Figure MEREEX10: MSR intervention

The bits mrmMSRSTAT.4 to mrmMSRSTAT.B are taken directly from the bits mrmMSR_CAN.4 to mrmMSR_CAN.B.

Calculation of intervention quantity:

The MSR intervention torque mrmMSR_roh (converted physical value mroMD_MSR (the raw value is output in mrmMSR_roh) is transmitted via CAN from the ASR/MSR control unit. mrmBI_SOLL) multiplied.From this amount of intervention mroM_EMSRr, the current amount of the idle controller mrmM_ELLR is deducted and the result is limited to 0 below, resulting in the amount relevant for determining the desired amount mroM_EMSR results.

Message error brake (mrmMSRSTAT.4 = 1):

When the bit mrmMSR_CAN.4 is set, the status bits mrmMSRSTAT.4 and mrmASRSTAT.4 are set. Subsequently, the bit mrmMSRSTAT.7 is set.

MSR - request for intervention can not, or not fully be fulfilled (mrmMSRSTAT.7 = 1):

This bit is set • with a
data record deactivated MSR-CAN intervention cowFUN_MSR ÿ 2, • with message
errors ASR/MSR mrmMSR_CAN.4 (timeout or message data inconsistent) • when the limit quantity
mroM_EBEGR is exceeded increased by the tolerance value mrwM_E_ToB by the intervention quantity
mroM_EMSRr (mroHYSSTAT. 2). If the amount of intervention mroM_EMSRr falls below or to the current limit amount mroM_EBEGR, the bit mroHYSSTAT.2 is reset.

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Physical plausibility violation of the MSR intervention (mrmMSRSTAT.9 = 1):

It is checked when the mrmMSRSTAT.A bit is not set and the MSR request bit mrmMSRSTAT.5 is set.

The intervention is physically implausible when the integral MSR moment mroMDIntdt

$$mroMDIntdt \; MM \int dt \; y\left(\; _{MSR} \qquad _{ib}\,\mathrm{Re} \right)$$

exceeds the threshold mrwMDIntMX. Then the error fbbEMSR_H is also considered defective reported. The current value of the integral is shown in the OLDA mroMDIntdt. The integral is limited to 0 below. When the integral has reached the value 0 and the neutral value was sent, the error fbbEMSR_H is well reported. Further MSR interventions However, this is only permitted again if the ABS control unit has at least once checked the neutral value sends as a moment of intervention and the error has meanwhile been finally healed.

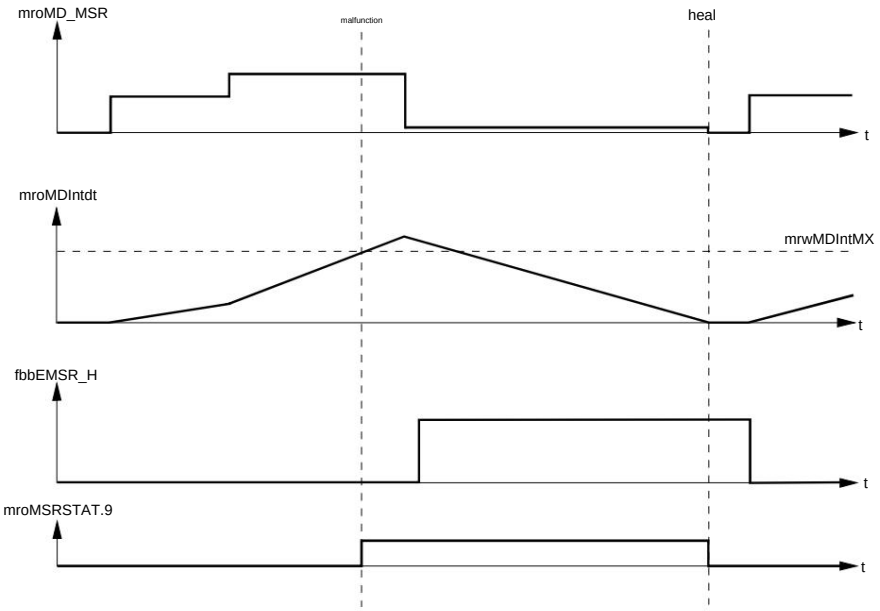


Figure MEREEX11: Physical Plausibility MSR

Plausibility violation of the MSR intervention (mrmMSRSTAT.A = 1):

This bit is set MSR request bit mrmMSRSTAT.5 on the following conditions checked and set if at least one condition is met:

- when bit mrmMSR_CAN.7 is set,
- in the case of quantity metering errors zmmSYSERR.2 (see "summarized system monitoring concept errors")
- for message counter errors (mrmMSR_CAN.B; see Appendix B - CAN, CAN interpreter),
- at the intervention moment - error code mrmMSR_roh = 0xFF,
- when the ASR request bit mrmASRSTAT.5 is set,
- if the binary complement condition is not met (mrmMSR_roh is not the binary complement from mrmASR_raw)
- in the event of a functional plausibility violation

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The intervention is then functionally implausible when the reference speed of the ABS SG is mrmFG_ABS<mrwMSRFG_L. Then the error fbbEMSR_P is reported defective and cannot be cured again. If the error is finally defective, no more ASR or MSR intervention is allowed for this driving cycle.

replacement amount:

On the replacement amount mroM_EXMSR at least one of the following is fulfilled conditions switched:

- When bit mrmMSRSTAT.7 is set
- when not set MSR - request bit mrmMSRSTAT.5,
- when ASR is set - request bit mrmASRSTAT.5,
- in the case of quantity metering errors zmmSYSERR.2 (see "summarized monitoring concept system errors"),
- for message counter errors (mrmMSR_CAN.B; see Appendix B - CAN, CAN interpreter),
- if the binary complement condition is not met (mrmMSR_roh is not the binary complement from mrmASR_raw)
- at intervention moment - error code mrmMSR_roh = 0xFF monitoring concept). (see also

When switching to the replacement quantity mroM_EXMSR, the MSR intervention quantity mroM_EMSR is ramped down to the neutral value 0 (status information: OLDA mrmMSRSTAT). As a special case, if the MSR is not set - request bit mrmMSRSTAT.5 and simultaneous neutral value at the moment of intervention (mrmMSR_roh = 0), the intervention ends immediately without a ramp (mroM_EXMSR = 0).

Impact:

The MSR - intervention has a quantity-increasing effect, ie the quantity mroM_EMSR is greater than the driver's request mrmM_EWUNF, the quantity mroM_EMSR goes into the quantity request mrmM_EWUN. A possibly existing EGS at the same time - intervention (quantity reducing) is superimposed (mrmEGSSTAT.7 is set).

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Description of the OLDA status of the MSR - quantity intervention by mrmMSRSTAT:
(Bits 4-6 and B from mrmMSRSTAT correspond to those of mrmMSR_CAN).

Bit position	decimal value	comment
0	1	Quantity intervention by MSR active
1	2	Quantity intervention by MSR via ramp
2	4	no quantity intervention by MSR (ramp final value reached)
4	16	ASR/MSR message error (timeout or message data inconsistent)
5	32	MSR - request bit (intervention moment thus becomes valid)
6	64	Hiding of the CAN monitoring
7	128	mrmMSR_CAN: CAN errors or message errors mrmMSRSTAT: CAN error or message error or MSR - request for intervention cannot be fulfilled or not completely fulfilled (see assessment of the intervention above, as well as monitoring concept).
9	512	Physical plausibility is violated (moment integral too large)
A	1024	General plausibility criteria violated (CAN message, functional plausibility)
B	2048	Message counter error: the message counter B_COUNT of the last received message differs by more than mrwMSR_Bmx from the message counter of the latest message (none Check at mrwMSR_Bmx = 15) **OR** for more than mrwMSR_Bmn Main program periods (= 20 ms) was none Change of the message counter registered (deactivation of the Verification with mrwMSR_Bmn = 127).

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2.11.6 ASG intervention

ASG intervention via CAN:

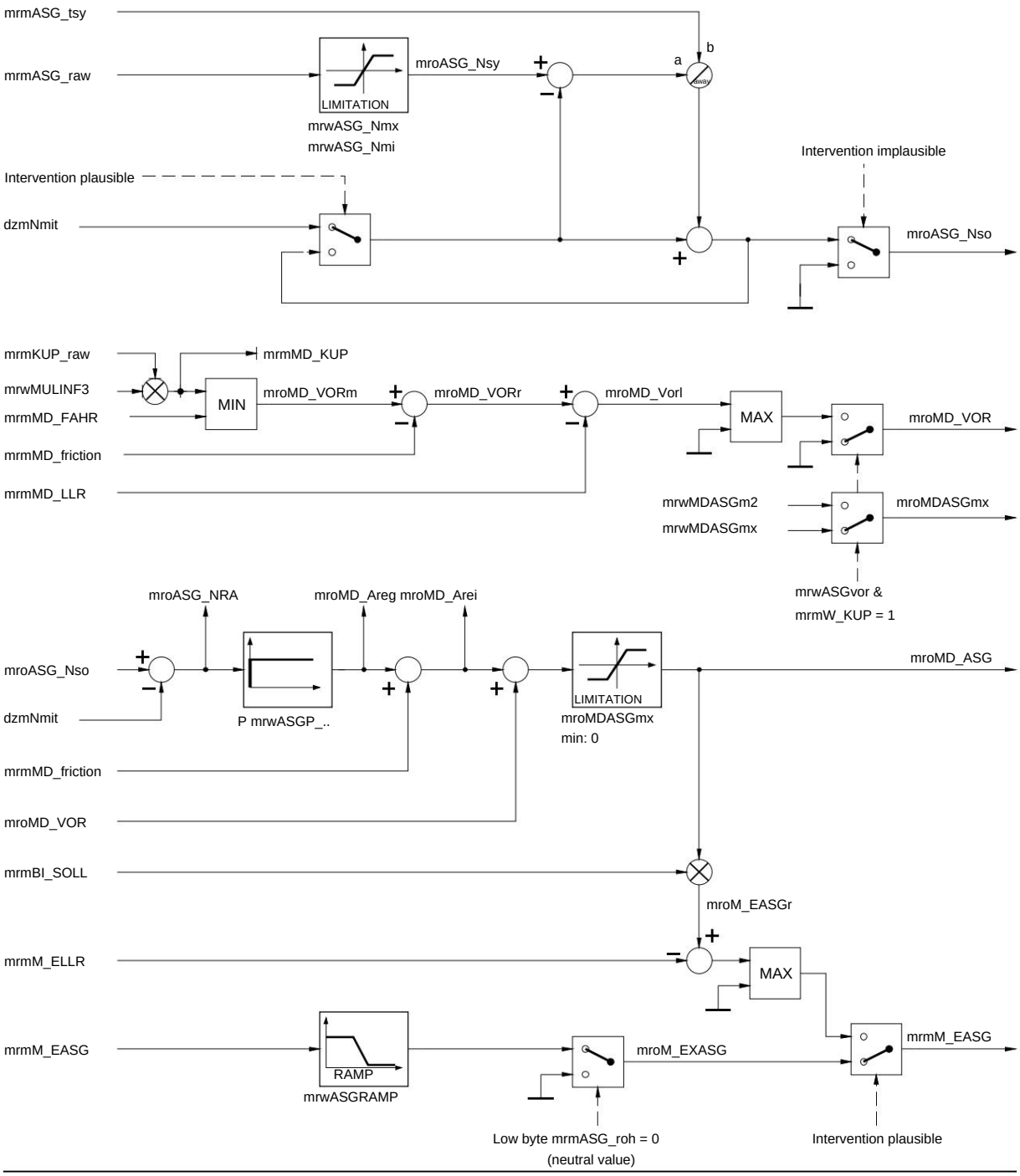


Figure MEREEX15: ASG intervention

General:

The ASG intervention is intended to enable smooth shifting of the transmission by the engine control unit adapting the speed to the new transmission ratio before re-engaging.

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Calculation of intervention quantity:

The ASG control unit transmits via CAN a desired synchronous speed (raw value = mrmASG_roh) and a synchronization *time mrmASG_tsy* from which the SG calculates a speed setpoint in order to bring the current speed to the desired speed in the time desired by the transmission.

The desired synchronous speed is limited to the maximum value *mrwASG_Nmx* and the minimum value *mrwASG_Nmi* (= *mroASG_Nsy).*

In order to eliminate stationary control deviations during the engagement (slipping clutch *mrmWKUP* = 1), a pilot *torque mroMD_VOR* is calculated. For this purpose, the friction torque *mrmMD_Reib* and the idle *torque mrmMD_LLR is* subtracted from a minimum selection between driver 's desired torque *mrmMD_FAHR* and clutch torque *mrmMD_KUP* received via CAN and then *mroMD_VORm* value limited to the positive number range.The pre-control torque calculation can be activated via the label *mrwASGvor .*

If the intermediate gas flag mrmASGSTAT.5 is set and there are no termination conditions (see plausibility of the intervention) actively regulates a P-controller from the actual speed *dzmNmit* to the speed *setpoint mroASG_Nso.* The resulting torque of the controller *mroMD_Areg* is compensated by adding the friction torque *mrmMD_Reib* and applied to the current pilot *torque mroMD_VOR* to the maximum value *mroMDASGmx* and the minimum value 0 limited *(mroMD_ASG).* The limit *mroMDASGmx* is taken over with active pre-control from the label *mrwMDASGm2* and with pre-control switched off from *mrwMDASGmx .*

The ASG intervention torque mroMD_ASG is multiplied by the specifically indicated fuel consumption *mrmBI_SOLL .* From this amount of intervention mroM_EASGr the current amount of idle controller mrmM_ELLR is deducted and the result is limited to 0 below, resulting in the amount relevant for determining the desired amount mroM_EASG results.

blanking:

With CAN suppression (mrmAUSBL = 1), the errors fbbEASG_P (plausibility clutch) and fbbEASG_H (quantity integral too large = "cup diesel") are not reported and the error debouncing reset. However, there is an immediate reaction (abortion of the intervention). However, the errors must be cured for the replacement reaction to be withdrawn.

If the driver *'s desired torque mrmMD_FAHR* is greater than or equal to the ASG intervention *torque mroMD_ASG* and the clutch is slipping *(mrmW_KUP* = 1), the "cup of diesel" *mroMDInAdt is* frozen.

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Plausibility check of the intervention:

The intervention is performed when

• the request bit (intermediate gas flag) mrmASGSTAT.5 is set,

• no neutral value (low byte of *mrmASG_roh* ÿ 0)

and none of the following **termination** (error) conditions exist:

formal plausibility:

• Binary compliment from *mrmASG_roh* (Highbyte LowByte) is wrong,

• Message counter error (mrmASGSTAT.11 = 1 with error) is present,

• Message contains error information (one of the raw values = 0FFh),

• Message error, CAN defect (mrmASG_CAN.7=1),

• Quantity metering error zmmSYSERR.2 (see monitoring concept-"summarized System error")

remaining plausibility:

• Driving speed *fgmFGAKT* <the threshold *mrwASGvmin,*

• The clutch is opened during the intervention *(dimKUP* = 0),

or error fbbEASG_P still up to date

• Integral moment *mroMDInAdt* >= *mrwMDIntAX* ,

or error fbbEASG_H still up to date

If a termination condition occurs during an ASG intervention (request bit set and no neutral value sent), the termination occurs via the substitute quantity mroM_EXASG or the intervention is not started.

Resumption of the intervention:

A new intervention is only allowed again after all of the following conditions have been met at the same time:

• Request bit (intermediate gas flag) mrmASGSTAT.5 not set

• Neutral value sent (low byte of *mrmASG_roh* = 0)

• Integral moment mroMDInAdt already at 0.

• Message was received correctly (mrmASG_CAN.4 = 0)

• no termination condition is active anymore

Annotation:

After SG initialization (K15 on), these conditions must be met once before an intervention is allowed.

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Clutch plausibility of the ASG intervention (fbbEASG_P):

General:

The intervention is only carried out if the clutch is also disengaged or is immediately aborted without debouncing if the clutch is engaged.

If the intervention bit is set without the clutch being in the disengaged state, the resumption conditions (neutral value, etc.) must be reached after the debouncing time fbwEASG_PA before a new intervention is permitted. This applies to the beginning and end of the intervention. The error fbwEASG_P occurs when during this state the masking for the time fbwEASG_PA was continuously inactive.

If the error fbbEASG_P is currently pending and has not yet been healed, there is no intervention.

Healing of fbbEASG_P error:

In order to heal the error fbbEASG_P, the intervention for the time fbwEASG_PB must be formally plausible without interruption, the clutch must be in the disengaged state and the CAN suppression must be inactive. During this time, the "Access not possible" bit (S_EGS) remains set. After this time, the resumption conditions (neutral value, etc.) must be reached (mroASGSTAT bit A set) until a new intervention is permitted.

For the transmission, this means that it must carry out the intervention for the time fbwEASG_PB!

ECO mode (mrmASGSTAT (.8) = 1):

In order to reduce consumption, you can switch between the two ASG modes SPORT and ECO. The respective status is sent from the transmission control unit via CAN and mapped in mrmASGSTAT (.8).

In the ECO mode, a torque limiter (see chapter on quantity limitation, figure MEREBG02) and a maximum speed limit are switched on (see chapter on maximum speed limit).

When switching to torque limitation, it must be ensured that the driver is not demanding more torque at this point. This is implemented using a flip-flop.

If the ECO mode is requested via CAN (mrmASGSTAT.8 = 1) and the amount mrmM_EWUNF is less than or equal to the ASG ECO limit amount mrmBM_ASG, the flip-flop is released and mrmASGSTAT(.13) is set.

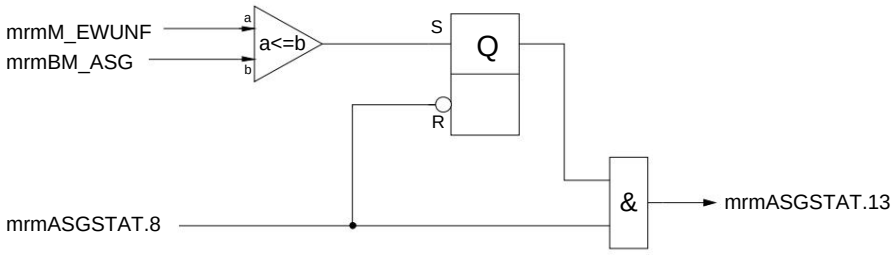


Figure MEREEX17: ASG ECO mode

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Physical plausibility violation of the ASG intervention (mrmASGSTAT.9 = 1):

The intervention is physically implausible when the integral ASG moment *mroMDInAdt*

ASG mroMDInAdt (

exceeds the threshold *mrwMDIntAX .* Where MASG is equal to mroMD_Areg (Momemt to correct the deviation) + mrmMD_Reib (torque to overcome friction) + mroMD_VOR (pre-torque against slippage of the clutch) is limited to 0 and mrwMDASGmx (corresponds to mroMD_ASG). Then the error fbbEASG_H is also reported as defective (if no hide condition is active). The current value of the integral is shown in the OLDA mroMDInAdt.

The ASG moment *MASG* corresponds as long as the integral moment *mroMDInAdt* is below the threshold *mrwMDIntAX ,* the intervention *moment mroMD_ASG.* As soon as the threshold *mrwMDIntAX* is exceeded, the intervention *torque mroMD_ASG* is set to 0 (intervention is aborted mroASGSTAT.9 = 1), but the ASG torque *MASG* = mroMD_Areg + mrmMD_Reib + mroMD_VOR is still limited to 0 and mrwMDASGmx used for the integrated torque.

If the error bit is finally defective, the integral is reduced with the friction torque (MASG = -mrmMD_Reib). The integral is limited to 0 below. If the integral reaches the value 0 and neutral value is sent, the error fbbEASG_H is reported as good.

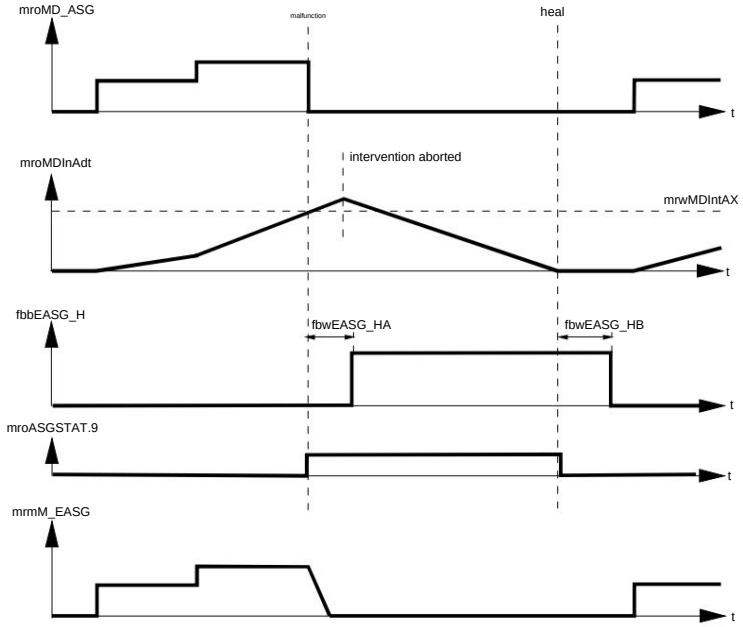


Figure MEREEX16: Physical Plausibility ASG

replacement amount:

Upon termination or termination (see termination conditions) is switched to the replacement amount mroM_EXASG and the intervention amount ASG intervention amount mroM_EASG ramped down to zero. If the ASG-SG also sends the neutral value (LowByte mrmASG_roh = 0), the intervention is immediately terminated without a ramp (mroM_EXASG = 0).

Impact:

The ASG - intervention has a quantity-increasing effect, ie the quantity mroM_EASG is greater than the driver's request mrmM_EWUNF, the quantity mroM_EASG goes into the quantity request mrmM_EWUN.

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Description of the OLDA mroASGSTAT "Status of the ASG - quantity intervention":
(Bits 4-6, B and C from mrmASGSTAT correspond to those of mrmASG_CAN).

Bit position	decimal value	comment
0	1	Quantity intervention by ASG active
1	2	Crowd intervention by ASG via ramp
2	4	No quantity intervention by ASG (ramp final value reached)
4	16	Message error ASG (timeout or message data inconsistent)
5	32	ASG - request bit (intervention moment becomes valid)
6	64	Hide monitoring
7	128	ASG - procedure cannot be carried out (applied away). Subject to one of the following conditions: • mroM_EASGr > (mrmM_EBEGR + mrwM_E_ToG) (intervention quantity is larger than limiting quantity) • mrmASG_CAN bit 7 is set (CAN defect, bus off, message timeout, message inconsistency) • fbbEASG_P (clutch plausibility) or not clutch actuated (dimKUP = 0) and the intervention remained over time fbwEASG_PA also formally plausible (intervention bit set and no error in the message). • Speed too low • Intervention becomes plausible, but bit A is still set (bit A is deleted by sending the neutral value)
9	512	Physical plausibility is violated (moment integral too large) (The bit remains set until the point “Resume of the intervention” described conditions were met.)
A	1024	General plausibility criteria violated. It was after Initialization (K15 On) before the intervention request die Resume conditions not met OR one or more of the following occurred during the procedure Conditions on: (Only if desired raw speed value ÿ 0 and request bit set) • one of the raw values is 0ffh (nsy,tsy) • Message counter error • Binary compliment wrong • mrmASG_CAN bit 7 is set (message error, CAN defect). • Quantity metering errors (see zmmSYSERR.2 Monitoring concept - "summarized system errors") • fbbEASG_P (clutch plausibility) or not clutch actuated (dimKUP = 0) and the intervention remained over time fbwEASG_PA also formally plausible (intervention bit set and no error in the message). • Substitute reaction always takes place without error debouncing. healing with error debouncing. With CAN blanking, the error is neither reported still cured. • Speed too low (The bit remains set until the point “Resume conditions described in the procedure were met.)

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Continuation of the description of the OLDA mroASGSTAT "Status of the ASG - quantity intervention":
(Bits 4-6, B and C from mrmASGSTAT correspond to those of mrmASG_CAN).

Bit position	decimal value	comment
B	2048	Message counter error: the message counter B_COUNT of the last received message does not differ or differs by more than mrwASG_Bmx from the message counter of the latest message (none Check at mrwASG_Bmx=15)
C	4096	Synchronization *time mrmASG_tsy* implausible (raw value = 0FFh)

2.12 Active judder damper

2.12.1 Aisle detection

The aisle recognition takes place centrally. Refer to Idle Control - Gear Detect section.

2.12.2 Parameter set selection

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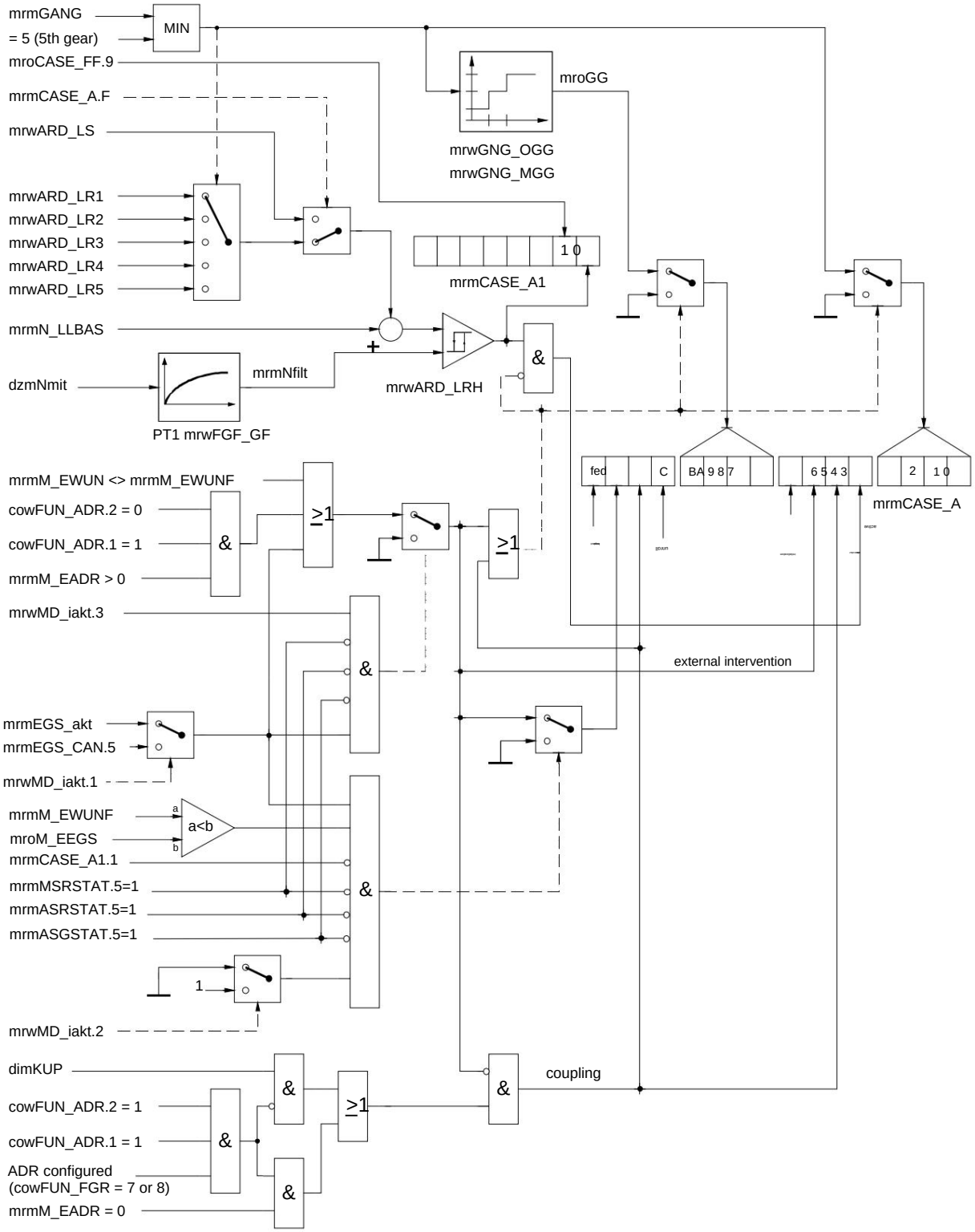


Figure MEREAR01: Parameter set selection for the ARD

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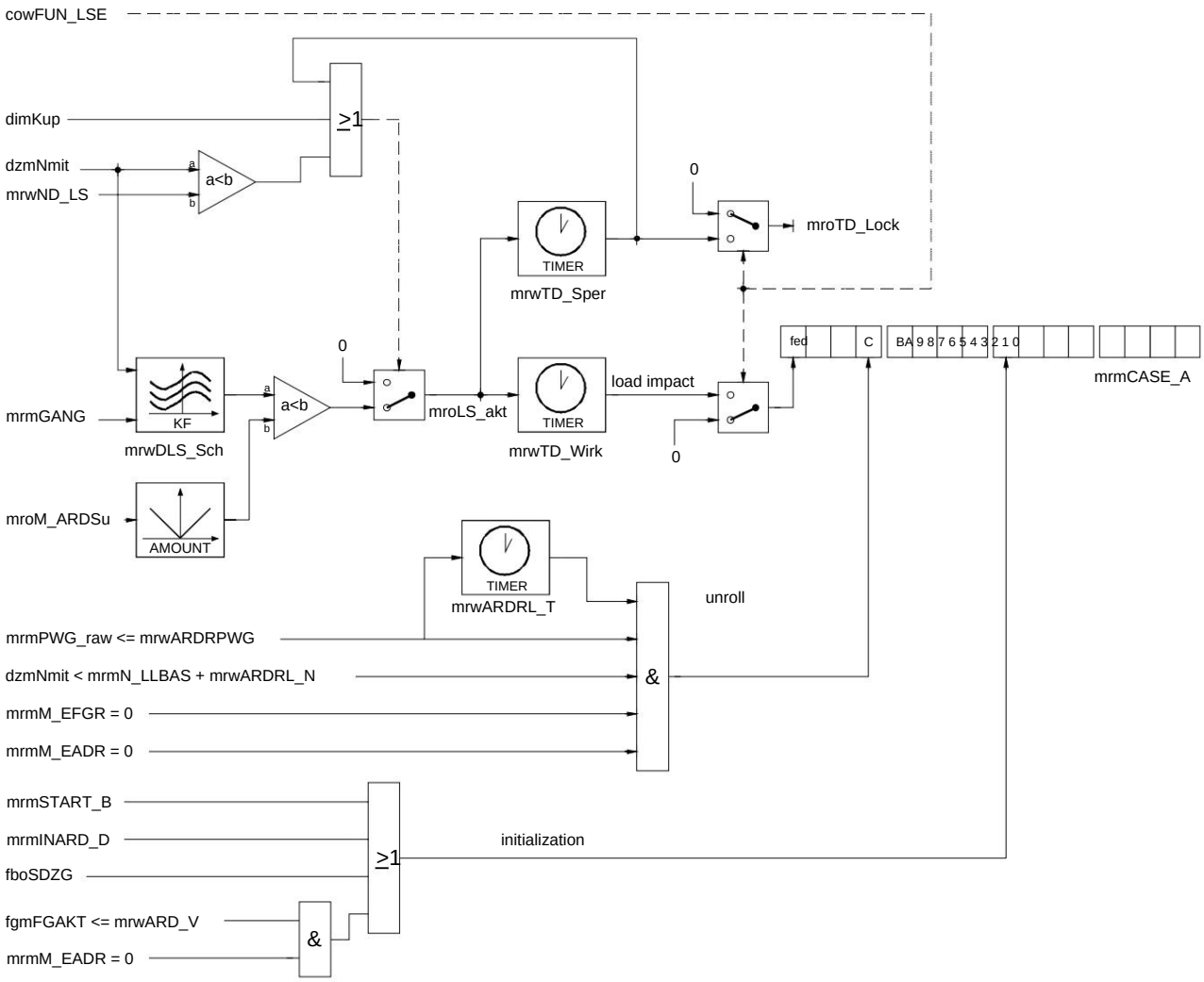


Figure MEREAR11: Parameter set selection 2 for the ARD

In the following, groups of parameters that are assigned to a controller type (e.g. D2T2 element for the disturbance controller, coupling or idling active consisting of: mrwDSKUPK and mrwDSKUPX), for reasons of clarity, only with the structure-determining part of the parameter set name together with "..." (in this example mrwDSKUP...) specified.

Likewise, a specific value from different parameter blocks (e.g. mrwDSKUPK, mrwDSR1GK or mrwDSL1GK) is addressed if its structure-determining part is replaced by ".." (i.e. mrwDS...K). This simplification is possible because the assignment of the controller types to their parameter structures remains unambiguous.

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The Active Rudder Dampener (ARD) consists of a guide shaper and a disturbance controller, which are decoupled from one another. The lead shaper is a PDT1 element (lead-lag element of the first order) with a gradient limitation in a predefinable band range. Input size is the desired target amount mrmM_EWUSO, output the amount mroM_ARDFF. The band in which the gradient limitation is active is spanned around the loss amount calculated from the fuel consumption map. The bandwidth is on the characteristics mrwFPoO_KL and mrwFPuU_KL at pos.

Volume trend and mrwFNoO_KL and mrwFNuU_KL for neg. Volume trend depending on the speed dzmNmit set. The maximum incline can also be applied. at pos.
Quantity tendency is specified on the map mrwFPPA_KF and neg. If there is an external quantity intervention or if the clutch is actuated, mrwFFRaoff is used as the maximum slope.

The disturbance controller is implemented as a D2T2 element, with the ARD speed dzmN_ARD as an input and the limited amount of intervention mroM_ARDSR as an output. The limitation of the disturbance controller component is done by the characteristics mrwARDSoKL as the upper limit and mrwARDSuKL as the lower limit if load impact was not detected. When a load impact is detected, the limit from mrwARDDoKL is switched over as the upper limit and mrwARDDuKL as the lower limit. If the speed dzmNmit exceeds the activation limit mrwND_LS and the clutch is not actuated nor is the blocking timer mroTD_Sper running, the load impact detection is activated. If the amount of the

unlimited output of the D2T2 element is greater than the speed and gear-dependent size from the map mrwDLS_Sch, two timers are started.

The blocking timer with the term mrwTD_Sper switches over mroTD_Sper the limitations of the disturbance controller and prevents a retriggering of the function, the effective timer with the term mrwTD_Wirk switches the disturbance controller to load impact parameters via mrmCASE_A.F.

The load impact detection can be disabled with cowFUN_LSE = 0 to save runtime.

The parameter sets are selected according to the structure of the judder damper, separately for the guide former and disturbance controller and is essentially a function of the ratio of vehicle speed to speed mroVzuNfil and the speed dzmNmit. The parameters of the disturbance controller and ARD guide shapers differ in the higher gears (mroVzuNfil large) only slightly. There is therefore a limitation in the parameter selection, so that from the 5th gear (mrmGANG >= 5) only the parameter sets of the 5th gear are available.

The parameter set "Rolling out" for the disturbance controller and master shaper (status bit C for the Parameter selection in mrmCASE_A) is used under the following conditions:

Driver request amount mrmPWG_roh <= mrwARDRPWG AND

Speed dzmNmit <threshold mrmN_LLBAS + mrwARDRL_N AND

no FGR intervention (mrmM_EFGR = 0) AND

no ADR intervention. (mrmM_EADR = 0) AND

Timer runtime > mrwARDRL_T

The timer starts to run as soon as the mrmPWG_roh value falls below the applicable threshold mrwARDRPWG. The timer is reset as soon as the threshold is exceeded again.

When the clutch is actuated (dimKUP = 1), the clutch parameters are used for the ARD. With external quantity intervention mrmM_EWUNF <> mrmM_EWUN and EGS is active

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on own CAN parameter sets mrwDSCAN... (D2T2 controller coefficient), mrwPSCAN... (D2T2-element memory factor polynomial) for the disturbance controller and, if the ARD-FF CAN parameter set masking is not active, also for the master shaper.

This can be set via the application label mrwMD_iakt.1 whether transmission message mrmEGS_akt ("circuit active") or bit 8 EGS intervention active from the CAN message Transmission 1, shown in mrmEGS_CAN.5 should be used.

If there is only an external quantity intervention (no ASR, MSR, ASG) through the transmission message (mrmEGS_akt or mrmEGS_CAN.5), can through the application label mrwMD_iakt.3 Switching to the ARD parameter “external intervention” can be prevented and the ARD Parameters for the selected gear remain in effect. Do other external crowd interventions occur (ASR,ASG,MSR) but it does cause a switch to the parameter “external intervention".

The corresponding guide shaper parameters are mrwFFCAN ... p, mrwFFCAN ... n and mrwFPCAN_..., mrwFNCAN_... (coefficients for the PDT1 member). Is external crowd intervention or the gearbox is active and the clutch operated at the same time, the CAN parameter sets apply.

In the case of a negative volume trend, non-active ASR, MSR or ASG intervention but active EGS intervention at mrmM_EWUNF <mroM_EEGS via the application label mrwMD_iakt.2 Switching to the guide shaper CAN parameter set can be switched off. Instead of the CAN parameters, the gait parameters are then activated.

This function prevents the injection quantity being suddenly increased by the CAN parameter set mrmM_EARD is lowered to zero mg/stroke, although the external quantity requirement is greater is zero mg/stroke. The current injection quantity is displayed when the CAN parameter set is hidden filtered (gear parameters) tracked the desired quantity.

About the configuration date cowFUN_ADR the ARD is configurable to the ADR (Working speed controller) to support in its regulation. Bit 1 of cowFUN_ADR determines whether the ARD parameter sets are to be used for the ADR. Bit 2 of cowFUN_ADR switches between using the CAN parameter sets and using the gait parameter sets. If bit 2 of cowFUN_ADR is set, then with active ADR (mrmM_EADR> 0) selected the course parameters for the ADR, with inactive ADR (mrmM_EADR = 0) only the clutch parameter set is used. For this purpose, with configured ADR (cowFUN_FGR = 7 or 8, and ADR operation enabled in EEPROM) the clutch hidden. If bit 2 of cowFUN_ADR is not set, then with active ADR (mrmM_EADR > 0) the CAN parameter set is used, with inactive ADR the normal parameter sets are in Depending on the operating status selected.

In the case of the guide shaper, there are 18 sets of parameters for driving and for the clutch to disposal. We put these together as follows:

Coupling: mrwFFKg... / mrwF.Kg._.
Roll out: mrwFFRg... / mrwF.Rg._.
lower gear group: mrwFFUg... / mrwF.Ug._.
middle gear group: mrwFFMg... / mrwF.Mg._.
upper gear group: mrwFFOg... / mrwF.Og._.
increasing volume trend: mrwFF.g..p / mrwFP.g._.
falling volume trend: mrwFF.g..n / mrwFN.g._.
high speed: mrwFF.gO.. / mrwF..gO_.
low speed: mrwFF.gU.. / mrwF..gU_.

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Switching of the guide shaper parameters depending on the filter direction

mrmM_EWUSO - mroM_ARDFF

happens speed-synchronously.

If the filter output is smaller than the filter input, the parameters mrwFF.g.Kp, mrwFF.g.Xp, mrwFP.g._a, mrwFP.g._b and mrwFP.g._c used. Is the filter output greater than the filter input, the parameters mrwFF.g.Kn, mrwFF.g.Xn, mrwFN.g._a, mrwFN.g._b and mrwFN.g._c used. This switch depends on mroCASE_FF.9.

Also the switchover of the command shaper parameters depending on the filtered speed mrmNfilt is speed-synchronous via a hysteresis with the upper limit (as a function of Transmission group) mrwFFUggUO, mrwFFMggUO, mrwFFOggUO or mrwFFKupUO and the Hysteresis width mrwFF_UOH. If the speed hysteresis is active (corresponds to high speed), then the parameters mrwFF.gOK., mrwFF.gOX., mrwF..gO_a, mrwF..gO_b and mrwF..gO_c used. If the speed hysteresis is inactive, the parameters mrwFF.gUK., mrwFF.gUX., mrwF..gU_a, mrwF..gU_b and mrwF..gU_c used. This switch depends on mroCASE_FF.8 from.

Condition mroCASE_FF xxxx xx1x xxxx xxxx		time constant	P gain
> 0 mrmM_EWUSO - mroM_ARDFF <= 0 xxxx xx0x xxxx xxxx mrwFN.g._a, _b, _c xxxx xxx1		mrwFP.g._a, _b, _c mrmM_EWUSO - mroM_ARDFF	mrwFF.g.Kp
xxxx xxxx mrwF.gO_a , _b, _c High speed hysteresis Low speed hysteresis			mrwFF.g.Kn
			mrwFF.gOK.
	xxxx xxx0 xxxx xxxx mrwF.gU_a , _b, _c		mrwFF.gUK.

There are also separate parameter sets for driving when idling, depending on the Ratio of driving speed to speed mroVzuNfil available. The switch between "ARD bucking" (LLR not engaged) and "ARD idling" (LLR engaged). speed-dependent by means of gear-dependent thresholds mrwARD_LR1 to mrwARD_LR5 and the Threshold for load impact mrwARD_LS and the hysteresis mrwARD_LRH. The condition "ARD Idling" is in the case of "no load impact detected" depending on the detected gear mrmGANG when falling below the speed threshold (mrmN_LLBAS + mrwARD_LR.) activated, when exceeding (mrmN_LLBAS + mrwARD_LR. + mrwARD_LRH) on "ARD Jerking "switched. If the state "load shock" before (mrmCASE_A.F) is for the Calculation of the speed threshold of the parameters mrwARD_LS instead of a gear parameter used. The speed range determined via the hysteresis is displayed in mrmCASE_A1.0.

Gear in gear	speed condition for "ARD idle"	speed condition for "ARD bucking"
mrmGANG = 1 n	< mrmN_LLBAS + mrwARD_LR1 n >	mrmN_LLBAS + mrwARD_LR1 + mrwARD_LRH
mrmGANG = 2 n	< mrmN_LLBAS + mrwARD_LR2 n >	mrmN_LLBAS + mrwARD_LR2 + mrwARD_LRH
mrmGANG = 3 n	< mrmN_LLBAS + mrwARD_LR3 n >	mrmN_LLBAS + mrwARD_LR3 + mrwARD_LRH
mrmGANG = 4 n	< mrmN_LLBAS + mrwARD_LR4 n >	mrmN_LLBAS + mrwARD_LR4 + mrwARD_LRH
mrmGANG = 5 n	< mrmN_LLBAS + mrwARD_LR5 n >	mrmN_LLBAS + mrwARD_LR5 + mrwARD_LRH
mrmCASE_A.F n	< mrmN_LLBAS + mrwARD_LS n >	mrmN_LLBAS + mrwARD_LS + mrwARD_LRH

The disturbance controller is initialized when one of the conditions is met:

- Start bit mrmSTART_B = 1 OR
- Speed sensor defective fboSDZG <> 0 OR

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- ARD-D initialization request mrmINARD_D <> 0 through external crowd intervention

OR

- Driving speed fgmFGAKT <speed threshold mrwARD_V for speed branch initialization

AND

Quantity request all-speed controller mrmM_EADR=0.

Value range of the OLDA status bits of the active jerk damping mrmCASE_A (in the high byte hexadecimal coded: Selection of guide shaper parameter set; hexadecimal coded in the low byte: Selection of disturbance controller parameter set; Low byte bit 7: disturbance controller switched off and initialized):

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bitmask	ValueHex	Active parameters
0000 0001 0000 0000	0100	lower transmission group Guide shaper parameter set = mrwFFUg...., mrwF...Ug....
0000 0010 0000 0000	0200	middle gear group Guide shaper parameter set = mrwFFMg...., mrwF...Mg....
0000 0011 0000 0000	0300	upper gear group Guide shaper parameter set = mrwFFOg...., mrwF...Og....
0001 0000 0000 0000	1000	"roll out" Disturbance controller parameter set = mrwDSROLK, mrwDSROLX mrwPSROL_a, mrwPSROL_b, mrwPSROL_c Guide shaper parameter set= mrwFFRg..., mrwF...Rg...
0010 0000 0000 0000	2000	clutch or idle gear Guide shaper parameter set = mrwFFKg..., mrwF...Kg... .
0100 0000 0000 0000	4000	external crowd intervention Guide shaper parameter set = mrwFFCan..., mrwF...CAN...
1000 0000 0000 0000	8000	load impact detected Disturbance controller parameter set = Low speed, falling amount: mrwDSLLSn .., mrwPSLLSn .. Speed high, amount falling: mrwDSRLSn .., mrwPSRLSn .. Low speed, increasing amount: mrwDSLLSp .., mrwPSLLSp .. High speed, increasing amount: mrwDSRLSp .., mrwPSRLSp ..
0000 0000 000X 0001	0001	1st gear Disturbance controller parameter set = mrwDS...1GK, mrwDS...1GX mrwPS...1G_a, mrwPS...1G_b, mrwPS...1G_c
0000 0000 000X 0010	0002	2nd gear Disturbance controller parameter set = mrwDS...2GK, mrwDS...2GX mrwPS...2G_a, mrwPS...2G_b, mrwPS...2G_c
0000 0000 000X 0011	0003	3rd gear Disturbance controller parameter set = mrwDS...3GK, mrwDS...3GX mrwPS...3G_a, mrwPS...3G_b, mrwPS...3G_c
0000 0000 000X 0100	0004	4th gear Disturbance controller parameter set = mrwDS...4GK, mrwDS...4GX mrwPS...4G_a, mrwPS...4G_b, mrwPS...4G_c
0000 0000 000X 0101	0005	5th gear Disturbance controller parameter set = mrwDS...5GK, mrwDS...5GX mrwPS...5G_a, mrwPS...5G_b, mrwPS...5G_c

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bitmask	ValueHex	Active parameters
0000 0000 0001 XXXX	0010	Idle controller active Disturbance controller parameter set = mrwDSL...K, mrwDSL...X mrwPSL..._a, mrwPSL..._b, mrwPSL..._c
0000 0000 0010 0000	0020	clutch operated Disturbance controller parameter set = mrwDSKUPK, mrwDSKUPX mrwPSKUP_a, mrwPSKUP_b, mrwPSKUP_c
0000 0000 0100 0000	0040	external quantity intervention Disturbance controller parameter set = mrwDSCANK, mrwDSCANX mrwPSCAN_a, mrwPSCAN_b, mrwPSCAN_c
0000 0000 1000 0000	0080	Initialize fault controller

Value range of the extended status bits of the active bucking mrmCASE_A1
hexadecimal coded:

bitmask	ValueHex	Active parameters
0000 0001	01	upper speed range
0000 0010	02	positive volume trend
xxxx xx00		not used

The parameter set selection for the ARD is done when driving in the gears using the Ratio speed / speed (mroVzuNfil). In the case of the disturbance controller, the engaged gear (mrmGANG) the corresponding parameter set, taking into account the State "ARD idle" or "ARD bucking" selected.

In the case of the guide shaper, 22 parameter sets are available, with 2 (“amount tendency increasing/decreasing") for "external quantity intervention". When driving in the gears, one of three transmission groups is inferred. Per gear group and for "Coupling" and for the state of coasting, 4 parameter sets are provided (2 times "Amount tendency falling/rising" in combination with "high/low speed").

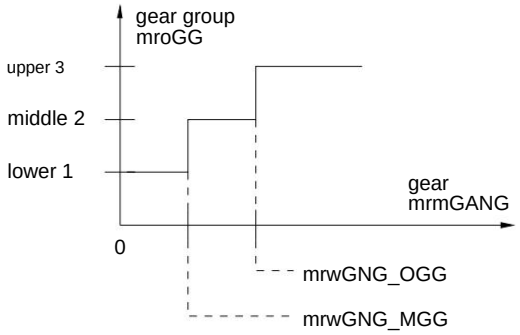


Figure MEREAR03: Parameter set selection for the guide shaper

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2.12.3 Control Algorithm

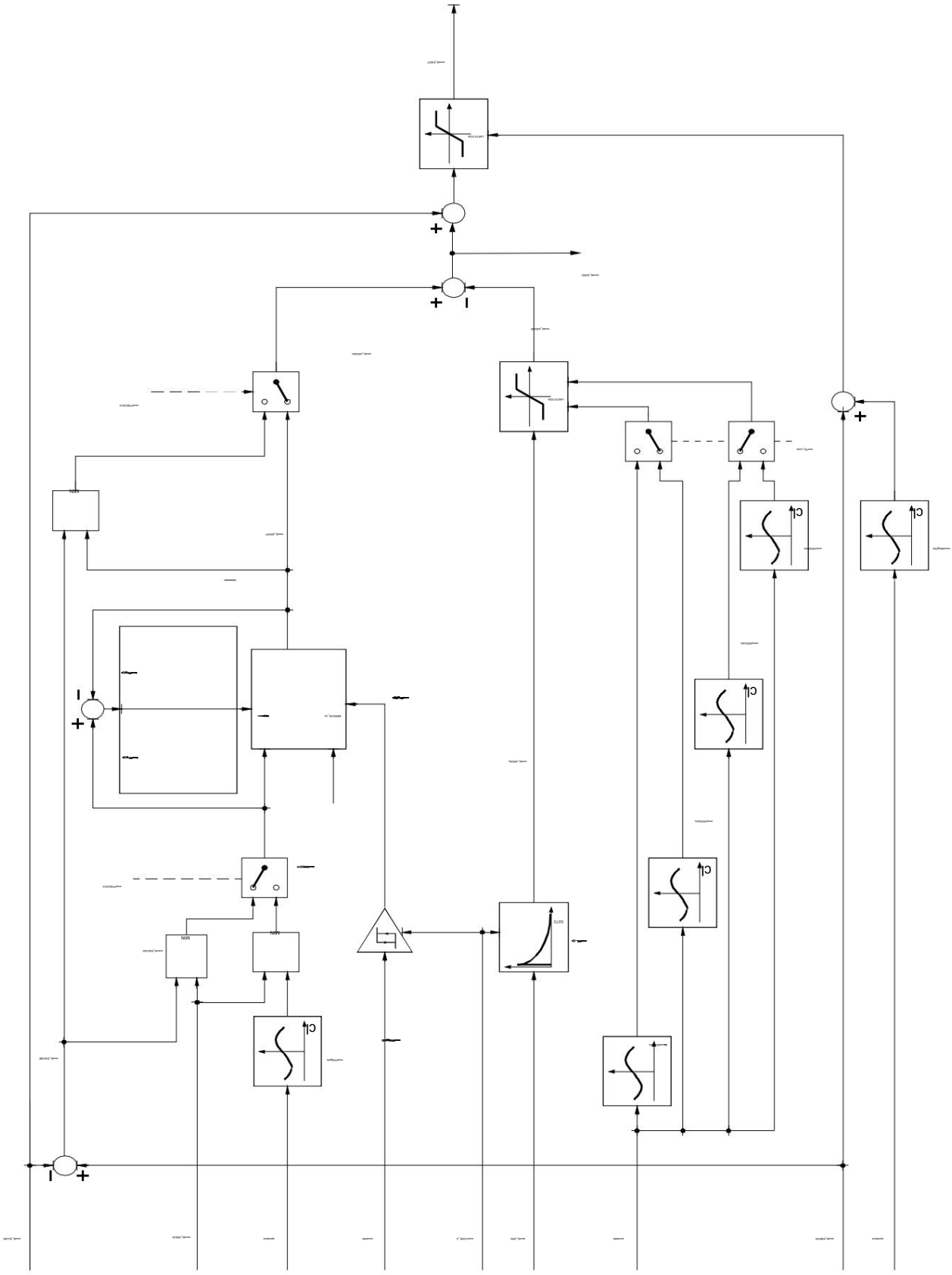


Figure MEREAR04: Active judder damper

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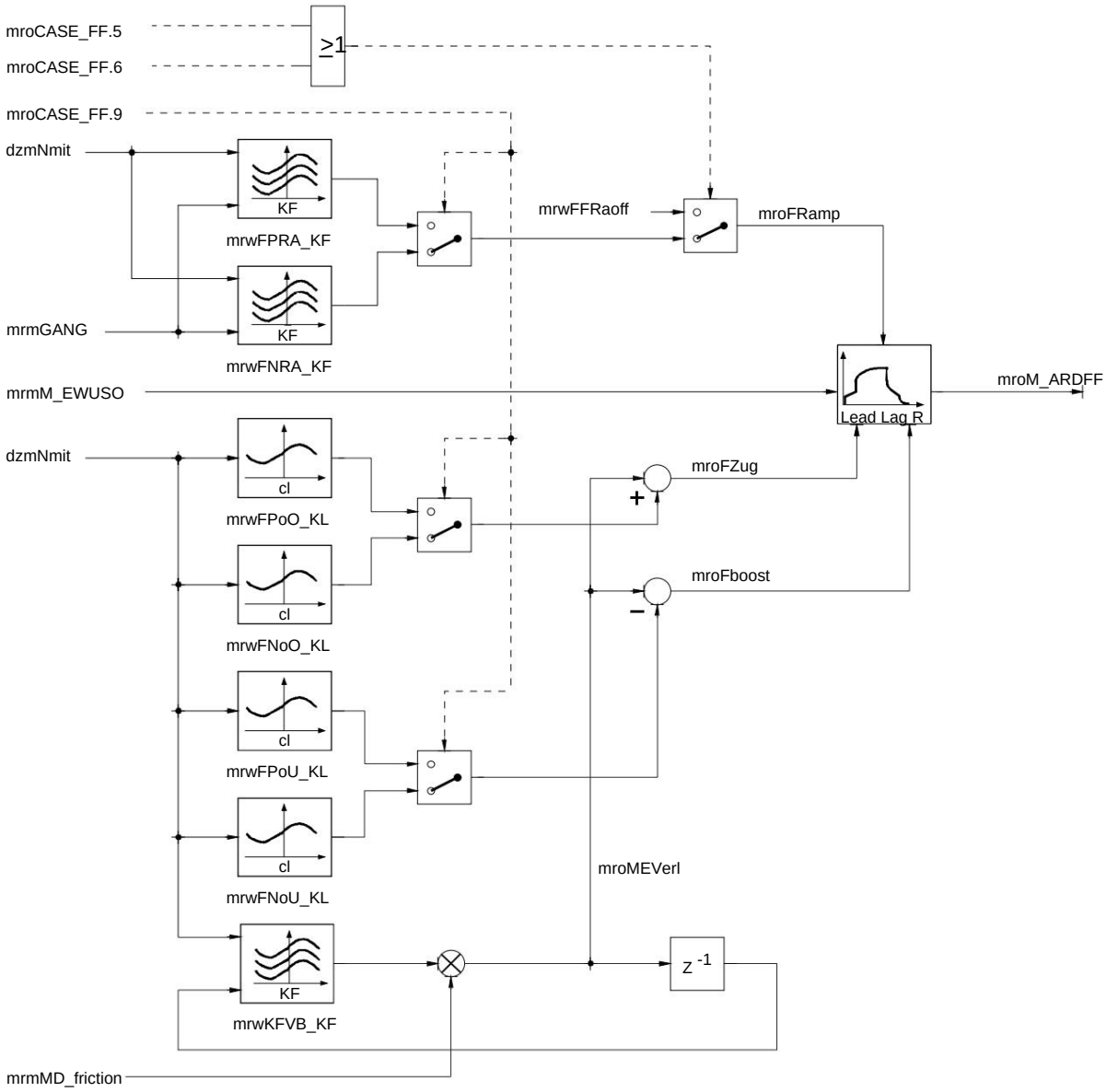


Figure MEREAR14: Lead-lag term with slope limitation

The active judder damper dampens the speed fluctuations that occur as a result of the vehicle's (drive train) repercussions on the engine by influencing the fuel quantity. It consists of a D2T2 element with asymmetrical limitation (fault controller/speed branch) and a PDT1 element with gradient limitation (reference shaper/quantity branch).

The mrwFFBGSCH switch can be used to select the input variable of the guide shaper mrmM_EWUSO:

Driver's desired amount limited by limiting amount mroMEBEGR (limitation by torque and smoke map mrwFFBGSCH = 0).

Driver's desired amount limited by characteristic mrwFFBgrKL (mrwFFBGSCH = 1).

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The parameters are selected synchronously for the fault controller (see Chapter
parameter set selection). With external quantity intervention, the CAN parameter sets are adopted immediately.
Only then are the clutch parameters displayed when the clutch is actuated
accepted if there is no longer any external quantity intervention. The switch to
Load impact parameters occurs when load impact has been detected and neither the parameter sets for
external quantity intervention, coasting or clutch are active. When transitioning from “external
Quantity intervention" to "driving in gear" become the specific gear parameters in the speed branch
taken over immediately. When changing from "clutch operated" to "driving in gear".
the specific gear parameters are only used in the speed branch if the output variable of the
disturbance controller has changed its sign. When changing from "driving in gear" to "clutch
actuated" or "external quantity intervention" the respective parameter sets are activated immediately
accepted.

Condition	mroCASE_SR	D2T2 link	T polynomial
External quantity intervention (CAN) 01000000 see		mrwDSCAN.	mrwPSCAN.
coasting	mroCASE_FF mrwDSROL.		mrwPSROL.
clutch + no external quantity intervention + no VZ change + no roll out	00100000	mrwDSKUP.	mrwPSKUP.
load impact Speed low, volume falling Speed high, volume falling Speed low, quantity increasing Speed high, quantity increasing	see mroCASE_FF and mrmCASE_A1	mrwDSLLSn.mrwDS RLSn.mrwDSLLSp. mrwDSRLSp.	mrwPSLLSn. mrwPSRLSn. mrwPSLLSp. mrwPSRLSp.
5th gear + LLR inactive 4th	00000101	mrwDSR5G.	mrwPSR5G.
gear + LLR inactive 3rd gear	00000100	mrwDSR4G.	mrwPSR4G.
+ LLR inactive 2nd gear +	00000011	mrwDSR3G.	mrwPSR3G.
LLR inactive 1st gear + LLR	00000010	mrwDSR2G.	mrwPSR2G.
inactive 5th gear + LLR active	00000001	mrwDSR1G.	mrwPSR1G.
4th gear + LLR active 3rd	00010101	mrwDSL5G.	mrwPSL5G.
gear + LLR active 2nd gear +	00010100	mrwDSL4G.	mrwPSL4G.
LLR active 1st gear + LLR	00010011	mrwDSL3G.	mrwPSL3G.
active errors in mrmCASE_A	00010010	mrwDSL2G.	mrwPSL2G.
	00010001	mrwDSL1G.	mrwPSL1G.
	11111111	mrwDSKUP.	mrwPSKUP.

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The aisle-dependent selection of the parameters of the guide shaper is time-synchronous; the Distinction between the parameters for positive and negative volume trend as well as between high and low speed is speed synchronous.

Condition	mroCASE_FF	lead lag	T polynomial
Roll out, positive volume trend, n low 0000 0000	0000 0010 0001 0000 mrwFFRgU.p mrwFPRgU_.		
Roll out, negative volume trend, n low 0000 0011	0001 0000 mrwFFRgU.n mrwFNRgU_.		
Roll out, positive volume trend, n to the power of	0001 0000 mrwFFRgO.p mrwFPRgO_.		
Roll out, negative volume trend, n high clutch,	0000 0001 0001 0000 mrwFFRgO.n mrwFNRgO_.		
positive volume trend, n low 0000 0010 0010 0000 mrwFFKgU.p mrwFPKgU_.			
Clutch, negative volume trend, n low Clutch, positive	0000 0000 0010 0000 mrwFFKgU.n mrwFNKgU_.		
volume trend, n high 0000 0011 0010 0000 mrwFFKgO.p mrwFPKgO_.			
Clutch, negative volume trend, n high Upper GG,	0000 0001 0010 0000 mrwFFKgO.n mrwFNKgO_.		
positive volume trend, n low 0000 0010 0000 0011 mrwFFOgU.p mrwFPOgU_.			
Upper GG, negative volume trend, n low Upper GG,	0000 0000 0000 0011 mrwFFOgU.n mrwFNOgU_.		
positive volume trend, n high 0000 0011 0000 0011 mrwFFOgO.p mrwFPOgO_.			
Upper GG, negative volume trend, n high Middle	0000 0001 0000 0011 mrwFFOgO.n mrwFNOgO_.		
GG, positive volume trend, n low 0000 0010 0000 0010 mrwFFMgU.p mrwFPMgU_.			
Medium GG, negative volume trend, n low Medium	0000 0000 0000 0010 mrwFFMgU.n mrwFNMgU_.		
GG, positive volume trend, n high 0000 0011 0000 0010 mrwFFMgO.p mrwFPMgO_.			
Middle GG, negative volume trend, n high Lower	0000 0001 0000 0010 mrwFFMgO.n mrwFNMgO_.		
GG, positive volume trend, n low 0000 0010 0000 0001 mrwFFUgU.p mrwFPUgU_.			
Lower GG, negative volume trend, n low Lower GG,	0000 0000 0000 0001 mrwFFUgU.n mrwFNUgU_.		
positive volume trend, n high 0000 0011 0000 0001 mrwFFUgO.p mrwFPUgO_.			
Lower GG, negative volume trend, n high Ext.	0000 0001 0000 0001 mrwFFUgO.n mrwFNUgO_.		
volume intervention, positive volume trend 0000 0010 0100 0000 mrwFFCAN.p mrwFPCAN_.			
Ext. Quantity intervention, negative quantity	0000 0000 0100 0000 mrwFFCAN.n mrwFNCAN_.		
tendency error in mrmCASE_A, positive quantity tendency 1111 1111 1111 1111 mrwFFKup.p mrwFPKUP_.			
Error in mrmCASE_A, negative volume trend 1111 1111 1111 1111 mrwFFKup.n mrwFNKUP_.			

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2.13 Volume Balancing Scheme

2.13.1 Task and Overview

The purpose of the quantity balancing control (MAR) is to ensure that the indicated torques of all Z cylinders are the same ('cylinder equalization', 'quantity equalization'). When idling and in the lower engine speed range, driving comfort and smoothness should be guaranteed - as with the use of the previous smoothness control (LRR).

The superimposition of the frequency components with camshaft frequency (= half the engine order) and their integer multiples less than or equal to the half the firing frequency is used. Tooth pitch errors of the speed sensor wheel are corrected beforehand and torsional influences are suppressed by filters and compensated by modified sensor wheel adaptation.

The active range of the MAR can be applied in the speed range from idling to a maximum speed and in the entire load range. This applies to the 'neutral' and 'disengaged' states as well as driving in all gears. Depending on the motor type, the maximum speed is between 3000 rpm and the nominal speed.

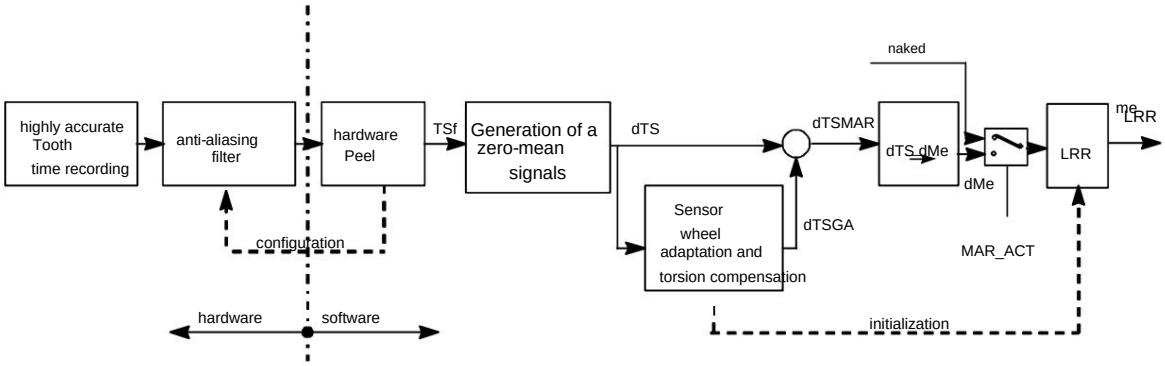


Figure MEREMR01: The structure of the MAR

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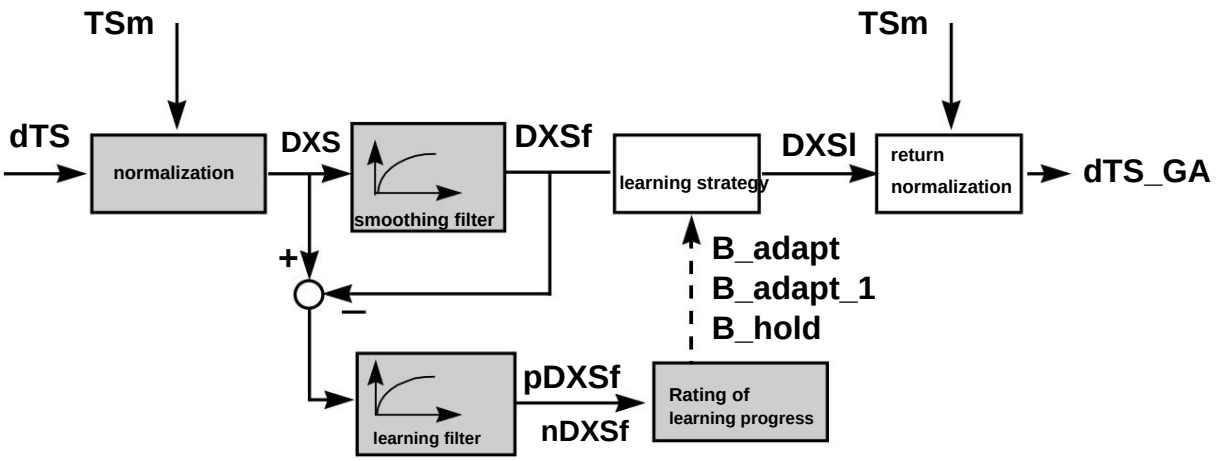


Figure MEREMR02: The functional structure of the encoder wheel adaptation and torsional compensation.

2.13.1.1 Measurement channels:

labels	long identifier
dzoTS_AKT MAR: output hardware shell after FIR filter [400ns]	
*dzoDXS** MAR: Current normalized segment deviation	
*dzoDXSf** MAR: Filtered normalized segment deviation	
*dzopDXSf** MAR: Learning filter 1	
*dzonDXSf** MAR: Learning filter 2	
*dzoDXSl** MAR: Learning result storage	
dzoDXadapt MAR: Current learning assessment	
dzoBadapt MAR: Learning progress status	
dzoMAR_ST MAR: Status of the MAR	
dzoIDX_N MAR: Current speed range	
dzoIDX1 MAR: First learned speed range	
dzmdMe MAR: Quantity error assessment	
dzmLRR_ST MAR: Status of sensor wheel adaptation to the LRR	

*) These are the base values of Olda arrays. The names of the individual values are composed as follows together:

<olda base name> <index>

Index runs from "0" to "2Zmax - 1"

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2.13.1.2 Fixed values applicable:

labels	long identifier
dzwDYN_GR	MAR: Switch off dynamic limit value for LEARNING
dzwT_F	MAR: Filter constant smoothing filter
dzwT_FLRN	MAR: Filter constant learning filter
dzwDXadptU	MAR: Lower threshold learning assessment
dzwDXadptO	MAR: Upper threshold learning assessment
dzwN_GR0	MAR: Lower speed threshold for sensor wheel adaptation
dzwN_GR1	MAR: Medium speed threshold for sensor wheel adaptation
dzwN_GR2	MAR: Upper speed threshold for sensor wheel adaptation
dzwN_GA	MAR: upper n-threshold for LRR without sensor wheel adaptation
dzwMAR_AKT MAR: Activation of the MAR	
mrwLRR1INSW LRR segment number for n > dzwN_GA 1-fold f NW	
mrwLRR2INSW LRR segment number for n > dzwN_GA 2-fold f NW	
mrwLRR3INSW LRR segment number for n > dzwN_GA triple f NW	
mrwLRR4INSW LRR segment number for n > dzwN_GA 4-fold f NW	

The labels dzwTSm_M0..1, dzwALF0, dzwN_HYST, dzwDN_NORM, dzwMAR_FSW, dzwMAR_FIO, dzwMAR_ANZ, dzwMAR_GRD and dzwMAR_A0..4 contain among other things Configuration values for the anti-aliasing filter and must therefore not be changed.

2.13.2 Functional description

2.13.2.1 Description of the sub-functions of the MAR

2.13.2.1.1 Highly accurate time tracking

For its function, the MAR requires a very precise measurement of the engine speed or the period of a segment. Due to the 60-2 gear wheel, the speed cannot be directly measured, but only the time between a certain number of teeth (sub-segment). The entire MAR therefore does not work with speeds up to the arrival of the LRR but only with times. So that these times even through a low-pass filter of higher frequencies Shares can be freed, they will also be released with a correspondingly higher frequency (in the form of sub-segment - times). This highly accurate time recording is carried out by an ASIC.

2.13.2.1.2 Anti-aliasing filtering

The anti-aliasing low-pass filtering (filtering out higher frequency components than half Sampling frequency) also takes place in this ASIC and is implemented by an FIR filter whose Order and filter coefficients are adjustable.

2.13.2.1.3 Hardware shell

The hardware shell has the task of pre-processing the sub-segment times by the FIR filter for the rest of the software to a uniform value (independent of the number of cylinders and filters). standardize This software calculates in the normal segment grid, which means that it performs an additional scan of the filtered values supplied by the ASIC.

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2.13.2.1.4 Generation of a mean-free signal For

the MAR as for the LRR, speed changes and thus changes in the segment times, which are caused by different indicated torques of the individual cylinders, are decisive. A mean segment time TSm is therefore calculated and subtracted from the segment time TS in order to then only process deviations dTS from the mean value TSm.

2.13.2.1.5 Calculation of the quantity error evaluation

dMe The quantity error evaluation converts the time differences dTS_MAR of the input signal, in which the disruptive influences of encoder wheel pitch errors and crankshaft torsion have already been eliminated, into speed differences and scales them with the number of cylinders and with Gain adjustment fixes.

When MAR is switched on (via the *dzwMAR_AKT* switch, dMe acts on the downstream smooth-running control, alternatively when MAR is switched off, the smooth-running control is fed directly with Nakt as before, although changes to the application are required.

dzwMAR_AKT:

value	**meaning**
0	MAR not active
1	MAR active

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2.13.2.2 Description of the sub-functions sensor wheel adaptation and torsion compensation

2.13.2.2.1 Normalization

Denotes the reference of the segment time differences to the current average segment time *TSm.* This means that times are dimensionless and speed-independent passed:

DXS = dTS / TSm = ÿÿ / ÿ

where *DXS = /* error is ÿÿ ÿ the relative angular error of a segment, i.e. the relative encoder wheel denoted.

2.13.2.2.2 Smoothing and Learning Filters

The relative sensor wheel errors *DXS* obtained from the normalization are now segment -specific low-pass filtered (output: DXSf), ie there are a total of 2Z (Z: number of cylinders) low-pass filters (smoothing filter). The difference between the input and output of these filters is now reduced to two further low-pass filters connected in parallel (training filters pDXSf and nDXSf) are given, but which ones start with different initial conditions:

One filter starts at the positive, the other filter at the negative maximum deviation.

The absolute maximum of these 4Z learning filters (pDXSf and nDXSf each 2Z times) now represents a measure for the quality of the learning process and is therefore used for the state control of the learning process used. If the maximum amount of these 4Z filter outputs falls below a certain Limit value, if the DXSf values are taken over in the learning memory DXSl, exceeds it on the other hand, an upper threshold value, the learning process is stopped.

2.13.2.2.3 Renormalization

The renormalization of the taught-in relative encoder wheel error DXS takes place with the middle one Segment time TSm, the result of this operation is the correction time dTS_GA.

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2.14 Smooth running controller

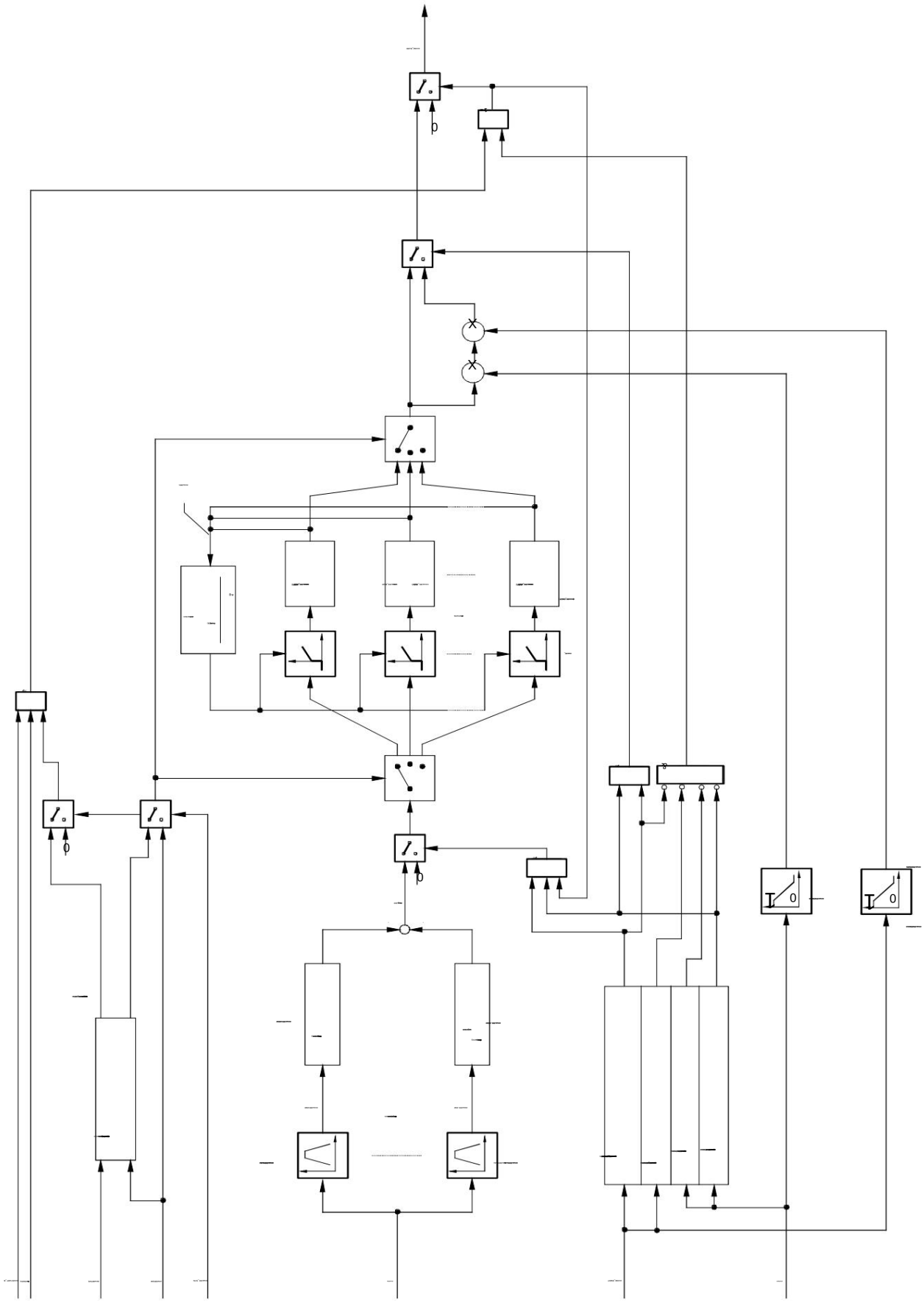


Figure MERELR01: smooth running controller

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The smooth-running control regulates the speed fluctuations of the injection system, which result from different cylinder injection quantities and cylinder efficiencies, in the speed range below the first segment suppression. This is done by quickly switching on regulated corrective injection quantities for each cylinder. From the different quantity error evaluations *dzmdMe* can be derived when the correction *quantity mrmM_ELRR* is to be issued for the next cylinder.

Perfect synchronization is required for smooth running control to function correctly.
It is present when sampling time maxima each fall on the same values of the message segment number zmoSEGM. The synchronization can take place internally, ie by the LRR itself, or externally using a synchronous segment counter zmoSEGM. The method for realizing the synchronization can be selected by the applicable label *mrwLRR_SYN .*

mrwLRR_SYN	synchronization procedure
0	Internal synchronization according to the sampling time minima or maxima
1	synchronization by external segment counter; Ignition occurs at odd segment counts
2	Synchronization by external segment counter, ignition takes place with even segment counter readings

If internal synchronization *mrwLRR_SYN* = 0 is selected, the smooth-running controller detects asynchronous if within *mrwLRR_SEG* segments twice the sampling time maximum dzoABTAS coincide with unforeseen segment counts. Then the controller integrators are initialized and the band-pass filters are resynchronized.

Outside the speed window lower speed *limit mrwLRNRMIN* and upper speed *limit mrwLRNSMAX* and outside the amount window lower limit *mrwLRMSMIN* and upper limit *mrwLRMSMAX there* is no quantity intervention of the smooth-running controller. The smooth running is regulated when the speed is in the range of *mrwLRNRMIN* to *mrwLRNRMAX* and the motor *quantity mrmM_EMOT* is between *mrwLRMRMIN* and *mrwLRMRMAX .* If none of the switch-off conditions are met and the speed is in the range *mrwLRNRMAX* to mrwLRNSMAX or the current amount is between mrwLRMRMAX and mrwLRMSMAX or mrwLRMSMIN and mrwLRMRMIN, smooth running is controlled. In the smooth-running control, the frozen integrator values are linearly weighted depending on the speed dzoNmit or the amount *mrmM_EMOT .* At speeds less than or equal to mrwLRNRMAX, the rating is 1, from *mrwLRNSMAX* 0. The brand *mrwLRNSMAX* must be below the speed threshold for the first segment masking. Equivalent to the speed, the weighting is a function of the engine quantity, with the labels *mrwLRMRMAX* and *mrwLRMSMAX* or *mrwLRMRMIN* and *mrwLRMSMIN being* relevant here. The amount of smooth running that is output is determined from the integrator amount multiplied by both weighting factors. At start condition *mrmSTART_B* = 1, at speed *sensor defect fboSDZG* <> 0 or at engine standstill dzoNmit = 0, the integrators and bandpass filters are initialized. The band-pass filters are initialized at speeds dzoNmit which are above the first segment blanking.

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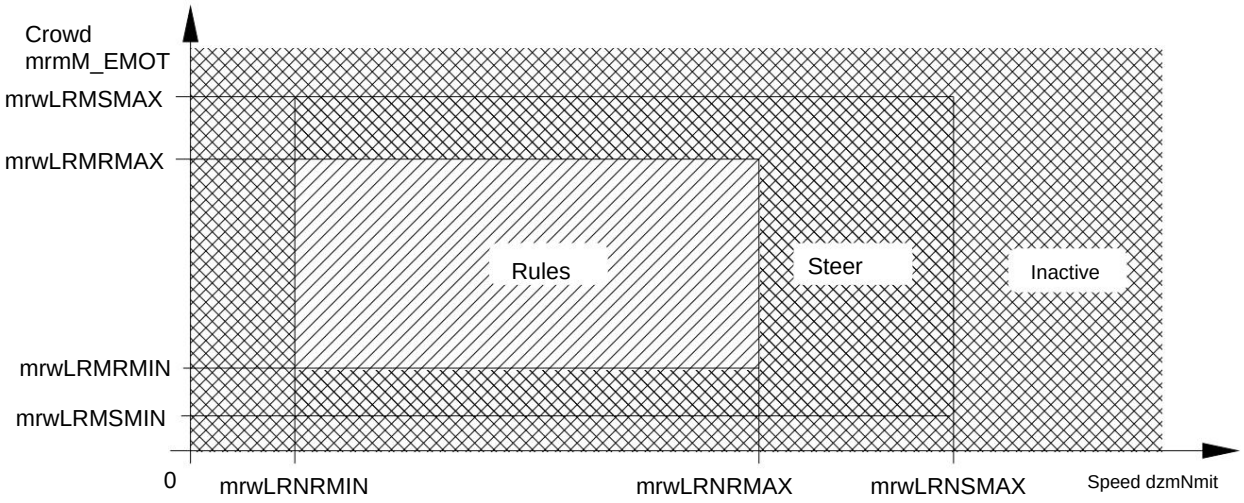


Figure MERELR02: Smooth running controller work area

The state of the smooth-running controller can be recognized from the OLDA output *mroLRRZust .*

mroLRRCondition	condition description
1	Segment masking active (e.g. 4-cylinder dzoNmit>2500/min) OR MAR initialization request
2	Start bit set, speed sensor defective or motor standstill
3	Initialization of the internal synchronization detection
4	LRR inactive because engine *amount mrmM_EMOT* too high
5	LRR inactive because engine *amount mrmM_EMOT* too low
6	LRR inactive, speed dzoNmit on upper control limit *mrwLRNSMAX*
7	LRR inactive, speed dzoNmit under lower control limit *mrwLRNRMIN*
8th	sync Error found; new synchronization
9	Smooth running control active
10	Smooth running control active

z (one per cylinder) PI controllers are used for the adjustment. The calculation of
Correction quantity takes place one interrupt before the injection in the cylinder under consideration. To the
Calculation of the deviation *mroLRRReg* is the quantity error assessment *dzmdMe*
Bandpasses filtered. The center frequencies of the z/2 band-pass filters are integer multiples of
Nockenwellenfrequnz , with the choice of filter *gain mrwLRRN .. B* different
Distance gains for the individual frequencies can be realized. Each band pass is
followed by a segment evaluation. The parameters *mrwLRR..NSW* for smooth running control without
Geber wheel adaptation (smooth-running *controller status dzmLRR_ST* = 0) or *mrwLRR..INW* for
Smooth-running control with sensor wheel adaptation *(dzmLRR_ST* = 1) give the selection and weighting of
segments for the specific frequency. The smooth running *controller status dzmLRR_ST* is through the

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Quantity equalization regulation (MAR) set. The sum of all outputs of the segment assessments form the control deviation *mroLRRReg.*

The smooth-running integrators and the manipulated variables for all cylinders are limited to the LRR limiting amount *(+/-)mroLLR_BGR* via the motor quantity-dependent characteristic curve *mrwLRR_BGR (mroLRR_BGR* = f *(mrmM_EMOT))* . Furthermore, the smooth-running integrators are corrected every two engine revolutions in order to keep the smooth-running quantity proportion equal to zero on average.

Under certain operating conditions of the engine or the vehicle, the system switches to smooth-running control. During the control, the smooth-running integrator values are frozen and evaluated with a speed-dependent and engine quantity-dependent factor.

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3 exhaust gas recirculation

3.1 Overview

Exhaust gas recirculation consists of five tasks: actual value calculation, target value calculation, regulation, parallel control and monitoring and shutdown.

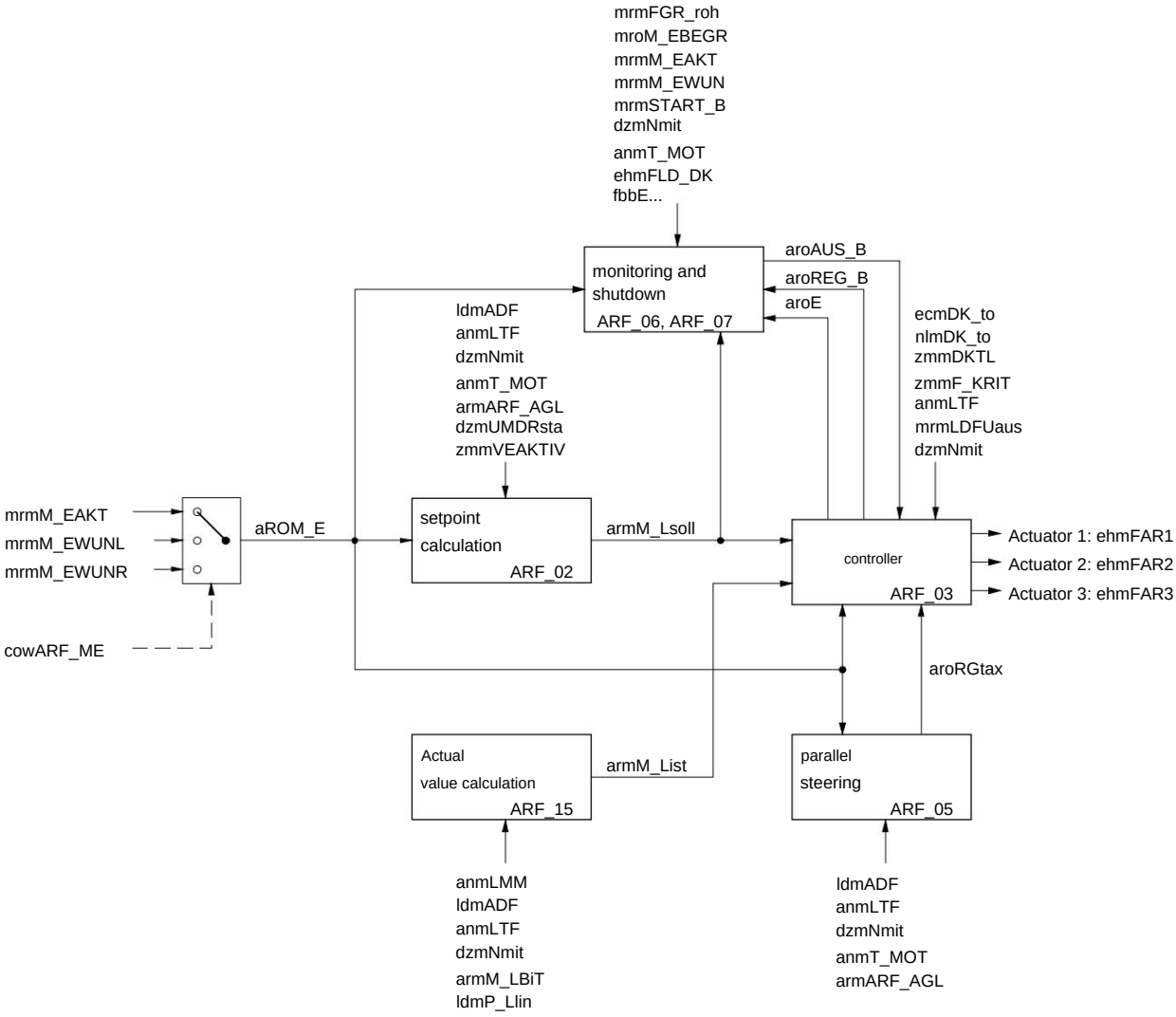


Figure ARF_01: Structure of the exhaust gas recirculation

With the software switch cowFUN_ARF the exhaust gas recirculation is switched on or off (0 = switched off, 1 = switched on)

With the software switch cowARF_ME you determine which fuel quantity signal should be used. The sub-functions then work with the set armM_E.

Description of the software switch ARF - quantity input request cowARF_ME:

decimal value	comment
1	current injection quantity
2	Desired quantity + idle quantity
3	Desired quantity raw + idle quantity

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3.2 Actual Value Calculation

Calculating the air mass from the air volume:

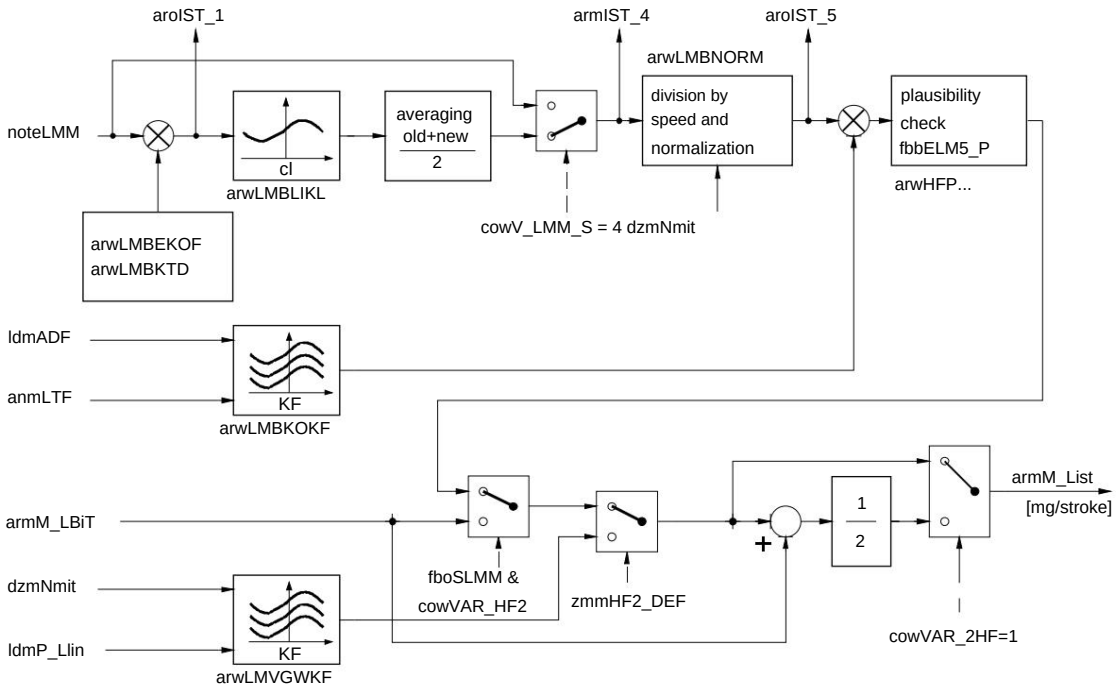


Figure ARF_15: Air mass calculation from the analogue value

The non-ratiometric after switching on errors that occur

Hot film air mass meter (cowV_LMM_S = 1) is multiplicative by means of the switch-on correction balanced. The switch-on correction is made using the factor arwLMBEKOF and the time constant arwLMBEKTD applied. The time starts when the first speed > 0 is detected.

$$1\ aroIST\ anmLMM\ arwLMBEKOF\ 1 + \qquad arwLMBEKOF\ ( ) \qquad * \frac{t}{arwLMBKTD}$$

applies to all t <= arwLMBEKTD

For a cowV_LMM_S = 1 or 3, this correction must be shut down application-wise. For cowV_LMM_S = 4, this switch-on correction is never active, since the air volume is already linearized and averaged into the air mass calculation.

The input signals corrected in this way are linearized via the correction characteristic arwLMBLIKL. After averaging with the last measured value, this variable is divided by the speed and the normalization constant arwLMBNORM (= number of cylinders) to an air mass value per stroke standardized:

$$aroIST_5\ [\frac{mg}{hub}] = poor_4\ [\frac{kg}{H}] * \frac{1}{dzmNmit\ [rpm]} * \frac{1}{60\ [at\ least]} * \frac{H}{1} * \frac{2}{arwLMBNORM\ [hub]} * \frac{u}{1}$$

The normalized variable aroIST_5 is adjusted with a correction factor that depends on the air temperature and depends on the atmospheric pressure via the map arwLMBKOKF, corrected multiplicatively.

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The air mass is checked for plausibility. Is the speed within a window (arwHFPNu < dzmNmit ÿ arwHFPNo), the air temperature within arwHFPTu < anmLTF ÿ arwHFPTo, the boost pressure within arwHFPPu < ldmP_Llin ÿ arwHFPPo and the ARF is not active (arwHFPA.u ÿ ehmFAR. ÿ arwHFPA.o for all 3 ARF actuators) so if for the time fbwELM5_PA the condition air mass / stroke within a window (arwHFPMmin <armM_List ÿ arwHFPMax) is not met, a plausibility error. In the case of SRC errors in the LMM or defective DZG, LTF or LDF sensors, a plausibility check cannot be carried out.

For the BiTurbo control, the air mass in both turbocharger trains must be able to be recorded.
When cowVAR_2HF = 2, the total air mass and the partial air mass in the 2nd line of chargers is detected. If a partial HFM is installed in each charger train (cowVAR_2HF=1), the total air mass must be formed from the sum of the two partial air masses.

EDC15C:

If the HFM is defective (fboSLMM ÿ 0) and more than one HFM is installed (cowVAR_HF2 ÿ 0), the air mass of the 2nd HFM armM_LBiT is used as a substitute value.
If the 2nd HFM is also defective or if the two HFM are implausible to one another, both HFM are set to the same default value from the map arwLMVGWKF via zmmHF2_DEF=1 (see chapter monitoring concept).

All other systems: With
a defective HFM (fboSLMM ÿ 0 and cowVAR_HF2 = 0) zmmHF2_DEF is set to one, and the air mass replacement value from the map arwLMVGWKF is used. The substitute value is a model of speed dzmNmit and boost pressure ldmP_lin.

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3.3 Setpoint Calculation

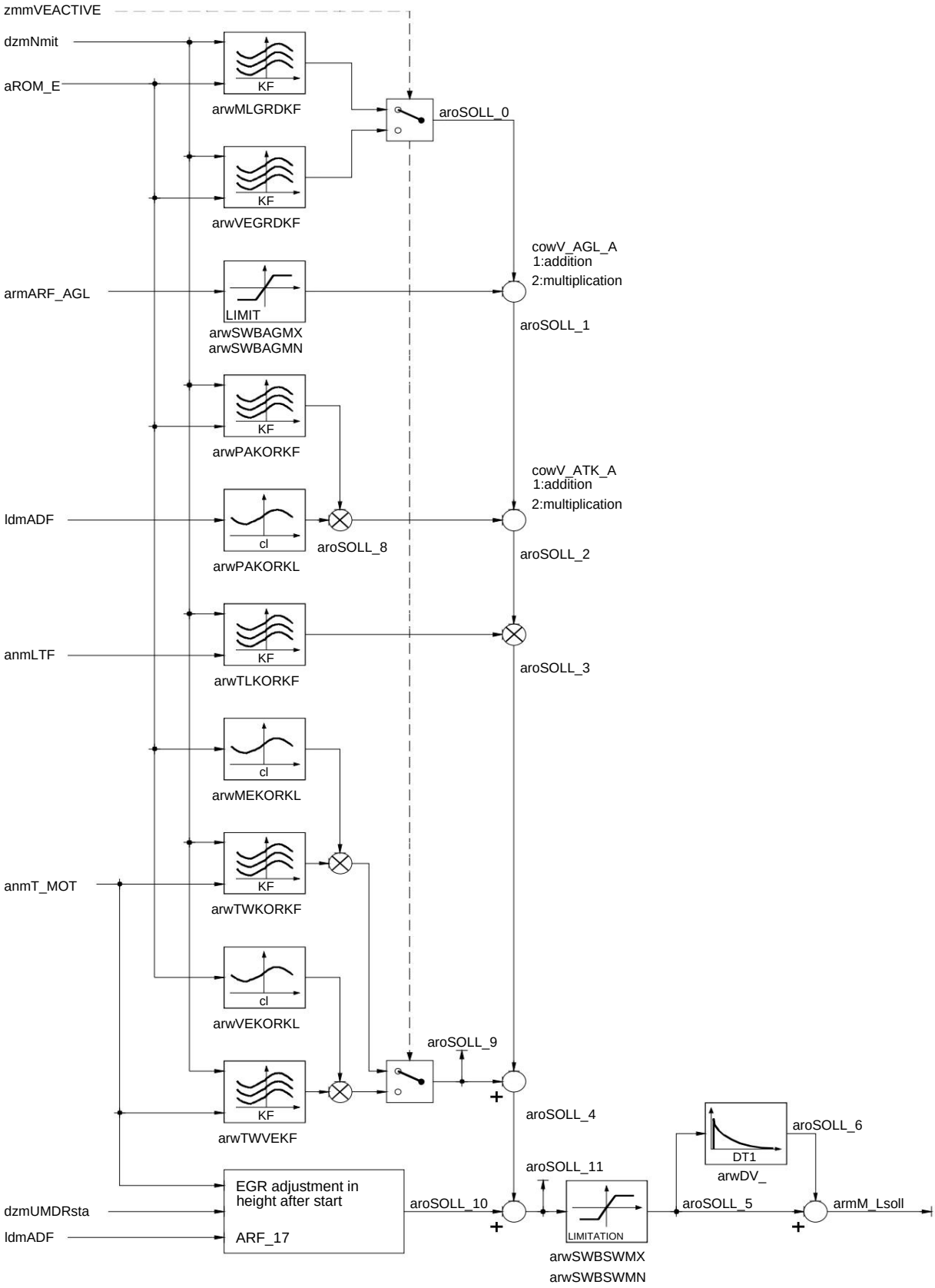


Figure ARF_02: Target value calculation

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The target value of the exhaust gas recirculation is a function of speed, quantity, air temperature, engine temperature and atmospheric pressure. The maps and characteristic curves must be standardized in terms of air mass/stroke. The basic value is determined with quantity armM_E and speed dzmNmit from the basic map arwMLGRDKF (OLDA aroSOLL_0). With active pre-injection (only VP44) zmmVEAKTIV=1, the basic map arwVEGRDKF is used.

This basic value is corrected using the following variables:

- Adjustment value armARF_AGL (initialized with cowAGL_ARF) via diagnostic interface, limited by arwSWBAGMX and arwSWBAGMN (OLDA aroSOLL_1). The correction can either be multiplicative or additive (using DAMOS - switch cowV_AGL_A: 1 = additive [unit air mass], 2 = multiplicative [unitless])

ÿ Altitude correction via the characteristic curve arwPAKORKL times the map arwPAKORKF, the correction can either be multiplicative or additive (OLDA aroSOLL_2). (using DAMOS - switch cowV_ATK_A: 1 = additive [unit air mass], 2 = multiplicative [unitless])

ÿ Intake air temperature correction depending on the engine speed via the map arwTLKORKF, the correction is multiplicative (OLDA aroSOLL_3).

ÿ Engine temperature correction depending on the speed and the amount of the map arwTWKORKF times characteristic arwMEKORKL, the correction is additive (OLDA aroSOLL_4). With active pre-injection (VP44 only), the map arwTWVEKF and the characteristic curve arwVEKORKL are used.

ÿ In order to reach the operating temperature in the combustion chamber more quickly after the start, the ARF rate can be adjusted for a period dependent on the engine temperature.
The correction value aroSOLL_10 for the EGR setpoint is atmospheric pressure-dependent (ldmADF) formed from the characteristic curve arwPSKORKL and after the start shedding (mrmSTART_B = 0) an engine temperature-dependent (anmT_MOT) number of engine revolutions aroUMDRp long additively fed.

The message dzmUMDRsta provides the number of engine revolutions since the start drop.
This value is compared with the engine temperature-dependent threshold aroUMDRp from the characteristic curve arwUMDRpKL. When the threshold is reached, the current correction value is saved and taken to zero via the ramp gradient arwPSKRamp.

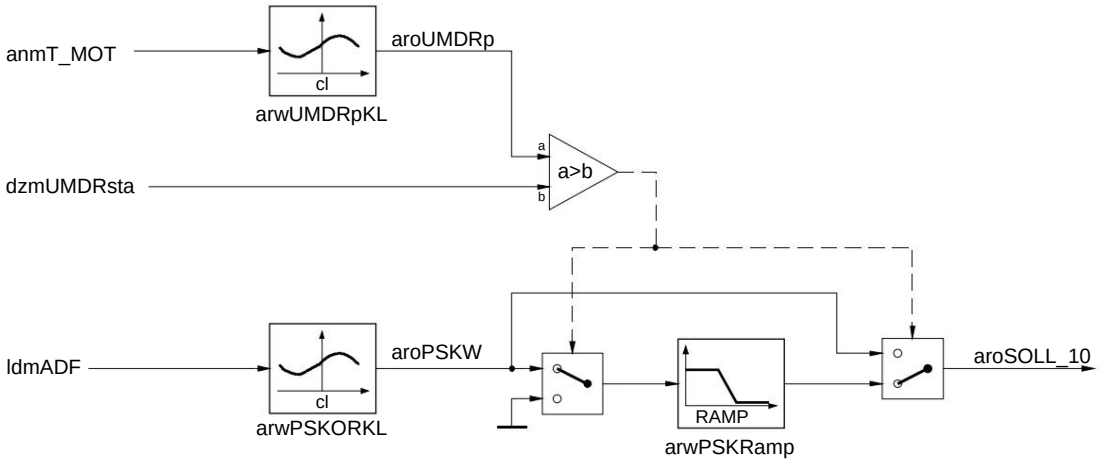


Figure ARF_17: EGR adjustment in height after takeoff

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The determined setpoint is limited to the limits arwSWBSWMX and arwSWBSWMN. Of the Target value aroSOLL_5 is in the dynamic pre-control arwDV_.. with DT1 - characteristic prepared (OLDA aroSOLL_6).

$$\textit{Setpoint pre-control KD} = * \frac{(\mathrm{d}\ \textit{setpoint})}{\text{German}}$$

Separate parameters for small and large signal behavior are used for the differential amplification saved. Inside a window, small-signal differential amplification is used, outside the Calculated window with large signal differential gain. The setpoint pre-control is additive enter the target value armM_Lsoll.

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3.4 Controller

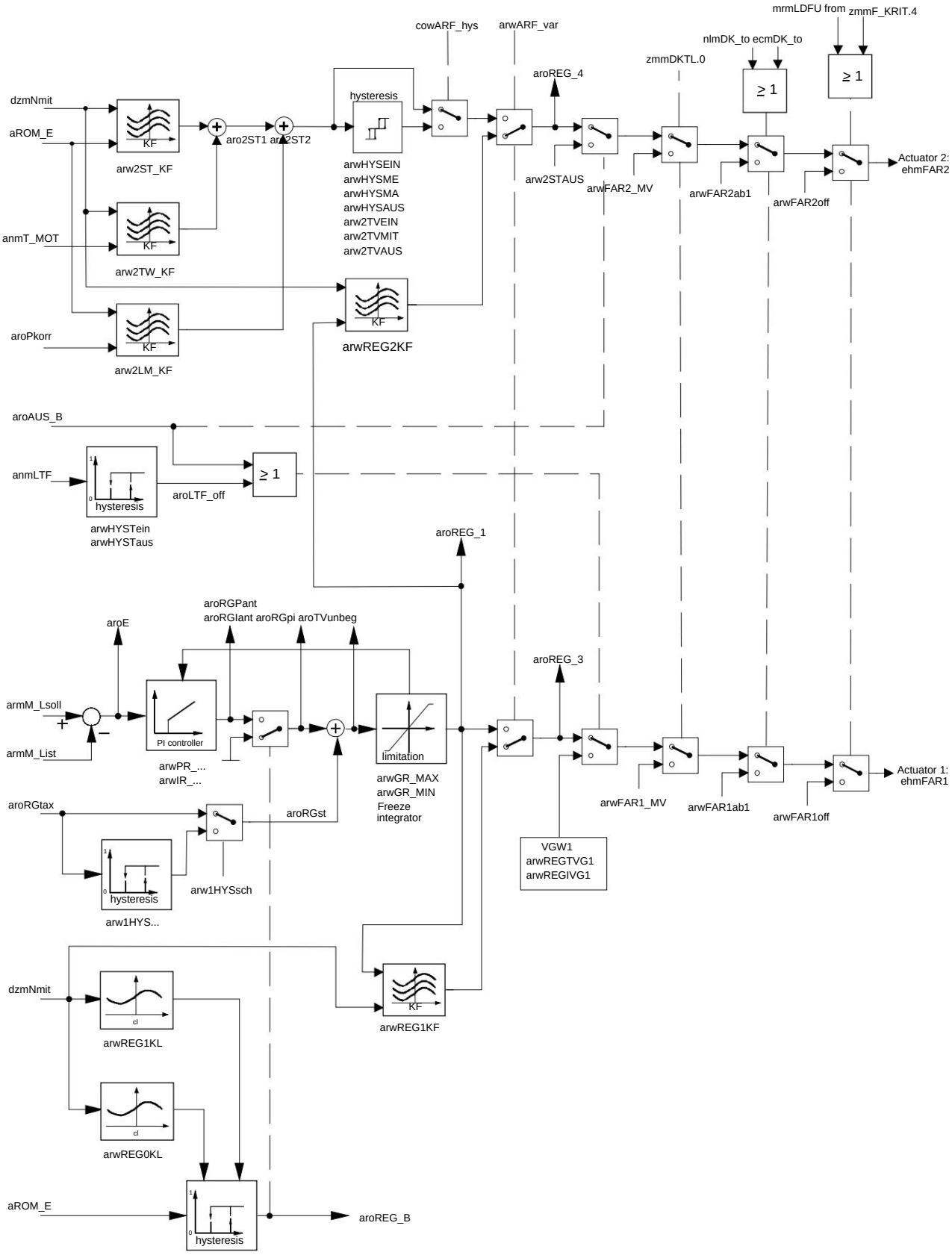


Figure ARF_03: ARF controller and control of the AR3 power stage

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3.4.1 Function while driving

The exhaust gas recirculation is adjusted with 3 different actuators. The actuator 1 is regulated depending on the working range and controlled in parallel, only controlled or switched off. In the case of arwARF_var = 0, this also applies to actuator 2. The two manipulated variables ehmFAR1 and ehmFAR2 then depend in an analogous manner on duty cycle aroREG_1 and speed dzmNmit. In the case of arwARF_var = 1, actuator 2 is fully switched on, controlled or switched off depending on the working range. The control can be continuous (cowARF_hys = 0) or by a triple hysteresis (cowARF_hys = 1).

Three different systems can be used. In the first case, actuator 1 is an exhaust gas recirculation valve and actuator 2 is a throttle valve, with both actuators being controlled continuously (arwARF_var = 0). The second system differs from this only in that the ARF valve and throttle valve have been interchanged. In the third system (arwARF_var = 1), the exhaust gas recirculation valve is continuously regulated with ehmFAR1, and a throttle valve is controlled with ehmFAR2, which may not be used at all when driving.

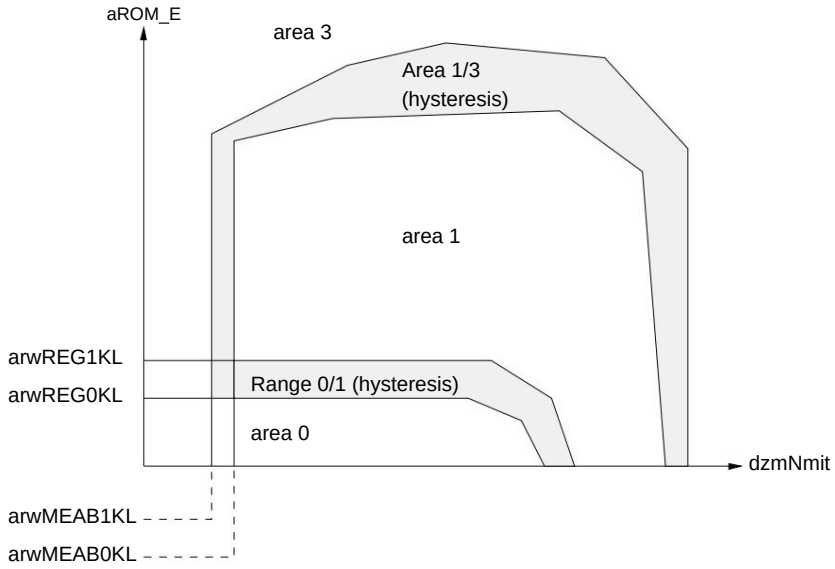


Figure ARF_04: Working areas of the ARF

Range 0 (control switched off for small quantities): **aroREG_2 = 0**

If the amount reaches or falls below a speed-dependent threshold from the characteristic curve arwREG0KL, then the ARF is controlled with aroRGsteu. In the case of arwARF_var = 1, aroRGsteu affects only ehmFAR1, for arwARF_var = 0 also ehmFAR2 (cf. area 1). The purpose of the pure control is to set the correct ARF rate despite the inaccuracy of the air volume measurement with small air volumes. The regulation is only switched on when the injection quantity armM_E exceeds a speed-dependent threshold from the characteristic curve arwREG1KL.

Due to the hysteresis arw1HYS... and switching off the PI controller via arwREG0KL, a 2-point control with the control value aroRGst can also be achieved at the output ehmFAR1.

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Area 1 (regulation with parallel control): **aroREG_2 = 1**

If the amount armM_E rises above the characteristic curve arwREG1KL, the actual air mass value armM_List (see chapter "Input / output signals") is controlled with a PI controller to the setpoint armM_Lsoll. The fixed values arwIR_.. and arwPR_.. apply to the I and P parameters.
In the small signal case, the gains arwIR_SIG and arwPR_SIG apply within the windows arwIR_FEN and arwPR_FEN. In the case of a large signal, the amplifications arwIR_POS or arwIR_NEG and arwPR_POS or arwPR_NEG apply to the portion of the control deviation that exceeds the window. Control is carried out in parallel with the PI controller. Control value aroRGst and PI controller output aroRGpi are added and then limited. The output variable of the limiting element is the pulse duty factor aroREG_1.

When the limit arwGR_MAX or arwGR_MIN is reached, the integrator of the PI controller is frozen. When switching on the controller (= transition from range 0 to range 1), the integrator is pre-assigned 0. When the control is switched on (= transition from area 2 or 3 to area 1), the integrator is preassigned with arwREGIVG1. The label arwREGIVG1 must be applied so large that the sum of the integrator defaults and the current control value (arwREGIVG1 + aroRGst) prevents the air mass from undershooting when it is switched on.

In the case of arwARF_var = 1, aroREG_1 is output directly and exclusively to the actuator ehmFAR1. The actuator ehmFAR2 is then controlled via arw2ST_KF. If cowARF_hys ÿ 0, then the manipulated variable is still performed via a triple hysteresis.

In the case of arwARF_var = 0, however, the duty cycle aroREG_1 is distributed to ehmFAR1 and ehmFAR2. The manipulated variable is distributed via the linearization maps arwREG1KF and arwREG2KF depending on the speed dzmNmit.

Area 2 (switching off ARF actuator 1 with air temperature): **aroREG_2 = 2**

If the air temperature anmLTF falls below the value arwHYSTaus, arwREGTVG1 is applied to ehmFAR1. The manipulated variable ehmFAR2 is not affected by this. If the air temperature anmLTF rises above the value arwHYSTein again, the system switches back to area 1. This function can only be used meaningfully if actuator 1 is the throttle valve and arwARF_var = 1.

Area 3 (ARF shutdown): **aroREG_2 >= 3**

If the amount armM_E rises above the characteristic curve arwMEAB1KL, or if another switch-off condition is met, then arwREGTVG1 and arw2STAUS are applied to ehmFAR1 and ehmFAR2. These default values are to be applied in such a way that the throttle flap is fully opened and the exhaust gas recirculation valve is fully closed. If the quantity armM_E falls below the characteristic curve arwMEAB0KL again, or if the switch-off condition no longer applies, the system changes back to range 0 or 1. The switching valve ehmFAR3 is set to the value arwREGTVG1 when the ARF is switched off.

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Application notes:

In order to ensure correct switching between the ranges, it is necessary for the output values of the characteristic curve arwREG1KL to be greater than the output values of the characteristic curve arwREG0KL. In order to avoid constant switching between the ranges, it is advisable to apply the two characteristic curves with a correspondingly large hysteresis distance.

The two maps arwREG1KF and arwREG2KF are to be matched to one another in such a way that the air volume increases approximately linearly with the manipulated variable aroREG_1 at every speed (arwARF_var=0). The parallel control can only be meaningfully designed when the maps arwREG1KF and arwREG2KF are fixed.

Function when the engine is switched off (after-run, Ecomatic) or when intake manifold vacuum occurs:

As a measure to prevent the shutdown knocking, the 2 actuators ehmFAR1,2 are switched to the respective applicable value arwFAR1ab1 or arwFAR2ab1 as soon as nlmDK_zu or ecmDK_zu has the value 1 in the run-on and in the event of a quantity shutdown by the Ecomatic. When detecting intake manifold vacuum (mrmLDFUaus = 1), the 2 actuators ehmFAR1,2 are switched to the applicable value arwFAR1aus or arwFAR2aus.

Intervention by throttle test:

If requested by the throttle valve test (zmmDKTL.0 = 1), then the 2 actuators ehmFAR1-2 are switched to the applicable values arwFAR1_MV or arwFAR2_MV.

Intervention in case of error "Solenoid valve is stuck closed (zmmF_KRIT.4, only EDC15M):

If the solenoid valve is jammed, the 2 actuators ehmFAR1-2 are switched to the two applicable values arwFAR1aus or arwFAR2aus, just as in the case of intake manifold vacuum.

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3.5 Parallel Control

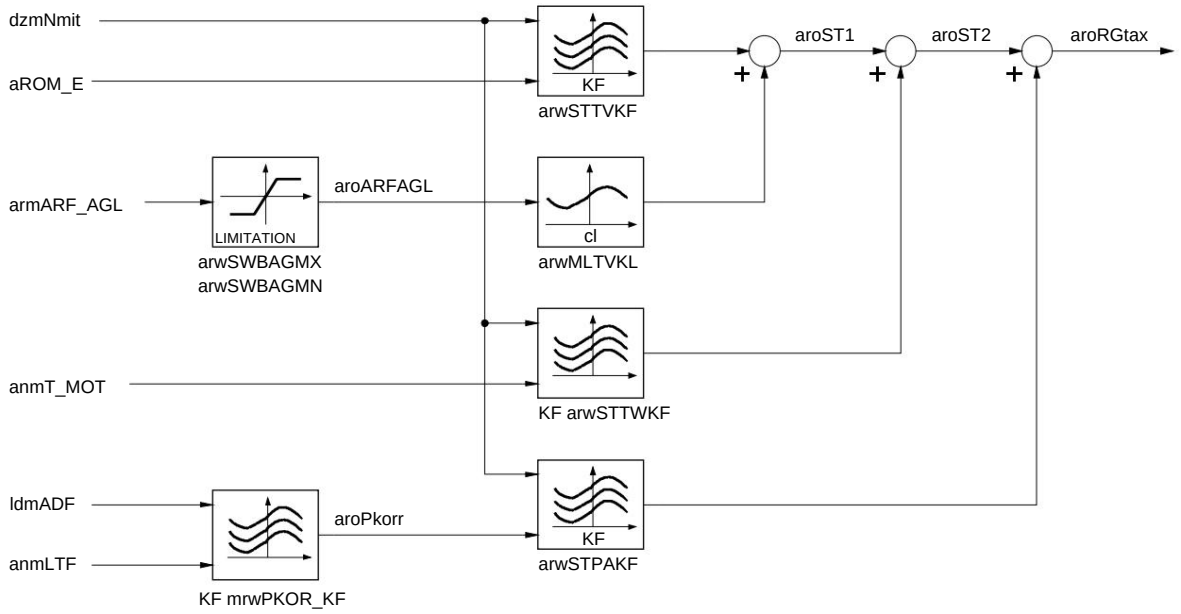


Figure ARF_05: Parallel control

The control value aroRGsteu is a function of speed dzmNmit, quantity armM_E, engine temperature anmT_MOT, corrected atmospheric pressure aroPkorr and adjustment value armARF_AGL. The characteristic diagrams and characteristic curves must be normalized in duty cycles of the exhaust gas recirculation actuator.
With the amount armM_E and the average speed dzmNmit the basic value from the map arwSTTVKF is determined.

This basic value is corrected using the following variables:

- ÿ Adjustment value via diagnostic interface, limited by arwSWBAGMX and arwSWBAGMN. This air quantity correction value is converted into a pulse duty factor with the characteristic curve arwMLTVKL. The correction is additive.
- ÿ Altitude correction via the map arwSTPAKF. The correction is additive.
- ÿ Motor temperature correction via the map arwSTTWKF. The correction is additive.

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3.6 Activation of an EGR cooler bypass valve

The exhaust gas recirculation cooler should be switched depending on the water temperature of the engine. At higher water temperatures, a bypass around the EGR cooler is switched off via an electric switching valve (EUV) and a vacuum unit, ie the EGR cooling is only activated when the engine is warm.

The switch-on or switch-off threshold (air mass setpoint) of the hysteresis is defined via the two speed-dependent characteristics arwEGRnEin and arwEGRnAus. The EGR cooling should be switched off when armM_Lsoll <arwEGRnAus or anmWTF <arwEGRHyA. If the ARF is switched off, the default value arw3STAUS applies.

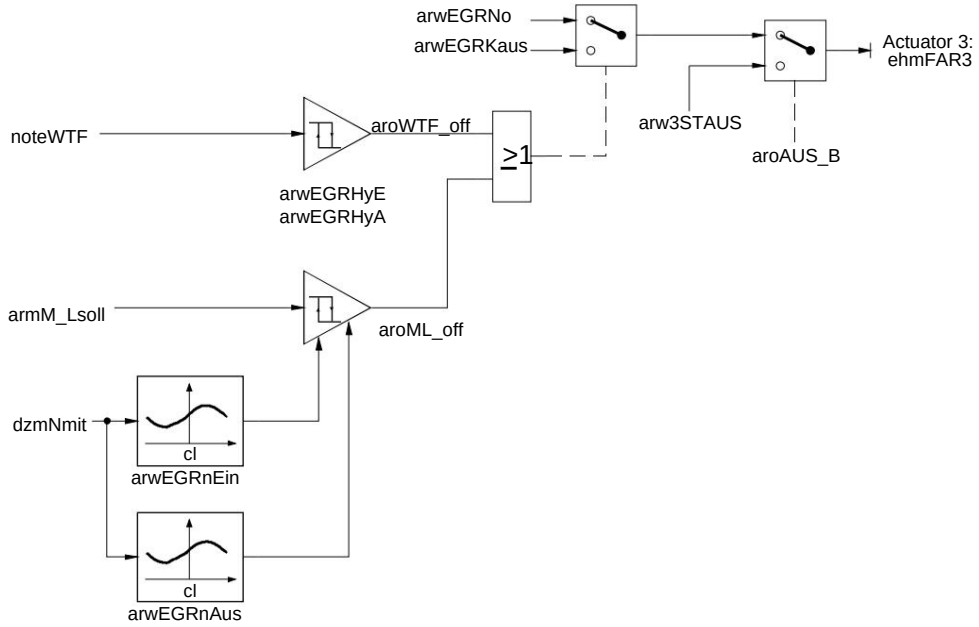


Figure ARF_19: Activation of an EGR cooler bypass valve

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3.7 Monitoring and Shutdown

3.7.1 Control deviation monitoring

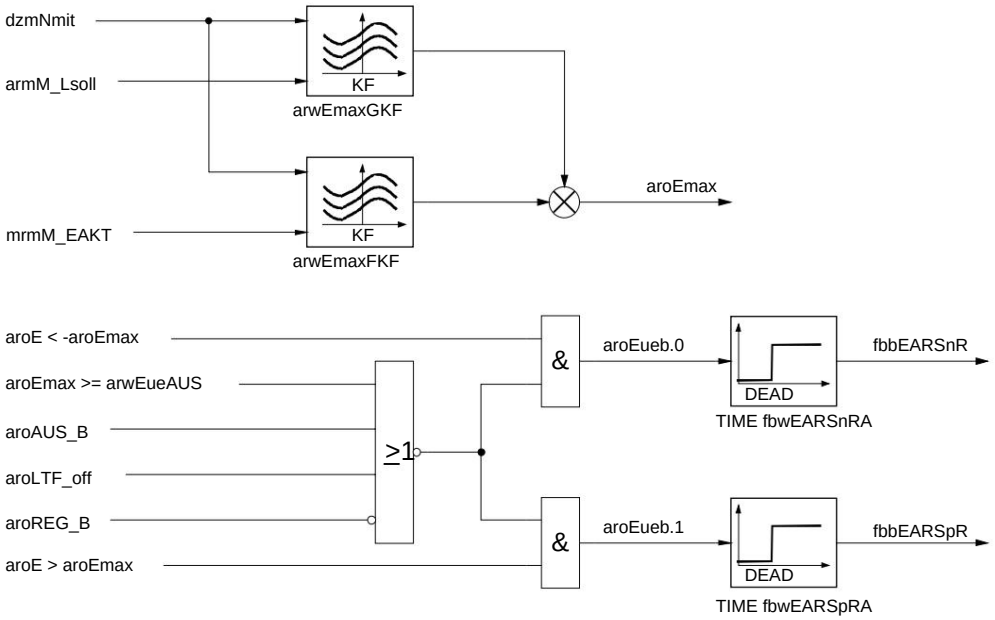


Figure ARF_06: Control deviation monitoring

With two maps (arwEmaxGKF and arwEmaxFKF), a maximum permissible control deviation aroEmax is calculated depending on the air mass target value, speed and load and compared with the current control deviation aroE. If there is a greater control deviation than aroEmax for a period of time fbwEARSpRA, the control loop is identified as defective. If for a time fbwEARSnRA a smaller control deviation than - (aroEmax), the control circuit is recognized as defective.

Application note:

Each speed has its maximum and minimum amount of fresh air. The further the air mass target value is from these limits, the smaller the permissible control deviation can be applied. This permissible control deviation is corrected with a load-dependent factor. Monitoring of the control deviation can thus be adapted for large and small loads.

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3.7.2 Shutdown

The regulation or control of the ARF is switched off or switched off under the following conditions.
switched (description of the ARF status aroREG_2):

decimal value comment	
0	taxes on small quantities
1	Rules
2	Switching off the AR1 - controller ehmFAR1 with air temperature
3	Shutdown with default value (cause see OLDA aroAB_VGW1)
4	Shutdown due to throttle test
5	Overrun active - ARF shutdown
6	Intake manifold vacuum - ARF shutdown
7	Default setting for LDR or ARF

The bit OLDA aroAB_VGW1 shows the causes for the shutdown with default value 1:

Bit position	decimal value	comment
0	1	Exceeding a quantity threshold
1	2	permanent deviation - (fbbEARSpR or fbbEARSnR)
2	4	overrun - (dzmNmit > arwREGSBN (f(anmWTF)) & mrmM_EAKT < arwREGSBME)
3	8th	Engine idling for a long time - (dzmNwith < arwREGNLL1 & t > arwREGTLL1)
4	16	in the event of errors (see shutdown due to system errors)
5	32	Falling below a battery voltage threshold - (anmUBATT < arwREGUBAB)
6	64	start condition
7	128	Shutdown after start
8th	256	Exceeding the limit quantity with FGR desired quantity
9	512	boost request
A	1024	ADR state "Rules"

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In the event of a switch-off condition, the ARF valve is closed with a default value. If several causes occur, the status with the higher identifier is displayed on aroREG_2 and its action is taken.

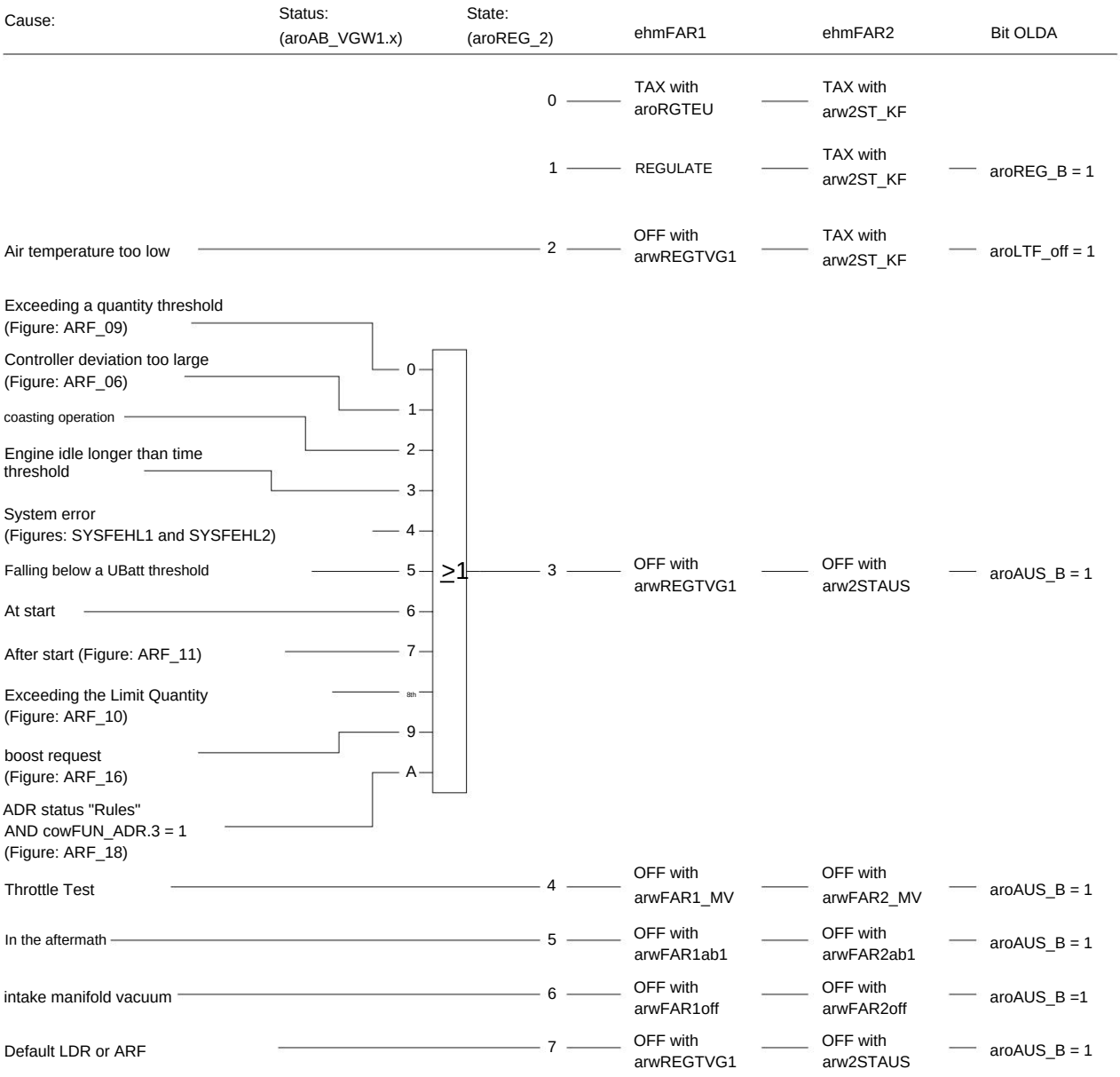


Figure ARF_07: shutdown

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Shutdown when a quantity threshold is exceeded:

If the quantity armM_E is greater than a threshold from the characteristic curve arwMEAB1KL=f(n), then the ARF is switched off. If the quantity is again smaller than the threshold from the characteristic curve arwMEAB0KL, then the ARF can be switched on again. If the quantity

armM_E exceeds the threshold arwMEAB2KL with a positive quantity trend, a timer with the term aroTi_abKL is started. If the timer has expired and aroTi_Ein is still equal to one, the ARF is switched off. The ARF is only switched on again if armM_E is smaller than arwMEAB2KL.

If armM_E falls below the threshold arwMEAB2KL while the timer is running, the timer is stopped and reset and the ARF remains switched on.

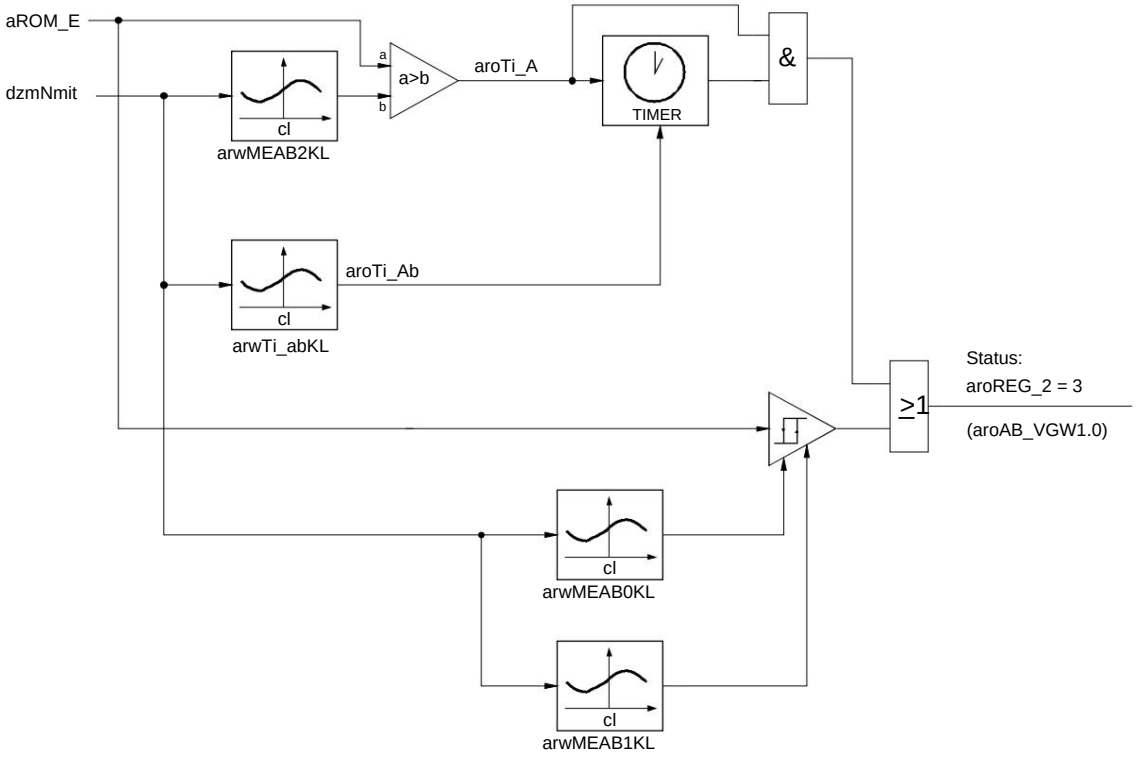


Figure ARF_09: Exceeding a quantity threshold

Shutdown when the limit quantity is exceeded:

If the unlimited desired amount FGR mrmFGR_roh greater than the limit amount mroM_EBEGR, the ARF is switched off. Is mrmFGR_roh + mrwFGR_OFF less than mroM_EBEGR, the ARF is turned on again. Since the ARF intervenes directly in the limiting set via armM_List, this measure enables a larger FGR area.

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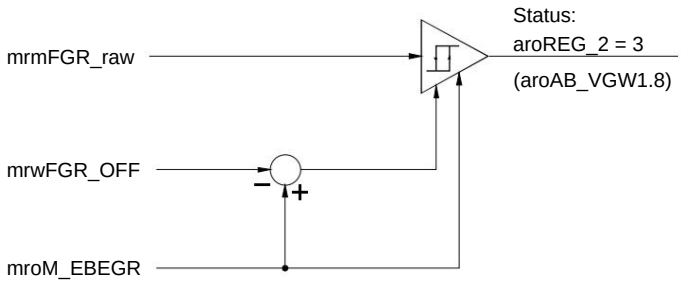


Figure ARF_10: Exceeding the limit quantity

Shutdown after start:

A motor temperature-dependent time (characteristic arwANSTWKL) after start shedding, the ARF remains switched off.

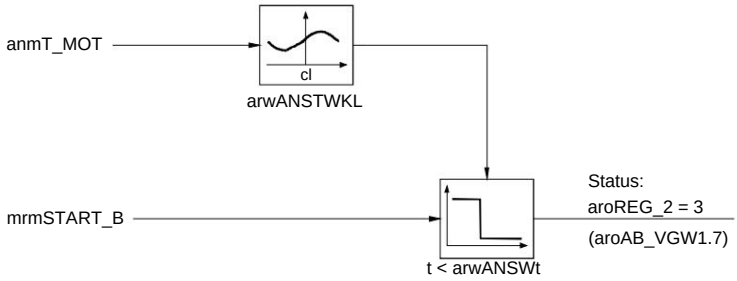


Figure ARF_11: shutdown after start

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Shutdown on boost pressure request:

In the part-load range, the exhaust gas recirculation should be closed quickly with a high positive desired quantity change in order to enable a rapid boost pressure build-up. The LDR-TV is frozen so that the loading shovels can be closed quickly only after the ARF has been switched off. The working range is defined by a speed and volume range (arwABdzu, arwABdzo and arwABmeu, arwABmeo). Shutdown should only take place when the valve is relatively wide open (ehmFAR1 < arwAB_TV). If there is a strong increase in the LDR-TV in this operating range (change greater than arwABldmax), which is caused by a positive quantity request (mrmM_EWUN > arwABwunmx), then the shutdown takes place. After each trip, the shutdown will remain switched off at least for the time arwABmint. If a shutdown takes place, then the triggering TV output by the LDR is frozen for an applicable time (TV before the rise), during this time ldmVZ_akt = 1. The freezing time depends on the average speed (characteristic ldwVZDZ_KL) and the ARF TV (characteristic ldwVZAR_KL) before shutdown. If the applied time is 0 µs, the function is not executed. The freeze time is only started once, the function is only triggered again after the LDR TV has been released.

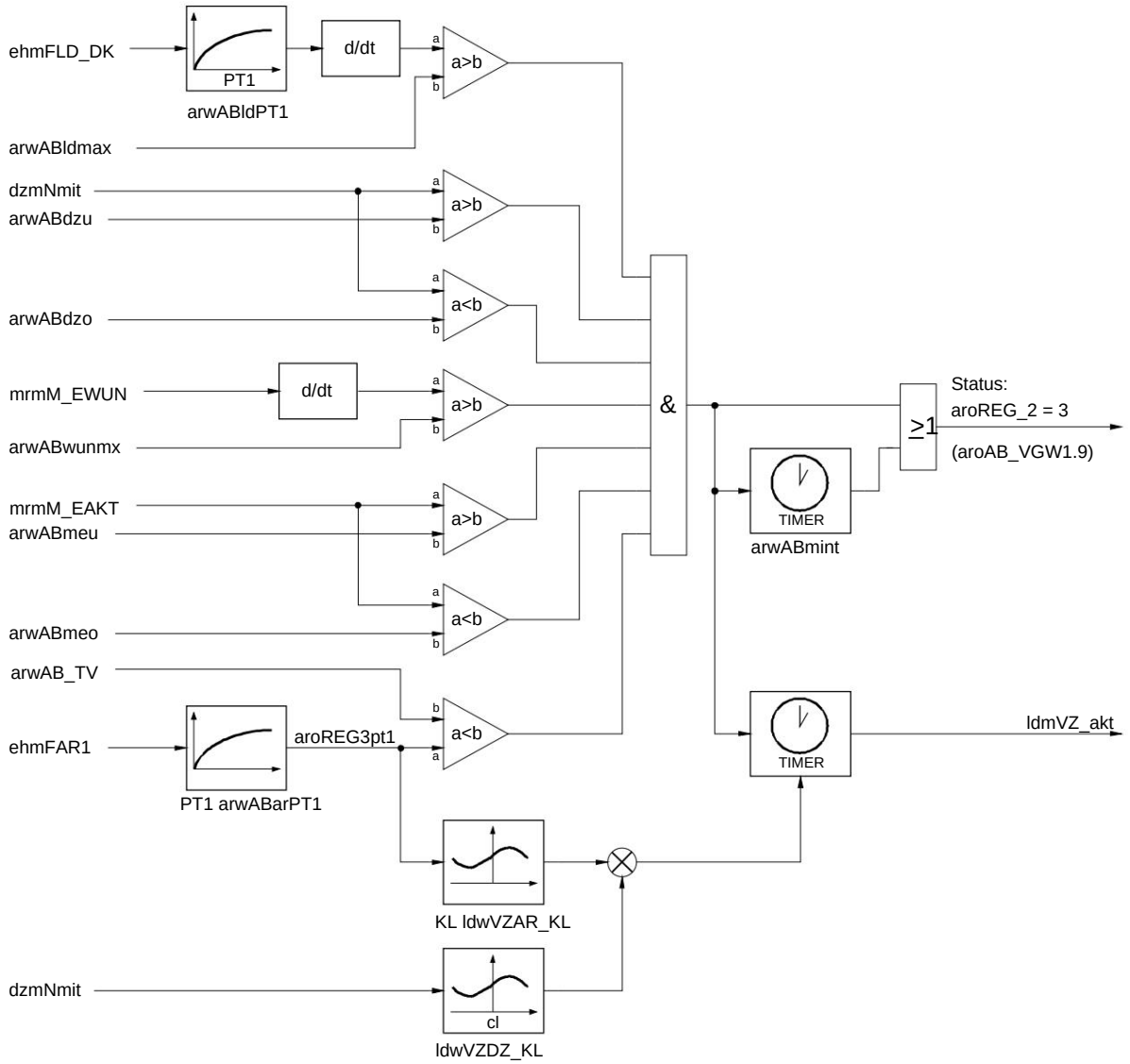


Figure ARF_16: Shutdown when boost pressure is requested

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Shutdown with working speed control:

If the working speed control in the state "rules" (mrmADR_SAT = 3) and bit 3 of the software switch cowFUN_ADR is set, the exhaust gas recirculation is switched off.

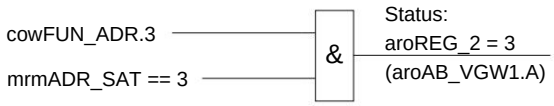


Figure ARF_18: Shutdown with working speed control

Basic setting for LDR:

As long as the basic setting for LDR is active, the ARF must be switched off.

Basic setting for ARF:

With the basic setting for ARF, the ARF switch-off mechanism is activated on the one hand so that the integrator is correctly initialized when it is switched on again and error debouncing is stopped in the event of a control deviation. On the other hand, all 3 actuators ehmFAR1, ehmFAR2 and ehmFAR3 are controlled by the basic setting.

Follow-up active:

As long as the run-on is active and the ARF sets actuators to default values, the ARF must be switched off.

intake manifold vacuum:

If intake manifold vacuum occurs, the ARF actuators are set to default values and the ARF must be switched off.

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3.7.3 Status line monitoring

The control valve should be monitored in its function. This requires the status line evaluate the control valve. The control flap is an intelligent actuator, the internal one Malfunctions signaled via a status line. If an internal error occurs, the Control flap the status line and goes to the specified, open position.

Monitoring the function of the status line:

After K15 on, an edge change from LOW to HIGH must be recognized on the status line (see Figure ARF_12). Is the line initially HIGH or LOW for too long or then not long enough in the HIGH state, the status line is considered defective assumed. If the status line is defective, the error bit fbbEAR1_S is set.

Monitoring the function of the control valve:

If the function of the control valve is ensured, then there may be a defect in the control valve be monitored. If the line is HIGH, the control valve is considered OK. Is the line to LOW, then the control flap is considered defective. Depending on this, the error bit fbbEAR1_S set or deleted.

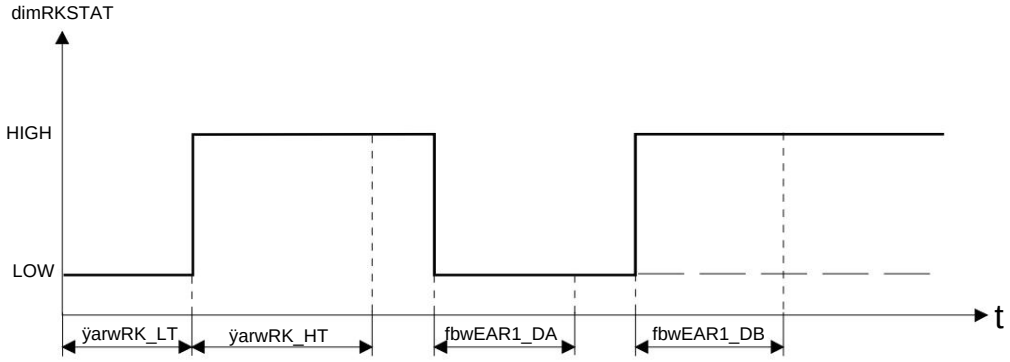


Figure ARF_12: Signal curve of the status line dimRKSTAT

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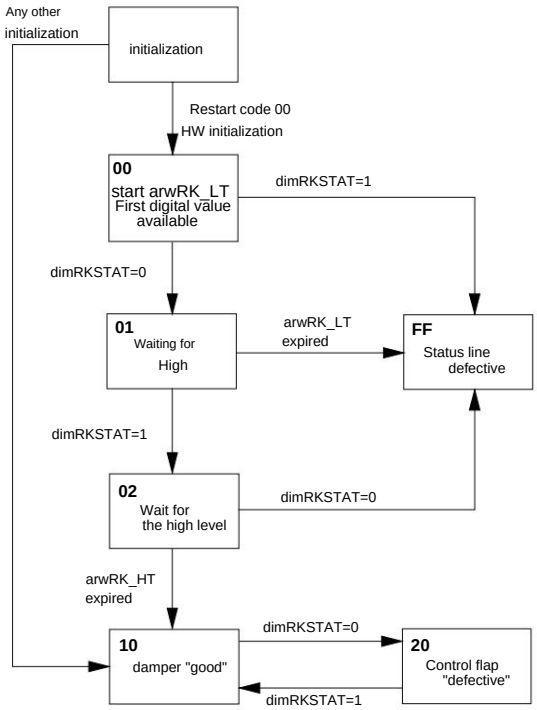


Figure ARF_13: Monitoring states of the status line in aroRKSTAT

Initialization:

The reason why the initialization was carried out is checked. If it is on because of "K15", the status line must then be checked. In any other case, the line cannot be checked and the control damper is monitored immediately.

00H - Waiting for the first digital value:

Since the digital values are not available in the initialization, it is only possible to check here whether the status line is really LOW. If this is the case, the first time arwRK_LT is started and the edge change is awaited. If the line is HIGH, then it is defective and the state changes to FF.

01H - Waiting for the first digital value:

The edge change from LOW to HIGH is awaited. If the time arwRK_LT expires beforehand, the line is considered defective and the state changes to FF. If the state changes to HIGH, the time arwRK_HT is started and switched to state 02. The smallest adjustable time is 20ms, because a time of 0 would correspond to a HIGH level right from the start, and a faulty status line is thus detected. In addition, the LOW level on the status line must be present for at least 150ms, because initialization takes that long and only the values that are then on the line are valid. Therefore a set time arwRK_LT=0 has the same effect as arwRK_LT = 20ms.

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02H - Waiting for the end of the test sequence:

A time arwRK_HT is waited for. During this time, there must be no level change to LOW. If this does occur, the status line is considered defective and the system switches to the FF state. However, if the time expires, the error fbbEAR1_S is reported well and switched to state 10 and the status line is therefore considered to be functional.

10H - Control damper OK:

If the level on the line is LOW, the system switches to state 20 since a defect is signaled. Otherwise the control valve is considered good and the fbbEAR1_D error is reported as good.

20H - Control damper OK:

If the level on the line is HIGH, then it switches to state 10, since a defect is no longer signaled. Otherwise, the control valve is considered defective and the error fbbEAR1_D is reported as defective.

FFH - status line defective:

The status line is considered defective. Therefore, the error fbbEAR1_S defective is reported. No other status is switched from this status.

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4 boost pressure control

4.1 Overview

The boost pressure control can be used for the regulation or control of an exhaust gas turbocharger with waste gate as well as a charger with variable turbine geometry (VTG - charger).

When controlling an exhaust gas turbocharger with a waste gate, the actuator is a bypass valve, through which the exhaust gas flow can be directed to the turbine or past the turbine. When controlling a VTG charger, the changeable turbine geometry serves as an actuator.

The boost pressure control is subdivided into setpoint calculation, boost pressure controller, boost pressure control, controlled adaptation of the control parameters and monitoring and shutdown.

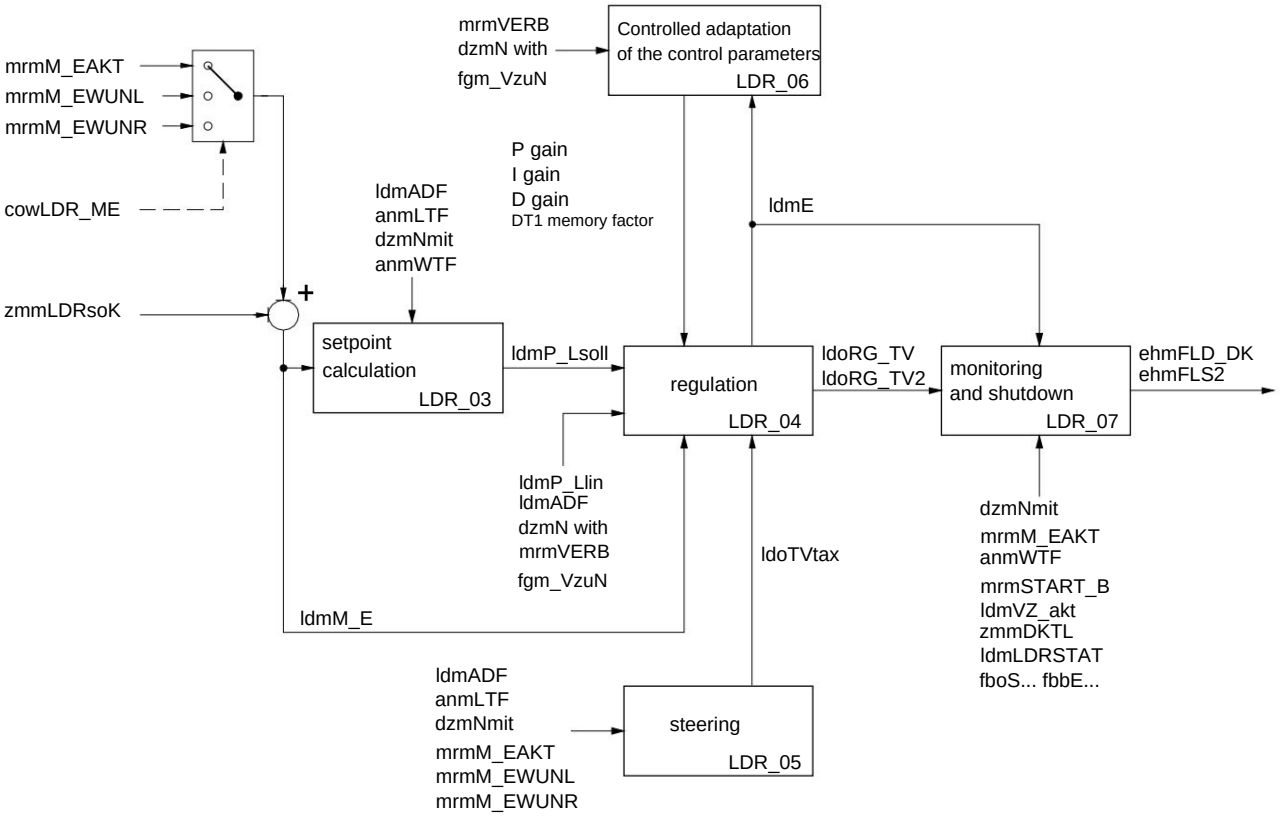


Figure LDR_01: Structure of the boost pressure control

With the software switch cowFUN_LDR you switch the boost pressure control on / off (0 = switched off, 1 = switched on). At the same time, the LDS power stage is activated with the software switch cowVAR_LDR = 8, deactivated with cowVAR_LDR = 0.

With the software switch cowLDR_ME you determine which fuel quantity signal should be used. The sub-functions then work with the set ldmM_E.

Description of the software switch LDR - quantity input request cowLDR_ME:

Decimal value	Comment
1	Current injection quantity
2	Desired quantity + idle quantity
3	Desired quantity raw + idle quantity

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4.2 Setpoint formation

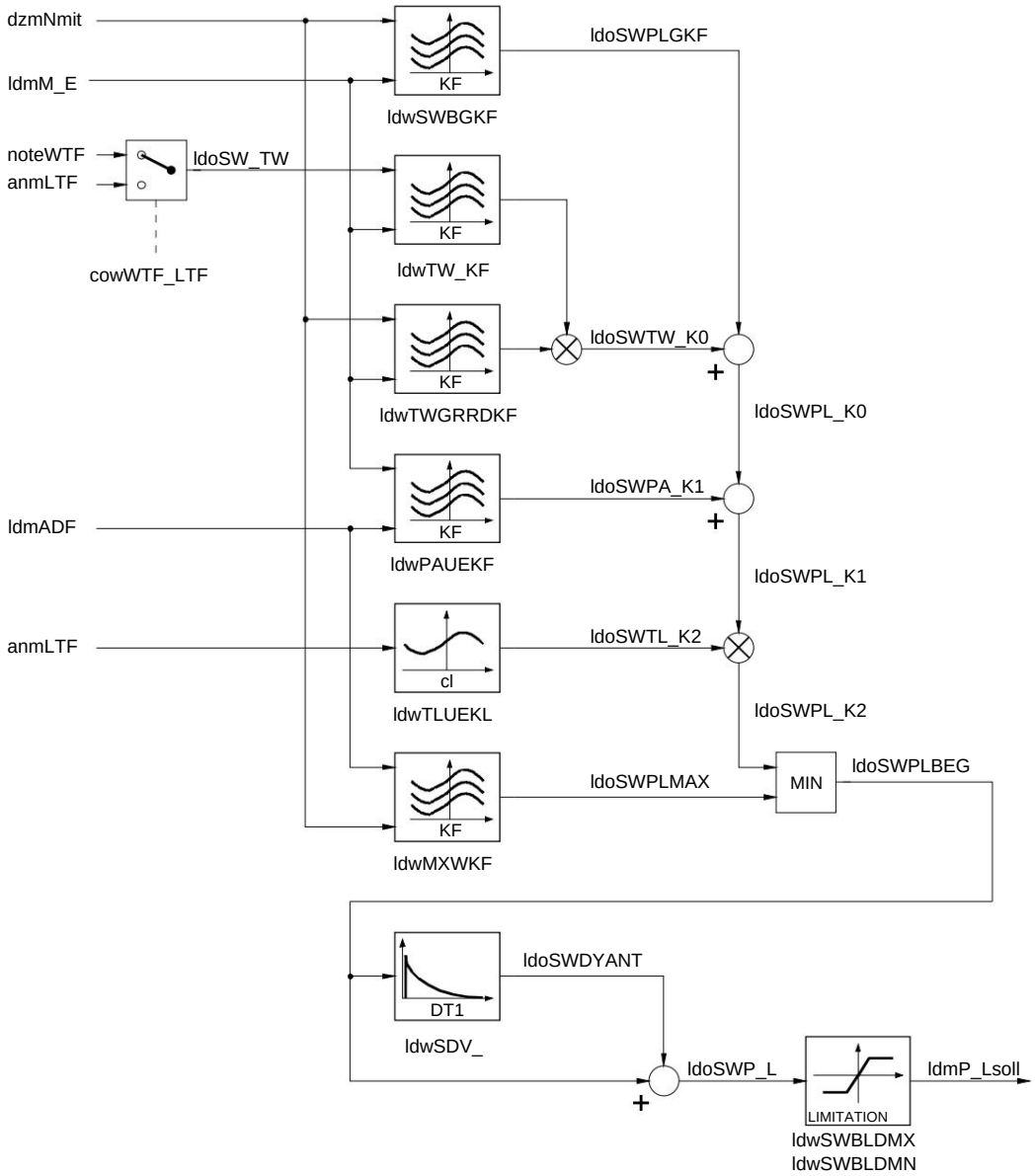


Figure LDR_03: Setpoint formation

The absolute or relative boost pressure is formed from the target map ldwSWBGKF depending on the speed dzmNmit and quantity ldmM_E. Whether the boost pressure setpoint value applied in the setpoint map is an absolute pressure or an overpressure relative to atmospheric pressure depends on the cowLDR_R_A switch position.

To minimize noise, the boost pressure setpoint is corrected additively depending on the temperature. About the switch cowWTF_LTF either the water temperature anmWTF or the air temperature anmLTF is used for correction. The correction value is calculated from the basic characteristics map ldwTWGRDKF, whose output value is compared with the water temperature-dependent weighting factor from the characteristics map ldwTW_KF. The correction value obtained in this way can have both an increasing and a reducing effect on the boost pressure setpoint.

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Depending on the atmospheric pressure ldmADF and quantity ldmM_E, an additive takes place
Correction, which is formed via the map ldwPAUEKF. Depending on the
Air temperature anmLTF is a multiplicative correction factor over the characteristic ldwTLUEKL
educated.

This value is limited to a maximum. The maximum will depend on the
Atmospheric pressure ldmADF and the speed dzmNmit calculated from the map ldwMXWKF.

The setpoint is processed in a dynamic pre-control with DT1 characteristics.

$$\textit{Setpoint pre-control KD} = * \frac{(\mathrm{d}\ \textit{setpoint})}{\text{German}}$$

Separate parameters for small and large signal behavior are used for the differential amplification
saved (ldwSDV_). If the input signal change is within a window,
Small signal differential amplification, outside is calculated with large signal differential amplification. the
Selection of the memory factor is based on the sign of the output signal.

The result represents the dynamic setpoint component. This component becomes the previously determined one
setpoint added.

The target value formed in this way is ldwSWBLDMN to the minimum value and to the maximum value
ldwSWBLDMX limited.

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4.3 Regulation

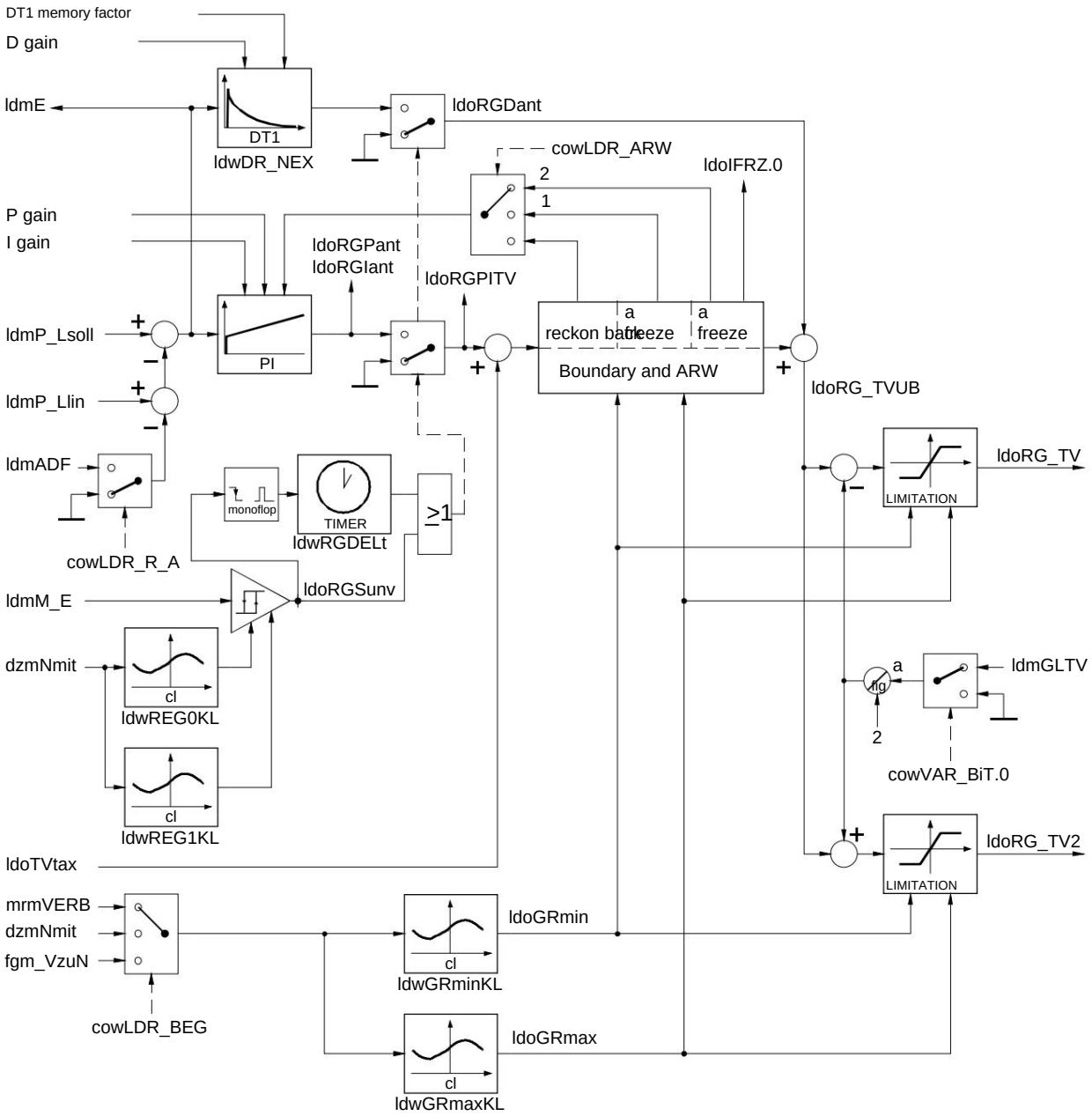


Figure LDR_04: Boost pressure regulator

The boost pressure controller is implemented as a bypass PI controller, ie the manipulated variable of the PI controller ldoRGPITV is added to the control value ldoTVsteu. There is another DT1 controller parallel to the PI controller and the controller. Since the controlled system of the VTG charger changes during operation, the control parameters are adapted in a controlled manner. The control parameters depend on the control deviation ldmE and consumption mrmVERB or the speed dzmNmit or the gear fgm_VzuN. The monitoring switches off the intervention of the control and regulation in the event of certain system errors and outputs default values to the actuator. The boost pressure ldmP_Llin (= filtered value anmLDF) is controlled by specifying the setpoint pressure ldmP_Lsoll using PIDT1 - controller with parallel control. The control remains switched off for small quantities.

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The control is only switched on when the quantity exceeds a speed-dependent threshold from the characteristic curve ldwREG1KL. When switching on, the I component is pre-assigned zero.
If there is a deviation when the controller is switched on, the P component generates a jump at the output.

The D regulator is switched on in such a way that its output is zero immediately after switching on.

The control is switched off when the quantity reaches or falls below a speed-dependent threshold from the characteristic curve ldwREG0KL. The switching after the hysteresis with the timer ensures that the switchover of rules after control is delayed by the time ldwRGDELt. Each negative edge starts the timer and the timer delivers high as an output signal until the timer has expired. The instantaneous value from the hysteresis is mapped to the OLDA ldoRGSunv. On the other hand, the control is switched on without delay if the quantity exceeds the speed-dependent threshold from the characteristic curve ldwREG1KL. When switching off, the pulse duty factor at the output will change abruptly because the manipulated variable of the PIDT1 controller is no longer added. If the controller is switched off, there is no monitoring of the control deviation (see below).

In order to carry out the charger calibration, the pulse duty factor at the output of the boost pressure control is changed before the limitation through the intervention of the BiTurbo control. When cowVAR_BiT.0 = 0, both boost pressure actuators are controlled with the same duty cycle. When BiTurbo control is activated, the duty cycle for the 1st boost pressure actuator is reduced by ldmGLTV/2 (charger adjustment value) and the duty cycle for the 2nd boost pressure actuator is increased by ldmGLTV/2.

Application note: In order to ensure that the control is switched on and off correctly, it is necessary for the output value of the characteristic curve ldwREG1KL to be greater for all speeds than the output value of the characteristic curve ldwREG0KL. In order to avoid constant switching on and off, it is advisable to apply the two characteristic curves with a correspondingly large hysteresis distance. The control value ldoTVsteu and the output of the PI controller ldoRGPITV are added and limited by the characteristics ldwGRmaxKL and ldwGRminKL. When the limit is reached, there are 3 options for integrator handling:

cowLDR_ARW = 0: ARW (anti-reset windup) by recalculation of the integrator: When limiting the I - component is recalculated in such a way that ldoTVsteu + ldoRGPITV is exactly at the limit.

cowLDR_ARW = 1: ARW by freezing the integrator: When the upper limit ldoGRmax is reached, the integrator may no longer be increased - ie its value is frozen. However, the integrator may be reduced if the controller input is negative and the upper limit is exceeded at the same time. The same applies vice versa when the lower limit ldoGRmin is reached.

cowLDR_ARW = 2: ARW by freezing the integrator 2: When the upper limit ldoGRmax is reached, the integrator may no longer be increased - ie its value is frozen (ldoIFRZ (.0) = 1). Freezing of the integrator is only reversed (ldoIFRZ (.0) = 0) when the boost pressure falls or is greater than the setpoint.

After addition of the D component, there is again a limitation by the characteristics ldwGRmaxKL and ldwGRminKL. However, there is no ARW action.

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The software switch cowLDR_R_A can be used to choose whether an absolute pressure control or a relative pressure control is to take place. An absolute pressure control represents the absolute pressure ldmP_Lsoll in the intake manifold. A relative pressure control sets the to atmospheric pressure relative overpressure in the intake manifold. The actual value for the controller results in ldmP_Llin - anmADF, the setpoint is an overpressure value.

Description of the software switch type of pressure control cowLDR_R_A:

decimal value	comment
0	Absolute pressure control (actual value = boost pressure)
1	Relative pressure control (actual value = boost pressure - atmospheric pressure)

Description of the DAMOS switch limiting the controller output cowLDR_BEG:

decimal value	comment
0	about consumption
1	about the speed
2	across the aisle

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4.4 Control

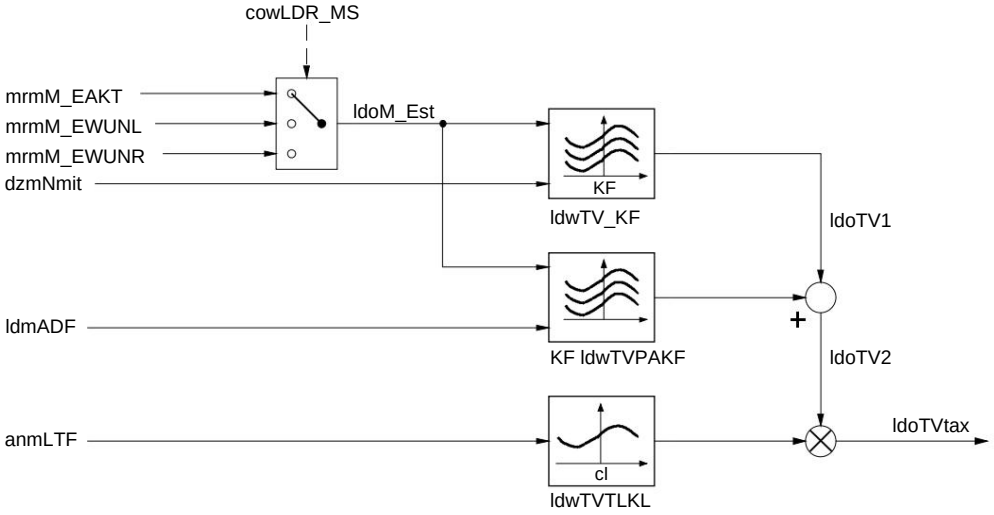


Figure LDR_05: boost pressure control

Description of the software switch quantity input for control cowLDR_MS:

decimal value	comment
	current injection quantity
1	Desired quantity + idle quantity
2 3	Desired quantity raw + idle quantity

The structure for calculating the control value ldoTVsteu is partially identical to the structure for calculating the target value. The maps and curves have the same input signals. The description in the chapter Set value calculation applies analogously (see above).

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4.5 Adaptation of the control parameters

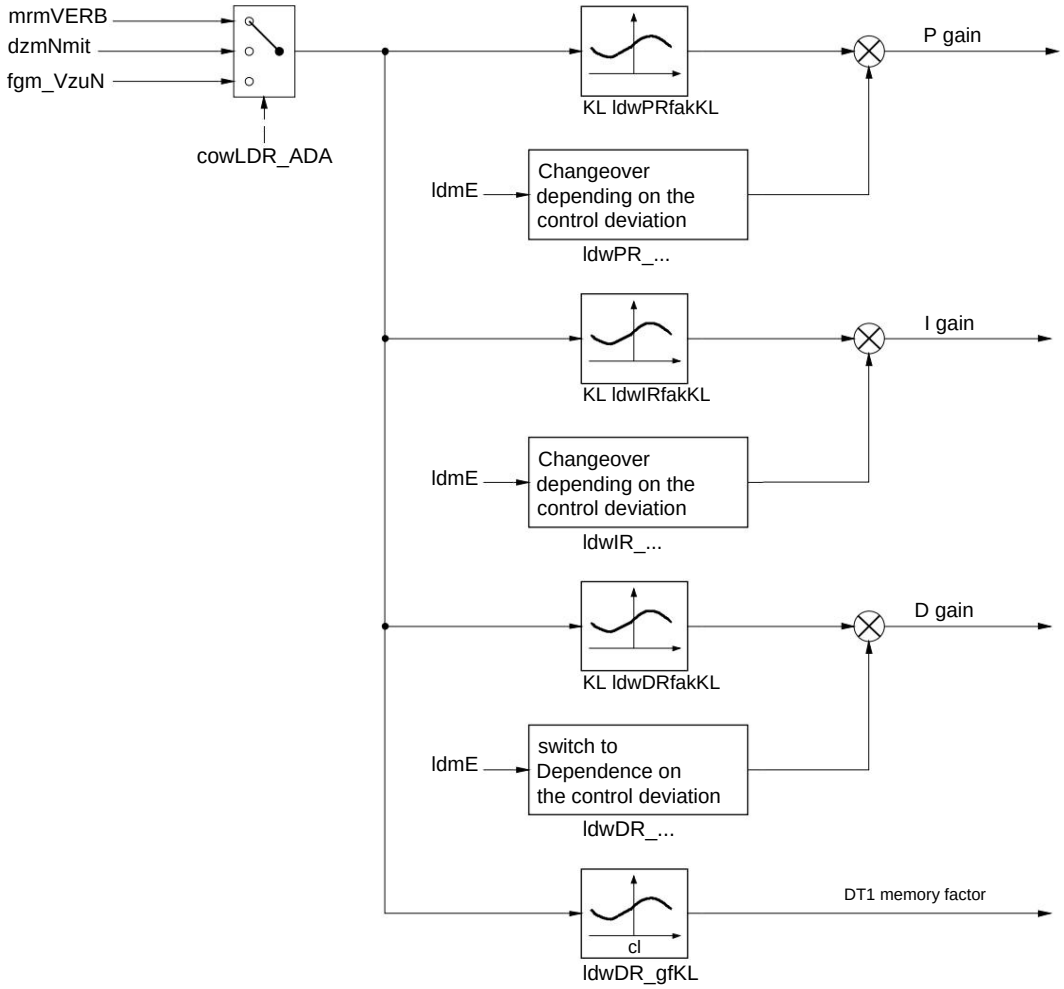


Figure LDR_06: Controlled adaptation of the control parameters

The boost pressure is controlled with a PIDT1 controller. The fixed values ldwIR_.., ldwPR_.. or -, P - and D - ldwDR_.. apply to the I parameters.

The gains ldwIR_SIG and ldwPR_SIG apply to small signals within the window ldwIR_FEN and ldwPR_FEN. For large signals, the gains ldwIR_POS or ldwIR_NEG and ldwPR_POS or ldwPR_NEG apply to the controller input values that exceed the window. The fixed values ldwDR_.. for the D gain apply to the DT1 element. It is a D controller with dynamic pre-control with DT1 characteristics: separate parameters for small and large signal behavior are stored for the differential amplification. Within a window (ldwDR_FEN, ldwDR_FEP) calculations are made with small signal differential amplification (ldwDR_SIP, ldwDR_SIN), outside of the window with large signal differential amplification (ldwDR_POS, ldwDR_NEG).

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Due to the VTG - loader, the controlled system changes during operation, so that a controlled adaptation of the control parameters is required. Therefore, the IP - and D - -, Amplification of the PIDT1 controller each multiplied by one of 3 factors. The 3 Factors are determined with the help of characteristic curves. Input variable of these characteristics is either the Consumption mrmVERB, the speed dzmNmit or the gear fgm_VzuN. With the DAMOS - Switch cowLDR_ADA can be selected, whether the factor of consumption, speed or should depend on the gear.

Description of the DAMOS - switch adaptation of the controller gains cowLDR_ADA:

decimal value	comment
0	about consumption
1	about the speed
2	across the aisle

The P gains ldwPR_SIG, ldwPR_POS and ldwPR_NEG are calculated with the factor from the Characteristic ldwPRfakKL multiplied. The result of the multiplication is the current P gain of the PIDT1 controller. The I - gains ldwIR_SIG, ldwIR_POS and ldwIR_NEG are with multiplied by the factor from the characteristic ldwIRfakKL. The multiplication result is the current one I - gain of the PIDT1 - controller. The D - gains ldwDR_SIP, ldwDR_POS, ldwDR_SIN and ldwDR_NEG are calculated with the factor from the characteristic ldwDRfakKL multiplied. The result of the multiplication is the current D gain of the PIDT1 controller.

The memory factor is interpolated from the ldwDR_gfKL characteristic. Also here can with the DAMOS - switch cowLDR_ADA as an input variable of the characteristic either the consumption mrmVERB, the speed dzmNmit or the gear fgm_VzuN are used.

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4.6 Shutdown

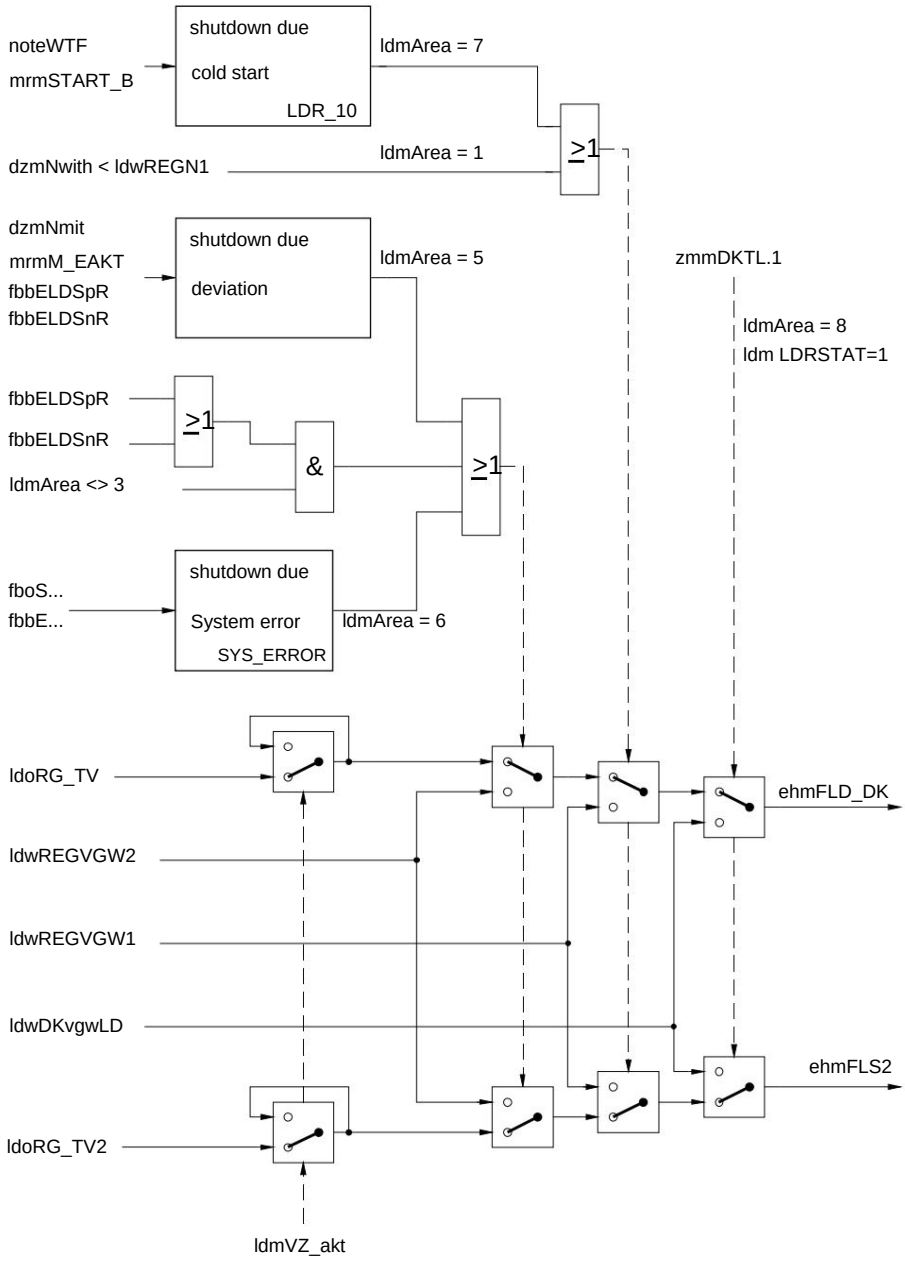


Figure LDR_07: Monitoring and shutdown

In the part-load range, the exhaust gas recirculation should be closed quickly with a high positive desired quantity change in order to enable a rapid boost pressure build-up. The LDR-TV is frozen (ldmVZ_akt=1) to allow the loading shovels to be closed quickly only after the ARF has been switched off. Otherwise, premature closing of the supercharger blades would briefly push the exhaust gas flow through the exhaust gas recirculation.

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Switching off the boost pressure control depends on the operating status ldm area (working area see figure LDR_08):

Operating status ldm area	Workspace	measure	measure at permanent RA	monitoring on RA	healing of RA
0	0	control after maps	ldwREGVGW2	no	no
1	1	ldwREGVGW1	ldwREGVGW1	No	no
2	2	regulation	ldwREGVGW2	no	no
3	3	regulation	Regulation		Yes
4	4	Control	ldwREGVGW2		no
5	4	ldwREGVGW2 because of permanent		yes	no
6	-	RA ldwREGVGW2 because of system		yes	no
7	-	error ldwREGVGW1 because of cold		no	no
8	-	start ldwDKvgwLD because of throttle valve test (has the highest switch-off priority)		no no no	no

The data ldwREGVGW1 and ldwREGVGW2 are default values for the drive duty ratio of the boost pressure actuator. When the controller is switched on again, the I component with ldwREGIVG1 or ldwREGIVG2 initialized. The initialization values ldwREGIVG1 and ldwREGIVG2 are only useful if no parallel control is applied. In this case, the two values usually applied with the same values as ldwREGVGW1 and ldwREGVGW2. Are but the maps for the parallel control applied so must ldwREGIVG1 and ldwREGIVG2 can be applied with zero.

Due to the load, the boost pressure control with the data ldwREGN1, ldwREGN2 and ldwREGN3 and ldwREGME3 and ldwREGME4 as well as by the hysteresis characteristics (Functions of ldmM_E) ldwREG0KL and ldwREG1KL divided into 5 work areas. This Data represent thresholds for the average speed dzmNmit and the amount mrmM_EAKT:

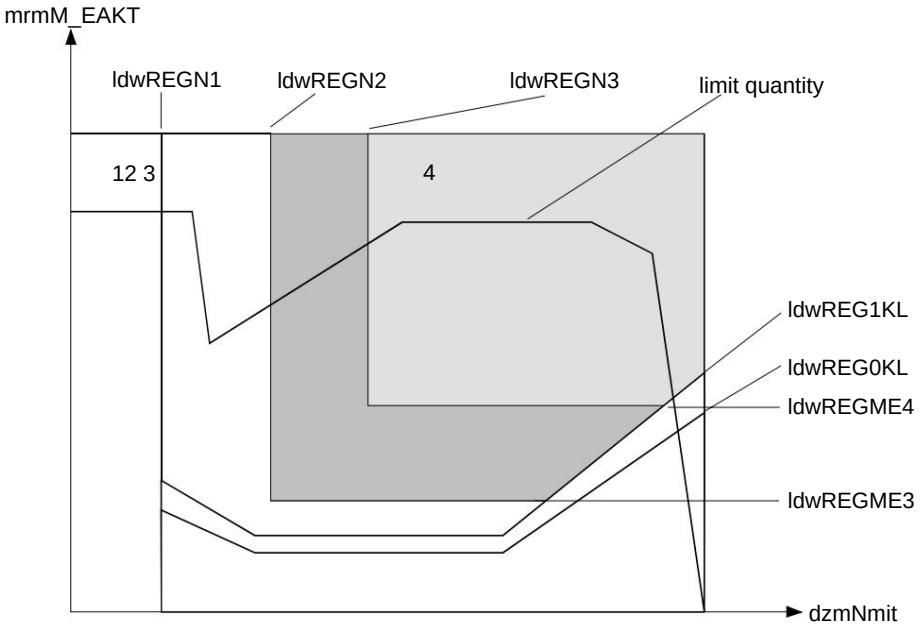


Figure LDR_08: Working areas

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If the boost pressure control is in the working ranges 0, 2, 3 or 4 and there is no deviation, this means that the boost pressure control is regulating or controlling while driving. This information is made available to other functions in the message ldmRGST.

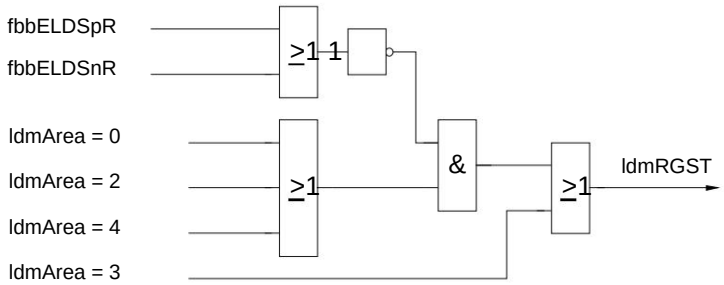


Figure LDR_11: Message ldmRGST

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4.6.1 Shutdown due to permanent control deviation

Depending on the operating range, the boost pressure control is switched off by a permanent control deviation. (Remaining control deviation see chapter "Monitoring concept").

4.6.2 Shutdown due to cold start

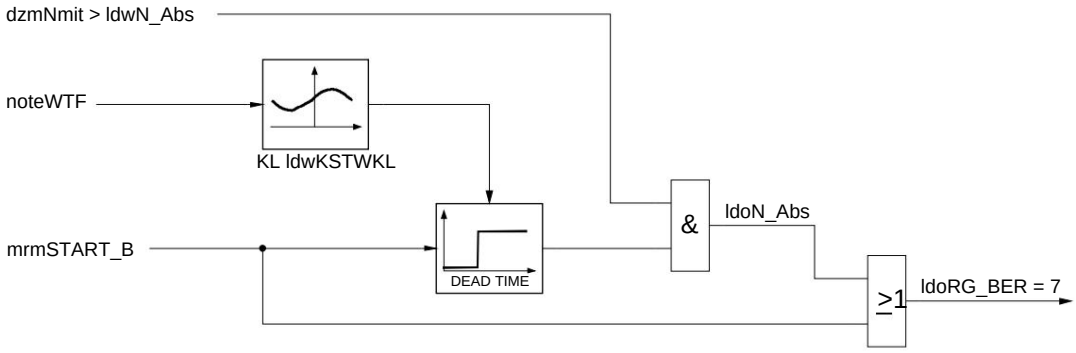


Figure LDR_10: Shutdown due to cold start

In the case of a cold start (ldm range = 7), the device is switched off by specifying the duty cycle ldwREGVGW1. Cold start is during the starting process (mrmSTART_B = 1) and also an applicable time after start shedding, but only if the speed threshold ldwN_Abs is exceeded. This maximum switch-off time (ldoKSTWt) depends on the water temperature (characteristic ldwKSTWKL) and is determined with the water temperature anmWTF at the time of the start shedding.

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5 Other functions

5.1 Glow Time Control

5.1.1 Glow plug control

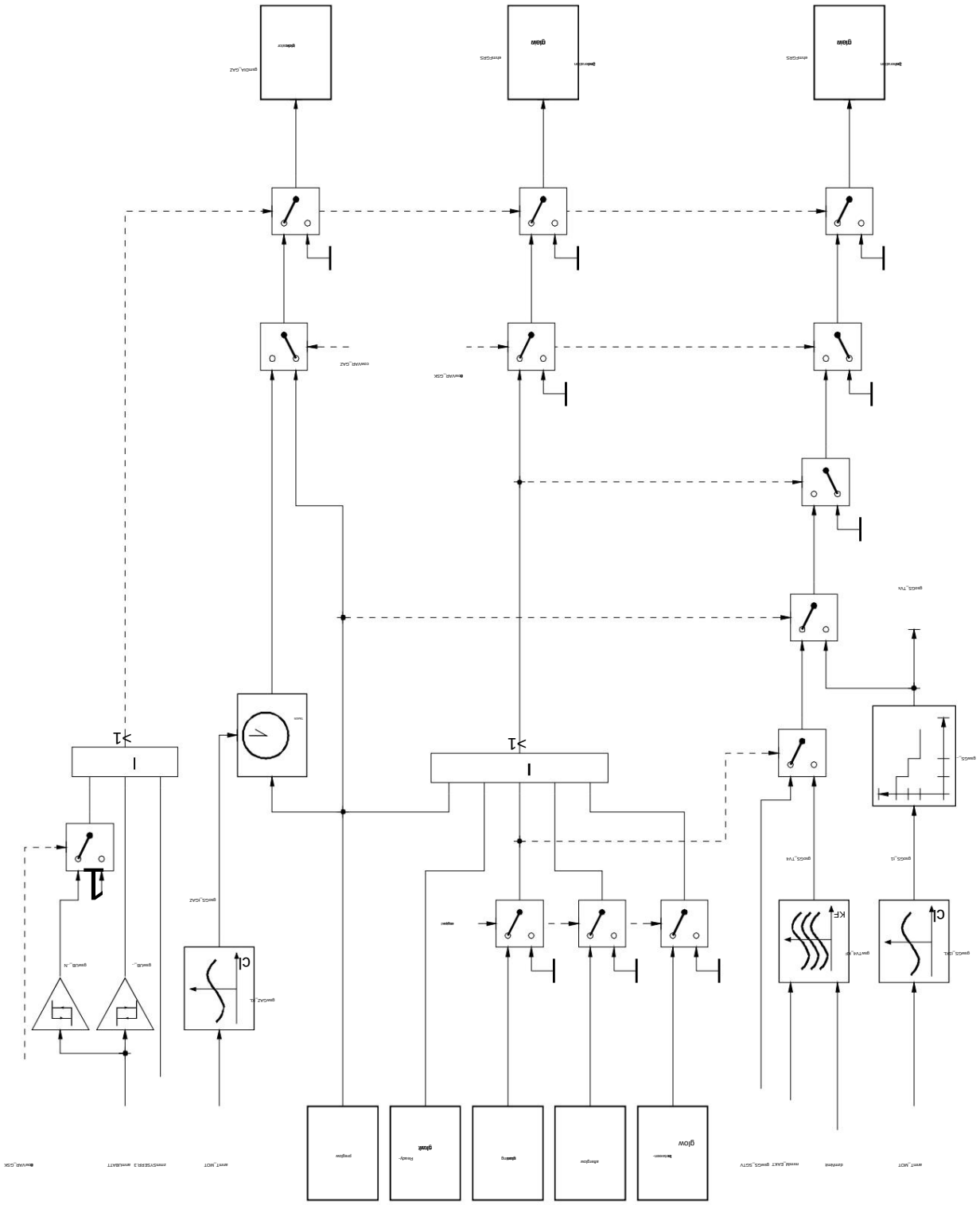


Figure SONSGZ01: Glow plug control

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• Control of the glow indicator: About
the variant switch cowVAR_GAZ can be applied regardless of the real pre-glow any control duration in the engine temperature-dependent characteristic gswGAZ_KL. About the battery voltage hysteresis gswUB_.. or if there is no speed that can be evaluated (zmmSYSERR.3 is set), the glow indicator is switched off.

• Selection of the glow plug generation:
cowVAR_GSK = 0 GSK 2 cowVAR_GSK =
1 GSK 3, Bosch product cowVAR_GSK = 2 GSK
3, competitor product

• Glow plug control, 2nd generation (cowVAR_GSK = 0): Via the battery
voltage hysteresis gswUB_.. or if there is no speed that can be evaluated

(zmmSYSERR.3 is set), the relays are switched off.

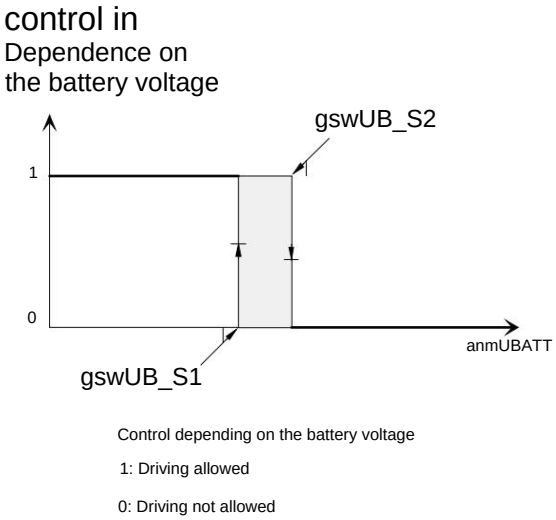


Figure SONSGZ07: Battery voltage hysteresis GSK 2

When the engine is at a standstill, all glow phases are switched off, except for the pre-glow and ready-to-start glow. The glow relays are only activated after a delay time gswGS_T_1G during afterglow and intermediate glow.

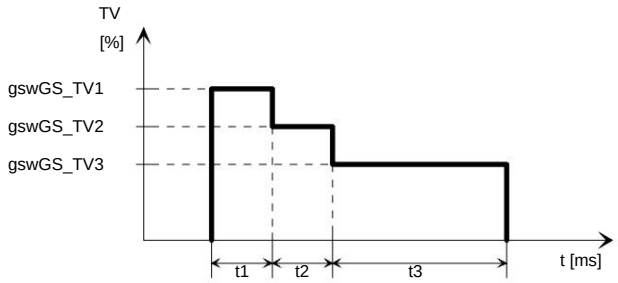
Glow plug control, 3rd generation (cowVAR_GSK = 1) The control in the preheating phase consists of 3 areas:

- In area 1, the glow plugs are controlled with the duty cycle gswGS_TV1 for the time gsoGS_t1 (can be applied in the engine temperature-dependent characteristic curve gswGS_t1KL).
- In area 2, the glow plugs are driven with duty cycle gswGS_TV2 for time gswGS_t2.
- In area 3, the glow plugs are controlled with the pulse duty factor gswGS_TV3 for the time gsmGS_t_VG (preheating time from the map gswGS_VGKF) - gswGS_t2 - gsoGS_t1. If the map gswGS_VGKF is applied to zero, there is no preheating.

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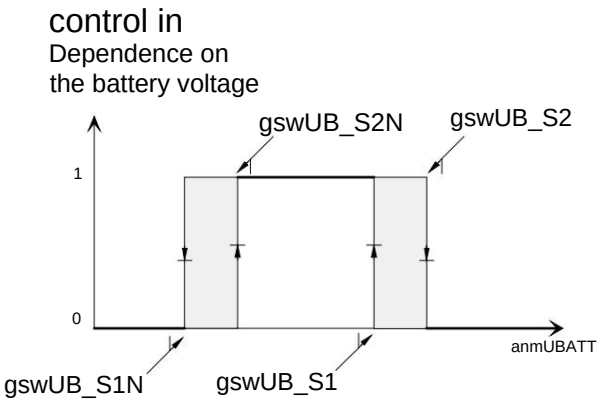
t1 ... gsoGS_t1 (from characteristic curve gswGS_t1KL)

t2 ... gswGS_t2

t3 ... gsmGS_t_VG (preheating time from map gswGS_VGKF) - gswGS_t2 - gsoGS_t1

Figure SONSGZ03: Preheating for glow plug control, 3rd generation

The glow plugs are controlled with a duty cycle gsoGS_TV4 for the states of ready glow, intermediate glow and afterglow. This value results from the map gswTV4_KF depending on the current amount mrmM_EAKT and the engine speed dzmNmit. During the start glow gswGS_SGTV is controlled with the duty cycle. About the battery voltage hysteresis gswUB_.. or if there is no speed that can be evaluated (zmmSYSERR.3 is set), no duty cycle is output.



Control depending on the battery voltage
1: Driving allowed
0: Driving not allowed

Figure SONSGZ08: Battery voltage hysteresis GSK 3

Battery voltage correction: see chapter "Input and output signals" - Glow relay actuator

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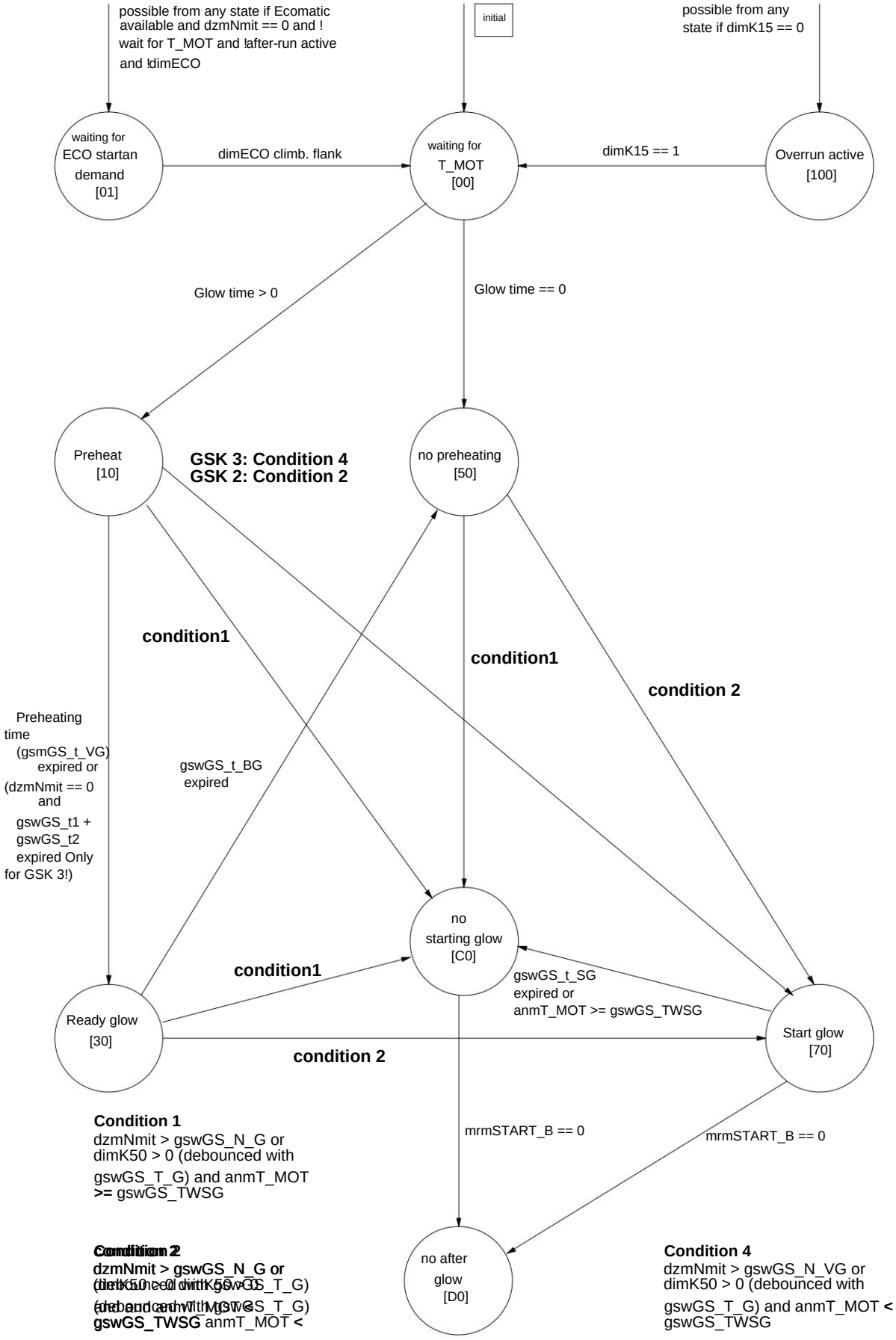


Figure SONSGZ02_1:

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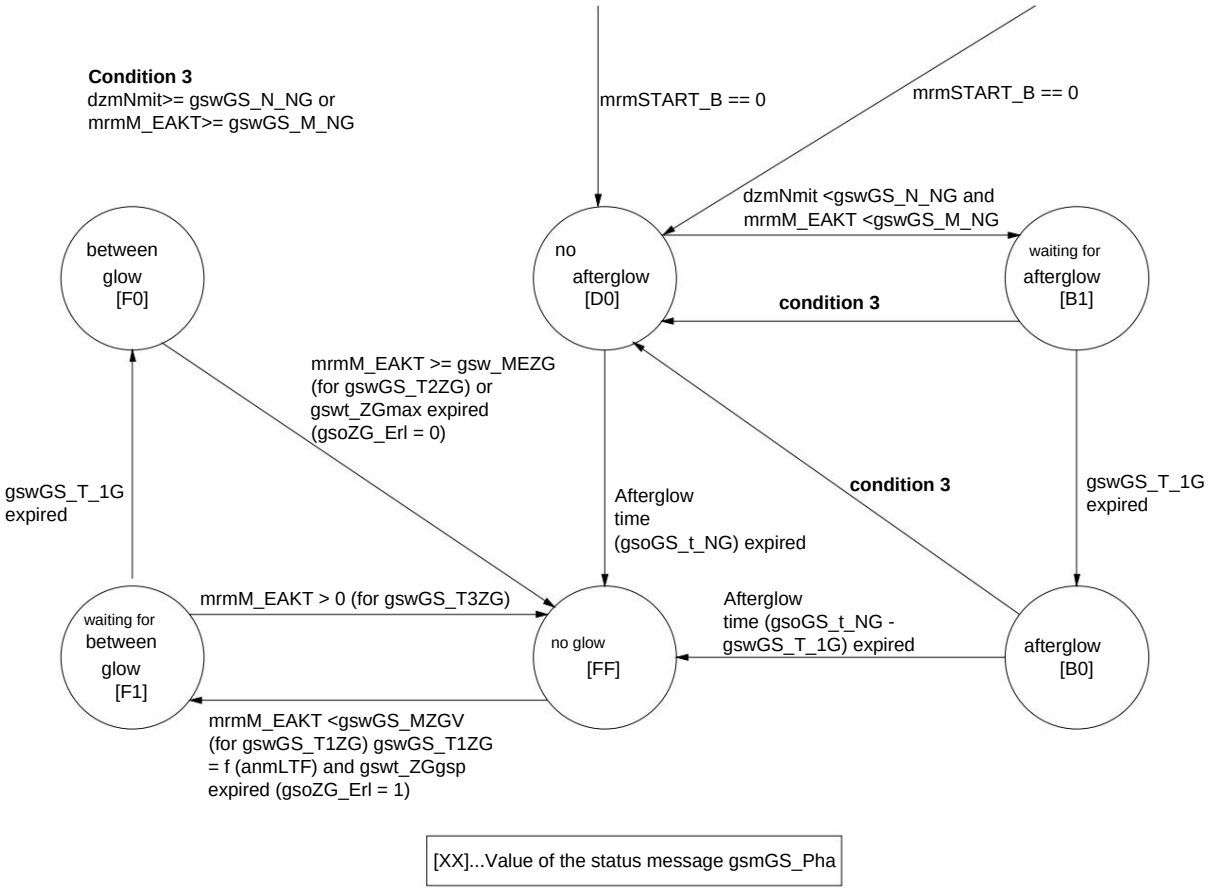


Figure SONSGZ02_2

Status diagram of the glow time control If

several conditions are met at the same time, not all transitions are displayed on the status message.

5.1.2 Determination of the glow requirement

The glow time control can be activated by two conditions.

1) After K15 - On, the control unit is in the “waiting for T_MOT” state. During this state, a preheating time is determined from the engine temperature.

2.) When the ECOMATIC is activated (cowECOMTC.0 == 1), the glow time calculation is always carried out at speed 0 (status “ECOMATIC - wait”). In this case, with a preheating time gsmGS_t_VG > 0 and dzmNmit = 0, a glow information bit gsmGLUEH is set in all states except the state 0x30 “ready glow” for information to the Ecomatic-SG. The Ecomatic only changes to the 0x10 “preheating” state after a start request (signal change of the engine off bit dimECO).

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5.1.3 Description of the states of the glow time control

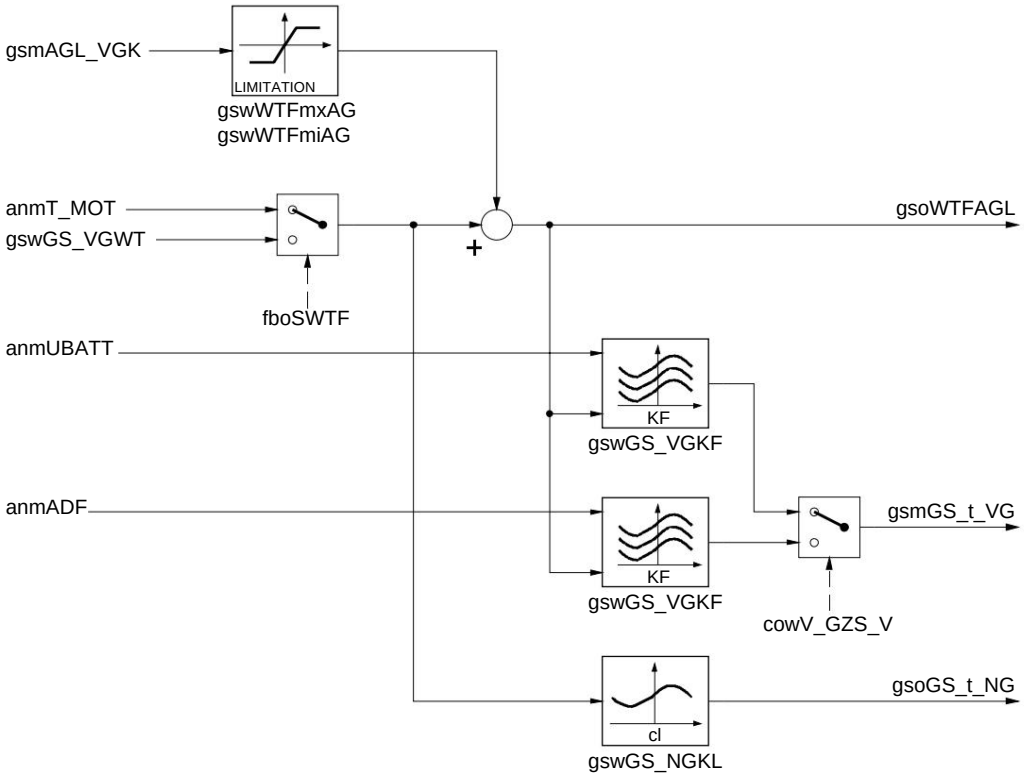


Figure SONSGZ04: Determination of the pre- and afterglow time

Preheat:

After switching on the control unit supply voltage, the preheating phase begins when the calculation of the preheating time has determined a value greater than zero.

Preheating ends when one of the 3 requirements is met:

- the preheating time (gsmGS_t_VG) from map gswGS_VGKF has expired or the timer gsoGS_t1 + gswGS_t2 expired and the speed is zero (transition to ready glow)

- Condition 1: the engine speed dzmNmit is greater than the speed threshold gswGS_N_G or the starter dimK50 is greater than zero (debounced with gswGS_T_G) and the engine temperature anmT_MOT is >= the temperature threshold gswGS_TWSG (transition to no starting glow)

- cowVAR_GSK = 0:
  Condition 2: the engine speed dzmNmit is greater than the speed threshold gswGS_N_G or the starter dimK50 is greater than zero (debounced with gswGS_T_G) and the engine temperature anmT_MOT is <the temperature threshold gswGS_TWSG (transition to start glow)

  cowVAR_GSK = 1 or 2:
  Condition 4: the engine speed dzmNmit is greater than the speed threshold gswGS_N_VG or the starter dimK50 is greater than zero (debounced with gswGS_T_G) and the Motor temperature anmT_MOT is < the temperature threshold gswGS_TWSG (transition to starting glow)

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No preheat:

If the calculation of the preheating time returns a value equal to zero, the no preheating state begins.

No preheating is terminated if one of 2 requirements is met:

- Condition 1: the engine speed dzmNmit is greater than the speed threshold gswGS_N_G or the starter dimK50 is greater than zero (debounced with gswGS_T_G) and the engine temperature anmT_MOT is >= the temperature threshold gswGS_TWSG (transition to no starting glow)

- Condition 2: the engine speed dzmNmit is greater than the speed threshold gswGS_N_G or the starter dimK50 is greater than zero (debounced with gswGS_T_G) and the engine temperature anmT_MOT is < the temperature threshold gswGS_TWSG [end of condition 2]

The preheating time gsmGS_t_VG is calculated before the preheating phase from the map gswGS_VGKF = f (anmUBATT, anmT_MOT) or f (anmADF, anmT_MOT) plus the adjustment value gsmAGL_VGK (initialized with cowAGL_VGK). The adjustment value gsmAGL_VGK (OLDA gsoWTFAGL) is limited by gswWTFmxAG and gswWTFmiAG and can be changed via the diagnostic interface. The switching of the input variable of the map is done by means of DAMOS - switch cowV_GZS_V (0 = pre-glow time dependent on battery voltage, 1 = pre-glow time dependent on altitude). If the water temperature sensor is defective, the preheating time is determined using a default value gswGS_VGWT from the map.

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Ready to start glow:

The glow-to-start glow only follows the pre-glow phase if one of 2
Requirements are met:

ÿ the preheating process was terminated by the expiry of the preheating time gsmGS_t_VG and the time gsmGS_t_VG calculated at the beginning of the preheating was >0

- the time t1 + t2 of the preheating phase has expired and the speed dzmNmit == 0.

The ready-to-start glow stops when one of 3 requirements is met:
(Explanation of condition1 and condition2: see no preheating)

ÿ the start readiness glow time gswGS_t_BG has expired and not condition 1 and Condition2 are met. (transition to no preglow)

ÿ the condition 1: (transition to no start glow) dzmNmit > gswGS_N_G or dimk50 > 0 (debounced with gswGS_T_G) and anmT_MOT >= gswGS_TWSG

- Condition 2: (transition to start glow) dzmNmit> gswGS_N_G or dimk50> 0 (debounced with gswGS_T_G) and anmT_MOT <gswGS_TWSG

Start glow:

The initial glow can be activated from the phases pre-heat, no pre-heat and ready-heat. To do this, the following requirements must be met.

Preheating: Condition 2 or the speed dzmNmit is > than the speed threshold gswGS_T_G (this is debounced over time gswGS_T_G)

No pre-heating: Condition 2

dzmNmit > gswGS_N_G or dimk50 > 0 (debounced with gswGS_T_G) and anmT_MOT < gswGS_TWSG

Ready glow: Condition 2

dzmNmit > gswGS_N_G or dimk50 > 0 (debounced with gswGS_T_G) and anmT_MOT < gswGS_TWSG

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If the WTF is defective, the default value gswGS_VGWT is used for the motor temperature.

The start glow is ended

- after the start glow time gswGS_t_SG - if the starting
quantity shedding speed was exceeded or - after exceeding the engine
temperature threshold gswGS_TWSG

The start glow phase is not interrupted when the speed threshold gswGS_N_G is undershot. If the start glow was ended, there is no new start glow when the engine speed falls below the gswGS_N_G threshold.

The duty cycle gswGS_SGTV is used for the start glow.

Afterglow: The

afterglow begins when the starting quantity drop speed is exceeded (mrmSTART_B = 0).
It ends with the end of the afterglow time (gsoGS_t_NG - gswGS_T_1G). The time gsoGS_t_NG is calculated once from the engine temperature-dependent characteristic gswGS_NGKL.

If the water temperature sensor is defective, the default value gswGS_VGWT is used to calculate the afterglow time.

Afterglow is interrupted when condition 3 is met:

a quantity threshold gswGS_M_NG or a
speed threshold gswGS_N_NG is exceeded.

During this interruption, the time gsoGS_t_NG continues.

intermediate glow:

After the end of the afterglow phase (= no glow) the status "wait for intermediate glow" changes when the current quantity mrmM_EAKT is less than the quantity threshold gswGS_MZGV longer than the time gswGS_T1ZG (this time is determined in the air temperature-dependent characteristic curve gswGS_T1ZG). After the time gswGS_T_1G is started with the intermediate glow. If in the "waiting for intermediate glow" state the current quantity is greater than zero for longer than the time gswGS_T3ZG, the "no glow" state is returned to. The intermediate glow is terminated when the current amount longer than the time gswGS_T2ZG is greater than the threshold gswGS_MEZG. The intermediate glow is limited to the applicable time gswt_ZGmax. After this time, the status "no glow" (gsmGS_Pha = FF) is returned and the blocking timer gswt_ZGgsp is started. Intermediate glowing is only possible again after the blocking time has expired. The status of the intermediate glow (0:blocked, 1:allowed) is displayed on the Olda channel gsoZG_Erl.

Follow-up active:

If after-run is requested (terminal 15 = 0), the status of the glow phase changes to "after-run active".
(Value of the status message gsmGS_Pha = 100). If terminal 15 is switched on again before the after-run has ended (after-run aborted), the preheating phase is restarted with "Wait for T_MOT".

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5.1.4 "Pushing" for 3rd generation glow plugs

"Pushing" means raising the effective value of the pulse width modulated control signal (GRL line) for the GZS. "Pushing" is enabled in the pre-glow phase and during the start glow. To do this, the battery voltage correction must be carried out in the MSG (cowVAR_GSK = 1). In all other states (ready-to-start glow, afterglow, intermediate glow and in the after-run) "pushing" is prohibited. During "pushing" gsmGS_Vor1 = 1.

5.1.5 Protection of the GSK 3 against overheating

The glow plugs of the 3rd generation are protected against overheating by repeated "pushing" by storing the information "pushing allowed/prohibited in the next driving cycle" in the EEPROM.

Procedure:
During the initialization of the glow time control, the information "pushing allowed" (edmPsh_erl = 1) or "pushing blocked" (edmPsh_erl = 0) is read from the EEPROM.

- Pushing allowed: In the states "Preheating" (1st and 2nd phase) (gsmGS_Pha = 10h) as well as in the state "Starting glow" (gsmGS_Pha = 70h) is pushed. Pushing is blocked for the next driving cycle (gsmPsh_erl_). As soon as the glow time control is in the "no glow" state (gsmGS_Pha = FFh), a timer is started. After the applicable time gswt_Psh_E has expired, pushing is enabled in the EEPROM for the next driving cycle (gsmPsh_erl = 1).

- Push blocked: There is no push during the entire driving cycle. A timer is started as soon as the glow time control is in the “no glow” state (gsmGS_Pha = FFh). After the applicable time gswt_Psh_E has expired, pushing is enabled in the EEPROM for the next driving cycle (gsmPsh_erl = 1).

Messages:
gsmPsh_erl: contains information on whether pushing is allowed in this driving cycle
the information is read from the EEPROM
1 = pushing allowed
0 = Pushing prohibited
edmPsh_erl: Contains the information as to whether pushing is permitted in the next driving cycle. The information is written to the EEPROM
1 = pushing allowed
0 = Push forbidden

5.1.6 Sum error diagnosis

With the group error diagnosis, the glow relays are no longer controlled directly, but by a glow control device, which switches the glow relays on or off depending on ehmFGRS. Since the glow plug does not have its own fault memory, it reports any faults that may appear to the control unit via its own line (input dimGZR).

If the GRS - output stage is defective, the error fbbEGZS_I is not reported until the output stage is considered intact again - therefore the defect detection time of this error must be greater than that of the output stage error.

If the group error diagnosis is active and the output stage is not defective, the output signal of the

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GRS - output stage (glow time control ehmFGRS or diagnosis ehmDGRS) with the input signal dimGZR checked. If dimGZR is not inverse to the output stage control, then the error fbbEGZS_I reported defective, otherwise it is reported intact.

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5.1.7 GSK3 diagnosis

Since the GZS (3rd generation) does not have its own error memory, the MSG clocks the serial Diagnostic information from the GZS. After each falling edge on the GRL line (control line), the GZS sets the GZR line (diagnosis line) to a high or low level in order to MSG thereby to transmit logical 1 or 0.

The transfer is divided into 2 phases:

1. Synchronization

While the GZS is diagnosing the spark plugs, a logical 1 is output on the diagnosis line.
The MSG internally counts the number of synchronization bits (gsoCO_Bit). To prevent, that an error on the line is mistakenly evaluated as a start bit must be at least gswSYNC_HI synchronization bits have been detected.

2. Data Transfer

In this section, the diagnostic data is transmitted serially to the MSG.

A total of 32 bits are transmitted (22 bits of synchronization, 8 bits of data, 1 start and 1 stop bit).

The status of the transfer is sent in the message gsmDIA_STA and can have the following values accept:

decimal meaning	
	Synchronization, waiting for start bit
1 2	read data

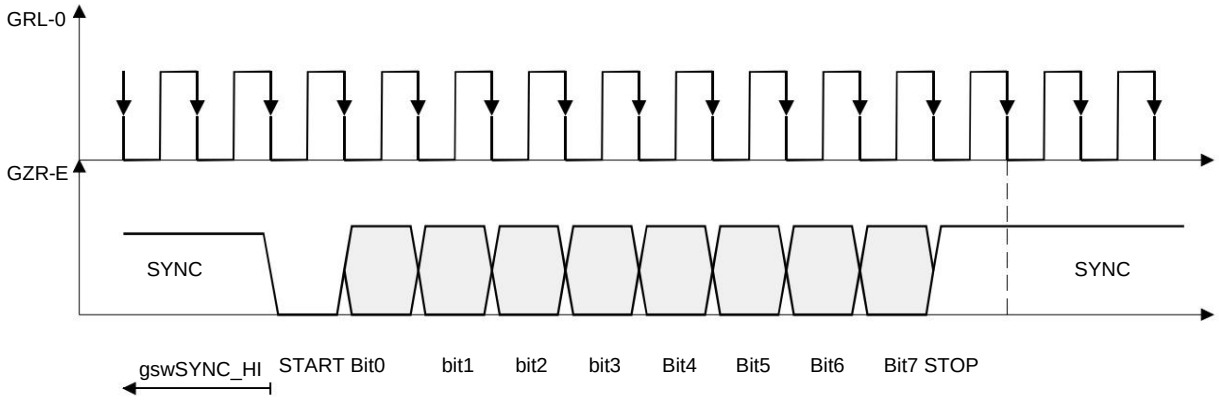


Figure SONSGZ05: Transmission of diagnostic data

Bit No.	Description	level
0	Condition glow plugs G1	0 for glow plugs good or overcurrent 1 for glow plug failure
...	...	...
5	Condition glow plugs G6	0 for glow plugs good or overcurrent 1 for glow plug failure
6	overcurrent	0 for glow plugs good or failed 1 for overcurrent on any glow plug
7	sum error	0 no error 1 Glow plug failure, overcurrent, or relay sticking is not evaluated by the MSG

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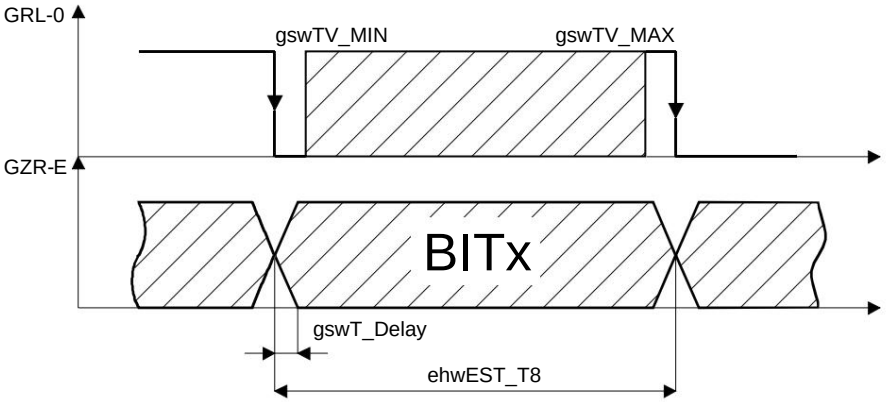


Figure SONSGZ06: data bit

If ehmFGRS_K (battery voltage corrected duty cycle) < gswTV_MIN or ehmFGRS_K> gswTV_MAX, it can no longer be ensured that the GZS the signal recognized as a clock. Therefore, the current transfer is aborted. Is the TV back on? valid range, the diagnosis is restarted with a synchronization cycle.

The information on the GZR-E line has a delay compared to the falling edge the GRL-0 line. With the help of the gswT_Delay label, the minimum time can be applied the MSG must elapse before valid data is read from GZR-E.

If all data bits have been read, or a transmission error has occurred, the information in the message gsmGSK3_ST (initialization value = 0) is sent and the "data valid bit" is set (gsmGSK3_ST.F = 1).

In the event of a transmission error, the low byte is deleted, and the corresponding one in the high byte Error bit and the "data valid bit" set (gsmGSK3_ST.F = 1).

gsmGSK3_ST	
Bit Position	Description
0 - 7	diagnostic data
8th	1 = stop bit - error
9	1 = Flatline Low - Error
A	1 = Flatline High - Error
B	1 = timeout - error
f	1 = valid data sent

If all errors were reported by the control, the message "Error reported" is set (gsmER_READ = 1) and the diagnosis takes the "data valid bit" until the next Diagnostic cycle back (gsmGSK3_ST.F = 0).

Application note:

Delay time gswT_Delay + 20ms < period duration ehwEST_T8

At least (10 bit init. + 22 bit sync. + 10 bit data) * ehwEST_T8 must be glowed after K15 to allow 1 valid data transfer in the driving cycle.

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5.2 Fuel Cooling

Fuel cooling is available so that the fuel *temperature anmKTF* in the return flow to the tank does not exceed certain temperature thresholds. For this purpose, a circulation pump *ehmFKSK* is controlled via a relay.

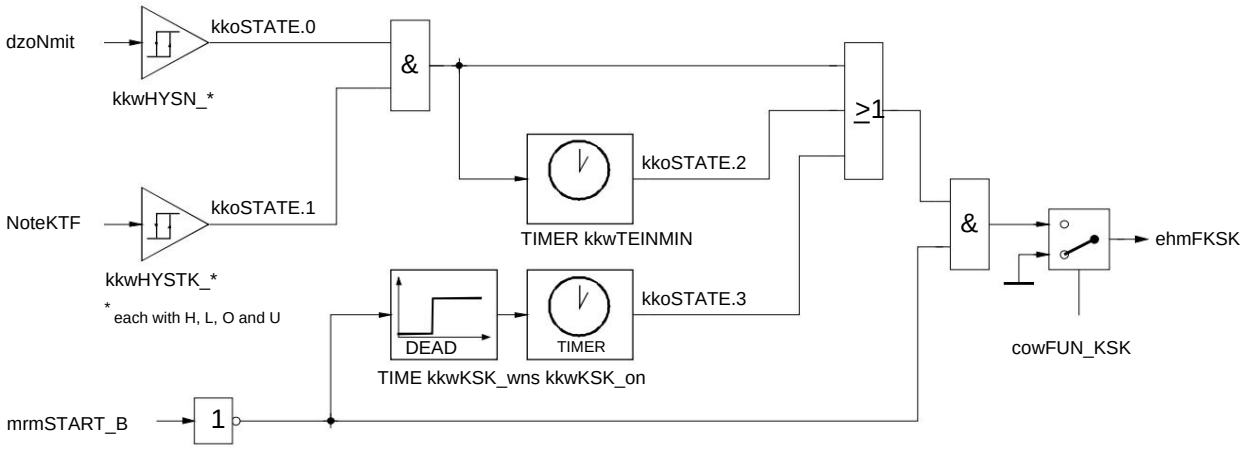


Figure SONSKK01 : Fuel cooling

Above the temperature *threshold kkwHYSTK_O* and above the speed *threshold kkwHYSN_O ,* the output *ehmFKSK* is activated for the minimum *duty cycle kkwTEINMIN .* After falling below the hysteresis *thresholds kkwHYSTK_U* or *kkwHYSN_U* and after the minimum switch-on time has elapsed, the output is deactivated again. The entire fuel cooling can be deactivated via the function *switch cowFUN_KSK (cowFUN_KSK* = 0).

The initial states of the two hystereses are shown in the BIT-OLDA *kkoSTATE .*
The speed hysteresis is displayed with bit 0 and the temperature hysteresis with bit 1.
In addition, bit 2 is set during the minimum switch-on time.

The fuel circulation pump is only switched on when the start shedding (mrmSTART_B=0) has already been reached.

In order to prevent silting up in the fuel cooling circuit, the fuel circulating pump is switched on for the duration kkwKSK_on once per driving cycle after the start is dropped and the waiting time kkwKSK_wns has elapsed.

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5.3 Air conditioning compressor

The air conditioning compressor is switched depending on various vehicle or SG states.
With the help of the air conditioning compressor control logic, a sufficiently high torque is provided by switching off the air conditioning compressor in the event of a brief high torque requirement (starting off, accelerating, undercutting the idling speed). In addition, if the driving speed (fboSFGG), the pedal value sensor (fboSPWG or fboSPGS) or the speed (fboSDZG) is incorrectly measured, the air conditioning compressor is prevented from being switched on below a speed threshold (hysteresis). If the water temperature (anmWTF_CAN) is too high, this also leads to the switch-on lock. The air conditioning compressor can also be switched off via CAN (message gearbox 1 or BSG_Last).

To increase the idle speed, the air conditioning compressor control always sets the message klmN_LLKLM to the value klwKLM_NLL; the parameter selection of the idle controller increases the idle speed to this value when the air conditioning compressor is switched on (dimKLB = 1).
The climate control input is queried independently of the climate output ehmFKLI0 and is processed during idle control.

In the following text, a ".." stands for U (lower hysteresis threshold) or O (upper hysteresis threshold) for all hysteresis limit values.

Each switch-off condition causes a switch-off for an applicable minimum time.

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5.3.1 Lockout Conditions

The conditions that can cause the A/C compressor to shut off are OR linked, which means that at least one condition must be met so that the switching on of the Air conditioning compressor is prevented (output ehmFKLI0 to 0%).

The current states of the individual switch-off conditions are displayed in the OLDA klmSTAT summarized bitwise encoded. In the OLDA klmHYS, the individual hysteresis outputs displayed bit by bit.

Description of the OLDA klmHYS:

Bit position	decimal value	comment
0	1	full throttle detected (anmPWG > klwH_PWG_..)
1	2	Vehicle drives in neutral or in 1st gear (fgm_VzuN < klwH_VZN_..)
2	4	rel. low speed (fgmFGAKT < klwH_FGG1..)
3	8th	rel. low speed (dzoNmit < klwH_DZG1..)
4	16	High accelerator pedal change (anmPWG - Diff. > klwH_PWGD ..)
5	32	rel. low speed (fgmFGAKT < klwH_FGG2..)
6	64	rel. low speed (dzoNmit < klwH_DZG2..)
7	128	rel. low speed (dzoNmit < klwH_DZG3..)
	256	rel. low speed (dzoNmit < klwH_DZG4..)
8	512	rel. high water temperature (anmWTF_CAN > klwH_WTF_..)
9	1024	rel. low ambient temp. and high air pressure (low altitude)
10 11	2048	rel. low ambient temp. and Compressor duty cycle > klwTMIN_BS

Description of the OLDA klmSTAT:

Bit position	decimal value	comment
0	1	The vehicle is in the starting state
1	2	Shutdown due to start-up condition
2	4	Vehicle is in the acceleration state
3	8	Shutdown due to acceleration
4	16	Shutdown due to startup
5	32	System error detected (FGG -, PWG - or DZG - error)
6	64	Shutdown due to system error
7	128	Shutdown due to undercutting idle speed
8th	256	Shutdown due to excessive water temperature
9	512	Shutdown via CAN - Transmission 1
A	1024	Shutdown via CAN – BSG_Last
B	2048	Shutdown due to refrigerant pressure or ambient temperature
f	32768	minimum duty cycle

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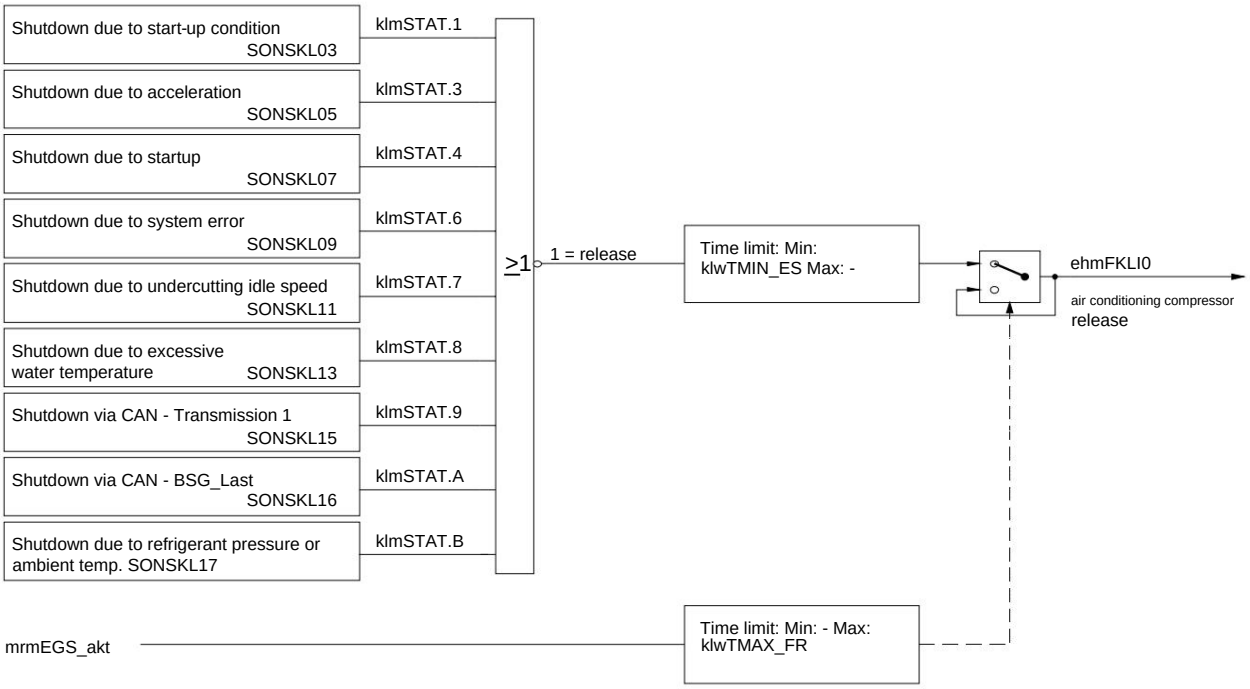


Figure SONSKL01: Consideration of the minimum duty cycle

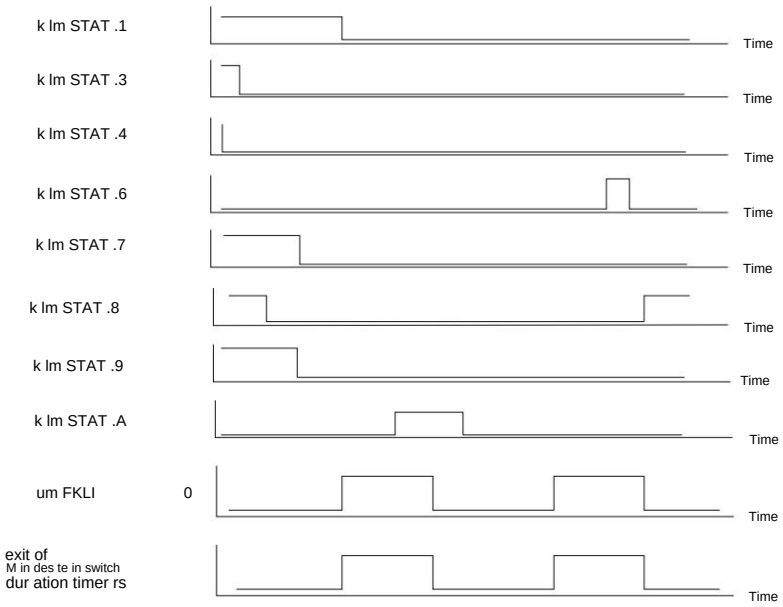


Figure SONSKL02: Time diagram for switching off / releasing the air conditioning compressor

When the air conditioning compressor is enabled (ie setting the output ehmFKLI0 to 100%), the minimum duty cycle klwTMIN_ES is awaited, during which it is not possible to switch off the air conditioning compressor. This prevents the air conditioning compressor from switching on too quickly.

During a switching process (mrmEGS_akt = 1), but for a maximum of the time klwTMAX_FR, the air compressor release is frozen ehmFKLI0. If klwTMAX_FR = 0, ehmFKLI0 is never frozen.

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The following conditions are checked:

start-up state:

(Accelerator pedal value anmPWG > klwH_PWG_..) AND
[(Ratio speed/engine speed fgm_VzuN < klwH_VZN_..)
OR (speed fgmFGAKT < klwH_FGG1..)] AND (speed dzoNmit <
klwH_DZG1..)

If the conditions are met for a shorter time than kloTMIN_AN, there is a shutdown for the minimum shutdown time kloTMIN_AN. If the conditions are met for longer than the maximum switch-off time kloTMAX_AN, the air conditioning compressor is alternately enabled (minimum switch-on time klwTMIN_ES) and switched off (maximum switch-off time kloTMAX_AN) until the switch-off condition disappears.

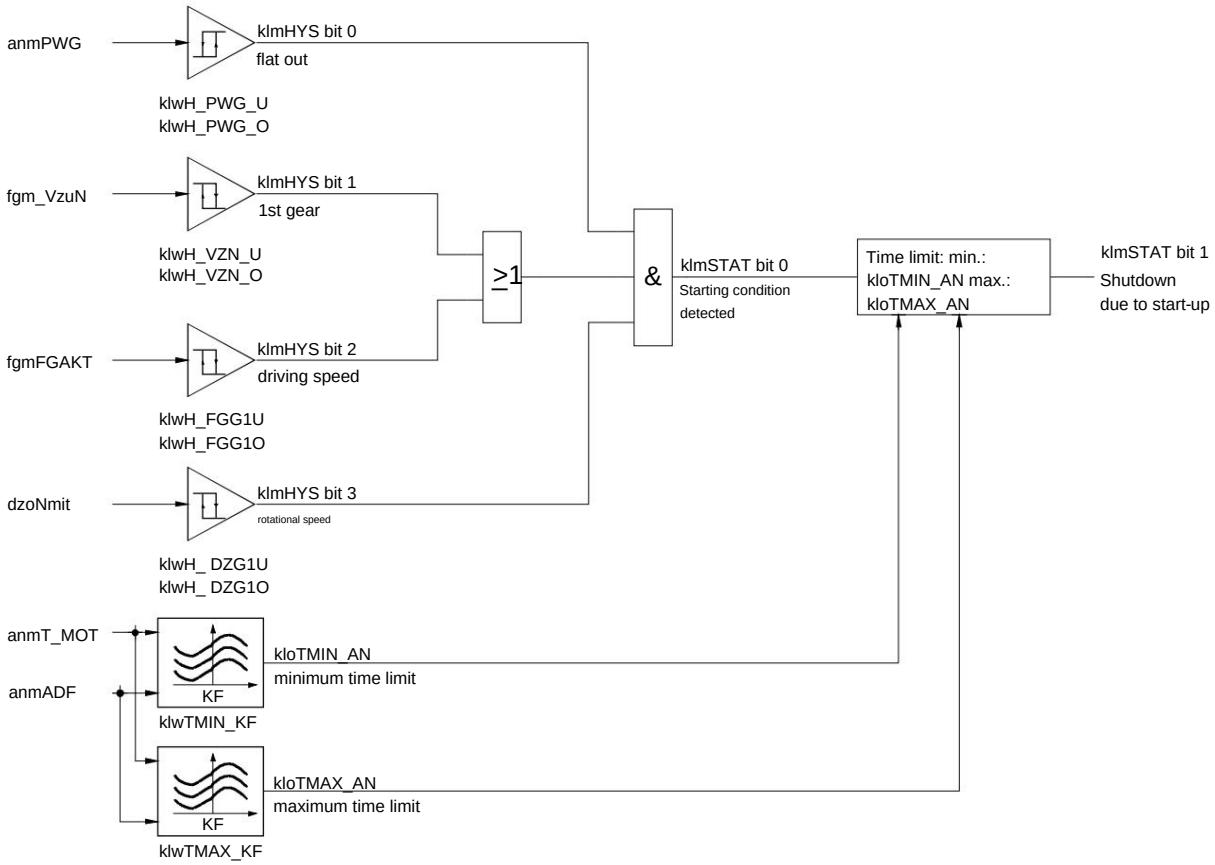


Figure SONSKL03: Switch-off condition for start-up

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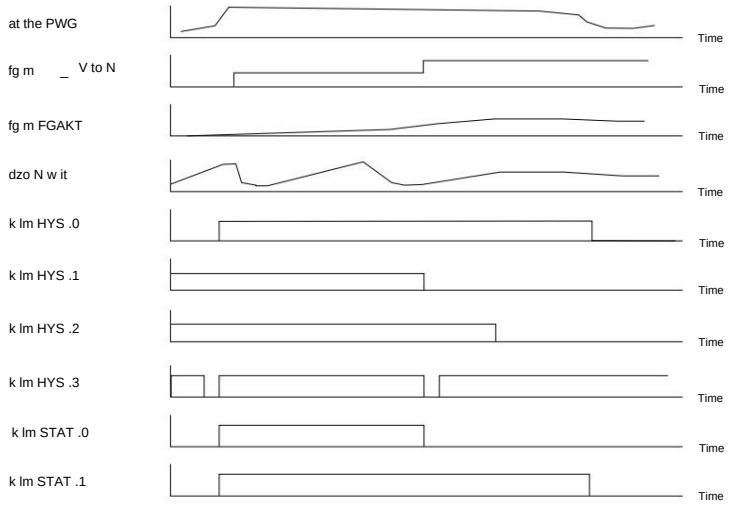


Figure SONSKL04: Timing diagram for switch-off condition, approach

Starting off, accelerating with rapid acceleration:

(Accelerator pedal change > klwH_PWGD..) AND
(Speed fgmFGAKT < klwH_FGG2..) AND
(Speed dzoNmit < klwH_DZG2..) AND
NOT((ambient temp. anmUTF < klwH_UTF1..) AND
(Ambient pressure anmADF > klwH_ADF..)) AND
NOT((ambient temp. anmUTF < klwH_UTF2..) AND
(switch-on time > klwTMIN_BS))

If these conditions are met, there is a shutdown for the period klwTMIN_B. Becomes an acceleration process is detected again within this period of time, this period of time, in the air conditioning remains switched off, started again, ie shutdown can be retriggered.

The last two conditions avoid unnecessary compressor shutdowns (where the air conditioning compressor hardly absorbs any torque) avoided :

- UTF1,ADF1 : full engine torque available
- UTF2, on-time : no high cooling capacity necessary

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due to low ambient temperature and already longer compressor duty cycle

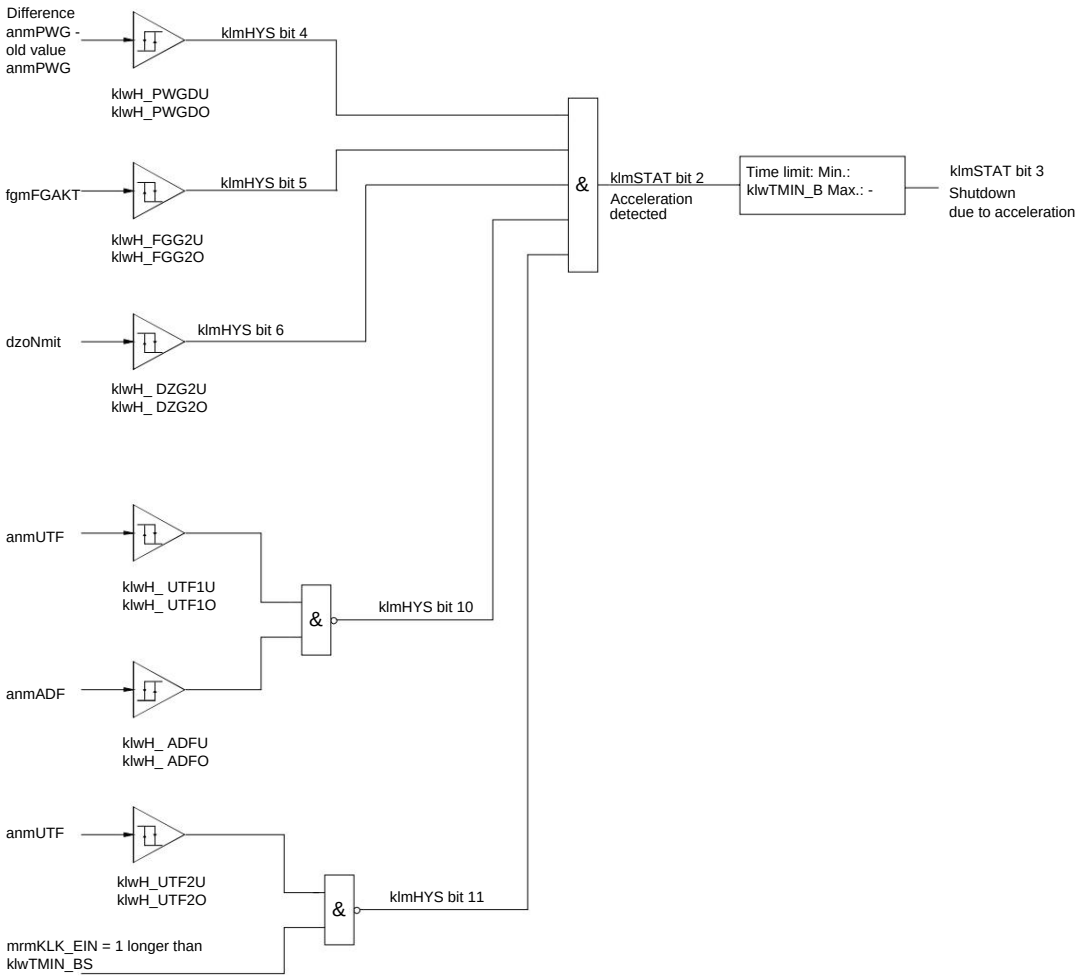


Figure SONSKL05: Acceleration switch-off condition

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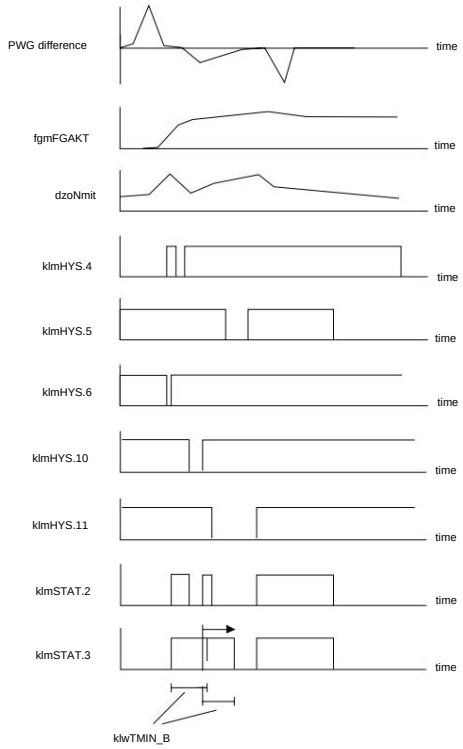


Figure SONSKL06: Acceleration time diagram

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Boot process:

If the start bit mrmSTART_B is deleted, the air conditioning compressor is released after the delay time klwTMIN_ST.

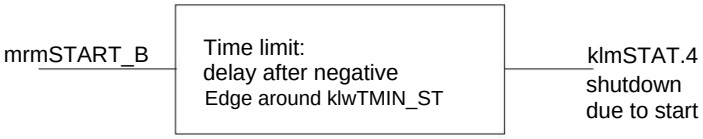


Figure SONSKL07: switch-off condition starting process

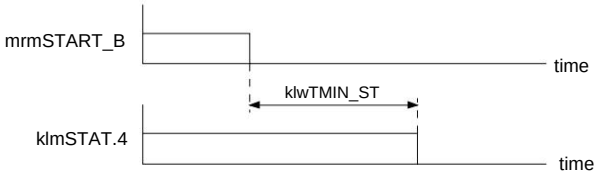


Figure SONSKL08: Timing diagram of the start-up process

System error:

[(Error in the vehicle speed sensor fboSFGG) OR (accelerator pedal defective fboSPWG or fboSPGS) OR (speed sensor defective fboSDZG)] AND (Speed dzoNmit < klwH_DZG3..)

If these conditions are met, there is a shutdown for the period klwTMIN_SF.

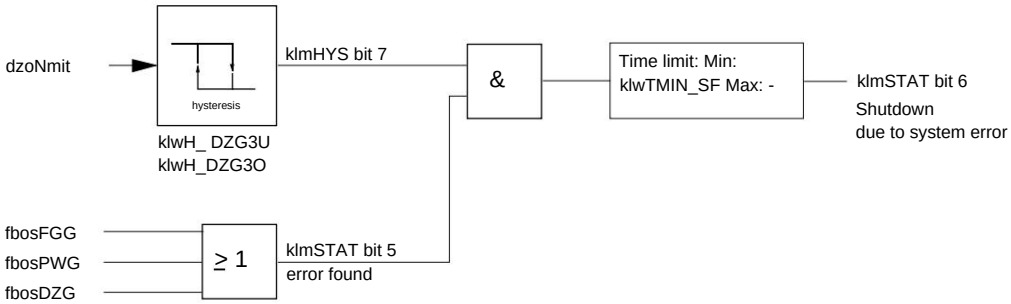


Figure SONSKL09: System error switch-off condition

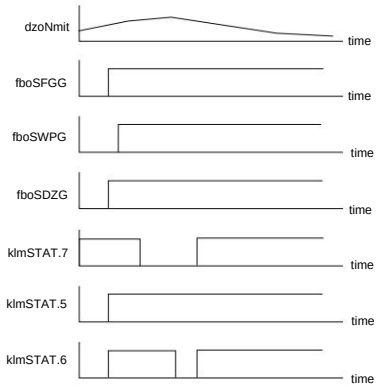


Figure SONSKL10: System error timing diagram

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Undercut idle speed:

Speed dzoNmit < klwH_DZG4..

If this condition is met, there is a shutdown for the period klwTMIN_SG.

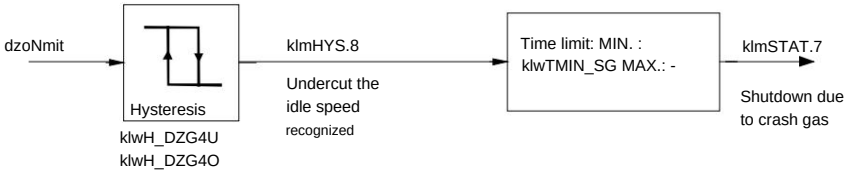


Figure SONSKL11: switch-off condition undercutting the idle speed

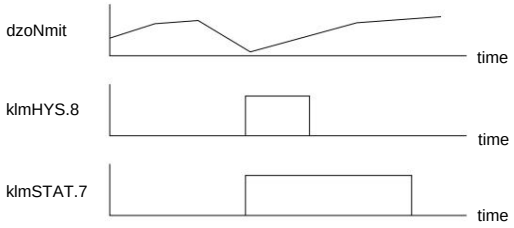


Figure SONSKL12: Undercutting of idle speed timing diagram

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water temperature:

If the water temperature anmWTF_CAN exceeds a threshold kloWTFschw that is dependent on the driving speed fgmFGAKT via the characteristic curve klwWTab_KL, the air conditioning compressor is switched off and the switch-off hysteresis klmHYS.9 is active.

If the water temperature anmWTF_CAN falls below the threshold kloWTFschw reduced by a hysteresis width klwWTHyst, the switch-off hysteresis is deactivated. The minimum duration of the air conditioning compressor shutdown is klwTMIN_WT.

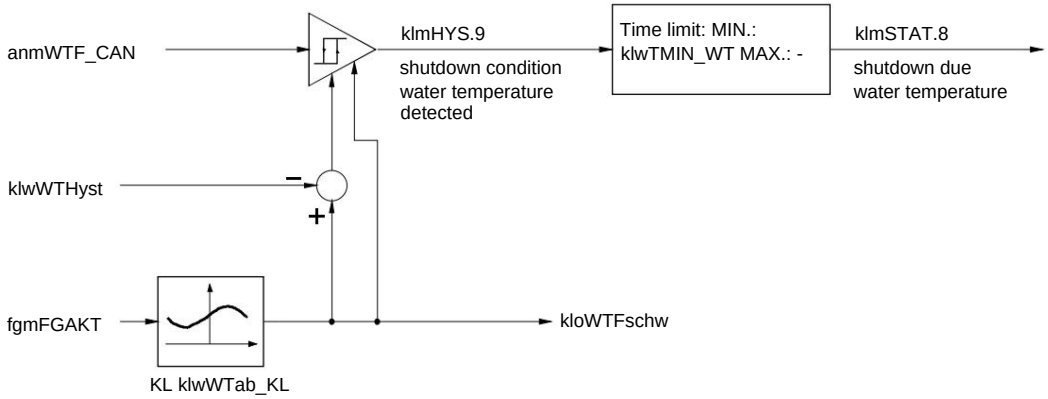


Figure SONSKL13: Water temperature switch-off condition

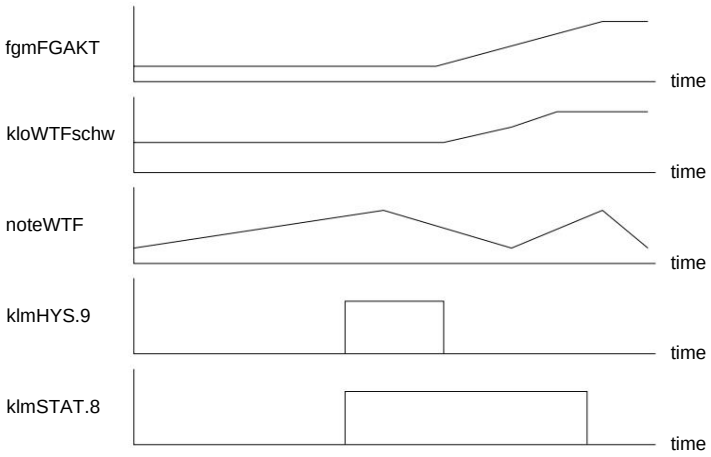


Figure SONSKL14: Water temperature time diagram

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Shutdown via CAN – Gearbox 1:

If CAN is activated (cawINF_CAB > 0) and the message gearbox 1 (identifier 440H) was received correctly, it is checked whether bit 2 in byte 1 is set. If this is the case, the message mrmCAN_KL is set to 1 and the air conditioning compressor is switched off. If there is no CAN or in the event of an error, there is no shutdown. The switch-off time is for the minimum switch-off time klwTMIN_CN.



Figure SONSKL15: switch-off condition CAN – transmission 1

Shutdown via CAN – BSG_Last:

If CAN is activated (cawINF_CAB > 0) and the message BSG_Last (identifier 570H) was received correctly, it is checked whether bit 7 in byte 3 is set. If this is the case, the message mrmBSG_KLI is set to 1 and the air conditioning compressor is switched off. If there is no CAN or in the event of an error, there is no shutdown. The switch-off period takes place for the minimum switch-off period klwTMIN_C2.

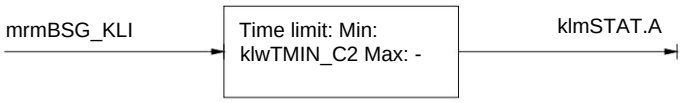


Figure SONSKL16: switch-off condition CAN – BSG_Last

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Shutdown due to refrigerant pressure or ambient temperature:

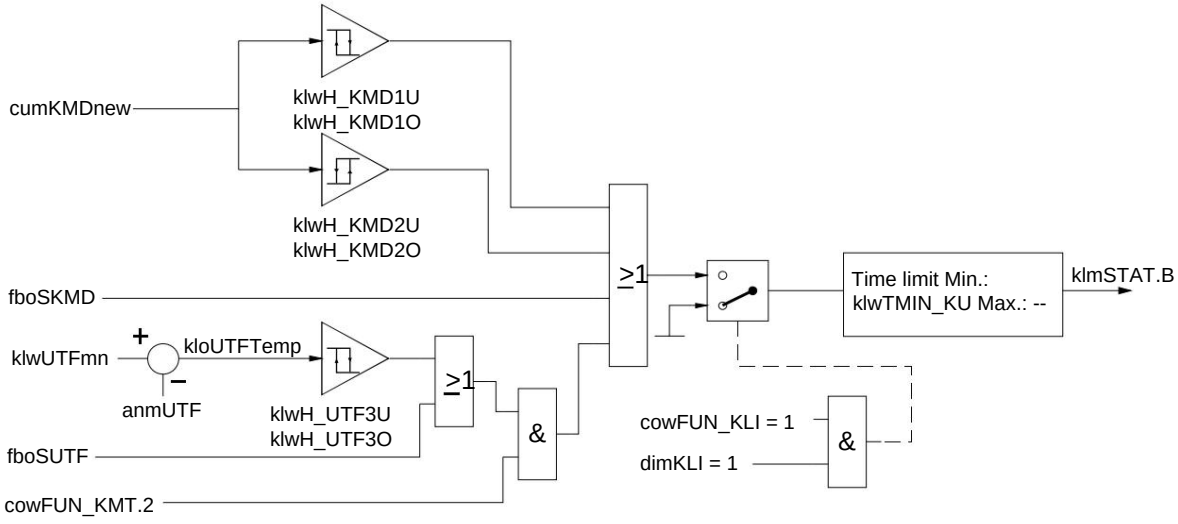


Figure SONSKL17: shutdown due to refrigerant pressure or ambient temperature

The additional switch-off condition for the air conditioning compressor only occurs if the refrigerant pressure is read in via the PWM input (cowFUN_KLI = 1) and the air conditioning system is switched on (dimKLI = 1). The switch-off condition is based on the refrigerant pressure kumKMDneu or the ambient temperature anmUTF. If the refrigerant pressure kumKMDneu is less than or equal to a minimum climate pressure klwH_KMD1(U/O) or greater than or equal to a maximum climate pressure klwH_KMD2(U/O) or if an error has occurred in the error path fboSKMD, the compressor is switched off.

If the ambient temperature anmUTF is less than or equal to a minimum temperature klwH_UTF3(U/O) or if an error has occurred in the fboSUTF error path and no Climatronic is installed (cowFUN_KMT.2=1), there is also a shutdown.

The shutdown takes place for a minimum duration klwTMIN_KU.

If this additional switch-off condition is active, the klmSTAT.B bit is set.

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5.4 Cooling water heater

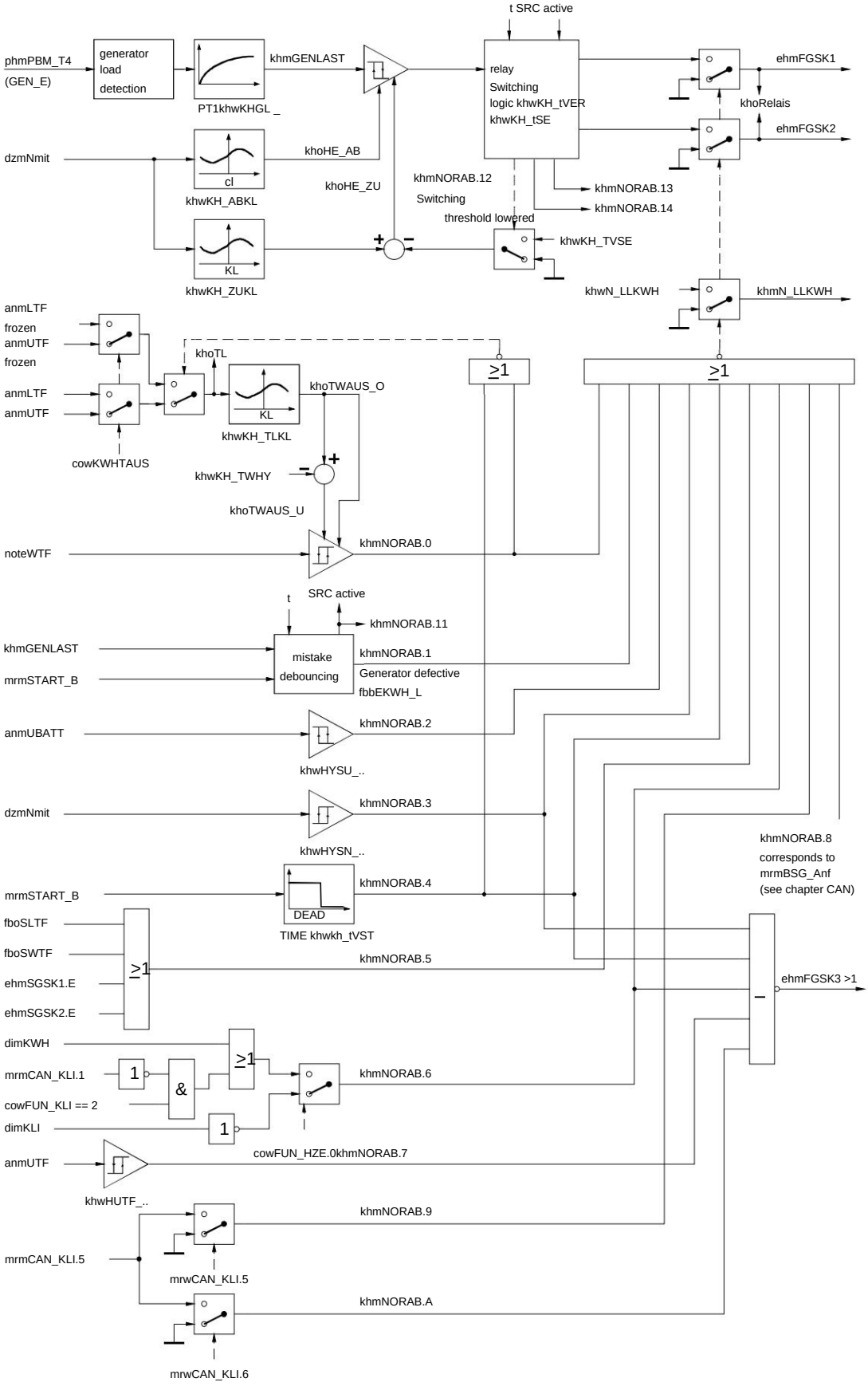


Figure SONSKW01: Heat output increase

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The increase in heat output is used to heat the cooling water using electrical heating elements (End stages ehmFGSK1, ehmFGSK2) or diesel heater (end stage ehmFGSK3) to the low Compensate for lost heat at high engine efficiencies. The heating elements are only electrical power reserves switched on. The number of switched-on heating elements (0 - 3) can be set with the software switch cowKWHKERZ, where the specification of 0 heating elements corresponds to a switch-off of the "Heat output increase" function.

There are two output stages ehmFGSK1 and ehmFGSK2 for controlling the heating elements Disposal. If you want 3 heating elements, the output stage output ehmFGSK1 must be equipped with a Heating element and the output stage output ehmFGSK2 are wired with two heating elements. at The arrangement of the heating elements is taken into account when switching heating elements on and off and the number of active heating elements khoRELAIS increases or decreases by 1.

Description of the software switch number of heating elements cowKWHKERZ:

decimal value	comment
0	Heat output increase function not active
1	1 heating element on output stage 1
2	1 heating element on power stage 1, 1 heating element on power stage 2
3	1 heating element on power stage 1, 2 heating elements on power stage 2

To determine the available power reserves, the alternator delivers via PBM Duty cycle, which corresponds to the current generator load. The assignment of the high level duration of the PWM signal to the duty cycle or to the blanking time of the duty cycle takes place via the data record parameter khwPBMINV. Since this generator load signal is strong at idle Subject to fluctuations, it is filtered before use by a PT1 filter khwKHGL.

Description of the status information heating output increase khmNORAB:

Bit position	decimal value	comment
0	1	switch-off condition temperature sufficient
1	2	Switch-off condition generator load SRC error fbbEKWH_L
2	4	Switch-off condition Battery voltage too low
3		Shutdown condition Speed too low
4	8	Switch-off condition start delay active
5	16	Switch-off condition WTF, LTF or output stage defective
6	32 64	Control unit switch-off condition (driver request)
7	128	Ambient temperature anmUTF not too high
8th	256	Switch-off condition Request from the on-board power supply control unit BSG
9	512	shutdown condition Clima 1 - no heating desired ehmFGSK1/2
A	1024	shutdown condition Clima 1 - no heating desired ehmFGSK3
B	2048	State generator load in the SRC and mrmSTART_B=0
C	4096	Status switch-on threshold lowered
D	8192	State Gen. Load. Activation delay active
E	16384	State Gen. Load. Switch-off delay active
f	32768	unused

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The auxiliary heating (= diesel auxiliary heater) serves to warm up the passenger compartment more quickly and corresponds to an auxiliary heating for the cooling water. The auxiliary heater consumption is taken into account when calculating the consumption signal (see “Input and output signals TQS/MFA/VBS/Signal”).

The additional heating ehmFGSK3 is switched off if at least one of the following conditions are met:

o) The ambient temperature anmUTF is above the hysteresis threshold khwHUTF_.. o) The start bit mrmSTART_B is set o) The speed dzmNmit is below the threshold khwHYSN_.. o) The driver switches off by input dimKWH or dimKLI o) The bit "No heating power desired" of the CAN message Clima 1 is set

5.4.1 Connection condition

A generator threshold value khoHE_ZU is determined from the current speed dzmNmit via the characteristic curve khwKH_ZUKL. If the generator load falls below this value and remains below this threshold for a time khwKH_tVER (message khmNORAB.13 - switch-on delay active), a (further) heating element is switched on. At the same time, the first threshold value khoHE_ZU is lowered by the value khwKH_TVSE for the time khwKH_tSE (message khmNORAB.12 - switching threshold lowered) in order to avoid unstable switching processes.
The threshold value for connection is also reduced in this way in the event of a switch-off caused by the fulfillment of any switch-off condition.

If the generator load rises above a threshold value khoHE_AB, which is determined from the current speed dzoNmit and the characteristic curve khwKH_ABKL, and it remains above this threshold for a time khwKH_tVER (message khmNORAB.14 - switch-off delay active), a heating element is switched off.

The number of active heating elements is displayed in the Olda khoRELAIS.

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5.4.2 Shutdown

control element:

The increase in heat output can be switched off using a control panel. This control panel is either directly via the digital input GSK-E (dimKWH) or via CAN message Clima1 Byte1 Bit 1 driver request additional heater in mrmCAN_KLI.1 if Clima1 message is evaluated (cowFUN_KLI = 2), or via the digital input KLI-E (dimKLI) executed. If this input is active (digital input logic high), the heating output increase is switched off (message khmNORAB.6 - switch-off request control unit).

The control panel is selected with the software switch cowFUN_HZE.

Description of the software switch cowFUN_HZE:

cowFUN_HZE	comment
XXX XXX0	Input dimKLI
XXX XXX1	input dimKWH or no driver request additional heater via CAN
XXX XX1X	see ECOMATIC (no effect on the cooling water heater)
XXX X1XX	see ECOMATIC (no effect on the cooling water heater)

Begin:

No increase in heat output is permitted during the starting process. An increase in heat output is only possible after the time khwKH_tVST has elapsed after the start drop (message khmNORAB.4 - start delay active).

Rotational speed:

The increase in heat output is made possible according to the speed hysteresis khwHYSN_.. (message khmNORAB.3 - speed hysteresis undershot).

battery voltage:

The increase in heat output is made possible according to the battery voltage hysteresis khwHYSU_.. (message khmNORAB.2 - battery voltage hysteresis undershot)

Generator defect:

The alternator provides the control unit with a duty cycle that represents the alternator load.
Since this signal is subject to strong fluctuations when idling, it is PT1 filtered before processing. After start shedding (mrmSTART_B = 0) is an SRC check of the duty cycle to less than or equal to khwNULLAST (error fbbEKWH_L). While the generator load is in the SRC (message khmNORAB.11 - generator load in the SRC), work continues with the last valid value of the generator load, but switching on of heating elements is prevented. After the debounce time has elapsed (error finally detected as defective), the heating output increase is switched off (message khmNORAB.1 - generator defective).

Temperature:

From the air temperature anmLTF or the ambient temperature anmUTF, a temperature threshold value is determined with the characteristic khwKH_TLKL, which must be exceeded so that the heating output increase is switched off. The temperature sensor - selection is made with the software switch cowKWHTAUS. The increase in heating output is only switched on again if the temperature falls below this threshold value, reduced by the hysteresis value khwKH_TWHYY (message khmNORAB.0 - temperature sufficient). Is the water temperature below the lower hysteresis threshold and is the delay time after clearing

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of the start bit has expired, the temperature threshold value just determined is frozen. The freeze is released when the water temperature exceeds the upper hysteresis threshold.

Description of the software switch cowKWHTAUS:

decimal value	comment
0	Temperature shutdown using ambient temperature anmUTF
1	Temperature shutdown using air temperature anmLTF

Mistake:

If the air temperature sensor (fboSLTF) or water temperature sensor (fboSWTF) is defective, or if there is a malfunction in the output stages ehmFGSK1 or ehmFGSK2 (information from the output stage handler via the status messages ehmSGSK1 and ehmSGSK2), it is not possible to increase the heat output (message khmNORAB.5).

ESR requirement:

When the target idling speed is increased by the onboard power supply control unit BSG, the glow plugs or PTC elements are switched off for the time required to reduce the load.
For this purpose, the bit khmNORAB.8 is used as a switch-off condition for the KWH, which corresponds to the state of the message mrmBSG_Anf (request bit bit 1.0 of the received message BSG_Last).

Clima1 requirement:

If the bit is set "No heating desired" the CAN message Clima1 (no heating means that the temperature controller is set to "blue") and the intervention is applied (mrwCAN_KLI.5 means intervention on ehmFGSK1/2, mrwCAN_KLI.6 means set). intervention on ehmFGSK3), the heating elements or the diesel auxiliary heater are switched off for the time of the request.

Idle speed increase:

The idling speed is independent of the number of heating elements currently switched on (the idling speed is also increased if no heating element is switched on due to high generator load). This function can be applied using khwN_LLKWH = 0.

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5.5 Engine Mount Control

At higher torques, the rigid coupling between the engine and body causes unwanted vibrations to be transmitted from the engine to the body. The engine mount control is used to adjust the degree of coupling between the engine and body by controlling pneumatic valves that regulate the oil pressure in the variable (hydraulic)

Adjust damper.

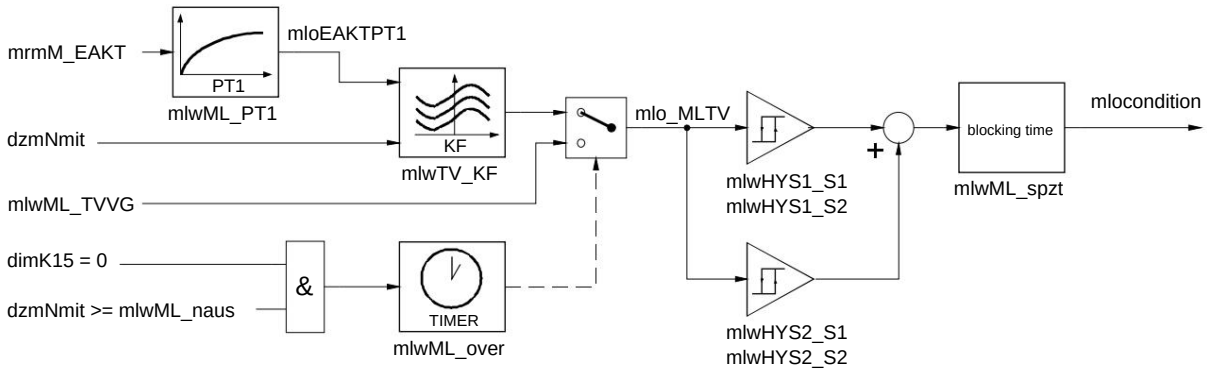


Figure SONSML01: Motor mount control

With the software switch mlwML_on you switch the engine mount control on / off (0 = no engine mount control, 1 = switched on). A pulse duty factor for the output stages is determined via the map mlwTV_KF. Input variables are the average speed and the current injection quantity filtered via mlwML_PT1.

As long as the speed after "K15 off" remains above an applicable threshold mlwML_naus, a duty cycle is specified via the data record parameter mlwML_TVVG. This default value may be present for a maximum of an applicable time mlwML_over.

The calculated or specified duty cycle is displayed with the OLDA mlo_MLTV and then converted into a status signal via a two-stage hysteresis with the limits mlwHYS1_S1, mlwHYS1_S2 and mlwHYS2_S1, mlwHYS2_S2 (the outputs of the two hystereses are added).

This status signal (result of the addition) is written to the OLDA mloStatus and mloStatus then remains unchanged for an applicable blocking time mlwML_spzt. The current status is only accepted after this time has elapsed. With the help of an applicable table, mloStatus is evaluated and the result is made available to the output stage control via the messages ehmFML1 and ehmFML2.

state / mlostate	Output 1 / ehmFML1	Output 2 / ehmFML2
0	mlwML_1_0 (Off)	mlwML_2_0 (on)
1	mlwML_1_1 (Off)	mlwML_2_1 (off)
2	mlwML_1_2 (On)	mlwML_2_2 (on)

The engine bearing states can be applied via the data record parameters mlwML_1_.. and mlwML_2_.. With the software switch mlwML_on, the engine mount control can be deactivated (applied away).

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5.6 Ecomatic

A

Data exchange between Motor-SG and DigiSwing-SG necessary. With the SW switch cowECOMTC.0 the function is switched on / off (1 = switched on, 0 = switched off).

The communication between Motor-SG and DigiSwing-SG can either be via CAN or Digital inputs take place. With the SW switch cowECOMTC.1 you can choose whether that Ecomatic signal comes via CAN or digital input (1 = CAN, 0 = digital input). is on Digital input LOW level on means "motor off", HIGH level means "start request". The CAN message (1 = "engine off", 0 = "start request") is inverted in mrmCAN_ECO, so that the information is coded as in dimECO (TRUE = "Start request", FALSE = "Motor out").

With the SW switch cowECOMTC.2 you can choose whether the clutch signal via CAN or Digital input comes (1 = CAN, 0 = digital input). Is present at the digital input HIGH level means "clutch engaged/disengaged", LOW level means "clutch not actuated/engaged". The CAN message can represent several clutch states, it is the evaluation, however, only between "clutch open" and "clutch not open" distinguished. The information is prepared accordingly in the message dimKUP (TRUE = "Clutch engaged/disengaged", FALSE = "Clutch not engaged".

With the SW switch cowECOMTC.3 you can choose whether after an Ecomatic error (ecoECO_STA = 4) the engine should be switched off via ecmUso_ECO = 0 or not (1 = engine off, 0 = engine not off).

Description of the Ecomatic Status ecoECO_STA:

decimal value	comment
0	No ECOMATIC function
4	Ecomatic error (dimECO not HIGH after ecwINIT_T or CAN error)
8th	Waiting for the first high level
28	Waiting for start bit to be cleared
12	dimECO == TRUE after mrmSTART_B = 0, waiting for 'engine off'
20	dimECO == FALSE to TRUE, wait for 'motor on'

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5.6.1 Ecomatic function via digital input

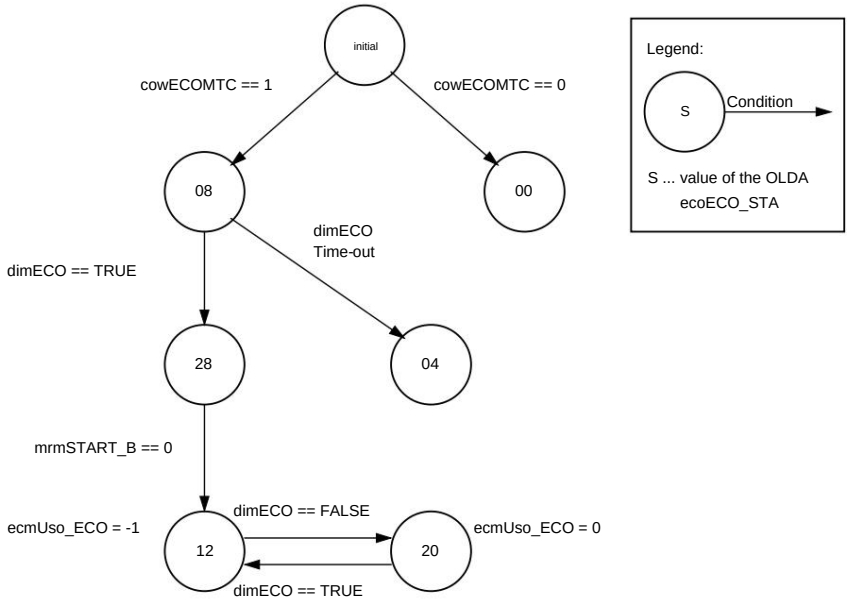


Figure SONSEC02: Flow chart with Ecomatic function via digital input

After an SG reset, the dimECO message must become TRUE within the ecwINIT_T time.
If this does not occur, the Ecomatic is ignored for the current driving cycle. The dimECO message is already debounced. If dimECO is FALSE, ecmUso_ECO is set to 0. If dimECO becomes TRUE, ecmUso_ECO is reset to -1 and the current quantity is released. Furthermore, the speed is dzmNmit on the difference between mrmN_LLBAS - ecwN_LOW checked. If it is below this threshold, the starting quantity is released. For this purpose, mrmSTART_B is assigned 20H.

5.6.2 Ecomatic function with CAN

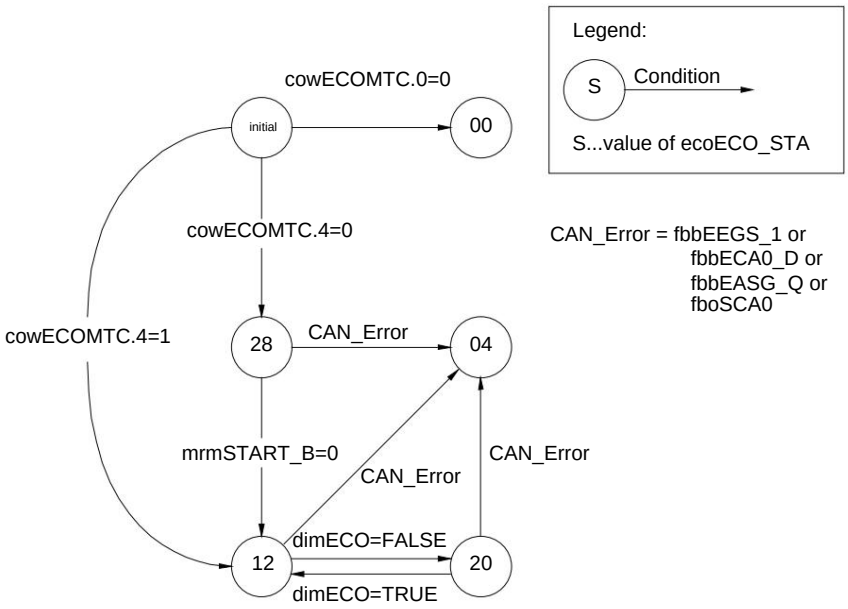


Figure SONSEC03: Flow chart with Ecomatic function via CAN

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The function corresponds to that described under Ecomatic via digital input, with the following Exceptions:

- status 08 (waiting for dimECO) is omitted
- You can get from any operating state (except 00) to state 04 (Ecomatic error) by a CAN error fboSCAN or fbbEEGS_1 or fbbEASG_Q or fbbECA0_D

Value range of the OLDA status mroEGSECST (bit-coded) for Ecomatic with CAN:

Bit Position	Decimal Value	Comment 16 64
4		Message error EGS (timeout or message data inconsistent)
6		Hide monitoring

Message error transmission (mroEGSECST.4 = 1):

With a message timeout (last message older than caw.._RTO) or with inconsistent message data (in two consecutive attempts to read the message data, the content was already partially overwritten) the status bit mroEGSECST.4 is set. Subsequently, the error fbbEEGS_1 is reported as long as the error condition is present. The error is not reported during active CAN blanking.

The error fbbEEGS_1 must be time-debounced because it can also be sent from the “External quantity intervention” handling (ie the error could be sent more often than desired; see also “EGS intervention”/“EGS intervention via CAN”).

5.6.3 'Engine off' / 'Engine on' command (from transmission control unit to MSG)

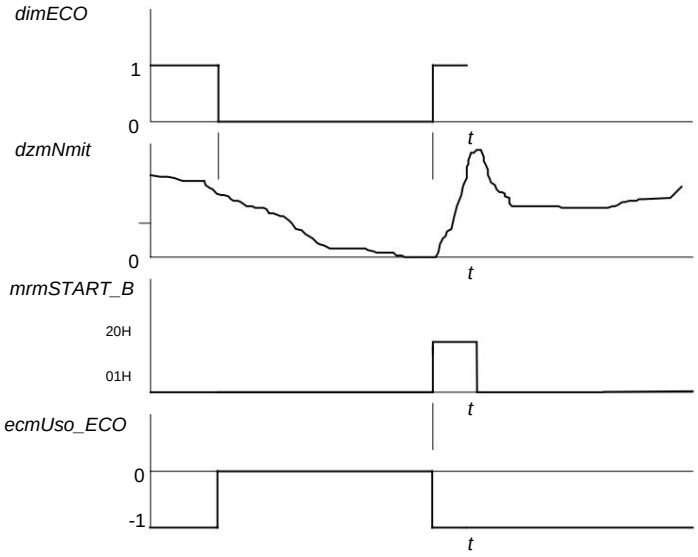


Figure SONSEC04: switch-off / switch-on process

If dimECO == FALSE, the current injection quantity is reduced, which leads to the engine being switched off. This function only becomes active above a water temperature threshold ecwWTF_O.
The calculation continues during the 'motor off' state.

If dimECO == TRUE, the current injection quantity is released again. The calculation continues during the 'motor off' state. If dimECO changes from FALSE to TRUE below an applicable speed threshold, the starting quantity is released in addition to the release of the current injection quantity and a starting process is carried out without a previous SG reset.

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No 'engine off' command (from engine control unit to transmission control unit)

In an ASG vehicle, it may be necessary to inform the gearbox control unit (via CAN) that the engine must not be switched off. The message khmKWH_CAN (corresponds to S_ECO in the CAN layout) is set to one if one of the following conditions is met:

- The time, which depends on the ambient or air temperature, has not yet expired. (This switch-off condition is only determined once after each initial start. This switch-off condition is also not activated when the engine is restarted after it has been switched off by Ecomatic.)

- The generator load exceeds the value khwGEN_MAX.

- The water temperature is lower than the value khwWTF_MIN.

- The cowFUN_HZE.1 bit is set and no cooling water heater switch-off request (dimKWH or dimKLI) is available.

- The bit cowFUN_HZE.2 is set and the air conditioning compressor is switched on (mrmKLK_EIN = 1)

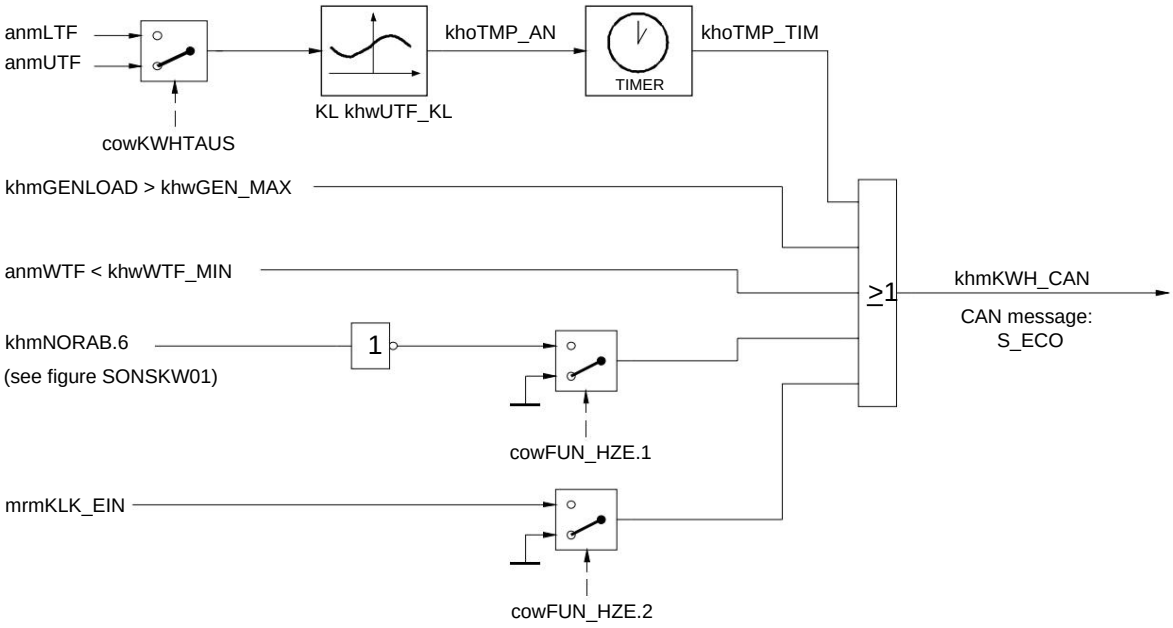


Figure SONSEC05: No 'motor off' command

In these cases, the gearbox control unit is not allowed to switch off the engine (except in the case of safety problems). However, the decision lies with the transmission control unit.

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5.7 Coolant Temperature Control

The coolant temperature control includes the 3 functions "coolant thermostat control", "radiator fan control" and "after-run and after-run pump". The purpose of this function is to influence the coolant in a targeted manner in order to be able to operate the engine in its operating ranges with optimized consumption and emissions.

5.7.1 Overview

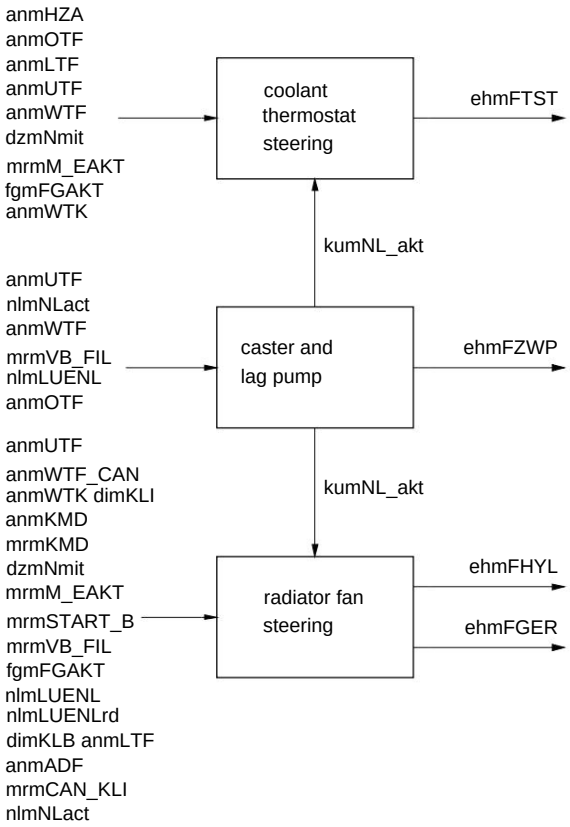


Figure SONSKM01: Overview of coolant temperature control

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5.7.2 Coolant thermostat control

The coolant thermostat control is activated via the software switch cowFUN_KFK (cowFUN_KFK = 1) or deactivated (cowFUN_KFK = 0).

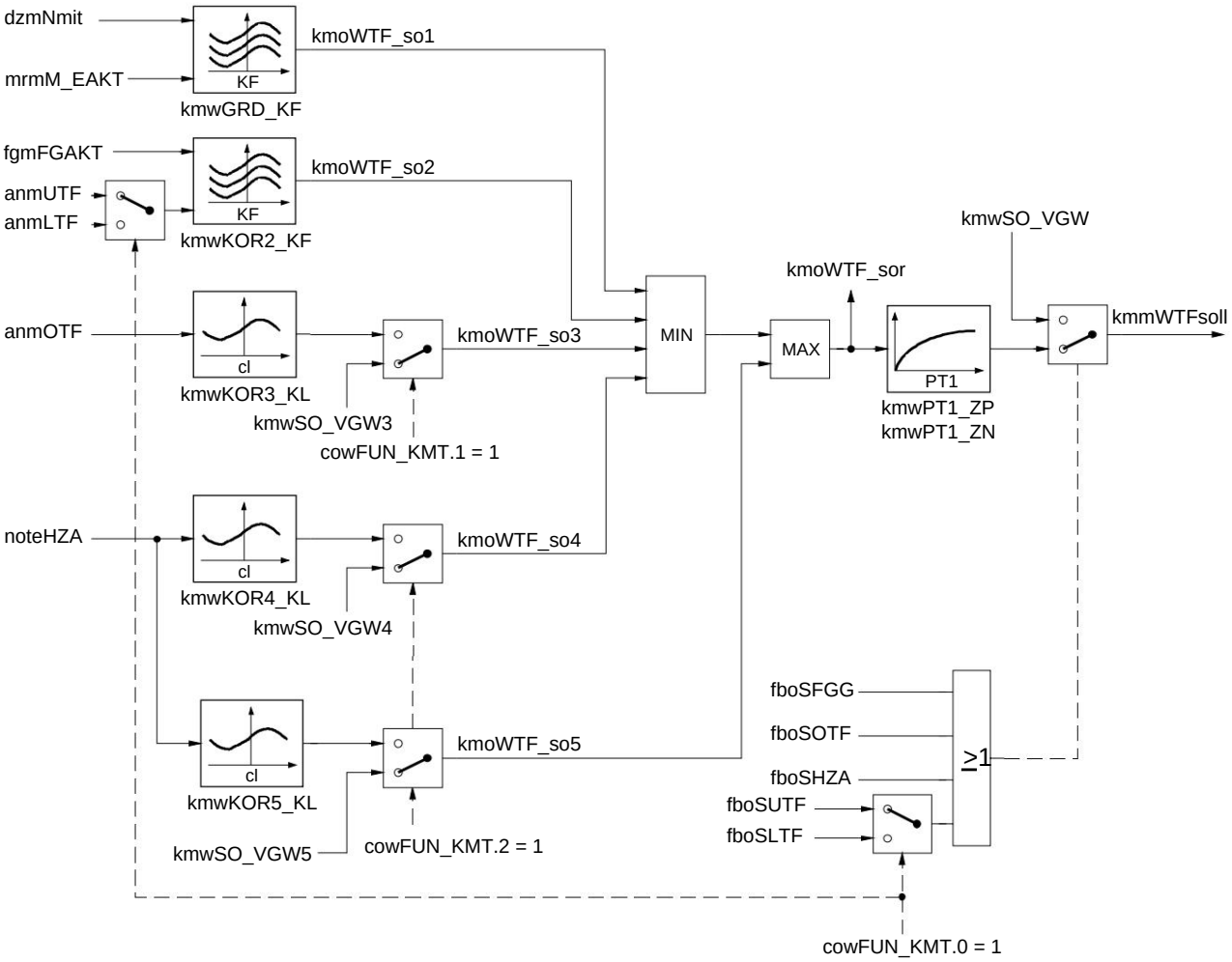


Figure SONSKM02: Water temperature setpoint calculation

From the basic map kmwGRD_KF a water temperature setpoint for the cylinder head outlet kmoWTF_so1 is determined depending on the engine speed dzmNmit and the current amount mrmM_EAKT. A minimum formation is carried out with the target values kmoWTF_so1 to kmoWTF_so4. The second setpoint kmoWTF_so2 results from the correction map kmwKOR2_KF depending on the driving speed fgmFGAKT and the ambient temperature anmUTF or the air temperature anmLTF (applicable with cowFUN_KMT.0. On the VS100 anmUTF is always displayed, even if anmLTF is applied. It is still anmLTF used for calculation). If there is a flexible service interval display (cowFUN_KMT.1 = 1), the third setpoint kmoWTF_so3 is determined from the correction characteristic kmwKOR3_KL depending on the oil temperature anmOTF. Otherwise, the default value kmwSO_VGW3 is used when forming the minimum. If there is no Climatronic (cowFUN_KMT.2 = 0), the fourth setpoint kmoWTF_so4 is formed from the correction characteristic kmwKOR4_KL depending on the heating requirement anmHZA. Otherwise, the default value kmwSO_VGW4 is used to form the minimum. So that sufficient heat output can be made available, after the minimum selection, a maximum selection is carried out with kmoWTF_so5, which

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results from the heating request via kmwKOR5_KL.

The water temperature setpoint kmoWTF_sor determined in this way is PT1-filtered. Depending on the direction of temperature change, one of two time constants (kmwPT1_ZP or kmwPT1_ZN) is selected. **(ATTENTION:** This PT1 filtering is processed in a 100 ms grid. The memory factor must therefore not be calculated with a sampling rate of 20 ms, as is the case with all other filters.)

If an error occurs in the error paths for UTF or LTF, OTF, FGG or HZA, the target value kmmWTFsoll is assigned the default value kmwSO_VGW. The selection of the error path UTF or LTF is also done via cowFUN_KMT (cowFUN_KMT.0 = 0 fboSUTF, cowFUN_KMT.0 = 1 fboSLTF).

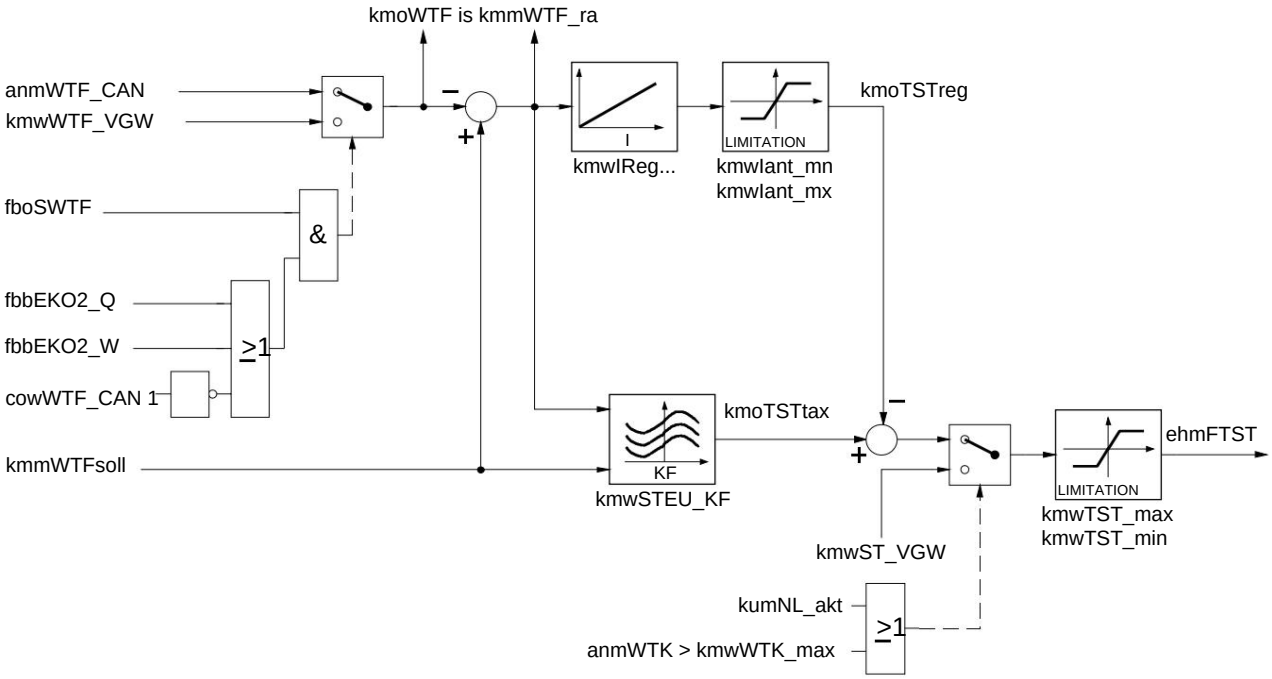


Figure SONSKM03: Open-loop and closed-loop control

If the water temperature is not received via CAN, the default value kmwWTF_VGW is used immediately if the WTF sensor is defective. If the water temperature anmWTF_CAN is received via CAN (Kombi2 message), the default value is only used if there are errors in both error paths.

In the kmwSTEU_KF control map, the control duty cycle kmoTSTsteu is determined from the setpoint temperature kmmWTFsoll and the control deviation kmmWTF_ra. At the same time, the system deviation kmmWTF_ra goes to an I controller that is limited in the positive and negative direction (kmwIAnt_mx and kmwIAnt_mn).

The control is only active in the small signal range (within an applicable temperature window). If the control deviation is outside the small-signal range, the I component is initialized with zero.

The difference in duty cycle from control (kmoTSTsteu) and regulation (kmoTSTreg) is limited to a minimum and maximum value (kmwTST_min and kmwTST_max) and is the activation duty cycle for the coolant thermostat.

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If the run-on is active (kumNL_akt = 1) OR if the water temperature at the cooler outlet is greater than the kmwWTK_max threshold, then the coolant thermostat output stage is controlled with the kmwST_VGW default value.

5.7.3 Formation of the "map cooling" bit:

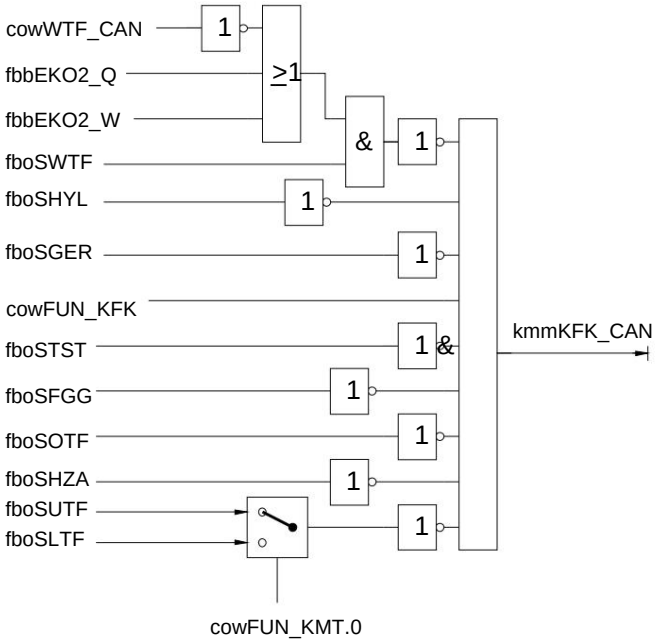


Figure SONSKM04: Formation of the "map cooling" bit

This bit has the following meaning: "The map cooling is installed in this vehicle and has no system error". The error paths fboSWTF and an error in the Kombi2 message, fboSHYL, fboSGER, fboSTST, fboSFGG, fboSOTF, fboSHZA and fboSLTF/fboSUTF (depending on the selection switch cowFUN_KMT.0) may not show any errors set. If the water temperature is not received via CAN (Kombi2 message), a defective WTF sensor is immediately identified as a system error. If, in addition to the water temperature anmWTF, the water temperature is received via CAN anmWTF_CAN, system errors are only recognized if there are errors in both messages. The message kmmKFK_CAN is sent in the message Motor5, Byte2, Bit6 via CAN. (see chapter 10 - CAN)

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5.7.4 Radiator Fan Control

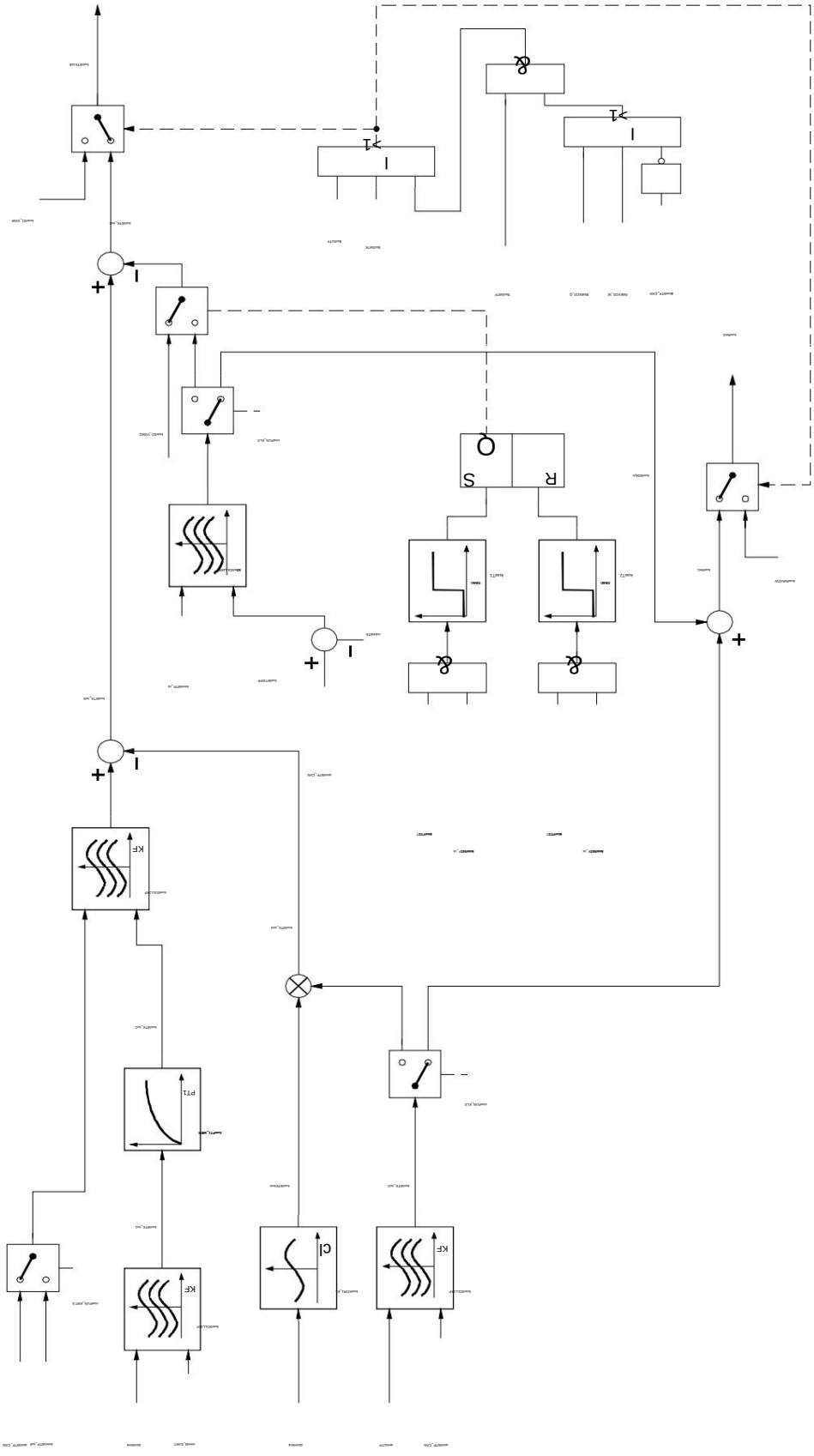


Figure SONSKU01: Water temperature setpoint calculation (at the cooler outlet)

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Depending on the position of the DAMOS switch cowFUN_KLS, there are two variants for determining the cooling capacity to be applied by the fans.

Variant 1 (cowFUN_KLS=1):
The water temperature setpoint at the cooler outlet kuoWTKsoll results from the water temperature at the cylinder head outlet anmWTF_CAN (cowFUN_KMT.5=0) or the water temperature setpoint kmmWTFsoll for the cylinder head outlet (cowFUN_KMT.5=1) and from the temperature kuoWTK_so2, which results from a load-dependent pre-control results. A setpoint temperature is specified via the map kuwSoll2KF, which is corrected via the temperature difference kuoWTK_so4, which reflects the influence of the cooler.

From the map kuwSoll1KF a target temperature kuoWTK_so1 for the cooler outlet is determined depending on the engine speed dzmNmit and the current amount mrmM_EAKT. This temperature is PT1 filtered. Depending on the direction of the change, one of two time constants is selected (kuwPT1_WEP or kuwPT1_WEN). The initial value is kuoWTK_so2.

Depending on the ambient temperature anmUTF and the water temperature at the cylinder head outlet anmWTF_CAN, a target temperature difference kuoWTK_so3 is determined via the cooler from the map kuwSoll3KF. This difference is corrected multiplicatively with the factor kuoWTKkorr. The speed-dependent factor results from the characteristic curve kuwKOR1_KL.

In order to recognize in good time when the thermostat is fully actuated but the desired target temperature at the cylinder head outlet is not reached sufficiently quickly, the fan should provide a higher cooling capacity if necessary. For this purpose, the setpoint at the cooler outlet can be reduced according to the following conditions.

If the control duty cycle of the thermostat ehmFTST is greater than the comparison value kuwTV1 and the control deviation for cylinder head outlet kmmWTF_ra is smaller than the comparison value kuwra1, then after the time kuwT1 a temperature offset depending on the control deviation for cylinder head outlet kmmWTF_ra and the temperature difference (anmWTF_CAN-anmWTK) is determined. This is subtracted from the target value kuoWTK_so5 in order to increase the cooling performance requirement for the fan.

The temperature offset is withdrawn again if, after the time kuwT2, the control duty cycle of the thermostat ehmFTST is less than the comparison value kuwTV2 and the control deviation at the cylinder head outlet kmmWTF_ra is greater than the comparison value kuwra2.

If an error in the error paths fboSUTF, fboSWTK or fboSWTF AND (fbbEKO2_Q OR fbbEKO2_W OR cowWTFCAN=0) occurs, kuwSO_VGW is used as a substitute value for the target temperature at the cooler outlet.

Variant 2 (cowFUN_KLS=0):
The relative cooling requirements from kuwSOLL3KF and kuwSOLL4KF are added to kuorel1. If one of the above errors occurs, the system switches to the default value kuwrelVGW.

The outputs of the maps kuwSOLL2_KF and kuwKOR4_KF are not in the unit °C, but in % relative cooling capacity.

With negative values of kmmWTF_ra, cooling down of the motor should be supported by the fan(s). The fan support is also desired depending on the temperature gradient across the cooler (anmWTF_CAN-anmWTK). The relative dynamic cooling requirement kuoSOdyn is determined via the map kuwSOLL4KF.

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Fan control due to increased water temperature at the cylinder head outlet:

Depending on the water temperature at the cylinder head outlet anmWTF_CAN and the ambient temperature anmUTF, the relative cooling requirement kuoWTK_so3 due to engine heat is determined via the map kuwSOLL3KF.

A notice:

In concepts with thermostat control (and a sensor at the radiator outlet), this map is used to control the fan(s) at temperatures above the maximum target temperature (cylinder head outlet). In the case of concepts without thermostat control, the fan control due to engine heat is determined solely on the basis of this map.

The dynamic cooling requirement and the cooling requirement due to increased water temperature at the cylinder head outlet are summed up (kuorel1).

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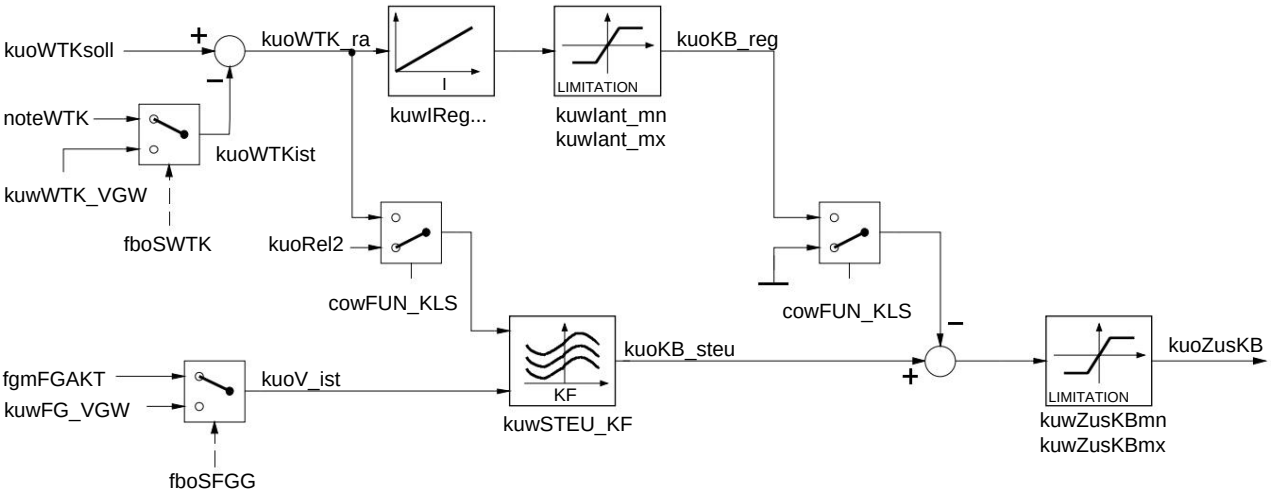


Figure SONSKU02: Calculation of additional cooling demand

Variant1 (cowFUN_KLS=1):
There is a new water temperature sensor that is installed at the cooler outlet. If this is missing or an error occurs in the fboSWTK error path, the default value kuwWTK_VGW is used as the actual water temperature value at the cooler outlet kuoWTKist.

The control deviation at the cooler outlet kuoWTK_ra and the driving speed kuoV_ist go to the control map kuwSTEU_KF, from which a relative cooling requirement is determined. If an error occurs in the error path fboSFGG, the default value kuwFG_VGW for the driving speed is used instead of fgmFGAKT.

At the same time, the control deviation kuoWTK_ra goes to an I controller, which is limited in the positive and negative directions (kuwIANT_mx and kuwIANT_mn).

The control is only active in the small signal range (within an applicable temperature window). If the control deviation is outside the small-signal range, the I component is initialized with zero.

The relative overall cooling capacity results from the difference between control (kuoKB_steu) and regulation (kuoKB_reg) (this proportion is negative) and is limited to a minimum and maximum value (kuwZusKBmn and kuwZusKBmx). The relative cooling capacity determined here is that which is to be applied by the fans.

Variant 2 (cowFUN_KLS=0):
Instead of kuoWTK_ra, kuorel2 is given on the control map kuwSTEU_KF. The relative cooling requirement can be reduced with increasing speed via this map. If an error occurs in the error path for FGG, the default value kuwFG_VGW is used instead of the driving speed. Parallel to switching off kuoWTK_ra via the DAMOS switch cowFUN_KLS, the controller component kuoKB_reg is switched to zero.

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5.7.5 Cooling Fan Power Stage Control

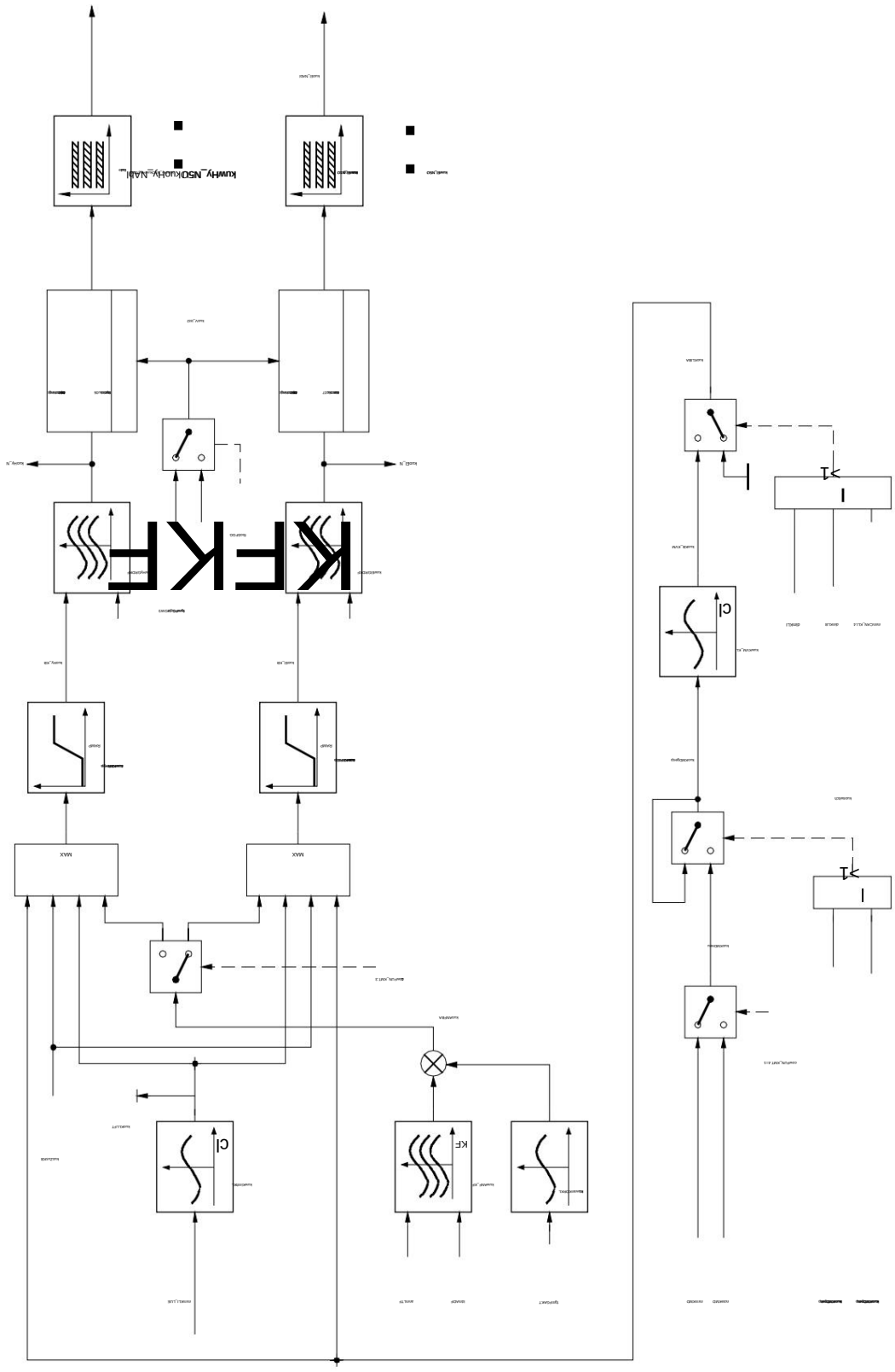


Figure SONSKU03: Cooling fan output stage control (1)

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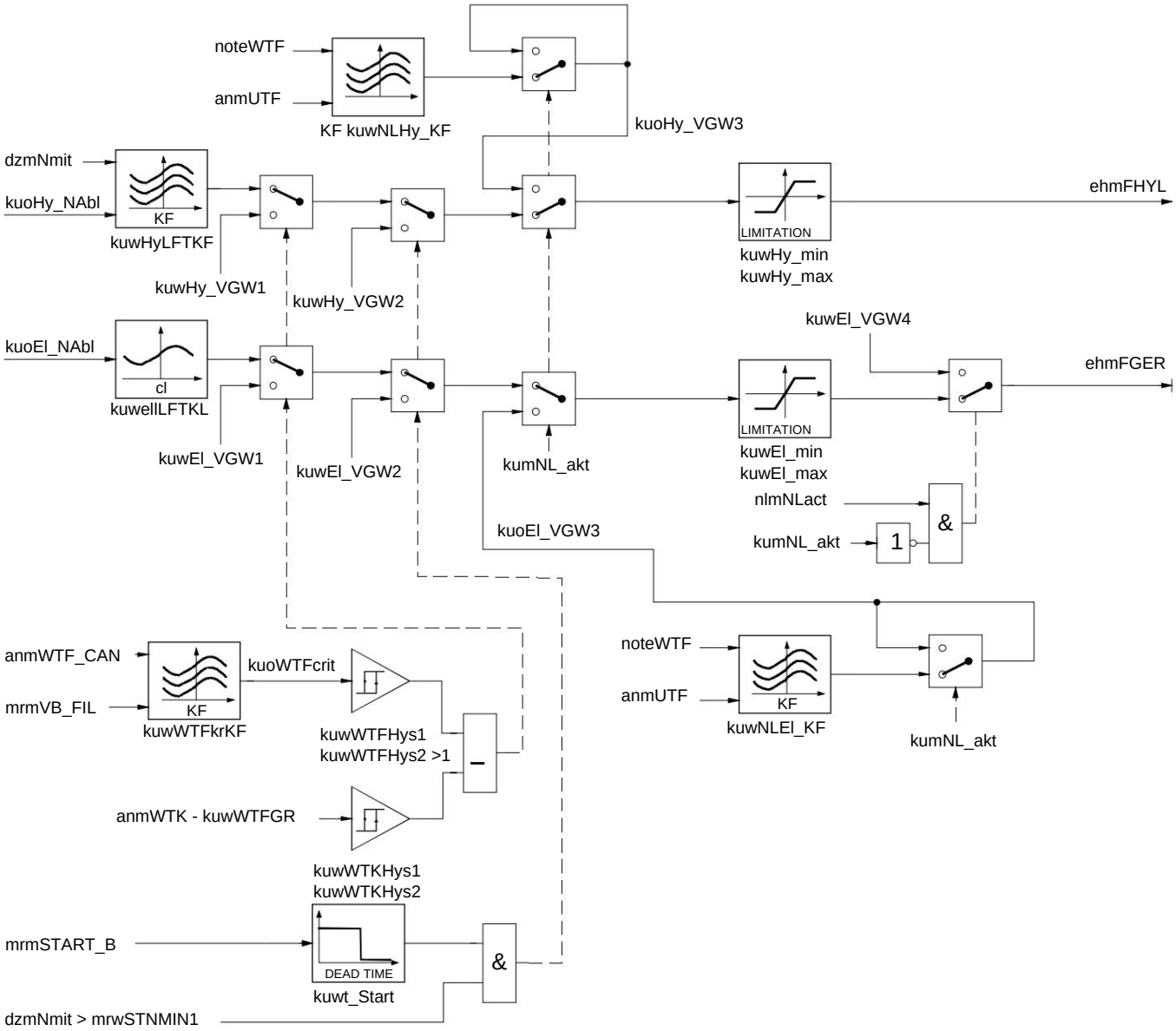


Figure SONSKU04: Cooling fan power stage control (2)

There is a maximum selection between the additional cooling requirement kuoZusKB from the "radiator fan control" function, the climate requirement requirement via CAN kuoKLIBA, the climate which results from the map kuwKlmftKL depending on mrmKLI_LUE, and a cooling requirement requirement for starting at the height kuoANFBA, met.

The cooling demand for starting at the level kuoANFBA results from the map kuwANF_KF depending on the intake air temperature anmLTF and the atmospheric pressure ldmADF. This value is corrected with a factor from the characteristic kuwKORANFKL depending on the driving speed fgmFGAKT. The fan selection is made using cowFUN_KMT (cowFUN_KMT.3=0 electric fan and cowFUN_KMT.3=1 hydraulic fan).

To ensure that the air conditioning function is not impaired, the air conditioning requirement kuoKLIBA is taken into account. When the air conditioning is switched on (dimKLI=1, dimKLB=1 or

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mrmCAN_KLI.4 = 1), the cooling requirement is determined via the characteristic kuwKVM_KL from the refrigerant pressure kumKMDneu (hysteresis). Via cowFUN_KMT it can be selected whether the refrigerant pressure is made available via a pressure sensor anmKMD (cowFUN_KMT.4=1) or via CAN mrmKMD (cowFUN_KMT.4=0). A hysteresis-like behavior with applicable thresholds (kuwKMDH..) in positive and negative direction is realized via the switch and the OR element.

The cooling requirement is filtered via a ramp with the gradient kuwKBR...p for positive changes and kuwKBR...n for negative changes. The ramp is intended to prevent “fan saws”.

After the maximum selection, the fan speed for the corresponding fan (kuoHy_N for the hydraulic fan and kuoEl_N for the electric fan) is determined from the cooling requirement (kuo..._KB) depending on the engine speed dzmNmit via the respective fan basic map (kuw...GRDKF).

It is possible to suppress up to five speed ranges (kuwHy_N...U to kuwHy_N...O and kuwEl_N...U to kuwEl_N...O) for acoustic reasons. Instead of these fan speeds, the lower limit value (kuwHy_N...O or kuwEl_N...O) is used.

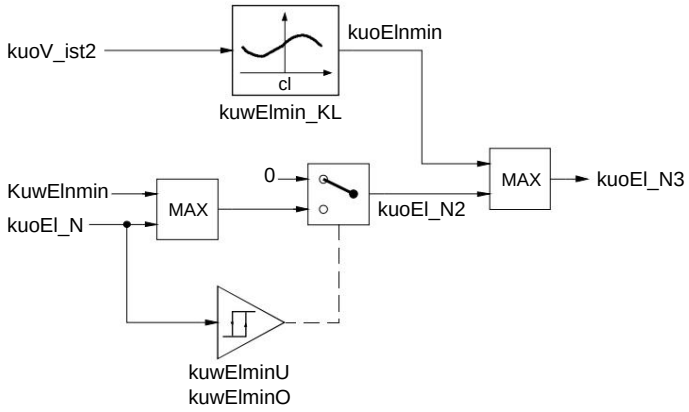


Figure SONSKU06: switch-on and switch-off hysteresis electric fan

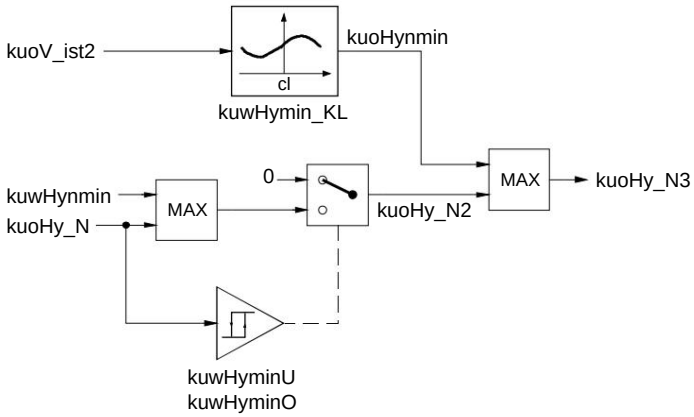


Figure SONSKU07: Switch-on and switch-off hysteresis of hydraulic fan

In order to prevent the fan speed from jumping back and forth at low fan speeds, a switch-on and switch-off hysteresis is connected in front of the blanking ranges.

A speed threshold kuw...nmin is defined below which the fan must not run.

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If the fan speed kuo..._N0 rises above the value (>=) kuw...minO, the fan speed kuo...._N2 is set from zero to maximum minimum speed kuw...nmin and kuo....._N0 . If the fan speed kuo..._N0 falls below the threshold (<=) kuw....minU, the fan speed kuo...._N2 is reset to zero.

The selection is extended by the characteristic curve kuw...min_KL, which specifies a minimum fan speed kuo...nmin depending on the driving speed kuoV_ist2. A further maximum selection between kuo...nmin and kuo..._N2 is then made, from which kuo..._N3 results.

If no hydraulic fan is installed, the characteristic curve kuw...min_KL should be applied with zero.

If an error occurs in the error path fboSFGG, the default value kuwFG_VGW3 for the driving speed is used instead of fgmFGAKT, which is to be applied in such a way that the maximum possible minimum fan speed is represented in kuoHynmin.

With the electric fan, the speed is converted into the duty cycle via the characteristic curve kuwElLFTKL. In the case of the hydraulic fan, this happens via the map kuwHyLFTKF depending on the engine speed dzmNmit, since the operating point can shift in the area close to idling. There can be areas in which the fan speed only changes as a function of the engine speed. In order to prevent the resulting fluctuations, the fan speed must be reduced. This output stage can also be used for another electric fan.

During the start-up process (mrmSTART_B = 1 and dzmNmit> mrwSTNMIN1), the fans for the applicable time kuwt_Start are controlled with the default values kuwHy_VGW2 and kuwEl_VGW2.

If the water temperature at the cooler outlet anmWTK is greater than the water temperature threshold kuwWTFGR or if a critical water temperature at the head outlet kuoWTFkrit is reached, the system switches to the default values kuwHy_VGW1 and kuwEl_VGW1. The critical temperature results from the map kuwWTkrKF depending on the water temperature at the head outlet anmWTF and the filtered consumption mrmVB_FIL. Switching takes place via a hysteresis (kuwWTFHys...). The query anmWTK - anmWTF also has hysteresis (kuwWTKHys1 and kuwWTKHys2).

During the run-on (kumNL_akt=1), the cooler fan output stages are controlled with kuoHyVGW3 or kuoElVGW3. KuoElVGW3, kuoHyVGW3 result from the map kuwNLEl_KF, kuwNLHy_KF depending on anmWTF and anmUTF at the beginning of the run-on. At the end of the run-on time, the pulse duty factors for both fans kuwElVGW3, kuwHyVGW3 are changed in such a way that the fan speeds are ramped down to the minimum value (kuw.._min) at the end of the fan run-on. (Use with 2 electric fans)

If a hydraulic fan is installed, it must be deactivated in the run-on.

The electric fan ehmFGER is controlled from the end of the cooler run-on kumNLact to the end of the MSG run-on with the duty cycle kuwEl_VGW4.

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5.7.6 Formation of the relative cooling capacity for CAN

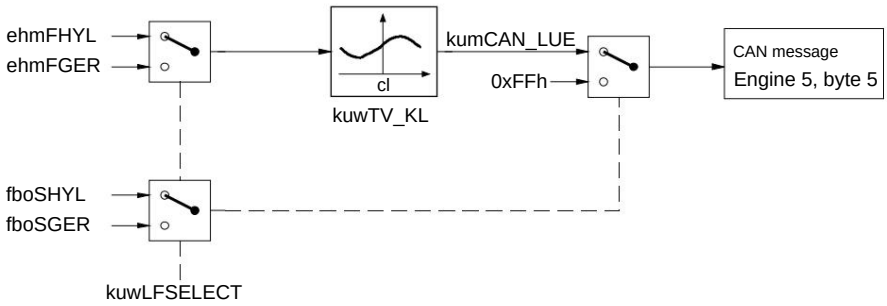


Figure SONSKU08: Formation of the relative cooling capacity for CAN

Depending on kuwLFTAUSW (0:ehmFHYL, 1:ehmFGER), the respective pulse duty factor with the characteristic curve kuwTV_KL is converted into a relative cooling capacity for the on-board power supply control unit and sent via CAN (motor 5, byte 5). If an error occurs in one of the output stages (fboSGER, fboSHYL), the value 0xFFh (error identification) is sent via CAN.

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5.7.7 After-run and after-run pump

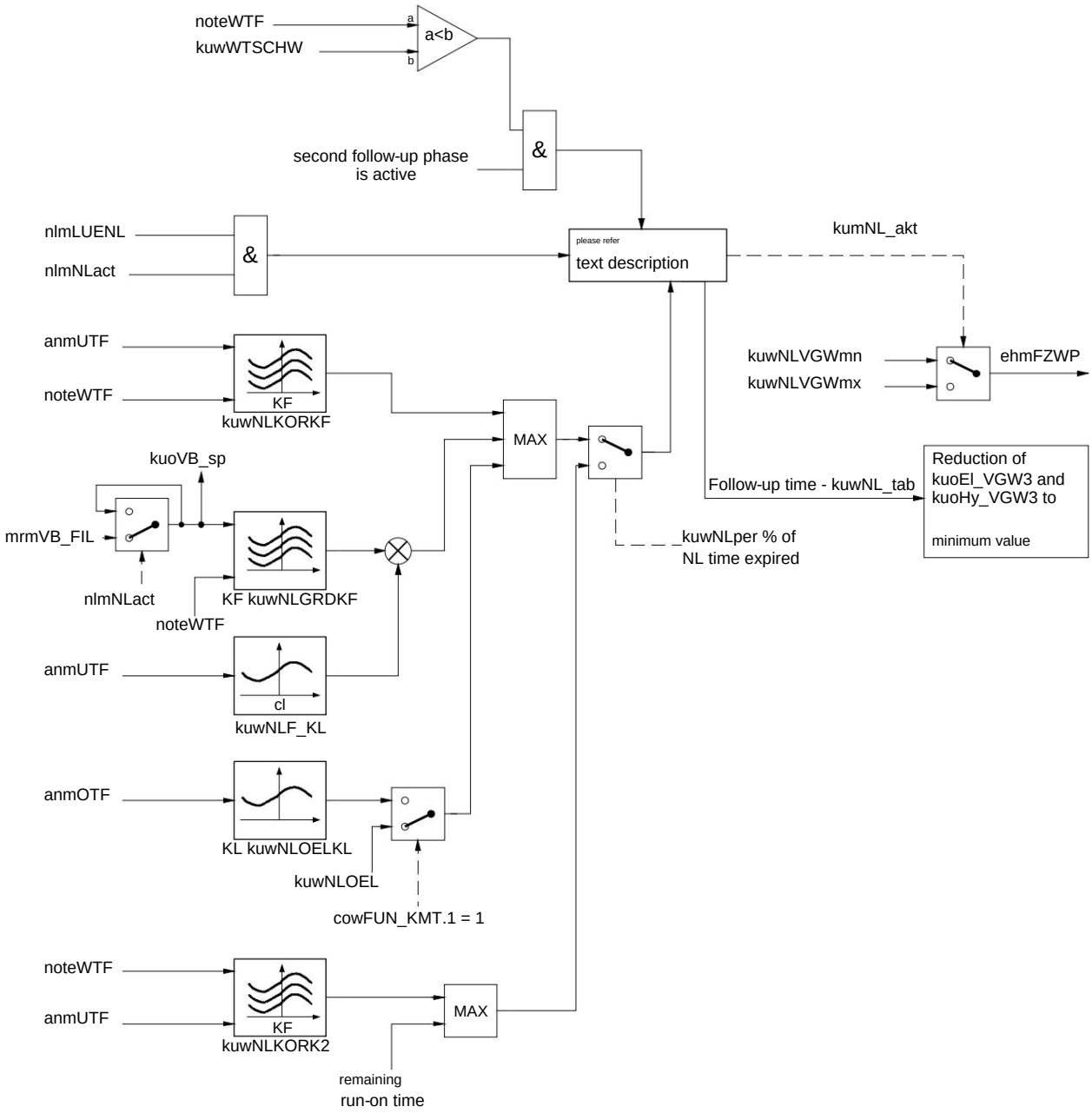


Figure SONSKU05: after-run and after-run pump

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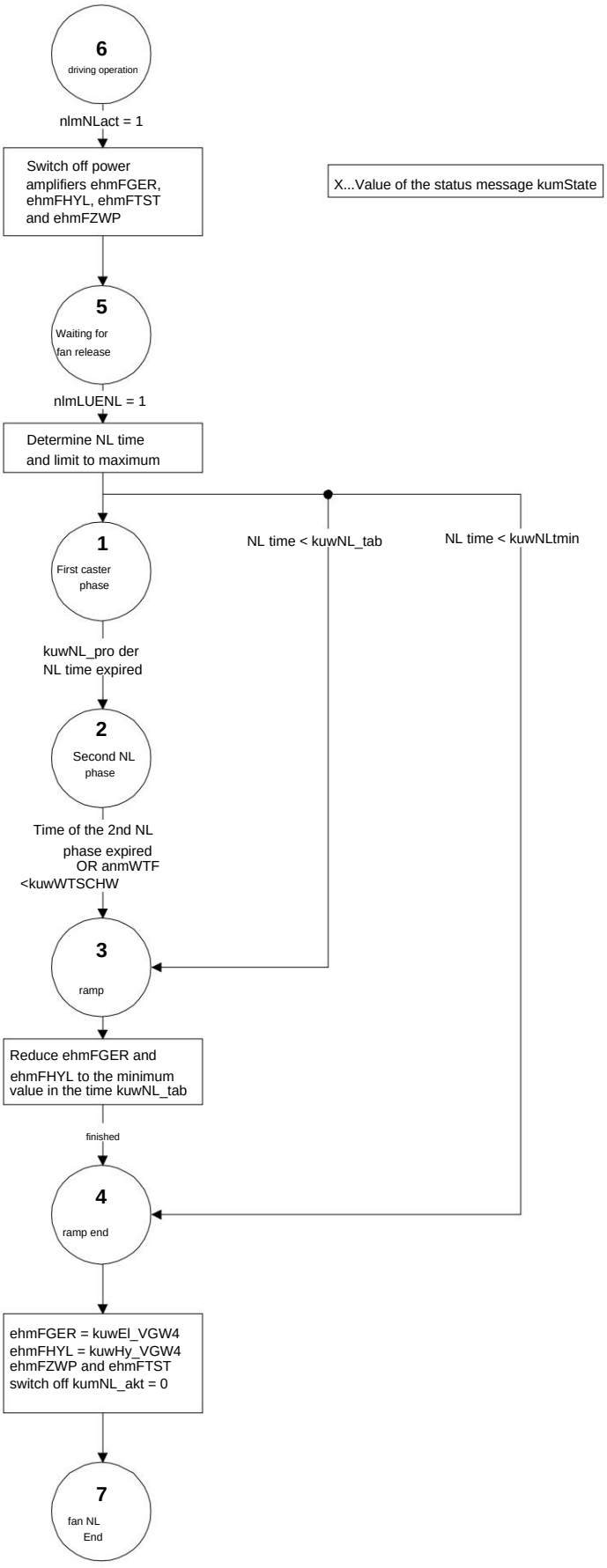


Figure SONSKU09: status of the fan run-on

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The meaning of the message kumState can be seen in the following table:

cumState (dec.) 1	meaning
	First follow-up phase
2	Second follow-up phase
3	ramp is running
4	Ramp finished
5	Waiting for fan release
6	driving operation
7	Fan run-on end

If the run-on phase is active (nlmNLact=1) and the release for the fan run-on or
Thermostat follow-up was granted (nlmLUENL=1), the follow-up pump is controlled with the default value kuwNLVGWmx. During the run-on, the fan output stages and the thermostat output stage are controlled with the corresponding default values.

At the beginning of the follow-up, the timer is started with a time that results from the maximum of the follow-up basic map kuwNLGRDKF and the follow-up correction map kuwNLKORKF. The input variables of the trailing basic map are the filtered consumption mrmVB_FIL and the water temperature at the cylinder head outlet anmWTF. The filtered consumption mrmVB_FIL is frozen in the wake so that the same consumption value is used for the second maximum selection. The output value of this map is multiplied by a factor that results from the characteristic curve kuwNLF_KL as a function of the ambient temperature in order to shorten the run-on time if necessary at cool temperatures. The input variables of the follow-up correction map are the ambient temperature anmUTF and the water temperature at the cylinder head outlet anmWTF. The run-on characteristic kuwNLOELKL is only activated if there is a WIV (cowFUN_KMT.1 = 1). The first calculation of the run-on time should be designed in such a way that the maximum temperature of the post-heating phase is exceeded. The filtered consumption mrmVB_FIL is stored at the beginning of the follow-up in E2 PROM.

Description of the black box:

After kuwNLpro% of the follow-up time determined in this way, the maximum selection between the map kuwNLKORKF2 and the remaining follow-up time is carried out. (second follow-up phase). The time for the overrun extension should result from the overrun correction map kuwNLKORKF. To do this, the filtered consumption kuoVB_gesp must be reset before the maximum selection is carried out again. If the newly determined run-on time is greater than the remaining old run-on time, the run-on phase is extended accordingly. At the time of the end of the lag - kuwNL_tab, the lag pulse duty factor kuoEl_VGW3 and kuoHy_VGW3 (from the "control of the cooling fan output stages" function) is reduced to a minimum value via a ramp in the time kuwNL_tab. If the newly determined run-on time is less than or equal to the remaining old run-on time, the run-on phase runs to the end. The reduction of the tracking duty cycle kuoEl_VGW3 and kuoHy_VGW3 also takes place.

During the second follow-up phase, there is an early termination condition. The termination condition is met and the timer is deleted when the water temperature anmWTF is below an applicable temperature threshold kuwWTSCHW. the

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The post-run duty cycle kuoEl_VGW3 and kuoHy_VGW3 is also reduced in the event of an abort.

kuwNLpro % of the minimum run-on time kuwNLtmin (> 0s run-on time) must be greater than or equal to kuwNL_tab. For run-on times less than kuwNLtmin, 0s run-on is recognized and the output stage is reduced to the minimum without a ramp.

The run-on time must be limited to a maximum run-on time kuwNLtmax.

The following condition must be met for proper functioning (application note):

(kuwNL_tab + follow-up time * (kuwNL_pro / 100)) <= follow-up time

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5.8 Flexible service interval display The flexible

service interval display enables the oil change intervals to be carried out depending on the actual oil load. This is to achieve optimal utilization of the engine oil.

Depending on the speed *dzmNmit,* injection *quantity mrmM_EAKT* and oil temperature *anmOTF ,* the specific oil load is determined. The oil load consists of a thermal wear *value (low byte of simOEL_BEL)* and a particle *entry value (high byte of simOEL_BEL) .*

The thermal wear value is calculated using the *siwOEL_tKF map* (thermal load) as a function of engine speed and oil temperature.

The particle entry value is calculated using the *siwOEL_rKF map* (soot entry) as a function of engine speed and injection quantity.

These values are determined in a staggered manner (so that new values are available every 100 ms) and, as applied for the CAN message, are transmitted cyclically every 1000 ms to the instrument cluster.

The telegram identifier 0 is sent up to the start shedding and further in the after-run. With telegram identifier 0, the wear values are not evaluated by the instrument cluster.

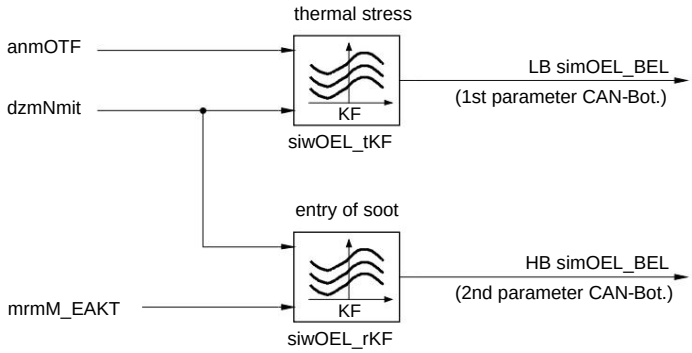


Figure SONSSI01: specific oil load

The instrument cluster sums up the values and calculates the root mean square of the soot entry, thermal load index and distance travelled. When a limit value is reached, the driver is signaled that an oil change is to be carried out.

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5.9 Generator excitation

In order to improve the starting behavior of the engine, the excitation of the alternator is only switched on after the start drop has taken place or a speed threshold has been exceeded.
For this purpose, the generator is excited by the EDC. For this purpose, a relay is controlled by a negative pulse on the GEA output stage. This activation occurs only once during an operating cycle during the starting process. If the condition is met for the first time in the overrun, the excitation is not switched on. The GEA output stage is supplied by the message ehmFGEA.

After initialization, ehmFGEA is ON (TV 100%). After the start shedding has taken place or the speed threshold mlwERR_n has been exceeded, the message ehmFGEA is set to OFF (TV 0%) for the duration mlwERR_tda, delayed by the time mlwERR_twa. After mlwERR_tda expires, ehmFGEA goes back ON for the remainder of the duty cycle.

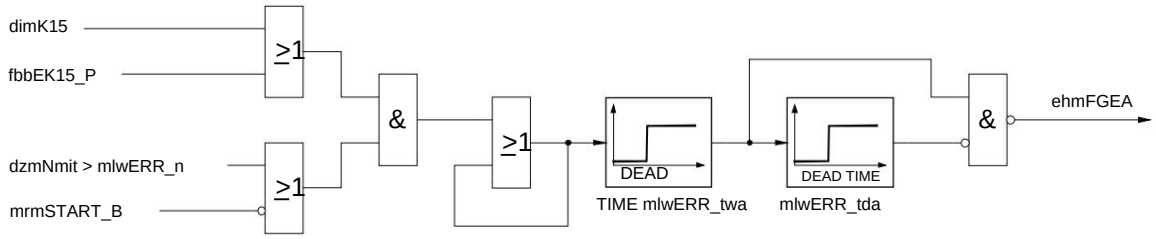


Figure: SONSGEA1: Activation of generator excitation

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5.10 Odometer

The odometer (edoKMZ) is integrated by integrating the current driving speed counted while driving. (but not afterwards)

In order to retain this variable beyond the driving cycle, it must be stored in the EEPROM. This takes place afterwards (edoKMZ_STA.0 = 1 if saved) and also afterwards Covering the distance edwKMZ_ZYK. In the next driving cycle, the odometer will initialized with the value stored in the EEPROM.

If edwKMZ_ZYK is applied to "0", the mileage, the error bit and the Overflow bit in EEPROM cleared ("reset all").

If the odometer (edoKMZ) exceeds its maximum value, an overflow takes place and the overflow bit (OvB) edoKMZ_STA.1 is set. Once the overflow bit occurs, it stays received for the life of the SG.

(except when the KMZ is reset)

In addition, a parity bit of the mileage to be saved is determined and with the Information saved in EEPROM.

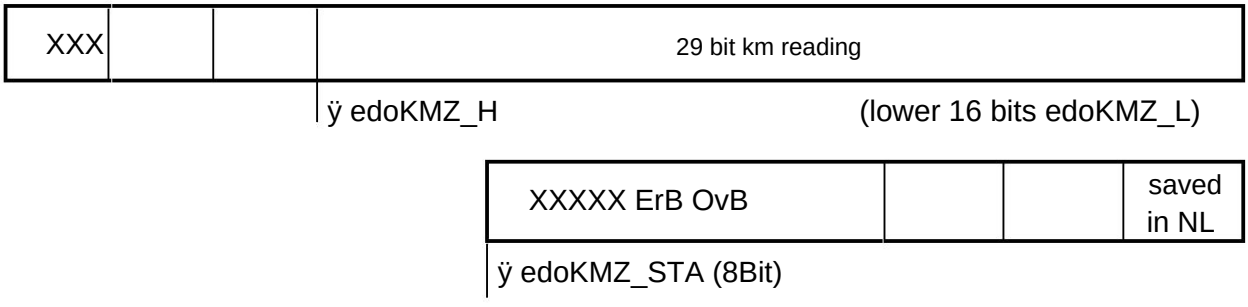
When reading from the EEPROM, the saved mileage becomes a parity again calculated and compared with the stored one. If the comparison shows a negative result, an error bit (ErB ÿ edoKMZ_STA.2) is set, but is read with the Mileage further processed so that possible test intervals may continue to be carried out can become. (e.g.: check a specific actuator every 1000km) If the error bit occurs once, it remains for the lifetime of the SG. (except when the KMZ is reset)

The resolution of the km counter was chosen to be 0.01 km. This results in a maximum Mileage of 5,368,709.11km = [(229 -1) * 0.01km].

Application values: edwKMZ_ZYK

Input values: fgmFGAKT, current driving speed
nlmNLact, overrun active (true/false)

Initial values: edoKMZ_L, Olda LOW - Word (16 bit)
edoKMZ_H, Olda HIGH - Word (16-bit)
edoKMZ_STA, Olda status km status



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5.11 Misfire detection

5.11.1 General

The misfire detection (OBDII requirement) is used to detect and report periodically occurring misfiring of a cylinder as a result of severe compression loss or missing fuel injection. Firing misfires that occur periodically are entered in the error memory as OBDII-relevant errors.

The subtask contains the following functions:

ÿ Checking the monitoring conditions
ÿ Delayed start of acquisition / premature end of acquisition
ÿ Dropout detection
ÿ Result analysis

5.11.2 Monitoring conditions Monitoring

for misfiring is only carried out under the following operating conditions: ÿ Speed dzmNmit <max. speed for monitoring mrwAUS_Nmx ÿ Speed dzmNmit> min. Speed for monitoring mrwAUS_Nmi AND ÿ Current amount mrmM_EAKT <max. amount for monitoring mrwAUS_Mmx AND ÿ Current mrmM_EAKT > min. Amount for monitoring mrwAUS_Mmi AND - Current driving speed. fgmFGAKT <= maximum speed for monitoring mrwAUS_Vmx AND ÿ water temperature anmWTF> min. water temp. for monitoring mrwAUS_WT AND - Time since the last change of state in dimKUP clutch actuation hide time mrwAUS_KUt - Time since engine start (mrmSTART_B) > Start hide time mrwAUS_Stt - ((clutch dimKUP = 1 AND monitoring when the clutch is actuated mrwAUS_KUP) OR - (clutch dimKUP = 0 AND monitoring when the clutch is not actuated mrwAUS_nKU))

AND

AND

AND

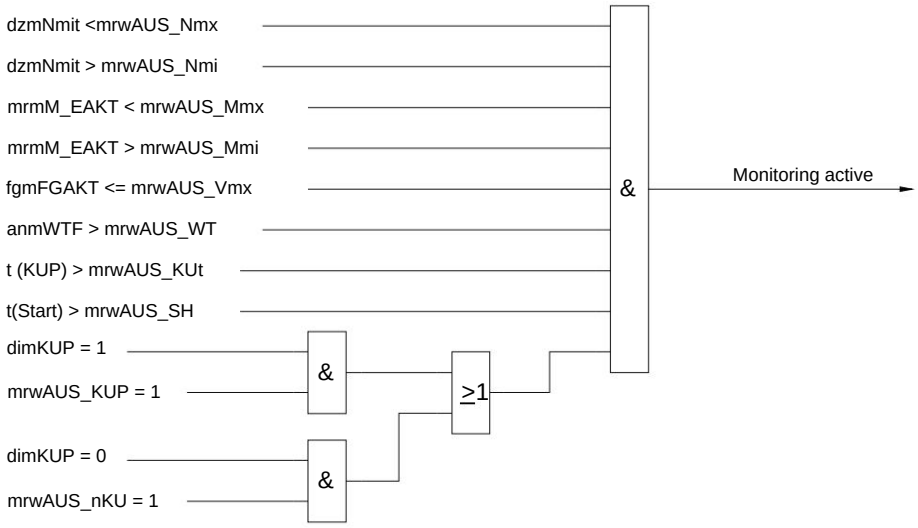


Figure SONSZA01: Misfiring monitoring conditions

An interrupted test is continued after re-entering the monitoring area.

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5.11.3 Delayed start of recording / early end of recording

This function is used to hide the transient engine operating states as they are to be expected when leaving or entering the monitoring area.

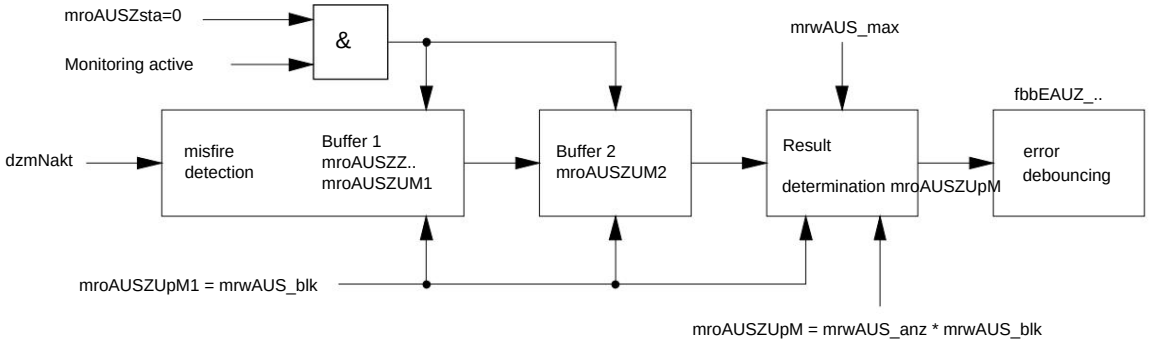


Figure SONSZA02: delay in recording or determining the results After the monitoring conditions have been met, the recording is delayed by mrwAUS_blk engine revolutions. The acquisition begins when the OLDA mroAUSZsta has reached the value 0.

By recording the evaluated engine revolutions (mroAUSZUM1) in Buffer 1 and re-storing after mrwAUS_blk engine revolutions in a buffer (Buffer 2, mroAUSZUM2), it is achieved that the actual test result determination is delayed until after 2 x mrwAUS_blk engine revolutions. If the monitoring condition no longer applies in the meantime, the two buffer memories are discarded and the last engine revolutions are therefore no longer taken into account when determining the result. The OLDA mroAUSZsta is initialized with mrwAUS_blk for the test continuation.

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5.11.4 Dropout Detection

The required minimum speed increase mroAUSZ_dN is formed once per two engine revolutions, which is calculated from the percentage of the average speed increase mrwAUS_dN.

$$\text{mroAUSZ dN} = \frac{\sum_{k=0}^{z-1} \text{nkz}[k]}{\sum_{k=0}^{e.g-1}} * \frac{\text{mrwAUS dN}}{100\%}$$

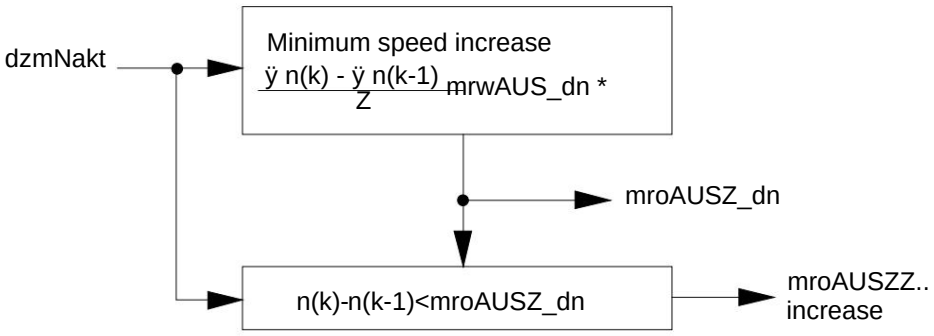


Figure SONSZA03: misfire detection

The misfire detection checks whether the speed increases after injection are above the minimum mroAUSZ_dN. Insufficient speed increases increase the error event counter belonging to the cylinder (mroAUSZZ ..) in buffer 1.

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5.11.5 Test result

The error status of the misfire detection does not result from finding a single one dropouts, but because of its frequency.

The error message Misfiring in a cylinder fbbEAUZ_.. (.. = 1 .. z) is reported if within a test frame of mrwAUS_anz * mrwAUS_blk engine revolutions more than mrwAUS_max misfiring of this cylinder were detected. Then the test is repeated started.

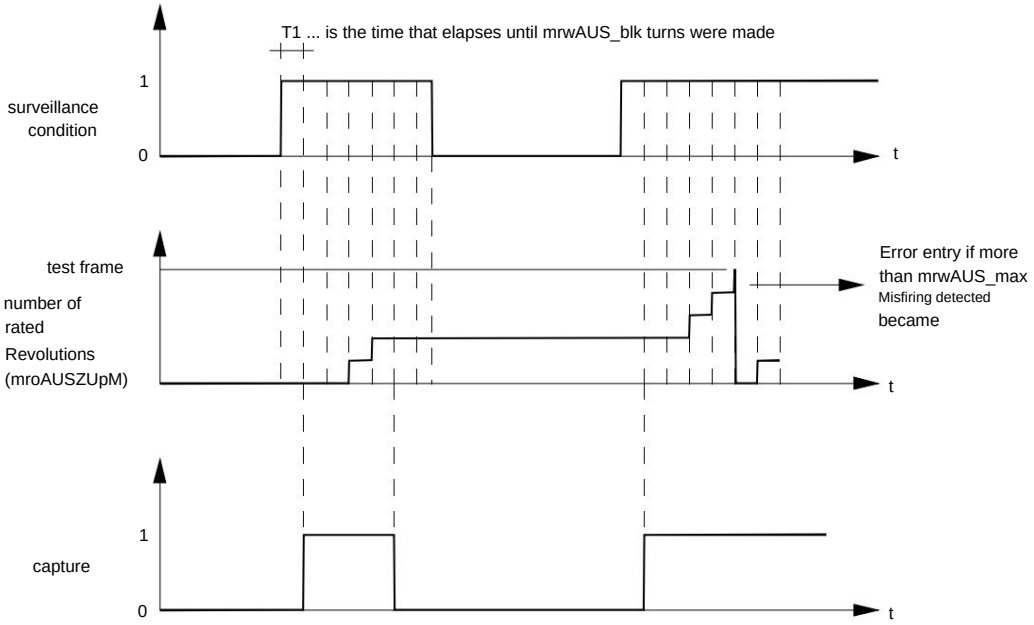


Figure SONSZA04: Timeline

Error bit fbbEAUZ_M of the misfire detection path has the meaning: have several cylinders dropouts at the same time.

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5.12 Fuel Cooling

Fuel cooling is available so that the fuel *temperature anmKTF* in the return flow to the tank does not exceed certain temperature thresholds. For this purpose, a circulation pump *ehmFKSK* is controlled via a relay.

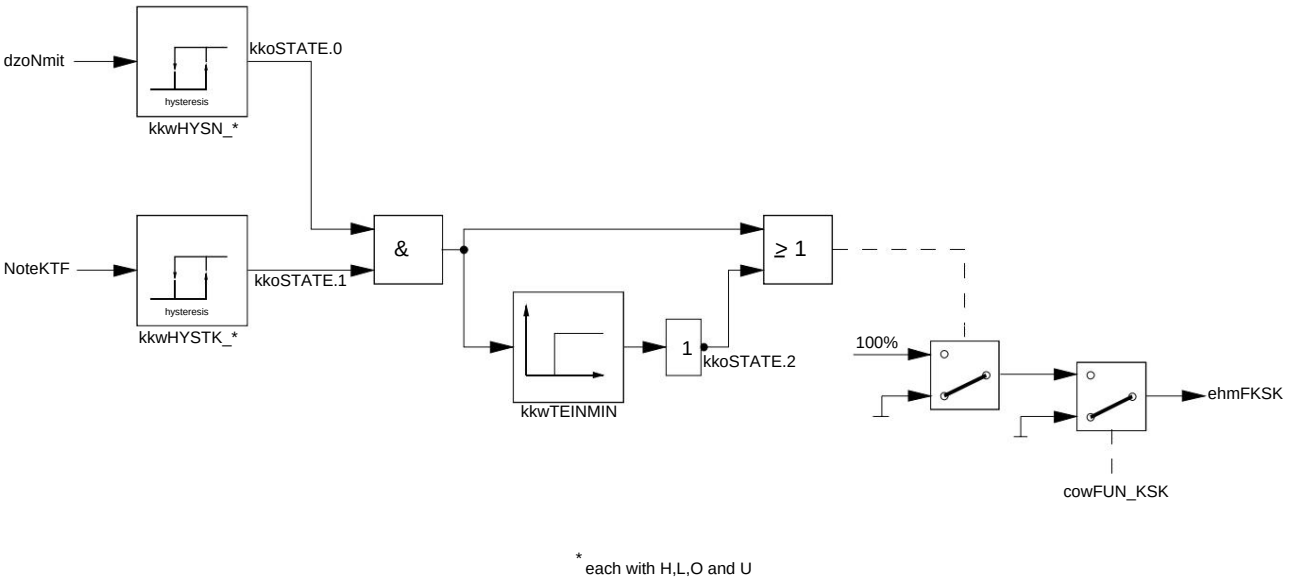


Figure SONSKK01 : Fuel cooling

Above the temperature *threshold kkwHYSTK_O* and above the speed *threshold kkwHYSN_O ,* the output *ehmFKSK* is activated for the minimum *duty cycle kkwTEINMIN .* After falling below the hysteresis *thresholds kkwHYSTK_U* or *kkwHYSN_U* and after the minimum switch-on time has elapsed, the output is deactivated again. The entire fuel cooling can be deactivated via the function *switch cowFUN_KSK (cowFUN_KSK* = 0).

The initial states of the two hystereses are shown in the BIT-OLDA *kkoSTATE .*
The speed hysteresis is displayed with bit 0 and the temperature hysteresis with bit 1.
In addition, bit 2 is set during the minimum switch-on time.

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5.13 Shut-off flap control at overspeed

If the engine accelerates unintentionally, it should be slowed down to an applicable speed by actuating the shut-off flaps.

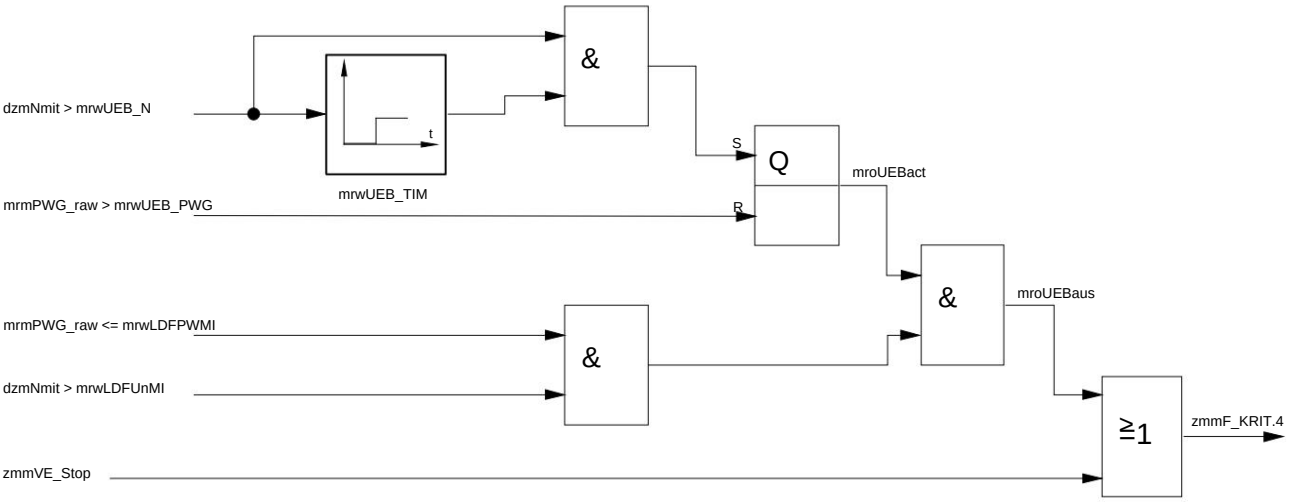


Figure SONSAA01 : Shutdown flap control at overspeed

If the engine speed *dzmNmit* for the time *mrwUEB_TIM* is greater than the threshold *mrwUEB_N* AND the pedal *position mrmPWG_roh* <= the threshold *mrwUEB_PWG* , the OLDA mroUEBakt is set. If the pedal position exceeds the threshold *mrwUEB_PWG* , the OLDA mroUEBakt will be deleted again.

Has the monitoring of overspeed detected *(mroUEBakt* = TRUE) AND is the pedal *position mrwPWG_roh* less than or equal to the threshold *mrwLDFPWMI* AND the speed is greater than the threshold *mrwLDFUnMI,* the OLDA *mroUEBaus* is set to TRUE and the shut-off flap is closed (zmmF_KRIT.4 = TRUE) .

It should be noted that the intake manifold vacuum detection via the message *mrmLDFUaus* can close the parking flaps.

Below the speed *threshold mrwLDFUnMI* or above the pedal value threshold

mrwLDFPWMI the shut-off flap is opened again, but the overspeed detection remains active up to the pedal *value threshold mrwUEB_PWG .*

Application note:

1) The labels *mrwLDFPWMI* and *mrwLDFUnMI* are through the
Intake manifold vacuum detection specified. See chapter Boost pressure control monitoring concept.

The output stage of the shut-off flap **must be** active during run-on so that the function with
K15 off is still effective in the event of an "overspeed" error.

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5.14 El. Fuel pump / tank shut-off valve

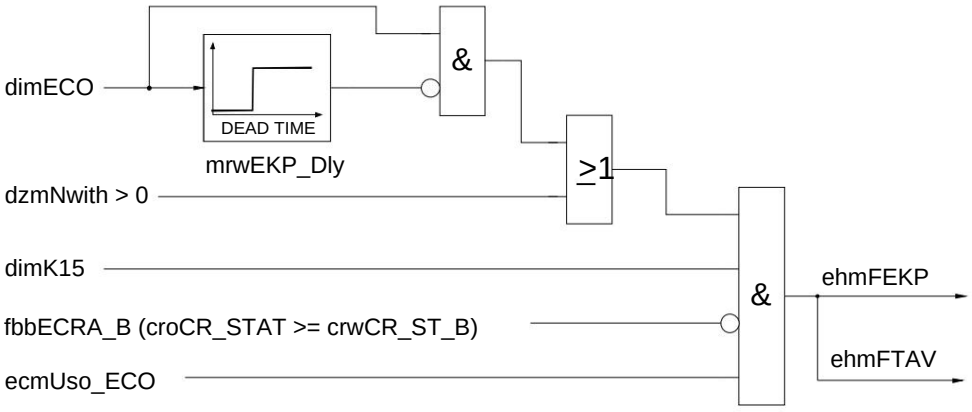


Figure EKP_01: Electric fuel pump / tank shut-off valve

The function switch cowFUN_EKP (cowFUN_EKP=0) can be used to deactivate the control of the electric fuel pump and the tank shut-off valve.

As soon as terminal 15 is active, the crash error fbbECRA_B has not been reported as definitely defective and ecmZUMEAN (ecmUso_ECO corresponds to ecmZUMEAN) should not be switched off via ECOMATIC, the fuel pump output stage can be switched on in two different ways:

- if the speed dzmNmit is greater than zero, ehmFEKP and ehmFTAV are switched on,

or

- when there is an ECOMATIC request (dimECO = 1). If the ECOMATIC requirement is present, the output stages fuel pump ehmFEKP and tank shut-off valve ehmFTAV are controlled for the applicable duty cycle mrwEKP_Dly.

5.14.1 El. Fuel pump and TAV during the initialization phase

In the initialization, an ECOMATIC requirement is simulated independently of dimECO, whereby ehmFEKP and ehmFTAV are switched on for the duty cycle mrwEKP_Dly (if the above conditions for dimK15, fbbECRA_B and ecmUso_ECO are met).

Application note:

The task of the el. Fuel pump and the tank shut-off valve is carried out every 100ms, this should be considered when applying mrwEKP_Dly.

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5.15 Hour meter

The hour meter (OLDA's mroBSTZl and mroBSTZh) has one in the EEPROM
Value range of 6 bytes (secured against wear of the low byte, overflow, etc.).
Operating intervals are only counted if the speed dzmNmit is greater than the threshold
mrwBTS_NMX, and the current injection quantity mrmM_EAKT greater than the threshold
mrwBTS_MMX are. This state is called driving operation. An operating interval consists of
mrwBTS_BIN times the period mrwBTS_TIK. After that, the hour meter
incremented. When the vehicle is not in operation, the current operating interval is stopped. Will he
Completed driving cycle, started operating intervals are not taken into account.

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6 Error Handling

6.1 Overview

Error handling is organized as follows:

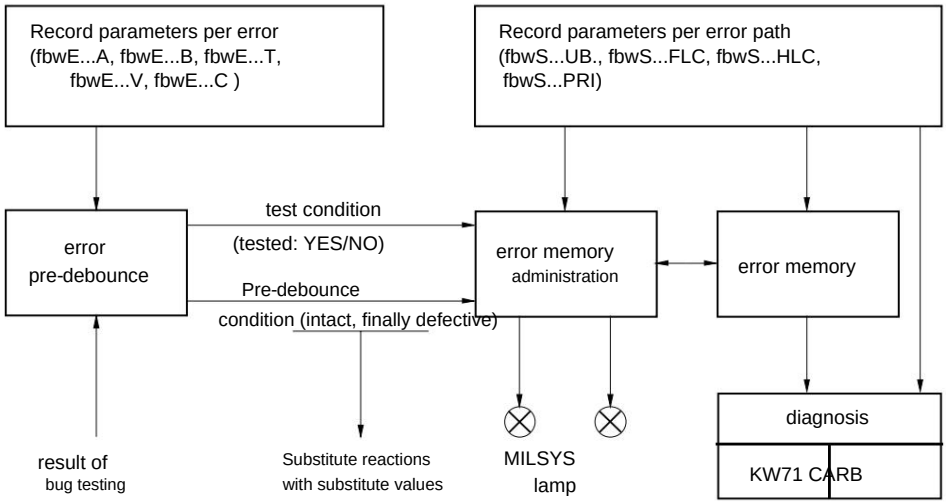


Figure UEBEFB01: Error handling

Each SG function group (e.g. quantity calculation, exhaust gas recirculation, ...) carries out monitoring. The result of this monitoring (hereinafter referred to as error) is reported to the error pre-debouncing.

The error pre-debouncing takes place individually for each error. It is used for detection security (eg a "Signal Range Check" SRC must be violated for a certain time so that even short interference pulses do not trigger an error). There is a separate data record parameter block for each error. If the error is *finally defective* , a message is sent to the error memory management.

Individual errors are combined into error paths. The error memory management carries out the entry debouncing for each error path. If an error is *finally* reported as defective, there are substitute functions in the driving software and a provisional error memory entry of the path, which must be confirmed in the entry debouncing.

The status of an error path in the error memory determines whether the MIL or SYS lamp is lit and whether the error entry is visible for diagnosis.

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6.2 Error pre-debouncing

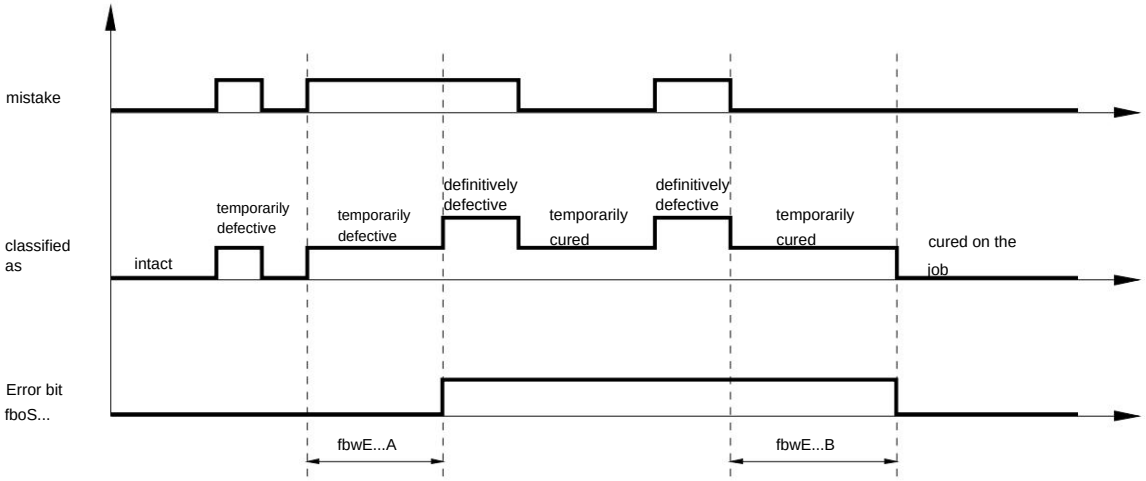


Figure UEBEFB02: Error pre-debouncing

6.2.1 Defect Detection

If an error occurs, it is initially classified as *provisionally defective* and after the debounce time fbwE..A has elapsed as *definitively defective .* If healed during the debounce time, the error is classified as *intact* again . The error pre-debouncing can be switched off by applying fbwE..A with zero or maximum value, with the maximum value of the error never being classified as *definitively defective* and zero immediately .

6.2.2 Intact detection

When an error is cured, it is classified as *provisionally cured* and classified as *cured during operation* after the healing debounce time fbwE..B has elapsed . If it occurs again during the debounce time, the error is reported as *definitely defective .* The error debouncing can be switched off by applying fbwE..B with zero or maximum value, whereby the corresponding error cannot be healed at maximum value and it is immediately classified as *healed in operation* at zero .

Danger:

The substitute function of an error and its entry in the error memory takes place in the pre-debounce state *finally defective.* If an error is recognized and classified as *provisionally defective ,* the last valid state is frozen for the duration of the debouncing time fbwE..A! The switchover from substitute to normal function takes place when *healed during operation.*

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6.2.3 Test State

An error receives the "tested" status when it is reported for the first time after ignition as *intact* or *finally defective* by the pre-debouncing.

An error path (see next chapter) is considered tested if an error occurs in the path or all errors in the path have been tested.

If fbwE...A is applied with the maximum value (= error is never *finally defective) ,* the error is considered tested after the first monitoring has started.

Example:

If an error is reported as good for the first time after "ignition on" by monitoring, the error is immediately considered tested, but if it is reported as bad, it is only classified as tested after the pre-debouncing has expired.

6.2.4 Follow-up - low K15 voltage Monitoring

can be hidden for each error depending on the terminal 15 voltage level in the application, ie there is no pre-debouncing of an error and therefore no error storage.

The error is not permanently defective, but not cured either. There is also no substitute function. The status of terminal 15 is recorded both as a digital and analog signal. If the voltage drops below the threshold determined by the hardware (voltage at K15; approx. 4.5V), the EDC control unit detects **run** -on (message dimK15 = 0, nlmNLact = 1).

Some vehicle components (CAN bus, output stages..) or control units switch off when the voltage falls below a higher terminal 15 threshold. In order to avoid undesired error entries when monitoring these components, the voltage of terminal 15 is recorded analogously as an analog value anmK15. If anmK15 falls below the lower hysteresis threshold anmwK15_H_U, this is recognized as an analog K15 OFF (message anmK15_ON =0) and the pre-debouncing is deactivated for those errors in which there is no monitoring at low Klemme15 voltage. If anmK15 exceeds the upper hysteresis threshold anwK15_H_O, this is recognized as analog K15 ON (message anmK15_ON =1) and debouncing is released again.

Either the analog or digital K15 signal can be used to hide each error. However, each error can also be treated completely independently of K15 (ie also in the post-processing). (see data record parameters per error 6.4.2)

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6.3 Record Parameters per Fault Path

The following error memory parameters can be applied separately for each error path:

Parameter Description
fbwS..UB1 environmental condition 1 (message number)
fbwS..UB2 environmental condition 2 fbwS..UB3
environmental condition 3 fbwS..UB4 environmental
condition 4 fbwS..UB5 environmental condition 5
fbwS..FLC start value debounce counter for debounced
error entry fbwS..HLC start value debounce counter for error deletion
fbwS..PRI priority

6.3.1 Environmental Conditions

When an error is entered for the first time, the current data of the applied environmental conditions (= data set fbwS...UB1 to fbwS...UB5) are read in, normalized and transferred to the error memory. A change in an error entry has no influence on its environmental conditions. This means that once the environmental conditions have been entered, they are retained until the error memory entry is deleted.

The environmental conditions to be applied are selected via message numbers (see appendix "List of environmental conditions").

Application note:

These environmental conditions are only for customer-specific diagnosis (not for the OBDII tester). Only the message numbers ÿ h0F00 should be used for this.

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6.3.2 Debounce counter for error entry

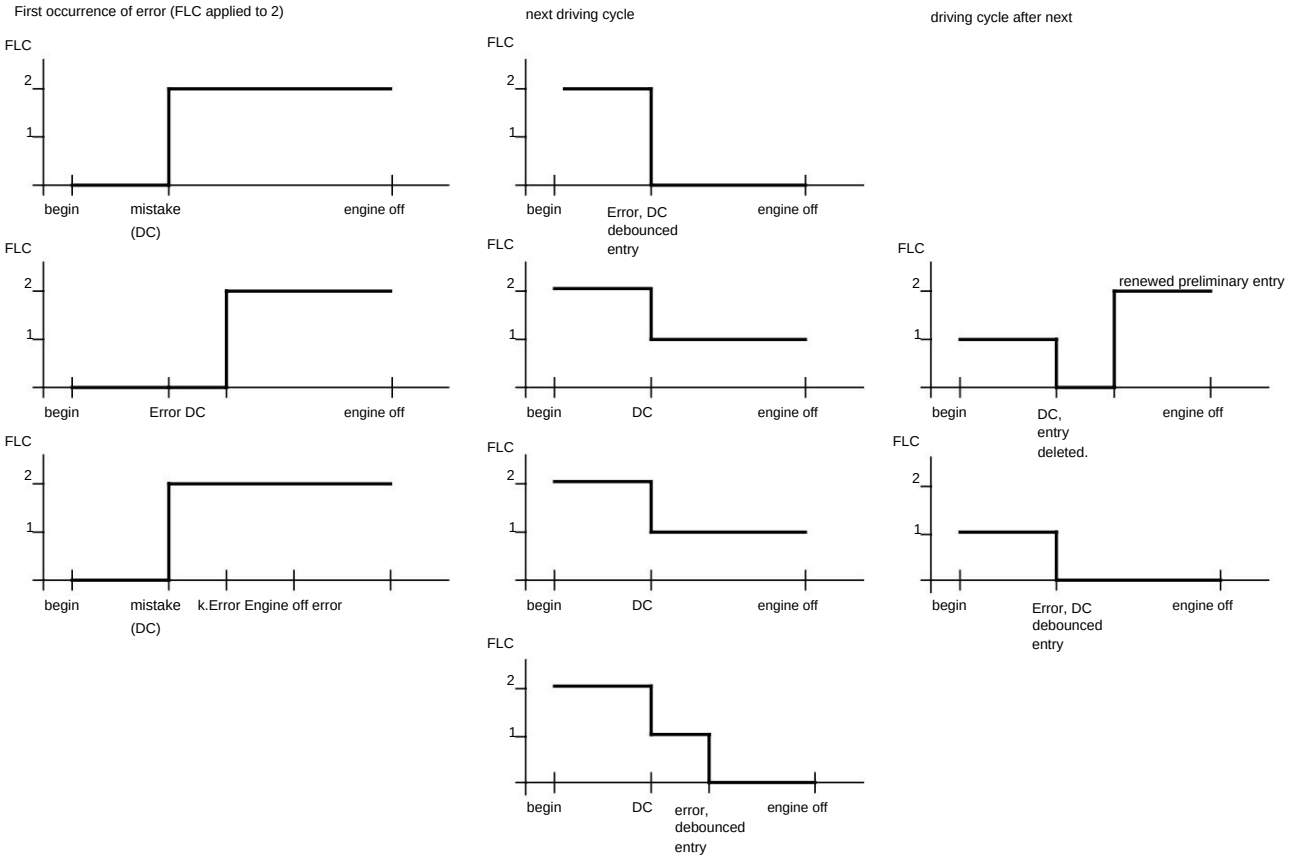


Figure UEBEFB04: counter for debounced entry fbwS..FLC

For each path, the number of debounce cycles can be defined in the parameter fbwS..FLC for debounced entry. If an error path is *finally defective* (pre-debouncing), it is provisionally entered in the error memory and the entry debouncing counter (byte 4 in the associated FSP entry) is set to the value fbwS..FLC. The status of the error entry then no longer changes within the same DC (only error status bits, frequency counters and sporadic bits are continuously updated). At each subsequent DC, the entry count is decremented.
If the counter reaches 0 without the error path *finally becoming defective* in another DC , the error entry is completely deleted. If the error path in one of the other DCs *finally becomes defective* (pre-debouncing) before the entry counter has reached 0, the error entry is debounced and entered in the error memory. **That means: If the error occurs in at least 2 DCs within fbwS..FLC DCs, the error is entered debounced.**

Application note:

If fbwS...FLC is applied to a value of 0, there is an immediate debounced error entry in the error memory if the classification is *"finally defective" (pre*-debouncing).
If fbwS...FLC is applied to a value of 255, there is no error entry of the path in the error memory. The replacement function is performed if this is applied in the fbwE...T label.

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According to the CARB definition, a DC consists of engine on, engine operation with testing of the respective error and engine off. It is therefore not permissible immediately after ignition on in the second DC an error to be deleted again immediately, so the start value of the FLC should be set to at least 2.
As a result, the deletion of a non-confirming error only takes place at the beginning of the following DC (at least after the run-on of the 2nd DC).

However, the lamp is already controlled during operation in the second DC (according to entry debouncing) if the error is confirmed.

6.3.3 Debounce counter for error clearing

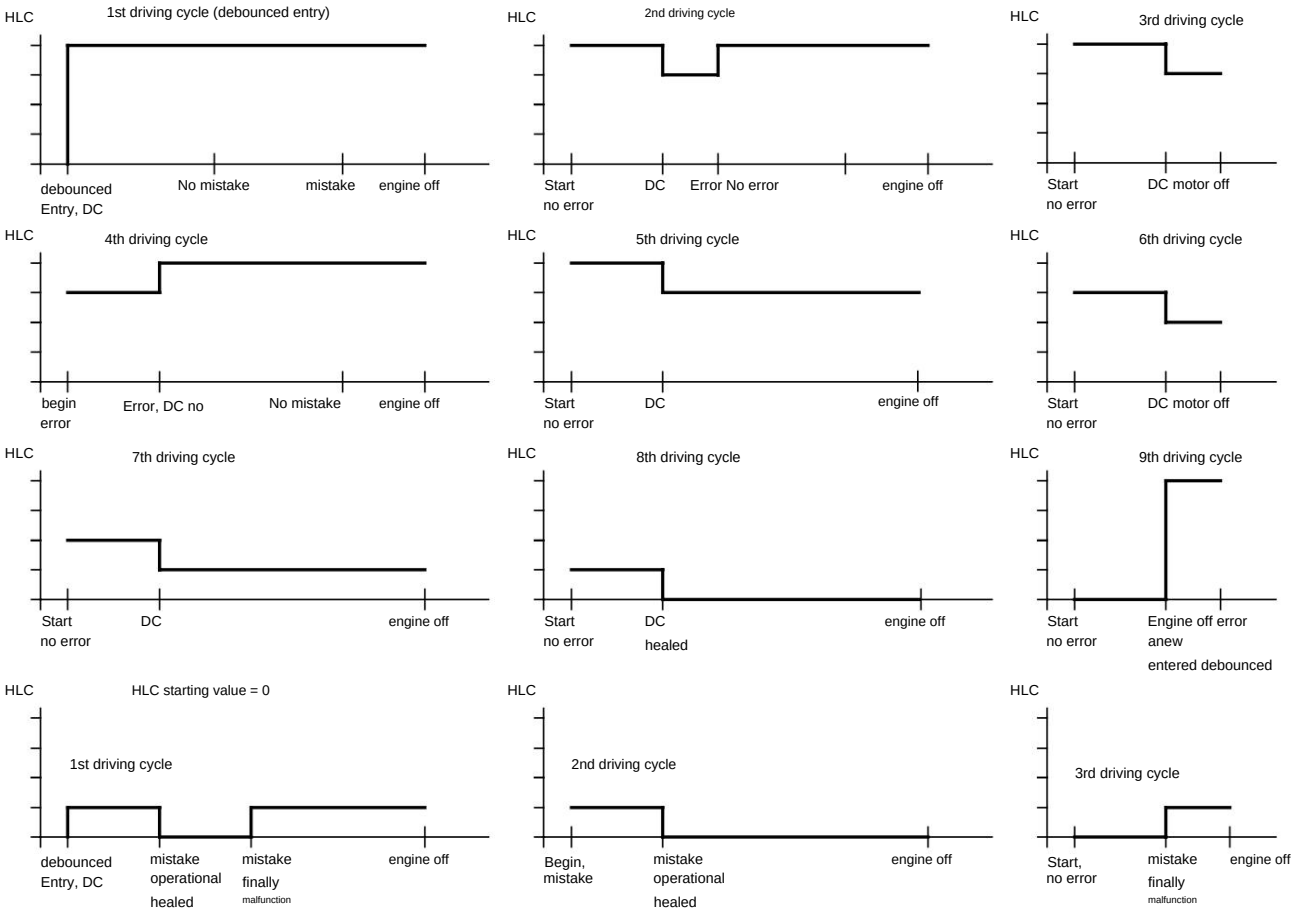


Figure UEBEFB05: counter for debounced healing fbwS..HLC

For each path, the number of healing cycles can be defined in the parameter fbwS..HLC for healing will. The heal count (byte 5 in the associated FSP entry) stays the same for debounced entries long on the starting value fbwS..HLC, like the error path in the pre-debouncing *finally defective* is recognized. When the fault path is no longer defective, in each detected DC the counter decreased by one. When the healing counter reaches 0, the bug is considered “healed” registered. If the error occurs again, the counter is reinitialized with the start value (Immediately renewed debounced entry). **That means: For error healing, the error path must be** ÿ **fbwS..HLC DC's have not been defective continuously.**

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Application notes:

If fbwS...HLC is applied to a value of 0, then "healed during operation"
(Pre-debouncing) classification an immediate error healing of the path in the error memory (lamp
out). The healing counter in the FSP entry is set to 1 with a starting value of 0 as long as the error
debounced is defective.

If fbwS...HLC is applied to a value of 255, there is no error healing. That means
the error lamp stays on until the entire error memory is read via the diagnostic interface
is deleted.

According to OBDII, 3 DC are required for healing. To prevent the MIL lamp in the 3rd
DC goes out (before engine off) the labels fbwS...HLC should be applied to 4.

6.3.4 Priority and Readiness

For each error path, its priority can be defined using fbwS..PRI. With priority one
You can influence the reaction when the error memory is full and the type of error
Define lamp control (MIL, SYS lamp). Higher priority errors displace at full
Error memory lower-priority errors.

The priority is coded as follows in the 2 least significant bits of fbwS...PRI:

fbwS...PRI	priority	Activate emissions-relevant MIL + OBD diagnosis (if debouncing is done)
xxxx xx00	0 LOWEST	NO
xxxx xx01	1	NO
xxxxxx10	2	YES
xxxx xx11	3 HIGHEST	YES

In addition to the MIL lamp, there is a system lamp. Whether this can be controlled
also be applied via fbwS...PRI:

fbwS..PRI SYS	lamp control (if debouncing is done)
xxxx x0xx	NO
xxxx x1xx	YES

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6.4 Record Parameters per Error

To determine the pre-debounce times or the number of events, there is a for each error
Parameter block defined, which is structured as follows:

Parameter name	unit	function	
fbwE..A	µs / number	debouncing for *final* *malfunction*	Must for event-driven errors be applied to 0 if the Monitoring only once per driving cycle takes place.
fbwE..B	µs / number	Debounce for *in operation healed*	
fbwE..T *LOW bytes*	-	bit mask for Error Description	see item 6.4.1
fbwE..T *HIGH bytes*	-	VAG code - type of error	Memory code: reading the Error memory via KW71
fbwE..V	-	VAG code - fault location	Memory code: reading the Error memory via KW71
fbwE..C	-	CARB code according to SAE1979	memory code: reading out the Error memory via OBD Scan Tools with address word 33hex

6.4.1 Debouncing for entry and healing

When applying the data sets, a distinction must be made between time- and event-controlled errors will. For time-controlled errors, the entry corresponds to the absolute time at event-driven errors the number of error messages of this error.

6.4.2 Error type (fbwE..T low byte)

Bit No.	Status	Function	
0 *01d* *01h*	1	**timed;** A mistake must for a time be recognized continuously, so that the classification as *definitively defective* he follows. The time is checked always only if an error test is on report result!	**MUST NOT BE CHANGED!!! MUST TYPE OF FAULT TEST (VIEW FREQUENCY) PASS!** CAN ONLY **BE CHANGED BY SW !!!**
	0	**event driven;** An error must be for a number of Error test messages be reported continuously so that the *final defective* classification takes place.	
1 *02d* *02h*	1	**no error storage;** For this error no Error storage performed. the Pre-debouncing and the replacement function done as applied.	applicable
	0	**Error storage takes place**	

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Bit No.	Status	Function	
2 *04d* *04h*	1	**not self-extinguishing** (through Warm Up Cycle); A fault is not automatically deleted from the fault memory, but is invisible to CARB once the clear counter has expired. **self-extinguishing** (through Warm Up Cycle)	Applicable This bit should be applied immediately for all errors in the path, otherwise the next error inherits the bit from the error in the first path entry.
	0		
3 *08d 08h*	1	**Actuate MIL (flashing)** when the error is *finally* classified as defective	Applicable This bit should be applied immediately for all errors in the path, otherwise the next error inherits the bit from the error in the first path entry. applicable
	0	MIL control if error in error memory according to fbwS..PRI	
4 *16d* *10h*	1	**in the run** -on there is no pre-debouncing of an error and therefore no error storage. The error is *not permanently defective* but not cured either! There is also **no substitute function !**	
	0	Follow-up treatment as **in** normal operation	
5 *32d* *20h*	1	**No replacement function** on these Error, i.e. the error is saved normally, but the driving software does not see the error	applicable
	0	**All replacement functions** for this error are carried out. **If the terminal 15 voltage** is 4.5V <	
6 *64d 40h*	1	anmK15 **<** anwK15_H_U, there is no debouncing of an error and therefore no error storage. Error is *not broken* but also not healed! There is also **no substitute function !**	applicable The debouncing of the error depends on the analog **K15** evaluation (see chapters "Input signals", "Error handling - overrun detection").
	0	The error evaluation takes place as in driving operation.	
7 *128d* *80h*	1	A possible *"defective"* **status** is **transferred to the next driving cycle** and remains until the next test. In the next driving cycle, however, the error is only considered to be tested when the test has been carried out.	can be applied for tests that are carried out in the after-run and whose replacement function is to take place in the next driving cycle. This bit should be applied at the same time for all errors in the path, otherwise the next error inherits the bit from the error in the first path entry.
	0	The error has the **status** *"intact"* **at the beginning** of the next driving cycle.	

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Error monitoring can be hidden depending on the terminal 15 voltage.
If the corresponding bit of the parameter fbwE....T is set, there is no pre-debouncing and therefore no error entry and no substitute reaction. (see also "Overrun - Low K15 Voltage")

fbwE....T	Error suppression at low K15 Voltage (anmK15 < anwK15_H_U)	Error masking when detected Overrun via dimK15
x0x0xxxx	NO	NO
x0x1xxxx	NO	YES
x1x0xxxx	YES	NO
x1x1xxxx	YES	YES

The high byte of the label fbwE...T is used to apply the type of error in the diagnosis function used (see also chapter Troubleshooting - memory codes).

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6.4.3 Storage Codes

6.4.3.1 VAG codes - FSP read out with VAG tester - KW71

Three independent bytes are assigned to each applied error bit as text pointers for the tester (error location and error type).

In VAG mode (address word 01), the 2-byte error location is determined via the error parameter label fbwE...V and 1 byte via the error type (fbwE...T / high byte).

The fault memory of the SG can be read out with the VAG tester function "read fault memory". For this purpose, three data bytes are transmitted in the ISO block (07) for each error memory entry, which are structured as follows:

Error code HIGH								Error code LOW								Error type							
15							8	7							0	7							0

Error code

The error code describes the component or function that is defective, such as: **"PEDAL TRANSMITTER".** From this code (applicable data records: fbwE...V) a plain text is generated in the tester, which is shown in the display. However, the memory code must not be set to 0, otherwise the VAG tester will display "End of output".

Error type

Bit_7 contains the status of the error, static(0) or sporadic(1), which is output on the tester with **"/SP"** on the right edge of the second line of the display.

A code is stored in Bit_0-6 (applicable data record: high byte of fbwE...T), which provides information about the reason for the error, such as: **"SIGNAL TOO BIG".** A plain text is generated from this code in the tester, which is output in the second line of the display.

A notice:

With VAG codes (from fbwE...V) that already generate two-line displays on the tester (usually CARB codes converted into VAG code), the error type (high byte of the label fbwE...T) should only be set to $23 (= no display) are applied to prevent text overlaps.

Example of display on the VAG tester:

pedal sensor
signal too large /SP

If **several** error bits are set in **an** error path, the tester outputs a corresponding number of errors.

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6.4.3.2 CARB Codes - Exclude FSP with OBD II ScanTools with address word 33

In OBD mode (address word 33, mode03 and 07) the error code is determined from the error parameter label fbwE...C. (see interface description from 04/08/97 VAG 1551 and SAE J2012)

This error word consists of 4 nibbles (=16bit) with the first nibble classifying the errors does in classes. The last 3 nibbles are the actual code in BCD representation (0-999).
See also: DRAFT SAE J1979 Revised for ISO 14230-4 Mode$03-Request Emission-Related Powertrain Diagnostic Trouble Codes

With Mode$03, only emissions-related errors are output, ie the corresponding error paths must be applied with priority 2 or 3 (fbwSPRI... is then greater than 1).

Example of the structure of a CARB-compliant error code (Throttle Position Sensor Reference Voltage error P1219):

	vehicle system (P=power train)	diagnostic code (0 - 3)	error code (0 - 999)		
CARB code	P	1	2	1	9
Application value binary	00	01	0010	0001	1001
Application value Hex	1		2	1	9

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6.5 Error memory management

Up to eight errors are grouped together in an error path (see Appendix E). An error is defined by its error bit in the error path, where 0 means intact and 1 means defective.

Using the speed sensor as an example, this looks as follows: The error path fboSDZG is assigned to the sensor speed sensor (DZG). It is monitored for static plausibility (fbbEDZG_S = bit 6), dynamic plausibility (fbbEDZG_D = bit 5), plausibility with the boost pressure (fbbEDZG_L = bit 4) and overspeed (fbbEDZG_U = bit 1). If an error (= an error bit) is set in an error path and the error is classified as *definitively defective ,* an error entry is stored in the error memory. There can be a maximum of one error memory entry per error path. This means, for example, that the error fbbEDZG_D "speed sensor dynamically defective" is set, its error path fboSDZG is saved. If the error is cured and the error fbbEDZG_U (overspeed) occurs instead, no further entry is made, but the existing one

will be updated.

After the control unit has been initialized, error debouncing always starts with the status “no error present”. This means that the same status is always present when the control unit is reset.
Error states from previous trips no longer have any effect.

exception

The T parameter can be used to make the last test result from a previous driving cycle visible again for the substitute function. (Application: follow-up tests)

For each error path there is an OLDA fboS.. with eight error status bits and an OLDA fboO.. with eight status bits, which provide information as to whether monitoring has already taken place since "ignition on" (bit = 1). Unused bits are initialized with 1. In addition, there are collective OLDA's (path errors: fboS_00, fboS..02, ...; path tested: fboO_00, fboO..02, ...) in which 16 error paths are combined per OLDA (1 bit per path, in the order the paths see appendix E).

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Error states in the error memory:

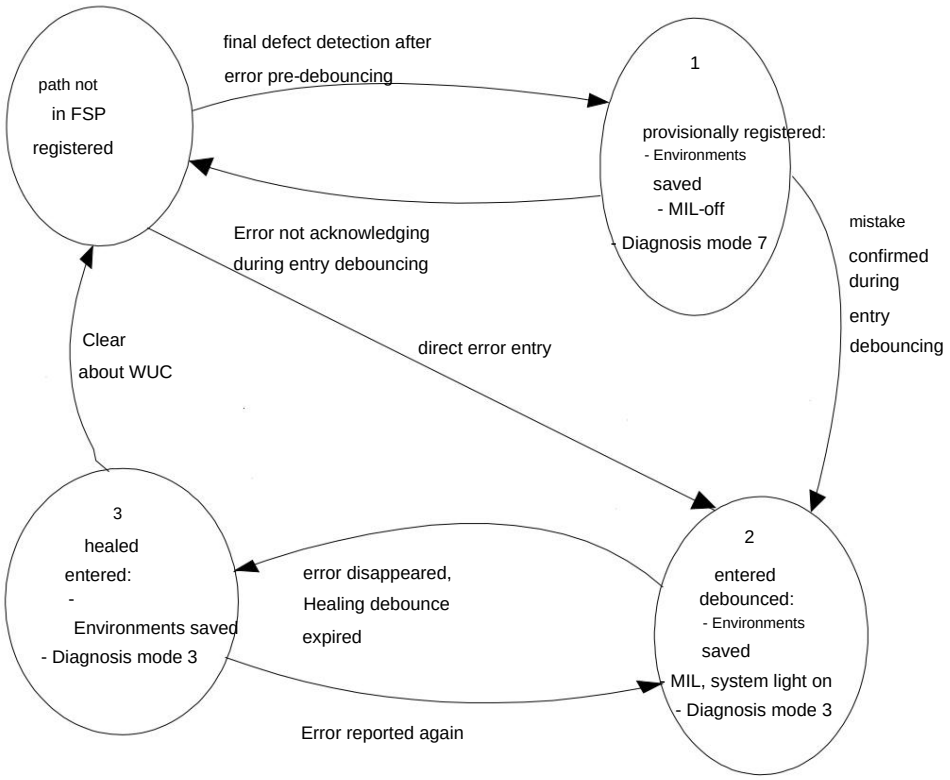


Figure UEBEFB03: error states

State 1 (Preliminary Error):

After an error has been classified as *definitively defective* by the pre-debouncing , it is stored in the error memory as a temporary error with the associated environmental conditions.

State 2 (debounced error):

If a provisionally entered error is confirmed by further error tests, then it is entered debounced. In this state, the associated error lamp lights up and in the case of OBDII errors, the error is then reported to the OBDII tester (generic scan tool) via the diagnosis.

State 3 (Healed Error):

If the error has not occurred for long enough, it will be healed. The indicator light is no longer energized (for this error) and the error is waiting to be cleared by "warm up" cycles.
In this state, the error is still visible via the diagnostic interface. The diagram shows the status for diagnosis via the OBDII tester. All statuses (1-3) are reported for the VAG tester.

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6.5.1 Driving Cycle (DC)

The **"Driving Cycle" (DC)** is used as a debounce cycle :

The DC is determined separately for each path, ie each path error must have tested the status. (collect OLDA fboO_.. or path OLDA fboO...)

A DC is reached when all error tests of a path have been run through at least once and error pre-debouncing is no longer running for one of these error tests or an error has occurred in the path.

After the ignition is on, a DC is initially not reached for any path. After a path reaches the DC, the error debounce counters are updated. After that, the state of the DC does not change until the ignition is switched off. This means that only 1 DC can be reached per "journey" (per basic initialization of the SG).

6.5.2 Warm Up Cycle (WUC)

The counters for self-clearing are only decremented when a warm-up cycle is reached.
This is recognized when the water temperature has increased by at least fbwVERW_DT since "ignition on" **AND** the end of the blocking time fbwVERW_SZ **AND** has reached the value fbwVERW_ET (fbmWUC = 255). If this is the case, all errors where the debounce for heal has expired (bit_6 in the status is clear) will have their self-clear counter decremented.
When this counter reaches zero, the respective error is removed from the error memory, but only under the condition that the self-deletion is not deactivated using fbwE..T.
Any existing associated freeze frame is also deleted. If the water temperature sensor is defective, no warm-up cycle can be achieved.

6.5.3 General data set parameters

The following parameters are defined for general administration:

parameter	function
fbwVERW_ET	Warm Up Cycle end temperature
fbwVERW_DT	Warm Up Cycle differential temperature
fbwVERW_SZ	Warm Up Cycle blocking time after initialization (time by which the detection of starting temperature after ignition on is delayed)
fbwVERW_ZB	Time base for cycle management
fbwVERW_LI	Initial value for self-deletion (value with which the delete counter is initialized during the current entry, value is meaningless in the current implementation, must only be> 0.)
fbwVERW_LS	Start value for self-deletion (value with which the delete counter is initialized when the error memory entry is debounced) This value indicates how many WUCs are necessary so that a healed error memory entry can be deleted from the error memory.

With the switch cowVAR_OBD (bit 0) you can apply whether a MIL lamp is available:

cowVAR_OBD (bit 0) = 1 MIL lamp available

cowVAR_OBD (bit 0) = 0 MIL lamp not available, the SYS lamp is also controlled if the MIL lamp should be controlled.

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Readiness

In the SG there are the following exhaust gas-related components that are monitored:

• Checking the entire system **=** comprehensive component monitoring • Checking the fuel system **=** Fuel system monitoring • Misfire monitoring • Catalyst = Catalyst monitoring • Exhaust gas recirculation = EGR system monitoring

Several readiness bits and error paths are assigned to each component in the SG. Readiness of a component (= readiness bit set) is reached after the number of DCs applied for the component in *fbwRDY_Cnt has elapsed ,* ie all error tests belonging to readiness must have been carried out just as often. The result of the error tests is not relevant. Error paths that can prevent the test of an emissions-relevant path must be applied in an emissions-relevant manner (priority 2 and 3) and assigned a readiness bit. This ensures that the MIL lamp comes on and readiness is achieved.

The assignment of error path - readiness bit is done with fbwS...PRI:

Data record fbwS...PRI	path belongs to:	Data record bit pos. CARB	OLDA number of paths	OLDA number tested
0000 0xxx	kein OBD Pfad			
1000 0xxx	„comprehensive components“ fbwRBP_COM fboO_COM_P fboO_COM_T „fuel system“			
0100 0xxx	fbwRBP_FUE fboO_FUE_P fboO_FUE_T „misfire monitoring“ fbwRBP_MIS fboO_MIS_P fboO_MIS_T „catalyst monitoring“ fbwRBP_KAT fboO_CAT_P fboO_CAT_T 0000 1xxx „EGR system monitoring“ fbwRBP_EGR fboO_EGR_P fboO_EGR_T			
0010 0xxx				
0001 0xxx				

It is possible to assign a path to several readiness bits at the same time. In this way, for example, the legal requirement to set readiness for continuous tests only after the readiness of non-continuous tests has been achieved can be met.

Readiness bits that have not been assigned to a path are automatically reported as not supported in the diagnostics. The OLDAS (fboO_..._P, fboO_..._T) can be used to determine the number of associated paths and the number of associated tested paths for each readiness bit.
(The number of associated paths is determined once during initialization).

The messages fbmCPID1AB (Mode 01 - Pid 01 - Data A and Data B) and fbmCPID1CD (Carb Mode 01 - Pid 01 - Data C and Data D) show the readiness bits as they are output via the diagnosis. With fbwRBP_... you can apply the bit position within the display (see chapter diagnosis - parameter identification).

In addition to the readiness bits, status bits are determined and displayed in the OLDA fbmRyBits: Bit7 Bit5 Bit4 compreh. misfire catalyst monitoring monitoring components 0 ... all paths belonging to this readiness bit have already been tested during this DC

	Bit6 fuel system			bit3 EGR system	Bit2 unassigned, always 0	Bit1 unassigned, always 0	Bit0 unassigned, always 0

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1 ... not all paths belonging to this readiness bit have been tested.

A 2-bit counter is kept in the EEPROM for each readiness bit (= DC counter of a readiness bit). The counters are summarized in the message fbmRDYNES.

Allocation of the OLDA fbmRDYNES:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	bit5	Bit4	bit3	Bit2	Bit1	Bit0
0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	0
						EGR system monitoring		catalyst monitoring		misfire monitoring		fuel system monitoring		comprehens. comp. monitor	

These counters are set to 0 when the fault memory is cleared. Each time the status associated with a readiness bit changes from 1 to 0, the associated 2-bit counter is incremented. The counter is limited to 3. If the counter reaches a value greater than or equal to the value which is applied in *fbwRDY_Cnt* (coded in the same way as fbmRDYNES), the readiness bit is set.
If an error is entered debounced, the counter is set to the value 3 (this ensures that readiness is also reported when the MIL lamp is activated).

Application note:

After changing the sensor, the error memory must be deleted and readiness must be awaited! (Only then can it be determined that, for example, there is no longer an error).

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6.6 Error log

The error memory consists of a maximum of 5 error entries and a freeze frame. A
Error memory entry is structured as follows:

byte -No.	description	influence through application	Olda
0	path number (see Appendix F) 1	NO	fboFS.PFD
	status	YES (Bit_0,1,4)	fboFS.STA
2	error type current	NO	fboFS.FAA
3	Error type debounced 4	NO	fboFS.FAE
	Debounce counter for Statusbit_6 start value in fbwS...FLC 5	NO	fboFS.FLZ
	Debounce counter for error healing start value in fbwS...HLC 6 Counter	NO	fboFS.HLZ
	for self-deletion start value in fbwVERW_LS 7 Frequency counter 8	NO	fboFS.SLZ
	Environmental condition 1 9 Environmental condition 2 10 Environmental	NO	fboFS.HFZ
	condition 3 11 Environmental condition 4 12 Environmental condition 5	YES	fboFS.UB1
	by fbwS...UB1 appl. by fbwS...UB2 appl. by fbwS...UB3 appl. by fbwS...UB4 appl. by fbwS...UB5	YES	fboFS.UB2
		YES	fboFS.UB3
		YES	fboFS.UB4
		YES	fboFS.UB5

Status (byte 1):
Relevant control bits for error handling are entered in this byte.

The structure of this byte is as follows:

7	6	5	4	3	2	1	0

Bit	Value	Meaning
0	1	error relevant to exhaust gas (applied with priority 2 or 3, fbwS..PRI)
1	1	If an error is classified as *definitively defective* , the MIL is activated (flashing), regardless of the status of debouncing. This is for Catalyst dangerous errors provided and can be applied using fbwE..T Bit 3.
2	1	Error currently present, is set when error is recognized as *definitively defective* or deleted if the error is classified as being corrected during operation
3	1	Error sporadically present, is set if the frequency counter is greater than 1 becomes.
4	1	error is not self-extinguishing can be applied using fbwE..T bit 2.
5		unused
6	1	is set after debouncing has expired or cleared when healing debounce has expired. Control of the MIL or SYS lamp, if applied using fbwS..PRI.
7	1	All errors in byte 2 (current error type) of the FSP are reported at the beginning of the next Driving cycle set to the *"finally defective"* status if bit 2 (error currently available) is also set. This bit can be applied using fbwE..T bit 7 will.

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Current error type (byte 2)

Last error status (error bits) of the error path. Remains even if the path is no longer defective. Updated when path becomes broken again. Only the errors whose bits are set in this byte are output via the diagnosis.

Error type debounced (byte 3)

Is a copy of the error path of the error (bit) when it is first classified as definitively defective and entered in the error memory.

Debounce counter for status bit_6 (byte 4)

Counter with which the debouncing is carried out when the error is entered. Is used as long as an error memory entry is currently entered. Initialization value fbwS..FLC.

Debounce counter for error recovery (Byte_5)

Contains the count of the debouncing for error healing. After successful debouncing, Bit_6 (error debounced) of the status is deleted. The counter is initialized with fbwS..HLC when an error is entered debounced for the first time. After that, an initialization takes place whenever the error occurs again.

Counter for self-clearing (Byte_6)

Contains the counter reading for self-extinguishing. The counter is initialized with the value fbwVERW_LS when the error path is entered debounced and then whenever the error path is currently defective. The counter is decremented when a warm up cycle is reached **AND** when the debounce counters for status bit_6 **AND** error recovery are zero. If it reaches the value 0, the error entry is removed from the error memory unless this is locked by the parameter fbwE..T (Bit_2). If deletion is locked, the error will be invisible to the OBDII tester.

Occurrence counter (Byte_7)

Incremented each time a fault transitions from operationally cured to *definitely defective .*
It has an upper limit of 255.

Environmental Conditions 1-5 (Byte_8 - 12)

These are read in, normalized and stored in the error memory the first time an error is entered and the error is classified as *definitively defective .* The environmental conditions are not updated with changes in the error path. i.e. they correspond to the conditions when the error was first recognized as definitively defective, i.e. the 3rd byte of an error entry (error type debounced).

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6.6.1 Behavior when the error memory is full

If the error memory is full and a new error is recognized as *definitively defective ,* the error path of which is not yet in the error memory, then the error memory is searched for low-priority errors. If such an entry is found, it is removed. In order to maintain the chronological order of the errors entered, the following error entries are moved up and the new error is entered last.

6.6.2 Freeze frames

The freeze frame is an applicable comprehensive set of environmental conditions. Only these environmental conditions can be read out via the OBDII diagnosis tester (SAE generic scan tool) (not the 5 customer-specific fault memory entries!). Using **fbwFFRM_01 - 15 ,** up to 15 environmental conditions can be applied for the freeze frame. The environmental conditions are selected via message numbers, whereby only the message numbers ÿ h0f00 should be used for OBDII (partially different standardization on the diagnostic interface).

Allocation of the freeze frame:

The freeze frame is occupied the first time an error path with priority 2 or 3 is definitively defective and entered in the error memory. The variant switch cowVAR_OBD can be applied whether the freeze frame

for the diagnosis is only visible when the error has been confirmed (entered debounced or healed, cowVAR_OBD bit 7 = 1) or becomes visible as soon as the freeze frame is occupied (cowVAR_OBD bit 7 = 0).

If the freeze frame is occupied by a priority 2 error path, it can be reoccupied by a priority 3 error path. If the error memory entry associated with a freeze frame is deleted from the error memory, the freeze frame is also deleted.
It can therefore happen that the error memory is almost full and no valid freeze frame exists. The next error that occurs with priority 2 or 3 will then occupy it again.

Construction:

Byte no.	description
0	Path number of the error path (see Appendix E) = FFH if unassigned error
	type (copy of byte 3 of the associated error memory entry)
1 2	1. Environmental condition
...	...
16	15. Environmental Condition

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Substitute value handling for freeze frame and diagnostics:

The OBDII law requires that the actual values and no substitute values are used as environmental conditions (freeze frame and living values). If substitute values are used, they must be clearly different from valid values. The analog value acquisition holds the last valid value before an SRC error. After the pre-debounce has expired, the substitute value is specified. The message belonging to such an analog value therefore always has values that do not differ from valid sensor values. In order to still meet the OBDII requirement, a special treatment can be applied for the message numbers 0000h - 0011h. If the path associated with the message number (assigned by fbwPIDPF..) SRC low or SRC high becomes defective, an applicable value is saved instead of the current message associated with the message number. The value to be saved can be applied separately for each message number for SRC low (fbwEWLO_..) and SRC high (fbwEWHI_..).

fbwPIDPF00 ..... fbwPIDPF11 (hex)	Path number for PID 00 .. 11h (message numbers 0000h - 0011h). If the path number is applied to 255, the current PID value is always saved.
fbwEWLO_00 .... fbwEWLO_11(hex)	Substitute value for SRC Low error in path fbwPIDPF.. for associated PID (message number)
fbwEWHI_00 ..... fbwEWHI_11(hex)	Substitute value for SRC High error in path fbwPIDPF.. for associated PID (message number)

PID: see chapter “ Parameter identification”.

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6.7 Controlling the MIL lamp

The MIL lamp (ehmFMIL) is activated under the following conditions (fbmMIL):

Value range of the OLDA fbmMIL (bit-coded):

- ÿ 0 = An error relevant to emissions (fbwS..PRI.1=1) is entered in the error memory debounced.
- ÿ 1 = An error relevant to the exhaust gas and endangering the catalytic converter (fbwE..T Bit_3) is *finally defective* (lamp flashes)
- ÿ 2 = continuous light (fbwT_MIMAX = infinite)
- ÿ 3 = lamp test 1 (n < fbwT_MIDRZ)
- ÿ 4 = lamp test 2 (n >= fbwT_MIDRZ and t < fbwT_MITES)
- ÿ 5 = delay time fbwT_MIVER expired ÿ 6 = lamp on ÿ 7 = not used

The MIL lamp test is used by the driver to visually check the functionality.
It takes place after "ignition on" and can be applied as follows:

Surname	description
fbwT_MIMAX	duration of the lamp test; at the maximum value, the switch-off takes place only after Exceeding fbwT_MIDRZ and expiry of fbwT_MITES fbwT_MIDRZ speed
threshold fbwT_MITES	duration of the lamp test after exceeding fbwT_MIDRZ; the lamp is switched off even if the time fbwT_MIMAX has not yet expired.
FbwT_MIVER	If there is an error relevant to emissions, the activation of the MIL is delayed around the time fbwT_MIVER (see OLDA fbmMIL).
FbwT_MIBLK	Flashing frequency for emissions-related errors that endanger the catalytic converter (half a period)

If a catalytic converter-endangering error is active (MIL flashes), the request from an external control unit to activate the MIL has no effect; in all other cases, the ext.
Requirements and the requirement of the EDC ORed.
The transmission control unit has the ability to request a MIL request via CAN (RCOS message mrmCANMIL).

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6.8 Control of the system lamp

The diagnostic lamp (ehmFDIA) is activated under the following conditions (fbmDIAL):

Value range of the Olda fbmDIAL (bit-coded):

ÿ 0 = An error (at fbwS..PRI - Bit2 = 1) is entered in the error memory debounced and not yet healed status (HLC = 0) ÿ 1 = not used ÿ 2 = continuous light (fbwT_DIMAX = infinite)

ÿ 3 = lamp test 1 (n < fbwT_DIDRZ)
ÿ 4 = lamp test 2 (n >= fbwT_DIDRZ and t < fbwT_DITES)
ÿ 5 = delay time fbwT_DIVER expired ÿ 6 = lamp on ÿ 7 = if a system light is applied using cowSYS_LMP (ORing of DIA and preheating lamp) **AND** the glow time control is in the preheating operating state.

The lamp test is used by the driver to visually check the functionality. It takes place after "ignition on" and can be applied as follows:

Surname	description
fbwT_DIMAX	duration of the lamp test; at the maximum value, the switch-off takes place only after Exceeding fbwT_DIDRZ and expiry of fbwT_DITES fbwT_DIDRZ speed
threshold fbwT_DITES	duration of the lamp test after exceeding fbwT_DIDRZ; the lamp is switched off even if the time fbwT_DIMAX has not yet expired. fbwT_DIVER If an error (at fbwS..PRI - Bit 2 =1) is debounced and entered in the error memory, the lamp is controlled with a delay of the time fbwT_DIVER.
fbwT_DIBLK	Flashing frequency for errors to be displayed (half the period)

Using cowSYS_LMP, a lamp can be used simultaneously as a preglow and as an error lamp (0 = incandescent lamp and error lamp separately, 1 = system lamp). To distinguish between an error and preheating, the lamp is activated with the flashing frequency fbwT_DIBLK.

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6.9 Terms Used

Error

Smallest monitoring unit (eg: "Signal range check low" is an error).

Timed Errors (Pre-debounce)

A time-controlled error is debounced by expiry of applicable times.

Event driven errors (pre-debounce)

An event-driven error is debounced by counting certain error-dependent events, such as activating a contact. The values until a state is debounced can be applied.

error path

Summary of a maximum of eight individual errors that affect the same component/function/sensor.

"provisionally defective" (pre-debouncing, per error bit)

Due to an incorrect state, an error is set as provisionally defective by the error handling. If it is healed again during the debounce time (applicable) assigned to it, it is reset again. The last valid value is frozen at analog inputs during the "temporarily defective" status.

"finally defective" (pre-debouncing, per error bit)

An error state remains intact for the entire debounce time (applicable) assigned to it. Any replacement functions will be carried out.

"temporarily healed" (pre-debounce, per error bit)

An error that was already "finally defective" no longer occurs. As long as heal debounce time is running, bug is temporarily healed.

"Healed in operation" (pre-debouncing, per error bit)

An error that was already "defective" has not occurred longer than the debounce time for healing. Substitute reactions are withdrawn.

current error (error memory management, path):

An error was detected in the diagnostics. It is provisionally entered in the error memory together with the environmental conditions. The diagnostic lamp is still off. If it is not confirmed within the entry debounce cycle time, it is deleted again.

debounced error (error memory management, path):

A current error was also confirmed after debouncing. It is entered correctly in the error memory, the error lamp comes on. The error is only removed again by healing and deleting procedure (or deleting via tester).

healed error (error memory management, path):

An error that was already "debounced" entered in the error memory had not existed for long enough and was healed via the healing debounce. The diagnostic lamp has been switched off.

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CARB (California Air Resource Board)

California Emissions Authority

OBDII (On Board Diagnosis II)

Is a law passed by the California Emissions Authority CARB. It prescribes the monitoring of all electronically controlled, emission-related functions in all passenger cars, light trucks and other medium-heavy vehicles. A fault indicator lamp (MIL) and standardized diagnostic interface are also required. Specifications must be observed as to when the lamp is activated and extinguished. If a vehicle is not applied for certification in California, the OBDII comments in this chapter do not apply. All possibilities can then be exhausted!

Driving Cycle (DC)

A DC consists of motor start, motor run and motor off. Each error bit is now debounced individually, i.e. regardless of whether other tests have already been carried out. A DC is only reached for a fault path when the fault path has been fully tested.

Warm Up Cycle (WUC)

OBDII debouncing cycle for error clearing (self-clearing), is reached when the water temperature has reached an applicable value and has risen by an applicable value since engine start.

Readiness (bits)

Is queried by the diagnostic tester and is given when the counter of the respective readiness bit (counter in fbmRDYNES, see text) has reached or exceeded the value in fbwRDY_Cnt. The counter is incremented each time all error paths associated with the bit have been tested (all associated paths have reached a DC). With the help of the readiness information, a connected tester can see whether sufficient tests have been carried out (have been driven) since the last time the error memory was erased, and whether any errors that may be present are also in the error memory.

Freeze frame

Memory in which environmental conditions that can be applied are stored when an exhaust gas-related error occurs (priority 2 or 3).

MIL (Malfunction Indicator Lamp)

An error lamp required by CARB for OBDII for emissions-related errors.

MIL request

The MIL can only be controlled by the EDC, other control units have the option of controlling the MIL via MIL request. This is implemented via the MIL-E input on the EDC, which is monitored and evaluated by the software. Alternatively, the CAN bus can also be used instead.

VAG tester

Workshop tester of the VAG concern. Tool for diagnosing all control units in a vehicle.

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7 Diagnosis

7.1 Overview

External communication can be carried out via KW 71 (standard test device) or via KW 2000 (OBDII scan tool). It is determined by the test device during the stimulation of the control unit, which operating mode should be used.

The stimulation (initialization) with 5 baud is divided into a functional and a functional one physical part, based on the communication setup (initialization, addressing) is distinguishable. Systems are addressed with functional addresses (e.g. emissions-relevant system) and with physical addresses individual control units (SG), whereby a system also consists of can only pass one SG. The selection of the operating mode to be used is based on the address word, which clearly defines the desired type of communication.

The stimulation is carried out by a 5-baud transmission from the test device (TG) on the K-line address word and is composed as follows (in the order of transmission):

- ÿ 1 start bit (logical "0", LOW potential)
- ÿ 7 data bits (address word), beginning with the LSB
  where:
  xcwSGADR physical SG address = week 71
  33 hex func. SG address = emission relevant system
  08 hex phys. SG address = control unit
- ÿ 1 parity bit
  The parity is checked in week 71 according to the entry in xcwDIASCH. For the functional. Addressing applies even parity while for physical addressing odd parity applies.
- ÿ 1 stop bit (logical "1", HIGH potential)

The baud rate for further communication is set to 9600 baud for the standard tester, while for the "OBDII scan tool" 10400 baud applies.

The Controller will stop pacing when

- ÿ the start bit is invalid (even if there is a fault)
- ÿ or after all data bits have been received and
  - the data bits are corrupted
  - the received address has wrong parity
  - the received address is not known
  - no valid stop bit is detected (even in the event of a fault)
  - the mean speed exceeds the threshold xcw_n_stimulus (only week 71)

If the irritation detection is aborted, xcwt_ini is automatically reactivated after the time Irritation detection switched on.

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7.2 Default Protocol

External communication according to KW71 consists of two tasks:

- ÿ Communication handler
- ÿ Command interpreter

The communication handler takes over the communication tasks related to the diagnosis the HW level:

- ÿ Responding to the operating mode recognized by the communication stimulus
- ÿ Connection establishment
- ÿ Data transfer according to specified time sequences

The command interpreter takes on the following tasks with regard to the software level:

- ÿ Interpretation of received request blocks
- ÿ Information exchange with system components
- ÿ Creation of corresponding answer blocks

7.2.1 Establishing communication

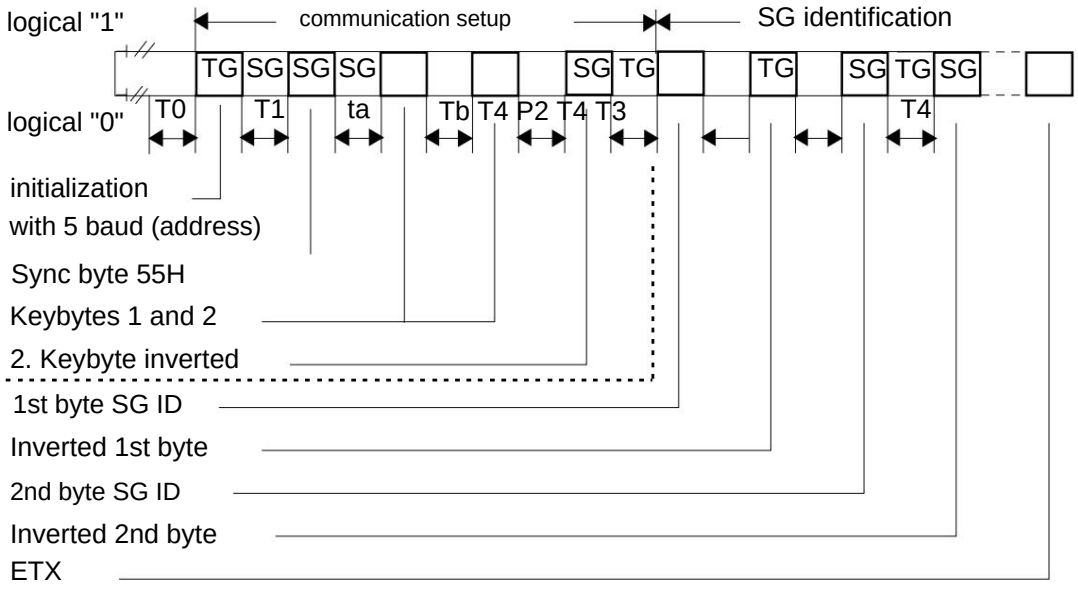


Figure XCOM01: Communication structure according to ISO 9141 for week 71

T0 ... xcwt_ini, T1 ... xcwt_sync, Ta ... xcwt_kw1, Tb ... xcwt_kw2,

P2 ... xcwt_reabl, T3 ... xcwt_reaby, T4 < xcwt_outby

The communication structure following the successful bidding consists of

- ÿ the synchronization byte (55 hex, 8 data bits/no parity) from the SG to the TG
- ÿ the two keybytes xcwKeybyt1 and xcwKeybyt2 (7 data bits/odd parity) and
- ÿ the logical inversion of the 2nd keybyte from the TG to the SG

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In the event of an error, this communication setup can be repeated without renewed stimulation, until the number xcwFehzmax programmed for this in the SG has been reached. This error occurs when the xcwt_outby time for the logical inversion of the 2nd keybyte is exceeded or the SG receives an incorrect inversion. The SG then starts again with the output of the synchronization byte.

7.2.2 Communication flow

The communication process begins with the first block of the control unit identification, which the control unit sends automatically after receiving the logical inversion of the 2nd key byte. Depending on the scope, the control unit identification can include several blocks. If the transmission is correct, each of these blocks is answered by the tester with an "acknowledge" block.

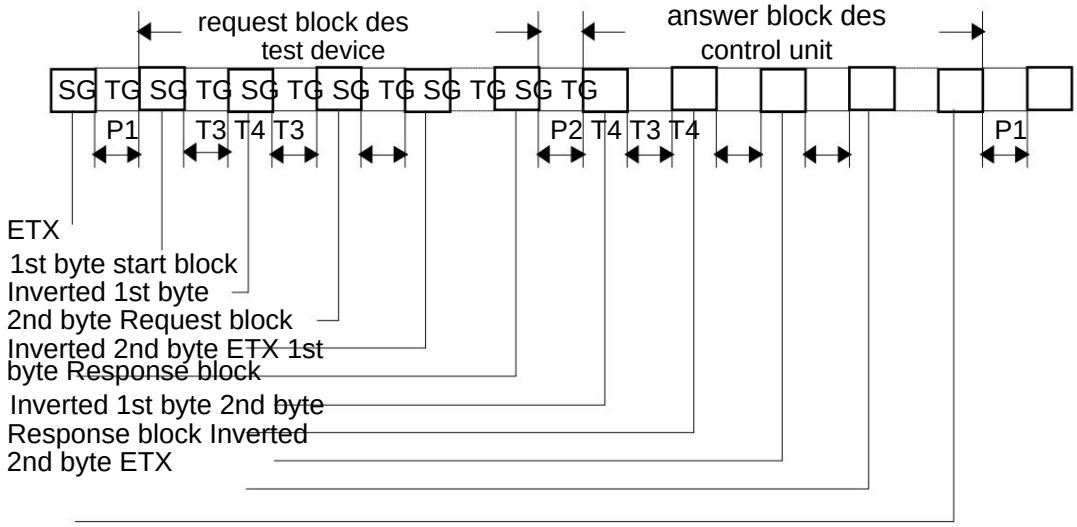


Figure XCOM02: Communication process

P1 < xcwt_outbl, P2 ... xcwt_reabl

Subsequent to the transmission of the SG identification, the TG must inform the SG in the form of a request block which information is required. The SG responds with appropriate response blocks.

A block consists of:

- ÿ Block length - length of the block excluding block length byte ÿ Block counter - consecutive number of the block. It starts at 1. If the block counter > 255, the block counter is reset to 0
- ÿ Block title (identification of the request or response block
- ÿ Data part - maximum 169 bytes
- ÿ ETX - end-of-block identifier

The bytes output by the master (sender of the block) are returned inverted byte by byte by the slave (receiver of the block). With this form of output, the master receives information immediately after each byte as to whether the output byte was received correctly.

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If the time xcwt_outby (byte timeout) is exceeded during the block transfer, both the TG and the SG go back to the beginning of the block transfer. The master waits another timeout period before beginning to re-issue the first byte of the block to ensure that the slave has definitely timed out.

The last byte of a block (ETX) is not returned by the slave. If the last byte was received correctly by the slave, it takes over the master function and can start transmitting the next block. If the last byte is received incorrectly (incorrect content or missing), the slave has the option of having the block just received repeated. To do this, it sends the "No Acknowledge" block with the block counter of the block to be repeated.

The communication sequence ends with the "End of diagnosis" block if it is not aborted by switching off the ignition. Between the first and the last block of the communication process, there is a constant alternation of the master and slave function, ie the transmission direction of two consecutive blocks is never the same.

If the distance between two blocks exceeds the time xcwt_outbl (block timeout), the SG breaks the connection. As long as the TG does not send a request block to the SG, so-called "acknowledge" blocks are exchanged in order to maintain a connection that has been set up. Furthermore, these blocks form a control function for the functionality of the K-line. To send a request block, the TG must wait until it has mastered the role and insert it instead of an "acknowledge" block. After the xcwt_reabl time, the SG responds with a corresponding response block.

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7.3 Standard Telegram Contents

function	block title	block ID	VAG
General			
Read control unit identification	00	B05 01	
Read RAM cells	01	B20 20	
Read ROM/EPROM cells	03	B21 21st	
Clear fault memory	05	B07 05	
diagnosis end	06	B03 06	
Read error memory	07	B06 02	
Read ADC channel	08	B19 09	
Acknowledge	09	B01	-
No Acknowledgment	0A B02 -		
Read ECU-specific addresses 0B		-	-
Parameter coding 10		B13 07	
Read E2PROM 19		B23 26	
Write E2PROM	1A	B24 27	
Login request	2 B	B17 11	
ECU outputs			
Initiate/continue actuator test	04	B08 03	
readings			
Read	12	B10 08 00	
Read normalized	29	B12 08 01 bis	08 25
adjustment			
Read	21	B14 10	
Testing	22	B15 10	
Save on computer	2A B16 10		
default setting			
Initiate	11	B09 04 00	
Initiate normalized	28	B11 04xx	

Function) Designation of the executed function in the SG and in the tester
block title) internal SG and tester identification
blockid) Specification identification
VAG) VAG tester function number

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7.3.1 Read SG identification

This function is used to determine the identity of the control unit with regard to the hardware variant, Software version and production date. After successful communication establishment the control unit independently outputs its entire identification. After that, the identification can be called up again at any time via a separate request block.

The control unit identification consists of 4 blocks. Each of these blocks is individually connected to the test device transmitted and, if the transmission was correct, with an acknowledgment block from the test device answered.

The tester display shows the data as follows (2 examples):

Display number 1 1 1 1 2 3 4 5 6 7 8 9 0 1 2	1 1 1 1 1 1 1 2 2 2 2 2 3 4 5 6 7 8 9 0 1 2 3 4	2 2 2 2 2 3 3 3 3 3 5 6 7 8 9 0 1 2 3 4 5
4 D 0 9 0 7 4 0 1 ---	2 5L _ R 5 _ TDI _	0 1 0 0 AG -- D 0 0
4 D 0 9 0 7 4 0 1 ---	2 , 5L _ R 5 _ TDI _	G 1 0 7 AG -- D 0 0

Data transfer:

Channel	byte hex 1. $03	ASCII	display title	
tester	2.			block length
requirement	e.g			Block counter on bus
	3rd $00			block title
	4th $03	ETX		end of block
Control unit	1. $1B			block length
1st block	2nd z+1			Block counter on bus
	3rd $F6			block title
	4th $34	4	1	device number
	5th $44	D	2	Application via *xcwSGBlk1*
	6th $30	0	3	
	7th $39	9	4	
	8th. $30	0	5	
	9. $37	7	6	
	10 $34	4	7	
	11. $30	0	8th	
	12. $31	1	9	
	13th $20		10	index
	14th $20		11	index
	15th $20		12	spaces
	16th $32	2	13	designation
	17th $2C	.	14	
	18th $35	5	15	
	19. $6C	l	16	
	20. $20		17	
	21st $52	R	18	
	22nd $35	5	19	
	23rd $20		20	
	24th $54	T	21	
	25th $44	D	22	
	26th $49	I	23	
	27th $20		24	
	28th $03	ETX		end of block
tester	B01			z+2 Acknowledge

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Transmitter	byte hex 1. $07	ASCII	display title	
control unit	2. z+3			block length
2nd block				Block counter on bus
	3rd $F6			block title
	4th $30	0	25	zero or
	$47	G		GRA is released or
	$41	A		ADR is released
	$56	V		ADR: Ramp-up time, variable speed threshold or fixed speed not equal to default value
	5. $30	0	26	no adjustment
	$31	1		Customization A
	$32	2		Customization B
	$33	3		Customization A & B
	$34	4		Customization C
	$35	5		Customization A & C
	$36	6		Customization B&C
	$37	7		Customization A & B & C
	6. $30	0	27	no adjustment
	$31	1		Customization D
	$32	2		Adaptation E
	$33	3		Customization D&E
	$34	4		Customization F
	$35	5		Customization D&F
	$36	6		Adaptation E & F
	$37	7		Customization D&E&F
	7. $30	0	28	no adjustment
	$31	1		Customization G
	$32	2		Customization H
	$33	3		Customization G&H
	$34	4		Customization I
	$35	5		Customization G&I
	$36	6		Customization H&I
	$37	7		Customization G & H & I
	8th. $03	ETX		end of block
tester	B01			z+4 Acknowledge

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Overview of the supported customization functions:

	VAG	No. Adaptation 01	OLDA
A	100	Limiting quantity 02 Idling	MrmBEGaAGL or mrmBEGmAGL
B	200	speed 03 Exhaust gas	MrmLLR_AGL
C	400	recirculation 05 Starting	ArmARF_AGL
D	010	quantity 04 Start of	MrmSTA_AGL
E	020	injection / start of delivery 12	SbmAGL_SBR / fnmAGL_FN
f	040	Preheating 18	GsmAGL_VGK
G	001	Maximum speed limit MrmV_HGBSW	
H	002	Login fuel cooling	See login request
I	004	Login FGG tacho constant switching	See login request

VAG) Display on the VAG tester if adjustment has been made

No.) see overview adaptation (= adaptation channel number)

Adjustment) Description of the adjustment

OLDA) OLDA Channel of the corresponding adjustment value

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Transmitter	byte hex 1.		ASCII	display title		
control unit	$0A 2.				block length	
3rd block		z+5			Block counter on bus	
	3rd	$F6			block title	
	4th	$41	A	29	automatic transmission	above
		$53	S		manual transmission	
		$44	D		direct switch (ASG)	
	5.	$47	G	30	for gears	*xcwSGBlk2*
	6.	$20		31	spaces	applicable
	7.	$20		32	spaces	
	8th	$44		33	for version number	
	9th	$30	D0	34	Version 00	
	10.	$30	0	35		
	11.	$03	ETX		end of block	
tester	B01				z+6 Acknowledge	
Control unit	1.	$08			block length	
4th block	2.	z+7			Block counter on bus	
	3rd	$F6			block title	
	4th	$00			Separator (NULL)	
	5.PP0 6.				%PMC14,.,PMC07	
		PP1			%PMC06,PMC05,..,PMC00,WSC16	
	7.PP2 8.PP3				%WSC15,WSC14,..,WSC08	
	$03				%WSC07,WSC06,..,WSC00	
	9.		ETX		End of block (ETX)	
tester	B01				z+6 Acknowledge	

PMC ... parameter code, WSC ... workshop code

Byte 5 of the 4th control unit block (workshop code of the last adjustment) is omitted if in xcwDIASCH applied (see description of parameter blocks).

7.3.2 Read RAM cells

With this function it is possible from the internal and external RAM, as well as from messages read at least 1 and a maximum of 169 bytes. By default, you read out with this function Messages (2 bytes), where the address is not to be regarded as a physical address, but as message number.

If you want to read from the internal or external RAM, use the E2PROM function serially write to select the corresponding memory area. When reading from RAM, understands the address is an offset to the start of the RAM in memory.

byte request block		TG->SG
1	block length	06
2	block counter	xx
3	block title	01
4	byte count	xx
5	Address/message number HB	xx
6	Address/message number LB	xx
7	Blocking ETX	03

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byte response block		SG -> TG
1	block length	n
2	block counter	xx
3	block title	FE
4	RAM/Message 1	xx
	...	
n-1	RAM/message x	xx
n	Blocking ETX	03

7.3.3 R

Read OM/EPROM cells

With this function you can read a maximum of 169 and a minimum of 1 byte from the data record (physical address F0000H ... FBFFFH). The address is an offset to the beginning of the to see the data set.

byte request block		TG->SG
1	block length	06
2	block counter	xx
3	block title	03
4	byte count	xx
5	Address HB	xx
6	Address LB	xx
7	Blocking ETX	03

byte response block		SG -> TG
1	block length	n
2	block counter	xx
3	block title	FD
4	EPROM cell 1	xx
	...	
n	EPROM cell x	xx
n+1	Blocking ETX	03

7.3.4 Delete error memory

The error memory can be deleted with this function. Currently broken errors will be however not deleted. After deleting the error memory, the contents of the error memory is output, or if no errors are entered ACKNOWLEDGE.
However, before sending the response block, the time xcw_twti is awaited (to avoid errors still the possibility to be entered in the error memory). Also will also deleted the CARB test results.

byte request block		TG->SG
1	block length	03
2	block counter	xx
3	block title	05
4	Blocking ETX	03

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7.3.5 End of diagnosis

This function causes the control unit to break off the connection to the test device. A possibly Actuator test that has been carried out is aborted. Access granted by a login request to the E2PROM, will be blocked again (repeated login required for new bidding).

byte request block		TG->SG
1	block length	03
2	block counter	xx
3	block title	06
4	Blocking ETX	03

7.3.6 Read error memory

With this function, the content of the error memory is transferred to the test device. Depends on stored error entry, 3 bytes per error (applied error codes and error type - see error handling) and converted into the error text on the tester.

byte request block		TG->SG
1	block length	03
2	block counter	xx
3	block title	07
4	Blocking ETX	03

byte response block		SG -> TG
1	block length	n
2	block counter	xx
3	block title	FC
4	Signal path code HB	xx
5	Signal path code LB	xx
6	error type	xx
	...	
n	Content of error memory x	xx
n+1	Blocking ETX	03

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7.3.7 Read ADC channel

An ADC channel can be read out with this function. The result is unnormalized and sent unlinearized to the test device.

byte request block		TG->SG
1	block length	04
2	block counter	xx
3	block title	06
4	channel number	xx
5	Blocking ETX	03

byte response block		SG -> TG
1	block length	05
2	block counter	xx
3	block title	06
4 ADC	value HB	xx
5 ADC	value LB	xx
6	Blocking ETX	03

Channel Numbers:

channel no.	designation
00.65	Pedal sensor supply
01.64	pedal sensor
2	air flow meter
3	atmospheric pressure sensor
5	battery voltage detection
6	Boost pressure sensor supply
7	Air flow meter supply
	needle movement sensor
8 9	reference voltage
10	NOX temperature sensor 1
11	NOX temperature sensor 2
66	fuel temperature sensor
67	air temperature sensor
68	intake manifold temperature sensor
69	water temperature sensor
70	boost pressure sensor

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7.3.8 Acknowledgment

If no special function is requested by the tester, it sends Acknowledge blocks, which are control unit can be answered with acknowledgement. This is to maintain the Communication.

Byte request block/response block		TG<->SG
1	block length	03
2	block counter	xx
3	block title	09
4	Blocking ETX	03

7.3.9 No Acknowledgment

This block is read by the tester or the control unit if a transmission error has occurred. or an unknown block title was received.

byte request block		TG->SG
1	block length	04
2	block counter	xx
3	block title	0A
4	Block counter - 1	xx
5	Blocking ETX	03

7.3.10 Read SG addresses

With this function, 6 addresses (xcwAdr1 ... xcwAdr6) are sent to the test device. This Addresses can be used, for example, when reading E2PROM later.

byte request block		TG->SG
1	block length	03
2	block counter	xx
3	block title	0B
4	Blocking ETX	03

byte response block		SG -> TG
1	block length	15
2	block counter	xx
3	block title	FA
4	Address 1 HB	xx
5	Address 1 LB	xx
...	...	...
14	Address 6 HB	xx
15	Address 6 LB	xx
16	Blocking ETX	03

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7.3.11 Parameter Coding

With this function the data record variant can be selected. Using the parameter code one of 32768 different variants can be selected. The workshops - and Parameter code will be in the same place as workshops/parameter code of customization saved. The response block of this function corresponds to the control unit identification (see block title 00).

byte request block		TG->SG
1	block length	07/08
2	block counter	xx
3	block title	10
(4) PMC15 ... PMC07 4/5		xx
PMC6 ...	PMC0, WSC16	xx
5/6 WSC15 ... WSC8		xx
6/7 WSC7 ... WSC0		xx
7/8	Blocking ETX	03

PMC ... parameter code, WSC ... workshop code

The length depends on xcwDIASCH (see description of parameter blocks).

7.3.12 Read E2PROM

With this function, a maximum of 169 and a minimum of 1 byte can be read from the E2PROM. In order to be able to execute this function, however, a successful login request must first be submitted have been carried out. Some areas are separately locked (WFS) and therefore cannot be read out.

byte response block		SG -> TG
1	block length	06
2	block counter	xx
3	block title	19
4	Number of E2PROM cells	xx
5	Address HB	xx
6	Address LB	xx
7	Blocking ETX	03

byte response block		SG -> TG
1	block length	n
2	block counter	xx
3	block title	EF
4 E2PROM cell 1		xx
5 E2PROM cell 2		xx
...	...	...
n E2PROM cell n-4		xx
n+1	Blocking ETX	03

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7.3.13 Write E2PROM

This function can be used to select memory areas for the read RAM and read ROM/EPROM functions. To do this, the corresponding memory area must be set to the address FFFFH can be written.

One of the following memory areas can be selected and read out with the specified request blocks:

No.	address	designation	request block
0	-	Message's	Read RAM (default)
1	F600H - FDFFH	internal RAM	read RAM
2	C000H - DDFFH	external RAM	read RAM

byte request block		TG->SG
1	block length	07
2	block counter	xx
3	block title	1A
4	byte count	01
5	Start address HB	FF
6	Start address LB	FF
7	storage area	xx
8th	Blocking ETX	03

byte response block		SG -> TG
1	block length	07
2	block counter	xx
3	block title	F9
4	Number of E2PROM cells	xx
5	Start address HB	xx
6	Start address LB	xx
7	Verify OK/Verify not OK	FF/00
8th	Blocking ETX	03

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7.3.14 Login Request

The login request has the following functions:

ÿ Release for the E2PROM write functions: read E2PROM
and read/test/write adaptation. The 16-bit password received from the control unit must match the password stored in the data record **(xcwPEEPROM) .** If this is the case, the above functions are enabled until the diagnosis is aborted. The control unit responds with an acknowledge block. The parameter code and workshop code are not taken into account.

ÿ FGR / ADR release: With
this function, the FGR / ADR system is released if it was previously blocked.
The 16-bit password received from the control unit must match the password **(xcwPFGROn)** stored in the data set . This function can only be used if the E2PROM is OK. The workshop code and the FGR function switch are entered in the E2PROM, however the workshop code is not entered in the same place as the workshop code when storing adaptation. If the function could be completed successfully, the control unit responds with Acknowledge, otherwise with No Acknowledge UB.

ÿ FGR / ADR blocking: With
this function, the FGR / ADR system is blocked if it was previously released.
The 16-bit password received from the control unit must match the password **(xcwPFGROff)** stored in the data set . Otherwise, the same applies to this function as to FGR / ADR release.

ÿ FGG Tacho frequency 1:
With this function, the tacho frequency 1 for the driving speed sensor is defined.
The 16-bit password received from the control unit must match the password stored in the data record **(xcwPFGG1) .** This function can only be used if the E2PROM is OK. The function switch for the tacho frequency is deleted in the E2PROM. If the function could be completed successfully, the control unit responds with Acknowledge, otherwise with NoAcknowledge. The parameter code and workshop code are not taken into account.

ÿ FGG Tacho frequency 2:
With this function, the tacho frequency 2 for the driving speed sensor is defined.
The 16-bit password received from the control unit must match the password **(xcwPFGG2)** stored in the data record . This function can only be used if the E2PROM is OK. The function switch for the tacho frequency is set in the E2PROM. If the function could be completed successfully, the control unit responds with Acknowledge, otherwise with NoAcknowledge. The parameter code and workshop code are not taken into account.

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ÿ Deactivate HGB (maximum speed limit):

With this function, the maximum speed limit is deactivated again if it was activated via adaptation channel 18. The 16-bit password received from the control unit must match the password **(xcwPHGBOff)** stored in the data set .
This function can only be used if the E2PROM is OK. The deactivation is entered in the E2PROM. If the function could be completed successfully, the control unit responds with Acknowledge, otherwise with NoAcknowledge. The workshop code is stored in the E2PROM (workshop code adaptation).

ÿ Activate KSK (fuel cooling):

This function activates the fuel cooling function for hot countries using a tank temperature sensor and fuel circulation pump. The 16-bit password received from the control unit must match the password **(xcwPKSKon)** stored in the data set . This function can only be used if the E2PROM is OK. The activation is entered in the E2PROM. If the function could be completed successfully, the control unit responds with Acknowledge, otherwise with NoAcknowledge. The workshop code is stored in the E2PROM (workshop code adaptation).

ÿ Deactivate KSK (fuel cooling):

This function deactivates the fuel cooling function for hot countries using the tank temperature sensor and fuel circulation pump. The 16-bit password received from the control unit must match the password **(xcwPKSKoff)** stored in the data record . Otherwise, the same applies to this function as to activating KSK.

ÿ Set readiness acceleration:

With this function, the readiness counters in fbmRDYNES are set to fbwSRDYm1, the error memory (including OBD freeze frame) and all OBD mode $06 test results are deleted. The 16-bit password received from the control unit must match the password **(xcwPRDYm1)** stored in the data record .

ÿ UTF signal source selection:

With this function, the signal source of the ambient temperature sensor can be selected. You can choose from: UTF via analog input, UTF via CAN or UTF via the signal source defined in cowVAR_FZG:

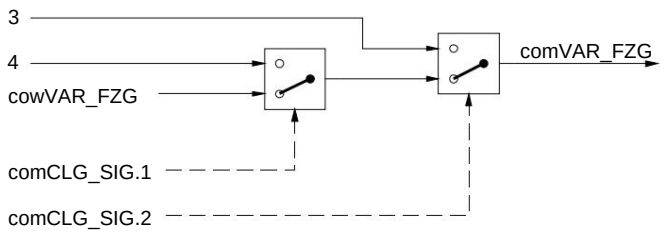


Figure CANLog04_128: Ambient temperature from the combination or analog input

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The message comVAR_FZG shows the selected signal source:

Decimal value	Comment
0	no data transmission
1	Data telegram 5ms/bit
2	Data telegram 50ms/bit
3	via CAN
4	via analogue input

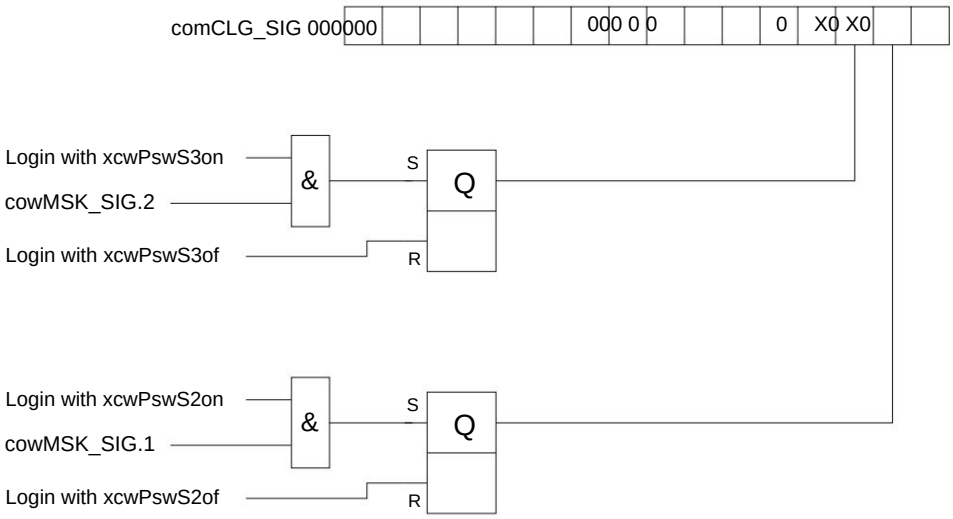


Figure CANLog02_128: Login request for signals

The bit comCLG_SIG.1 is set or deleted via the passwords xcwPswS2on or xcwPswS2of.
The bit comCLG_SIG.2 is set or deleted via the passwords xcwPswS3on or xcwPswS3of.
The comCLG_SIG message is stored in the E2 PROM and only affects comVAR_FZG after a renewed control unit initialization.

The label edwINI_LGS is available for the first initialization of the E2 PROM.
However, this label is logically AND-linked with the mask cowMSK_SIG and only the result is written into the E2 PROM.

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ÿ Set variable ADR/maximum speed:

With this function, the adaptation channel 28 for the application of the maximum speed (mrmADR_Neo) unlocked for the variable ADR. The 16- received from the control unit Bit password must match the password **(xcwPADV)** stored in the data record .

ÿ ADR – set fixed speed:

With this function, the adjustment channel 29 for the application of the fixed ADR speed (mrmADR_Nfe) is enabled. The 16-bit password received from the controller must match the password **(xcwPADE)** stored in the data record .

ÿ Range 0-9999 is reserved for the immobilizer:

The function of this area can be found in the respective specifications.

If the control unit receives a password other than the ones mentioned above, it breaks the connection and is only ready for communication again after a new start process.

byte request block		TG->SG
1	block length	08
2	block counter	xx
3	block title	2 B
4	Password HB	xx
5	Password LB	xx
6	PMC6 ... PMC0,WSC16	xx
7	WSC15 ... WSC8	xx
8	WSC7 ... WSC0	xx
9	Blocking ETX	03

PMC ... parameter code, WSC ... workshop code

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7.3.15 Reading measured values

If the control unit receives the block reading measured values, a maximum of 10 measured values can be read at the same time to be read. These measured values can xcwMWB_KF in the map by application of defined message numbers. Will be an undefined message number entered, the output is sent to the tester after the last valid message number canceled.

These are the measured values converted into 8-bit sizes, which after the conversion were limited to 0 and 255 respectively.

byte request block		TG->SG
1	block length	03
2	block counter	xx
3	block title	12
4	Blocking ETX	03

byte response block		SG -> TG
1	block length	n
2	block counter	xx
3	block title	F4
4	measured value 1	xx
5	reading 2	xx
...	...	...
n	Reading n-4	xx
n+1	Blocking ETX	03

7.3.16 Initiate/continue actuator test

This function can be used to carry out a semi-automatic test of the actuators. each Time when the request block is received, will automatically move to the next actuator advanced. The response to this request is normally Acknowledge. Of the Answer block contains a code that is evaluated by the test device, whereupon the Designation of the actuator is output.

The actuator test can only be activated if the speed is less than or equal to xcwSGSchw. is if this is not the case, the control unit responds with the block No Acknowledge UB.

If the speed threshold xcwDrSchw is exceeded during an actuator test, or it is no speed signal that can be evaluated (zmmSYSERR.4=1; see monitoring concept "combined system errors"), the actuator test is aborted. Definitely he will Actuator test aborted after time xcwMaIoTim.

If the actuator test has already been completed once, the control unit responds to another prompt to test the actuator with No Acknowledge.

If the ELAB is to be tested with this function, it is not clocked, but only switched off. It remains switched off for the current driving cycle.

The actuator for which the actuator test is carried out is for the time xcwSt..Tim with the Duty cycle xcwSt..TV controlled. After this time, the actuator with the Duty cycle 100% - xcwSt..TV controlled. This process repeats itself until one of the above mentioned termination conditions are met.

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The output stages can be identified via their message number (see appendix, ehmF...).
Assign actuator numbers (xcwActuator..). In addition, a code can be set for each actuator
be applied (xcwCode..), which is output in the response block.

byte request block		TG->SG
1	block length	04
2	block counter	xx
3	block title	04
4	Pin number (currently no function)	xx
5	Blocking ETX	03

byte response block		SG -> TG
1	block length	05
2	block counter	xx
3	block title	F5
4	actuator code hb	xx
5	actuator code LB	xx
6	Blocking ETX	03

7.3.17 Read normalized measured values

With this function, the measured values belonging to the transmitted display number are included
Transmitted standard display number and standardization value to the test device, where they are then in physical
units can be displayed.

Measured values are combined into display groups in the channel table parameter block
(xcwK01_1/2/3/4 ... xcwK40_1/2/3/4).

The entries in the channel table each relate to the entries in the parameter block
group table.

- ÿ xcwGrpxx_A ... standard display number
- ÿ xcwGrpxx_N ... normalization value
- ÿ xcwGrpxx_M ... message number of the measured value (xx : 00 to 80)

Valid display numbers are 1 ... 40. Invalid display numbers are answered by the control unit
No Acknowledgment.

byte request block		TG->SG
1	block length	04
2	block counter	xx
3	block title	29
4	ad number	xx
5	Blocking ETX	03

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byte response block		SG -> TG
	block length	0F
1 2	block counter	xx
	Response block title 1.	E7
3 4	Standard display number 1.	xx
	Normalized value 1. Measured	xx
5 6	value	xx
7	2. Standard display number 2.	xx
8	Standardization value	xx
	2. Measured	xx
9 10	value 3. Standard display number	xx
11	3. Normalized value 3. Measured	xx
12	value	xx
13	4. Standard display number 4.	xx
14	Standardization value	xx
15	4. Measured	xx
16	value end of block ETX	03

Since we only support a limited number of channels, the label xcwK100on

introduced, which redirects the channel specified in the label to display number (channel number) 100.
The channel number that is in this label is blocked at the same time, this also applies to the
Read normalized measured values function.

7.3.17.1 Definition of the group numbers

See **Appendix B** for definition of group numbers.

7.3.17.2 Measured value blocks 190 to 199

This function is mainly used for end-of-line tests.

With the display numbers 190 to 199, the values are output without normalization (block title F4h,
see Reading measured values without normalization), so ten measured values can be displayed at the same time.

With the map xcwMWB_KF, the desired measured values can be defined application-wise.
For each display number (190-199) there is a breakpoint on the y-axis for each reading
there is a support point on the x-axis.

If an invalid message number is applied in the xcwMWB_KF map, the output
aborted after the last valid message number. If the first message number is invalid,
no measured value displayed (only applies to this function).

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7.3.17.3 Measured value blocks for the CAN bus

A text describing the bus participant can be defined for each position of the CAN measured value blocks. The link mask xcwCANxx_X can be used to create a reference to the CAN messages to be received.

If all of the bits specified in the mask are set in the camRCSTAT message (see appendix CAN), the position in the measured value block indicates that no message is received (measured value).

In the other case, it is indicated that one of the specified messages is received (=measured value+1).

In the CAN channel table, the bus participants are grouped into display groups (xcwK125c1/2/3/4 ... xcwK129c1/2/3/4). The value 255 means no display on this position.

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The entries in the channel table refer to the entries in the CAN bus subscriber table.
(xcwCANxx_.)

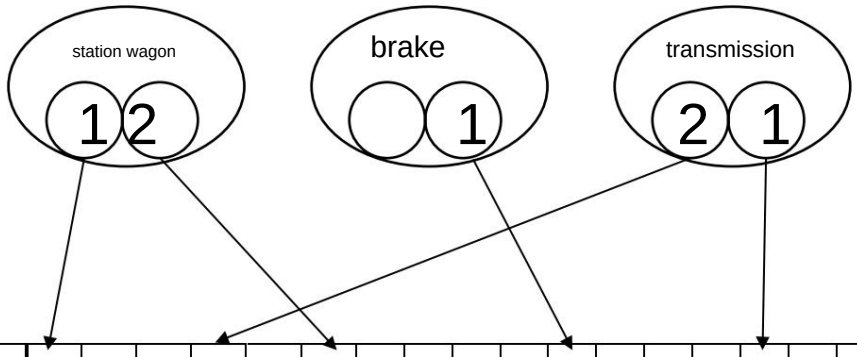
ÿ xcwCAN_A ... standard display number for all CAN measured value blocks (37)

ÿ xcwCANxx_X ... link mask with *camRCSTAT*
ÿ xcwCANxx_N ... normalization value
ÿ xcwCANxx_M ... measured value (xx: 00 to 10)
ÿ xcwCANxx_F ... link mask with *comCLG_FUN*
ÿ xcwCANxx_S ... link mask with *comCLG_SIG*

The text which is to be displayed must be described via normalization value and measured value if the control unit does not receive any messages from this bus node. The other text yields from measured value+1.

~~Example: Determining the mask (xcwCAN.._X) for a control unit:~~

Current assignment see chapter CAN.



bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	value
camRCSTAT	0	0		0	0		0	0	0	0	0	0	0	0	0	0	all messages are received
camRCSTAT	0	0		0	**1**		0	0	0	0	0	0	0	0	0	0	gear 2 message failed.
camRCSTAT	0	0		0	0		0	**1**	0	0	0	**1**	0	0	0	0	Combi 2 and brake 1 message failed.
Masks:																	
xcwCAN00_X (Transmission)	0	0	0	**1**			0	0	0	0	0	0	0	0	**1**	0	2^1+2^12= **4098**
xcwCAN01_X (Brake)	0	0		0	0		0	0	0	0	0	0	**1**	0	0	0	2^5= **32**
xcwCAN02_X (station wagon)	**1**	0	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	2^15+2^10= **33792**

xcwCAN.._X is always assigned to a control unit, CAN bus participant.

VAG_Tester only shows "failed" when all messages of a SG (e.g. failure of all combined messages) have failed.

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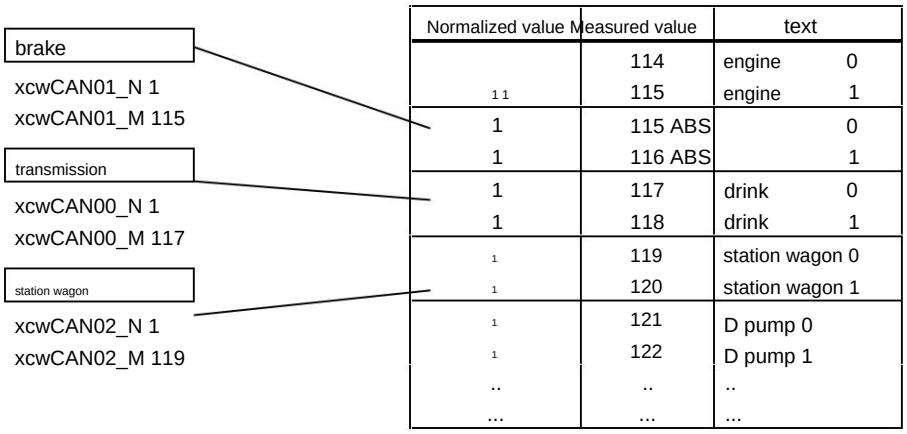
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Determining the display text on the VAG tester:

The standard display number for text must always be applied as the standard display number xcwCAN_A will:

xcwCAN_A = 37 dec

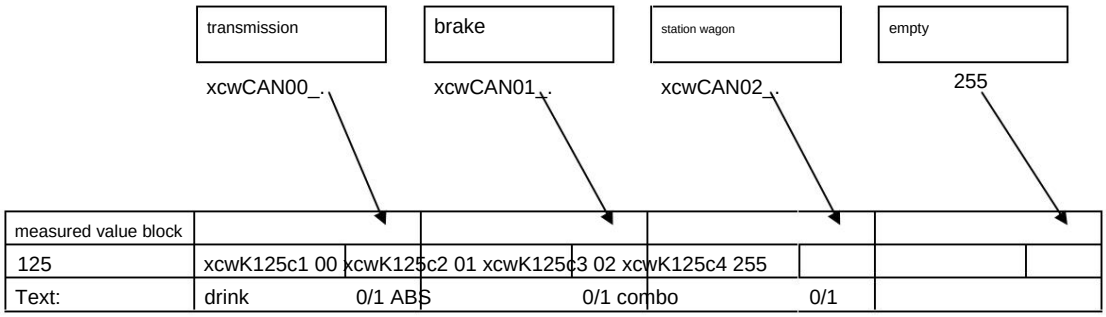
The display text is selected via standardization value and measured value:



Normalized value	Measured value	text	
	114	engine	0
1 1	115	engine	1
1	115 ABS		0
1	116 ABS		1
1	117	drink	0
1	118	drink	1
1	119	station wagon	0
1	120	station wagon	1
1	121	D pump	0
1	122	D pump	1
..	..	..	
...	...	...	

The text that describes the failure of the message must always be selected. as text which indicates the receipt of the message, the applied value + 1 is accepted.

Assignment to the measured value blocks:



measured value block						
125	xcwK125c1 00	xcwK125c2 01	xcwK125c3 02	xcwK125c4 255		
Text:	drink	0/1 ABS	0/1 combo	0/1		

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7.3.17.4 Hide the display

By applying the value 255 in a CAN channel table entry, the respective position hidden (eg: xcwK126c3=255).

The hiding is also activated by the function or signal activated by the login code influenced:

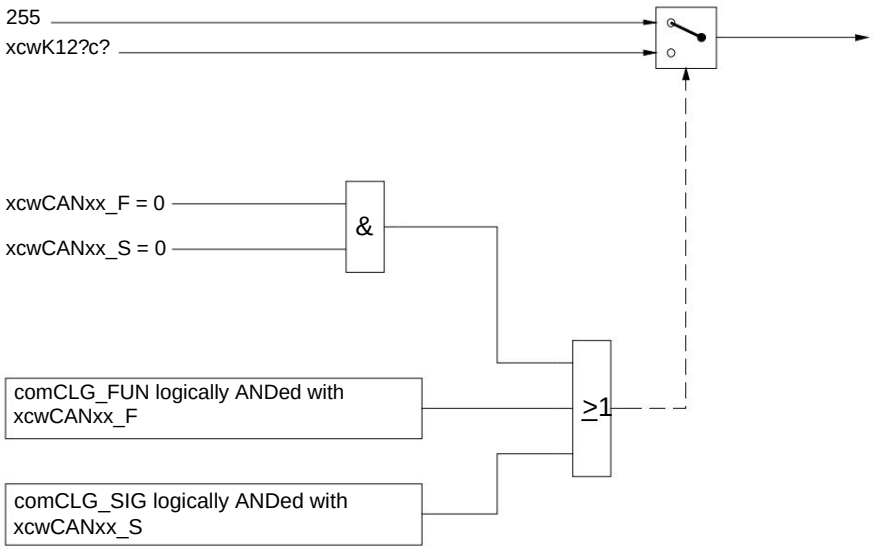


Figure CANLog12_128: Hiding of the display

In xcwCANxx_F and xcwCANxx_S, the function or the signal can be selected bit-coded which influences the display of the CAN bus participant on the VAG tester. Are both Label applied with zero, the selected display group is always displayed. Should one Display groups are only displayed if the associated CAN function or the associated CAN signal has been enabled via login code, the corresponding bit must be in xcwCANxx_F or xcwCANxx_S must be set.

7.3.17.5 Example:

Channel 125

Display group number 125							
drink	0/1 ABS	0/1	station wagon	0/1	climate	0/1	

Channel 126

Display group number 126							
D pump 0/1	air bag	0/1					

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7.3.18 Customization overview

With the adjustment, it is possible to use engine-specific correction values for quantity adjustment, Idle speed, exhaust gas recirculation and starting amount to read, test and in the E2PROM to save. The adjustment channel numbers for selecting the correction values are identical with the numbers of the measured value output.

The customization function is only available:

- ÿ after successful login (if required)
- ÿ with an intact E2PROM

Whether a login is necessary for the selected adjustment channel can be determined using the Label xcwLOG_0 to xcwLOG_7 are applied. The label xcwLOG_0 decides with bit 0 whether for Channel 0 requires a login and Bit 15 whether a login is required for channel 15. At labels xcwLOG_7 the login requirement for channels 112 to 127 can be set.

Adjustment values that are, are or will be read, written or tested with this function limited. The adjustment values are:

Adjustment channel number 1	match value
	quantity adjustment
2	idle speed
3	exhaust gas recirculation
4	start of injection
5	starting amount
12	preglow
18	Maximum speed (HGB)
27	ADR ramp-up time
28	var. ADR maximum speed
29	ADR fixed speed

All matching values are 16-bit integer values.

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The response block for the fitting functions is the following block (fitting output with standard values):

byte response block		SG -> TG
1	block length	13
2	block counter	xx
3	block title	E6
4	adjustment channel number	xx
5	Adjustment value HB	xx
6	Adjustment value LB	xx
7	subblock title	E7
8th	1. Standard display number 1.	xx
9	Standardization value	xx
10	1. Measured	xx
11	value 2. Standard display	xx
12	number 2. Normalized value	xx
13	2. Measured	xx
14	value 3. Standard display	xx
15	number 3. Normalized value	xx
16	3. reading	xx
17	4. Standard display number 4.	xx
18	Standardization value	xx
19	4th reading	xx
20	end of block ETX	03

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7.3.19 Read customization

With this function, it is possible to select the current corresponding to the adjustment channel number to read the used adjustment value.

byte	request block	TG->SG
1	block length	04
2	block counter	xx
3	block title	21
4	adjustment channel number	xx
5	Blocking ETX	03

7.3.20 Test fit

The control unit uses the transferred adjustment value as the currently used adjustment value. This function enables the control unit to react immediately to a new calibration value to test. The set adjustment value only applies to the driving cycle in which it was set, except for him is written to the E2PROM with save adaptation.

bytes	request block	TG->SG
1	block length	06
2	block counter	xx
3	block title	22
4	adjustment channel number	xx
5	Adjustment value HB	xx
6	Adjustment value LB	xx
7	Blocking ETX	03

7.3.21 Save customization

Once the correct adjustment value has been found, the operator can use this function to save the adjustment value in the E2PROM. In addition, a workshop code is also entered in entered the E2PROM. The parameter code is ignored.

If it is ensured that the adjustment value was stored in the E2PROM, then the responds Output control unit with the adaptation block with standard values. while saving the control unit exchanges acknowledge blocks with the test device in order to improve communication to maintain.

byte	request block	TG->SG
1	block length	09
2	block counter	xx
3	block title	2A
4	Adjustment channel number	xx
5	adjustment value HB adjustment	xx
6	value LB PMC6 ... PMC0.WSC16	xx
7		xx
8th	WSC15 ... WSC8	xx
9	WSC7 ... WSC0	xx
10	Blocking ETX	03

PMC ... parameter code, WSC ... workshop code

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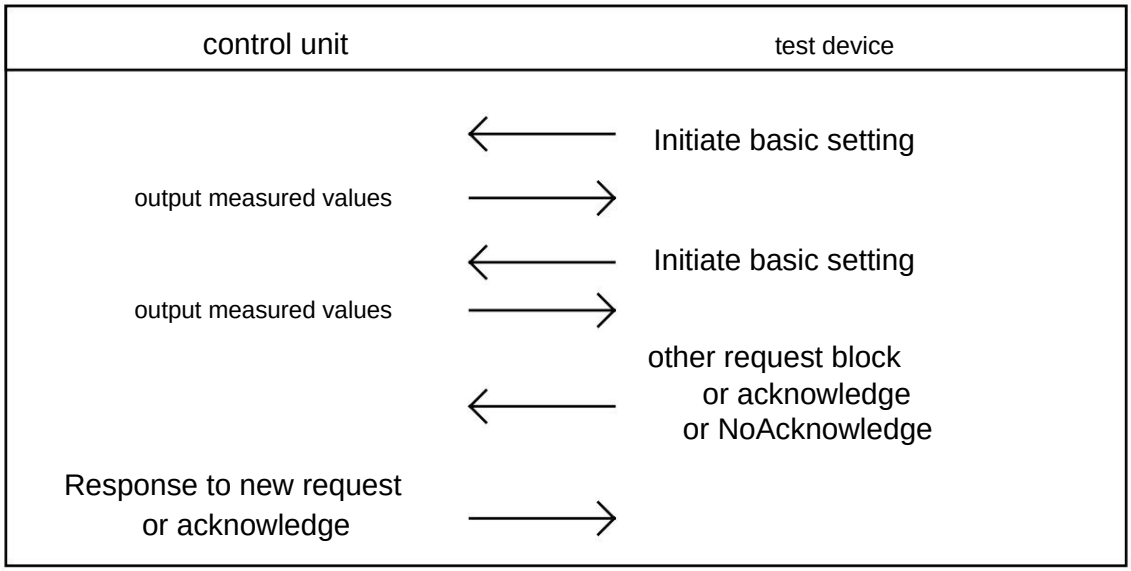
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7.3.22 Initiate basic setting

The basic setting function is used to keep the motor in a defined operating state
operate and then read the measured values. In order to achieve this state, certain
Actuators driven with a fixed duty cycle. For security reasons, this
Function only below the speed threshold xcwDrSchw and if an evaluable
Speed signal is present (zmmSYSERR.4=0; see monitoring concept-"summarised
System error") can be activated. For information that the system is in the basic setting
located, the diagnostic lamp flashes with the frequency xcwFreq. The solenoid valve actuator
(ehmDMVS) is controlled with the duty cycle xcwSBTV.

The communication proceeds as follows:



The following special cases should be noted:

- ÿ If the speed is above the speed threshold xcwDrSchw, this answers
  control unit initiate the basic setting block with No Acknowledge UB.
- ÿ At the same time, the basic setting is ended when the xcwDrSchw threshold is exceeded.
- ÿ If the speed falls below the xcwDrSchw threshold again, the basic setting can be repeated
  be initiated.

byte	request block	TG->SG
1	block length	03
2	block counter	xx
3	block title	11
4	Blocking ETX	03

Response block see reading measured values

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7.3.23 Initiate basic setting normalized

For safety reasons, this function can also only be used below the speed threshold xcwDrSchw and if there is a speed signal that can be evaluated (zmmSYSERR.4=0; see Monitoring concept "summarized system errors") can be activated.

The following basic settings are possible with this function:

Adjustment channel number 03	default setting
	exhaust gas recirculation (ARF)
04	Start of Injection (SBR)
11	Loader control (LDR)

If a basic setting is carried out, then in mrmN_LLDIA a target idle speed of xcwGRARF_N, xcwGRSBR_N, or xcwGRLDR_N specified.

With the basic setting ARF, the ARF control is switched off and all 3 actuators (ehmFAR1, ehmFAR2 and ehmFAR3) for the time xcwGRARF_T with the Duty cycles xcwAR1ein, xcwAR2ein and xcwAR3ein driven. After this time the actuators will be xcwAR1off, xcwAR2off and xcwAR3off for the same time driven. This process is repeated until the basic setting is aborted.

With the basic setting SBR, the start of injection control remains switched on. As a target value sbmPHIsoll the start of injection angle xcwSBRein is specified for the controller for the time xcwGRSBR_T. To At the end of this time, the controller is given the angle xcwSBRaus. This process is repeated until the basic setting is aborted.

With the basic setting LDR, the boost pressure control and the ARF control are switched off. That Actuator ehmFLD_DK is xcwGRLDR_T with the duty cycle xcwLDRein for the time driven. After this time has elapsed, the actuator is switched off for the same time with xcwLDRaus driven. This process is repeated until the basic setting is aborted.

Instead of the 2nd measured value, which is read out normalized during adaptation, another one is used applicable measured value output. Standard display number is 37, standardization value 0. At Specification of xcw..on, the measured value xcwGR..ME is output, with specification xcw..off, the Value xcwGR..MA.

Basic setting is not possible for the remaining display group numbers. The answer block is output normalized measured values for the corresponding adaptation channel number.

byte	request block	TG->SG
1	block length	04
2	block counter	xx
3	block title	21
4	adjustment channel number	03/04/11
5	Blocking ETX	03

The VAG tester offers the option of reading out the readiness code via special function 15.

This is possible if the control unit initiate normalized using the basic setting function (Block title 28H) for channel number 100 the readiness code with the standard display number 16 spends

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Since we only support a limited number of channels, the label xcwK100auf was introduced, which redirects the channel specified in the label to display number (channel number) 100.
The channel number in this label is blocked at the same time, this also applies to the normalized reading of measured values.

A notice:

The xcwK100auf label must be applied to the value **255** to deactivate the function .

7.3.24 Entering calibration values using the VAG tester

The comparison is set using diagnosis block title 2A, the corresponding block number, high byte and low byte of the int(16bit) value.

Note: All comparison values are checked again for validity by the driving software before they are used.

7.3.24.1 Multiplicative matching

The following variables are compared multiplicatively:

- ÿ Starting amount
- ÿ Limited quantity
- ÿ Boost pressure throttle setpoint
- ÿ ARF setpoint if cowV_AGL_B = 2

Given: Phys. Factor [-]

Limits: for Phys.: - FAKT_MAX ... + FACT_MAX

int(16bit) value = phys. Factor * 10000

7.3.24.2 Additive adjustment

The following variables are adjusted additively:

- ÿ Target idle speed

Given: Adjustment speed (offset) [U/min]

Limits: for Phys.: - N_LLABGL ... + N_LLABGL

int(16bit) - value = adjustment speed / N_QNT

ARF setpoint if cowV_AGL_B = 1

The values M_EQNT, N_QNT, M_LQNT and PROZ_QNT can be found in the current .PHY file.

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7.4 OBDII protocol

The external communication of the "OBDII scan tool" is based on the following specifications:

- ÿ SAE J1979 edition Dec. 1991, revised on June 14, 1993
- ÿ In this form, the diagnostic protocol corresponds to the communication and block structure
  Keyword Log 2000

External communication consists of two tasks:

- ÿ communication handler and
- ÿ Command interpreter

The communication handler takes over the communication tasks related to the diagnosis
the HW level:

- ÿ Responding to the operating mode recognized by the communication stimulus
- ÿ Connection establishment according to the operating mode
- ÿ Data transfer according to specified time sequences

The command interpreter takes on the following tasks with regard to the software level:

- ÿ Interpretation of received request blocks
- ÿ Information exchange with system components
- ÿ Creation of corresponding answer blocks

7.4.1 Establishing communication

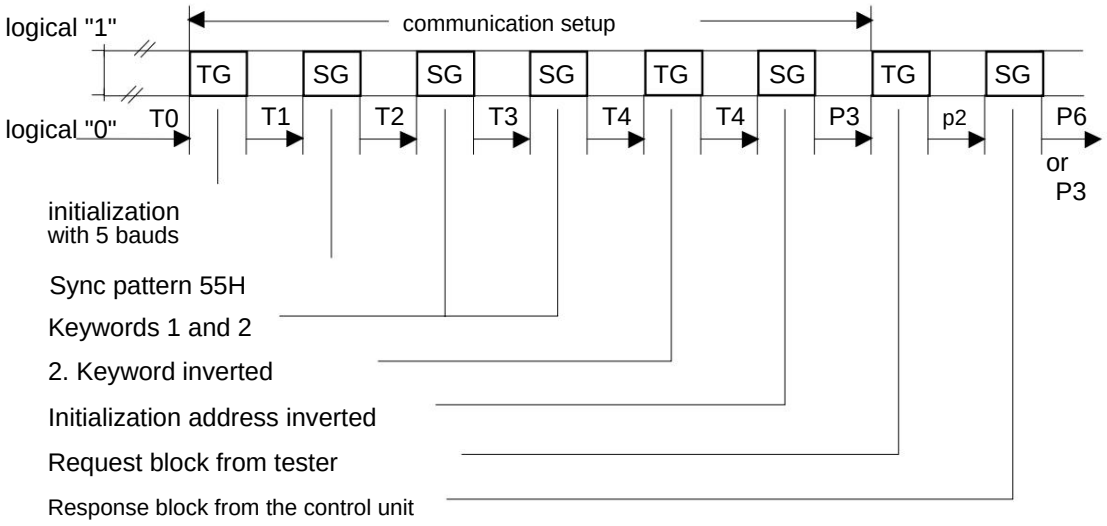


Figure XCOM03: Data flow according to ISO 9141

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The communication structure following the successful bidding consists of

- ÿ the synchronization pattern (55 hex, 8 data bits/no parity) from the SG to the TG
- ÿ two keywords (7 data bits/odd parity) from the SG to the TG
- ÿ the logical inversion of the 2nd keyword from the TG to the SG and
- ÿ the logical inversion of the initialization address from the SG to the TG

address word	keyword 1	keyword 2	
33hex	08 44	08	
08hex		46	is not supported

7.4.2 Communication flow

After the communication has been established, the TG must inform the SG in the form of a request block which information is required. The SG responds with appropriate response blocks.

A block consists of:

- ÿ Headboard:
  - Type identifier or specification of the format and
  - Target address (recipient address or direction of communication) and
  - Source address (sender address)
- ÿ Information part:
  - mode byte and
  - Message length (optional) and data bytes and
  - (The maximum length of the information part is 256 bytes consisting of length and 255 data bytes)
- ÿ Test part:
  - Checksum in hex code where CS = LOW byte of checksum.

Header Breakdown:

- ÿ Exhaust relevant system (SAE J1979 - Init. with 33 hex functional, 5 vols)

	TG --> SG	SG --> TG	remark
Type	68h	48h	Type of communication flow
Target	6A hex	6B hex	Type of message (request / response)
Source	fx hex	SG address	physical address of the sending participant

- ÿ Functional/physical addressing (Init.<>33 hex functional) (is not supported)

	TG --> SG	SG --> TG	remark
Type	xx hex	xx hex	
Target	SG address	TG address	Address of the receiving station
Source	TG address	SG address	Address of the sending station

A byte of the block transmission consists of:

- ÿ 1 start bit
- ÿ 8 data bits, starting with LSB
- ÿ 1 stop bit

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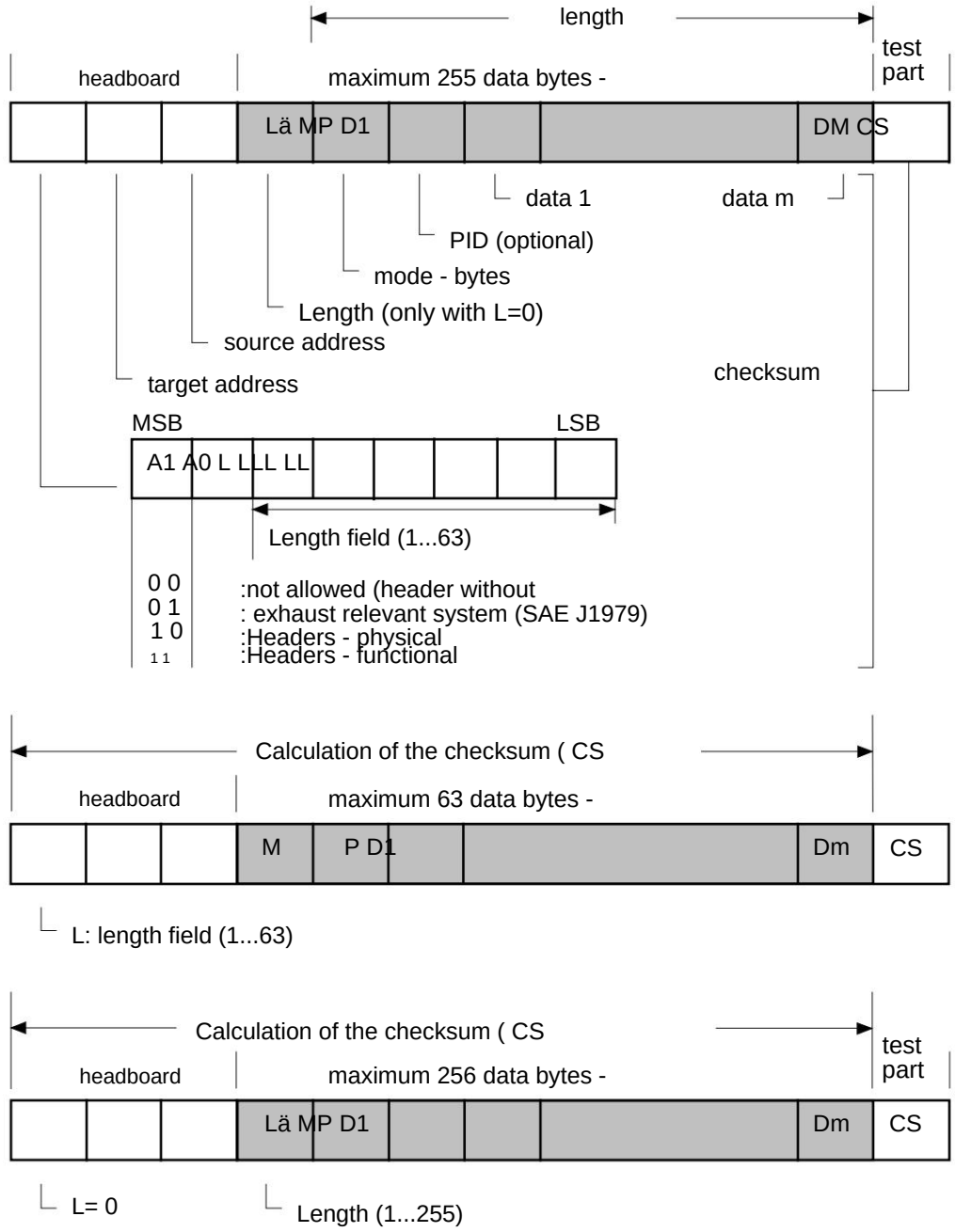


Figure XCOM04: block structure

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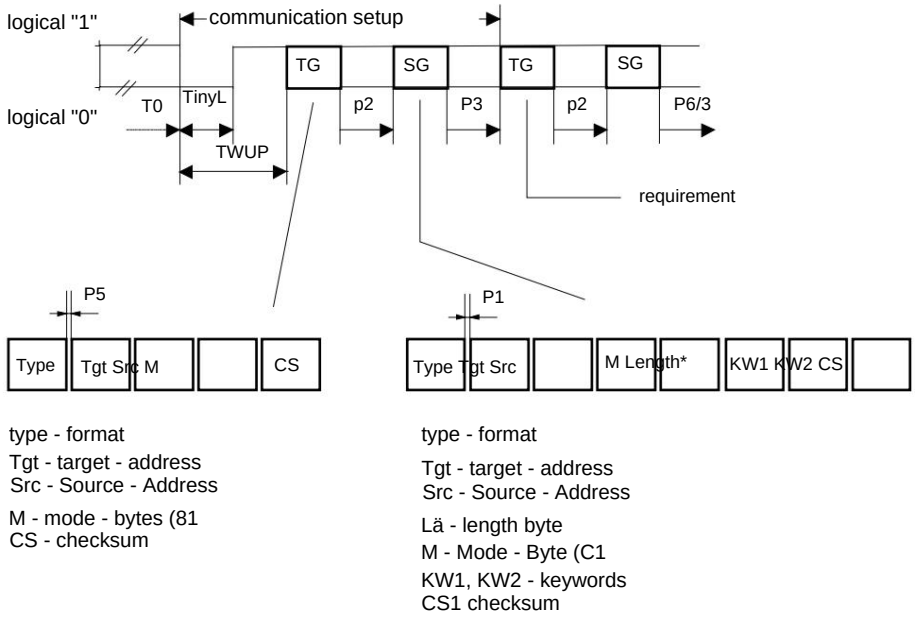
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7.4.3 Initialization using WUP

Irritation with wake-up pattern:

The TG can send a "wake-up pattern" to shorten the time it takes for communication to be established.

Establishing communication with wake-up pattern:



type - format
Tgt - target - address
Src - Source - Address
M - mode - bytes (81
CS - checksum

type - format
Tgt - target - address
Src - Source - Address
Lä - length byte
M - Mode - Byte (C1
KW1, KW2 - keywords
CS1 checksum

* depending on the type - byte

Figure XCOM05: Establishing communication with wake up pattern

After sending the "wake-up pattern", the TG sends the "diagnostic start" request block (Mode 81) to the SG. The control unit sends the response block, and within the time frame P2 informs the tester about the block format using keywords 1 and 2 (see "Communication setup").

Communication process:

The communication process for "Quick Start" corresponds to that for initialization with 5 Baud.

Diagnostic test modes:

The diagnostic test modes for "Quick Start" correspond to the modes for initialization with 5 bauds.

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7.4.4 Time definition

300ms <	T0			Logic "1" time before initialization
24ms <	TinyL <		26 ms	time of logic "0" at initialization (quick start)
49ms <	TWup <		51 ms	duration of the wake-up pattern (quick start)
60ms <	T1	<	300 ms	time between the end of the initialization and the start of the synchronization pattern
5ms <	T2	<	20 ms	time between the end of the synchronization pattern and the beginning of the first keywords
0ms <	T3	<	20ms	Time between the end of the 1st and the beginning of the 2nd keyword
25ms <	T4	<	50 ms	time between the end of the 2nd keyword and the beginning of the logical one Inversion of the 2nd keyword and the time between the end of the logical inversion of the 2nd keyword and the beginning of the logical Inversion of the initialization address
300ms <	T5			Time after the diagnostic tester detects an initial error and with starts again after sending the initial address
0ms <	P1	<	20 ms	byte sequence time for transmission blocks from the control device to the test device
P2min <	p2	<	P2max	Time between the end of a block from the test device and the beginning of the blocks from the control unit
P3min <	P3	<	5 s	Time between the end of the last block of the SG and the beginning a new block from the test device
P4min <	P4	<	20 ms	byte sequence time for transmission blocks from the test device to the control unit; Initialization 5 baud: P4min = 5 ms, fast entry: P4min = 0-5 ms
5ms <	P5	<	20 ms	byte sequence time for the "Diagnostics start" request block (mode 81) at "Quick Start"
5ms <	P6	<	P2max	time between blocks from SG to TG

7.4.5 Error handling

Initialization:

In case of an initialization error caused by a timeout of T4 or by
a faulty transmission, the control unit switches back to reception within the time T5min
the stimulus address.

Communication:

If the control unit receives a block with an incorrect checksum, it sends an SG acknowledgment (mode 7F) with the acknowledgment code 13 hex (incomprehensible request).
If the SG recognizes an incorrect structure of the request block, it behaves as if it were checksum error. A violation of the time interval P4 leads to the above errors, and will be treated accordingly. If P3max is exceeded, the SG ends the Communication.

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7.5 OBDII telegram contents

The implementation of the functional diagnostic test mode according to SAE J1979 fulfills the Californian OBD II requirements for emission-related systems (initialization with 33 hex):

block title
(Fashion) function

01 ..... Reading of exhaust gas relevant information
02 ..... Readout of stored boundary conditions (freeze frame)
03 ..... Read out debounced entered emission relevant error codes
04 ..... Delete/reset emissions-related information
..... Lambda probe monitoring (not implemented)
05 06 ..... Readout of test results (not for VP44 (136))
07 ..... Reading of the emission-related error codes in the debouncing
09 ..... Reading vehicle information
- VIN (chassis number)
- Calibration ID (program version)
- Calibration Verification Number (quasi checksum)

7F ..... Control Units Acknowledge
81 ..... Start diagnostics

Corresponding response modes have an offset of +40 hex.

7.5.1 Read emissions-related information

Fashion 01h

This mode gives you access to exhaust gas-related information such as analog and digital Input and output, as well as system status information. The request block contains a Parameter - Identification (PID) used to tell the SG the information it needs.

byte request block		TG->SG
1	type identifier	68
2	Target	6A
	Source	fx
3 4	Mode—Bytes	01
5	PID	xx
6	checksum	xx

The length of the request is 6 bytes, the length of the response block is of the one used PID dependent.

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4	Mode—Bytes	41
5	PID	xx
6	Data A	xx
7	Data B (optional)	xx
8th	Data C (optional)	xx
9	Data D (optional)	xx
10	checksum	xx

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7.5.1.1 PID 00h - Supported PIDs (01-20 hex)

The SG responds to Mode 01 PID 00 with a message that is 4 bytes (bit-encrypted) contains information. Each bit indicates whether a PID is supported or not.

ÿ 0 = PID is not supported by the SG
ÿ 1 = PID is supported by the SG

byte	bit	PID
Data A	7	01
Data A	6	02
...	...	...
Data B	7	09
...	...	...
Data D	0	20

7.5.1.2 PID 01h – error memory info/readiness

The SG responds to Mode 01 PID 01 with a message that is 4 bytes (bit-encrypted) contains information.

Data A - Number of emission-related trouble codes and MIL status

bit	supported evaluation
0-6	Number of error codes stored in the SG (debounced and relevant to emissions)
7	0 = MIL is not activated by the SG 1 = MIL is driven by the SG

Data B (bits 0-3) and **Data C** - Each bit indicates support or none Support from an on-board diagnostic evaluation

Data B includes continuous monitoring

Data C includes tests that are run through at least once per trip,

where:

ÿ 0 = test is not supported by the SG
ÿ 1 = test is supported by the SG

Data B (Bits 4-7) and **Data D** - Each bit shows the status of diagnostic evaluations regarding **Data B** (bits 0-3) and **Data** C:

- 0 = test completed or Not supports.
- 1 = test not yet finished

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Data B:

bit	evaluation	Evaluation	RBP record	
	supported:	*supports:*		
0	Misfire monitoring	Misfire monitoring		fbwRBP_MIS
1	Fuel system monitoring	Checking the fuel system	8 9	fbwRBP_FUE
2	Comprehensive component monitoring	Checking the entire system	10	fbwRBP_COM
3	reserved (report as 0)	not occupied	11	
	status:	*Status:*		
4	Misfire monitoring	Misfire monitoring	8th	fbwRBP_MIS
5	Fuel system monitoring	Checking the fuel system	9	fbwRBP_FUE
6	Comprehensive component monitoring	Checking the entire system	10	fbwRBP_COM
7	reserved (report as 0)	not occupied	11	

Data C (supported) and Data D (status):

bit	evaluation	Evaluation	RBP record	
0	Catalyst monitoring	catalyst	0	fbwRBP_CAT
1	Heated catalyst monitoring	catalyst hot	1	
2	Evaporative system monitoring	evaporation system	2	
3	Secondary air system monitoring	Secondary air system	3	
4	A/C system refrigerant monitoring	Coolant air conditioning	4	
5	Oxygen sensor monitoring	Lambda probe	5	
6	Oxygen sensor heater monitoring	Lambda - probes - heating	6	
7	EGR system monitoring	exhaust gas recirculation	7	fbwRBP_EGR

The readiness bit position can be applied via the label fbwRBP_...

7.5.1.3 PID 02h - Trouble Code

is not supported in this mode.

7.5.1.4 PID 03h - 1Fh - Data

The SG responds with a message containing 2 bytes of information.

The PIDs correspond to the message numbers 0x03 to 0x1F listed in Appendix C. It will the corresponding measured value is returned.

The message numbers 0x000C and 0x0010 have 2 bytes of information. The rest are just 1 byte long.

7.5.1.5 PID 1Ch - OBD requirements that the vehicle supports

The SG responds to mode 01 PID 01 with a message containing 1 byte of information.

The content can be applied with xcwPID1C.

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7.5.2 Read freeze frame

Fashion 02h

This mode gives access to a set of stored boundary conditions, which are
first occurrence of an emission-relevant error according to OBD II (freeze frame). in the
Request block includes PID and freeze frame No. (OBD II freeze frame No.: 0). the
The length of the request is 7 bytes, the length of the response block depends on the PID used
dependent.

7.5.2.1 PID 00h - Supported PIDs (01-20 hex)

Same as Mode 00h PID 00h.

7.5.2.2 PID 02h - Trouble Code

the 2-byte trouble code of the error that caused the entry is returned

7.5.2.3 PID 03h – 1Fh - data

The SG responds with a message containing 2 bytes of information.

The PIDs correspond to the message numbers 0x03 to 0x1F listed in Appendix C. It will
the corresponding measured value is returned.

With these PIDs, data byte A is always the freeze frame number. Data B corresponds to the value
the message. The message numbers 0x000C and 0x0010 are 2 bytes long. The second byte stands
then in Data C

byte request block		TG->SG
1	type identifier	68
2	Target	6A
3	Source	fx
4	Mode—Bytes	02
5	PID	xx
6	freeze frame no.	xx
7	checksum	xx

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4	Mode—Bytes	42
5	PID	xx
6	Data A	xx
7	Data B	xx
8th	Data C (optional)	xx
9	Data D (optional)	xx
10	checksum	xx

A notice:

The freeze frame is only displayed if the error entered is debounced (error visible under mode 03).
output, but storage takes place as soon as the error occurs for the first time.

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7.5.3 Read emissions-related errors

fashion 03h

Stored error codes can be read out by the TG using mode 03. There are two steps to this necessary:

- ÿ The number of stored error codes must be determined via mode 01 PID 01.
  If no errors are saved, the SG responds with "0 errors saved".
- ÿ With mode 03, all errors entered debounced are output. The SG sends up to 3
  Error codes per block and if no error is stored, the SG sends on this request
  No Answer.

The length of the request block (mode 03) is 5 bytes and the length of the response block is fixed at 11 bytes. If fewer than 3 error codes are transmitted, the corresponding data bytes padded with 00 hex to a fixed block length of 11 bytes ensure. For the structure of the error codes, see the "Error codes" chapter.

byte request block		TG->SG
1	type identifier	68
2	Target	6A
3	Source	fx
4	Mode—Bytes	03
5	checksum	xx

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4	mode - bytes	43
5	Error code 1 (high byte)	xx
6	Error code 1 (low byte)	xx
7	Error code 2 (high byte)	xx
8th	Error code 2 (low byte)	xx
	Error code 3 (high byte)	xx
9 10	Error code 3 (low byte)	xx
11	checksum	xx

(with more than 3 error codes)

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
	Source	10
3 4	mode - bytes	43
5	Error code 4 (high byte)	xx
6	Error code 4 (low bytes)	xx
7	Error code 5 (high byte)	xx
8	Error code 5 (low bytes)	xx
9	Error code 6 (high byte)	xx
10	Error code 6 (low bytes)	xx
11	checksum	xx

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7.5.4 Delete emission-related information

Fashion 04h

The purpose of this mode is to delete or reset all emissions-related information.
This relates to:

- ÿ Deleting the number of error codes (Mode 01 PID 01)
- ÿ Deleting the error codes (mode 03)
- ÿ Delete test results (mode 06 - test results are initialized with 0)

byte request block		TG->SG
1	type identifier	68
2	Target	6A
3	Source	fx
4	mode - bytes	04
5	checksum	xx

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4	mode - bytes	44
5	checksum	xx

7.5.5 Reading test results

Fashion 06h

This mode is not supported by VP44 (136). Otherwise applies:

In mode 6, the last test results and the associated comparison values of not
continuously monitored errors. After deleting the error memory (Mode 04)
the test results for WTF test, KTF test and start, stop position test are discarded and the
Values in EEPROM overwritten with 0. The value 0 is used as the identifier ”test not carried out”
used and must not be the result of a conversion with xcwCARF...

byte request block		TG->SG
1	type identifier	68
2	Target	6A
3	Source	fx
4 mode - byte 5		06
	Test ID	xx
6	checksum	xx

With the test ID 0, the available test IDs can be queried.

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Answer block for available test IDs:

Byte response block 1		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode	- byte 5	46
	Test ID	00
6	response block no.	FF
7	available IDs 1 to 8 available	xx
	IDs 9 to 16 available IDs 17	xx
8 9	to 24 available IDs 25 to 32	xx
10	checksum	xx
11		xx

The test ID can be used for:

- xcwWTF_ID ... - dynamic plausibility of the water temperature sensor
xcwKTF_ID ... - dynamic plausibility of the fuel temperature sensor
xcwSTT_ID ... - Start/stop position test
xcwLDF_ID ... Plausibility of LDF with ADF

Application note:

A test result can be hidden by entering an invalid ID in the label xcw..._ID
(ID > 32 eg: 255). The SG reports only valid ID's as available and unavailable
ID's are not queried by the tester.

The normalization of the signals corresponds to the normalization in modes 1 and 2.

The test results (except for the LDF and KTF tests) are saved when they are entered in the EEPROM converted to 1 byte with the conversion for the error memory. Will the test results read out, they are converted to 2 bytes with the conversion for the error memory and then prepared with the diagnostic conversion for the output. Applicable values become also converted three times, so that the relations in relation to those stored in the EEPROM values correct again.

- Times ... xcwCARFS_Z, xcwCARFO_Z, xcwCARDS_Z, xcwCARDO_Z
- temperatures ... xcwCARFS_T, xcwCARFO_T, xcwCARDS_T, xcwCARDO_T
- Temp. differences ... xcwCARFSdT, xcwCARFOdT, xcwCARDSdT, xcwCARDOdT
- Tensions ... xcwCARFSUD, xcwCARFOUD, xcwCARDSUD, xcwCARDOUD

Bit coding of the response block number:

Bit 7 = 0: Test Limit (bytes 9/10) is maximum
Bit 7 = 1: Test Limit (bytes 9/10) is minimum

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Response blocks related to test ID "xcwWTF_ID":

Three blocks are defined for this response, in which time, temperature rise and final temperature of the test carried out are output with their respective limit values. Depending on how the test ended, the following is transmitted:

Test not yet performed:
Identification 00h in EEPROM after error memory deletion.
3 blocks with FFh values are sent.

Test negative:
All 3 blocks with the test results are sent.

End of test reached due to minimum temperature rise:
It becomes block 1 (times) and block 2 (temperature rise, minimum temperature rise) Posted.

End of test reached by final temperature:
Block 1 (times) and block 3 (temperature at the end of the test, minimum temperature) Posted.

Byte	Response block 1	SG -> TG
	Type identifier	48
1 2	Target 3 Source	6B
4 Mode - Byte 5	xcwWTF_ID 6	10
	Response block no.	46
		xx
		01
7	Timer reading at the end of the test (high)	xx
8	Timer reading at the end of the	xx
	test (Low) Permissible heating time	xx
9 10	(High) Permissible heating time (Low)	xx
11	checksum	xx

Byte	Response block 2	SG -> TG
1	Type ID Target	48
2	3 Source 4 Mode	6B
- Byte 5	xcwWTF_ID Response block	10
	no. 6	46
		xx
		82
7	Temperature Rise (High)	xx
8	Temperature Rise (Low)	xx
	Minimum Temperature Rise (High)	xx
9 10	Minimum Temperature Rise (Low)	xx
11	checksum	xx

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Byte response block 3		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		46
xcwWTF_ID 6 response		xx
block no.7 Temperature at the end of the		83
test (high)		xx
	Temperature at the end of the test (Low)	xx
8 9	Minimum temperature (High)	xx
10	Minimum temperature (Low)	xx
11	checksum	xx

Response blocks related to test ID "xcwKTF_ID":

Three blocks are defined for this response, in which time, maximum temperature change and Achieved temperature change integral of the test performed, each with their limit values will spend. Depending on the status of the test, the following is transmitted:

Test not yet performed:

Identification 00h in EEPROM after error memory deletion.

3 blocks with FFh values are sent.

Test negative:

All 3 blocks with the test results are sent.

End of test positively reached due to maximum temperature change:

Block 2 (maximum temperature change, minimum temperature change) is sent.

End of test positively reached through temperature change integral:

Block 1 (times) and block 3 (temperature change integral, Minimum temperature integral) sent.

Byte Response block 1 Type		SG -> TG
1	identifier Target 3	48
2	Source 4 Mode -	6B
Byte 5 xcwKTF_ID block		10
no.		46
		xx
6		01
7	Runtime of the test (high)	xx
8	Operating hours of the test (Low) Permissible	xx
	operating hours (High) Permissible operating	xx
9 10	hours (Low)	xx
11	checksum	xx

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Byte response block 2		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		46
xcwKTF_ID response	block no.	xx
6	reached max. (High)	82
7	reached max. (Low) min. required temperature	xx
	change. (High) Min. required temperature	xx
8 9	change (Low)	xx
10		xx
11	checksum	xx

Byte Response block 3 Type		SG -> TG
1	identifier Target 3	48
2	Source 4 Mode -	6B
Byte 5 xcwKTF_ID	Response block	10
	no. reached max. temp.	46
integral (high) reached	max. temp. integral	xx
6	(low) min. required	83
7	temp. integral (high) min. required temp.	xx
8th	integral (low)	xx
9		xx
10		xx
11	checksum	xx

Response blocks related to test ID "xcwSTT_ID":

Byte Response block 1 Type		SG -> TG
1	identifier Target	48
2	Source Mode -	6B
3	Byte xcwSTT_ID	10
4	Response block	46
5	no.	xx
6		1
7	dsoUist_Ag at the end of the test (high)	xx
8th	dsoUist_Ag at the end of the test (low)	xx
9 mrwNL_MOST (high) 10 mrwNL_MOST (low)		xx
11		xx
	checksum	xx

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Byte response block 2		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		46
xcwSTTb_ID response block no.		xx
6	dsoUist_Ag at the	82
7	end of the test (high) 8 dsoUist_Ag at	xx
the end of the test (low) 9 mrwNL_MUSP (high) 10 mrwNL_MUSP (low) 11		xx
checksum		xx
		xx
		xx

Byte Response block 1		SG -> TG
1	Type identifier	48
2	Target 3 Source	6B
4 Mode xcwSTT_ID Byte 5		10
Response block no.		46
dsoUist_Ag at the end of the test (high) 8		xx
6	dsoUist_Ag at the	3
7	end of the test (low) 9 mrwNL_MOSP	xx
(high) 10 mrwNL_MOSP (low)		xx
		xx
		xx
	Checksum 11	xx

Byte Response block 2 Type		SG -> TG
1	ID Target 3 Source	48
2	4 Mode - Byte 5	6B
xcwSTTb_ID 6 Response block no.		10
		46
		xx
		84
7	dsoUist_Ag at the end of the test	xx
8	(high) dsoUist_Ag at the end of the	xx
test (low) 9 mrwNL_MUSP (high) 10		xx
mrwNL_MUSP (low) 11		xx
	checksum	xx

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Response block related to test ID "xcwLDF_ID":

A block is defined for this response, in which the absolute difference ADF-LDF (ldmLDFP_dp) of the test carried out with its limit value ldwLA_MAX. je after the test has ended, the following is transmitted:

Test not yet performed:
Identification 00h in EEPROM after error memory deletion.
The block with FFh values is sent.
Test was performed:
The block with the test result is sent.

Byte	Response block 1	SG -> TG
	Type ID Target 3	48
1 2	Source 4 Mode	6B
– Byte	Response block	10
no.		46
		xx
		01
7	Section. Diff.ADF/LDF at the end of the test	xx
8	(high) abs. Diff.ADF/LDF at the end of the	xx
	test (Low) permissible abs. Diff.ADF/LDF	xx
9 10	(High) permissible abs. Diff.ADF/LDF (Low)	xx
11	checksum	xx

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7.5.6 Read current emissions-related errors

Fashion 07h

Error codes that are being debounced can be read out by the TG using mode 07. This Mode is equivalent to Mode 03 in block structure and function.

Physical implementation of the SAE J1979 messages

The previously discussed diagnosis - test - modes are based on a functional addressing with 33 hex perish. With physical addressing, only a single SG is addressed and thus the answers refer only to the respective control unit.

7.5.7 Reading vehicle information

Fashion 09h

Mode 09 is used to provide testers with vehicle-specific information such as VIN (chassis number) and to provide Calibration ID's. From the CARB are only reading out the Calibration ID (program version) and the Calibration Verification Number (checksum) required.

The request block contains an Info Type (InT) with which the SG receives the required information is communicated. The length of the request is 6 bytes, the length of the response block is from depends on the info type used.

byte request block		TG->SG
	type identifier	68
1 2	Target	6A
3	Source	fx
4 mode - byte 5		09
	Info Type (InT)	InT
6	checksum	xx

7.5.7.1 Info Type = 00h

With info type 00h, all available ones are output in coded form. The coding corresponds to mode 01 PID 00.

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		49
	Info Type (InT)	00
6	MessageCount	01
7	available InTs 1 to 8 (dec)	xx
	available InTs 9 to 16 (dec)	xx
8 9	available InTs 17 to 24 (dec)	xx
10	available InTs 25 to 32 (dec)	xx
11	checksum	xx

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7.5.7.2 VIN (Chassis Number) - InfoType 01h&02h

This info type is only supported with learned immobilizer 3 data. With deactivated or Immobilizer 2, this information is not available.

This InfoType can be applied away with bit 0 in *xcwINF_M09 .*

Bit 0 = 0 ... InfoType not retrievable
Bit 0 = 1 ... InfoType is retrievable if available

InfoType = 01h

Returns the number of messages (responses) for the transmission of the VIN for Info Type 02h. the The number of responses to be transmitted is always 05h .

byte response block		SG -> TG
	type identifier	48
1 2	Target	6B
3	Source	10
4 mode - byte 5		49
	Info Type (InT)	01
6 Number of messages 7		NM's
	checksum	xx

Info Type = 02h

Returns the chassis number consisting of 17 characters in ASCII in 5 blocks of 4 characters each, where the first 3 data bytes are filled with 00h.

byte response block		SG -> TG					
	type identifier	48					
1 2	Target	6B					
3	Source	08					
4 mode - byte 5		49					
	Info Type (InT)	02					
6	MessageCount	MSC 01h 02h 03h 04h 05h					
7	Info byte 1	in1	0h #2 #6 #10 #14				
8	Info byte 2	In 2	0h #3 #7 #11 #15				
	Info byte 3	in3	0h #4 #8 #12 #16				
9 10	Info byte 4	in4	#1 #5 #9 #13 #17				
11	checksum	xx					

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7.5.7.3 Cal ID (Calibration ID) – InfoType 03h&04h

The calibration identification (CAL-ID) (e.g. program version) or calibration verification Number (CVN) (e.g. checksum) only needs to be changed if it is relevant to approval given is. The CAL ID can be applied via the label *xcwCAL_ID* .

The Calibration ID must uniquely identify the installed software. This is controlled by the OBD Provisions are required in order to provide the emission-relevant software in a standardized form identify.

Adjustments that were not developed by the vehicle manufacturer must have an unequal Calibration ID so that they can be distinguished from those of the vehicle manufacturer.

This InfoType can be applied away with bit 1 in *xcwINF_M09* .

Bit 1 = 0 ... InfoType not retrievable
Bit 1 = 1 ... InfoType is retrievable

Info Type = 03h

Returns the number of messages (responses) for the transmission of the Cal ID for Info Type 04h.

The number of responses to be transmitted is always 04h with this control unit. This Controller has only one Cal ID.

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		49
	Info Type (InT)	03
6 Number of messages (NMs) 7		04
	checksum	xx

Info Type = 04h

Returns the Calibration ID consisting of 16 characters in ASCII in 4 blocks of 4 characters each. This 16 characters can be applied via the label *xcwCAL_ID* .

byte response block		SG -> TG			
1	type identifier	48			
2	Target	6B			
3	Source	08			
4 mode - byte 5		49			
	Info Type (InT)	04			
6	MessageCount	MSC 01h 02h 03h 04h			
7	Info byte 1	in1	#1 #5 #9 #13		
8	Info byte 2	In 2	#2 #6 #10 #14		
	Info byte 3	in3	#3 #7 #11 #15		
9 10	Info byte 4	in4	#4 #8 #12 #16		
11	checksum	xx			

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7.5.7.4 CVN (Calibration Verification Number) - InfoType 05h&06h

The OBD laws require these values to change the emissions-related software recognize. A CVN must be unmistakably and unambiguously assigned to each Calibration ID.

Adjustments not developed by the vehicle manufacturer must have an unequal CVN, so that they can be distinguished from those of the vehicle manufacturer.

The CVNs are transmitted in 4-byte hex values, the most significant byte in data byte A. Calculations that do not require 4 bytes fill the empty data bytes with $00.

This system only supports a 2-byte calibration ID.

The control unit cyclically determines an internal checksum for the current code and data area. The first checksum is determined in the SG initialization. Is the first If the checksum is incorrect, a reset is triggered immediately, ie the SG software cannot run. Based on the last calculation, if the checksum is correct, the CVN with the label *xcwCVN_OK* and if the checksum is not correct, the CVN is output with the label *xcwCVN_NOK .*

The label *xcwCVN_NOK* must be applied in such a way that an error code is displayed.

This InfoType can be applied away with bit 2 in *xcwINF_M09 .*

Bit 2 = 0 ... InfoType not retrievable
Bit 2 = 1 ... InfoType is retrievable

Info Type = 05h

Returns the number of messages (responses) for the transmission of the CVN for info type 06h.

The number of responses to be transmitted is always 01h with this control unit. This Controller has only one CVN.

byte response block		SG -> TG
	type identifier	48
1 2	Target	6B
3	Source	10
4 mode - byte 5		49
	Info Type (InT)	05
6 Number of messages (NMs)		01
	checksum 7	xx

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Info Type = 06h

Returns the CVN consisting of 4 byte hex values in a block, with the first two Infobytes are filled with 00h. The two infobytes 3&4 correspond to the data through the label *xcwCVN_OK* or *xcwCVN_NOK* were applied.

byte response block		SG -> TG
1	type identifier	48
2	Target	6B
3	Source	10
4 mode - byte 5		49
	Info Type (InT) 6	06
	MessageCount	01
7	Info byte 1	00
8	Info byte 2	00
	Info byte 3	HighByte(xcwCVN_[N]OK)
9 10	Info byte 4	LowByte(xcwCVN_[N]OK)
11	checksum	xx

7.5.8 Control Unit Acknowledgment

This response from the control unit represents an acknowledgment that the request has been received, or includes an acknowledgment code giving the reason for the rejection of a requested answer marked.

Acknowledgment codes:

Confirmation:	00h - 10h	Request accepted; confirmation
Request status:	- 11h -	General refusal without giving reasons
	12h -	Fashion is not supported
	13h -	Request not supported or invalid format
	21h -	Incomprehensible request
	22h - 31h	busy
	-	Operating conditions not correct
		Request outside the allowed range

Byte acknowledge block		SG -> TG
1 mode - byte 2		7F
	Demand mode	xx
3 acknowledgment code		xx

With regard to the data structure, the test modes are based on the SAE J2190 regulation (MODE 81 = diagnosis start). Corresponding response modes have an offset of +40 hex.

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7.5.9 Diagnosis - Start

With this diagnosis - test - mode, the TG demands the information at "quick access". specifying the block format. The TG transmits according to the wake-up pattern} (WuP, see Chapter "Initialization using a wake-up pattern") this request block.

byte request block	TG->SG
1 mode byte	81

The SG responds with keywords 1 and 2:

byte response block	SG -> TG
1 mode byte	C1
2 keywords 1	C4
3 keywords 2	46

keyword 1	Keyword 2	block format
C2	46 46 46	Length information in the type byte
43		Length information in the opt. length byte
C4		SG understands both block formats

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7.6 Description of the parameter blocks

bitmask	Bit value	software switch xcwDIASCH	
0000 0001 0		0	Parity check stimulus word off
		1	Parity check stimulus word on
0000 0010 1		0	even parity
		1	odd parity
0000 0100 2		0	Login request off
		1	login request
0000 1000 3		0	Custom bytes off
		1	Custom bytes
0010 0000 5		0	checking the block counters
		1	checking the block counter
1000 0000 7		0	Length WSC / parameter coding = 3 bytes
		1	Length WSC / parameter coding = 4 bytes

bitmask	Bit value	software switch cowFUN_COM	
0000 0001 0		0 KW71 protocol active	
		1 KW71 protocol disabled	
0000 0010 1		0 KW2000 protocol active	
		1 KW2000 protocol disabled	
0000 0100 2		0	Blink code active
		1	Blink code disabled
0000 1000 3		0 McMess protocol active	
		1	McMess protocol deactivated
0001 0000 4		0 CARB active (only if KW2000 protocol is active)	
			CARB deactivated (even if KW2000 protocol is active)

Surname	communication header
xcwSGADR	While the communication is being established, the test device sends a Control unit address (0 ... 127) sent to the control unit (without parity). This must match xcwSGADR.
xcwADRCARB	This is reported after the CARB stimulation via the address word 33h control unit with this address.
xcwKeybyt1	1. Keybyte - is sent from the control unit to the tester (0 ... 255).
xcwKeybyt2	2. Keybyte - is sent from the control unit to the tester (0 ... 255)
xcw_n_stimulus	The average speed dzoNmit must be <= xcw_n_stimulus (0 ... N_MAX) during the start of communication
xcwKSbyte1	Customer-specific byte 1: Via the diagnostic switch xcwDIASCH selectable (transmission to keybyte 2).
xcwKSbyte2	Custom byte 2
xcwKSCheck	Checksum over the customer-specific bytes
xcw_N_End	Abort speed KW71 - diagnosis

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Surname	communication timing
xcwt_sync	Duration after which the control unit, after receiving the SG address, Sync byte sends (µs).
xcwt_reaby	Duration from receiving a byte to sending a byte (µs).
xcwt_outby	Byte Timeout - The test device must send a byte within this time (µs).
xcwt_reabl	Period of time in which the control unit responds to a request block with a Response block should react (µs).
xcwt_outbl	Period of time in which the control unit expects a request block (µs).
xcwt_ini	Time from termination of stimulus detection to the beginning of the next Stimulus Detection (µs).
xcw_twti	Time from error memory deletion to error memory output, maximum time save for customization.
xcwFehzmax	Number of attempts to establish communication (0 ... 255)

Surname	ECU identification
xcwBHardNr	Bosch hardware no. (10 characters + 1 end character)
xcwBSoftNr	Bosch software no. (10 characters + 1 end character)
xcwKHSNr	Customer HW/SW number (11 characters + 1 end character)
xcwDate	Date of manufacture (MMJJ, 4 characters + 1 end character)
xcwSGBlk1	SG-ID 1 (25 characters + 1 end identifier) - is sent as the first block.
xcwSGBlk2	SG-ID 2 (9 characters + 1 end identifier) - is sent as the third block.
xcwSGBlk3	SG-ID 2 (9 characters + 1 end identifier) - is output as the change status for channel 80.
xcwSGfrID1	Message number of the ID of an additional control unit - (e.g. pump control unit for VP44)

Note: The end character FF(Hex) is generated automatically by DAMOS!

Surname	Passwords, actual usage is project specific
xcwPEEPROM	When logging in with this password, access to all E2PROM - functions released.
xcwPFGROn	The FGR / ADR can be switched on with this password.
xcwPFGROff	The FGR / ADR can be switched off with this password.
xcwPFGG1	Password FGG constant 1
xcwPFGG2	Password FGG Constant 2
xcwPHGBOff	Switch off password HGB
xcwPKSKon	Switch on password KSK for hot country
xcwPKSOff	Turn off password KSK
xcwPRDYm1	Password readiness for the next driving cycle
xcwPADV	Password ADR/ var. Maximum speed can be applied
xcwPADE	Password ADR/ fixed speed can be applied

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Name	Thresholds for actuator test
xcwDrSchw	Speed threshold for the actuator test, the activation of a control unit output and the basic setting
xcwMaIoTim	The maximum time for which an actuator test or the activation of a Control unit output is carried out.

Name (.._.. 1-40_1-4)	Measuring channel table
xcwK.._..	Number of an entry in **group table -** 255 stands for one dummy entry.
xcwK100on	redirects the specified channel to channel 100.

Name (.. from 1 - 21, last entry = 0)	actuator table
xcwstell..	Message number of the actuator - This number must be the Message number of a power stage.
xcwSt..TV	The maximum duty cycle with which the actuator can be controlled target (%).
xcwSt..Tim	Clock time - The actuator is for the time xcwStxxTim with xcwStxxTV controlled, then for the time xcwStxxTim with 100% - xcwStxxTV, .. This happens until the time xcwMaIoTim expires. (µs)
xcwCode..	Actuator Code - This code is sent from the SG to the tester as Identification sent for the controlled actuator.

Name (.. from 0 - 80)	measurement group table
xcwGrp.._A and enables	Standard Display Number - This number is sent from the SG to the tester it to display a formula measured value in physical units.
xcwGrp.._N	Normalized value - Is sent from the control unit to the test device and from used to calculate the physical measured value.
xcwGrp.._M	Message number of the measured value

Name (.._.. 125 - 129c1 - 4)	CAN - measuring channel table
xcwK..c..	Number of an entry in CAN bus subscriber table **-** 255 stands for one dummy entry.

Name (.. from 0 - 5)	measurement group table
xcwCAN.._X	Link mask with camRCSTAT
xcwCAN.._N	normalization value
xcwCAN.._M	Text number of the bus participant
xcwCAN_A	The standard display number is the same for all CAN measured value blocks

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Surname	Unnormalized measured value
xcwMWB_KF	output Message numbers for the unnormalized output of measured values on channels 190-199 and 0.

7.7 Error Codes

According to SAE J2012, error codes are made up of 2 bytes, with the first 4 bits (first nibble) identifying the area and the following three nibbles the BCD-coded error code.

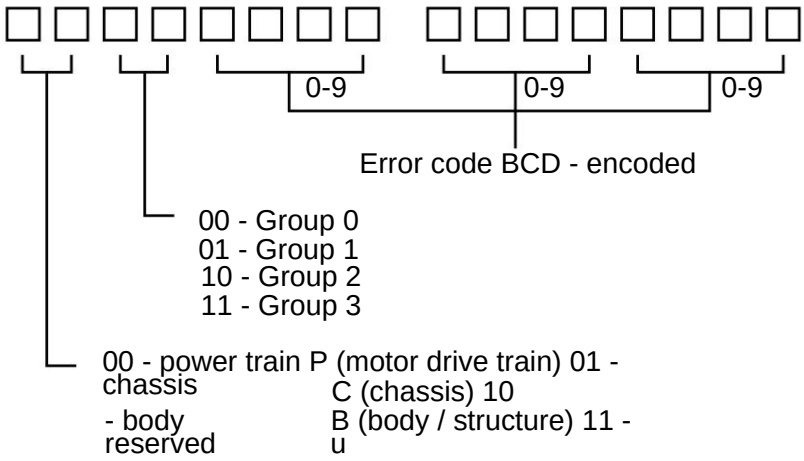


Figure XCOM08: Structure of the error codes according to SAE J2012

7.7.1 Error code list

The individual error paths of the engine drive train are to be applied according to the scheme indicated in SAEJ2012.

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7.8 McMess

McMess is a transmission protocol for communication between a control unit (SG) and a test device (TG). McMess has been optimized to use the K-line as a transmission medium. The K line is a digital single-wire interface with Ubatt level. the Information is transmitted asynchronously, similar to the V.24 standard. the Transmission units consist of 9 data bits as well as start and stop bits. The SG and the TG never send simultaneously. McMess allows the TG to quickly query RAM contents from the SG. That SG is minimally loaded compared to other protocols.

Definition of the address space:

McMess address	SG address	designation
0000 - 0FFF	F0000 - F0FFF or D8000 - D8FFF or E4000 - E4FFF depending on data set var.	system table
1000 - BFFF	F1000 - FBFFF or D9000 - E3FF or E5000 - EFFFF depending on data set var.	DAMOS - parameters, characteristics, maps
C000 - DDFF	C000 - DDFF	External RAM
DE00 - DEFF	DE00 - DEFF	Gate array - control register
DF00 - DFFF	DF00 - DFFF	OLDA
E000 - E7FF	E000 - E7FF	ExtendedRAM
E800 - EEFF	E800 - EEFF	reserved
EF00 - EFF	EF00 - EFF	CAN
F000 - F5FF	F000 - F5FF	Internal uC registers
F600 - FDFF	F600 - FDFF	Internal RAM
FE00 - FFFF	FE00 - FFFF	Internal uC registers

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The following function codes are implemented in the current McMess version:

- o) 02 read pp
- o) 04 Read var 1
- o) 07 Read var 2
- o) Read 0B ROM (Var 2, Var 1ÿ).
- o) Read 0D EEPROM (Var 2, Var 1ÿ).
- o) Read 0E RAM (Var 2, Var 1ÿ).
- o) Read byte (Var 1ÿ) of the requirements table
- o) Read 10 error memory (Var 2, Var 1ÿ).
- o) Read 13 SG identification (DAMOS identification) number (Var1ÿ).
- o) 1C Read checksum
- o) Trigger 2A system initial start (pp = ! = 11h)
- o) 25 Var1 : = pp (serves as address LSB)
- o) 26 Var2 := pp (serves as address MSB)
- o) 31 Byte(Var1ÿ) of the requirements table := pp
- o) Switch off 3B protocol (only if pp = EEh)
- o) Activate 3D ignition synchronous measurement
- o) Activate 3E time-synchronous measurement with menu like ignition-synchronous
- o) 4F output menu length for function 3D and 3E

In most functions, the variables Var1 and Var2 serve as addresses (Var1 as low byte and Var2 as high byte). The abbreviation pp stands for parameter and the sign “ÿ” stands for one Increase the variable by 1. More detailed information about the individual functions is the **See McMess specification 2/10 .**

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8 monitoring concept

8.1 Overview

This chapter describes monitoring algorithms and the corresponding replacement functions that are carried out when errors are detected. It's them Monitoring of all components and functions, every possible error bit (marked in italics in the text) and all parameters required for this described. All error bits and parameters are also listed in the index to make searching easier. Those associated with the error bits Error paths (see also Chapter **Error handling)** can be found in an overview in Appendix E. (For data of the form cowFARFAB .., cowFLDRAB .. or cowFMEBEG.. the dots at the end represent the numbers 1,2,3 or 4.)

Structure of the table:

monitoring from	**monitoring strategy**	**Data**	**substitute function**	**Data**
What is monitored	How is it monitored	Which parameters are used for The supervision needed	What happens if the monitoring detects an error := **substitute function**	parameters for the substitute function

! " #

$" # % &

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8.2 Exhaust gas recirculation (ARF)

monitoring from	monitoring strategy	Data	substitute function	Data
control deviation	It is monitored for positive (error fbbEARSpR) or negative (error fbbEARSnR) deviation. If the control deviation for the time fbwEARSpRA or fbwEARSnRA exceeds the value + aroEmax or -(aroEmax), errors are detected. The aroEmax value is derived from the maps arwEmaxGKF and arwEmaxFKF determined depending on the air mass target value, speed and quantity. Monitoring only takes place if aroEmax <= arwEueAUS.	arwEmaxGKF arwEmaxFKF arwEueAUS	Shutdown of the ARF Deactivation of the LDR (applicable) Full load limitation (applicable)	cowFLDRAB. cowFMEBEG.

8.3 Exhaust gas recirculation actuator (AR1, AR2, AR3)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEAR1_O is set.		Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	cowCOLORF. cowFLDRAB. cowFMEBEG.
power amplifier short circuit	The error fbbEAR1_K is set in the short circuit status of the output stage.			
status line	The function of the control valve is monitored via a status line. After K15, a change from LOW to HIGH , must be a flan can be detected on the status line. Is the line to start on HIGH or LOW for too long (t > arwRK_LT) or not in the HIGH state long enough afterwards (t <arwRK_HT), the status line is assumed to be defective and the error bit is fbbEAR1_S set.	arwRK_HT arwRK_LT	Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	cowCOLORF. cowFLDRAB. cowFMEBEG.
damper	If the level of the status line is LOW, a defect in the control valve is signaled and the error bit fbbEAR1_D is set.		Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	cowCOLORF. cowFLDRAB. cowFMEBEG.
power amplifier Neutral	If the power stage is idle, the error fbbEAR2_O is set.		Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	cowCOLORF. cowFLDRAB. cowFMEBEG.
power amplifier short circuit	The error fbbEAR2_K is set when the output stage is short-circuited.			
power amplifier Neutral	If the power stage is idle, the error fbbEAR3_O is set.		no	
power amplifier short circuit	The error fbbEAR3_K is set in the short circuit status of the output stage.			

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8.4 Adaptive Cruise Control (ACC)

monitoring from	monitoring strategy	Data	substitute function	Data
fade out the mistake monitoring	In general, the error detection of the errors fbbEACC_B, fbbEACC_C, fbbEACC_D, fbbEACC_F, fbbEACC_Q, fbbEACC_V, fbbEACC_P and fbbEACC_A stopped when the hiding of the CAN error monitoring is active. The suppression of the CAN error monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants is not required (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date Error fbbEACC_Q in debouncing reset.			
"ADR defective" via CAN	If the bit "ADR defective" is set in the ADR1 message, the error fbbEACC_D is reported		Deactivation of the ACC intervention via ramp to 0.	
error detection in current f.	If the error code 0xFFH is recognized at the requested moment, the error fbbEACC_F is reported.		Deactivation of ACC intervention via ramp to 0.	
requirement below v threshold	If requested at a speed below the threshold mrwFAS_BVK moment, the Error fbbEACC_V reported.	mrwFAS_BVK	Deactivation of the ACC intervention via ramp to 0.	
requirement implausible	Used during OFF signal from control panel (NOT (dimFGA AND dimFGL)) or driver braking (dimBRE OR dimBRK) Moment requested, the error fbbEACC_P is reported		Deactivation of the ACC intervention via ramp to 0.	
CAN error	If no new message is received for the time caw..._RTO or the message content is inconsistent (with two immediately consecutive attempts to read out the data of the message, the content already partly overwritten again), the error fbbEACC_Q is reported when the hiding the CAN error monitoring is not active. Until the error is finally defective, the last valid message is used as a substitute value.		Deactivation of the ACC intervention via ramp to 0.	
Checksum error GRA message	If the checksum is correct (or incorrect), an error counter is decremented (or incremented) to 0 (or mreACC_Cog). If the error counter exceeds the value mreACC_Cmx, the error fbbE ACC_C is reported.	mrwACC_Cmx mrwACC_Cog	Deactivation of the ACC intervention via ramp to 0.	
Message counter implausible	If the value of the current message counter differs by more than mrwACC_Bmx from the previous value, the error fbbEACC_B is reported. Likewise, if the message counter does not change over more than mrwACC_Bmn main program periods.	mrwACC_Bmx mrwACC_Bmn	Deactivation of ACC intervention via ramp to 0.	
General plausibility	In order to avoid clocked incorrect operation of the ACC without error detection, a counter is increased by the value 10 in each main program cycle in which an event occurs that reports one of the errors fbbEACC_B, fbbEACC_C, fbbE ACC_D, fbbEACC_F, fbbEACC_V, fbbEACC_P, otherwise decreased by 1. If the counter exceeds the threshold mrwACC_Amx, the error is event-driven fbbEACC_A entered	mrwACC_Amx	Shutdown of the ACC intervention ramp to 0.	

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8.5 Working speed controller (ADR)

monitoring from	monitoring strategy	Data	substitute function	Data
rule deviation	It is monitored for positive (error fbbEADRpR) or negative (error fbbEADRnR) control deviation. If the control deviation for the time fbwEADRpRA or fbwEADRnRA exceeds the value mrwADR_pRA or mrwADR_nRA is detected as an error.	mrwADR_pRA mrwADR_nRA	Deactivation of the ADR	

8.6 Atmospheric pressure sensor (ADF)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (error fbbEADF_H), if anoU_ATM > anwADF_MAX Signal range check down (error fbbEADF_L), if anoU_ATM < anwADF_MIN	appADF_MAX appADF_MIN	A substitute value calculated from the boost pressure is used (see chapter input signals). If the LDF is defective, the VGW anwADF_VOR used.	anwADF_VOR

8.7 Battery voltage (U_BAT)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (fbbEUBT_H error) if anoU_UBAT> anwBAT_MAX Below the vehicle speed threshold anwBAT_FG, the signal range check is raised (Error fbbEUBT_H) hidden. The error is healed without blanking. Signal range check down (fbbEUBT_L error) if anoU_UBAT < anwBAT_MIN	appBAT_MAX appBAT_MIN anwBAT_FG	default value	anwBAT_VOR

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8.8 Brake contacts (BRE, BRK)

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility main with red undantem brake contact	**Brake signals implausible:** A decision is made as to whether the brake signals are implausible if only one signal is logically active. **Dynamic defect detection:** Every time for a time t_dyn > threshold diwtBREdyn uninterrupted an implausible Brake signal status is present, a provisionally defective brake contact is detected and a counter dioBREPLAU incremented. This counter is subsequently saved as dimBREPLAU in the EEPROM. If the counter exceeds a fixed value diwPBREdyn, the brake contacts become defective detected (error fbbEBRE_P). The dynamic defect detection is deactivated using diwPBREdyn = 255. **Static defect detection:** A defective brake contact is detected if implausible for a time t_stat > diwtBREsta Brake signal states are present. The time t_stat is the accumulated time of the implausible states without interim detection of plausible brake signals (see below, intact detection). Show both signals same state, the debounce time t_stat is stopped. The value diwtBREsta = 655350000 µs deactivates the static defect detection. **Braking signals plausible:** A decision is made on plausible brake signals if both signals have the status for the time diwtBREiO "Braking" (when this condition is met, the time t_stat is reset) and then both signals display the "Non-braking" status for the time diwtBREiO. In this case, the counter di oBREPLAU is reset to 0. **Intact detection:** The error fbbEBRE_P "brake contacts implausible" is healed during operation if in fbwEBRE_PB specified number of "plausible brake signals" can be detected. The intact detection is at dioBREPLAU > 0 reset. **A notice:** The detection of "static errors" serves as a supplement for errors with e.g. E.g. over the driving cycle there is a constant error pattern (plug on the brake pedal has fallen off - only effective if the input wiring of the two signals is the same). Both defect detections act on the error bit fbbEBRE_P, where Due to the debouncing already contained in the detection over time/counter the value fbwEBRE_PA to be applied to 0.	fbwEBRE_PA diwtBREdyn diwPBREdyn diwtBREsta diwtBREiO	Shutdown of the FGR	

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8.9 Onboard power supply control unit (BSG)

monitoring from	monitoring strategy	Data	substitute function	Data
CAN message BSG_Last, message error	Message timeout BSG_Last: Is the receipt of the CAN message BSG_Last applied (cowVAR_BSG=2) the time between two messages is monitored. Will caw for the time..._RTO no new message received or the content of the message is inconsistent (in two consecutive attempts to read out the data of the message, the content was already partial again overwritten), substitute data from the substitute data bytes caw100_DTx are processed. From this The error fbbEBSG_Q (time-controlled) is reported as long as the error condition is present, if the suppression of the CAN error monitoring is not active. The suppression of the CAN error monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants is not required (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date Error fbbEBSG_Q in debouncing reset.	fbwEBSG_QA fbwEBSG_QB fbwEBSG_QT		

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8.10 CAN bus (CA0)

monitoring from	monitoring strategy	Data	substitute function	Data
bus error	If the CAN module is in the bus-off state (camSTATUS0.1), the error fbbECA0_O is reported unless one of the hide conditions for the CAN monitoring is active. The CAN is after Flow of cawINF_TBO reinitialized. If the CAN block is in the warning state (camSTATUS0.3), the error fbbECA0_W is reported, unless one of the masking conditions for the CAN monitoring is active. The suppression of the bus monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants cannot be assumed and is therefore not intended. The suppression of the CAN monitoring is active as long as • the start takes place (camSTATUS0.8 = 1; mrmSTART_B=1 and dzmNmit<0 or t<cawINF_INI), • the overrun is active (camSTATUS0.9 = 1), • the voltage of the K15 anmK15 < anwK15_H_U (camSTATUS0.10 = 1) is (at anmK15 > anwK15_H_O this condition is released again) • the cawINF_DLY delay time after the above conditions have disappeared has expired. An error fbbECA0_O that may already be currently in debouncing is reset. (for a detailed description of camSTATUS0 see monitoring "External quantity intervention via CAN") The masking of the bus monitoring is only terminated after there is no longer a reason for masking and the delay time cawINF_DLY has then expired.	cawINF_INI cawINF_DLY anwK15_H_U anwK15_H_O	CAN quantity interventions are aborted. The monitoring of the transmission/brake message timeout is hidden (see external quantity intervention/transmission). If Ecomatic is applied via CAN like this will be for the rest of the driving cycle Ecomatic disabled.	

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8.11 Crash Detection (CRA)

monitoring of	monitoring strategy	Data	substitute function	Data
GRA and fuel shutdown	The input of the function can be switched using the switch cowFUN_CRA (0=no/1=PWM/2=CAN). The PWM evaluation supplies crmCRSTpwm to the crash detection, while the airbag1 message (byte 0, bits 5-7) is used for the crash detection via CAN. The crash level croCR_STAT can have values from 0 to 3. The following table shows the assignment of the crash levels:	fbwECRA_A. fbwECRA_B.	The error fbbECRA_A leads to switching off the GRA. The error fbbECRA_B turns off the engine and interrupts the fuel supply (EKP, TAV, TIP).	

CAN bits 5-7 crash level crash designation no crash		
0 0 0	0	
0 0 1		belt tensioners
0	1 2	U.S
1x1xx	3	RDW

Figure UEBE_08: Crash levels

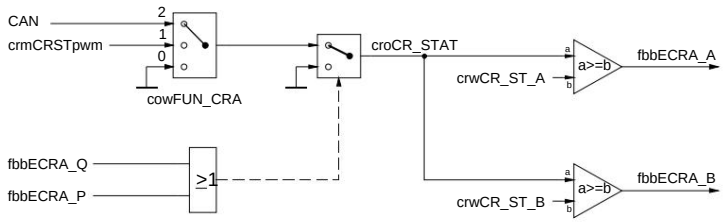


Figure UEBE_07: Overview of crash detection

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Continued crash detection

monitoring from	monitoring strategy	Data	substitute function	Data
CAN message Airbag 1, message error	Message timeout airbag 1: For vehicles with crash detection via CAN (cowFUN_CRA=2). monitors the time between two messages. If no new message is received for the time caw..._RTO or if the message content is inconsistent (with two consecutive attempts, read out the data of the message, the content was already partially overwritten), then the Error fbbECRA_Q (time-controlled) reported if the hiding of the CAN error monitoring is not is active. If the error fbbECRA_Q is finally defective, the crash level is set to zero. The suppression of the CAN error monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants is not required (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date Error fbbECRA_Q in debouncing reset.	fbwECRA_QA fbwECRA_QB fbwECRA_QT	The crash detection via CAN is switched off. The crash level is set to 0.	
PWM crash signal	With crash detection via PWM, the airbag SG sends a PWM signal to the motor SG to signal a crash. In normal operation (no crash) the PWM signal is 40 ms low and 200 ms high. In the event of a crash, 20x sent the inverted signal: 40ms high and 200ms low. The evaluation takes place with a signal time tolerance of +-20% (see chapter 9.1.9). At least an applicable number of crash signal sequences (crwPWM_ANZ) must be recognized before the signal is evaluated as a crash event. If the PWM signal is evaluated as a crash event, the GRA AND fuel are switched off. This done by setting crmCRSTpwm to the crwCR_ST_B crash level. If a no-crash signal sequence is detected, crmCRSTpwm is supplied with crash level 0. In the case of an implausible PWM signal (spikes or flat line: detected by timeout crwCR_TOUT!), crmCRSTpwm with the Crash level 0 supplied and reported the error fbbECRA_P defective.	fbwECRA_PA fbwECRA_PB fbwECRA_PT	The crash detection via PWM is switched off.	

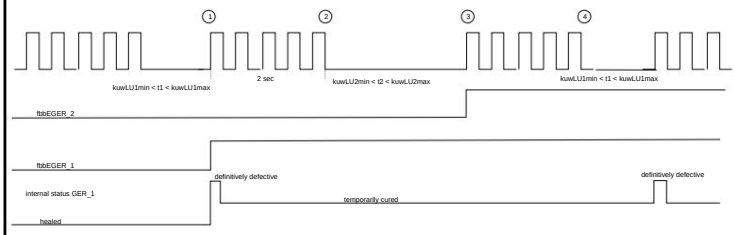
8.12 Electric fan - power stage (GER)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEGER_O is set.		no	
power amplifier short circuit	The error fbbEGER_K is set in the short circuit status of the output stage.			

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Fan 1 or Fan 2 blocked	The cooler fan output stage (KLE) reports to the MSG via the bidirectional PWM line (SG pin 11; for VM+) whether the fans are working or not. The KLE pulls the line LOW for a certain time. The distinction between fan1 and fan2 is realized by the duration. Fan1 blocked is detected when the PWM line was pulled to LOW for a time between kuwLU1min and kuwLU1max. The labels kuwLU2min and kuwLU2max apply to fan 2. Tolerance must be included in these labels. The line is released again between the LOW phases. If a fan is reported as defective, the output stage remains activated so that any errors can be corrected. Application note: Example: PWM signal is between the ground keys for 2 sec. released => fbwEGER_xB must be applied greater than 40 events.  1. The error is finally reported as defective, since the number of defect reports is set to 0. However, the error status immediately changes back to provisionally healed, since the signal is ok again for two seconds. 2. During these two seconds, the error counter is decremented by 20 in total. (The task runs in the 100ms disc. In two seconds, it comes up 20 times. The counter is decremented by one for each task run.) 3. The error fbbEGER_2 is finally reported as defective, since the number of defect reports is applied to 0. However, the error counter of fbbEGER_1 remains at the previous value. 4. The error counter of fbbEGER_1 was decremented by another 20. The error fbbEGER_1 is finally reported defective again, since the number of defect reports is applied to 0. This reinitializes the error counter. The error fbbEGER_1 remains definitively defective.	kuwLU1min kuwLU1max kuwLU2min kuwLU2max	no	

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8.13 External quantity intervention/gear (EXME)

defect detection

monitoring from	monitoring strategy	Data	substitute function	Data
AG4 shift switch signal timeout	In vehicles with an AG4 gearbox, the quantity is reduced via a switching signal (AG4-E). If this signal is longer than the error debounce time, the error fbbEAG4_L is set. If this signal is again inactive in state AG4 for the healing debounce time, the error reset.		Cancellation of the quantity intervention and deactivation Switch to normal function	
ECOMATIC switching signal Time-out	In vehicles with ECOMATIC, the engine is switched off via a switching signal (AG4-E). If the level of the dimECO signal does not go to high within the ecwINIT_T time after a SG reset the error fbbEECO_L is set.	ecwINIT_T	Deactivation of the ECOMATIC	
CAN message Transmission 1, message error EGS intervention	Message error gearbox 1: With electronic gearbox controls via the CAN BUS with the communicate with the control unit, the time between two messages is monitored. Will for the time caw._RTO no new message received or the message content is inconsistent (in the case of two immediately consecutive attempts to read out the message data, the content was already back partially overwritten) or there is a CAN defect (bit 0, bit 1 or bit 2 is set in camSTATUS0), the status bit mrmEGSSTAT (.4) is set and the quantity intervention ends. From this point on, as long as the error condition is present, the error fbbEEGS_1 (time-controlled) reported if the masking of the intervention monitoring is not active. The suppression of the intervention monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants cannot be assumed (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date Error fbbEEGS_1 in debouncing reset.	mrwCANAUSB	Below V threshold limitation of Desired quantity through the starting torque characteristic mrwANFAHKL (continuous). Above the V threshold, there is a ramp-like increase in the amount of intervention on mrwM_EMAX. Bit mrmEGSSTAT (.7) is set (information transmission intervention cannot, or not carried out in full)	mrwANFAHKL mrwV_ANFAH mrwEGSRAMP mrwM_EMAX
CAN message Transmission 1, EGS intervention	Intervention moment invalid: The EGS intervention becomes invalid when the EGS request bit mrmEGSSTAT (.5) is not set, or the EGS intervention moment with the error code mrmEGS_roh = 0xFFH is occupied. No errors are entered. Timeout: If the time monitoring of the EGS intervention is activated via mrwEGSbegr, and the current EGS intervention has exceeded the applied intervention time mrwEGS_TIM, the error fbbEEGS_A is set.		Abort behavior as with message timeout EGS, as a special case, the intervention without a ramp is terminated at neutral value mrmEGS_roh = 0xFEH The EGS intervention quantity mroM_EEGS is set to zero, in addition there is a Cancellation of the speed sync. ASG crowd intervention	mrwEGSbegr mrwEGS_TIM mrwASGRAMP

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8.14 External quantity intervention/brake (ABS)

monitoring from	monitoring strategy	Data	substitute function	Data
CAN message Brake 1, message error monitored by ASR and MSR - intervention	Message error brake 1: In vehicles with ASR/MSR control, the time between two messages is monitored. If no new message is received for the time caw.._RTO or if the message content is inconsistent (in two consecutive attempts to read out the message data, the content was already partially overwritten) or there is a CAN defect (in camSTATUS0 bit 0 , Bit 1 or bit 2 set) the status bits mrmMSRSTAT (.4) and mrmASRSTAT (.4) are set and the current quantity intervention ends. From this point in time, as long as the error condition is present, the error fbbEASR_Q (time-controlled) is reported if the hiding of the intervention monitoring is not active. The suppression of the intervention monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants cannot be assumed (see chapter CAN - suppression of errors of the external control unit intervention). During the hiding of the error monitoring, the debouncing times of the error fbbEASR_Q that may already be currently being debounced are reset.		Shutdown via ramp to 0 (MSR) or mrwM_EMAX (ASR). Acknowledgment bit brake in message engine 1 is irreversibly set for the driving cycle after the debouncing time fbwEASR_QA. Bit mrmASRSTAT (.7)/ mrmMSRSTAT (.7) is set (information in message engine 1 - brake intervention cannot be carried out or not fully carried out)	mrwMSRRAMP mrwASRRAMP mrwM_EMAX
CAN message brake 3	If no new brake 3 message is received for the time caw..._RTO or if the message content is consistent (in the case of two immediately consecutive attempts to read out the data of the message, the content was already partially overwritten again) and blanking of the CAN monitoring is not active (mrmAUSBL=0) an error fbbEAS3_Q is reported.	caw..._RTO		
CAN message brake 1, validity Intervention MSR	A MSR intervention moment mroMD_MSR becomes invalid if: - the intervention moment of the MSR (mrmMSR_roh) does not correspond to the binary complement of the ASR (mrmASR_roh) OR - the received moment mrmMSR_roh is occupied with the error code 0xFFH OR - the MSR request bit mrmMSRSTAT (.5) = 0 is OR - the MSR request bit mrmMSRSTAT (.5) = 1 AND the ASR request bit mrmASRSTAT (.5) = 1 is No errors are entered.		Shutdown of intervention via ramp to 0, is also the moment received mrmMSR_roh on the neutral value 0, it is switched off without a ramp.	mrwMSRRAMP
CAN message brake 1, validity ASR intervention	An ASR intervention moment mroMD_ASR becomes invalid if: - the received moment mrmASR_roh is occupied with the error code 0xFFH OR - the ASR request bit mrmASRSTAT (.5) = 0 OR - the ASR request bit mrmASRSTAT (.5) = 1 AND the MSR request bit mrmMSRSTAT (.5) = 1 No errors are entered.		Shutdown of the intervention via ramp on mrwM_EMAX, is also the received torque mrmASR_roh on the neutral value 0xFEH, it is switched off without a ramp.	mrwASRRAMP mrwM_EMAX

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CAN message Brake 1, physical plausibility MSR	An MSR moment becomes implausible when the integral moment W $W_{MSR} = \int_0^t (M_{MSR_Gradient} - M_{MSR_Ref})$ exceeds the threshold mrwMDIntMX and the error fbbEMSR_H is reported defective. The intervention is then considered plausible again only when the integral moment is 0 again and with it the error fbbEMSR_H is reported as good. In order to allow the intervention again, the MSR moment must at least once reach the neutral value.	mrwMDIntMX	shutdown of the MSR intervention ramp to 0.	mrwMSRRAMP
CAN message Brake 1, functional plausibility MSR	If the reference speed of the ABS control unit is valid, then the MSR intervention becomes functional implausible if the reference speed V_AKT (of brake 1) <mrwMSRFG_L and the error fbbEMSR_P is reported defective. This error can no longer be cured in the same driving cycle. If the error is finally defective, the MSR intervention is aborted and in this driving cycle no longer allowed.	mrwMSRFG_L	shutdown of the MSR intervention ramp to 0. Block all further ASR/MSR interventions	mrwMSRRAMP mrwASRRAMP mrwM_EMAX

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8.15 External quantity intervention/automatic gearbox (ASG/VL30)

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility transmission over setting message Gear_1	It is sent from the transmission transfer function mrmGTR_UEB with an SG internally determined value fgmFVN_UEB (drive train transfer function, determined from driving speed fgmFGAKT [km/h], engine speed dzmNmit [rpm] and distance factor fgwDA._SF [pulses/m]) compared. If the difference of the two transfer functions is longer than the debounce time is greater than that Maximum of the two times the factor mrwFVHGTdi, and none of the hide conditions is active (transmission in neutral (mrm_P_N = 1), clutch actuated (dimKUP = 1) or SRC error transmission ratio (fbbEASG_L)), the error fbbEASG_U is set (Attention: no storage in EEPROM desired).	mrwFVHGTdi default	value for translation mroFVHUEst.	mrwFVHVGWU
signal range gear ratio message Gear_1	The signal range is only monitored if the transmission is not in P or N position (mrm_P_N = 0). Signal range check (error fbbEASG_L) if mrmGTR_UEB <mrwFVHUEun or if mrmGTR_UEB > mrwFVHUEob.	mrwFVHUEun mrwFVHUEob	As with plausibility gear ratio fbbEASG_U. Default value for transfer function mrmGTR_UEB.	mrwFVHVGWU
CAN message gear_1, evaluation of EGS coding	The evaluation of the EGS coding in the engine SG is activated with cowECOMTC.5 == 1. The error bit fbbEASG_M is set when the bit "EGS coding in the MSG" S_KOD = 1 (= not in Order).		The error fbbEASG_M triggers the fuel shutdown (regardless of the start bit).	
plausibility EDC/CAN gear	Is the EDC gear mrmGANG longer than the debouncing time unequal to the gear information of the CAN message transmission 1 mrmGTRGANG and none of the fade-out conditions are active (transmission in neutral position (mrm_P_N = 1), clutch actuated (dimKUP = 1) or SRC error transmission ratio (fbbEASG_L)), the error fbbEASG_G is set.			
CAN message gear 2, message error	If no new gearbox2 message is received for the time caw..._RTO or if the message content is consistent (in the case of two immediately consecutive attempts to read the data of the message the content was already partially overwritten) an error fbbEASG_Q is reported. From this point on, as long as the error condition is present, the error fbbEASG_Q (time-controlled) reported if the masking of the intervention monitoring is not active. The suppression of the intervention monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants cannot be assumed (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date Error fbbEASG_Q in debouncing reset.	caw..._RTO	Cancellation of the speed synchronizing crowd intervention	MrwASGRAMP

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message counter implausible	If the value of the current message counter differs by more than mrwASG_Bmx from the previous value, the error fbbEASG_I is reported. Likewise, if the message counter is a Main program period does not change. In any case, the function is switched off as soon as the message counter is identified as defective.	MrwASG_Bmx CowECOMTC.6	The error fbbEASG_I represents the engine away.	
CAN message gear_2, functional plausibility Synchronize ASG speed.	Speed intervention by the ASG is only possible if the dimKUP clutch bit is set (clutch open during shifting). If a speed requirement is detected when the clutch is closed/controlled, the error fbbEASG_P is reported. The replacement function occurs without error debouncing. After error debouncing has expired, another intervention is only possible after the conditions for resuming have been met. The replacement function is only withdrawn after the error has been corrected. With CAN blanking, this error is neither reported nor healed. The substitute function still occurs. see also chapter Quantity control, ASG intervention		Cancellation of the speed synchronizing crowd intervention	MrwASGRAMP
CAN message gear_2, physical plausibility Synchronize ASG speed.	An ASG speed request is implausible if the integral torque W $W_{FM}(German_{ASG}) = \int_0^T (German_{ASG} - German_{re\,is})$ exceeds the threshold mrwMDIntAX and the error fbbEASG_H is reported defective. The intervention is then considered plausible again only when the integral moment becomes 0 again and thus the Error fbbEASG_H is reported as good. In order to allow the intervention again, the ASG speed request must reach the resumption conditions (neutral value 0, etc.) at least once. With CAN blanking, this error is neither reported nor cured. The friction torque is only deducted when the amount of intervention mrmM_EASG = 0 is.	mrwMDIntAX	Cancellation of the speed synchronizing crowd intervention	mrwASGRAMP
CAN message gear_2, functional plausibility ASG speed sync.- threshold	A speed intervention by the ASG is only allowed if the current driving speed fgmFGAKT ÿ the speed threshold is mrwASGvmin. If this threshold is violated when a speed request is made, a new intervention can only take place after the achievement of the readmission conditions. There is no error entry.	mrwASGvmin	Cancellation of the speed synchronizing crowd intervention	mrwASGRAMP
collective error for error memory entry failure of CAN transmission Embassies	A total of 5 errors can be applied via the mask mrwMSK_FGT, their states are additionally summarized in a separate error bit fbbEASG_S. This is intended to prevent the timeout errors of both CAN messages for gearbox 1 and Transmission 2 and consequential errors are entered in the error memory. Any fault selected must be so be applied that it is not entered in the error memory. If one of these errors now becomes defective reported, the error bit fbbEASG_S is reported defective without error debouncing (applied) and im Error memory entered. Mask mrwMSK_FGT: xxxxxxx1 b fbbEEGS_1 xxxxxx1x b fbbEASG_Q xxxxx1xx b fbbEASG_P xxxx1xxx b fbbEASG_G xxx1xxxx b fbbEASG_H	mrwMSK_FGT		

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CAN message Gear 2, timeout for VL30 intervention	As soon as the VL30 transmission requests a valid LL target speed > zero, debouncing of the error fbeECVT_Q is started. If the intervention is not completed before the debounce time fbwECVT_QA has expired this error detected defective, set the bit mroCVTSTAT.2 and a LL target speed request mrmN_LLCAN = zero sent to the LL target speed calculation. Once the gear itself again LL setpoint speed = zero, error recovery is started.	fbwECVT_Q.	Termination of intervention by setting to zero the request mrmN_LLCAN.	
CAN message Gear 2, limitation of the from the VL30 onwards required N LL target	As soon as the requested N-LL target (from mroN_LLCAr) exceeds the value mrwCVTNLLM converted requirement mrmN_LLCAN limited to this value and bit mroCVTSTAT.1 set, however, the intervention remains valid. This threshold must be chosen because of the redundant thrust monitoring smaller mrwLLR_AUS.	mrwCVTNLLM Limit the intervention	mrwCVTNLLM.	
CAN message gear 2, reception of error detection from the VL30 transmission	If the requirement of the transmission (in mroN_LLCAr) is equal to 0xFF, bit mroCVTSTAT.3 is set and a LL target speed requirement mrmN_LLCAN = zero sends to the LL target speed calculation ge. However, no error is reported.		Termination of intervention by zeroing the request mrmN_LLCAN.	
CAN message gear 2, signal range	Signal range check up (error fbbECVT_H) if mrmN_LLCAN> mrwCVTNmax Signal range check down (error fbbECVT_L) if mrmN_LLCAN <mrmCVTNmin	mrwCVTNmax mrwCVTNmin fbwECVT_H. fbwECVT_L.	Termination of intervention by setting to zero the request mrmN_LLCAN.	

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8.16 Ground Speed Signal (FGG)

monitoring from	monitoring strategy	Data	substitute function	Data
Signal range If the	driving speed is fgmFGAKT> fgwDA1_VMA (or fgwDA2_VMA), the error fbbEFGG_H set. (fgwDA1_VMA > 40 km/h or fgwDA2_VMA > 40 km/h)	fgwDA1_VMA fgwDA2_VMA	The VGW fgwDA1_VGW or fgwDA2_VGW is used. The selection is made using an ISO login request (password xcwPFGG1, xcwPFGG2 and VGW cowFUN_FGG) Shutdown of the FGR Shutdown of the air conditioning compressor	fgwDA1_VGW fgwDA2_VGW xcwPFGG1 xcwPFGG2 cowFUN_FGG
High level duration monitoring (only applies to Kienzle tachograph)	After successfully determining the route factor (number of measurements in the tolerance band fgoHPDC = fgwKTG_ANZ) the high level duration (HPD) is reset. If the current HPD leaves the tolerance band, the error is reported to fbbEFGG_S in an event-driven manner. After detection on finally def. is switched to default value fgwDA.._VGW for the driving speed.		default value	fgwDA._VGW
Frequency range I	the input frequency exceeds the value 5 kHz permitted by the system, the error becomes fbbEFGG_F set. This error no longer heals. Is not monitored at vehicle speed via CAN.		Shutdown of the FGR Shutdown of the air conditioning compressor	
error detection receive / CAN problem	When measuring the driving speed via CAN, the error fbbEFGG_C is reported as soon as the error identifier 0xFF is received in the CAN message instead of the speed, or if no valid message was received (timeout caw..._RTO expired or data inconsistent) AND the CAN monitoring (message timeout error) is hidden. Debouncing this error should be in the Follow-up can be prevented, fbwEFGG_CA should be shorter than mrwCANAUSB applied. See also Chapter CAN.		Switch to default value.	fgwDA1_VGW fgwDA2_VGW
embassies Time-out	In the case of vehicle speed measurement via CAN, the error fbbEFGG_Q is reported as soon as the CAN message configured as the origin of the speed has the corresponding timeout error (fbbEASR_Q, fbbEKO1_Q or fbbEAS3_Q) has set. That happens to also in this case the appropriate trigger replacement reactions. The timeout errors are not reported if CAN masking is active is. fbbEFGG_Q should be debounced with zero (fbwEFGG_QA = 0) and applied to "replacement reaction without error memory entry" (otherwise: double error entry).		Switch to default value.	fgwDA1_VGW fgwDA2_VGW
plausibility with speed and Crowd	If the driving speed fgmFGAKT <mrwFAS_CNV **AND** the current amount mrmM_EAKT ÿ mrwFAS_CNM **AND** the speed dzoNmit ÿ mrwFAS_CNN **AND** the ADR quantity mrmM_EADR equal to zero **AND** [the function switch cowFUN_ADR.0 = 0 **OR** the handbrake contact is not activated dimHAN = **0]** the error fbbEFGG_P is set. This error no longer heals. mrmM_EAKT and mrwFAS_CNM are in code with daeFGR_RMo between wheel torque (1) and Torque (0) switchable.	mrwFAS_CNV mrwFAS_CNM mrwFAS_CNN cowFUN_ADR	The VGW fgwDA1_VGW or fgwDA2_VGW is used.	

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8.17 FGR control panel, variant LT2

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility FGR-V with remaining one walks	If one of the contacts FGR-A, FGR-W, FGR-+ or FGR-- is recognized as active, then (within half the time mrwALL_LT2) the control contact FGR-V must also be recognized as active, otherwise there is one Control panel defect before (error fbbEFGA_P). This error is event-driven, the error counter is therefore counted up by one with each actuation in which the control contact is not recognized as active within the time mrwALL_LT2.	mrwALL_LT2	Shutdown of the FGR	
plausibility FGR-V with remaining one walks	If the control contact is actuated and no other, then there is a control panel defect (error fbbEFGA_A). This error is event-driven, with each actuation of the control contact without prior Active recognition of another contact, the error counter is incremented.			
plausibility contact closure	In addition to the control contact, only one other contact may be active, otherwise the control panel is defective (Error fbbEFGA_X). This error is event driven.			

8.18 FGR control panel, VW variant

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility FGR-L with the remaining inputs	When the dimFGL control panel is switched off, one of the contacts FGR-A, FGR-W or FGR-+ becomes active detected, there is a control panel defect (error fbbEFGA_F).	mrwALL_DEF	Shutdown of the FGR	
plausibility FGR-A with FGR-W	If the resume contact dimFGW is recognized as active when the off switch dimFGA is actuated, there is a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF.	mrwALL_DEF		
plausibility FGR-A with FGR-+	If the acceleration contact dimFGP is recognized as active when the off switch dimFGA is actuated, then a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF will.	mrwALL_DEF		
plausibility FGR-+ with FGR-W	If the acceleration contact dimFGP is recognized as active when the resume dimFGW is actuated, so there is a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF.	mrwALL_DEF		

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8.19 FGR control panel, VW variant via CAN, "Locked on-off

monitoring from	monitoring strategy	Data	substitute function	Data
fade out the error monitoring	In general, the error detection of the errors fbbEFGC_Q, fbbEFGC_C, and fbbEFGC_B is stopped, if the suppression of the CAN error monitoring is active. The error fbbEFGC_Y becomes independent reported by the hiding, and the fbbEFGC_P error is reported if none of the errors fbbEFGC_Q, fbbEFGC_Y, fbbEFGC_B and fbbEFGC_S is present. The suppression of the CAN error monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants is not required (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date above errors in debouncing are reset.			
plausibility FGR-L with rest common inputs	When the dimFGL control panel is switched off, one of the contacts FGR-A, FGR-W or FGR-+ becomes active detected, there is a control panel defect (error fbbEFGA_F). This error can be detected using mrwALL_DEF be applied away.	mrwALL_DEF	Shutdown of the FGR	
plausibility FGR-A with FGR-W	If the resume contact dimFGW is recognized as active when the off switch dimFGA is actuated, there is a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF.	mrwALL_DEF		
plausibility FGR-A with FGR-+	If the acceleration contact dimFGP is recognized as active when the off switch dimFGA is actuated, then a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF will.	mrwALL_DEF		
plausibility FGR-+ with FGR-W	If the acceleration contact dimFGP is recognized as active when the resume dimFGW is actuated, so there is a control panel defect (error fbbEFGA_F). This error can be applied using mrwALL_DEF.	mrwALL_DEF		
plausibility FGR-L with GRA-Hpt.Sch.	If the information of the contact dimFGL ("locked on-off") at the digital input does not match the redundant information in byte 1 bit 0 (S_HAUPT) of the GRA or GRA_Neu message ("GRA/ADR - Main switch") match, there is a control unit error (error fbbEFGC_P).		Shutdown of the FGR	
CAN error	If no new message is received for the time caw.._RTO or the message content is inconsistent (with two immediately consecutive attempts to read out the data of the message, the content already partially overwritten), the errors fbbEFGC_Q and fbbEFGC_Y are reported. if the suppression of the CAN error monitoring is not active. In contrast to fbbEFGC_Q, the error fbbEFGC_Y is also reported when the hiding of the CAN error monitoring is active. He only serves to switch off the function and must be applied in such a way that no errors are stored is set (fbwEFGC_YT.1). Until one of the errors is finally defective, the last valid message is used as a substitute value.		Shutdown of the FGR	
Checksum error GRA message	If the checksum is correct (or incorrect), an error counter is decremented (or incremented) to 0 (or mrwGRA_Cog). If the error counter exceeds the value mrwGRA_Cmx, the error fbbEFGC_C reported. In any case, the function is switched off as soon as the checksum has been recognized as defective (counter > threshold ÿ mrmGRACoff.0). As soon as an incorrect checksum is detected, the last valid control panel state is frozen.	mrwGRA_Cmx mrwGRA_Cog	Shutdown of the FGR	

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embassies counter implausible	If the value of the current message counter differs by more than mrwGRA_Bmx from the previous value, the error fbbEFGC_B is reported. Likewise, if the message counter does not change over more than mrwGRA_Bmn main program periods. In any case, the function is switched off as soon as the message counter has been identified as defective (mrmGRACoff.1). As long as the counter is greater than the threshold, the message is evaluated.	mrwGRA_Bmx mrwGRA_Bmn	Shutdown of the FGR	
transmitter code tion implausible	If the GRA_Neu message to be received does not match the transmitter coding contained in the message with that which is determined by mrwMULINF0 (see driving speed control), the error fbbEFGC_S is reported.	mrwMULINF0	shutdown of the FGR	

8.20 Glow relay (GLR)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEGRS_O is set.		no	
power amplifier short circuit	The error fbbEGRS_K is set in the short circuit status of the output stage.			
plausibility with dimGZR	If the glow feedback dimGZR does not match the control of the output stage ehmFGRS (logical 0 or 1) match, the error fbbEGZS_I is reported.			

8.21 Glow time control (GZS)

monitoring from	monitoring strategy	Data	substitute function	Data
glow plug 1-6	If bit 0 - 5 is set in the message gsmGSK3_ST, the corresponding error bit fbbEGSK_1 - fbbEGSK_6 set.		no	
overcurrent	If there is overcurrent on any glow plug (gsmGSK3_ST.6), the error fbbEGZS_H is reported.			
transmission	In the event of a transmission error (gsmGSK3_ST.8 - gsmGSK3_ST.B, stop bit error, flatline low, flatline High, timeout) the error fbbEGZS_P is reported. There is a stop bit error if a low level was read in after 8 data bits. Flatline High, - Low There is an error if the same level has been read in 32 times. There is a timeout error if gsoCO_TO = 0. The counter is initialized with gswTO_INIT, and loaded with gswTO_REL after sending gsmGSK3_ST.	gswTO_INIT gswTO_REL		

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8.22 Main relay (HRL)

monitoring from	monitoring strategy	Data	substitute function	Data
shutdown of EDC	After recognizing KL15 = LOW **AND** after the time mrwNCL_DA (after-running debounce time) and Expiry of the time mrwNCL_N0 after reaching the speed 0, various cells in the EEPROM are processed and the time mrwNCL_SP started to allow any error storage. Thereafter takes place the fan control (time = kuot_NL) and then again the time for mrwNCL_SP Error memory activities awaited. Finally, the HRL is thrown (control CJ911). and after the error debounce time the error fbbEHRL_S set. Normally the voltage drops before the error debounce time has elapsed, otherwise the main relay "sticks" or there is another defect (eg defective CJ911). Warning: fbwEHRL_ST.7 must not be set, otherwise the error can no longer be deleted.	at V, M, P: mrwNCL_DA mrwNCL_N0 mrwNCL_SP at C: nlwNCL_DA nlwNCL_N0 nlwNCL_SP	no If KL15 = HIGH, a RESET occurs.	

8.23 Heating request (HZA)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (error fbbEHZA_H) if anoU_HZA> anwHZA_MAX Signal range check down (error fbbEHZA_L), if anoU_HZA < anwHZA_MIN	anwHZA_MAX anwHZA_MIN	default value	anwHZA_VOR

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8.24 Maximum speed limit (HGB)

monitoring from	monitoring strategy	Data	substitute function	Data
fade out the mistake monitoring	Generally, the error detection of the errors fbbENIV_Q, fbbENIV_C, fbbENIV_B, fbbENIV_P and fbbEALR_Q stopped when the hiding of the CAN error monitoring is active. The suppression of the CAN error monitoring prevents unnecessary error entries in the case of environmental conditions in which communication of all CAN bus participants is not required (see chapter CAN - suppression of errors of the external control unit intervention). While the error monitoring is being suppressed, the debounce times of the may already be up to date above errors in debouncing are reset.			
CAN error level1	If no new message is received for the time caw.._RTO or the message content is inconsistent (with two immediately consecutive attempts to read out the data of the message, the content already partly overwritten again), the error fbbENIV_Q is reported when the hiding the CAN error monitoring is not active.		Retaining the latest values of mrmHGB_Anf.0 and mrmHGB_Anf.1	
Checksum error NIV message	If the checksum is correct (or incorrect), an error counter is decremented (or incremented) to 0 (or mrwNIV_Cog). If the error counter exceeds the value mrwNIV_Cmx the error fbbE NIV_C is reported.	mrwNIV_Cmx mrwNIV_Cog	Retaining the latest values of mrmHGB_Anf.0 and mrmHGB_Anf.1	
Message counter implausible	If the value of the current message counter differs by more than mrwNIV_Bmx from the previous value, the error fbbENIV_B is reported. Likewise, if the message counter does not change over more than mrwNIV_Bmn main program periods. In any case, the function is switched off as soon as the message counter is identified as defective.	mrwNIV_Bmx mrwNIV_Bmn	Maintaining the latest values of mrmHGB_Anf.0 and mrmHGB_Anf.1	
Wrong code tion (motor in hunters)	If an implausibility between label cowFUN_HUN and the bit 'construction coding' in level 1, Byte5 Bit4 detected, the error fbbENIV_P is reported. In addition to hiding the CAN error monitoring, error detection is also stopped for this error if the message content of level 1 is faulty (fbbENIV_Q, checksum or message counter error).	cowFUN_HUN		
CAN error 4WD1	If no new message is received for the time caw.._RTO or the message content is inconsistent (with two immediately consecutive attempts to read out the data of the message, the content already partly overwritten again), the error fbbEALR_Q is reported when the hiding the CAN error monitoring is not active.		Keep the last value of mrmHGB_Anf.4	

8.25 Hydrol fan - power stage (HYL)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	The error fbbEHYL_O is set when the power stage is idle.		no	
power amplifier short circuit	The error fbbEHYL_K is set in the status short circuit of the output stage.			

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8.26 Kickdown switch (KIK)

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility	If anmPWG is less than an applicable threshold (mrwPWG_KIK), the kickdown signal dimKIK is present and there is no PWG error, after the error debounce time the kickdown signal is output as recognized as implausible. The error is healed if no kickdown signal is present for the duration of the healing time under the above conditions.	mrwPWG_KIK		

8.27 Terminal 15 (KL15)

monitoring from	monitoring strategy	Data	substitute function	Data
plausibility	The monitoring takes place during the initialization of the EDC. The un-debounced KL15 status is read in, and if the error fbbEK15_P is detected as LOW, it is set. However, the control unit does not start up if the K15 is constantly on LOW. possible error causes: • a short LOW pulse during initialization (defective ignition lock) • a conductor in the control unit is interrupted (control unit defective)	cowFLDR	There is no follow-up. Deactivation of the LDR can be applied, ARF and full load limitation.	cowCOLORF. cowFLDRAB. cowFMEBEG.

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8.28 Air conditioning relay (KLI)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	The error fbbEKLI_O is set when the power stage is idle.		no	
power amplifier short circuit	The error fbbEKLI_K is set in the short circuit status of the output stage.			
CAN message climate 1	If no new Clima 1 message is received for the time caw..._RTO or if the message content is consistent (with two immediately consecutive attempts to read out the message data the content was already partially overwritten) and does not hide the CAN monitoring active (mrmAUSBL=0) an error fbbEKLI_Q is reported.	caw..._RTO		

8.29 Instrument cluster CAN message (KBI)

monitoring from	monitoring strategy	Data	substitute function	Data
CAN message Combo1	If no new Kombi1 message is received for the time caw..._RTO or if the message content is consistent (in the case of two consecutive attempts to read out the message data the content was already partially overwritten) and does not hide the CAN monitoring active (mrmAUSBL=0) the error fbbEKO1_Q is reported.	caw..._RTO		
CAN message Combo2	If no new Kombi2 message is received for the time caw..._RTO or if the message content is consistent (in the case of two immediately consecutive attempts to read out the message data the content was already partially overwritten) and does not hide the CAN monitoring active (mrmAUSBL=0) the error fbbEKO2_Q is reported.	caw..._RTO	if signal applied via CAN: • anmOTF to default value anmOTF_VOR • anmWTF_CAN to default value (AnmWTF plus max. WTF tolerance anwWTFdelt) • anmUTF to default value anmLTF	
WTF via CAN Description see water temperature sensor at the cylinder head outlet (WTF)				

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8.30 Fuel temperature sensor (KTF)

monitoring of	monitoring strategy	Data	substitute function	Data
Signal area The errors	fbbEKTF_H and fbbEKTF_L are always reported with VP44 (136), otherwise the following applies: Signal range check up (error fbbEKTF_H) if anoU_TK> anwKTF_MAX Signal range check down (error fbbEKTF_L), if anoU_TK < anwKTF_MIN	appKTF_MAX appKTF_MIN	default value	anwKTF_VOR
dynamic plausibility	The error fbbEKTF_P is always reported with VP44 (136), otherwise the following applies: The KTF is checked for plausibility by means of its change, with two tests being carried out: - the absolute change test (A test); It is limited to one driving cycle. - the differential temperature integral test (DTI test); It can take several driving cycles. With SG initialization, both the DTI value anmKTF_Int stored in the E2PROM and the operating hours counter reading (BSZ status) at the start of the current DTI test anmBSTZiO are transferred to the current value anoKTF_Int or OLDA anoBSTZiO. Every time the absolute deviation anmKTF-anoKTF_akt (reference temperature, corresponds for the first time to the KTF temperature during SG initialization) exceeds the threshold anwKTF_Imn, this (absolute) temperature difference is added to the DTI value anoKTF_Int and the reference temperature anoKTF_akt is set to anmKTF. The error fbbEKTF_P is well reported when the DTI threshold is exceeded anwKTF_Int within the time (in operating hours counter ticks) anwKTF_T. In this case, the DTI test duration is written to the E2PROM via the message anmKTF_Td and a new DTI test is started; the A test is stopped for this driving cycle. At the start of the DTI test, the current value of the operating hours counter is copied to the OLDA anoBSTZiO (low word of the operating hours counter BSZ) and to the E2PROM (every 3 bytes of the BSZ, anmBSTZiO represents the low word of the BSZ). The error can only be reported well via the A test. This occurs when the KTF has an absolute minimum change (difference between anmKTF and anoKTF_Ini, KTF at initialization) of anwKTF_dT within a driving cycle. In this case, the absolute temperature change achieved is output on the OLDA anoKTF_PT and a new DTI test is started; the A test is also stopped for the driving cycle in this case	anwKTF_Imn anwKTF_Int anwKTF_T anwKTF_dT anwKTF_Tmn anwKTFPRDY	pure monitoring function	

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Continuation of KTF monitoring

monitoring from	monitoring strategy	Data	substitute function	Data
dynamic plausibility (Continuation)	If neither of the two positive events arrive, the error fbbEKTF_P is reported as faulty, a new DTI test is started, the DT integral anoKTF_Int is set to zero and the A test is stopped. If there is an error fbbEKTF_H or fbbEKTF_L at the same time, the DTI start value is anoBSTZiO set to the current value of the BSZ. This action is also taken if the DTI start value is greater than the value of the BSZ. In the aftermath, the values anmKTF_Int (DTI value, corresponds to anoKTF_Int), anmBSTZiO (DTI start value) and anmKTF_PT are stored in the E2PROM. If the driving cycle lasts (current BSZ minus BSZ at SG initialization, anoBST_ZSH (high word) and anoBST_ZSL (low word)), without iO event shorter than anwKTF_Tmn, anmBSTZiO is extended before saving by the duration of the current operating cycle If the parameter anwKTFPRDY has a value not equal to zero, the error fbbEKTF_P in the SG initialization well reported to enable early readiness for the KTF path. Test results can be read and reset using CARB mode 6. Test status information in anmKTF_PT, bits 14 and 15 and bits 0 to 13: 0 0 00000000000000 .. neither DTI test nor A test completed 1 0 00000000000000 .. DTI test completed negative 1 1 00000000000000 .. DTI test completed positive 0 0 xxxxxxxxxxxxxx .. (x not equal to zero) : A test completed positively, achieved Temperature change readable on anoKTF_PT	anwKTF_Imn anwKTF_Int anwKTF_T anwKTF_dT anwKTF_Tmn appKTFPRDY	pure monitoring function	

8.31 Coolant thermostat - final stage (TST)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbETST_O is set.		no	
power amplifier short circuit	The error fbbETST_K is set in the short circuit status of the output stage.			

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8.32 Cooling water heater (KWH)

monitoring from	monitoring strategy	Data	substitute function	Data
generator load zero %	The alternator provides the EDC with a duty cycle corresponding to the generator load. This signal is subject to strong fluctuations when idling and is therefore filtered by a PT1 element. If this signal corresponds to a generator load that is less than or equal to khwNULLAST for the time fbwEKWH_LA, the Error fbbEKWH_L set.	khwZERO LOAD fbwEKWH_LA	Shutdown of the KWH	

8.33 KWH Relay 1 (GSK1)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	The error fbbEGK1_O is set when the power stage is idle.		no activation of the glow plugs	
power amplifier short circuit	The error fbbEGK1_K is set when the output stage is short-circuited.			

8.34 KWH Relay 2 (GSK2)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEGK2_O is set.		no activation of the glow plugs	
power amplifier short circuit	The error fbbEGK2_K is set in the short circuit status of the output stage.			

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8.35 Boost pressure sensor (LDF)

monitoring of	monitoring strategy	Data	substitute function	Data
signal range feeding	Signal range check up (fbbELD2_H error) if anoU_LDF2 > anwLD2_MAX Signal range check down (fbbELD2_L error) if anoU_LDF2 < anwLD2_MIN	anwLD2_MAX anwLD2_MIN	default value (jump) Deactivation of the LDR (applicable) Switching off the ARF (applicable) Full load limitation (applicable) The atmospheric pressure is used as a substitute value for the smoke limitation and for the LDR and not the default value from the analog treatment (anwLDF_VOR).	anwLD2_VOR cowFLDRAB. cowCOLORF. cowFMEBEG.
Signal range The monitoring is only if no intake manifold vacuum is detected (mrmLDFUaus = 0).	Signal range check up (error fbbELDF_H) if anoU_LDF > anwLDF_MAX Signal range check down (error fbbELDF_L), if anoU_LDF < anwLDF_MIN	appLDF_MAX appLDF_MIN	Deactivation of the LDR (applicable) Switching off the ARF (applicable) Full load limitation (applicable) The atmospheric pressure is used as a substitute value for the smoke limitation and for the LDR and not the default value from the analog treatment (anwLDF_VOR).	cowFLDRAB. cowCOLORF. cowFMEBEG.

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Continued LDF monitoring

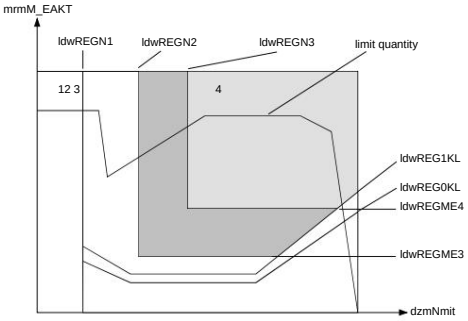
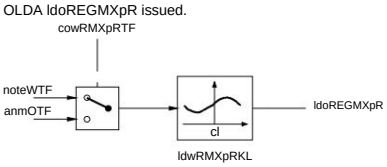
monitoring from	monitoring strategy	Data	substitute function	Data
plausibility with atmospheric pressure sensor (ADF)	The monitoring is only with intact donors (LDF & ADF no SRC errors) and if no intake manifold vacuum has been detected (mrmLDFUaus = 0) performed. The test is also aborted when speed is detected. If none of these conditions occur, the procedure is as follows: After SG initialization, the time ldwLA_DLY awaited. Thereafter, ldwLA_ANZ samples of the measured values anmADF and made onmLDF. Once all measured values have been read in, the average pressure difference is calculated: $ldoLA_DIF = \frac{\left\lvert \sum_{1}^{ldwLA_NUM} (anmLDF - anmADF_{n}) \right\rvert}{ldwLA_NUM}$ The error fbbELDF_P is now reported as defective if ldoLA_DIF should reach the value ldwLA_MAX or exceed. If ldoLA_DIF falls below the value ldwLA_MAX, the error becomes fbbELDF_P reported intact. If the error fbbELDF_P was reported as defective or intact, the test ended as normal and was not aborted, the test result is sent to CARB mode 6 as ldmLDF_dp. Occupancy Statusolda ldoLDFP_St: Bit position Decimal value Meaning 0 1 Waiting for the ldwLA_DLY wait time to expire 1 2 Measure 2 4 End of test, test performed 3 8 Test abort, speed detected 4 16 Condition SRC error ADF fulfilled 5 32 Condition SRC error LDF fulfilled Application note: fbwELDF_PT=16 (event debounced), fbwELDF_PA=0, fbwELDF_PB=0	ldwLA_DLY ldwLA_MAX ldwLA_ANZ fbwELDF_PA fbwELDF_PB fbwELDF_PT	Deactivation of the LDR (applicable) Switching off the ARF (applicable) Full load limitation (applicable) As a substitute value for smoke limitation and for the LDR, the atmospheric pressure is used and not the default value from the analogue treatment (anwLDF_VOR). However, if it is defective ADF, the VGW anwADF_VOR is used.	cowFLDRAB. cowCOLORF. cowFMEBEG.

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8.36 Boost Pressure Control (LDR)

monitoring from	monitoring strategy	Data	substitute function	Data
control deviation	The monitoring depends on the load condition of the motor. For this, the speed quantity diagram is in divided into five areas.  Figure LDR_08: Working areas	ldwREGN1 ldwREGN2 ldwREGN3 ldwREG1KL ldwREG0KL ldwREGME3 ldwREGME4		
control deviation	A control deviation is only monitored in areas 3 and 4. The control loop is classified as defective if the system deviation ldmE is greater for the time fbwELDSpRA or fbwELDSnRA as ldoREGMXpR or ldwREGMXnR. (Errors fbbELDSpR, fbbELDSnR).	fbwELDSpRA fbwELDSnRA ldwREGMXnR	The LDR is only switched off in area 4.	
	The maximum control deviation is determined via the ldwRMXpRKL characteristic. For you can over the Variant switch cowRMXpRTF, depending on your choice, the cooling water temperature anmKTF or the oil temperature anmOTF can be selected as the input variable. The maximum positive LDR deviation is based on the OLDA ldoREGMXpR issued.  Figure LDR_12: max. pos. LDR deviation	ldwRMXpRKL cowRMXpRTF	Switching off the ARF (applicable) Full load limitation (applicable)	cowFARFAB1 cowFARFAB2 cowFARFAB3 cowFMEBEG1 cowFMEBEG2 cowFMEBEG3

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Continued LDR

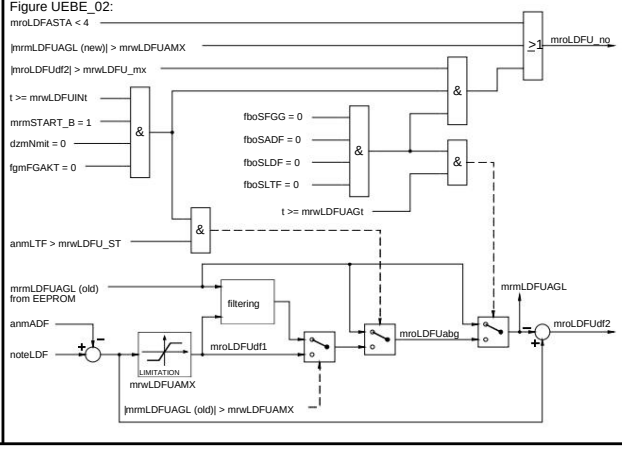
monitoring from	monitoring strategy	Data	substitute function	Data
intake manifold vacuum	In order to enable reliable evaluation of the vacuum in the intake manifold, an adjustment value for the pressure difference between ADF and LDF is used to compensate for differences in components and aging effects used. To determine the comparison value mrmLDFUAGL, the following conditions must be met: - the start bit is on first start (mrmSTART_B = 1), - the speed dzmNmit = 0, - the driving speed fgmFGAKT = 0, - The intake manifold temperature anmLTF is greater than mrwLDFU_ST - The waiting time mrwLDFUINt after initialization has expired. If all conditions are met, the comparison is carried out once. The result of the difference anmLDF - anmADF is limited to the value [-mrwLDFUAMX, +mrwLDFUAMX]. This value mroLDFUdf1 is filtered and written to mroLDFUabg. As a filter function, if anmLDF ÿ anmADF the function (2*mrmLDFUAGL (old) + mroLDFUdf1) / 3 otherwise the function (5*mrmLDFUAGL (old) + mroLDFUdf1) / 6 used. Is the saved adjustment value implausible (| mrmLDFUAGL (old) | > mrwLDFUAMX), the new value is mroLDFUdf1 without filtering mroLDFUabg taken over. Are after the waiting time mrwLDFUAGt the donors for ADF, LDF, LTF and FGG intact (fboSADF = 0, fboSLDF = 0, fboSLTF = 0, fboSFGG = 0), the determined adjustment value is mroLDFUabg after mrmLDFUAGL taken over and written to the EEPROM. Otherwise the comparison is recognized as implausible and discarded. The old value in the EEPROM is retained and used as the adjustment value. If the above conditions for the comparison are not met, the Adjustment value mrmLDFUAGL unchanged. Is the adjusted pressure difference mroLDFUdf2 when the adjustment condition occurs outside the permissible range (| mrmLDFUdf2 | > mrwLDFU_mx - assumption of exchanged / damaged sensor), so in this driving cycle, no monitoring of intake manifold vacuum is carried out (mroLDFU_no = 1). Likewise, the monitoring is not carried out if the comparison value mrmLDFUAGL is implausible (| mrmLDFUAGL| > mrwLDFUAMX), or as long as the comparison has not been completed. Note: New SG must be in production with an implausible value (0x7FFF) for mrmLDFUAGL be initialized.	mrwLDFU_mx mrwLDFUAMX mrwLDFUAGt mrwLDFU_ST mrwLDFUINt		

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Continued LDR

surveillance from	surveillance strategy	Data	substitute function	Data
intake manifold vacuum (Continuation)	The OLDA mroLDFASTA shows the current status of the comparison. It can take the following values men: - 0 = No adjustment made yet - 1 = Only control of |mrmLDFUAGL| > mrwLDFUAMX. Is carried out if one of the conditions start bit = 1, dzmNmit = 0, fgmFGAKT = 0 or sensors are OK is not met. - 2 = |mroLDFUdf2| Calculate and check > mrwLDFU_mx - 3 = wait for the error debouncing time mrwLDFUAGt - 4 = complete adjustment. Application note: The time mrwLDFUINt should be > 80ms applied to ensure that the LDF value used is correct and the existing speed is reliably detected. The intake manifold temperature threshold mrwLDFU_ST should be set > 15 degrees to ensure that the sensors are in the temperature-compensated area despite low temperatures in winter. Furthermore, the time mrwLDFUAGt must be greater than the SRC - debounce times for ADF, LDF, STF and FGG. Figure UEBE_02:  			

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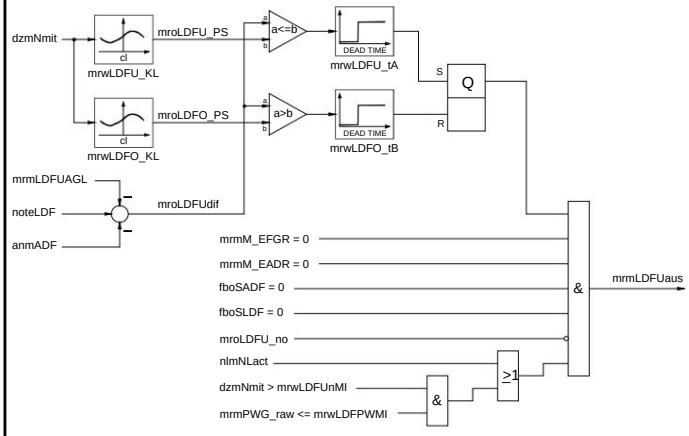
monitoring from	monitoring strategy	Data	substitute function	Data
intake manifold vacuum (Continuation)	Is for a time mrwLDFU_tA the adjusted intake manifold pressure mroLDFUdif (anmLDF - anmADF - mrmLDFUAGL) less than or equal to a speed-dependent threshold value (mroLDFU_PS) obtained from the characteristic curve mrwLDFU_KL, the condition of intake manifold vacuum is detected. Is for the time mrwLDFU_tB the adjusted intake manifold pressure greater than that from the characteristic mrwLDFO_KL threshold value mroLDFO_PS obtained, then the intake manifold vacuum condition is restored turned off. If the condition of intake manifold vacuum was detected and all of the following conditions are met: - No desired quantity specified via FGR (mrmM_EFGR = 0), - No desired quantity specified via ADR (mrmM_EADR = 0), - No desired quantity specified via PWG (mrmPWG_roh ÿ mrwLDFPWMI), - the encoders for ADF and LDF are intact (fboSADF = 0, fboSLDF = 0), - the speed dzmNmit is greater than mrwLDFUnMI, - the monitoring of intake manifold vacuum is active (mroLDFU_no = 0), so the output stages ehmFAR1, ehmFAR2 and ehmFAR3 on mrmLDFUaus = 1 in the ARF Default values set, but no error memory entry is generated. If one of the conditions is not met, the normal function is immediately switched back to (mrmLDFUoff = 0). In the wake (nlmNLact = 1), the conditions dzmNmit> mrwLDFUnMI and mrmPWG_roh <= mrwLDFPWMI hidden to ensure safe shutdown of the engine.	mrwLDFU_KL mrwLDFO_KL mrwLDFU_tA mrwLDFU_tB mrwLDFPWMI mrwLDFUnMI	Control of ARF actuators 1-3 (can be applied). see Chapter 5.3 Exhaust gas recirculation This measure also remains in the follow-up active until after speed=0 the time mrwNCL_N0 has expired, and until the Time mrwNCL_DA has expired after the start of the run.	arwFAR1off arwFAR2off

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Continued LDR

monitoring from	monitoring strategy	Data	substitute function	Data
intake manifold vacuum (Continuation)	 Figure UEBE_05:			

monitoring from	monitoring strategy	Data	substitute function	Data
control deviation	Healing can only take place in area 3, since the control remains active in this area if there is a control deviation. The healing occurs when the deviation for the time fbwELDSpRB or fbwELDSnRB is smaller than ldoREGMXpR or ldwREGMXnR.	fbwELDSpRB fbwELDSnRB ldwREGMXnR	Switch to normal function	

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8.37 Boost Pressure Adjuster (LDS)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbELDS_O is set.		Full load limitation (applicable) Switching off the ARF (applicable) Deactivation of the LDR (applicable)	cowFMEBEG. cowCOLORF. cowFLDRAB.
power amplifier short circuit	The error fbbELDS_K is set in the status short circuit of the output stage.			

8.38 Air mass meter (LMF)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range feeding	Signal range check up (error fbbELM2_H) if anoU_LMM2 > anwLM2_MAX Signal range check down (error fbbELM2_L) if anoU_LMM2 < anwLM2_MIN Monitoring is only carried out if the speed is less than	anwLM2_MAX anwLM2_MIN	default value	arwLMBPVGW
signal range grinder	anwLMD_N2 **AND** greater than anwLMD_N1 and no 1 ms sampling present. Signal range check up (error fbbELMM_H), if anoU_LMM> anwLMM_MAX Signal range check down (error fbbELMM_L), if anoU_LMM <anwLMM_MIN The monitoring only takes place if the speed is less than	anwLMM_MAX anwLMM_MIN anwLMD_N1 anwLMD_N2	default value Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	arwLMBPVGW cowFARFAB. cowFLDRAB. cowFMEBEG.
signal range Grinder n - synchronous (HFM5)	anwLMD_N2 **AND** greater than anwLMD_N1 and no 1 ms sampling present. Signal range check upwards (error fbbELM5_H) if anoU_LMM > anwLMM_MAX Signal range check downwards (error fbbELM5_L) if anoU_LMM < anwLMM_MIN The monitoring only takes place if the speed	anwLMM_MAX anwLMM_MIN anwLMD_N1 anwLMD_N2	default value Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	arwLMBPVGW cowFARFAB. cowFLDRAB. cowFMEBEG.
signal range grinder at 1ms sampling (HFM5)	is smaller than anwLMD_N2 **AND** larger than anwLMD_N1 and 1 ms - sampling of LMM available. Signal range check up (error fbbELM5_H), if anoU_LMM2S (already PT1-filtered)> anwLMM_MAX Signal range check down (error fbbELM5_L), if anoU_LMM2S (already PT1-filtered) <anwLMM_MIN There must be no SRC violation of the LMM, the Paths for DZG, LTF and LDF must be intact.	anwLMM_MAX anwLMM_MIN anwLMD_N1 anwLMD_N2	default value Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	arwLMBPVGW cowFARFAB. cowFLDRAB. cowFMEBEG.
plausibility	If the ARF is not active (arwHFPA.u <ehmFAR. ÿ arwHFPA.o for all 3 ARF actuators), and the boundary conditions arwHFPNu ÿ dzmNmit ÿ arwHFPNo, arwHFPTu ÿ anmLTF ÿ arwHFPTo, arwHFPPu ÿ ldmP_Llin ÿ arwHFPPo are met, then if the condition arwHFPMmin ÿ armM_List ÿ arwHFPMmax is not met, the error reported fbbELM5_P.	arwHFPA.u arwHFPA.o arwHFPN. arwHFPP. arwHFPT. arwHFPMmin arwHFPMmax	default value Switching off the ARF (applicable) Deactivation of the LDR (applicable) Full load limitation (applicable)	arwLMBPVGW cowFARFAB. cowFLDRAB. cowFMEBEG.

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8.39 Air temperature sensor (LTF)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (fbbELTF_H error) if anoU_TL > anwLTF_MAX Signal range check down (fbbELTF_L error) if anoU_TL < anwLTF_MIN	appLTF_MAX anwLTF_MIN	default value	anwLTF_VOR

8.40 MIL Lamp (MIL)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEMIL_O is set.		no	
power amplifier short circuit	The error fbbEMIL_K is set in the short circuit status of the output stage.			

8.41 Follow-up pump - output stage (ZWP)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	The error fbbEZWP_O is set when the power stage is idle.		no	
power amplifier short circuit	The error fbbEZWP_K is set in the short circuit status of the output stage.			

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8.42 Oil temperature sensor (OTF)

monitoring of	monitoring strategy	Data	substitute function	Data
Signal range for OTF via ADC (anwOTF_KAN = 00xxH):	Signal range check upwards (fbbEOTF_H error) if anoU_TO > anwOTF_MAX Signal range check down (fbbEOTF_L error) if anoU_TO < anwOTF_MIN With OTF via CAN (anwOTF_KAN = 01xxH): The error fbbEOTF_P (implausible) is reported if the error value 0xFF or 0x00 (= not installed) is entered in the CAN message Kombi 2, field T_OTF_KO2 and no hiding of the CAN monitoring is active (mrmAUSBL = 0). The error fbbEOTF_S (defective) is reported if the error bit S_OTF is set in the CAN message combination 2 and no hiding of the CAN monitoring is active (mrmAUSBL = 0). Send application OTF with a fixed default value (anwOTF_KAN = 02xxH), anwOTF_VOR is always sent as oil temperature anmOTF.	anwOTF_MAX anwOTF_MIN	anmOTF to default value anmOTF_VOR anwO_VBtKL anwO_LUrKL anwOTF_VOR	
plausibility with WTF (ONLY AT EDC15M+)	After takeoff, a timer is started. After the time anwT_P_OTF has expired, there is a wait until anmWTF > anwSW_WTF. As soon as this threshold is exceeded, a new timer is started. After the time anwT_OTF is checked (once) whether anmOTF> anwFG_OTF is, if not, the error fbbEOTFrd is defective, otherwise reported as good. Monitoring is restarted when anmWTF falls below anmSW_WTF and then exceeds this value again.	anwT_P_OTF anwT_OTF anwSW_WTF anwFG_OTF	anmOTF to default value anmOTF_VOR anwOTF_VOR	

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8.43 Pedal value transmitter (PWG)

monitoring of	monitoring strategy	Data	substitute function	Data
signal range feeding potentiometer	Signal range check up (fbbEPW2_H error) if anoU_PWG2 > anwPW2_MAX Signal range check down (fbbEPW2_L error) if anoU_PWG2 < anwPW2_MIN	anwPW2_MAX anwPW2_MIN	default value (jump)	anwPW2_VOR
signal range grinder potentiometer	Signal range check up (fbbEPWG_H error) if anoU_PWG > anwPWG_MAX Signal range check down (fbbEPWG_L error) if anoU_PWG < anwPWG_MIN	appPWG_MAX appPWG_MIN	increased idle speed Default values (ramps) mrwPWG_Pof, mrwPWG_Pon. With SRC violation AND plausibility violation (LGS) only mrwPWG_Pof is used. see "PWG filter and driving behavior"	mrwLLR_PWD mrwPWG_Pof mrwPWG_Pon mrwPWG_Rau mrwPWG_Run

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Continued PWG

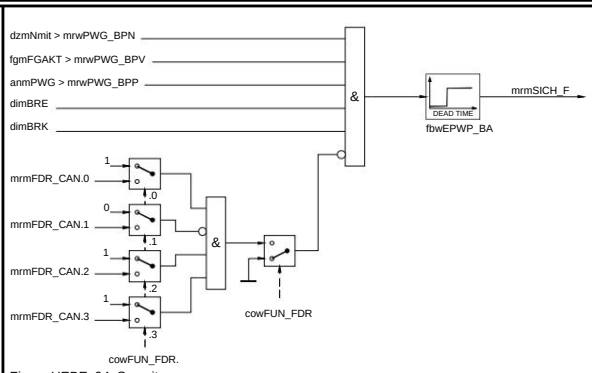
monitoring from	monitoring strategy	Data	substitute function	Data
plausibility General	Behavior with cowVAR_PWG=0 (PWG poti/switch): anmPWG is checked for SRC and checked for plausibility against the idle gas switch (dimLGS). This check can be deactivated using mrwPWG_LPA. Below mrwPWG_UPS the LGS must be in idle position, above mrwPWG_OPS be in full load. In the event of an error, the error fbbEPWP_A is set. Behavior with cowVAR_PWG=1 (double analogue PWG): The plausibility between PWG and PGS is checked if there is no error fbbETAD_L, fbbETAD_H, fbbETAD_D, fbbETAD_T, fbbEPW2_L, fbbEPW2_H, fbbEPG2_L, fbbEPG2_H, fbbEPWG_L, fbbEPWG_H, fbbEPGS_L or fbbEPGS_H, none of these Error related debouncing is active (anmFPM_EPA = 0) or the error fbbEPWP_A is currently available (mroFPM_BED, bit 10 or bit 11 set). If the voltage difference is | anmU_PWG - 2*anmU_PGS | within a plausibility window, the error fbbEPWP_A is reported, otherwise it is set. There are 3 plausibility windows available: Idle: anmPWG and anmPGS are smaller than mrwPWG_LLS: window width mrwPWG_PLL Partial load: anmPWG and anmPGS are both larger than mrwPWG_LLS and smaller than mrwPWG_VLS: window width mrwPWG_PTL Full load: anmPWG and anmPGS are larger than mrwPWG_VLS: window width mrwPWG_PVL A Switching between the plausibility windows only takes place if both the conditions for anmPWG and for anmPGS are met.	mrwPWG_LPA mrwPWG_UPS mrwPWG_OPS mrwPWG_LLS mrwPWG_VLS mrwPWG_PLL mrwPWG_PTL mrwPWG_PVL mrwPWG_HRP	increased idle speed Ramp on mrwPWG_Pof see "PWG filter and driving behavior"	mrwLLR_PWD mrwPWG_Pof mrwPWG_Rau mrwPWG_Run
plausibility potentiometer	Is only carried out with cowVAR_PWG=0 (PWG poti/switch). This check is carried out if there is a general plausibility violation. If the idle switch is at least for the time mrwPWG_LGT in the full load position and then (no specific time) at least for the same time in the idle position, there is a potentiometer defect (error fbbEPWP_P).	mrwPWG_LGT default	values as with defect PWG SRC grinder	
plausibility idle switch	Is only carried out with cowVAR_PWG=0 (PWG poti/switch). This check is carried out if there is a general plausibility violation. If anmPWG> mrwPWG_WOS and then (no specific time) anmPWG <mrwPWG_WUS there is an error in the LGS (error fbbEPWP_L).	mrwPWG_WUS mrwPWG_WOS	Full load limitation (applicable) The potentiometer value is used as the pedal value. With SRC violation AND plausibility violation (LGS) only the VGW mrwPWG_Pof is used (ramp).	cowFMEBEG. mrwPWG_Pof mrwPWG_Rau mrwPWG_Run

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Continued PWG

monitoring from	monitoring strategy	Data	substitute function	Data
security case plausibility brake	 Figure UEBE_04: Security case Above the speed mrwPWG_BPN AND the speed mrwPWG_BPV is when anmPWG> mrwPWG_BPP AND the brake is actuated AND no driving dynamics intervention is detected after the time fbwEPWP_BA on security case (mrmSICH_F = 1). The error fbbEPWP_B is never reported, only the labels are used for the time. The brake is applied when the main and redundant brake contacts are actuated. This test does not take place with a defective brake (fbbEBRE_P) and can be deactivated using mrwPWG_BPA. A driving dynamics intervention is present when the FDR is activated via the function switch cowFUN_FDR AND the following bit combination is received via the CAN message Bremse_1: S_FDR ÿ mrmFDR_CAN.0 = TRUE ... FDR intervention S_BLS ÿ mrmFDR_CAN.1 = FALSE ... Driver does not brake S_BKV ÿ mrmFDR_CAN.2 = TRUE ... Brake booster activated F_BKV ÿ mrmFDR_CAN.3 = TRUE ... installed brake booster and none mistake The substitute data byte of the Bremse_1 message should be applied in such a way that monitoring for a safety case is always active in the event of a CAN defect.	mrwPWG_BPN mrwPWG_BPV mrwPWG_BPP fbwEPWP_BA mrwPWG_BPA cowFUN_FDR	ramped transition to mrwPWG_Pbr Increased idle speed changed parameter selection idle controller	mrwPWG_SfB mrwPWG_Pbr mrwLLR_NSF

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monitoring from	monitoring strategy	Data	substitute function	Data
plausibility potentiometer with idle switch (fbbEPWP_A, fbbEPWP_P, fbbEPWP_L)	Is only carried out with cowVAR_PWG=0 (PWG poti/switch). To heal must be in the following order: - the pedal value sensor anmPWG> mrwPWG_WOS AND the idle switch in the full load position be. There must be no SRC violation (anymore). - the pedal position sensor anmPWG <mrwPWG_WUS AND the idle switch in idle position be. There must be no SRC violation (anymore). In addition, the PWG raw value must mrmPWG_roh be smaller than anmPWG.	mrwPWG_WOS mrwPWG_WUS	Transition to normal function (ramp) mrwPWG_Rau	mrwPWG_Run
signal range grinder potentiometer	Is only carried out with cowVAR_PWG=0 (PWG poti/switch). To heal the pedal value sensor must be anmPWG <mrwPWG_WUS AND the idle switch in the idle position. There must be no SRC violation (anymore). In addition, the PWG raw value must mrmPWG_roh be smaller than anmPWG.	mrwPWG_WUS		
dual analog PWG	Is only carried out with cowVAR_PWG=1. In the Olda mroFPM_BED, the collected conditions for the PWG monitoring are summarized, with the information "provisionally" being determined using the message anmFPM_EPA. If mroFPM_BED is equal to zero or bits 10 or 11 (plausibility PWG-PGS) are set, it will carried out the plausibility check PWG-PGS and treated the error fbbEPWP_A. If mroFPM_BED is not equal to zero, a replacement reaction must take place. The nature of the replacement reaction can be read from mroFPM_ZAK: mroFPM_ZAK = 0 (finally healed): no replacement reaction, anmPWG has access to mrmPWGfi mroFPM_ZAK = 1 (temporarily defective): the last valid value of anmPWG remains frozen mroFPM_ZAK = 4 (final defect): mrmPWGfi is set to 0%, the replacement reaction "idle speed" is activated (mrmLLR_PWD = 1) mroFPM_ZAK = 2 (healing ramp): It is mrmPWGfi from the driver's default value 0% on the Ramp mrwPWG_HRP gone to the current driver request anmPWG. If this is reached, the increased idle speed disabled (mrmLLR_PWD = 0)	mrwPWH_HRP "idle speed"	Freeze the last PWG value	
security case plausibility brake	The safety case is withdrawn when dPWG/dt> mrwPWG_dPS OR the brake OR PWG becomes inactive. The brake must have been inactive for it to be recognized again.	mrwPWG_dPS When	anmPWG < default value (ramp value) anmPWG is used immediately, otherwise it is ramped to anmPWG elevated	mrwPWG_SfE

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To evaluate the PWG monitoring, the following values are displayed in mroPWG_Z (cowVAR_PWG=0):

value	meaning	value	meaning
0	working correctly	4	Plausibility violation empty throttle switch
1	SRC violation detected	5	Potentiometer plausibility violation
2	SRC substitute function PWG = f(LGS) active	6	SRC and plausibility violation
3	Violation of plausibility in general		

The state of the PWG monitoring is contained in mroFPM_ZAK (cowVAR_PWG=1):

decimal value	comment
0	PWG finally healed
1	PWG temporarily defective
2	PWG healing ramp active
4	PWG finally defective

The reason for a substitute reaction PWG is contained in mroFPM_BED:

Bit position 0	decimal value	comment
1	1	Error fbbEPWG_H or fbbEPWG_L temporarily defective
	2	Error fbbEPWG_H or fbbEPWG_L finally broken
2	4	Error fbbEPGS_H or fbbEPGS_L temporarily defective
3	8	Error fbbEPGS_H or fbbEPGS_L finally defective
4	16	Error fbbEPW2_H or fbbEPW2_L temporarily defective
5	32	Error fbbEPW2_H or fbbEPW2_L finally broken
6	64	Error fbbEPG2_H or fbbEPG2_L temporarily defective
7	128	Error fbbEPG2_H or fbbEPG2_L finally defective
8	256	Error fbbETAD_H or fbbETAD_L temporarily defective
9	512	Error fbbETAD_H or fbbETAD_L finally defective
10	1024	Error fbbEPWP_A provisionally defective
11	2048	Error fbbEPWP_A finally defective
12	4096	Error fbbETAD_T temporarily defective
13	8192	Error fbbETAD_T finally broken
14	16384	Error fbbETAD_D finally broken

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8.44 Reference voltage (U_REF)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (fbbEURF_H error), if anoU_UREF > anwREF_MAX Signal range check down (error fbbEURF_L), if anoU_UREF < anwREF_MIN	appREF_MAX appREF_MIN	default value	anwREF_VOR

8.45 System light (SYS)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the status of the power stage is idle and the plausibility error fbbEK15_P is not set, the error becomes fbbEDIA_O set.		no	
power amplifier short circuit	In the status short circuit of the power stage and not set plausibility error fbbEK15_P the error fbbEDIA_K set.			
plausibility	The request from the engine control unit to the combination unit to switch the system lamp on or off is made via CAN message engine 5 (byte 1, bit 1). The combination device also sends the system lamp status CAN message combination 1 (byte 0, bit 7) back. The following applies to both bits: 0 = lamp off, 1 = lamp on. If these two bits do not match longer than fbwEDIA_PA, it must be assumed that that the combination device cannot implement the request. In this case, in the engine control unit Enter error fbbEDIA_P. The monitoring is deactivated when the CAN monitoring is hidden or there is a message timeout or inconsistency in the Combi 1 message. The evaluation takes place on the error fbbEKO1_Q that has not been debounced, so that this error is not hidden by the Debounce time of the error fbbEKO1_Q depends. Cure: The error fbbEDIA_P is healed if, with active monitoring, both a request “lamp off” and “lamp on” (from the engine control unit to the combination unit) with the minimum duration gswFHZ were continuously acknowledged with the correct status by the combination device. The order is not important. Application note: The data record label fbwEDIA_PA must be applied at least 100ms smaller than the minimum of fbwT_DIBLK and half the period of xcwFreq. The error recovery time gswFHZ must be applied at least 200ms less than the minimum of fbwT_DIBLK and half the period of xcwFreq.	gswFHZ	no	

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8.46 Ambient Temperature Sensor (UTF)

monitoring Of	monitoring strategy	Data	substitute function	Data
plausibility	If UTF evaluation via data telegram is selected (comVAR_FZG = 1 or 2), the following strategy is used for monitoring. If no data telegram is received for a time greater than aneUTF_MAX (20s) **OR** the content of the received data telegram is less than 7 **OR** the content of the received data telegram is greater than 250, then the UTF is recognized as implausible (error fbbEUTF_P) and the substitute value LTF is switched over. If the battery voltage anmUBATT falls below the threshold anwUTF_UBm **OR** the message comVAR_FZG is at 0, the system also switches to the substitute value LTF, but the error fbbEUTF_P is not reported. If UTF evaluation via CAN is selected (comVAR_FZG = 3), the UTF is recognized as implausible (error fbbEUTF_P) and switched to the substitute value LTF if in the Kombi_2 message via S_UTF or via the value of T_UTF_gef (0x00 = not installed or 0xFF) an error is reported. When the message timeout of the Kombi_2 message is switched to the substitute value LTF, but the error fbbEUTF_P is not reported. Application note: The error debounce time for defect detection must be greater than 20s if evaluation via data telegram is applied!	anwUTF_UBm	The LTF is used for the UTF.	
Signal range	With UTF via ADC (comVAR_FZG = 4): Signal range check up (fbbEUTF_H error) if anoU_UTF> anwUTFAMAX Signal range check down (error fbbEUTF_L), if anoU_UTF< anwUTFAMIN	anwUTFAMAX anwUTFAMIN	anmUTF_ANA to default value anmUTFAVOR	anwUTFAVOR

8.47 Water temperature sensor at the cooler outlet (WTK)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (fbbEWTK_H error) if anoU_TWK > anwWTK_MAX Signal range check down (error fbbEWTK_L) if anoU_TWK < anwWTK_MIN	appWTK_MAX appWTK_MIN	default value	anwWTK_VOR

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8.48 Water temperature sensor at the cylinder head outlet (WTF)

monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (error fbbEWTF_H) if anoU_TW > anwWTF_MAX Signal range check down (error fbbEWTF_L), if anoU_TW < anwWTF_MIN	appWTF_MAX appWTF_MIN	Either the fuel temperature or anwWTF_VOR as a default value Selection using anwWTFSCH The VGW gswGS_VGWT is used for the glow time control. A SB-specific VGW is used for the	anwWTF_VOR anwWTFSCH
dynamic plausibility	After "ignition on" when the speed threshold mrwMIN_DZ **AND** the quantity threshold mrwMIN_Me is exceeded, a timer is started after which the water temperature must have reached the value mrwEnd_Tmp **OR** the minimum increase dT_W/dt of mrwMIN_dT (error fbbEWTF_D). This test takes place once per driving cycle. As soon as one of these conditions is met, the test is terminated without waiting for the remaining time. In the event of a signal range check error or lag, the test is aborted or not started. The permissible heating time f (water temperature) is determined from the characteristic curve mrwWTF_KL. At the maximum heating time (655340000 µs) the test is not carried out and the error fbbEWTF_D is reported immediately. If the quantity or speed conditions no longer apply, the timer is frozen.	mrwMIN_DZ mrwMIN_Me mrwEnd_Tmp mrwMIN_dT mrwWTF_KL	SB control. The VGW gswGS_VGWT is used for the glow time control	gswGS_VGWT
dynamic plausibility	The following values are stored in the EEPROM: ÿ Temperature increase that has occurred since the start ÿ Temperature value at the end of the test ÿ Elapsed time ÿ Allowable heating time which was determined at the start from the characteristic line mrwWTF_KL. It is saved: ÿ when the test is completed by the expiry of the timer and a defect has been detected. ÿ if the test is completed by reaching the temperature increase or the end temperature and no defect is detected. No storage takes place: ÿ if the test was aborted by a WTF signal range check error or overrun. ÿ if the test was not carried out (e.g.: application based on characteristic value = 655340000 µs).		The VGW gswGS_VGWT is used for the glow time control	
operating temperature	After exceeding the speed threshold anwWSZ_DZ the water temperature must have exceeded the threshold anwWSZ_STM after the time anwWSZ_SZT (error fbbEWTF_S).	anwWSZ_DZ anwWSZ_SZT anwWSZ_STM		
WTF via CAN When	evaluating T_WTF (cowWTFCAN=1): The error fbbEKO2_W (coolant temperature is reported if the error value 0xFF is entered in the CAN message Kombi 2, field T_WTF or if the error bit S_WTF is entered in the CAN message Kombi 2 is set.		anmWTF_CAN = anmWTF plus max. WTF tolerance anwWTFdelt	anwWTFdelt

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8.49 Analogue to Digital Converter (TAD)

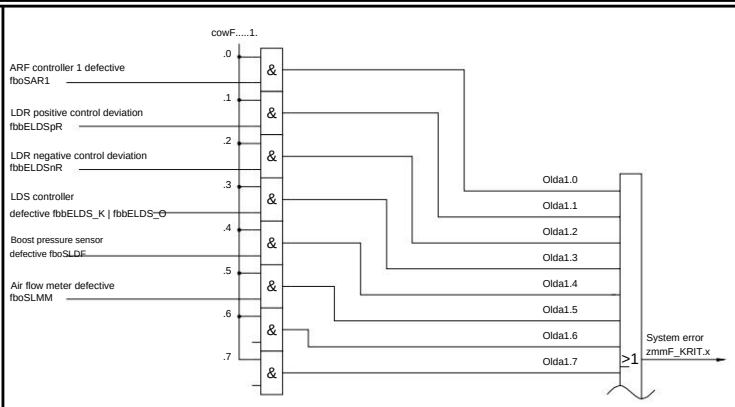
monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (error fbbETAD_H), if anoU_TAD > anwTAD_MAX Signal range check down (fbbETAD_L error) if anoU_TAD < anwTAD_MIN	appTAD_MAX appTAD_MIN	increased idle speed cowVAR_PWG=1 (double analogue PWG); see PWG monitoring concept	mrwLLR_PWD mrwLLR_PWB cowVAR_PWG
ram cells	The RAM cells (digitally converted value) of the PWG signal, the PGS signal and the TAD signal are checked for one-time use. If it has already been read at least once, the error becomes fbbETAD_D reported		increased idle speed cowVAR_PWG=1 (double analogue PWG); see PWG monitoring concept	mrwLLR_PWD mrwLLR_PWB cowVAR_PWG
idle gas test pulse	At intervals of anwLTI_PER, the PGS input is grounded. In this case, the message anmFPM_LTI is set to the value 255 (otherwise to 0), at the same time the plausibility is checked PWG/PGS not performed. The voltage value now measured at the PGS port is displayed on the OLDA anoU_PGSLT displayed. If this measured value reaches the error threshold anwLTI_FS , then the error fbbETAD_T reported.	anwLTI_FS	increased idle speed cowVAR_PWG=1 (double analogue PWG); see PWG monitoring concept	mrwLLR_PWD mrwLLR_PWB cowVAR_PWG

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8.50 Shutdown due to system error

monitoring from	monitoring strategy	Data	substitute function	Data
System error in the modules: ARF LDR limit amount	 Figure SYSFEHL1: System error	cowFARFAB1..3 cowFLDRAB1..3 cowFMEBEG1..3	ARF: see chapter 3.7.2; Figure ARF_07 LDR: see chapter 4.6; Figure LDR_07 Limit quantity: see chapter 2.3; Figure MEREBG03	

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Continued Shutdown due to system error

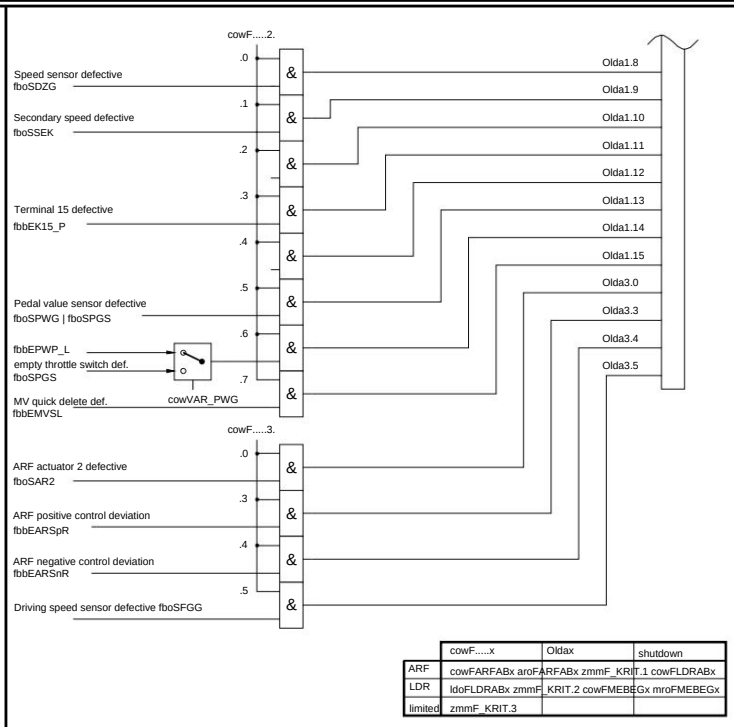
System error in the modules:

ARF

LDR

limit quantity

(Continuation)



	cowF.....x	Oldax	shutdown
ARF	cowFARFABx	aroFARFABx zmmF_KRIT.1	cowFLDRABx
LDR	ldoFLDRABx	zmmF_KRIT.2	cowFMEBEGx mroFMEBEGx
limited	zmmF_KRIT.3		

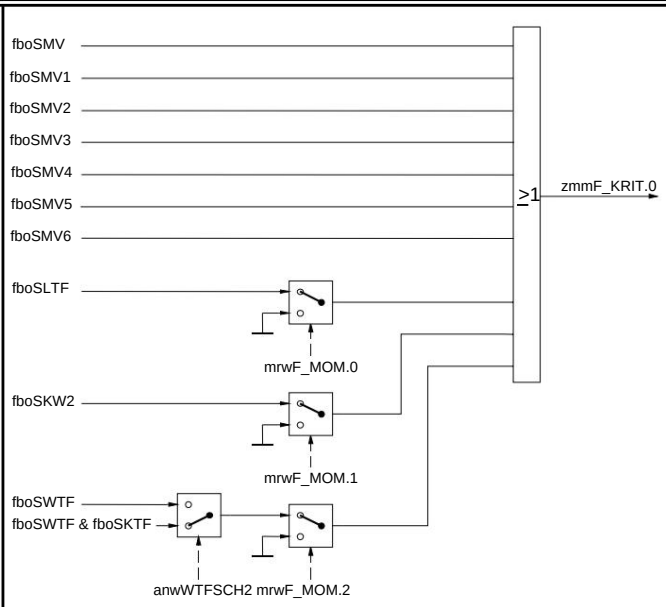
Figure SYSFEHL2: System error

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Continued Shutdown due to system error

monitoring from	monitoring strategy	Data	substitute function	Data
System error in the module: CAN	 Figure SYSFEHL3: System error	mrwF_MOM see Chapter 10.7.2 Sent message - engine 1		

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8.51 Speed sensor (DZG)

8.51.1 Defect Detection

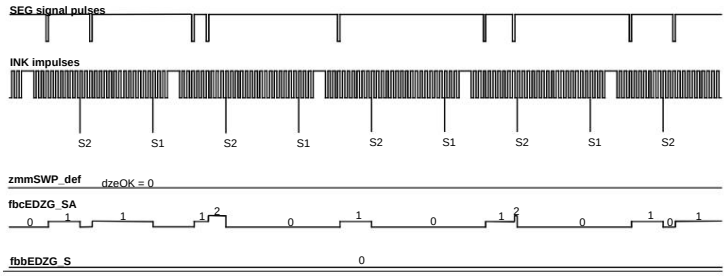
monitoring from	monitoring strategy	Data	substitute function	Data
Static plausibility	This error is intended to indicate a completely failed INK signal. For this purpose, the INK signal is counted by the SEG signal. With each SEG signal, the error *fbbEDZG_S is* reported, what increments the error counter. The error counter is reset with every WUP signal, regardless of whether it is plausible or not. If the error is entered debounced, the status *is zmmSWP_def* = *zmeNO_SIG* = 04h at the same time set. The error is debounced synchronously with the event, which is set with *fbwEDZG_ST* = 0. The debounce number to register with the label *fbwEDZG_SA,* the healing number to delete the error on the label *fbwEDZG_SB* set. Since inductive and Hall sensors may be attached to the motor, errors can occur during the formation of problems occur at low speeds, e.g. when the engine stops, the engine slows down slowly. In order to avoid this, the defect classification can be switched off below an applicable speed threshold. This threshold can be specified via the label *dzwKNFeMin* . When the engine is stopped, there is no longer any SEG signal that could count the INK encoder. Therefore, after *dzwK_TIOUT* runs of the 20ms slice, the signal is on here *zmmSWP_def* = zmeNO_SIG = 04h set. An error entry does not take place.	*fbwEDZG_SA, fbwEDZG_ST, dzwKNFeMin, dzwK_TIOUT*	Full load limitation (applicable), Injection fails	*cowFMEBEG*

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Speed sensor (DZG) continued

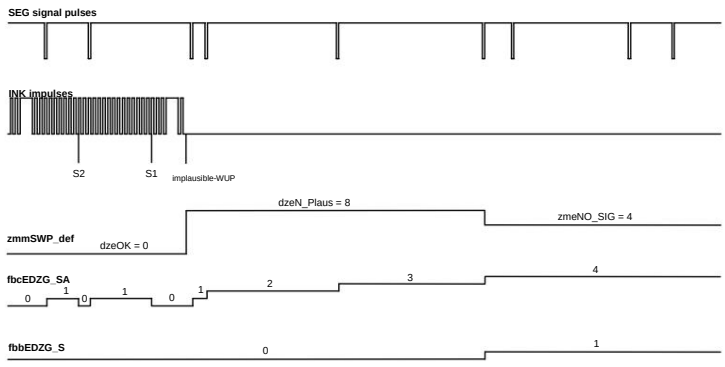
monitoring from	monitoring strategy	Data	substitute function	Data
	The following example shows the INK signal working correctly. Here you can see how occurring SEG pulses increment the error debouncing counter of the error *fbbEDZG_S* (the error debouncing counter is called *fbcEDZG_SA* here , but does not exist in this form). If WUPs occur, this counter zeroed. If the error debouncing is chosen large enough (depending on the possible number of SEG pulses between S1 and S2), there is no error entry, *fbbEDZG_S* remains 0. **Formation of the error fbbEDZG_S with an intact INK signal**  			

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Speed sensor (DZG) continued

monitoring from	monitoring strategy	Data	substitute function	Data
	The following example shows the defective INK signal. Here you can see how the occurring SEG impulses Report errors *to fbbEDZG_S* and increment the error debounce counter of this error (the error debounce counter is called fbcEDZG_SA here , but does not exist in this form). If DZG-WUPs occur, so this counter is zeroed. If the INK signal and thus also the WUPs fail, the error rebound counter runs up to the applied value *fbwEDZG_SA* , where the error *fbbEDZG_S* is debounced. **Formation of the error fbbEDZG_S with a defective INK signal**  			

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Continuation DZG defect detection

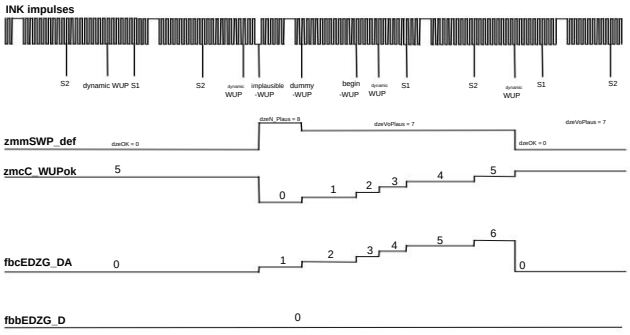
monitoring from	monitoring strategy	Data	substitute function	Data
dynamic plausibility	If the status of the INK encoder zmmSWP_def != dzeOK = 0h, then for *fbwEDZG_DA* occurred WUPs the error debouncing counter incremented and then the error *fbbEDZG_D* entered. kick a WUP with zmmSWP_def = dzeOK = 0h, the debouncing counter is set to 0 again. The error is debounced synchronously with the event, which is set with *fbwEDZG_DT* = 0. The debounce number for entries is set with the label *fbwEDZG_DA* . In order to avoid erroneous error entries, this error is not considered from the moment the engine starts. at starter intervention, the vibrations on the sensor wheel are so large that a plausible signal cannot be generated errors can be distinguished. For error classification, the speed dzoNmit must be greater than the minimum threshold *dzwKNFeMin* and the current battery voltage anmUBatt above the minimum battery threshold *dzwKUFeMin* . The battery voltage is considered because the battery voltage is too low can generate an incorrect speed signal and an incorrect error entry then occurs	*fbwEDZG_DA, fbwEDZG_DT,* dzwKNFeMin, *dzwKUFeMin*	Full load limitation (applicable)	*cowFMEBEG*

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Continuation DZG defect detection

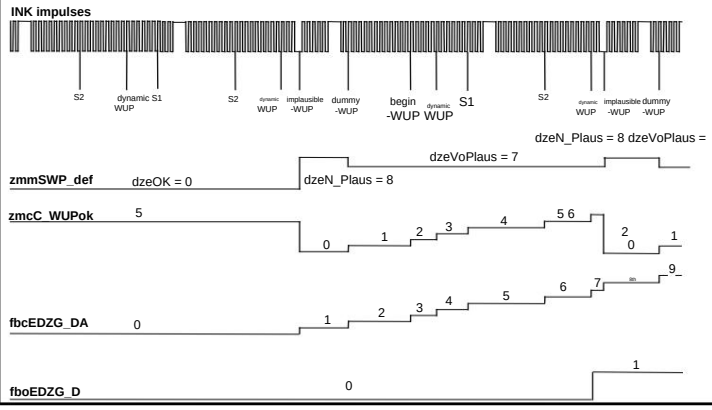
monitoring from	monitoring strategy	Data	substitute function	Data
	The following example shows the intact INK signal with a tooth that has fallen out. Here's how Occurring WUPs with *zmmSWP_def != dzeOK* (0h) report the error *fbbEDZG_D* and increment the error debounce counter of this error (the error debounce counter is called fbcEDZG_DA here, but does not exist in this form). If a certain number, determined by *dzwKCWPsok,* of WUPs with *zmmSWP_def = dzeVoPlaus* = 07h on (counted with *zmcC_WUPok,* displayed in *zmoC_WUPok),* the status changes to *zmmSWP_def = dzeOK* = 0h and the counter is zeroed. In the application, care must be taken to ensure that the error debounce counter *fbwEDZG_DA is* not smaller or is set equal to *dzwKCWPsok* . **Formation of the error fbeEDZG_D with missing tooth**  			

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Continuation DZG defect detection

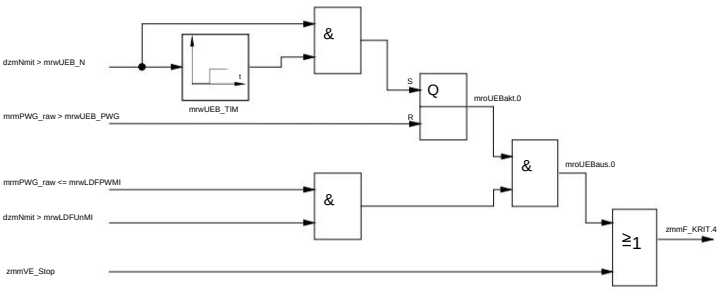
monitoring from	monitoring strategy	Data	substitute function	Data
	The following example shows the INK signal with a tooth that has fallen out. Here you can see how occurring WUPs with *zmmSWP_def != dzeOK* (0h) report the error *fbbEDZG_D* and increment the error debounce counter of this error (the error debounce counter is called fbcEDZG_DA here , exists but not in this form). Join a certain number of WUPs, determined by *dzwKCWPsok* *zmmSWP_def = dzeVoPlaus* = 07h on (counted with *zmcC_WUPok,* displayed in *zmoC_WUPok),* so the status changes to *zmmSWP_def = dzeOK* = 0h and the counter is zeroed. Here this value but not reached to confirm the correctness of the INK signal, the error counter continues to count up until the debounce count is reached and the error is entered debounced. **Formation of the error fbeEDZG_D in case of tooth loss** 			

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Continuation DZG defect detection

monitoring from	monitoring strategy	Data	substitute function	Data
Overspeed The error *fbbEDZG_U* is detected when the speed rises above the threshold *dzwDZ_NbMx* and remains greater than this for the *debounce time fbwEDZG_UA* . The debouncing type is set to time-synchronous via *fbwEDZG_UT* = 1.		*fbwEDZG_UA, fbwEDZG_UT*	Full load limitation (applicable)	*cowFMEBEG*
Shut-off flaps actuation at overspeed	If the engine accelerates unintentionally, it should be slowed down to an applicable speed by actuating the shut-off flaps.  Figure UEBE_10 shut-off flap control at overspeed If the engine speed *dzmNmit* for the time *mrwUEB_TIM* is greater than the threshold *mrwUEB_N* AND the pedal *position mrmPWG_roh* <= the threshold *mrwUEB_PWG* , the OLDA *mroUEBakt* is set to TRUE. If the threshold *mrwUEB_PWG* , the OLDA mroUEBakt will be deleted again. Has the monitoring of overspeed detected (mroUEBakt = TRUE) AND is the pedal *position mrwPWG_roh* less than or equal to the threshold *mrwLDFPWMI* AND the speed is greater than the threshold *mrwLDFUnMI* , the OLDA *mroUEBaus* is set to TRUE and the shut-off flap is closed *(mrmFARaus* = TRUE). It should be noted that the intake manifold vacuum detection via the message *mrmLDFUaus* and the combustion detection in overrun via the message *zmmVE_Stop* can close the shut-off flaps.	*mrwUEB_TIM mrwUEB_N mrwUEB_PWG mrwLDFPWMI mrwLDFUnMI*	Activation of the shut-off flap via *zmmF_KRIT.4* = TRUE	*ehwEST_AR2*

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Continuation DZG defect detection

monitoring from	monitoring strategy	Data	substitute function	Data
	Below the speed *threshold mrwLDFUnMI* or above the pedal *value threshold mrwLDFPWMI* the shut-off flap is opened again, but the overspeed detection remains active up to the pedal value threshold *mrwUEB_PWG* . **Application note:** 1) The labels *mrwLDFPWMI* and *mrwLDFUnMI* are through the Intake manifold vacuum detection specified. See chapter Boost pressure control monitoring concept. 2) The output stage of the shut-off flap **must be** active during run-on so that the function with K15 off is still effective in the event of an "overspeed" error. *(ehwEST_AR2)*			

8.51.2 Healing

monitoring from	monitoring strategy	Data	substitute function	Data
Static plausibility	The error *fbbEDZG_S* is healed with every occurring WUP, whether plausible or not. The healing number should be 0 here, since this error is intended to indicate a complete failure of the signal. Since inductive and Hall sensors may be attached to the motor, errors can occur during the formation problems occur at low speeds, e.g. engine stop. In order to avoid this, the defect classification can be switched off above an applicable cylinder segment period. This time can be specified via the label *dzwKTFeSMx*	*fbwEDZG_SB, fbwEDZG_ST,*	Switch to normal function	
dynamic plausibility	The error *fbbEDZG_D* is healed with each WUP with zmmSWP_def = dzeOK = 0h. The signal reaches the state *zmmSWP_def = dzeOK* = 0h only after an applicable number of DZG events, previously *zmmSWP_def = dzeVoPlaus* = 7h. The number of WUPs until the intact rating is specified with *dzwKCWPsok* . For this reason the healing time for this error should be set to 0. The counter *zmcC_WUPok,* which contains the number of provisionally plausible WUPs counted, can be found on the OLDA *zmoC_WUPok* can be read. The error is debounced synchronously with the event, which is set with *fbwEDZG_DT* = 0. The healing number for Deletion of the error is set via the label *fbwEDZG_DB* .	*fbwEDZG_DB, fbwEDZG_DT, dzwKCWPsok,* dzwKNFeDMx, dzwKUFeMin	Switch to normal function	
overspeed	If the speed falls below the threshold *dzwDZ_NbMx* and remains for the healing *time fbwEDZG_UB* less than this, the error *fbbEDZG_U is* discharged. The debouncing type is set to synchronous with *fbwEDZG_UT* = 1.	*fbwEDZG_UB, fbwEDZG_UT*	Switch to normal function	
Parking flap control at overspeed	Below the speed *threshold mrwLDFUnMI* or above the pedal *value threshold mrwLDFPWMI* the shut-off flap is opened again, but the overspeed detection remains active up to the pedal value threshold *mrwUEB_PWG* .	*mrwLDFUnMI mrwLDFPWMI mrwUEB_PWG*	Shutdown of the shut-off flap	

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8.52 Electric fuel pump (EKP)

monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbEEKP_O is set.			
power amplifier short circuit	The error fbbEEKP_K is set when the output stage is short-circuited.			

8.53 Refrigerant pressure sensor (KMD)

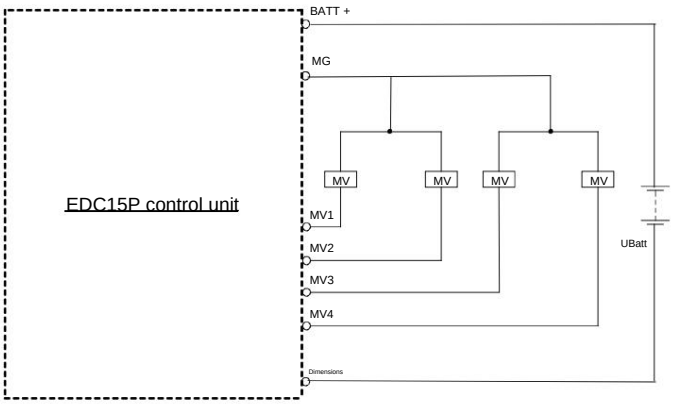
monitoring from	monitoring strategy	Data	substitute function	Data
signal range	Signal range check up (fbbEKMD_H error) if anoKMD_roh > anwKMD_MAX Signal range check down (fbbEKMD_L error) if anoKMD_roh < anwKMD_MIN	appKMD_MAX appKMD_MIN	applicable in anwKMD_GEB (default value via ramp, default value via jump, no default value)	anwKMD_VOR

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8.54 Solenoid valves (MV output stage)

monitoring from	monitoring strategy	Data	substitute function	Data
Solenoid valve control	The MV control can be disrupted by short circuits to ground or U-Batt in the wiring harness, in the cylinder head or by damage to the MV output stage. MV monitoring must recognize these errors and initiate appropriate responses. The solenoid valve to be controlled is selected via MVx and the current is applied via connection MG controlled for this solenoid valve.  A distinction is made between the following possible errors:			

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Solenoid valves continued

monitoring from	monitoring strategy	Data	substitute function	Data
short circuit by mass/ load drop (above quick delete monitoring)	Here, use is made of the fact that in the event of a short circuit to ground or a drop in load on an MV, the quick deletion does not work and the quick deletion monitoring logic (from SG EDC15P 4.X) diagnoses a quick deletion error on the affected MV. If the error occurs with *fbwEMVxMSA* subsequent controls on the same MV, the bit *fbbEMVxMS* in the associated error path *fboSMVx* set (x=1..4, ie MV-specific). The error can only be reset after switching the ignition off and on again. A cure of the error during operation is not possible (the application of *fbwEMVxMSB* has no effect). With a short to ground on an open circuit MV low side, it is possible that LLR and LRR compensate for the resulting increase in quantity on this cylinder. This will still within the defect classification time on this cylinder is recognized as overrun and the defect classification is stopped. However, as soon as the speed increases, the error is detected. In the event of a short-circuit to ground at MG or an interruption in MG, the software recognizes the non-MV-specific quick reset error (see below) instead of short-circuits to ground/load drop for all MV's.	*fbwEMVxMSA* *fbwEMVxMSB*	No further control of those affected MV (OFF-PIN, ie MV output stage control is blocked; Yselect on cyl. 8, ie no MV is selected; no Entry MVon/MVoff angle in ASIC) .	
short circuit to Ubatt	To detect the error, after selecting the MV to be controlled (Yselect), the MV current *zmoIMVxsel* measured. If it is above the applicable current *threshold zmwMV_IsMX,* the defect detection (debouncing event-driven) is started. If the current exceeds the threshold at *fbwEMVKUA* successive controls of the MV, the bit in the error *path fboSMV* *fbbEMVKU* set (not MV-specific). For hardware reasons, the following condition must be met be considered: *fbwEMVKUA<number of cylinders* Intact detection (healing during operation) must fall below the current threshold for *fbwEMVKUB* successive activations of the MV.	*zmwMV_IsMX* *fbwEMVKUA* *fbwEMVKUB*	No further control of those affected MV (OFF-PIN, ie MV output stage control is blocked; Yselect on cyl. 8, ie no MV is selected; no Entry MVon/MVoff angle in ASIC)	

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Solenoid valves continued

monitoring from	monitoring strategy	Data	substitute function	Data
Quick delete error	If the quick-clear monitoring logic detects a quick-clear error on all MVs with successive activations, error debouncing is started. After *fbwEMVSLA* consecutive Activation of the MV, the fbbEMVSL *bit* is set in the fboSMV error path and a quantity *reduction* is carried out. After *fbwEMVSLB* consecutive controls without quick clear error, the error is as in Classified operation cured. The same error entry results from a short circuit from MG to ground or an interruption in MG. In this case, however, the engine stops immediately and can no longer be started if the error persists.	fbwEMVSLA fbwEMVSLB	volume reduction	cowFMEBEG2
BIP detection If the	minimum bandwidth *zmwBP_BaBr* for *fbwEMVxBP* consecutive control below steps, the error bit fbbEMVxBP is set in *the* error path *fboSMVx* . An intact rating is only possible in the next driving cycle.	fbwEMVxBPA zmwBP_BaBr fbwEMVxBPB	Immediate transition to pure GDP control from the map: *zmoBPTvorh = zmmBPTerw - zmoBPFeneg* Was the last measured and valid expectation value deviation *zmoBPEwAbxeingefr.* Negative and greater in magnitude than the size of BIP - window early (|*zmoBPEwAbxeinfrozen*|> *zmoBPFeneg)* the lead value is calculated as follows: *zmoBPTvorh = zmmBPTerw - zmoBPEwAbxein* frozen BIP - window is switched off.	
	Falls below the BIP time, the maximum negative expected value *deviation zmwBP_EwAN* for *fbwEMVxBFA* successive controls, the error bit in *the* error path fboSMVx *fbbEMVxBF* set. An intact classification is only possible in the next driving cycle.	fbwEMVxBFA fbwEMVxBFB zmwBP_EwAN	Immediate transition to pure GDP control from the map: *zmoBPTvorh = zmmBPTerw - zmwBP_EwAN* BIP - window is switched off.	
	Exceeds the BIP time, the maximum positive expected value *deviation zmwBP_EwAP* for *fbwEMVxBSA* successive controls, the error bit in *the* error path fboSMVx *fbbEMVxBS* set. An intact classification is only possible in the next driving cycle.	fbwEMVxBSA fbwEMVxBSB zwwBP-EwAP	Immediate transition to pure GDP control from the map: *zmoBPTvorh = zmmBPTerw* BIP - window is switched off.	

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8.55 Secondary Speed Sensor (SEK)

monitoring from	monitoring strategy	Data	substitute function	Data
Static plausibility	This error is intended to indicate a completely failed SEG signal. For this purpose, the SEG signal is counted from the plausible INK signal. Condition is *zmmSWP_def* = *dzeOK* = 0h. With everybody plausible DZG-WUP signal (S1 or S2), the error *fbbESEK_S is* reported, which is the error counter incremented. The error counter is reset with every SEG signal, regardless of whether it is plausible or not. The error is debounced synchronously with the event, which is set with *fbwESEK_ST* = 0. The debounce number to register with the label *fbwESEK_SA,* the healing number to delete the error on the label *fbwESEK_SB* set. Since inductive and Hall sensors may be attached to the motor, errors can occur during the formation of problems occur at low speeds, e.g. engine stop. To avoid this, the defect classification can be switched off below an applicable speed threshold. This speed threshold can be specified via the label *dzwKNFeMin* .	*fbwESEK_SA*, *fbwESEK_ST*, *dzwKNFeMin*, *dzwK_TSOUT*	Full load limitation (applicable) Additional reaction when attempting to start: Start attempt carried out without NW encoder signal (redundant synchronization).	*cowFMEBEG*
interference signal activation	In the case of synchronous KW signal processing, it is checked whether after a maximum *of dzwSYPLmax* attempts *(dzo-SYPLver:* number of synchronization plausibility check attempts) there are at least two NW segment signals per NW revolution within the cylinder-specific SYNC windows *dzwKNrx...* (see also Synchronization), a NW segment signal is within the SEG window dzwKSegZa1 , *dzwKSegZa2* and no more than *dzwNWStMax* NW segment signal are outside of SYNC/SEG windows (interfering signals). If the check is successful, dzoSYNCPok is set to TRUE and the check synchronization plausibility ended. With non-synchronous KW signal processing, after a maximum *of dzwSYPLmax* attempts, the number of NW segment signals per NW revolution examined, displayed on the OLDA *dzoCSg_PUL* becomes. Is the number of NW segment signals outside of a window dependent on the NW encoder wheel *dzwPulMIN* and *dzwPulMAX* , so the error *fbbESEK_R* "interference signal switching" is set.	*dzwSYPLmax*, *dzwNWStMax*, *dzwPulMIN*, *dzwPulMAX*	Full load limitation (applicable) Start attempt without NW segment signal (redundant synchronization) carried out.	cowFMEBEG

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Secondary Speed Sensor (SEK) continued

monitoring from	monitoring strategy	Data	substitute function	Data
twist NW encoder wheel to KW encoder wheel	In the case of synchronous KW signal processing, it is checked whether after a maximum *of dzwSYPLmax* attempts *(dzo SYPLver:* number of synchronization plausibility check attempts) there are at least two NW segment signals per NW revolution within the cylinder-specific SYNC windows *dzwKNrx...* (see also Synchronization), a NW segment signal is within the SEG window dzwKSegZa1 , *dzwKSegZa2* and no more than *dzwNWStMax* NW segment signal are outside of SYNC/SEG windows (interfering signals). If the check is successful, *dzoSYNCPok* is set to TRUE and the check of the Synchronization plausibility ended. With non-synchronous KW signal processing, after a maximum *of dzwSYPLmax* attempts, the number of NW segment signals per NW revolution examined, displayed on the OLDA *dzoCSg_PUL* becomes. Is the number of signals in a window *dzwPulMIN* dependent on the NW encoder wheel and *dzwPulMAX,* the error *fbbESEK_P* "rotation KW to NW encoder wheel" is set.	*fbwESEK_PA , fbwESEK_PT, dzwSYPLmax, dzwNWStMax, dzwPulMIN, dzwPulMAX*	Full load limitation (applicable) No activation of the solenoid valves allow more **(engine stop).**	*cowFMEBEG*

8.55.1 Healing

monitoring from	monitoring strategy	Data	substitute function	Data
Static plausibility	The error *fbbESEK_S* is healed with every occurring SEG signal, whether plausible or not. The healing number should be 0 here, since this error is intended to indicate a complete failure of the signal. Since inductive and Hall sensors may be attached to the motor, errors can occur during the formation of problems occur at low speeds, e.g. engine stop. In order to avoid this, the defect classification is not carried out below an applicable speed threshold. This speed can be over the label *dzwKNFeMin* can be specified.	*fbwESEK_SB, fbwESEK_ST, dzwKNFeMin*	Switch to normal function	
interference signal activation	The error *fbbESEK_R* can only be cured by a restart.	*fbwESEK_RB, fbwESEK_RT,*	Switch to normal function	
twist NW encoder wheel to KW encoder wheel	The error *fbbESEK_P* can only be cured by a restart.	*fbwESEK_PA, fbwESEK_PT,*	Switch to normal function	

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8.56 redundant pedal value sensor (PGS)

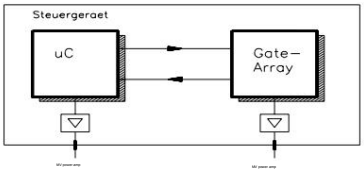
monitoring from	monitoring strategy	Data	substitute function	Data
Signal area Is only carried out with cowVAR_PWG=1 (double analogue PWG).	Signal range check up (fbbEPGS_H error) if anoU_PGS > anwPGS_MAX Signal range check down (fbbEPGS_L error) if anoU_PGS < anwPGS_MIN	appPGS_MAX appPGS_MIN	increased idle speed at cowVAR_PWG=1 (double analogue PWG); see PWG monitoring concept	mrwLLR_PWD mrwLLR_PWB cowVAR_PWG
feeding	Signal range check up (fbbEPG2_H error) if anoU_PGS2 > anwPG2_MAX Signal range check down (fbbEPG2_L error) if anoU_PGS2 < anwPG2_MIN	appPG2_MAX appPG2_MIN	increased idle speed cowVAR_PWG=1 (double analogue PWG); see PWG monitoring concept	mrwLLR_PWD mrwLLR_PWB cowVAR_PWG

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8.57 control unit (SG)

monitoring from	monitoring strategy	Data	substitute function	Data
gate array (monitoring module)	In the question answer communication between gate array and µC are alternately correct by the µC and incorrect answers given to the questions from the monitoring module in the gate array. There are three Possibilities of wrong answers: - Answers with the wrong content at the right time - Answers with correct content too soon - Answers with correct content too late By evaluating the error counter in the gate array, which is incremented in the event of incorrect answers (max. 7) and decremented in the case of correct answers, and to which the µC **only has read** access the correct response of the gate array can be monitored.  Figure UEBE_03 In the case of an incorrect reaction of the monitoring module, the error *fbbERUC_U* is set.		Switching off the MV control via mrmZUMEAUS	
	If the error "redundant thrust monitoring (fbbERUC_S)" occurs, the communication becomes Gate array aborted.-		Switching off the control by the Monitoring module in the gate array	

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Continued SG surveillance

monitoring from	monitoring strategy	Data	substitute function	Data
SHS pin in trailing	In the aftermath, the correct function of the SHS pin is checked and, if necessary, the error *fbbENLF_S* set.	Attention: error not debounce	no	
OFF pin in trailing	In the aftermath, the OFF pin is tested and, if necessary, the error *fbbENLF_A* is set (see Chapter Trailing).	"	no	
voltage stabilizer monitoring circuit in trailing	The voltage divider at the reference voltage of the CY08 is then changed in order to test the quantity shutdown if the voltage stabilizer is faulty. If the voltage divider in the CY08 is reduced, the CY08 should switch off all output stages in the same way as when the operating voltage is too high. If the MV output stage can then still be controlled, the error will occur *fbbESTB_U* set. If the voltage divider in the CY08 is increased, the CY08 should switch off all output stages, just as if the operating voltage is too low. If the MV output stage can then still be controlled, the error will occur *fbbESTB_O* set. (See chapter Overrun).	"	no	
gate array (monitoring module) in the wake	In the after-run, the communication between the gate array and µC is aborted. If the MV power amp can then still be controlled, the error *fbbERUC_W* is set (see chapter follow-up)	"	In addition to the hardware shutdown of the MV output stage over K15 is over mrmZUMEAUS switched off.	
µC	This monitoring is done by the **monitoring module (in the gate array).** If an error count greater than or equal to 5 is reached due to wrong or missing answers from the µC in the question Answer Communication, the µC is classified as defective. The error counter is located itself in the monitoring module.		Switching off the control by the Monitoring module in the gate array	

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monitoring from	monitoring strategy	Data	substitute function	Data
redundant thrust monitoring	Overrun mode is monitored when all of the following conditions apply **(AND** - linked, visible on the Bitolda mroSUEBSTA (#) or mroSUEBST2 (##)): - PWG not actuated (mrmPWGfi = 0, bit #0) **OR** **[mrmM_EARD** < mrwUW_ARD **AND** mrmPWGfi ÿ mrwPWG_OPS **AND** zmmM_Ekorr > *mrwSCHUPKL]* (Bit #1) **OR** **[filtered** idle switch *) dimLGF = 1 **AND** mrmPWGfi > mrwPWG_OPS] (Bit #2) - GRA amount mrmM_EFGR is equal to zero (bit #3) **OR** Brake applied (dimBRE = 1 (Bit #4) **OR** dimBRK = 1 (Bit #5)) **OR** **[(dimFGL** = 0 **AND** ((comFGR_OPT) configuration GRA = VW **OR** Configuration GRA = VW via CAN **OR** Configuration GRA = ACC), Bit #6) **OR** (dimFGA = 1 **AND** configuration GRA = LT2, bit #7) **OR** (Configuration GRA unequal (VW, VW via CAN, LT2, ACC), bit #8)] - ADR amount mrmM_EADR is zero (bit #9) **OR** [Switch-off contact actuated (dimADR = 0) **OR** handbrake contact not active (dimHAN = 0) **OR** ADR target speed equal to zero (mrmADR_SOL = 0)] (Bit #A) **OR** ADR deactivated (configuration ADR unequal (VAR, FES), bit #B) - ADR switch-off ramp not active (bit C#) Active on the switch-off ramp is recognized when the expression (dimADR = 1 **AND** dimHAN = 1 **AND** mrmADR_SOL> 0) has a transition from true to false. This condition stays for the time t = (mrmADR_SOL - mrwADR_Nau) / mrwADR_dNA upright. This term serves used to calculate the time that the ADR needs to ramp over the target speed turn off - MSR - quantity mrmM_EMSR is equal to zero (Bit #D) **OR** **[no** MSR - request via CAN **OR** incorrect binary complement MD_ASR and MD_MSR (Bit #E)] **OR [CAN** message timeout brake1 **OR** CAN error (Bit #F)] **OR** message counter error brake1 (bit ##0) - ASG - amount mrmM_EASG is equal to zero (Bit ##1) **OR** clutch is not activated (dimKUP=0, bit ##2) **OR** no ASG request via CAN (bit ##3) **OR** incorrect binary complement mrmASG_roh (bit ##4) **OR** message counter error ASG (bit ##5) **OR [CAN** message timeout ASG **OR** CAN error (Bit ##6)]	mrwUW_ARD mrwPWG_OPS mrwSCHUPKL mrwADR_Nau mrwADR_dNA	Shutdown of the solenoid valve control and a program restart (recovery), a defect is then detected again no further recovery takes place. A full SG initialization is not performed during a recovery. This State lasts max. 5 ms, after that transferred to the normal program flow.	

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monitoring from	monitoring strategy	Data	substitute function	Data
redundant thrust monitoring	If the speed threshold mrwUW_SNGR is also exceeded, it is checked whether the quantity *zmmM_Ekorr* determined by the quantity calculation and the temperature correction is equal to the thrust target *quantity mrwUW_ME_S* . If zmmM_Ekorr ÿ mrwUW_ME_S, after the debouncing time fbwERUC_SA set the error *fbbERUC_S* . **) Note: dimLGF corresponds to the digital input idle throttle switch dimLGS, but is debounced as a separate bit. The debouncing time for the negative flank (transition from PWG to idle position -> PWG to VL) must be identical to that debounce time for dimLGS, while the debounce time for the positive edge (transition PWG in full throttle position -> PWG in idle position) must be matched to the PWG filter.*	mrwUW_SNGR mrwUW_ME_S		
communication CAN	If no communication can be established between CAN controller and µC (camSTATUS0.0 = 1 or camSTATUS0.2 = 1), the error *fbbECAN_D is* reported. This occurs when the CAN The module is applied via cawINF_CAB but is not available, or on the DPRAM of the CAN controller cannot be accessed.		CAN quantity interventions are aborted. The monitoring of the transmission/brake message timeout is hidden (see external quantity intervention/transmission).	
Fixed values for WFS	Final (ie no refresh possible) inconsistencies in the fixed values lead to an error *fbbEIMM_C.*		Shutdown of the MV control	
Invalid record number	The data set number entered in the EEPROM must be correctly entered in the EEPROM and must be in one of the data sets stored in the EPROM, otherwise the error *fbbEEEP_V* is set. The initialization time is 50ms longer in the event of an error. The error is cured by a correct data record variant is programmed. The complete error path is removed from the error memory.		Default data set is used	
Invalid function switches	The function switches entered in the EEPROM must have a valid checksum, otherwise the error *fbbEEEP_F* is set. The initialization time is 50ms longer in the event of an error. Healed eliminates the error by programming the correct function switches.		Default values	cowFUN_FGR cowFUN_FGG

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monitoring from	monitoring strategy	Data	substitute function	Data
self test	After power up ("ignition on"), the following is carried out:			
out of the mask (internal ROM) executed	RAM test (internal RAM) Address/data bus portability test Monitoring module test		Message (7 bytes) on serial interface and then endless loop This state can only go through Power Up to be cancelled	
	EPROM test addressing (bit pattern) Checksum via EPROM Page_4 (Page_4 contains the code in the external EPROM that is the first is performed)		Message (7 bytes) on serial interface (only after power up) and then restart	
from external EPROM (Page_4) executed	Internal ROM checksum		Message (7 bytes) on serial interface and then endless loop This state can only be achieved by Power Up To get picked up.	
	RAM Test (External RAM)		Message (7 bytes) on serial interface (only after power up) and then restart	
	READY test for communication µC <-> CAN controller			
	Check sum over remaining EPROM (excluding Page_4) Separate code/data (can be switched off via generation).	Master EPROM tool	Message (7 bytes) on serial interface (only after power up) and then restart	
	EEPROM communication test Monitoring when reading into the RAM mirror (Error *fbbEEEP_K).* In the event of an error, the initialization time increases by 100ms.		Use of default values	cowAGL.. cowFUN_FGR cowFUN_FGG
	CAN controller test whether available or not		no	

8.58 Tank shut-off valve (TAV)

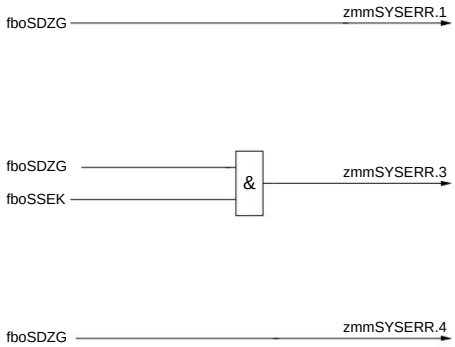
monitoring from	monitoring strategy	Data	substitute function	Data
power amplifier Neutral	If the power stage is idle, the error fbbETAV_O is set.			
power amplifier short circuit	The error fbbETAV_K is set in the status short circuit of the output stage.			

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8.59 Aggregated System Errors

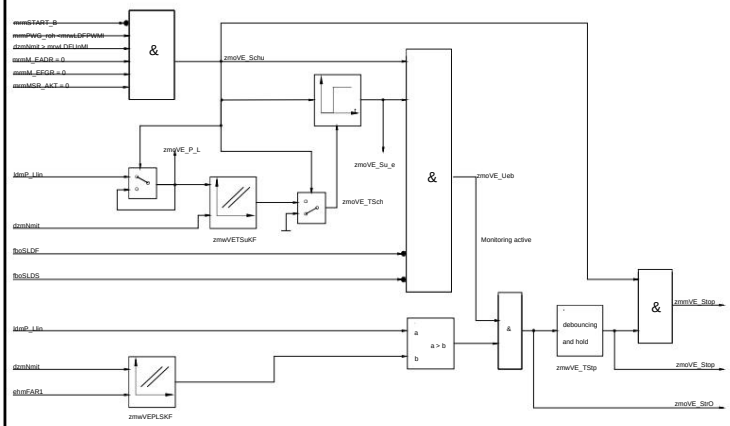
monitoring Of	monitoring strategy	Data	substitute function	Data
speed relevant mistakes	The message zmmSYSERR serves as interface information between basic and system functions and is structured as follows:  Figure UEBE_06: summarized speed-related errors zmmSYSERR		The CAN messages Motor1 and Motor2 send the corresponding information with the error flag value 0xFF (see chapter, CAN), since there is no speed that can be evaluated. Switching off the main glow and the glow indicator. Diagnostic function "Basic setting" not possible. Cancellation of the "actuator test" diagnostic function	

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8.60 Combustion detection in overrun via boost pressure

monitoring from	monitoring strategy	Data	substitute function	Data
burn detection	If the vehicle is on the overrun, after the dynamic effects have subsided when the supercharger blades are open, a boost pressure will occur that depends only on the speed *dzmNmit* and the exhaust gas recirculation *rate ehmFAR1* . If unwanted burns occur in this state, this can be recognized by an increased boost pressure. If combustion is now detected during overrun, the shut-off flap is actuated. The parking flap control is deactivated if overrun operation is not detected.  Figure UEBE_07: Combustion detection in overrun via boost pressure			

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8.60.1 Monitoring Conditions

monitoring from	monitoring strategy	Data	substitute function	Data
burn detection	If the start bit is dropped *mrmSTART_B=0,* and falls below the PWG raw value *mrmPWG_roh* the threshold *mrwLDFPWMI,* and the speed exceeds the threshold *mrwLDFUnMI,* and no increasing external quantity intervention is active, and is neither of the cruise control nor of the all-speed control requires an injection quantity that differs from zero, so *zmoVE_Schu = TRUE* is detected on overrun (un-debounced) and the boost pressure *ldmP_Llin* is stored in *zmoVE_P_L* . the Monitoring for increased boost pressure is activated *(zmoVE_Ueb=TRUE)* if thrust is detected for the time *zmo VE_TSch (zmoVE_Su_e=TRUE)* and the error *paths fboSLDF* and *fboSLDS are* not are set. The debounce time *zmoVE_TSch* is calculated from the map *zmwVETSuKF* as a function of the boost pressure *zmoVE_P_L,* which is stored from *ldmP_Llin* when the overrun conditions occur was, and the average speed *dzmNmit.* As soon as the un-debounced thrust condition is *removed zmo VE_Schu = FALSE,* the timer for the thrust debouncing is reset and the boost pressure *zmo VE_P_L* is updated again.	*mrwLDFPWMI* *mrwLDFUnMI* *zmwVE_TSuKF*		

8.60.2 Detection of increased boost pressure in overrun

monitoring from	monitoring strategy	Data	substitute function	Data
burn detection	If for the time *zmwT_VEStp* the monitoring of increased charge pressure in the overrun is active *zmo VE_Ueb=TRUE* and the charge pressure *ldmP_Llin* is greater than the output of the map *zmwVEPLSKF,* whose input variables are the mean speed *dzmNmit* and the duty cycle of the actuator *ehmFAR1* form, activation of the shut-off flap is requested in *zmoVE_STOP=TRUE* . penetration on *zmmVE_Stop=TRUE* has this requirement only if the un-debounced thrust condition *zmo VE_Schu* is met. **The status *zmoVE_STOP=TRUE* can only be reset by reinitializing the control unit (terminal 15 off/on).** On the measuring channel *zmoVEStRo* is the unbounced request for the Observe activation of the shut-off flap. The same application notes apply as in the chapter: Shutdown flap control in the event of overspeed number	*zmwT_VEStp* *zmwVEPLSKF*	Control of the parking flap via *mrmFARaus* during thrust conditions are fulfilled	*ehwEST_AR2*

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9 input and output signals

9.1 Input signals

9.1.1 Overview

The following table is used to find the connection 'SG input and its Description':

SG pin designation	see section / chapter	side
ATD-E ambient temperature	ambient temperature	9-5
BLS-E brake light switch	digital inputs	9-3
BTS-E brake contact	digital inputs	9-3
CAN1-H Controller Area Network	Chapter "CAN"	
CAN1-L Controller Area Network	Chapter "CAN"	
DKS-E throttle valve actuator	digital inputs	9-3
DZG-1 speed sensor	speed sensor	9-14
FGG-1 Ground Speed Sensor	vehicle speed sensor	9-26
GEN-E generator load signal	Chapter "Quantity Calculation"	
GRA- GRA minus	digital inputs	9-3
GRA-A GRA trip contact	digital inputs	9-3
GRA-L GRA reset contact	digital inputs	9-3
GRA-S GRA single contact	digital inputs	9-3
GRA-W GRA recovery	digital inputs	9-3
GZR-E glow time feedback	digital inputs	9-3
HFM1 hot film air mass sensor	analog inputs	9-7
ISO-K K line	"Diagnosis" chapter	
K15-E terminal 15	Digital inputs, analog inputs 9-3, 9-7	
KIK-E kickdown signal	digital inputs	9-3
KLI-B air conditioning compressor	digital inputs	9-3
KLI-E air conditioning input	digital inputs	9-3
KTF1 fuel temperature sensor	analog inputs	9-7
KUP-E clutch signal	digital inputs	9-3
LDF1 boost pressure sensor	analog inputs	9-7
LGS-E idle switch	digital inputs	9-3
LTF1 air temperature sensor, intake manifold temperature sensor	analog inputs	9-7
ODG-E oil pressure sensor	Digital inputs oil	9-3
OTF1 oil temperature sensor	temperature sensor	9-11
PWM-E PWM input (AG4)	digital inputs	9-3
PWG11 pedal value sensor	Pedal value transmitter, analog inputs 9-9, 9-7	
PWG21 redundant pedal sensor	Pedal value transmitter, analog inputs 9-9, 9-7	
STF1 intake manifold temperature sensor	analog inputs	9-7
WTF1 water temperature sensor	analog inputs	9-7, 9-10
ZHB-E auxiliary heater consumption signal	auxiliary heater consumption	9-6
ZHR-E KWH shutdown request	digital inputs	9-3

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9.1.2 Digital inputs

The digital inputs are read in centrally, debounced and distributed throughout the system.

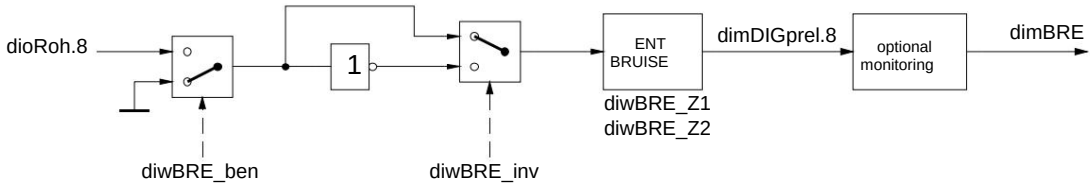


Figure EINAUS01: Processing of the digital inputs (e.g. brake input is used and not inverted)

There are four parameters for each input. Unused inputs diw.._ben (0 = unused, 1 = used) are masked out. Depending on the data set parameter diw.._inv (0 = not inverted, 1 = inverted), each input is converted into its assigned logic level and debounced separately for rising diw.._Z1 and falling edges diw.._Z2 with its own filter time constants.

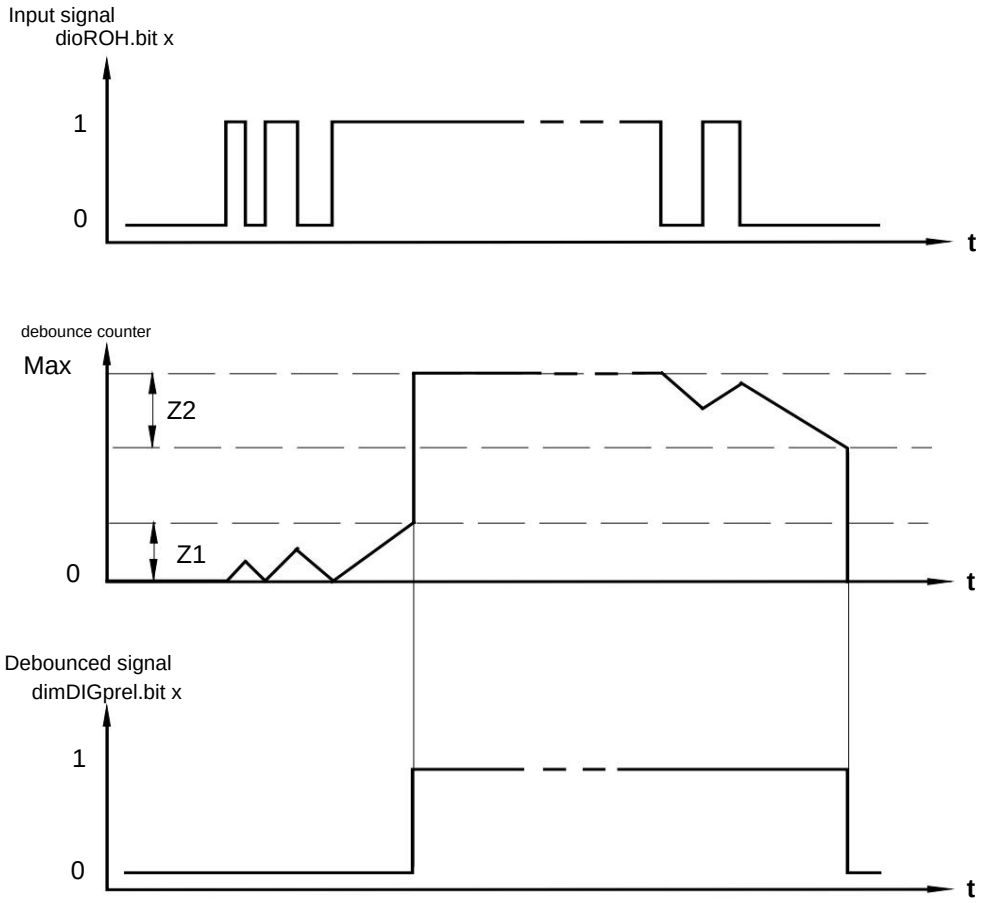


Figure EINAUS02: Debouncing the digital inputs

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debouncing:

Depending on the sampling rate (20 ms), the debounce times are set in counter thresholds for the Signal change implemented. For the debounced state Low (0), the debounce counter is set to the Minimum (0), for the debounced state High (1), the debounce counter is set to its maximum (Max) set. Based on this value, with a logical raw value High (1), the Debounce counter increments, with a logical raw value Low (0) the debounce counter decremented. If the debounce counter, coming from 0 (debounces low), exceeds the threshold Z1 (Counter threshold, determined from the filter time constant diw.._Z1), debouncing occurs in the state High (1) transitioned and the debounce counter set to its maximum (Max). falls below the Debounce counter, coming from the maximum (Max, debounces high), the threshold Z2 (counter threshold, determined from the filter time constant diw.._Z2), the debouncing state is Low (0) passed and the debounce counter is set to 0. For each digital input., its logical Level for initialization is high, its debounce counter is initialized with the maximum value (Max).

The OLDAs dioROH1 and dioROH2 give the status of the unprocessed digital inputs again. The messages dimDIGprel and dimDIGpre2 contain the digital inputs after the Debouncing and its logical treatment.

The structure for dioROH1 and dimDIGpre1 and the structure for dioROH2 and dimDIGpre2 are identical:

SG pin	Documentation symbol designation		bit position
PBM-E	dimAG4 dimECO	Automatic transmission AG4 Ecomatic	dioROH1.13 dioROH2.13
BLS-E	dimBRE	brake light switch	dioROH1.8
BTS-E	dimBRK brake test switch (redundant brake) dioROH1.4		
GRA-A	dimFGA dimHAN	GRA OFF handbrake	dioROH1.3 dioROH2.3
GRA	dimFGM GRA minus dimFGP		dioROH2.12
GRASS	 dimADP	GRA ON+ ADDR IN+	dioROH1.0 dioROH2.0
GRA-L	dimFGV dimFGL dimADR	Control contact at LT2 GRA extinguishing contact ADR active	dioROH2.6 dioROH2.7 dioROH1.6
GRA-W	dimFGW dimADM	GRA recovery ADR A	dioROH1.2 dioROH2.2
GZR-E	dimGZR	Glow relay feedback	dioROH1.12
K15-E dimK15		terminal 15 terminal 50	dioROH1.15
KL50-E (RED2) dimK50		starter kick down input air	dioROH2.14
KIK-E	dimKIK	conditioning compressor	dioROH1.5
KLI B dimKLB dimKLI dimKUP		air conditioning input clutch	dioROH2.5
KLI-E		dimKWH cooling water	dioROH1.10
KUP-E		heater switch-off request	dioROH1.7
ZHR-E	dioROH1.11		
LGS-E	dimLGF dimLGS	Idle switch filtered idle switch	dioROH1.14 dioROH1.9
ODG-E		currently no software function	dioROH2.1
DKS-E	dimRKSTAT throttle actuator		dioROH2.4

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The inputs dimKUP and dimECO can be overwritten by the equivalent CAN messages with the appropriate Ecomatic configuration (see 7.5, Ecomatic).

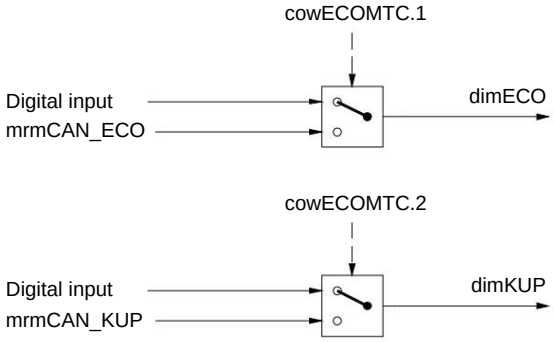


Figure SONSEC01: SW switch for Ecomatic

The inputs dimLGS and dimLGF are read via the SG pin LGS-E if the switch cowVAR_PWG = 0.

If the switch cowVAR_PWG has the value 1, the inputs dimLGS and dimLGF are determined using the sum of the pedal value anmPGS plus the empty path-optimized offset mrmPW_OFFS (this is limited to a maximum of diwLGSofMX): if it exceeds the value diwLGS_PGS, it is recognized as “0”. , otherwise to ”1”. Further processing takes place as usual with the labels diwLGS_.. and diwLGF_.. .

Furthermore, with cowVAR_PWG = 1, the message dimKIK is treated as follows:

Errors in the fboSPWG or fboSPGS paths are recognized as "0".

If no error has occurred in these paths, it is determined via the analog message anmU_PWG: if it exceeds the value diwKIKPWG1, it is recognized as "1"; if it falls below the value diwKIKPWG0, "0" is recognized.

In any case, further processing is carried out with the labels diwKIK_.. .

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9.1.2.1 Ambient temperature

The UTF signal (ambient temperature sensor) is a data telegram sent by the air conditioning control unit or the instrument cluster. The source and type of transmission can be set using the data record parameter cowVAR_FZG.

This means cowVAR_FZG = 0: no data transfer. cowVAR_FZG = 1, 2 transmission with data telegram. A data telegram consisting of a start bit, 8 data bits and a changeover bit (Celsius = 0, Fahrenheit = 1) is sent. Duration of a bit: cowVAR_FZG = 1:5 ms/bit, cowVAR_FZG = 2:50 ms/bit. With cowVAR_FZG = 3, the UTF value is received via CAN.

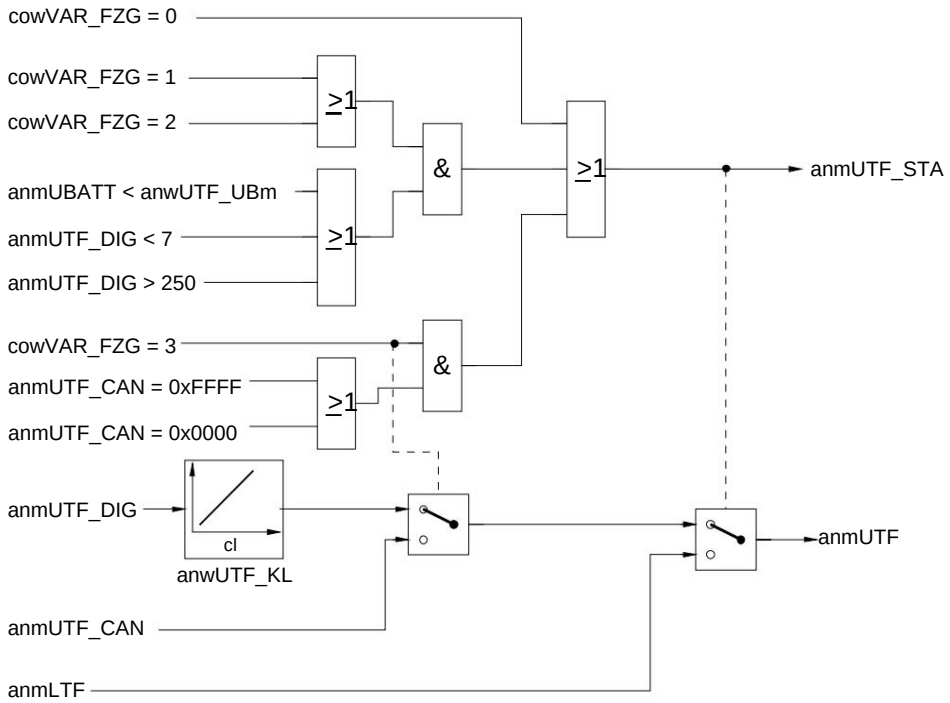


Figure EINAUS2B: Ambient temperature conversion

Transmission via data telegram:

The value that is read from the telegram has a non-linear conversion to the actual temperature and is made visible by the message anmUTF_DIG. The conversion into an analog value is carried out using the anwUTF_KL characteristic:

If no data telegram is received for a time greater than aneUTF_MAX (20s) or the content of the received data telegram is less than 7 or greater than 250, the system switches to the substitute value LTF and the error fbeEUTF_P is reported. If the battery voltage is too low (anmUBATT <anwUTF_UBm) or if the function switch cowVAR_FZG is equal to 0, it is also switched to the substitute value anmLTF, but the error fbeEUTF_P is not reported. The hysteresis (mrwUTF1_..H and mrwUTF2_..H) for the idle speed increase and the hysteresis kwhUTF_..H for the heat output increase then use the analog value anmUTF as an input parameter (see chapter "Idle target speed calculation" and "Heat output increase").

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The support points of the characteristic curves should therefore be as close as possible to these hysteresis limits, to achieve better accuracy for this area.

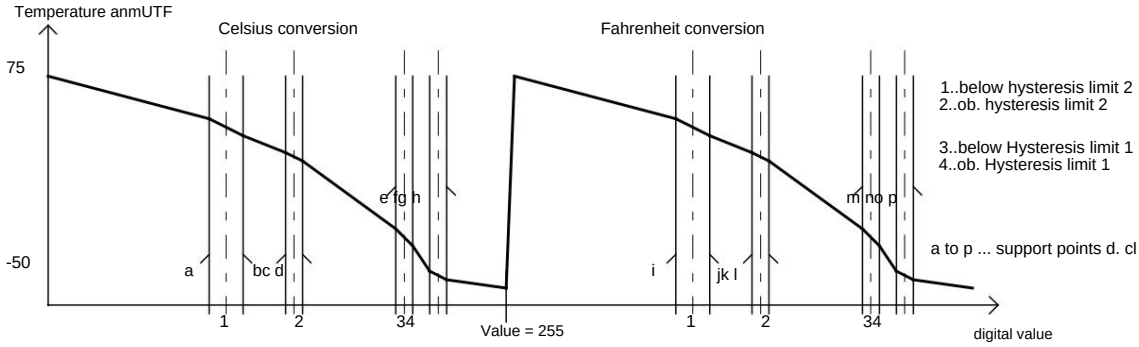


Figure EINAUS2A: Conversion characteristic anmUTF and hysteresis limits

Transmission via CAN:

If UTF evaluation is applied via CAN, the combination 2 message is evaluated and the filtered UTF value sent in anmUTF_CAN (see CAN). This is then converted to anmUTF accepted. In the event of an error (invalid value, not installed, ...) anmUTF_CAN with FFFFH occupied, the error fbeEUTF_P reported and anmLTF transferred to anmUTF. With station wagon 2 Message timeout is assigned to anmUTF_CAN with 0000H, anmLTF is transferred to anmUTF, however, the error fbeEUTF_P is not reported.

9.1.2.2 Additional heater consumption

The diesel auxiliary heater (see cooling water heater) supplies a digital signal whose frequency is proportional to its consumption. The period of this signal is measured (anmZHB_CNT*20 [ms]), converted into a frequency (mroF_VERZ [Hz]), then with one Additional heater constant (mrwVBZHBC [(ml/h)/Hz]) multiplied and finally as additional heater consumption (mroVERB_Z [l/h]) used for the consumption signal calculation (TQS / MFA / VBS signal, page 9-41).

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9.1.3 Analog inputs

The following analogue SG inputs are recorded centrally:

designation	block parameters	period [ms]	raw value	reading
Atmospheric pressure sensor signal	anwADF_.. 20	anoU_ATM	anmADF	
battery voltage	anwBAT_.. 20	anoU_UBAT	anmUBATT	
brake light switch	anwBRE_.. 20	anoU_BRE	anmBRE	
Terminal 15 signal	anwK15_.. 20	anoU_K15	anmK15	
Fuel temperature sensor signal	anwKTF_.. 100	anoU_TK	anmKTF	
Boost pressure sensor signal	anwLDF_.. n-syn	anoU_LDF	anmLDF	
Boost pressure sensor supply	anwLD2_.. 100	anoU_LDF2		
Air flow meter signal	anwLMM_.. n-syn or 20		anoU_LMM	anmLMM
Air flow meter supply	anwLM2_.. 100	anoU_LMM2		
Air temperature sensor in intake manifold	anwSTF_.. 100	anoU_TS	Air temperature	NoteSTF
sensor signal 100	anoU_TL	anwLTF_..		anmLTF
Solenoid valve current for Ubatt diagnosis	anwIMV_... n-syn	oil		zmoIMV...sel
temperature sensor signal	anwOTF_.. 100	sensor signal	anoU_PWG_.. 20	anmOTF
anoU_PWG	anmPWG			
Pedal value sensor supply	anwPW2_.. 100	anoU_PWG2	anmPW2	
red. Pedal position sensor signal	anwPGS_.. 20	anoU_PGS	anmPGS	
red. Pedal value sensor supply	anwPG2_.. 100	anoU_PGS2	anmPG2	
Reference voltage	anwREF_.. 20	anoU_UREF	anmU_REF	
Test voltage AD converter	anwTAD_.. 20	anoU_TAD	anmTAD	
Water temperature sensor signal	anwWTF_.. 100	anoU_TW	anmWTF	
Refrigerant pressure sensor signal	anwKMD_.. 20	anoKMD_roh	anmKMD	

The following record labels are mask reserves and are not used:

Electropneumatic converter	anwEPW_..
Analog FGR control panel	anwFGR_..
U_BAT linearization class	anwUBAT_KL

The acquisition stores the results of the periodic analog-to-digital conversion as raw scores. The saved values will be used at a later point in time (period column) evaluated. In addition to the periodic signal acquisition, there is also a speed-synchronous one Detection active (LMM depending on setting, LDF). When starting the speed-synchronous acquisition any ongoing conversion is stopped. In the next signal acquisition period restart the interrupted conversion.

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Stands for each voltage that is detected by the control unit using an ADC (Analog Digital Converter).
one parameter set block each with the following structure is available:

ÿ anw.._DPL step by ramp
ÿ anw.._GEB Encoder password
ÿ anw.._KAN group + channel, hardware-dependent, do not change!
ÿ anw.._KL ÿ linearization characteristic
anw.._MAX SRC maximum value
ÿ anw.._MIN SRC minimum value
ÿ app.._BEFORE Default value

When evaluating the analog signals, the converted raw values are checked and
transformed. The check consists of a signal range check (app.._MIN and
app.._MAX). If the valid range is exceeded, the error is returned during debouncing
(temporarily defective) the last valid value is frozen. If the error is finally broken, for the
analog value the default value anw.._VOR accepted. Per data set parameter anw.._GEB can
can be selected whether the default value is via the ramp with the gradient anw.._DPL or directly
is taken over. If the raw value is valid again after a signal range check error
range, the new value is also applied via the ramp with the gradient anw.._DPL to the
current value introduced.

The raw value is linearized using a characteristic anw..KL. The only exceptions are ATF1 - and
ATF2 sensor. These are first processed by the driving software as raw values. Additionally there is
special routines for evaluating PWG, LMM and LDF. These signals have one
Supply voltage over which the raw value is linearized.

The encoder password anw.._GEB is to be applied as follows (bitwise coded):

Bit Position	Value	Comment
00000001	0	Accept raw value (without linearization and default value)
	1	Linearization using a characteristic anw.._KL
00000110	00	does not go to the default value anw.._VOR in the event of a defect
	01	In the event of a defect, jumps to the default value anw.._VOR
	10	In the event of a defect, ramp step anw.._DPL to the default value anw.._VOR
11111000	00000	not assigned, apply to 0

Overview of the exceptions (details are described for the relevant sensor):

ÿ A permanently defective sensor is always healed via a ramp.
ÿ The supply voltages for PWG, LDF and LMM go up with a jump in the event of a defect
Default value app.._BEFORE.
ÿ When using the HFM5, the analog value is at anwLMD_N1 < dzoNmit < anwLMD_N2
calculated, the measured value remains frozen outside the window.
ÿ The slider of the PWG and LMM does not go to VGW if there is a defect.
ÿ With DZG synchronicity, ie if *zmmSINKsyn=TRUE,* the battery voltage in the case
from signal range check violation without debouncing jumped to default value.
The healing then takes place just as quickly.
- The message anmPGS is only updated if the switch cowVAR_PWG=1
(dual analog PWG) is.

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- The message anmFPM_EPA contains information for the double-analog PWG (cowVAR_PWG=1): If a corresponding error/healing debounce is active, then it is the corresponding bit is set.

Bit position 0	value	comment
	1	Debouncing fbbETAD_L or fbbETAD_H
	2	Debouncing fbbEPW2_L or fbbEPW2_H
1	4	Debouncing fbbEPG2_L or fbbEPG2_H
2	8	Debouncing fbbEPWG_L or fbbEPWG_H
3 4	16	Debouncing fbbEPGS_L or fbbEPGS_H
5	32	Debouncing fbbETAD_T

Description of anw..._KAN: Content depends on hardware, do not change.

Bit position	value	comment
00000111	000...111	MUX channel 0 to MUX channel 7
11110000	0000...1111	AD channel 0 to channel 15 (0:MUX 0; 1:MUX 1)

9.1.3.1 Temperature sensors

Filtering:

All temperature sensors are filtered and forwarded to the driving software every 100 ms. Not them filtering that can be applied is approximately a PT1 filter with a time constant of approx. 1.6s. Um to avoid that the driving software shows invalid temperature values for a few seconds after K15 gets to see (until the filtering has stabilized), the filter starts with the first Measured value pre-initialized.

Application note:

Due to the filtering, the value for the step of the ramp (app..DPL) is no longer correct, that's why it would make the most sense to apply the ramp for temperature sensors to the maximum value, since yes filtering has already taken place.

9.1.3.2 Pedal value sensor

9.1.3.2.1 Acquisition via potentiometer switch (cowVAR_PWG=0)

This signal has a supply voltage that is used to normalize the raw value. In case of an SRC error The default value is specified for the supply voltage. With the PWG, the default value becomes general determined by the PWG processing of the quantity calculation.

9.1.3.2.2 Acquisition via double analogue PWG (cowVAR_PWG=1)

In addition to the pedal value sensor anmPWG, the redundant pedal value sensor anmPGS is determined.

9.1.3.3 Atmospheric pressure sensor / boost pressure sensor

Capture:

The LDF signal has a supply voltage that is used to normalize the raw value. At an SRC The default value is specified if there is an error in the supply voltage.

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Calculation of the boost pressure ldmP_Llin:

The boost pressure is filtered with ldwLDF_GF. If the encoder is intact, it is monitored for plausibility using the atmospheric pressure sensor (see monitoring concept).

Calculation of the atmospheric pressure from the boost pressure:

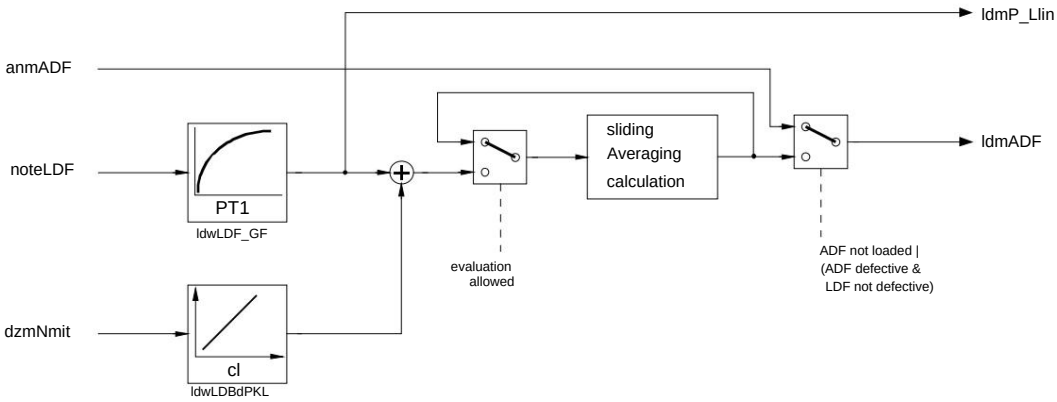


Figure EINAUS04: Atmospheric pressure calculation

The atmospheric pressure ldmADF can be calculated using either of the following
Conditions for the time ldwLDBTAL are met (evaluation allowed):

The speed dzoNmit falls below the threshold ldwLDBNAL

OR

(Throttle open AND driving function ARF active AND ARF valve closed)

The atmospheric pressure ldmADF is the sum of boost pressure in this operating state and a correction variable. This correction variable is formed as a function of the speed dzoNmit from the characteristic curve ldwLDBdPKL. The calculated atmospheric pressure is filtered by moving average. If none of the conditions are met, the last calculated value remains current in the system.

If the atmospheric pressure sensor (ADF) is not fitted (cowFUN_ADF = 0) or is defective, the atmospheric pressure is calculated from the boost pressure. The incoming boost pressure anmLDF is filtered using ldwLDF_GF PT1.

9.1.3.4 Water temperature sensor

If anwWTFSCH = 0, the KTF value is used as a substitute value for a defective WTF.

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9.1.3.5 Oil temperature sensor

Acquisition:

The oil temperature can be read either from an analog input of the control unit, via CAN or via a fixed default value.

With OTF via analog input *(anwOTF_KAN* = 00xxH), the acquisition is carried out as described for the analog inputs with the following exceptions: Switchover in the event of a defect or healing always takes place without a ramp. However, the usual PT1 filtering with a time constant of 1.6s for temperature sensors via analog input is still carried out. The calculated value *anmOTF_VOR* is used as a substitute value.

With OTF via CAN *(anwOTF_KAN* = 01xxH) there is no filtering and only the label *anwOTF_KAN* from analog value handling is used.

In the case of OTF using the default value *(anwOTF_KAN* = 02xxH), the default value *anwOTF_VOR* is used directly.

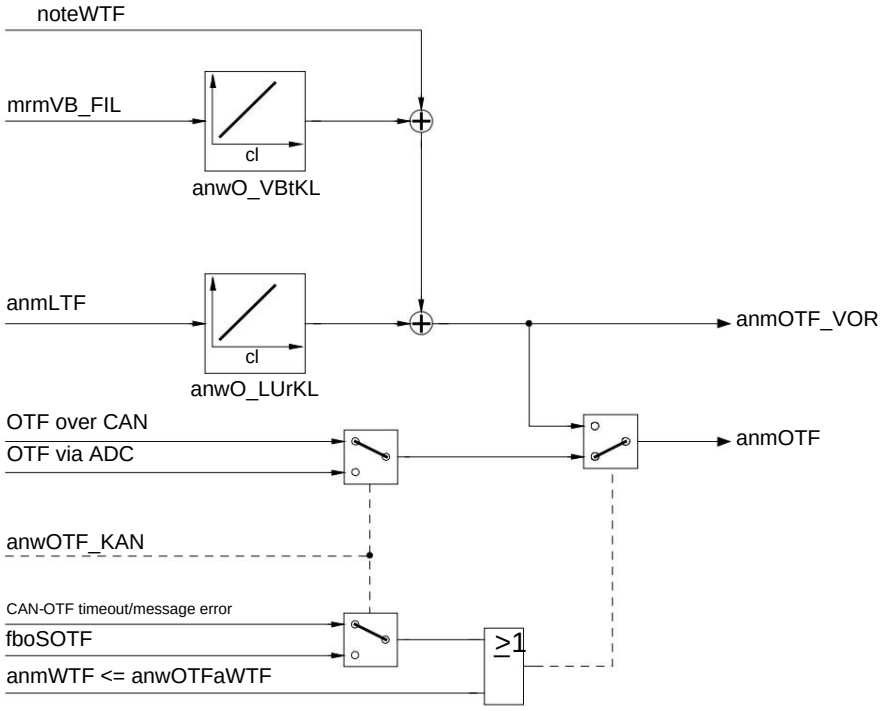


Figure EINAUS10: Oil temperature

Calculation of the substitute value:

The substitute value is calculated from the water temperature, which is increased by a proportion of the filtered consumption *(anwO_VBtKL)* and the air temperature *(anwO_LUrKL)* . In the event of a defect or below the water temperature *threshold anwOTFaWTF ,* the oil temperature *anmOTF* is switched hard to the calculated substitute value (filtering is still carried out for the analog input).

The OTF is used in the system for oil overheating protection in the limited quantity and for flexible service interval display.

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A notice:

Applicatively, either *anmKTF* or the default value *anwWTF_VOR* can be contained in *anmWTF* in the event of a WTF defect (see chapter Water temperature sensor or monitoring concept).

It should be noted that the WTF default value *anwWTF_VOR* is particularly important for glow time control.

9.1.3.6 Air flow meter

Calculation of the air volume with the different sensors:

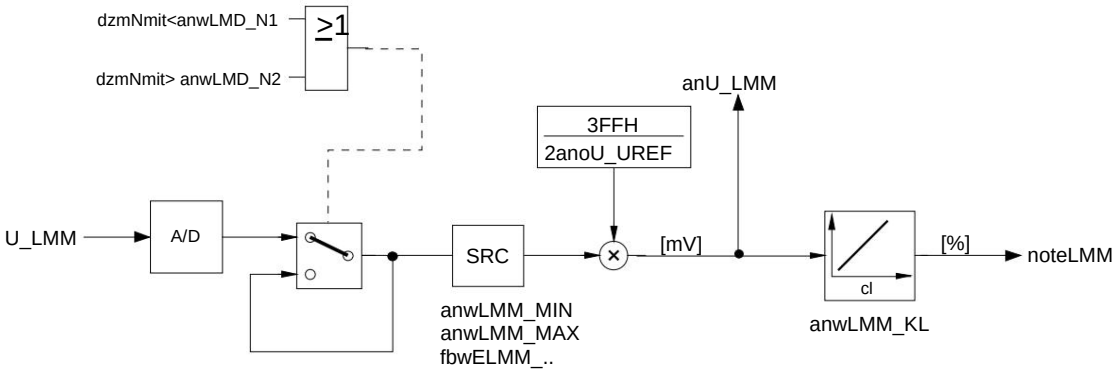


Figure EANA05: Non-ratiometric processing, speed-synchronous acquisition (2)

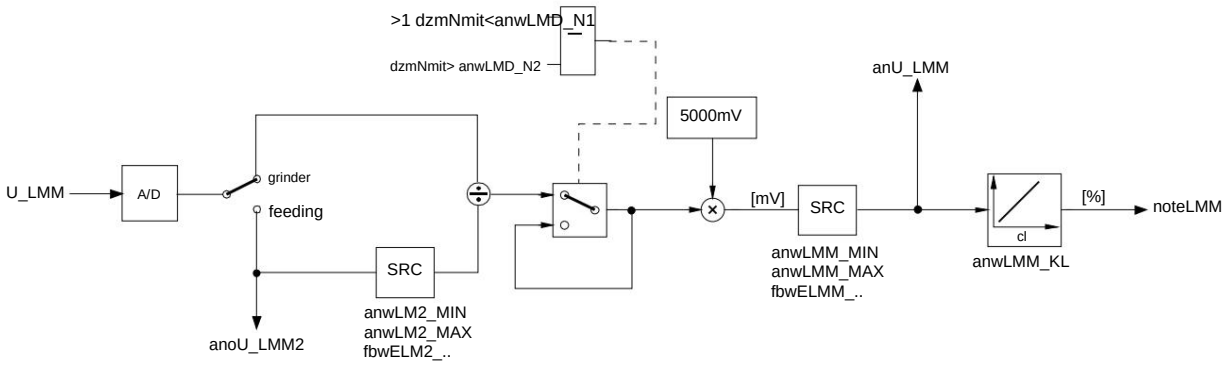


Figure EANA06: Processing ratiometrically and synchronously every 20 ms (1)

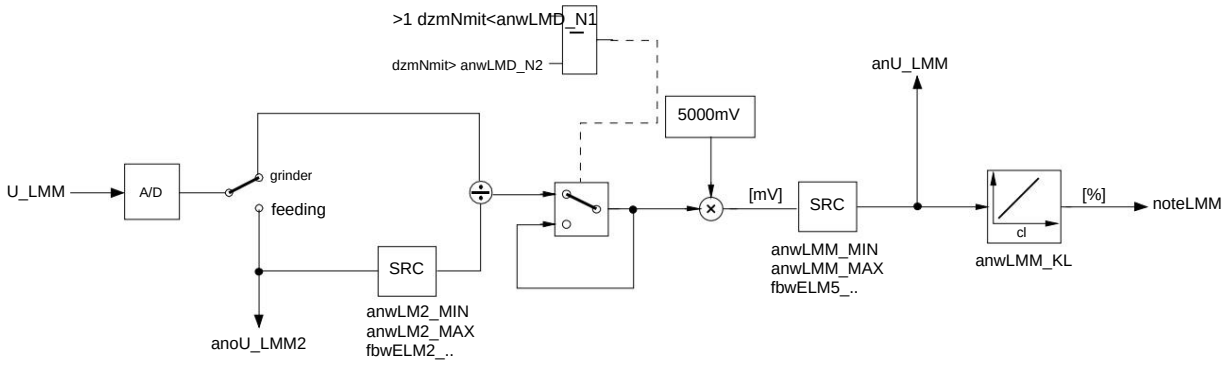


Figure EANA07: Processing ratiometric and speed-synchronous (3)

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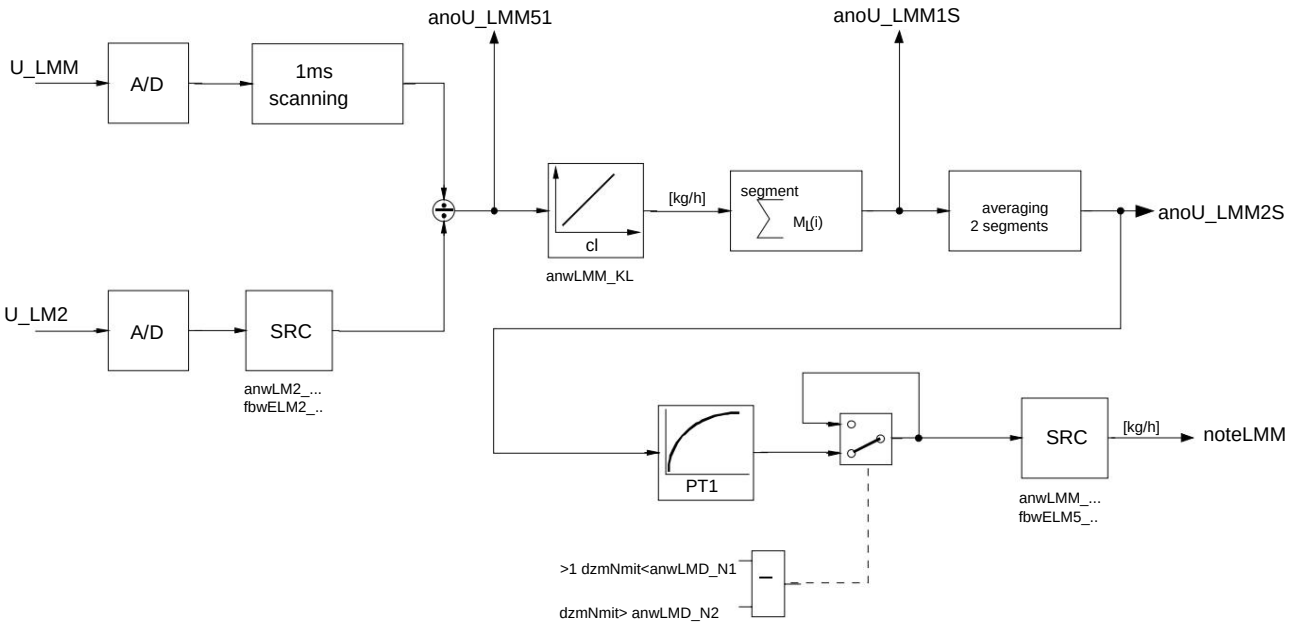


Figure EANA08: Ratiometric processing, synchronous acquisition every 1 ms (4)

Capture:

The signal of an air mass meter (eg hot film air mass meter (HFM), signal proportional to the air mass flow) or an air flow meter (eg flap air flow meter (KLM), signal proportional to the air mass flow) can be detected.

This signal has a supply voltage that is used to standardize the raw value. In the event of an SRC error in the supply voltage, the default value arwLMBPGW is specified for the air mass armM_List.

For the air flow meter (LMM), the signal range check is only carried out in the speed range (lower speed threshold anwLMD_N1, upper speed threshold anwLMD_N2). In the event of an SRC error, the default value arwLMBPVGW is specified for the air mass armM_List. With HFM2 and HFM5, the air quantity is only recorded within these speed thresholds; outside these thresholds, the last measured value is frozen. The measured value is also frozen if the limits anwLMM_MIN and anwLMM_MAX are under - or exceeded.

Description of the software switch air volume / air mass meter cowV_LMM_S:

decimal value	comment
1	Processing ratiometric, acquisition synchronously every 20 ms
2	Processing not ratiometric, detection speed-synchronous
3	Processing ratiometric, detection speed-synchronous
4	Processing ratiometric, recording synchronously every 1 ms

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9.1.4 Speed sensor

The DZG delivers a raw signal, which is debounced via the input module CY09 and converted into a digital signal. This digital signal is checked by the ASIC CC55x for dynamic and logical plausibility and, frequency-multiplied, is used to clock an angle clock that supplies the crankshaft angle. Two speed interrupts (so-called static WAKE-UPs (WUPs)) are generated symmetrically per cylinder segment by the angle clock structure per entry in the CC55x. A cylinder-proportional number of pulses per revolution is generated.

The periods between two pulses (static WUPs), called segment times, are stored in the message *zmmDZGPER* (cannot be displayed via VS100), made known to the system and used to calculate the sampling time *dzmABTAS .* This is limited to the value *dzwK_T_ABT.* The sampling time is the time between two activations of the speed-synchronous tasks. It is issued on the OLDA *dzoABTAS .*

At low engine speeds, the speed-synchronous calculations are activated per segment, ie two activations per cylinder. If the segment time falls below the value of 6000 µs, there is only one activation per cylinder, namely after each 1st static WUP.
One speaks of the *first segment blanking.*

The current speed *dzmNakt* is calculated from the entries in the message *zmmDZGPER* and the normalization constants *dzwNKSEG_h , dzwNKSEG_l dzwNKSEGHh ,* depending on whether there was a segment hiding or not, and made known[1] to the system. [1], [1] and *dzwNKSEGHl* [1]

The average speed is made known as *dzmNmit* and output on the OLDA *dzoNmit .*

In addition, the CC55x provides the period between two increments of the sensor wheel. The instantaneous speed *dzmNINK* at the speed interrupts is calculated from this and from the normalization constants *dzwNKINK_h , dzwNKINK_l* [1] [1].

TS1-S1 = cylinder segment time, time between two 1st static wake ups

$$T_{segment} = \begin{cases} T_{S2nd} & \text{Segment(= cylinder half segment) - time,} \\ & \text{Time between 1st and 2nd static wake up} \\ \text{or.} & \\ T_{S1st2} & \text{Segment(= cylinder half segment) - time,} \\ & \text{time between 2nd and 1st static wake up} \end{cases}$$

K = constant, depending on the number of cylinders

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TSegment > 6000µs	$nude(k) = \frac{K}{T_{segment}\,k\,(\,)}$
	$Nwith\,k\,(\,) = \frac{nact\,k(\,)\,ÿ + 1 \quad Naked\,k}{(\,)\,2}$
(below 1st segment blanking)	$ARD = \begin{cases} ÿ\,Nact\,k\,(1+ÿÿ) \quad \frac{Naked\,(\,)\,k\;Naked\,k\,(\quad 2\,)}{2} & \text{for } (\,)\,(\,dzmNakt\,k > Nakt\,k \quad 1\,)) \\ ÿ\,nude\,k\,(\,) & \text{otherwise} \end{cases}$
TSegment < 6000µs	$nude\,k\,(\,) = \frac{2K}{T_{s\$}\,k\,(\,)_1}$
	$Nwith\,k\,(\,) = nact\,k\,(\,)$
(above 1st segment blanking)	$N_ARD\,k\,(\,) = \frac{K}{T_{s\$1ÿ}\,k\,(\,)}$

When exceeding the period for a cylinder segment at 50 rpm, in *dzwK_T_MAX,* is set for *dzmNmit* = 0.

After reaching the speed of *dzwDZ_NzMn* by dzmNmit the injection is enabled. *Exceeds dzmNmit* the speed specified in *dzwDZ_NzMX* , the injection canceled.

The ARD speed can be calculated in different ways. Which of the two Calculation formulas should be used is set via the label *dzwK_DZARD* . at *dzwK_DZARD* = 0 applies dzmNakt as a calculation basis for *dzmN_ARD,* with *dzwK_DZARD* = 1 instead, *dzmNINK goes* into the calculation of the ARD speed. The segment number is included communicated to the system with the message *zmmSEGM .* The segment number can have values from 0 to *Assume 2*dzwK_C_SG* + 1. The label *dzwK_C_SG* contains the number of cylinders - 1.

The speed and angle are always calculated in the system based on a motor play, i.e. 2 crankshaft revolutions. The calculated zero point is reached after 720° CA. This Value is transmitted to the system with the label *dzwK_C720* 1 , which indicates the number of Contains teeth + virtual teeth in the gaps over 2 crankshaft revolutions.

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The segment number is communicated to the system with the message dzmSEGM and via the OLDA dzoSEGM mirrored externally. The current DZG period is set to the OLDA dzoDZGPERL written dzoDZGPERH. However, this output only occurs when the speed-synchronous tasks.

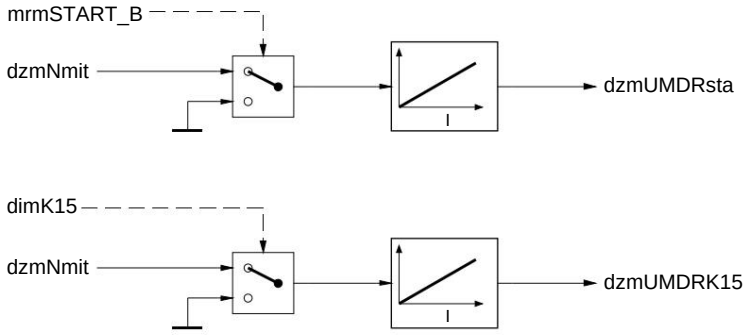


Figure EINAUS14: Revolutions since takeoff and K15 on

9.1.5 Secondary Sensors

The secondary encoder raw signal is debounced and digitized by the input module CY09. This Digital signal is checked by the controller for static plausibility (if a secondary encoder signal is existing KW encoder signal available?) checked. The secondary encoder signal becomes the Synchronization at start or restart, used for synchronization plausibility check and NW period/speed determination.

From the NW period, which after *dzwNWZaZl* secondary encoder signals (equal to the number of Secondary sensor wheel teeth, normally (number of cylinders*2-1) signals per NW revolution). and on the OLDAs *dzoTSg1SG* (low word of the 32-bit value) and *dzoTSg2SG* (high word of the 32-bit value) and the normalization constants *dzwNKNW_h 1* and *dzwNKNW_l* [1], a NW speed *dzmNSEG* is formed synchronously. The number of secondary encoder signals for the NW period duration recording is stored in the message *dzmCSg_n* . The counter becomes 0 reset when it reaches the value *dzwNWZaZl* .

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9.1.6 Synchronization

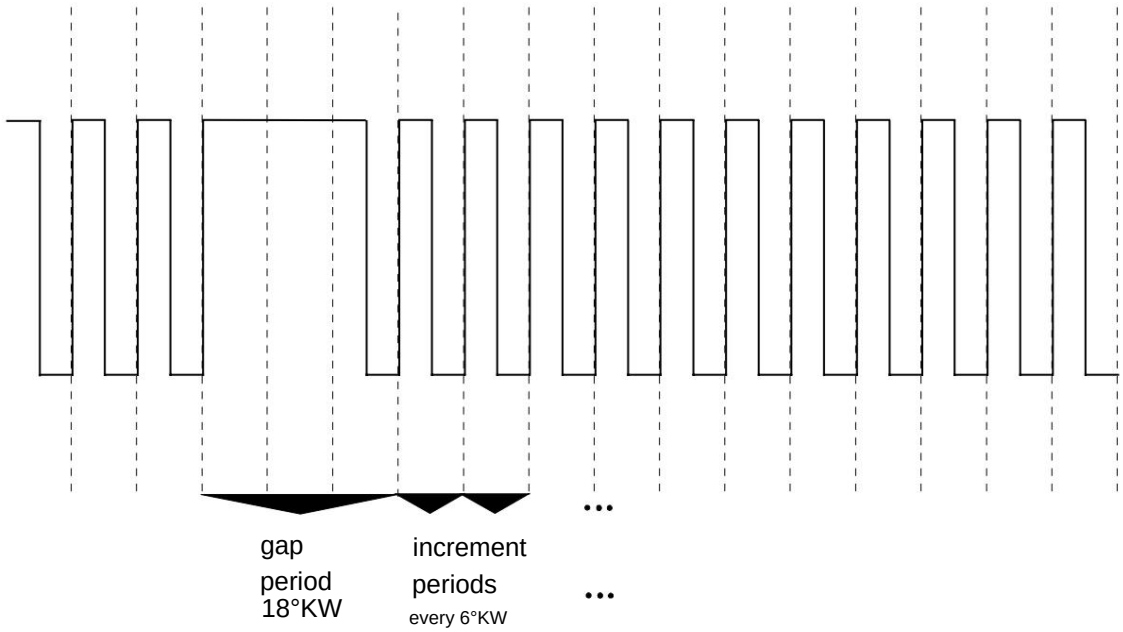
When restarting or resynchronizing, the speed sensor signal processing must
Determine the engine in relation to the individual cylinders (solenoid valves). This "synchronization"
can be done in two ways, shown on the OLDA zmmSINKsyn:

Synchronization using the segment signal	(h00)
redundant synchronization	(h10)

After successful synchronization, the status changes to (h01).

Before the first injection takes place, the angle clock is synchronized to the KW angle.

In the gate array, the position of the gap is derived from the INK signal of the crankshaft sensor wheel signal determined. The circuit for evaluating the dynamic plausibility is used for this.



The angle clock is kept on reset after initialization or in the event of an implausible INK signal.
If the status changes to plausible after the gap has been found, the angle clock starts running.

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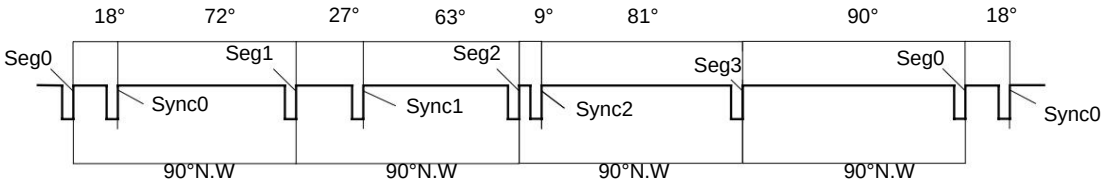
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9.1.6.1 Synchronization using the segment signal (NW encoder)

The segment signal is considered in conjunction with the angle clock. The number of teeth in which the segment and synchronous teeth must appear is known from the mounting position of the wheels relative to one another.

A status of the camshaft sensor wheel signal evaluation shows whether and which of the teeth has appeared.



In order to determine this, the status of the angle clock is considered with each occurring segment signal. If the system is correctly synchronized with the KW and NW signal, the angle clock must have a very specific counter reading when the NW encoder wheel pulses occur (this counter reading is calculated using the *dzwK_WUOfx* labels , which are automatically generated during software generation). This counter reading can be used to identify segment teeth and the differently positioned synchronous teeth of the individual cylinders. The message dzmSg_Art has the following states:[1]

ÿ *dzmSg_Art* = *dzeSGMark* = h00 - segment tooth found

ÿ *dzmSg_Art* = *dzeSynMark* = h80 - synchronous tooth found

ÿ *dzmSg_Art* = *dzeN_Plaus* = h08 - NW encoder wheel pulse cannot be assigned

ÿ *dzmSg_Art* = *dzeSegM360* = h07 - Segzahn shifted by 360°KW

ÿ *dzmSg_Art* = *dzeSynM360* = h87 - Sync tooth shifted by 360°KW

ÿ *dzmSg_Art* = *dzeUNDEF* = hFF - state before synchronization and after successful Synchronization.

If a synchronous tooth is detected, the cylinder number assigned to this special tooth is determined from the data record and written to the *dzmSYNCZYL* message . If one of the z segment teeth is detected, the cylinder number of the cylinder that does not have a synchronous tooth is assigned to it.

The increment signal processing evaluates the information from the two messages *dzmSYNCZYL* and *dzmSg_Art* for synchronization. In the still unsynchronized state of the signal processing, the start WUP and then the 1st static wake-up of each cylinder are used once to search for synchronization. These WUPs are placed in the cylinder segments in such a way that, if the sensor wheels are installed correctly, they are only generated when the synchronization mark of the cylinder with the greatest distance between the synchronization mark and the segment mark would have occurred.
This results in the security for the correctness of the status dzmSg_Art for the cylinder segment without synchronous mark. This status is always displayed by the incremental signal processing

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undefined *(dzeUNDEF* = hFF) reset in order to be able to register status changes from the camshaft signal processing.

If, as with the 3-cylinder, synchronization can already occur when the 2nd static WUP occurs (all possible SEG or SYNC teeth have occurred by then), this can be transmitted to the software by setting *dzwKDoS2Sy* = 1. If *dzwKDoS2Sy* = 0, the start WUP or the 1st static WUP can be synchronized.

If the current cylinder is identified in the start WUP, 1st or 2nd static WUP, the position of the cylinders is known, the angle clock can be set and injection can be started (synchronization takes place: OLDA *zmmSINKsyn* = h01).

The speed encoder evaluation of the NW and KW encoder signal can be adapted to the variants 3 cylinder with quick start and 4 cylinder with quick start.

Starting with software version V70, engine operation is only possible with quick-start encoder wheels.

9.1.6.1.1 4-cylinder

For the 4-cylinder, a 60 tooth wheel with 2 gaps and an NW sensor wheel with 4 segment teeth and 3 synchronous teeth are used. The 4 segment teeth are distributed symmetrically on the NW encoder wheel. Behind three of these four segment teeth follows a synchronous tooth at a distance specific to the respective cylinder. Since NW and KW have a specific position in relation to one another, segment and synchronizing teeth always appear at the same angular distance relative to the gaps in the KW signal. Here in the system, however, it is not the distance to the gaps that is considered, but the distance to the 2nd static WUP, which is not a problem, since the 2nd static WUP always has a constant distance to the gap.

KW and NW are connected via an elastic toothed belt. Minimum and maximum values are therefore defined for the distances between the teeth and the 2nd WUP.

The minimum distances between the 3 synchronous teeth and the 2nd WUP can be found in the data

ÿ *dzwKNr0SY1*

ÿ *dzwKNr1SY1*

ÿ *dzwKNr2SY1*

The maximum distances of the 3 synchronous teeth to the 2nd WUP can be found in the data

ÿ *dzwKNr0SY2*

ÿ *dzwKNr1SY2*

ÿ *dzwKNr2SY2*

The minimum distance applies to the segment teeth

ÿ *dzwKSegZa1*

and the maximum distance

ÿ *dzwKSegZa2*

It should be noted that the minimum distance value must always be smaller than the value for the maximum distance of the respective tooth.

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If a specific synchronous tooth is identified by checking the distance to the 2nd WUP, then an MV must be assigned to this tooth. This is done via the labels

ÿ *dzwKNr0SYZ*

ÿ *dzwKNr1SYZ*

ÿ *dzwKNr2SYZ*

The labels *dzwKnr0..., dzwKnr1..., dzwKnr2...* always belong together.

The solenoid valve number for the segment without a synchronous tooth is in the label

ÿ *dzwKNoSYZY*

fixed.

Each synchronous tooth can be assigned to a cylinder segment. So the numbers 0, 1, 2 in the names of the associated labels do not directly point to a cylinder number.

The labels

dzwKDoS2Sy = 0

indicates that the S2 is positioned within the cylinder segments in such a way that, when it occurs, there is no guarantee that the respective cylinder has been recognized. The synchronous tooth of this cylinder would appear after the S2 in this case.

9.1.6.1.2 3-cylinder

For the 3-cylinder, a 60 tooth wheel with 3 gaps and an NW sensor wheel with 3 segment teeth and 2 synchronous teeth are used. The 3 segment teeth are distributed symmetrically on the NW encoder wheel. Behind two of these three segment teeth follows a synchronous tooth at a distance specific to the respective cylinder. Since NW and KW have a specific position in relation to one another, segment and synchronizing teeth always appear at the same angular distance relative to the gaps in the KW signal. Here in the system, however, it is not the distance to the gaps that is considered, but the distance to the 2nd static WUP, which is unproblematic, since the 2nd static WUP always has a constant distance to the gap.

KW and NW are connected via an elastic toothed belt. Minimum and maximum values are therefore defined for the distances between the teeth and the 2nd WUP.

The minimum distances between the 2 synchronous teeth and the 2nd WUP can be found in the data

ÿ *dzwKNr0SY1*

ÿ *dzwKNr1SY1 = dzwKNr2SY1*

The maximum distances of the 3 synchronous teeth to the 2nd WUP can be found in the data

ÿ *dzwKNr0SY2*

ÿ *dzwKNr1SY2 = dzwKNr2SY2*

The minimum distance applies to the segment teeth

ÿ *dzwKSegZa1*

and the maximum distance

ÿ *dzwKSegZa2*

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It should be noted that the minimum distance value must always be smaller than the value for the maximum distance of the respective tooth.

If a specific synchronous tooth is identified by checking the distance to the 2nd WUP, then an MV must be assigned to this tooth. This is done via the labels

ÿ *dzwKNr0SYZ*

ÿ *dzwKNr1SYZ* = *dzwKNr2SYZ*

The labels *dzwKnr0..., dzwKnr1..., dzwKnr2...* always belong together.

The solenoid valve number for the segment without a synchronous tooth is in the label

ÿ *dzwKNoSYZY*

fixed.

Each synchronous tooth can be assigned to a cylinder segment. So the numbers 0, 1, 2 in the names of the associated labels do not directly point to a cylinder number.

The labels

dzwKDoS2Sy = 1

indicates that the S2 is positioned within the cylinder segments in such a way that when it occurs it is guaranteed that the respective cylinder has been recognized. The synchronous tooth of this cylinder appeared before the S2 in this case.

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9.1.6.2 Redundant synchronization

If synchronization is not possible due to a faulty secondary speed signal, synchronization is carried out without a secondary speed sensor signal. The synchronization status of the speed signal processing zmmSINKsyn changes to the status "redundant synchronization" (h10).

One of the two following conditions must be “redundant synchronisation” are present:

- no segment signal in the start/resynchronization *(fbbESEK_S)*
- Interference signal on segment *encoder input (fbbESEK_R)*

With redundant synchronization, the same solenoid valve is always activated until an increase in engine speed is detected as a result of successful injection and the actual position of the engine is therefore clear. The synchronization status zmmSINKsyn changes to "synchronous" (h01). The solenoid valve to be controlled during the redundant synchronization can be selected via the label *dzwKRedZyl .*

The speed increase is determined via the quotient of the new segment period to the old segment *period zmmSEGQuot .* For the release to recognize a speed increase, the speed must first be constant, the quotient is in the limits *dzwKQcNmin* and *dzwKQcNmax.* If the quotient then falls below the limit *dzwKMaxQ,* a correct control is used to conclude that the speed has increased. Then the variables relevant to the control must be corrected by the cylinder *correction value dzwKZylKor .* This correction value is necessary and must be able to be applied, since the point in time at which the speed increases due to successful injection depends on the engine.

In engines with an odd number of cylinders, depending on the occurrence of the first gap in the crankshaft wheel, the MV activations can be shifted by half a cylinder segment (3 cylinders by 120° crankshaft relative to TDC). If there is no "successful" MV control after *dzwLSP_Max* engine load cycles in engines with an odd number of cylinders, the MV control is corrected by half a cylinder segment and, as already described, a speed increase due to a successful injection is awaited.

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9.1.7 Plausibility checks

9.1.7.1 Plausibility check of the KW increment signal

The entire processing of the increment signal (INK) takes place in the ASIC. The teeth of the incremental encoder wheel are recorded with an inductive sensor and converted into a digital signal. During acquisition, interference may be superimposed on the resulting INK signal or edges may be missing. Since a faulty signal leads to incorrect information about the KW angle, the INK signal coming into the gate array is checked for dynamic and logical plausibility.

Dynamic plausibility

The dynamic plausibility assesses the time intervals between the INK edges with regard to the dynamics of the motor. Due to its rotating mass, acceleration and deceleration are only possible up to a certain limit. The result for consecutive INK periods is that their quotient cannot fall below or exceed certain values.

INK edges are only classified as plausible if they occur at specific intervals from the last edge (considering the positive edge). This classification is implemented by a window in which incoming flanks are accepted as valid. If the motor moves at a constant speed, the next INK edge would occur after the previously measured INK period has elapsed. Taking into account acceleration and deceleration, the next edge can occur earlier or later than the time of the previous period. Depending on the maximum permissible acceleration, a window is opened in which an edge is accepted. The window closes again according to the maximum permitted delay.

The lower border of the window is defined by the label

ÿ *dzwKUPLFUI* or *dzwKOPLFUI*

Are defined. 0 < *dzwKxPLFUI* < 1 applies to this value . This means that the following INK edge is accepted at the earliest *dzwKxPLFUI* * (period duration of the preceding INK) after the last edge.

The upper window limit is determined by the label

ÿ *dzwKUPLFOI* or *dzwKOPLFOI*

Are defined. 1 < *dzwKxPLFOI* < 4 applies to this value. This means that the following INK edge must have occurred no later than *dzwKxPLFOI* * (period duration of the preceding INK) after the last edge, otherwise a faulty signal is assumed.

In addition to consecutive increments, the sequence increment - gap is checked. For this purpose, a larger window is opened around the second positive INK edge after the gap. With stationary speed, this would occur after four times the time of the preceding INK (for arithmetic reasons, the first flank after the gap is not taken).

The lower border of the window is defined by the label

ÿ *dzwKUPLFUL* or *dzwKUPLFUL*

Are defined. 1 < *dzwKxPLFUI* < 4 applies to this value. This means that the second INK edge after the gap must have occurred *no earlier than dzwKxPLFUL* * (period duration of the preceding INK) after the last edge before the gap, otherwise a faulty signal is assumed.

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The upper window limit is determined by the label

ÿ *dzwKUPLFOL* or *dzwKOPLFOI*

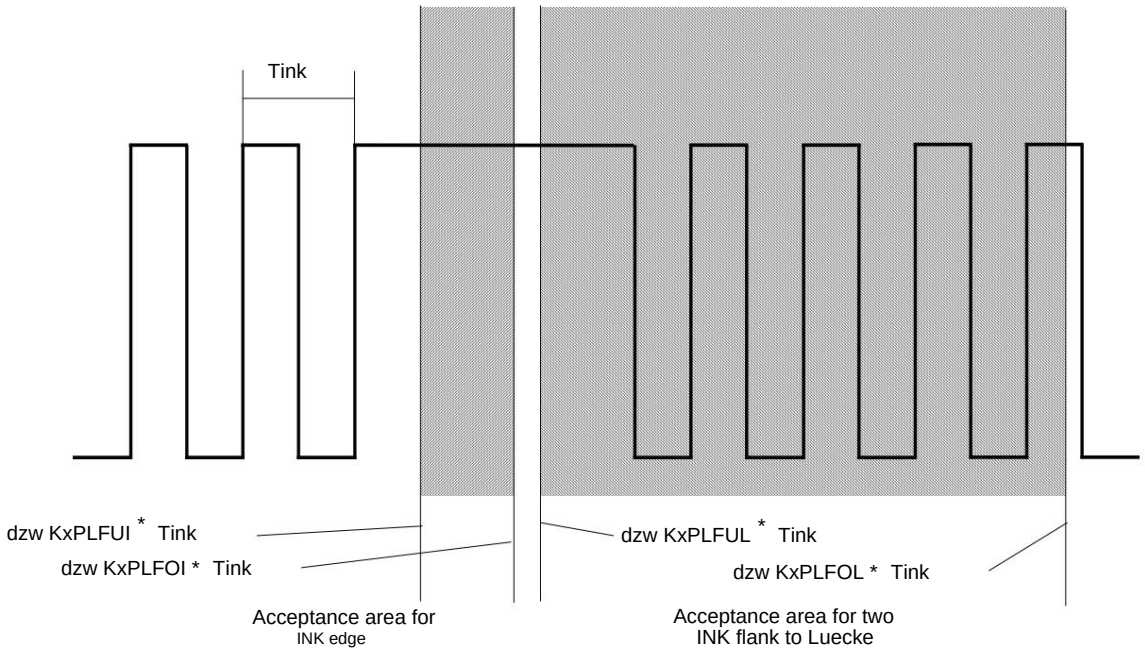
Are defined. For this value, 4 < *dzwKxPLFUI applies.* This means that the second INK edge after the Gap no later than *dzwKxPLFOL* * (period of previous INKs) after the last edge must have occurred before the gap, otherwise a faulty signal is assumed.

Since extreme conditions (very low outside temperatures) lead to greater Accelerations and decelerations than can occur in normal operation will be two Parameter sets required for the INK/gap plausibility window, which depend on engine speed (dzmNmit) are used to check the speed signal for plausibility. Below a speed *dzwK_N_PLF* is the parameter set for low speeds *dzwKUPLFxx* active above the Speed threshold is switched to the parameter set for higher speeds *dzwKOPLFxx* .

In the application it should be noted that the condition

ÿ *dzwKxPLFUI < dzwKxPLFOI < dzwKxPLFUL < dzwKxPLFOL*

is complied with.



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logical plausibility

The logical plausibility checks the number of INK edges counted between two gaps.
The number of teeth from gap to gap is determined by the shape of the incremental encoder wheel.

The labels

ÿ *dzwK_CZLue*

includes the number of teeth between the gaps. Another label derived from this is *dzwK_CIKSG.* This includes the number of teeth in a cylinder segment plus the number of teeth forming the gap. This label is calculated automatically when the software is generated, so it cannot be applied.

INK signal status

The zmmSWP_def status indicates the status of the incremental signal processing. He knows the values

ÿ *dzeOK* = h00

ÿ *dzeVoPlaus* = h07

ÿ *dzeN_Plaus* = h08

ÿ *zmeNO_SIG* = h04

accept.

The signal is classified *zmeNO_SIG* if no INK signal is present; *dzeN_Plaus* if the signal is present but has errors.

With normal functioning of the INK signal, the *dzeOK* signal is classified after it has proven itself for a certain number of events. If a WUP occurs for the first time, the signal *dzeVoPlaus* (provisionally classified as plausible), the counter *zmcC_WUPok* is incremented (this counter is output on the OLDA *zmoC_WUPok).* If this counter, incremented with each DZG event, reaches a threshold value that is specified via the label *dzwKCWPsok ,* the signal *dzeOK is* classified. If an error occurs during this time, the signal dzeN_Plaus is classified and the counter *zmcC_WUPok* is set to 0.

Violated plausibility

If an error occurs on the INK signal, this is indicated by the plausibility bit in the IWZ status register and the controller classifies the INK signal as defective after reading the status register. The injection is automatically aborted by the ASIC in order to avoid damage to the engine and high pollutant emissions.

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9.1.7.2 Checking the synchronization (synchronization plausibility check)

The synchronization plausibility check is only at the start or in the case of a new synchronization carried out. It checks the correctness of the synchronization and, if necessary, determines the Reason for non-/incorrect synchronization. For this purpose, the sequence and the number of NW segment signals are examined. This examination only takes place in the case of error-free Secondary *speed encoder path fboSSEK* and if the run-on is not active *(nlmNLact=0).* In addition, either the synchronization *plausibility status dzoSYNCPok* must be set to FALSE stand (not yet checked or incorrect synchronization plausibility) or the KW signal processing *(zmmSINKsyn)* not yet be synchronous.

With synchronous KW signal processing, it is checked whether after a maximum *of dzwSYPLmax* attempts *(dzmSYPLver:* number of synchronization plausibility checks) at least two NW segment signals per NW revolution within the cylinder-specific SYNC windows *dzwKNrx...* lie (see also synchronization), a NW segment signal lies within the SEG window *dzwKSegZa1, dzwKSegZa2 (dzoSEG_Za=TRUE)* and no more than dzwNWStMax NW segment signal is outside of SYNC/SEG windows (interfering signals, output on OLDA *dzoCStoPul).* If the check is successful, *dzoSYNCPok* is set to TRUE and the Check of synchronization plausibility finished.

In the case of non-synchronous KW signal processing, after a maximum of dzwSYPLmax attempts Number of NW segment signals per NW revolution (zmmEINE_NW=TRUE) examined, which on the OLDA dzoCSg_Pul is displayed. If the number of signals is in a window dependent on the NW encoder wheel, spanned by dzwPulMIN and dzwPulMAX, then the error occurs *fbbESEK_P* "Twist KW to NW encoder wheel" set. When this error occurs, no Activation of the solenoid valves is no longer permitted (engine stop), as otherwise the engine would be damaged can come. Is the number of NW segment signals per NW revolution *(dzoCSg_Pul)* Outside of the window, the error *fbbESEK_R* "interference signal switching" is set. In this case a start attempt without NW segment signal (start at NW segment signal failure) carried out.

The errors set by the error cases described can only be healed with a restart, in order to possibly be set again during a synchronization plausibility check.

About the Olda *dzoNW_KWWi* the angle of rotation of the NW encoder wheel is output relative to the KW encoder wheel in °KW. A positive twist angle is output when the camshaft is twisted towards TDC. The angle can only be measured if the twisting angle of the NW encoder wheel is less than ± 9°KW. With a torsion angle greater than or equal to ± 9°KW, the value output on the VS100 application system remains constant at the last one measurable value or the initialization value.

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9.1.8 Driving speed measurement

Depending on the application of cowVAR_FGG, the driving speed is determined from the digital signal of a HW pin or from the speed of the ABS control unit or the ABS control unit received via CAN.
instrument cluster determined.

To calculate the driving speed, the parameter set fgwDA1_.. or fgwDA2_.. is used for data set variant = 0 depending on the software switch cowFUN_FGG. With a data set variant > 0, the parameter set fgwDA1_.. or fgwDA2_.. is used depending on the function switch in the EEPROM (edoEEFUN). The software switch in the EEPROM can be adjusted using the login request diagnostic function. Furthermore, the type of driving speed measurement can be determined via the software switch cowVAR_FGG.

Description of the software switch cowFUN_FGG:

decimal value	comment
0	Use parameter set fgwDA1_.. for driving speed measurement Use parameter set
1	fgwDA2_.. for driving speed measurement

Description of the software switch cowVAR_FGG:

decimal value	comment
1	Driving speed measurement with FGG
2	Driving speed measurement with Kienzle Tachograph (KTG)
3	Driving speed via CAN from message Bremse1
4	Driving speed via CAN from message Kombi1

Remark: In the run-up, the FGG measurement and monitoring is stopped with an intact KL15 (fbbEK15_P = 0).

9.1.8.1 Measurement with vehicle speed sensor

When using the driving speed measurement with FGG, the variant *switch cowVAR_FGG* is to be set to 1. The vehicle speed sensor (FGG) delivers a number of pulses that is proportional to the vehicle speed. The pulses since the last calculation are counted and evaluated. To calculate the speed, the total period of the speed pulses added up is divided by the number of FGG pulses and normalized with the distance factor fgw.._SF and the normalization exponent fgw.._NE. The normalization exponent depends on the smallest speed to be measured fgw.._VMI and the FGG. This dependency is described in detail in the reprogramming instructions. The speed is filtered PT1 (fgwFGF_GF) and made available to the system as fgmFGAKT. Exceeding fgwDA.._VMA is reported by the error fbbEFGG_H. After error debouncing, the default value fgw.._VGW is output.

Note: The parameters fgw.._TMX and fgw.._SF must be applied identically!

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9.1.8.2 Measurement with Kienzle tachograph

When using a Kienzle tachograph for speed recording, the
Set variant switch cowVAR_FGG to 2. As a parameter for the speed or
Acceleration calculation is as with the driving speed measurement with FGG the (over
Software switch selectable) parameter set fgwDA1_.. or fgwDA2_.. used. Additionally
The parameter set fgwKTG_.. also applies to the Kienzle Tachograph - specific functions.

The distance factor is derived from the calibratable high level duration (HPD) of the tachograph signal
determined via the distance factor characteristic fgwSF_KL. The learned distance factor fgmDAT_SF
is used together with the standard exponent fgwDA.._NE in the current driving cycle
Speed calculation used and stored in EEPROM. At the next
driving cycle is used during the self-learning phase of the distance factor from the EEPROM fgmEE_SF
speed measurement used. If the distance factor from the EEPROM is not within
the limits of the smallest route factor fgwKTG_SFL and the largest route factor fgwKTG_SFH,
the distance factor is set to zero and the default value for the speed
fgwDA.._VGW output until a new distance factor is learned.

The distance factor is considered learned when the difference between the current HPD fgoHPDA and
the start value of the learning process fgoHPDS a defined number fgwKTG_ANZ times in a row
was less than or equal to the maximum deviation fgwKTG_ABW (tolerance band). After this
system start, the first measured value is the start value. During the learning process, the current HPD
filtered with the memory factor fgwKTG_GDF PT1 (fgoHPDF). Is the current HPD
outside the tolerance band, self-learning is set up again, the filtered value is used as the starting value
HPD used.

After successfully determining the distance factor (number of measurements in the tolerance band
fgoHPDC equal to fgwKTG_ANZ), the tolerance band is re-established with the filtered HPD.
If the current HPD now leaves the tolerance band, the error fbbEFGG_S is reported
(Event-driven) and after detection of definitively defective, the default value is fgwDA.._VGW
issued for the driving speed.

If the number of measurements to learn the route factor fgwKTG_ANZ is equal to zero, the
Distance factor fgmDAT_SF supplied from the parameter set with fgwDA.._SF and no self-learning
carried out.

The status of the vehicle speed recording with the Kienzle tachograph can be checked at the Statusolda
fgoSTAT can be read.

Description of Statusolda fgoSTAT:

Bit position	decimal value	comment
2	4	Driving speed measurement with Kienzle Tachograph (KTG) active
8th	256	Distance factor from EEPROM invalid
9	512	Non-learning activated (fgwKTG_ANZ = 0)
A	1024	distance factor learned
f	32768	Default value for the driving speed active

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9.1.8.3 Taking over the driving speed from the CAN bus

If cowVAR_FGG is applied to 3 or 4, the driving speed sent in the Bremse1- or Kombi1 message is used for the EDC instead of the speed determined from the HW pin. The speed of the CAN is multiplied by the factor mrwFGKORFA, sent as mrmFG_ASR1 or mrmFG_KO1 to the speed detection and made available to the system as fgmFGAKT. If the CAN message is not valid (message timeout caw..._RTO or data inconsistent) or the error identifier FF is received, the associated CAN speed remains “frozen” at the last valid value, fgmFGAKT is “frozen” to this value until the defect becoming of the corresponding error fgmFGAKT brings to the default value.

Exceeding fgwDA.._VMA is reported by the error fbbEFGG_H. When falling below the threshold fgwDA.._VMI, fgmFGAKT is supplied with 0. The received speed is PT1 filtered (fgwFGF_GF).

If the associated message error (message timeout caw..._RTO or data inconsistent - fbbEASR1_Q at Bremse1 or fbbEKO1_Q at Kombi1) is finally defective, the error fbbEFGG_Q is reported. This error is only used to trigger the FGG substitute reactions in the event of a message failure, so its debounce time should be zero and an entry in the error memory should be prevented by the application. The message errors are only reported if there is no CAN masking condition.

When receiving the error code 0xFF, the error fbbEFGG_C is reported. This error is also reported if no valid Bremse1- or Kombi1 message was received (message timeout caw..._RTO or data inconsistent), the message error (fbbEASR1_Q or fbbEKO1_Q) but not by hiding the CAN monitoring (e.g. because of BUSOFF). is reported and therefore cannot trigger any substitute reactions. The replacement reaction is then triggered via fbbEFGG_C. This error should not be debounced in the wake, the defect time fbwEFGG_CA should be shorter than the CAN fade-out time mrwCANAUSB applied.

The error fbbFGG_P (plausibility with speed and quantity) is reported as described in the monitoring chapter.

If the FGG path is finally defective, the default value fgwDA.._VGW is switched to.

In order to obtain correct values when calculating the transfer function, values corresponding to the wheel circumference on which the speed determination is based must be applied for fgwDA.._IMP and fgwDA.._SF (e.g. both to "4" for a 2m wheel circumference). In the case of speed via CAN, these values are only required for the transmission function.

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9.1.8.4 Acceleration Calculation

Acceleration is calculated using the formula

$$\text{acceleration(k)} = \frac{\text{filtered speed(k) - required speed(k -1)}}{\text{total period}}$$

calculated. The newly calculated acceleration is still filtered PT1 (fgwBEF_GF) and as fgmBESCH made available to the system.

The acceleration is limited with fgw.._BMI and fgw.._BMX.

For the v/n calculation, the filtered speed is divided by the average speed.
The value calculated in this way is still filtered PT1 (fgwVNF_GF) and sent to the system as fgm_VzuN provided. V/n is limited to fgw.._VNX.

9.1.8.5 Calculation of the transfer function

The transfer function is given by the formula

$$\text{transfer function} = \frac{\text{engine speed}}{\text{wheel speed}} =$$

$$= \frac{\text{Motor speed * pulses / wheel revolution * 60(sec / min)}}{\text{Distance factor * speed * 1000(m / km)}}$$

calculated and made available to the system as fgmFVN_UEB. After initialization, at stationary vehicle (fgmFGAKT = 0), in the wake, in the event of errors from DZG (fboSDZG) or FGG (fbosFGG) or when the maximum transfer function is exceeded mrwFVHUEob fgmFVN_UEB assigned the default value mrwFVHVGWU and the error detection for the Error plausibility gear ratio fbeEASG_U stopped.

See comment under "Taking over the driving speed from the CAN bus".

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9.1.9 Analog K15 evaluation

Due to the main relay control and corresponding requirements for the K15 evaluation of the EDC, an EDC15 control unit switches off relatively late compared to SG which are supplied via K15. The ignition switch can often show potentiometric behavior, ie it does not switch quickly to zero but creeps. So it can happen that other SG have already recognized K15 off or lose their supply voltage while the EDC is still in normal driving mode. This can lead to unwanted error entries, especially in connection with the CAN bus or loads in external control units.

9.1.9.1 Input and output signals

anoU_K15 ... raw value analog value acquisition K15

noteK15 ... filtered value K15

anmK15_ON ... current status of the hysteresis (K15 - off/on)

9.1.9.2 Functional description

When the SG is initialized, anmK15 is assigned the default value anwK15_VOR and anmK15_ON is assigned the default value anwK15_ONV. This avoids unwanted operating states when the ignition is switched on due to possible filtering.

The voltage value of the K15 signal is recorded analogously as anoU_K15 and PT1-filtered with the time constant anwK15_GF. The filtered voltage is mapped to anmK15.

The K15 signal is sampled in a 20 ms grid.

When falling below the lower hysteresis threshold anwK15_H_U, the hiding of the CAN monitoring (camAUSBL bit 6, previously dependent on anmUBATT) is activated and for those errors for which no monitoring is to take place in the follow-up (applicable via fbwE..._T, bit 4) the Pre-debounce disabled (reversible). This "follow-up condition" only applies to CAN - blanking and error handling, the follow-up control of the EDC is not affected! If anmK15 exceeds the threshold anwK15_H_O, the CAN monitoring and the debouncing of the follow-up-dependent errors are released again.

The current status of the hysteresis (K15 - off/on) is made available to the system in anmK15_ON.

9.1.9.3 Application suggestion:

anwK15_H_O = 10.5 V

anwK15_H_U = 8.5 V

anwK15_VOR = 12 V

anwK15_ONV = 1

anwK15_GF = 0.6

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9.1.10 PWM crash signal

The function is configured using the cowFUN_CRA switch (0=no/1=PWM/2=CAN).
With crash detection via PWM, the airbag SG sends a PWM signal to the motor SG to signal a crash. In normal operation (no crash) the PWM signal is 40 ms low and 200 ms high. In the event of a crash, the inverted signal is sent 20x: 40ms high and 200ms low.

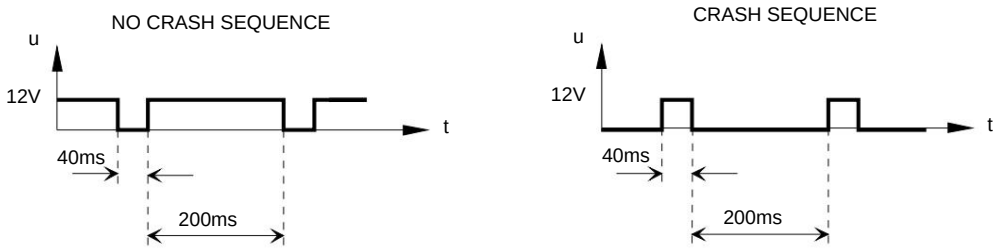


Figure EINAUS12: PWM signal from airbag SG

9.1.10.1 Input and output signals

crmCRSTpwm ... crash level via PWM
croCRzaehl ... PWM crash sequence counter
fbbECRA_P ... implausible PWM crash signal

9.1.10.2 functional description

The PWM crash signal (pin CRA-E) is polled every 10 ms. This signal can be inverted by crwCR_INV.

The evaluation is carried out with a signal time tolerance of +/-20%.

At least an applicable number of crash signal sequences (crwPWM_ANZ) must be recognized before the signal is evaluated as a crash event. The number of recognized crash signal sequences is made available to the system in croCRzaehl.

If the PWM signal is evaluated as a crash event, the GRA and fuel are switched off.
This is done by supplying crmCRSTpwm with the crash level crwCR_ST_B (see chapter 8.9. Crash detection).

If a no crash signal sequence is detected, crmCRSTpwm is set to crash level 0.

In the case of an implausible PWM signal (spikes or flat line: recognized by timeout crwCR_TOUT!), crmCRSTpwm is supplied with crash level 0 and the error fbbECRA_P defective is reported.

9.1.10.3 Application proposal for evaluation tolerances

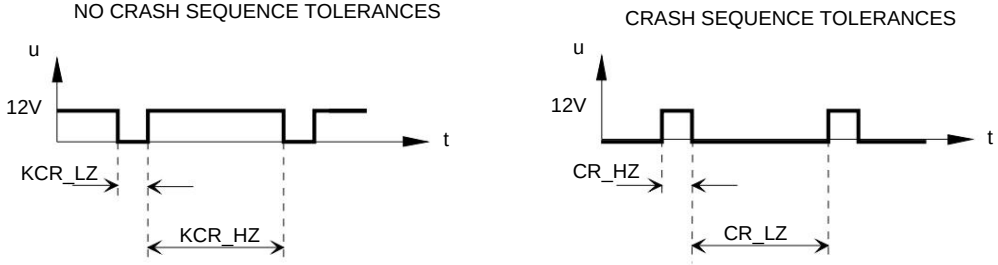


Figure EINAUS13: Evaluation tolerances for the PWM crash signal

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name in Illustration ONOFF13	name/meaning	min/max	Data record parameter	application suggestion	Unit
CR_HZ	HIGH TIME for CRASH SEQUENCE DETECTED	minimum	crwCRminH	20	[ms]
		maximum	crwCRmaxH	60	[ms]
CR_LZ	LOW TIME for CRASH SEQUENCE DETECTED	minimum	crwCRminL	140	[ms]
		maximum	crwCRmaxL	270	[ms]
KCR_HZ	HIGH TIME for NO CRASH - minimal SEQUENCE DETECTED maximum		crwKCRminH	140	[ms]
			crwKCRmaxH	270	[ms]
KCR_LZ	LOW TIME for NO CRASH - minimal SEQUENCE DETECTED maximum		crwKCRminL	20	[ms]
			crwKCRmaxL	60	[ms]
	TIMEOUT for evaluating the crash signal		crwCR_TOUT	370	[ms]
	Number of CRASH SEQUENCES counted as a crash event		crwPWM_ANZ	3	[-]
	GRA switch-off threshold at CRASH		crwCR_ST_A	1	[-]
	Fuel cut-off threshold at CRASH		crwCR_ST_B	3	[-]
	Inversion for CRASH PORT Entry		crwCR_INV	0	[-]

Example of calculating the tolerance times using CRASH SEQUENCE:

Tolerance for CR_HZ:

Signal timing tolerance: +/-20%

40ms +/-8ms -> 32ms < CR_HZ < 48ms

20ms is selected for crwCRminH. Due to the peculiarity of the polling when capturing the crash signal, this means in the WORST CASE an actual minimum HIGH TIME for CRASH SEQUENCE DETECTED by 30ms.

60 ms is selected for crwCRmaxH. In the WORST CASE, this results in a maximum HIGH TIME for CRASH SEQUENCE DETECTED of 50 ms.

-> 30ms < CR_HZ < 50ms

Tolerance for CR_LZ:

The same WORST CASE calculation applied to LOW TIME for CRASH SEQUENCE DETECTED results in:

-> 150ms < CR_LZ < 260ms

This results in 140ms for crwCRminL and 270ms for crwCRmaxL.

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9.1.11 Evaluation of refrigerant pressure signal

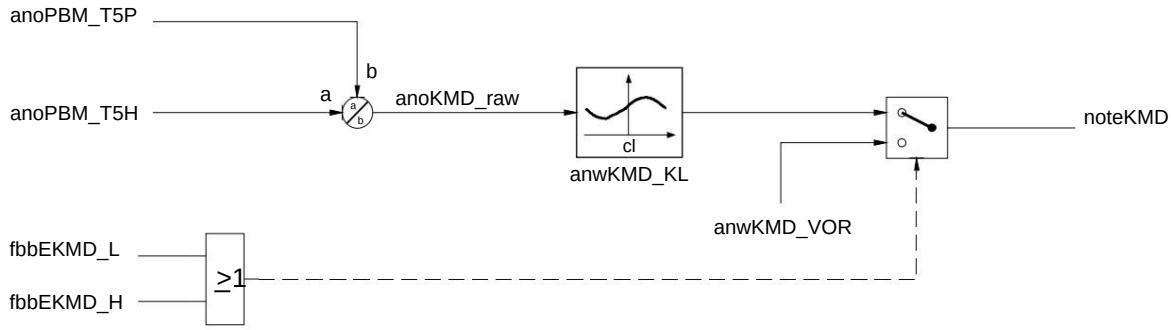


Figure EINAUS15: Evaluation of refrigerant pressure signal

9.1.11.1 functional description

The PWM climate load signal (pin KKD-E) is recorded in 1ms raster with PEC, and in 20ms raster sent.

This is made up of the period duration anoPBM_T5L and the high level duration anoPBM_T5H Duty cycle anoKMD_roh calculated, and in the linearization KL anwKMD_KL in one Pressure anmKMD converted.

9.1.11.2 error handling

The check of anoKMD_roh consists of a signal range check (anwKMD_MIN, appKMD_MAX). The last valid value is frozen during error debouncing. Is the Error finally defective, anwKMD_VOR is ramped to a default value with the slope anwKMD_DPL or switched directly (depending on the encoder password anwKMD_GEB).

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9.2 Output signals

9.2.1 Overview

The following table is used to find the connection 'SG output and its Description':

SG pin designation	see section	side
ARS-0 exhaust gas recirculation controller		9-36
CAN-H Controller Area Network	Chapter "CAN"	
CAN-L Controller Area Network	Chapter "CAN"	
DKS-0 throttle valve positioner (EPW)		9-36
EKP-0 Electric fuel pump		
GRL-0 glow relay		9-36
HRL-0 main relay	"Monitoring concept" chapter	
ISO-K K line	"Diagnosis" chapter	
KIK-A Kickdown	Chapter "Quantity Calculation"	
KLI-B climate control output KSK-0		9-36
fuel cooling KTH-0 radiator		9-36
thermostat - heating KVS-0 radiator fan		9-36
LDS-0 boost pressure controller MML1-0		9-36
solenoid valve anst. Motor bearing 1 MV1-0		9-38
Solenoid valve 1 MV2-0 Solenoid valve 2 MV3-0		9-36
Solenoid valve 3 MV4-0 Solenoid valve 4 MV5-0		9-38
Solenoid valve 5 MV6-0 Solenoid valve 6		9-38
		9-38
		9-38
		9-38
		9-38
SYS-0 system light		9-36
TAV-0 tank shut-off valve		
TDS-A speed signal		9-39
TQS-A Speed synchronous VBS		9-40
ZH1-0 additional heating 1		9-36
ZH2-0 additional heating 2		9-36

It is the task of the output stage processing to determine the various accesses to the output stages to be monitored according to their priority and, in the event of an error, to identify the defective output stage and turn off The power amp processing can be controlled from two sources. The normal case is the control by the driving software, the other possibility is the control by the Diagnosis. With simultaneous access, the diagnostic functions have priority over the driving software. The task of the PWM handler is the processing and output of pulse width modulated signals.

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Naming of the messages used by the output stage processing:

eh mxy := uh = power amp handler,
m = message,
x = f intervention by driving software,
x = D intervention by diagnosis,
x = status information,
y = S Abbreviation of the power stage designation

eg: ehmSARS output stage handler message status information of the exhaust gas recirculation.

Abbreviation designation		controller password
ARS-0	exhaust gas recirculation actuator	ehwEST_AR1
DKS-0	Throttle actuator (EPW)	ehwEST_AR2
-	-	ehwEST_AR3
EKP-0	Electric Fuel Pump	ehwEST_EKP
-	-	ehwEST_GAZ
GRL-0	Glow relay ehwEST_GRS	
KLI B	Climate control output ehwEST_KLI	
KSK-0	Fuel cooling ehwEST_KSK	
KTH-0	Radiator thermostat - heating ehwEST_TST	
KVS-0	Radiator fan ehwEST_GER	
LDS-0	Boost pressure controller ehwEST_LDS	
MML1-0 solenoid valve control engine mount 1 ehwEST_ML1		
RL2-0ehwEST_ML2	Reserve power output	
SYS-0 ehwEST_SYS	System lamp	
TAV-0ehwEST_TAV	TAV shutdown	
ZHB-1	additional heating 1	ehwEST_GK1
ZHB-2	additional heating 2	ehwEST_GK2
ZHB-0	Additional heating, control relay	ehwEST_GK3

A controller password (ehwEST_..) is stored in the data record for each logical output stage. In the low byte is assigned to a hardware pin (see reprogramming instructions), in the high byte set the following:

Bit position	decimal value	comment
	256	1: power stage used / 0: unused
8 9	512	1: PWM output signal / 0: digital
A	1024	1: UBATT correction (driving software and diagnosis)/ 0: no correction
B	2048	1: PWM TV limited between 5 and 95% / 0: no limitation
C	4096	1: level at initialization = ground / 0: UBATT
D	8192	1: invert duty cycle / 0: do not invert
E	16384	1: Power stage is switched off in the run-on (bit F is thereby taken into account)
f	32768	1: If bit E is set, the level is set to UBATT in the run- on 0: If bit E is set, the level is grounded in the run-on

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The battery voltage correction is used to compensate for the disturbing influence of Battery voltage changes performed on the controller current. About the characteristic ehwUBK_KL a correction value is determined depending on the battery voltage. The duty cycle for Signals with [ehwEST_xxx.12 equal to 1] are multiplied by this correction value.

The content of the "ehmSy" message is defined as follows (bits 0 - D correspond to the controller password):

Bit position	decimal value	comment
E	16384	1: output stage defective / 0: intact
f	32768	1: Driving software active / 0: Diagnosis active

In addition, for most power amplifiers/outputs (computer port 2, 3, 7 and 8) the possibility granted an early initialization:

	15	14	13	12	11	10	9				8th	7	6		5	4		3	2	1	0
cowP2INEST				GK2	KVS							EKP			TAV						
cowP3INEST										KSK											
cowP7INEST												KIK						GDP PWM	LDS	AR1	DKS
cowP8INEST																			TDS	PBM	TQS

If the corresponding bit is set, the corresponding output is activated during initialization set to +Ubatt; if the bit is not set, to -Ubatt (depending on the hardware).
Fields with a gray background are ignored.

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9.2.2 Boost Pressure Adjuster

The period of the LDS output stage can be set with the labels ehwuCP2_FR and ehwuCP2_TE (ÿ1).

9.2.3 Solenoid valve control

The signals **EIN, MODE, Ysel0, Ysel1** and **Ysel2** are used to control the solenoid valves.

All of these signals are processed by the **CY22,** the Power Control IC.

The signals **Ysel0, Ysel1** and **Ysel2** are generated (coded) by the controller and serve as 3-bit information for selecting (decoded by **CY22)** the solenoid valve to be controlled.

The **ON** and **MODE** signals are generated by the ASIC. They form a coded control sequence, which is decoded by the CY22 and leads to control of the high-side and low-side switches on the solenoid valve.

9.2.4 Glow relay actuator

The period of the GRS output stage is set with ehwEST_T8.

The GSK3 requires a separate battery voltage correction, which is calculated as follows:

$$\text{corr. duty cycle} = \text{duty cycle} \ddot{y} \text{ battery voltage}^2 \frac{\text{Nominal voltage of the GSK3}^2}{}$$

$$\text{ehmFGRS_K} = \text{ehmFGRS} \ddot{y} \frac{\text{ehwGSK3_Un}^2}{\text{anmUBATT}^2}$$

The label ehwGSK3_Uv can be used for the battery voltage correction in the 1st and 2nd phase of the preheating as well as during the start glowing (=pushing, see Chap. glow time control). This makes it possible to apply a higher voltage to the GSK3 in order to achieve a faster heating-up time.

$$\text{ehmFGRS_K} = \text{ehmFGRS} \ddot{y} \frac{\text{ehwGSK3_Uv}^2}{\text{anmUBATT}^2}$$

The corrected duty cycle ehmFGRS_K is limited with gswTV_MIN and gswTV_MAX so that a valid clock signal is still transmitted to the GZS even with a small duty cycle and high battery voltage or a large duty cycle and low battery voltage.

The battery voltage correction can be disabled with the label cowVAR_GSK = 2.

Application note: The conventional battery voltage correction must not be applied in the power amplifier password ehwEST_GRS ÿ the GSK3 uses the above battery voltage correction.

If the voltages ehwGSK3_Un or ehwGSK3_Uv are selected too high, this can lead to the destruction of the GSK3.

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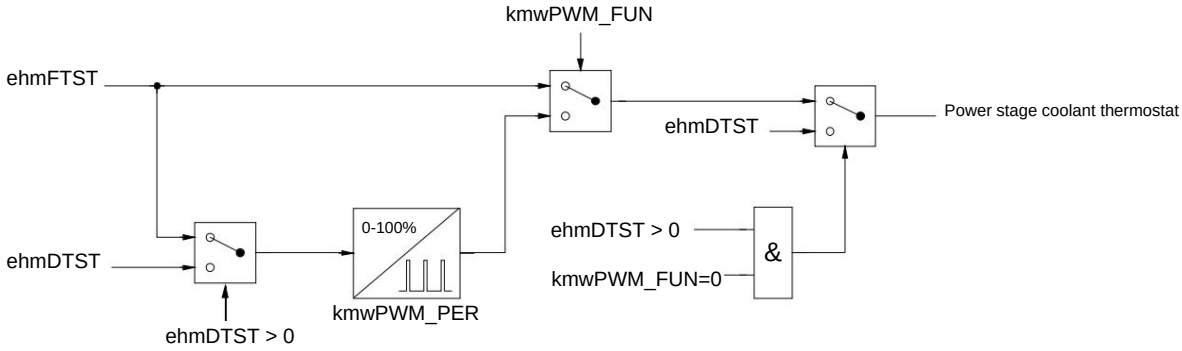
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9.2.5 Coolant thermostat

With the kmwPWM_FUN > 0 function switch, a PWM signal can be generated by software on a digital output stage for the coolant thermostat (ehmFTST).

PWM signal generation function:



Calculation of the necessary duty cycle of the output stage:

ehmFTST (0-100%) is multiplied by the desired period length kmwPWM_PER, which gives the necessary duty cycle kmoPWMPERh. At the beginning of a period, the output stage is switched on (100%) if ehmFTST is greater than 0. A timer is then started, which resets the power stage (0%) after the previously calculated duty cycle kmoPWMPERh has been reached. When the timer reaches kmwPWM_PER, a new period begins in which kmoPWMPERh is recalculated and the timer is reset.

Actuator test behavior:

If the PWM signal generation is activated (kmwPWM_FUN ÿ 0) and an actuator diagnosis is carried out (ehmDTST ÿ 0), the output stage is controlled in a modulated manner. With kmwPWM_FUN = 0, the function is the same as a normal power stage:

- Digital power amplifier:

ehmDTST values > 50% the power stage is switched on,

ehmDTST values ÿ 50% the power stage is switched off.

- PWM-capable output stage: The applied duty cycle is output.

Resolution and speed:

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With a period of kmwPWM_PER = 400ms (=2.5Hz), the smallest resolution is 5%.
The signal modulation occurs in the 20ms main program period.

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9.2.6 TD signal

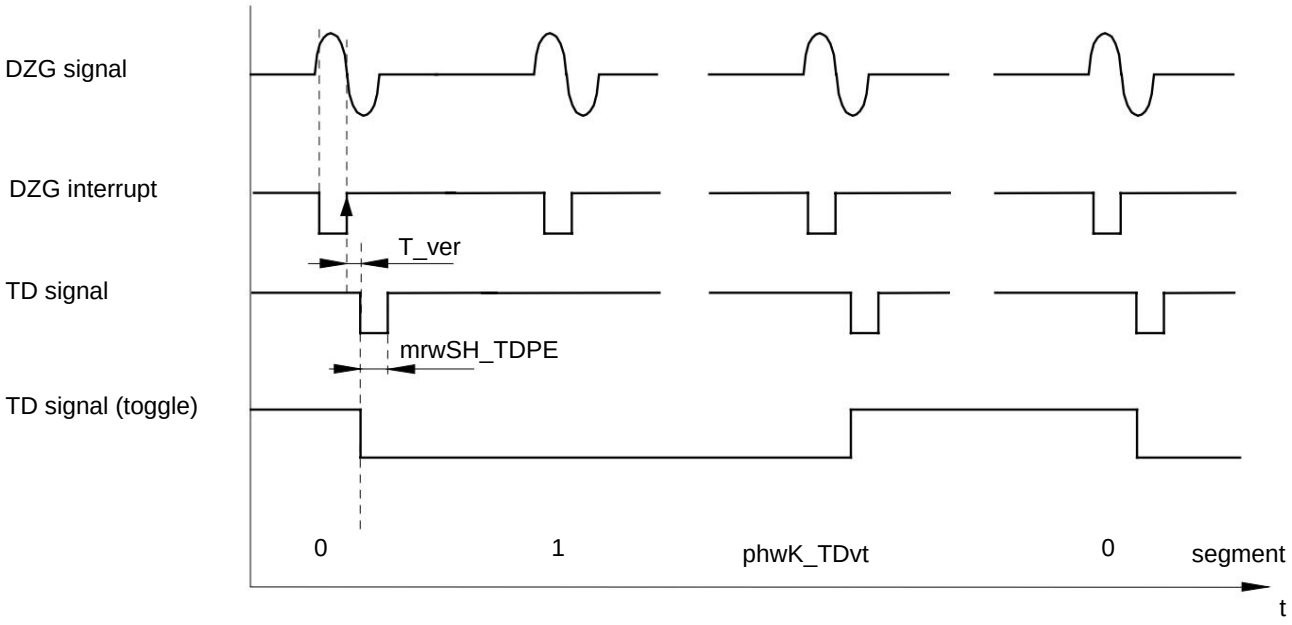


Figure EINAUS08: TD signal

The speed-synchronous TD signal is used to output speed information. It can be configured via the software switch cowFUN_TDS (changes only take effect after initialization):

Value range of the software switch tachometer signal TDS cowFUN_TDS (decimal coded):

ÿ 0 = do not generate a TD signal

The label phwK_TDvt is common to the following configurations cowFUN_TDS=(1,2,3,4): The segment number of the speed interrupt (0 to number of cylinders*2-1) must be an integer multiple of the prescaler phwK_TDvt.

ÿ 1 = TD signal with constant length and LOW level Corresponds to
the current speed interrupt with segment 0 or segment phwK_TDvt, the output is set to LOW for the duration mrwSH_TDPE.
After this time has elapsed, the output becomes HIGH.

ÿ 2 = TD signal with constant length and HIGH level Corresponds to
the current speed interrupt with segment 0 or segment phwK_TDvt, the output is set to HIGH for the duration mrwSH_TDPE.
After this time has elapsed, the output becomes LOW.

ÿ 3 = Toggle TD signal If the current
speed interrupt corresponds to segment 0 or segment phwK_TDvt, the status of the output is changed.

- 4 = TD signal **(only with VP44)**
If the current speed interrupt corresponds to segment 0 or segment phwK_TDvt, the status of the VP44-TD output is changed. If the DZG is defective, a period is calculated from the IWZ speed and the TD signal is toggled with this period. The TQ signal for VP44 is also generated via this configuration.

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9.2.7 TQS / MFA / VBS signal

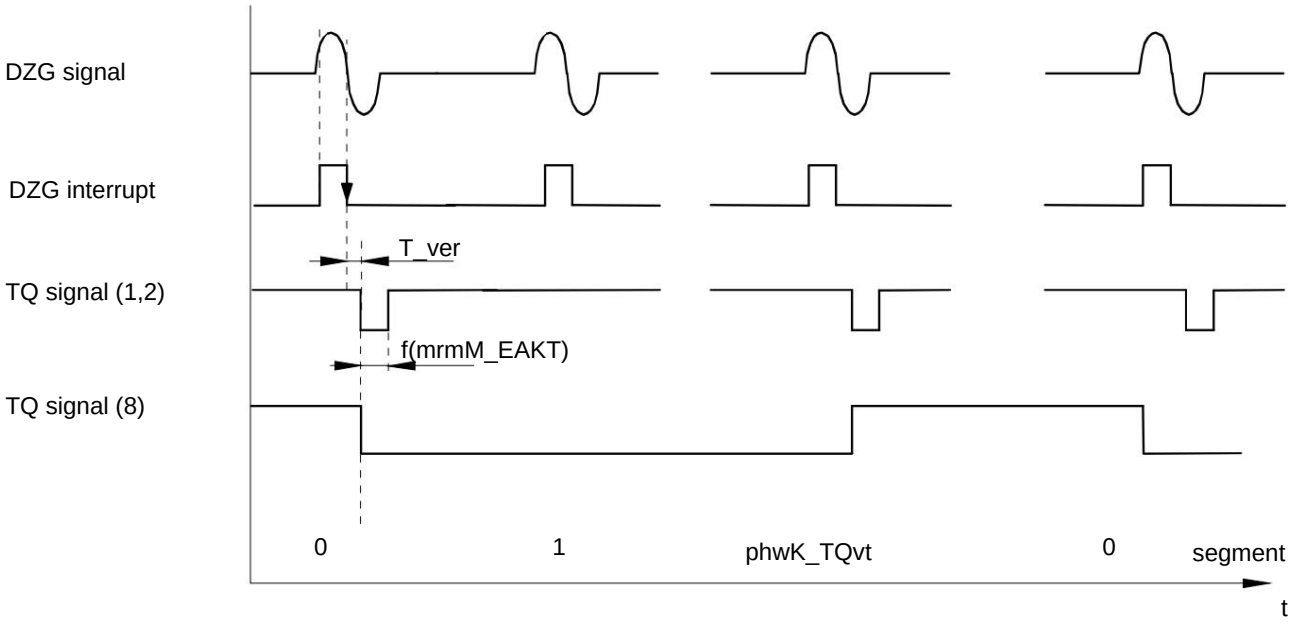


Figure EINAUS09: Consumption signals

For the consumption signal calculation, the quantities mrmM_EAKT (current injection quantity) and mroVERB_Z (diesel heater consumption) are used.

The selector switch cowFUN__VBS configures the consumption signal:

Value range of the software switch consumption signal TQS / MFA / VBS cowFUN_VBS (decimal coded):

ÿ 0 = do not generate a quantity signal No
TQS/VBS/MFA signal is output.

The label phwK_TQvt is common to the following configurations cowFUN_VBS = (1, 2): The segment number of the speed interrupt (0 to number of cylinders*2-1) must be an integer multiple of the prescaler phwK_TQvt.

ÿ 1 = speed synchron. TQ signal with length proportional to M_EAKT and LOW level
If the current speed interrupt corresponds to segment 0 or segment phwK_TQvt, the output is set to LOW for a quantity-proportional duration phmVBSTH. The normalization is designed for the reference quantity mrwSH_MAME and the maximum pulse duration mrwSH_TQPE.

ÿ 2 = speed synchron. TQ signal with length proportional to M_EAKT and HIGH level
If the current speed interrupt corresponds to segment 0 or segment phwK_TQvt, the output is set to HIGH for a quantity-proportional duration phmVBSTH. The normalization is designed for the reference quantity mrwSH_MAME and the maximum pulse duration mrwSH_TQPE.

ÿ 3 = VB signal with M_E prop. Frequency If the amount
exceeds a minimum amount mrwSH_MIME, then the product of speed and amount as well as mrwSH_VBBQ-related frequency (duration: phmVBSTH) is output.

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ÿ 4 = MFA signal with consumption prop. Pulse length (active HIGH)

If the speed exceeds a minimum speed mrwSH_VBKN, then a consumption (product of quantity and speed, based on normalization factor mrwSH_VBSF) is proportional to the HIGH level duration phmVBSTHin whole 2048 µs - parts every 10.24 ms output. The remainder is added up in the next period.

ÿ 5 = MFA signal with consumption prop. Pulse length (active LOW)

If the speed exceeds a minimum speed mrwSH_VBKN, then a consumption (product of quantity and speed, based on normalization factor mrwSH_VBSF) is proportional to the LOW level duration phmVBSTH in whole 2048 µs - parts every 10.24 ms output. The remainder is added up in the next period.

ÿ 8 = Use consumption signal as speed signal

The output signal at the VBS output toggles speed-synchronously. If the current speed interrupt corresponds to segment 0 or segment phwK_TQvt, the status of the output is changed.

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9.2.8 Consumption Calculation

For the boost pressure control, the current consumption is mrmVERB from the 20 ms grid current injection quantity mrmM_EAKT and the speed dzmNmit calculated. For the Radiator fan control and the thermostat control is filtered from the current consumption mrmVB_FIL calculated. The filtered consumption is determined every 100 ms.

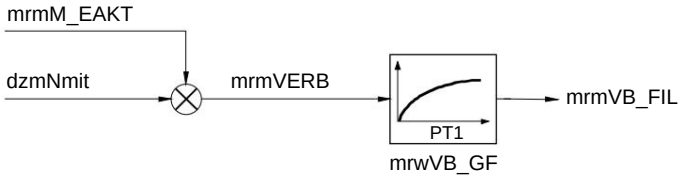


Figure EINAUS11: Calculation of the current consumption and the filtered consumption

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10 CAN

10.1 Overview

The CAN handler takes over the initialization and monitoring of the CAN controller in the C167, as well as the cyclic data exchange between the application programs and the CAN controller. The processing of 15 CAN objects is supported.

The driver layer provides services for controlling the respective communication module. The services are routines for managing the block (configuration, initialization and status query) and for data exchange over the network. The driver layer does not contain any additional communication protocols implemented in SW.

The transport layer enables the exchange of data that cannot be transmitted in a single message due to its length. The transport layer protocol breaks long data into smaller data segments and ensures that these segments are transported over the network in the correct order. To do this, the transport layer uses the services of the driver layer.

The interaction layer forms the interface to the application. It provides computer and bus-dependent communication services and handles network communication alongside the application. The interface between the application and the interaction layer is identical to the RCOS communication interface (RCOS Message Handling). The interaction layer thus enables transparent communication between distributed RCOS application tasks.
Depending on the length of the data to be exchanged, the interaction layer accesses either the transport layer or the driver layer directly.

The tasks of the station management are the initialization (communication module, variables of the communication software), the monitoring of the communication (module and data exchange) for error detection (station failure, reception timeout) and the handling of detected errors.

The cawINF_CAB parameter indicates whether the control unit is equipped with CAN (cawINF_CAB > 0) or not (cawINF_CAB = 0). The cawINF_TBO parameter specifies the time that is waited after the occurrence of a bus-off in order to carry out a reinitialization.

The transfer rate is set to 500 kbaud with cawINF_BTR=2301H.

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10.2 DPRAM layout

The assignment of RCOS message, configuration equates and CAN-HW (DPRAM) is in the shown in the following table:

CAN address	Surname	Data	RCOS message / value
00H	Control Register		0x41
01H	Status Register		0x07
02H	CPU Interface Register		0x60
03H	Reserved		
04H	High speed read low byte		
05H	High speed read high byte		
06H-07H	Global Mask Standard		0xFF, 0xE0
08H-0BH	Global Mask Extended		0x00
0CH-0FH	Last Message Mask		0x00
10-1EH	Message 1 Clockout		cammsg_01
1FH	Register Message 2		0x00
20-2EH	Bus Config.		cammsg_02
2FH	Register Message 3 Bit		0x40
30-3EH	Timing Register 0		cammsg_03
3FH	Message 4 Bit Timing	cawINF_BTR	0x03
40-4EH	Register 1 Message		cammsg_04
4FH	5 Interrupt register		0x23
50-5EH			cammsg_05
5FH			
60-6EH	Message 6		unused
6FH	test register BSP0		
70-7EH	Message 7		cammsg_07
7FH	test register BSP1		
80-8EH	Message 8		cammsg_08
8FH	test register BSP2		
90-9EH	Message 9		cammsg_09
9FH	P1 Conf.		0x41
A0-AEH	Message 10		cammsg_10
AFH	P2 Conf.		0x14
B0-BEH	Message 11		unused
BFH	P1 In		
C0-CEH	message 12		cammsg_12
CFH	P2 In		
D0-DEH	message 13		camsg_13
DFH	P1 out		
E0-EEH	message 14		cammsg_14
EFH	P2 out		
F0-FAULT	message 15		cammsg_15
FFH	Serial reset Address		

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The exact description of the meaning of each register can be found in the document

ECAN 82527

Stand alone controller area network component

Target Specification

Revision 1.5.1

Sep 1991

K8/ICE

be removed.

The oldas for the data of the individual CAN messages can be found in the following table:

Data from	OLDAs	Address in the CAN DPRAM
message 1	caoM01_B0...7	17-1EH
message 2	caoM02_B0...7	27-2EH
message 3	caoM03_B0...7	37-3EH
message 4	caoM04_B0...7	47-4EH
message 5	caoM05_B0...7	57-5EH
message 6	caoM06_B0...7	67-6EH
message 7	caoM07_B0...7	77-7EH
message 8	caoM08_B0...7	87-8EH
message 9	caoM09_B0...7	97-9EH
message 10	caoM10_B0...7	A7-AEH
message 11	caoM11_B0...7	B7-BEH
message 12	caoM12_B0...7	C7-CEH
message 13	caoM13_B0...7	D7-DEH
message 14	caoM14_B0...7	E7-EEH
message 15	caoM15_B0...7	F7-FEH

The OLDAs represent the physical content of the DualPortedRAM. That means if necessary pending replacement data (e.g. in the event of a message failure) are not visible on these OLDAs.

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10.3 Monitoring

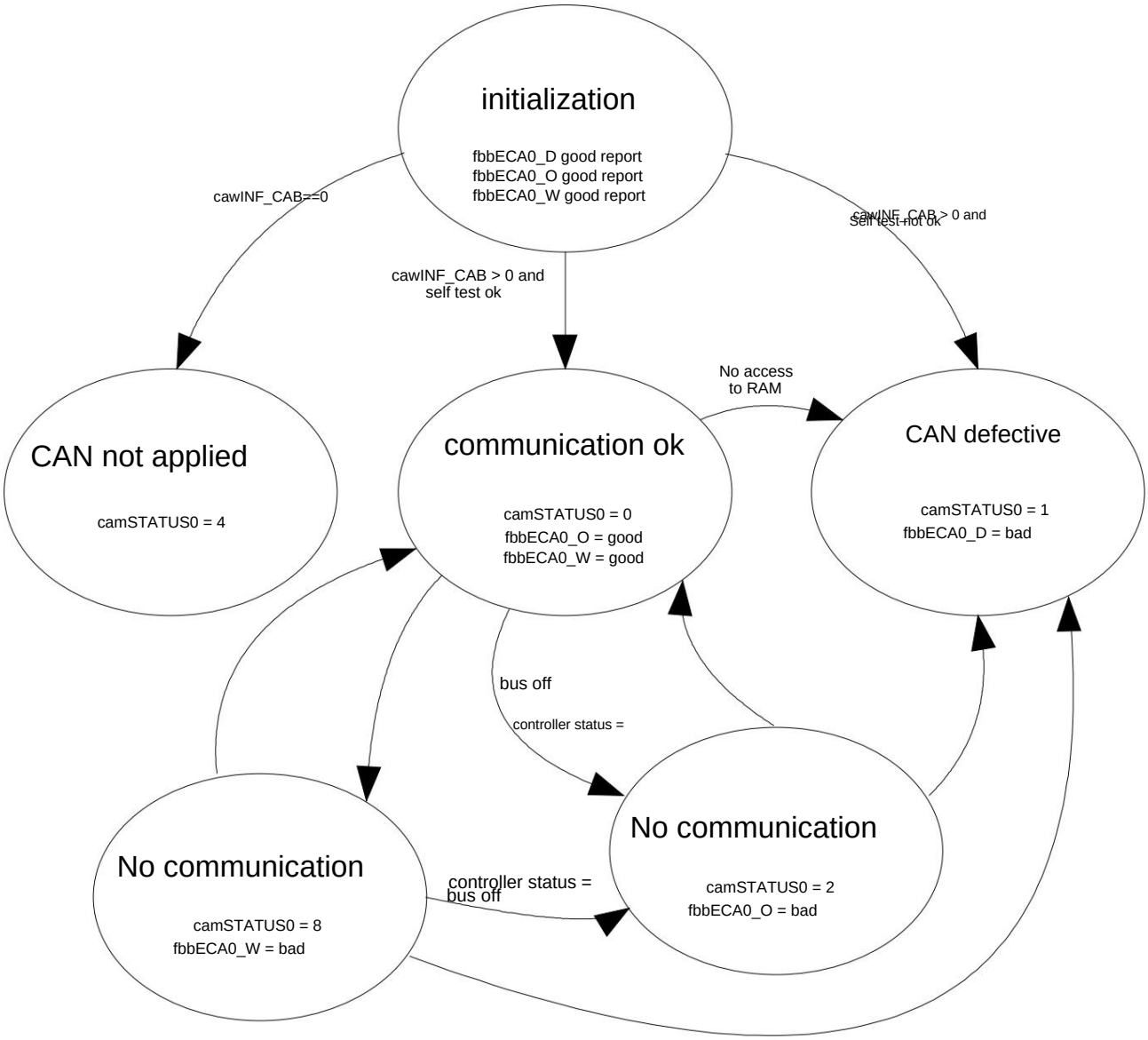


Figure CAN_05: CAN status

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The status of the CAN module is noted in bit-coded form in the message camSTATUS0. The initialization and all other actions are only carried out if a CAN block is applied (cawINF_CAB > 0).

bit camSTATUS0 bit	meaning
- xxxx xxxx 0000 0000 Module OK 0 xxxx xxxx	
xxxx xxx1 Module defective (DP	RAM error in initialization or recovery due to CAN or access error, ie the content of bit timing register 0 does not match cawINF_BTR) 1 xxxx xxxx xxxx xx1x Module not available (CAN module in bus off) 2 xxxx xxxx xxxx x1xx module not
available (cawINF_CAB = 0) 3 xxxx xxxx xxxx 1xxx module not available (CAN module in warning state) 4 xxxx	
xxxx xxx1 xxxx not used 5 xxxx	xxxx xx1x xxxx not used 6 xxxx xxxx x1xx xxxx not used 7 xxxx xxxx 1xxx xxxx not
used - 0000 0000 xxxx xxxx Block and communication can be monitored 8 xxxx xxx1 xxxx xxxx Start is active:	
mrmSTART_B=1 and dzmNmit>0 or t <	
	cawINF_INI after SG init. 9
xxxx xx1x xxxx xxxx Overrun 10	xxxx x1xx xxxx xxxx Bit is set
when the voltage of the K15 anm	K15 the lower falls below the hysteresis threshold anwK15_H_U. Bit is reset when the voltage of the K15 anmK15 exceeds the upper hysteresis threshold anwK15_H_O.
11 xxxx 1xxx xxxx xxxx not used	
12 xxx1 xxxx xxxx xxxx not used	
13 xx1x xxxx xxxx xxxx not used	14 x1xx xxxx xxxx
xxxx not used 15 1xxx xxxx xxxx	xxxx not used

The message camSTATUS0 is used to be able to hide the monitoring of the CAN communication.

The suppression of the monitoring is used to consciously suppress the error storage in various operating states (during start, during run-on and when the battery voltage is too low), but the module is still monitored for bus-off and warning, as well as access errors.

There are two different types of blanking, one of which relates to the CAN-relevant errors fbbECA0_O and fbbECA0_W and the other to quantity intervention-relevant errors such as fbbEEGS_1, fbbEASG_H, fbbEASG_P, fbbEASG_Q, fbbEASG_L, fbbEASR_Q, fbbEMSR_H and fbbEMSR_P.

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10.3.1 Hiding of the CAN monitoring

If a bit is set in the high byte of camSTATUS0 (- and the effect of this bit is permitted in the cawCANAMSK mask, see below), no CAN-relevant error is saved. The cawINF_DLY delay time is only started when all effective (cawCANAMSK !) bits in the high byte have been reset. Errors in the fboSCAN path can only be entered when the cawINF_DLY time has subsequently expired. The suppression of the monitoring is also active without prior triggering by camSTATUS0 after the control unit initialization for the time cawINF_INI.

If a condition occurs again during the cawINF_DLY time that leads to the monitoring being hidden, the cawINF_DLY time is restarted after it has disappeared.

With the cawCANAMSK mask it is possible to permanently switch off the effect of individual bits in the high byte of camSTATUS0 on preventing error entries in fboSCAN. Only the bits in the high byte are relevant here! If, for example, you want to allow monitoring of the CAN errors during the start process, bit 8 of this mask cawCANAMSK must be set to 0. If you want to prevent monitoring of the CAN errors during the start process, bit 8 of this mask must be set to 1 (ie camSTATUS0 and cawCANAMSK are "AND linked" with regard to the effect on error storage, but the cawCANAMSK mask has no effect on the display in camSTATUS0).

10.3.2 Suppressing errors of the external control unit intervention This

works in the same way as the suppression of the CAN monitoring, but here all bits of camSTATUS0 are taken into account. A possible active suppression can be detected at the OLDA mrmAUSBL (=1). The monitoring delay time is here mrwCANAUSB, the mask mrwCANAMSK.

It is not possible that the CAN error masking is active and that of the external control unit intervention is not (ie cawCANAMSK also has an influence here). This prevents CAN error entries from being hidden but the corresponding intervention timeout errors from being set.

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10.4 Data Exchange

Each object used is caw.._PER from the CAN handler when its repetition time has elapsed
processed. Is an object entered for receiving and also received by the CAN block
the data is transferred to the message cammsg_xx and sent to the application.
If an object is entered for sending, the corresponding message is sent by the interaction layer
accepted, the data transferred to the CAN module and the object set as to be sent.

For data exchange between the application programs and the CAN module, the
CAN handler has a maximum 8-byte message available for each object, with
a status byte is appended to received messages. This status byte contains the following
Information:

Status byte value: 0000?	meaning
xxx	0 ... Receive timeout no 1 ... receive timeout yes
0000x?xx	0 ... message without substitute data 1 ... message with replacement data
0000xx?x	0 ... Message is valid 1 ... Message is invalid (inconsistent)
0000xxx?	0 ... Message data are new 1 ... message data is old

The "receipt timeout" identifier is set if within the time caw.._RTO no new
data has been received. This identifier is only reset when a new one is
message was received without inconsistencies. If the "Timeout" identifier is set, then at
every task call, and not just after every reception period, checks whether the message has already been received
was received.

Otherwise, after the processing repetition time has elapsed, caw.._PER (quantization is 20ms)
checks whether the "new data" flag is set in the CAN block (message control register 1). is
If this is not the case, the "message data are old" identifier is set, ie since the last one
processing, no data was received. If the "new data" flag is set, it is deleted
and the data is copied from the DPRAM of the CAN block into the message. Direct
then it is checked whether the "new data" flag has been set in the meantime (i.e. during the
copying process). If this is the case, the new data are again transferred from the DPRAM to the
Message copied, otherwise they could be inconsistent. Was during this
copy process, the "new data" flag is set again, the identifier "message is invalid
(inconsistent)".

If a receive timeout or an inconsistent message occurs, it is checked whether
Substitute data for this object are applied (caw.._INF>0). If this is the case, they will
Substitute data is copied into the message and the "Message with substitute data" identifier is set.

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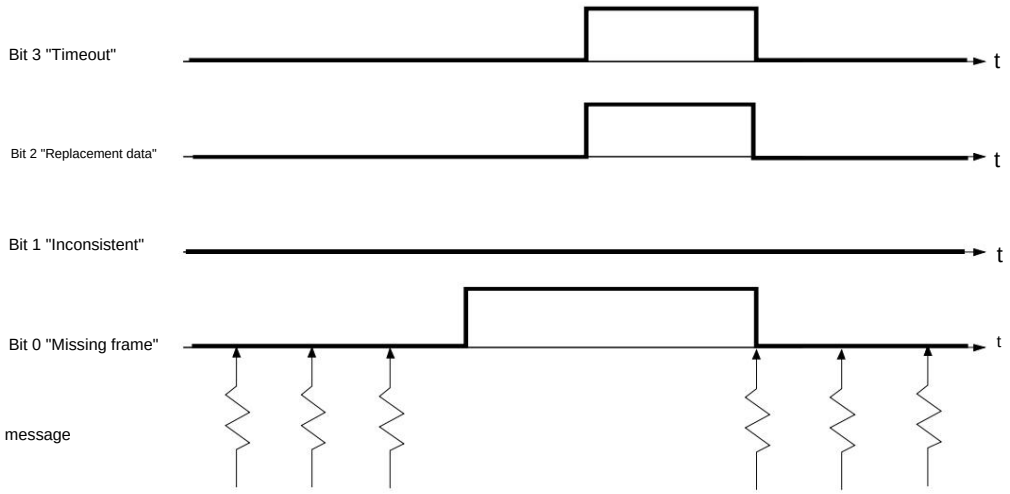


Figure CAN_02: Status bits in the event of message failure (bit 2 and 3 only if applied)

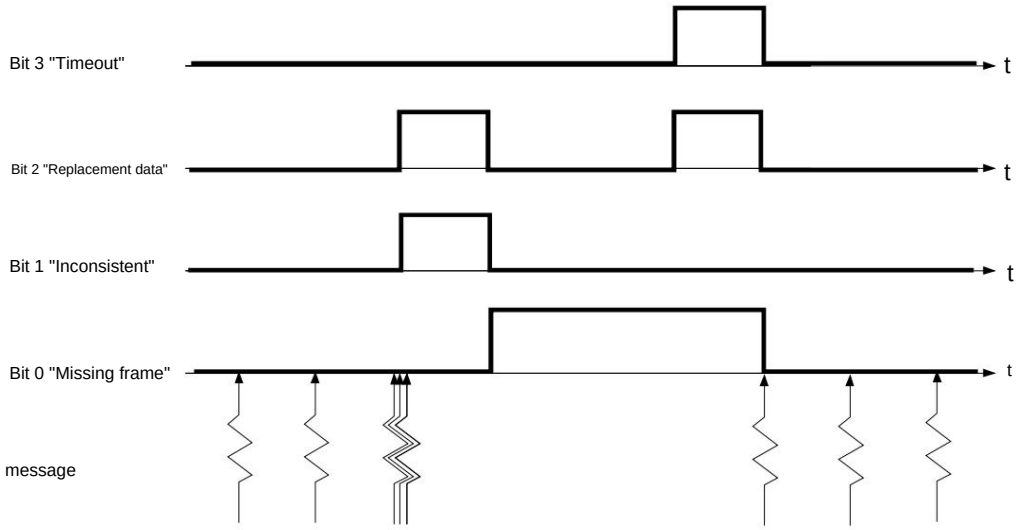


Figure CAN_03: Status bits in the event of message failure (bit 2 and 3 only if applied)

A status bit is displayed in the message camRCSTAT0 for all received messages. is
If this bit is set, the associated message is in the timeout, ie bit 3 of the status byte of
CAN message is displayed in this message.

camRCSTAT0 Bit	Corresponding CAN message	Corresponding parameters
1	gear 1	caw010_ADR
2	4WD 1	caw020_ADR
	station wagon 1	caw030_ADR
3 4	Combi 2	caw040_ADR
	brake 1	caw050_ADR
5 6	GRA	caw060_ADR
7	air bag	caw070_ADR
8th	brake 3	caw080_ADR
10	BSG_Last	caw100_ADR
11	climate 1	caw110_ADR
12	gear 2	caw120_ADR
13	level 1	caw130_ADR

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10.5 Configuration of Messages

The application-specific information for communication, such as number of
Data bytes, identifiers, device configuration data, etc. are stored in the parameter blocks
cawxxy_... (abbreviated to .. in the following table).

xx ... message number (connected to cammsg_xx)
y ... segment number

These parameter blocks serve the interaction and driver layer for setting up the
corresponding objects in the CAN controller.

Parameter name	Meaning
caw.._PER	Receive period n * Main program period in which the CAN handler die
caw.._NSG	Number of segments in the transport layer for a transmission of the Message must be formed.
caw.._RTO	receive timeout; is given as time. The value 2550000us indicates that no reception monitoring should take place.
caw.._INF	Information TRUE, FALSE; Send message: INF reports whether the PB addressed transmit object of the block must be reconfigured before transmission must (multiple use of objects). Message received: INF tells whether replacement data should be used.
caw.._DT0 to caw.._DT7	Spare data bytes 0-7
caw.._ADR	Object address in the block if the object address is caw..._ADR=0, the associated object is im CAN not initialized and cammsg_.. also not supplied. There must be no address be assigned twice, otherwise two logical objects of the same read physical object.
caw.._DTL	Data length of the object is fixed in DAMOS.
caw.._AB0 caw.._AB1	arbitration bytes 0 and 1; this data is written 1:1 into the registers of the CAN controller. Arbitration registers 2 and 3 are written with 0. Only relevant for received messages. The message identifier is encoded in these bytes (see arbitration 0, 1). The conversion from identifier to arbitration byte is done by rotating the bits at 3 to the right. If bits 0, 1 and 2 are zero, you can also divide by 8 will.
caw.._MSC	Message configuration bytes

Attention:

If the message parameters are set incorrectly in one PB, others cannot either
involved embassies are affected.

Data from the parameter block are written 1:1 to the CAN controller without being checked!

In the control unit initialization, the control unit internal CAN messages (with direction
received) filled with the substitute data if caw.._INF is applied that uses substitute data
should be.

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10.6 Structure of Messages

Object base address		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0		
+0	control 0	MsgVal			TxIE			RxIE		IntPnd	
+1	control 1	RmtPnd			TxRqst		CPUUpd		MsgLst	NewDate	
+2	Arbitration 0	Id28	Id27	Id26	Id25	Id24	Id23	Id22	Id21		
+3	Arbitration 1	Id20	Id19	Id18	Id17	Id16	Id15	Id14	Id13		
+4	Arbitration 2	Id12	Id11	Id10	Id9	Id8	Id7	Id6	Id5		
+5	arbitration 3	Id4	Id3	Id2	Id1	Id0			reserved		
+6	Configuration	Data length code						Dir	Xtd	reserved	
+7	data 0										
+8	data 1										
+9	data 2										
+10	Data 3	DATA									
+11	data 4										
+12	data 5										
+13	data 6										
+14	data 7										

message identifier: Id28 (MSB) ... Id18 (LSB)

Example of a 5-byte message to be received:

parameter name	meaning
caw.._PER	1
caw.._NSG	1
caw.._RTO	20000 (= 20ms)
caw.._INF	1
caw.._DT0 - 7	0,1,2,3,4
caw.._DTL	5
caw.._ADR	16
caw.._AB0 , 1	87H, E0H
caw.._MSC	50H

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10.7 version of the CAN data specification

The CAN data specification defines the layout of the messages and specifies for various
Vehicle concepts determine the flow of data. The label mrwMULINF0 contains the encoded version of the
CAN data determination (see also sent message - engine 2). The sending or
Reception status of certain messages depends on mrwMULINF0:

mrwMULINF0 Version -	CAN data specification	message GRA	message GRA_new	message Engine_ Flexia old	message Engine_ Flexia new
< 05	to 2.2	-	-	send	-
05	3.0 / 3.1.1	send	-	send	-
06	3.2.1	receive	-	send	-
07	3.2.2	send	-	send	-
08	3.3.2	send	-	send	-
09	4.0.1	-	receive	-	send
10	4.0.2	-	send	-	send
11	4.0.3	-	receive	-	send

Application Note: In addition to changing mrwMULINF0 must when switching from
Message GRA on GRA_Neu also the labels caw060_AB0, caw060_AB1, caw060_DTL and
caw060_MSC to be adjusted.

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10.8 Messages

The CAN messages are described in this chapter. The presentation is based on CAN DPRAM (dual port RAM) memory layout.

10.8.1 Overview - CAN object usage

CAN No. Mux 01 02	EDC15+ & C Driving operation release K_VMPCH Identifier R: Transmission							W.Rate
	1 (EGS) caw010.						440H	8/10ms
01		S: WFS					010H	50-100ms
	02 S: Beg.-AW.- Kanal 03 S:						201H	irregular
	Motor 1 04 S: Motor 2 05 S:						280H	20ms
	Motor 3 06 S: GRA (for ADR)						288H	20ms
							380H	20ms
							388H	10/20ms
	07 S: Motor 5 08 S:						480H	20ms
	Motor 6 09 S: MSG						488H	20ms
	2 10 S: Motor Flexia	caw170.					500H	20ms
	11 S: Motor 7 12 S: MSG						580H	1 second
	3 13 S: MSG 14 S: free transport 1						588H	20ms
		caw180.					700H	20ms
							7A1H	irregular
	... ...							
	20 S: free							
03	R: station wagon 1 caw030.						320H	20-32ms
04	R: station wagon 2 caw040.						420H	200ms
	R: Airbag 1 caw070.						050H	20ms/crash
05	R: brake 1 caw050.						1A0H	7-20ms
06	R: PSG 1 caw190.						112H	n-sync
	R: GRA (from LKS) caw060.						388H	20ms
07	R: PSG 2 caw200.						512H	handshake
	R: Airbag 1 caw070.						050H	20ms/crash
08	S: MSG 1 caw160.						100H	handshake
	R: brake 3 caw080.						4A0H	7-20ms
09	R: ADR 1 caw090.						52CH	20ms
	R: 4WD 1 caw020.						2C0H	10ms
0A/10	R: PSG 3 caw210.						712H	handshake
	R: BSG_Last caw100.						570H	100ms
0B/11	R: Clima 1 caw110.						5E0H	20ms
	R: level 1 caw130.						590H	48ms
0C/12	R: Transmission 2 (ASG) caw120.						540H	8/10ms
0D/13 1-20 S: multiplex 2 0E/14 R:							see No.02	see No.02
transport channel1							see SPEC.	irregular
		R: WFS					011H	50-100ms
0F/15 Buf 01 listening channel							200H	irregular
Buf 02 listening channel							up to 21FH	irregular

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10.8.2 Message sent - Motor 1

Transmission period: 20ms

Storage layout:

Message: Engine 1	Identifier: 280H	bit
F_MOM S_EGS S_ABS Q_ASR S_KUP S_KIK F_PWG S_LGS 0		
MD_INN		8th
N_MOT_MO1 (low) 16		
N_MOT_MO1 (high)		24
MD_IN_O_EX		32
PWGPBM		40
MD_ME_VERL		48
MD_REL The		56

fields with a gray background are not supported.

Description:

S_LGS: idle switch;
Bit addr. 0, bit no. 1
RCOS message dimLGS (bit 9 of dimDIGpre1)

F_PWG: Error PWG;
Bit addr. 1, bit no. 1, initial value 0,
is set if the PWG path fboSPWG or fboSPGS is defective

S_KIK: kickdown switch;
Bit addr. 2, bit no. 1
Corresponds to RCOS message dimKIK (bit 5 of dimDIGpre1prel) if there is no security case
(mrmSICH_F = 0) or no error fboSKIK is registered and in addition anmPWG = 100%.
If one of the conditions does not apply, S_KIK is sent with zero.

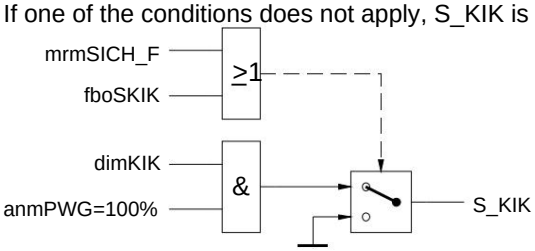


Figure CAN_08: Kickdown switch via CAN

S_KUP: clutch switch;
Bit addr. 3, bit no. 1
Inverted RCOS message dimKUP (bit 7 of dimDIGpre1l). Is the evaluation of the state
the converter clutch (transmission 1 message) is activated for the clutch bit (cowECOMTC.2=1).
the result is also included in S_KUP! For special applications you can use the application
diwUKU_vgw=1, a permanent default value of 0 is sent for the coupling bit.

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Q_ASR: acknowledgment bit ASR;
Bit addr. 4, bit no. 1, initial value 0, indicates that the ASR error bit
indicates that no new data was received from the brake control unit (ABS) within the error debouncing time fbwEASR_QA.

S_ABS: Status torque intervention brake; Bit
addr. 5, bit no. 1, initial value 0, indicates that the RCOS message corresponds to ABS.
It indicates that the desired torque intervention from the brake control unit (ASR / MSR intervention) can not be considered because mroM_EASRr <(mrmM_ELLR - mrwM_E_ToB) or mroM_EMSRr> (mroM_EBEGR + mrwM_E_ToB).

The tolerance value mrwM_E_ToB prevents jitter on this bit.
The bit is also set if the ASR or MSR intervention in the data set is not activated or has been deactivated due to errors (CAN defective fbbECA0_D, plausibility violation ABS speed fbbEMSR_P).

S_EGS: Status; Gear torque intervention bit addr.
6, bit no. 1, initial value 0, indicates that the desired
transmission control unit (EGS/ASG intervention) cannot be taken into account because mroM_EEGS <(mrmM_ELLR - mrwM_E_ToG) (during EGS intervention) or mroM_EASG> (mrmM_EBEGR + mrwM_E_ToG) (during ASG Intervention) or the transmission torque intervention in the data set is not activated (cowFUN_EGS ÿ 2), or due to errors (bus off, CAN defective, message timeout/inconsistency in transmission 1 or transmission 2, ASG clutch plausibility violation, ASG speed plausibility violation), this bit is also renewed ASG intervention request set if the resumption conditions have not yet occurred.

F_MOM: Torque information inaccurate; Bit
addr. 7, bit no. 1, initial value 0, if this bit is set
set. see chapter Monitoring shutdown due to system error.

MD_INN: internal engine torque; Bit
addr. 8, bit no. 8, value range 0-0xFE, error code. 0xFF RCOS message
mroMD_SOLL The error indicator value 0xFF is output when there is no speed
that can be evaluated. (zmmSYSERR.1; see monitoring concept "summarized system errors")

N_MOT_MO1: engine speed; Bit
addr. 16, bit no. 16, value range 0-0x7FFF, error code. 0xFFFF, RCOS message
dzoNmit The error flag value 0xFF is output if there is no speed that can be evaluated.
(zmmSYSERR.1; see monitoring concept "summarized system errors")

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MD_IN_O_EX: internal engine torque without external intervention (corrected); Bit addr. 32, bit no. 8, initial value 0, value range 0-0xFE, error code. 0xFF, RCOS message mrmMD_FAHR
The error indicator value 0xFF is output when there is no speed that can be evaluated. (zmmSYSERR.1; see monitoring concept "summarized system errors")

PWGPBM: accelerator pedal position; Bit addr. 40, bit no. 8, value range 0-0xFE, error code. 0xFF, RCOS message mrmPWGPBM, corresponds - with the appropriate application - the maximum of filtered pedal value mrmPWGfi, unfiltered pedal value mrmPWG_roh and determined from the GRA quantity inverse pedal value mroPWGinv.
The error flag value 0xFF is output if the PWG path fboSPWG or fboSPGS is defective.

MD_ME_VERL: mechanical torque loss; Bit addr. 48, bit no. 8, value range 0-0xFE, error code. 0xFF, RCOS message mrmMD_REIC, includes engine, air conditioning compressor - (only with bidirectional interface) and generator losses.

The error indicator value 0xFF is output with a defective WTF path fboSWTF, unless KTF is a replacement for WTF and KTF iO, with a defective LTF path fboSLTF or a defective generator load path fboSKW2, or if there is no speed that can be evaluated. The mrwF_MOM label can be used to select whether the errors fboSLTF, fboSKW2 and fboSWTF lead to the error code value 0xFF. Shown in figure CAN_10.

MD_REL: relative driver's desired torque; Bit addr. 56, bit no. 8, initial value 0xFF RCOS message mroMD_FAHx The error indicator value 0xFF is output when there is no speed that can be evaluated. (zmmSYSERR.1; see monitoring concept "summarized system errors")

Error reaction dependent on F_MOM:

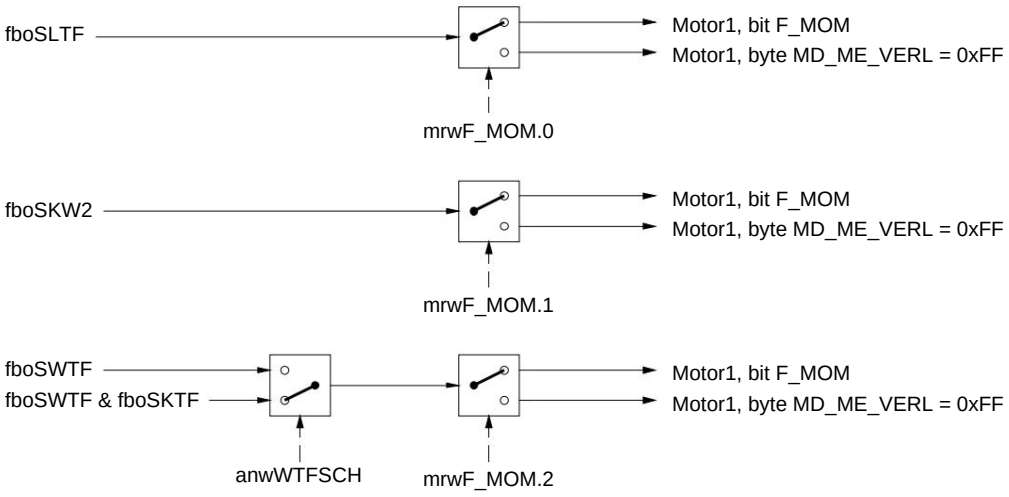


Figure CAN_10: Error response in engine message 1

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10.8.3 Message sent - Motor 2

Transmission period: 20ms

Storage layout:

Message: Engine 2							Identifier: 288H	bit
MUX_CODE_MO2	MUX_INFO_MO2 0							
T_WTF_MO2 8								
S_GRA	S_OBDII S_	NB S_KLB F_	WTF S_BRK	S_BRE 16				
V_AKT_MO2 24								
V_SOLL								32
N_LLBAS								40
MD_BEGR								48
free The								56

fields with a gray background are not supported.

Description:

MUX_INFO_MO2, MUX_CODE_MO2: multiplex information;
Bit addr. 0, bit no. 8, initial value 0,
Structure of the multiplex information:

MUX_COD_MO2	MUX_INFO_MO2
00	mrwMULINF0 (CAN Version)
01	mrwMULINF1 (EDC coding)
10	mrwMULINF2 (EGS coding)
11	mrwMULINF3 / 10 (maximum moment)

The 4 information is changed in the interval mrwMULTIME.

T_WTF_MO2: coolant temperature;
Bit address bit no. 8, initial value 0, value range 0-0xFE, error code. 0xFF,
8, RCOS message anmWTF

The error flag value 0xFF is issued with a defective WTF path fboSWTF if the
KTF does not represent a replacement value for a defective WTF (anmWTF_SCH = 1) or the KTF path fboSKTF is also defective.

S_BRE: brake switch;
Bit addr. 16, bit no. 1, initial value 0,
RCOS message dimBRE (bit 8 of dimDIGpre1)

S_BRK: redundant brake switch;
Bit addr. 17, bit no. 1, initial value 0,
RCOS message dimBRK

F_WTF: Error WTF;
Bit addr. 18, bit no. 1, initial value 0,
is set with a defective WTF path fboSWTF.

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S_KLB: Status feedback bidirectional climate interface; Bit addr. 19, bit no. 1, initial value 0, RCOS message dimKLB (in the case of SG without a bidirectional interface, the initial value 0 is sent)

S_NB: status normal operation;
Bit addr. 20, bit no. 1, initial value 0, the bit is set to 1 in normal operation. Normal operation means terminal 15 on, initialization phase completed and no engine start process.

S_OBDII: Status OBDII; Bit addr. 21, bit no. 1, initial value 0, EDC indicates with a value of 1 that an OBDII Freeze Frame is stored.

S_GRA: Status GRA; Bit addr. 22, bit no. 2, initial value 0,

S_GRA	GRA state off,
00	blocked by diagnosis or not applied (GRA in regular
01	operation) overrides (mrmM_EPWG> mrmM_EFGR)
10	free
11	

In the GRA mode ACC (cowFUN_FGR = 9), S_GRA has a different meaning (see cruise control).

V_AKT_MO2: vehicle speed; Bit addr. 24, bit no. 8, initial value 0, value range 0-0xFE, error code. 0xFF, RCOS message fgmFGAKT The error flag value 0xFF is output if the FGG path fboSFGG is defective.

V_SOLL: Target speed for GRA operation; Bit addr. 32, bit no. 8, initial value 0, value range 0-0xFE, error code. 0xFF, RCOS message mrmFG_SOLL, is only output when the GRA is active, otherwise the value 0 is output.

The error flag value 0xFF is output with a defective FGR control panel path fboSFGA.

N_LLBAS: target idle speed; Bit addr. 40, bit no. 8, initial value 0, range of values 0-0xFE, RCOS message mrmN_LLBAS

MD_BEGR: limiting torque, inner maximum possible torque; Bit addr. 48, bit no. 8, initial value 0, value range 0-0xFE, error code. 0xFF, RCOS message mroMD_BEGR The error indicator value 0xFF is output when there is no speed that can be evaluated. (zmmSYSERR.1; see monitoring concept "summarized system errors")

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10.8.4 Message sent - engine 3

Transmission period: 20ms

Storage layout:

Message: Engine 3				Identifier: 380H				bit
free S_M	SG_G S_DK	S_PWG free			S_NPRI S_	DSP VGL_B 0		
T_OFF								8th
PWG_ROH								16
MD_AB_LOW								24
S_ECO S_	EGAS free	MD_AB_	V	MD_AB_HIGH				32
N_BAKT								40
N_WUNSCH								48
DK The								56

fields with a gray background are not supported.

Description:

VGL_B: preheat message;
Bit addr. 0, bit no. 1, initial value 0
is set when preheating is required
RCOS message gsmGLUEH

S_DSP: Overtemperature protection by limiting the dynamic switching program

Bit addr. 1, bit no. 1, initial value 0
corresponds to RCOS Message mrmB_DSP

S_NPRI: Motor desired speed priority;
Bit addr. 2, bit no. 1, initial value 0
will not be processed

S_PWG: Accelerator pedal value inaccurate;
Bit addr. 4, bit no. 1, initial value 0
is set if there is an error in the fboSPWG or fboSPGS path

S_DK: Throttle angle inaccurate;
Bit addr. 5, bit no. 1, initial value 0
will not be processed

S_MSG_G: Engine control unit blocked
Bit addr. 6, bit no. 1, initial value 0
corresponds to inverted RCOS message xcmSt_free

T_AUS: Air temperature, value range 0-0xFE, error code. 0xFF;
Bit addr. 8, bit no. 8, initial value 0
RCOS message anmLTF
The error flag value 0xFF is returned for errors in the fboSLTF path

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PWG_ROH: raw value accelerator pedal position;
Bit addr. 16, bit no. 8, initial value 0 RCOS
message mrmPWG_lwo;

MD_AB_LOW: Desired wheel torque, low byte; Bit addr.
24, bit no. 8, initial value 0 OLDA mroMDW_CAN;

MD_AB_HIGH: Desired wheel torque, high byte; Bit addr.
32, bit no. 4, initial value 0 OLDA mroMDW_CAN;

MD_AB_V: desired wheel torque sign bit; Bit addr. 36, bit
no. 1, initial value 0 is set if desired wheel torque is negative;

S_EGAS: No E-GAS; Bit
addr. 38, bit no. 1, initial value 0

S_ECO: No "engine off" via ECOMATIC; Bit addr. 39,
bit no. 1, initial value 0 RCOS message khmKWH_CAN;

N_WUNSCH: Desired engine speed; Bit
addr. 48, bit no. 8, initial value 0 corresponds
to the value from the map mrwNwunVE.

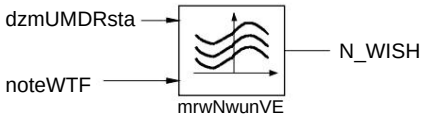


Figure CAN_12: formation of the CAN message N_WUNSCH

DK: throttle angle; Bit addr. 56,
bit no. 8, initial value 0 is not processed;

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N_BAKT: engine speed influencing; Bit addr.
40, bit no. 8, initial value 0

Depending on the water temperature anmWTF, a value between 0-100% is transferred from the characteristic curve arwCWTFkor to the CVT transmission, which influences the engine speed. This value can be switched off by applicable threshold values that depend on the ambient temperature and pressure. In order to prevent an abrupt switchover while exceeding the threshold values during operation, the entire function is activated or not activated once during the driving cycle at the start depending on the conditions (mrmSTART_B and arwCADTsch or arwCLTFsch). If a defect in the water temperature sensor is detected, the fixed value "0" is transmitted to the gearbox and the engine speed is therefore not affected.

The value mroN_BAKT is sent in the Motor3 message as a normalized value N_BAKT.

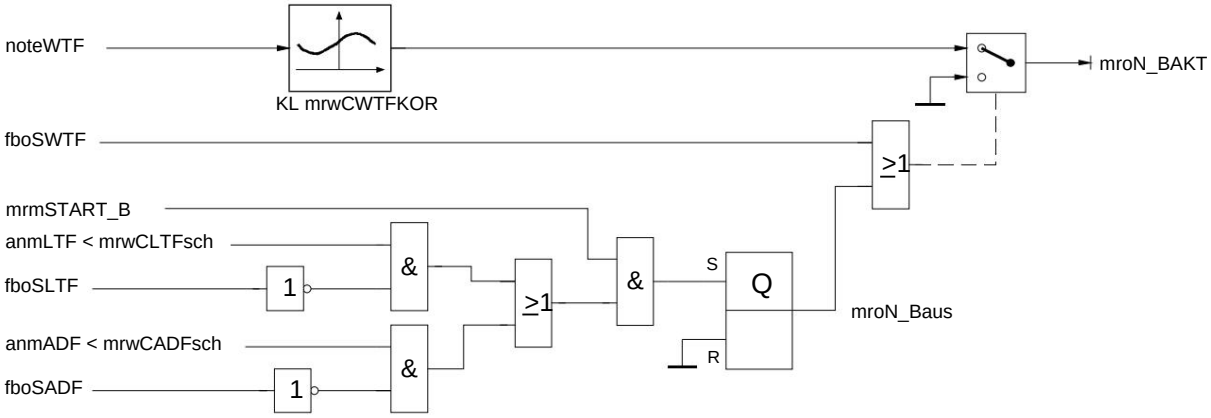


Figure CAN_13: formation of mroN_BAKT

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10.8.5 Message sent - Motor 5

Transmission period: 20ms

Storage layout:

Message: Engine 5					Identifier: 480H			bit
MUX_CODE_MO5					MUX_INFO_MO5 0			
S_KKL	S_KFK	S_KLIO	S_WCAT	S_LOBDII	S_LEGAS	S_LGAZ	S_LKL 8	
M_VERB_L 16								
S_VOV	M_VERB_H							24
TV_KULU								32
P_KMD								40
S_MOTOR_TEXT					free	GRA	free	48
								56

Free The fields with a gray background are not supported.

Description:

MUX_INFO_MO5, MUX_CODE_MO5: multiplex information;
Bit addr. 0, bit no. 8, initial value 0,
Structure of the multiplex information:

MUX_COD_MO5 MUX	INFO_MO5		
00	mrwMDmax max. torque /10 [Nm]		
01	mrwNMDmax speed at max. Torque /100 [rpm]		
10	mrwTabType :		
	bit 5	bit 4	bits 0..3
	0 .. Otto 1st. Diesel	0 .. Turbo 1st. suction	number of cylinders
11	mrwReserv		

The 4 pieces of information are changed at intervals of mrwMULANZ * 20ms.

S_LKL: status charge control lamp;
Bit addr. 8, bit no. 1, initial value 0,

S_LGAZ: glow indicator status;
Bit addr. 9, bit no. 1, initial value 0,
RCOS message ehmDDIA or ehmFDIA (if ehmDDIA = 0)
Corresponds to the status at SG pin SYS-O:
0 .. Lamp OFF
1 .. Lamp ON

S_LEGAS: Status E-Gas lamp, is not processed;
Bit addr. 10, bit no. 1, initial value 0;

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S_LOBDII: OBDII lamp status; Bit addr.
11, bit no. 1, initial value 0, RCOS message
ehmDMIL or ehmFMIL (if ehmDMIL = 0)
Corresponds to the status at the SG pin MIL-O: 0 ..
lamp OFF 1 .. lamp ON

S_WCAT: CAT warning, will not be processed; Bit addr.
12, bit no. 1, initial value 0;

S_KLI0: air conditioning compressor
OFF; Bit addr. 13, bit no. 1, initial value 0,
RCOS message ehmDKLI0 or ehmFKLI0 (if ehmDKLI0 = 0)
Corresponds to the status at the SG pin KLI-O: 0 ..
no request 1 .. air conditioning compressor OFF

S_KFK: status map cooling; Bit addr.
14, bit no. 1, initial value 0, RCOS message
kmmKFK_CAN 0 .. no map cooling or system
error in map cooling 1 .. map cooling installed
in the I²C and no system error

S_KKL: Request air conditioning compressor power reduction; Bit addr.
15, bit no. 1, initial value 0,

M_VERB_L: low byte consumption; Bit
addr. 16, bit no. 8, initial value 0, consumption
(mrmVERB20 + mrmVZHB20 (auxiliary heater)) since K15-ON in µl

M_VERB_H: high byte usage; Bit addr. 24,
bit no. 7, initial value 0, consumption
(mrmVERB20 + mrmVZHB20 (auxiliary heater)) since K15-ON in µl

S_VOV: Status overflow consumption; Bit
addr. 31, bit no. 1, initial value 0, this bit is set
and no longer reset when the consumption overflows for the first time (0..0x7FFF).

TV_KULU: duty cycle cooling fan control; Bit addr. 32, bit no.
8, initial value 0;

RCOS message kumCAN_LUE The
error indicator value 0xFF is output if the error path fboSGER or fboSHYL is defective.

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P_KMD: refrigerant pressure;
Bit addr. 40, bit no. 8, initial value 0;
RCOS message anmKMD with cowVAR_KMD = 1 otherwise 0
The error flag value 0xFF is output in the event of a defective refrigerant pressure path fboSKMD.

S_GRA: GRA lamp

Bit addr.50, bit no. 1, initial value 0;

Bit is set if the GRA is latched ON (dimFGL = 1)

S_MOTOR_TEXT: Motor text bits

0000 ... no error text display

0001 ... engine fault workshop (like diagnostic lamp)

0010 ... exhaust workshop (MIL). If there is an engine and exhaust gas fault, 0001 is sent.

0011 ... speed too high (not used)

0100-1111 reserved (not used)

If an error is entered in the error memory debounced, which requires activation of the diagnostic lamp (fbmDIAL.0=1), and the delay time fbwT_DIVER expired (fbmDIAL.5=1), this will happen DIAL motor text bit set (0001). If there is an error relevant to emissions (fbmMIL.0=1 or fbmMIL.1=1) and the delay time fbwT_MIVER has expired (fbmMIL.5=1), or is a CAN-MIL request to (mrmCANMIL=1) the MIL engine text bit (0010) is set, as long as the DIAL motor text bit is not activated. If there is both a MIL and a DIAL request, the DIAL has priority, since the motor text bit sequence 0011 has the meaning "speed too high" according to the CAN specifications. During the actuator test, the behave
Motor text bits same as respective lamp (motor text bits flash during actuator test).

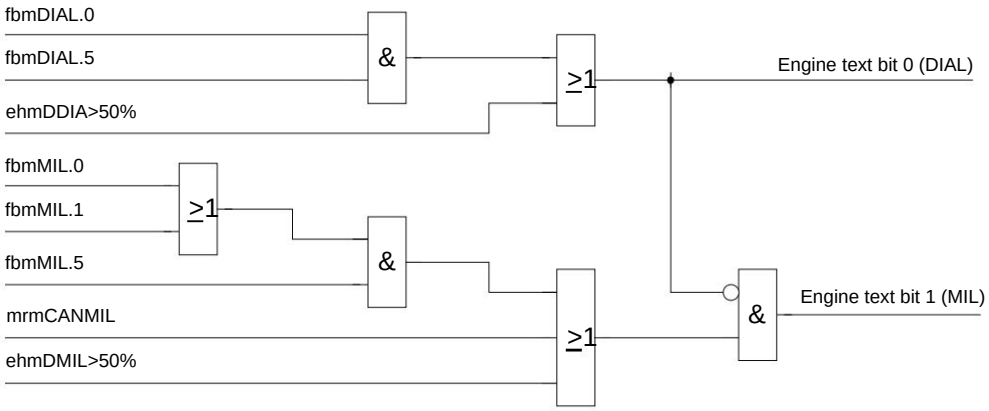


Figure UEBEMTB1: Control of motor text bits

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10.8.6 Message sent - Motor 6

Transmission period: 20ms

Storage layout:

Message: Engine 6	**Identifier: 488H**	bit
CHKSM		0
S_Mom_Getr		8th
I_Mom_Getr		16
H_Info		24
S_Besch_GRA		32
free free		40
		48
Z_Count	free	56

The fields with a gray background are not supported.

Description:

CHKSM: checksum
Bit addr. 0, bit no. 8, initial value 0
Valid value range 0x00..0xFF

S_Mom_Getr: Target torque for gearbox (without EGS or AG4 - influence)
Bit addr. 8, bit no. 8, initial value 0
RCOS message mroMD_SOL6

I_Mom_Getr: Actual torque for gear (without EGS or AG4 - influence)
Bit addr. 16, bit no. 8, initial value 0
RCOS message mroMD_IST6

H_Info: Height info
Bit addr. 24, bit no. 8, RCOS Initial value 0
message anmADF
The error flag value 0xFF is output if the ADF path fboSADF is defective.

S_Besch_GRA: GRA target acceleration
Bit addr. 32, bit no. 8, initial value 0
RCOS message mroRMP_gef
Conversion: 0.024 x value - 3.984 m/sec2 (xcwUMRCSSB, xcwUMRCOSB)
The error flag value 0xFF is returned if one of the following errors (paths) is defective
becomes: fbbEFGA_F, fbbECRA_A, fbbECRA_B, fboSFGC

Z_Count: message counter;
Bit addr. 60, bit no. 4, initial value 0
Valid value range 0x00..0x0F

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10.8.7 Message sent - engine 7

Sending the Motor 7 message can be suppressed with cowFUN_Mo7.

Transmission period: 20ms

Storage layout:

Message: Engine 7							Identifier: 588H							bit
S_PTC		free	free				ST_VBEG	S_VBEG	S_LLD_H	0				
Terminal_DFM 8														
H_Info 16														

The fields with a gray background are not supported.

Description:

S_LLD_H: Exceeding of the maximum target idle speed
Bit addr. 0, bit no. 1, initial value 0
is set when idle target speed mrmN_LLBAS> = the maximum, due to the
Voltage level achievable, target idle speed mrwN_LLBSG.

S_VBEG: Velocity limitation can be activated
Bit addr. 1, bit no. 1, initial value 0

ST_VBEG: status bit velocity limitation active
Bit addr. 2, bit no. 1, initial value 0

S_PTC: PTC/glow pins switched off
Bit addr. 5, bit no. 3, initial value 0
Status bits PTC/glow pins off are set as follows:

cowKWHKERZ	ehmFGSK2	ehmFGSK1		Bit 0.7	Bit 0.6	Bit 0.5
0	0%	0%		1	1	1
1	0%	0%				1
	0%	100%		10	11	1
2	0%	0%				1
	0%	100%		1		1
	100%	100%		00	110	1
3	0%	0%				1
	0%	100%		1		1
	100%	0%		0	1	1
	100%	100%		00	100	0

Instead of ehmFGSK1 or ehmFGSK2, ehmDGSK1 or ehmDGSK2 are used if their content > 0
(see chapter Diagnosis - initiate actuator test) is evaluated (content > 50% corresponds to output stage driven).
Attention: ehmDGSK1 and ehmDGSK2 are not subject to the restrictions by cowKWHKERZ!

Terminal_DFM: DFM signal duty cycle
Bit addr. 8 bit no. 8, initial value 0
RCOS message khmGENLAST

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The error indicator value 0xFF is output in the event of a defective generator load path fboSKW2.

H_Info: Height info
Bit addr. 16, bit no. 8, RCOS Initial value 0
message anmADF
The error flag value 0xFF is output if the ADF path fboSADF is defective.

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10.8.8 Message sent - MotorFlexia

Broadcast period: mrwFLEXPER

With values > 5.1sec, the sending of the message can be suppressed by the application.

Storage layout:

Message: MotorFlexia	Identifier: 580H	bit
free	Z_Count	0
I_RUSS		8th
I_VERSCHLEISS		16

The fields with a gray background are not supported.

Description:

Z_Count: message counter;
Bit addr. 0, bit no. 4, initial value 0
Counter is incremented with each new message;
Valid value range 0x01..0x0F

I_RUSS: soot index, value range 0-0xFE, error code. 0xFF;
Bit addr. 8, bit no. 8, initial value 0
High byte of RCOS message simOEL_BEL

I_VERSCHLEISS: wear index, value range 0-0xFE, error code. 0xFF;
Bit addr. 16, bit no. 8, initial value 0
Low byte of RCOS message simOEL_BEL

From CAN version 4.0, the following extension is used from bit 24:

2 multiplexed data blocks; (0) with an even, (1) with an odd message counter:

(0)

N_SPEED_MAXMOM			24
M_MAX_MOMENT			32
P_MLE_L			40
A_CYLINDER	A_VALVES	P_MLE_H 48	
S_ANSG	R_DISPLACEMENT		56

Description:

N_DREHZAHL_MAXMOM: Speed for maximum torque
Bit addr. 24, bit no. 8th;
Contains the wet from mrwNMDmax

M_MAX_MOMENT: Maximum torque
Bit addr. 32, bit no. 8th;
Contains the wet from mrwMDmax

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P_MLE_(L/H): Maximum engine power
Bit addr. 40, bit no. 9;
P_MLE_L represents the lower 8 bits, P_MLE_H the most significant bit 9 of the
Fixed value mrwLSmax (word)

A_VALVES: number of valves per cylinder
Bit addr. 49, bit no. 3;
Fixed value mrwAnzVent

A_CYLINDER: Number of cylinders
Bit addr. 52, bit no. 4;
Is equal to the application value cowVAR_ZYL

R_DISPLACEMENT: Displacement
Bit addr. 56, bit no. 7;
CAN representation of mrwHubraum

S_ANSG: intake system
Bit addr. 63, bit no. 1;
cowFUN_LDR inverted => 0=turbo, 1=sucker

(1)

N_OIL LEVEL			24
V_STANDARD CONSUMPTION			32
B_VERS_L	C_HERST_CODE		40
B_RUTU		B_VERS_H	48
S_BEF_KENN			56

Description:

N_OELNIVEAU : Oil level threshold
Bit addr. 24, bit no. 8th;
Is equal to mrwOelNiv

V_NORMVERBRAUCH: Normalized consumption per cylinder
Bit addr. 32, bit no. 8th;
mrwNVerb

C_HERST_CODE: Manufacturer code
Bit addr. 40, bit no. 4;
Always 0 (RBOS)

B_VERS_(L/H): Evaluation factor wear index
Bit addr. 44, bit no. 6;
mrwBewVer

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B_RUTU: Evaluation factor soot or turbo
Bit addr. 50, bit no. 6;
mrwBewRussia

S_BEF_KENN: Gradient of the filling characteristic
Bit addr. 56, bit no. 8th;
mrwStBkenn

10.8.9 Message sent - MSG_transport protocol request-response channel

Storage layout:

Message: MSG_Transportprotocol Request-response channel	**Identifier: 201H,** repetition rate = asynchronous bit	
DESTINATION		0
OPCODE		8th
CHANNEL_ID		16

Description:

DESTINATION: Recipient of the message;

OPCODE: type of message;
C0H Request (Inquiry),
D0H Reply (positive response),
D8H Negative Reply.

CHANNEL_ID: channel identifier for data transmission;
Channel identifier offset to 700H (local broadcast channel).

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10.8.10 Message sent - MSG_Transportkanal1

Storage layout:

Message: MSG_Transportkanal1	**Identifier: 7A1H,** repetition rate = asynchronous	bit
TPCI1		0
TPCI2 / Data1		8th
T1 / Data 2		16
T2 / Data 3		24
T3 / Data 4		32
T4 / Data 5		40
data 6		48
data 7		56

Description:

		TPCI bytes						
TPDU_Type	0 1234567							
DT	TPCI1D		D	D	D	D	D	D
AK	TPCI1	-	-	-	-	-	-	-
CS	TPCI1 TPCI2 T1			T2	T3	T4	-	-
APPROX	TPCI1 TPCI2 T1* T2* T3*					T4*	-	-
CT	TPCI1	-	-	-	-	-	-	-
DC	TPCI1 TPCI2		-	-	-	-	-	-

D	Data (1-7 bytes optional)
TPCI1	Transport control information byte 1
TPCI2	Transport control information byte 2
T1, T1*	Acknowledgment time out for data telegrams
T2, T2*	Maximum time interval between 2 transmission blocks
T3, T3*	smallest permissible distance between 2 telegrams
T4, T4*	Maximum time within which a recipient expects telegrams.

TPCI1: Transport Control Information Byte 1;

This byte contains the type of message and control information in coded form.

TPDU Type		**TPCI byte 1**							
		76543210							
Data	DT	0	0AR EOM			SN			
Acknowledge AK Connect		1	0	RS	1	SN			
Setup CS Connect Ack.		1	0	1	0	0	0	0	0
	APPROX	1	0	1	0	0	0	0	1
connect test	CT	1	0	1	0	0	0	1	1
Disconnect	DC	1	0	1	0	1	0	0	0

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AR Acknowledge Request (Request = 0, No Request = 1)

EOM End of Message
RS Receive Status (Receiver Ready = 1, Receiver Not Ready = 0)
SN Sequence Number (packet counter)

TPCI2: Transport Control Information Byte 2;

TPDU Type		**TPCI byte 2**						
		76543210						
Connect Setup	CS	-	-	-	-	B.S		
Connect Ack.	APPROX	-	-	-	-	B.S		
Disconnect	DC	-	-	-	-	B.S		

B.S Block size (number of data telegrams until an acknowledgment is requested)

8/10/11 Message sent - GRA

The message is sent at mrwMULINF0 = 5, 7 or 8.
Transmission period: 20ms

Storage layout:

Embassy: GRA	**Identifier: 388H**	bit
Z_Count		0
free	F_BTL ZU_VER ZU_BE$ T_WAB T_SEV T_AUS S_MAIN 8	
CHKSM		16

The fields with a gray background are not supported.

Description:

Z_Count: message counter;
Bit addr. 0, bit no. 8, initial value 0
Valid value range 0x00..0xFF

S_MAIN: GRA/ADR - main switch
Bit addr. 8, bit no. 1, initial value 0, default value 0
0 switched off, 1 switched on
RCOS message: dimFGL

T_AUS: GRA/ADR - Tip switch "Off"
Bit addr. 9, bit no. 1, initial value 0, default value 1
0 tip switch not actuated, 1 tip switch actuated
RCOS message: dimFGA inverted

T_SEV: GRA/ADR - tip switch "set/decelerate"
Bit addr. 10, bit no. 1, initial value 0, default value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: dimFGP

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T_WAB: GRA/ADR - tip switch "resume/accelerate"
Bit addr. 11, bit no. 1, initial value 0, default value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: dimFGW

ZU_BES: Accelerate GRA/ADR
Bit addr. 12, bit no. 1, initial value 0, default value 0
0 Do not decelerate, 1 Delay

ZU_VER: Delay GRA/ADR
Bit addr. 13, bit no. 1, initial value 0, default value 0
0 Don't accelerate, 1 Accelerate

F_BTL: GRA/ADR - control unit error
Bit addr. 14, bit no. 1, initial value 0, default value 0
0 OK, 1 error control lever
RCOS message: fbbEFGA_F

CHKSM: checksum
Bit addr. 16, bit no. 8, initial value 0
Valid value range 0x00..0xFF

8/10/12 **Message sent - GRA_New**

The message is sent at mrwMULINF0 = 10.
Storage layout:

Message: GRA_New								**Identifier: 38AH**			bit
CHKSM											0
free	F_BTL	ZU_BES	ZU_VER	T_BES	T_VER	T_AUS	S_MAIN	8			
Z_Count								COD_SND	T_WA	T_SET	16
F_BTLT	free			ZU_LIM	T_DST	T_TUP	T_TDN	24			

The fields with a gray background are not supported.

Description:

CHKSM: checksum
Bit addr. 0, bit no. 8, initial value 0
Valid value range 0x00..0xFF

S_MAIN: GRA/ADR - main switch
Bit addr. 8, bit no. 1, initial value 0
0 switched off, 1 switched on
RCOS message: dimFGL

T_AUS: GRA/ADR - Tip switch "Off"
Bit addr. 9, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: dimFGA

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T_VER: GRA/ADR - "Decelerate" tip switch Bit Addr.
10, Bit Num. 1, initial value 0 0 tip switch not actuated,
1 tip switch actuated RCOS message: dimFGP

T_BES: GRA/ADR - "Accelerate" tip switch, bit addr. 11, bit
no. 1, initial value 0 0 tip switch not actuated, 1 tip switch
actuated RCOS message: dimFGW

ZU_VER: GRA/ADR delay bit addr.
12, bit no. 1, initial value 0 0 do not accelerate,
1 accelerate

ZU_BES: GRA/ADR accelerate bit addr.
13, bit no. 1, initial value 0 0 do not decelerate,
1 decelerate

F_BTL: GRA/ADR - control unit error Bit
addr. 14, bit num. 1, initial value 0 0 in order, 1
error control lever RCOS message: fbbEFGA_F

T_SET: GRA/ADR - tip switch "set" bit addr. 16,
bit no. 1, initial value 0 0 tip switch not actuated, 1
tip switch actuated RCOS message: dimFGP (logical OR)

T_WA: GRA/ADR - tip switch "resume" bit addr. 17, bit no. 1,
initial value 0 0 tip switch not actuated, 1 tip switch actuated
RCOS message: dimFGW (logical OR)

COD_SND: Sender coding bit addr.
18, bit no. 2, initial value 0 00 onboard power
supply control unit 01 steering column module
10 motor SG 11 not assigned

Z_Count: Message counter bit
addr. 20, bit no. 4, initial value 0 Valid value range 0x0..0xF

T_TDN: Tip-Down Bit
Addr. 24, Bit Num. 1, initial value 0 0 tip switch
not actuated, 1 tip down

T_TUP: Tip-Up Bit
Addr. 25, Bit Num. 1, initial value 0 0 tip switch
not actuated, 1 tip up

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T_DST: ADR - tip switch distance request bit addr.
26, bit no. 1, initial value 0 00 button not pressed
01 desired distance none 10 desired distance
greater than 11 not assigned

ZU_LIM: Limiter one bit
addr. 28, bit no. 1, initial value 0 0 tip switch
not actuated, 1 tip switch actuated

F_BTLT: Tiptronic control panel error Bit
Addr. 31, Bit Num. 1, initial value 0 0 tip switch
not actuated, 1 tip switch actuated

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8/10/13 **Message received - brake 1**

Activation of the evaluation with: cowFUN_ASR = 2 (ASR intervention) or
cowFUN_MSR = 2 (MSR intervention) or
cowVAR_FGG = 3 (speed from CAN / Bremse1)

Associated record label: caw050...

Storage layout:

Message: Brake 1								**Identifier: 1A0H,** repetition rate = 5-10 ms bit								
A_EBV			S_ASR			S_FDR	S_EDS	S_BAB	A_MSR	A_ASR	0					
D_ABS	F_SWA	S_SWA	S_BKV	S_BLS	L_BRK	L_ASR	L_ABS	8								
V_AKT_BR1 (low)												F_BKV	16			
V_AKT_BR1 (high)	24															
MD_ASR_SL	32															
MD_ASR																40
MD_MSR																48
free						T_ASR		B_COUNT_BR1								56

The fields with a gray background are not supported.

Description:

A_ASR: ASR intervention request;
Bit addr. 0, bit no. 1, initial value 0,
RCOS message mrmASRSTAT[5]
The ASR intervention MD_ASR thus becomes valid. (see chapter "External quantity intervention").

A_MSR: MSR intervention request;
Bit addr. 1, bit no. 1, initial value 0,
RCOS message mrmMSRSTAT[5] (see chapter "External quantity intervention").

S_BAB: ABS braking, is not processed;
Bit address 2, bit no. 1, initial value 0

S_EDS: EDS intervention, is not processed;
Bit addr. 3, bit no. 1, initial value 0

S_FDR: FDR intervention;
Bit addr. 4, bit no. 1, initial value 0
RCOS message mrmFDR_CAN.0
Is only evaluated with cowFUN_ASR = 2 (ASR intervention) or with cowFUN_MSR = 2 (MSR intervention).

S_ASR: ASR switching influence is not processed;
Bit addr. 5, bit no. 2, initial value 0

A_EBV: Current intervention electronic brake force distribution, is not processed;
Bit addr. 7, bit no. 1, initial value 0

L_ABS: Lamp ABS, is not processed;
Bit addr. 8, bit no. 1, initial value 0

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L_ASR: Lamp ASR/FDR is not processed; Bit addr. 9, bit no. 1, initial value 0 **L_BRK:** Brake warning lamp, is not processed; Bit addr. 10, bit no. 1, initial value 0

S_BLS: driver brakes (previously, or without active brake booster: brake light switch); Bit addr. 11, bit no. 1, initial value 0 RCOS message mrmFDR_CAN.1 Is only evaluated at cowFUN_ASR = 2 (ASR intervention) or at cowFUN_MSR = 2 (MSR intervention).

S_BKV: Status of the active brake booster (previously, or without an active BKV: brake test switch); Bit addr. 12, bit no. 1, initial value 0 RCOS message mrmFDR_CAN.2 Is only evaluated at cowFUN_ASR = 2 (ASR intervention) or at cowFUN_MSR = 2 (MSR intervention).

S_SWA: bad path suppression, is not processed; Bit addr. 13, bit no. 1, initial value 0

F_SWA: Rough road suppression status is not processed; Bit addr. 14, bit no. 1, initial value 0

D_ABS: ABS in diagnosis, is not processed; Bit addr. 15, bit no. 1, initial value 0

F_BKV: error brake booster; Bit addr. 16, bit no. 1, initial value 0 RCOS message mrmFDR_CAN.3 Is only evaluated at cowFUN_ASR = 2 (ASR intervention) or at cowFUN_MSR = 2 (MSR intervention).

V_AKT_BR1: ABS - reference speed (RCOS message mrmFG_ABS), is used for the functional plausibility MSR fbbEMSR_P; is multiplied at cowVAR_FGG=3 with mrwFGKORFA, sent as mrmFG_CAN to the speed detection and made available to the MSG as driving speed fgmFGAKT.

The value 0xFF in byte 3 indicates an error.
Bit addr. 17, bit no. 15, initial value 0

MD_ASR_SL: ASR intervention torque slow, is not processed; Bit addr. 32, bit no. 8, initial value 0xFE

MD_ASR: ASR intervention torque fast; Bit addr. 40, bit no. 8, initial value 0xFE, RCOS message mrmASR_roh The moment raw value mrmASR_roh is sent without plausibility checks and has the value range 0x00 to 0xFF. The intervention is only made when A_ASR is set. (see chapter "External quantity intervention"). Is only evaluated with cowFUN_ASR = 2 (ASR intervention) or with cowFUN_MSR = 2 (MSR intervention).

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MD_MSR: MSR intervention torque;
Bit addr. 48, bit no. 8, initial value 0,
RCOS message mrmMSR_roh
The torque raw value mrmMSR_roh is sent without plausibility checks and has the
Value range 0x00 to 0xFF. The intervention is only carried out when A_MSR is set,
A_ASR is not set and mroMD_ASR contains the bit complement of mroMD_MSR.
(see chapter "External quantity intervention"). Is only evaluated with cowFUN_ASR = 2 (ASR intervention) or with cowFUN_MSR = 2 (MSR intervention).

B_COUNT_BR1: message counter;
Bit addr. 56, bit no. 4, initial value 0
Value range 0x00 to 0x0F

T_ASR: Type ASR, is not processed;
Bit addr. 60, bit no. 1, initial value 0

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8/10/14 **Message received - brake 3**

Activation of the evaluation with: cowFUN_AS3 = 2 (evaluation brake 3)
Associated record label: caw080...

Storage layout:

Message: Brake 3	**Identifier: 4A0H,** repetition rate = 7-20 ms bit	
VL (low)	reserved 0	
VL (high)		8th
VR (low)	reserved 16	
VR (high)		24
HL (low)	reserved 32	
HL (high)		40
HR (low)	reserved 48	
HR (high)		56

The fields with a gray background are not supported.

Description:

VL: left front wheel speed;
is evaluated at cowVAR_FGG=5 (v from brake 3 for front-wheel drive).
The value 0xFF in byte 1 indicates an error.
Bit addr. 1, bit no. 15, initial value 0

VR: right front wheel speed;
is evaluated at cowVAR_FGG=5 (v from brake 3 for front-wheel drive).
The value 0xFF in byte 3 indicates an error.
Bit addr. 17, bit no. 15, initial value 0

at cowVAR_FGG = 5 (v from brake 3 for front-wheel drive), the mean value of the wheel speed VL and VR is multiplied by mrwFGKORFA, as mrmFG_CAN to the Speed detection sent and available to the system as fgmFGAKT placed.

HL: left rear wheel speed;
is evaluated at cowVAR_FGG=6 (v from brake 3 for rear-wheel drive).
The value 0xFF in byte 5 indicates an error.
Bit addr. 33, bit no. 15, initial value 0

RW: right rear wheel speed;
is evaluated at cowVAR_FGG=6 (v from brake 3 for rear-wheel drive).
The value 0xFF in byte 7 indicates an error.
Bit addr. 49, bit no. 15, initial value 0

at cowVAR_FGG = 6 (v from brake 3 for rear-wheel drive) is the average of the wheel speed HL and HR multiplied by mrwFGKORFA, as mrmFG_CAN to the Speed detection sent and available to the system as fgmFGAKT placed.

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10.8.15 Message received - gear 1

Activation of the evaluation with: cowFUN_EGS = 2 (EGS intervention via CAN) or
cowECOMTC Bit 1 (Ecomatic via CAN) or
Bit 2 (clutch via CAN) set

Associated record label: caw010...

Storage layout:

Message: gear 1				**Identifier: 440H,** repetition rate = 8 ms bit				
A_EGS S_	KOD A_LL		S_WKUP		A_KL0 A_	WS S_SG 0		
S_WHP				S_GANG 8				
ÜB_FKT								16
MD_INN_SOLL								24
FW_I								32
A_OBDII				EGS_STAT				40
free							MOT_A 48	
MD_VERL_W								56

The fields with a gray background are not processed.

Description:

S_SG: circuit active
Bit address bit no. 1, initial value 0
0, RCOS message mrmEGS_akt; is required for parameter selection

A_WS: Transformer protection request; will not be processed;
Bit addr. 1, bit no. 1, initial value 0

A_KL0: Switch off air conditioning compressor request;
Bit addr. 2, bit no. 1, initial value 0,
RCOS message mrmCAN_KL

S_WKUP: converter clutch status;
Bit addr. 3, bit no. 2, initial value 0
RCOS message mrmW_KUP
With the appropriate application (cowECOMTC.2) contains mrmCAN_KUP the following value, which in further result also in dimKUP:

S_WKUP mrmCAN_KUP	
00 1	
01 mrwWKUP_VG	
10 0	
11 0	

A_LL: request idle speed increase is not processed;
Bit address 5, bit no. 1, initial value 0

S_KOD: EGS coding in EDC is OK. The value 1 indicates that the motor SG and the EGS are not compatible (see also chapter fbbEASG monitoring concept);
Bit addr. 6, bit no. 1, initial value 0
Evaluation is activated with cowECOMTC.5 = 1

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A_EGS: request EGS intervention;
Bit addr. 7, bit no. 1, initial value 0,

RCOS message mrmEGS_CAN.5 is set;
The EGS intervention MD_INN_SOLL then becomes valid
(see chapter "External quantity intervention").

S_GANG: Information target gear;
Bit addr. 8, bit no. 4, initial value 0,
RCOS message mrm_P_N becomes 1 if S_GANG = 0 (P/N)

S_GANG mrmGTRGANG	
1-5 1-5	
8 6	
	7
9 all other values	1

S_WHP: selector lever position;
Bit addr. 12, bit no. 4, initial value 0,
RCOS message mrmWH_1NRP becomes 1 if S_WHP == (1/N/R/P)
RCOS message mrmWH_POS (6 if S_WHP = N, 8 if S_WHP = P)

ÜB_FKT: transfer function;
Bit addr. 16, bit no. 8, initial value 0,
RCOS message mrmGTR_UEB. If the transmission is idling (mrm_P_N = 1) it will
mrmGTR_UEB occupied with the default value mrwFVHVGWU.

MD_INN_SOLL: internal engine setpoint torque;
Bit addr. 24, bit no. 8, initial value 0xFE,
RCOS message mrmEGS_roh
The torque raw value mrmEGS_roh is sent without plausibility checks and has the
Value range 0x00 to 0xFF. The intervention is only carried out when A_EGS is set.
(see chapter "External quantity intervention").

FW_I: driving resistance index, is not processed;
Bit addr. 32, bit no. 8, initial value 0x7F

EGS_STAT: transmission emergency operation;
Bit addr. 40, bit no. 4, initial value 0
Transmission - starting torque characteristic is activated (possibly active EGS intervention is
aborted) if bit 3 is set in EGS_STAT. Output on the messages mrmEGS_CAN.8
and mrmEGSSTAT.8

A_OBDII: Status OBDII;
Bit addr. 44, bit no. 4, initial value 0,
If bit 47 is set, the MI lamp is controlled reversibly;
Figure in RCOS message mrmCANMIL

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MOT_A: engine off;
Bit addr. 48, bit no. 1, initial value 0,
If the bit is set, the motor should be switched off;

RCOS message mrmCAN_ECO is 1 when MOT_A == 0; RCOS message mrmCAN_ECO becomes 0 when MOT_A == 1

MD_VERL_W: converter torque loss;
Bit addr. 56, bit no. 8, initial value 0,
RCOS message mrmKUP_roh
Error detection 0xFF

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8/10/16 **Message Received - Gear 2**

Activation of the evaluation with: cowFUN_ASG = 2 (ASG intervention) or
cowFUN_CVT = 1 (CVT intervention)
cowFUN_MGB = 1 (Moment gradient limitation (MGB))

Associated record label: caw120...

Storage layout:

Message: gear 2	**Identifier: 540H,** repetition rate = 10 ms bit	
B_COUNT_GT2	A_ZGF S_ECO S_SAB S_LFR 0	
N_LL_SOLL		8th
dMD_MGB		16
N_SYNC_WUN		24
N_SYNC_WUN_INV		32
T_SYNC		40
A_FKU A_MBR S_KSS A_LSL S_WUD A_GON A_SST A_LHS 48		
SPEED LEVEL	GEAR 56	

The fields with a gray background are not processed.

Description:

S_LFR: LFR adaptation;
Bit addr. 0, bit no. 1, initial value 0
will be sent in RCOS message mrmLFR_Adp.

S_SAB: overrun cut-off support, is not processed;
Bit addr. 1, bit no. 1, initial value 0

S_ECO: Ecomatic operation with vmax limitation and torque limitation or MGB
Bit addr. 2, bit no. 1, initial value 0
RCOS message mrmASG_CAN.8

A_ZGF: intermediate gas flag;
Bit addr. 3, bit no. 1, initial value 0,
0 .. no double-declutching requirement
.. Blip request active
1 is mapped in bit 5 in RCOS message mrmASG_CAN.

B_COUNT_GT2: message counter;
Bit addr. 4, bit no. 4, initial value 0
Value range 0x00 to 0x0F

N_LL_SOLL: target idle speed;
Bit addr. 8, bit no. 8, initial value 0
Requested by VL30 transmission, displayed in mroN_LLCAr, is converted and as
mrmN_LLCAN sent to target idle speed calculation.

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dMD_MGB: Limiting value for torque gradient limitation bit addr. 16, bit no. 8, error flag value 0xFF (error handled) mapped in RCOS message mrmdMD_MGB.

N_SYNC_WUN: Desired synchronization speed bit addr. 24, bit no. 8, initial value 0

Low byte of the RCOS message mrmASG_roh
Error ID 0xFF

N_SYNC_WUN_INV: Inverted desired synchronization speed bit addr. 32, bit no. 8, initial value 0 high byte of the RCOS message mrmASG_roh error code 0xFF

T_SYNC: synchronization time bit addr. 40, bit no. 8, initial value 0 error code 0xFF 20*value=RCOS message mrmASG_tsy

A_LHS: upshift lamp , is not processed; Bit addr. 48, bit no. 1, initial value 0

A_SST: Starter is controlled, is not processed; Bit addr. 49, bit no. 1, initial value 0

A_GON: Gong, will not be processed; Bit addr. 50, bit no. 1, initial value 0,

S_WUD: Suppression of warnings, will not be processed; Bit addr. 51, bit no. 1, initial value 0,

A_LSL: Shift-Lock_Lamp, will not be processed; Bit addr. 52, bit no. 1, initial value 0,

S_KSS: engine run, is not processed; Bit addr. 53, bit no. 1, initial value 0,

A_MBR: Motor readiness is not processed; Bit addr. 54, bit no. 1, initial value 0,

A_FKU: Clutch error lamp, bit addr. 55, bit no. 1, initial value 0, if this bit is set, the error fbbEEGS_F is reported.

GEAR: gear indicator, is not processed; Bit addr. 56, bit no. 4,

SPEED STEP: engaged speed step, is not processed; Bit addr. 60, bit no. 4,

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8/10/17 **Message received - station wagon 1**

Activation of the evaluation with: cowVAR_FGG = 4 (speed from CAN/Kombi1) or
anwKMW_CAN = 1 (KMW via CAN) or
cowVAR_KO1 = 1 (receipt combi 1 due to timeout monitoring.)

Associated record label: caw030...

Storage layout:

Message: station wagon 1	**Identifier: 320H,** repetition rate = 20-32 ms bit	
L_VGL S_KMW S_HLV S_KM D_ODW S_OD S_TANK S_TUER 0		
free	S_BRAKE	8th
S_TANK	IN_TANK	16
V_AKT_KO1 (low)	Q_V 24	
V_AKT_KO1 (high)		32
V_DISP (low)	R_BLI L_BLI V_DISP S_ADR	40
(high) Free The		48
fields with		56

a gray background are not supported.

Description:

S_TUER: Driver 's door contact switch is not processed;
Bit addr. 0, bit no. 1, initial value 0,

S_TANK: tank empty switch, is not processed;
Bit addr. 1, bit no. 1, initial value 0,

S_OD: Oil pressure switch, is not processed;
Bit addr. 2, bit no. 1, initial value 0

D_ODW: dynamic oil pressure warning, is not processed;
Bit addr. 3, bit no. 1, initial value 0

S_KM: lack of coolant, is not processed;
Bit address 4, bit no. 1, initial value 0

S_HLV: hot light pre-warning is not processed;
Bit addr. 5, bit no. 1, initial value 0

S_KMW: fuel quantity warning signal;
Bit addr. 6, bit no. 1, initial value 0
Is sent in tlmKMW_CAN when anwKMW_CAN is not equal to zero when applied.

L_VGL: glow plug lamp;
Bit address 7, bit no. 1, initial value 0

Is sent via message gsmCANGL.

S_BREMS: Brake info status, is not processed;
Bit addr. 8, bit no. 2, initial value 0

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IN_TANK: tank content, is not processed; Bit addr. 16,
bit no. 7, initial value 0

S_TANK: Tank warning (OBD), is not processed; Bit addr. 23, bit
no. 1, initial value 0

Q_V: Velocity signal source, is not processed; Bit addr. 24, bit no. 1,
initial value 0

V_AKT_KO1: driving speed; is multiplied at cowVAR_FGG = 4 with mrwFGKORFA, sent as
mrmFG_CAN to the speed detection and made available to the MSG as driving speed fgmFGAKT.

The value 0xFF in byte 4 indicates an error.
Bit addr. 25, bit no. 15, initial value 0

S_ADR: ADR feedback from the display is not processed; Bit addr. 40, bit
no. 4, initial value 0

L_BLI: Turn signal left, is not processed; Bit addr.
44, bit no. 1, initial value 0

R_BLI: turn signal right, is not processed; Bit addr.
45, bit no. 1, initial value 0

V_DISP (low, high): Displayed speed, including lead, is not processed; Bit addr. 46, bit no. 10, initial value
0

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8/10/18 **Received message - station wagon 2**

Activation of the evaluation with: anwOTF_KAN = 01xxh (OTF via CAN) or
cowVAR_FZG = 3 (UTF over CAN) or
cowWTFCAN = 1 (WTF over CAN)

Associated record label: caw040...

Storage layout:

Message: station wagon 2	**Identifier: 420H,** repetition rate = 200 ms bit	
free	S_WTF S_OTF S_UTF 0	
T_UTF_gef		8th
T_UTF_ugf		16
T_OTF_KO2		24
T_WTF		32
S_58d	Klemme_58d	40
S_58s	Klemme_58s	48
*free The fields		56

with a gray background are not supported.

Description:

S_UTF: error status UTF;
Bit addr. 0, bit no. 1;
Value "1" for "Error value or outside the measuring range (inaccurate)"
Is cowVAR_FZG = 3, so with value "1" T_UTF_gef not taken over in anmUTF but the
Error reported to fbbEUTF_P and sent to anmUTF_CAN=FFFFH.

S_OTF: Error status OTF;
Bit addr. 1, bit no. 1;
Value "1" for "Error value or outside the measuring range (inaccurate)"
If anwOTF_KAN=01xxH, T_OTF_K02 is not transferred to anmOTF if the value is "1".
but the error fbbEOTF_S reported.

S_WTF: Error status WTF;
Bit addr. 2, bit no. 1;
If cowWTFCAN = 1, then with value "1" T_WTF is not taken over in anmWTF_CAN but
anmWTF + mrwWTFdelt and reported the error fbbEKO2_W.

T_UTF_gef: filtered outside temperature;
Bit addr. 8, bit no. 8th;
FFH means "error"
If cowFAR_VZG=3, then T_UTF_gef is taken over in anmUTF_CAN. In the case of an error
(S_UTF=1 or T_UTF_gef=FFH or T_UTF_gef=00H) the error fbbEUTF_P is reported
and anmUTF_CAN=FFFFH sent.

T_UTF_ugf: unfiltered outside temperature, is not processed;
Bit addr. 16, bit no. 8th;
FFH means "error"

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T_OTF_KO2: oil temperature; Bit addr. 24, bit no. 8th; FFH means "error" If anwOTF_KAN=01xxH, T_OTF_KO2 is transferred to anmOTF; in case of error (T_OTF_KO2=FFH or T_OTF_KO2=00H) the error fbbEOTF_P is reported.

T_WTF: coolant temperature; Bit addr. 32, bit no. 8th; If cowWTFCAN = 1, the value is taken over in anmWTF_CAN otherwise anmWTF. In the event of an error (S_WTF=1 or T_WTF=FFH), anmWTF + anwWTFdelt is used as an alternative and the error fbbEKO2_W is reported.

Klemme_58d: display lighting, is not processed; Bit addr. 40, bit no. 7;

S_58d: error status display lighting, is not processed; Bit addr. 47, bit no. 1; Value "1" for "not available or substitute value"

Klemme_58s: switch lighting, is not processed; Bit addr. 48, bit no. 7;

S_58s: bad path suppression, is not processed; Bit addr. 55, bit no. 1; Value "1" for "not available or substitute value"

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8/10/19 **Message received - Airbag 1**

Activation of the evaluation with: cowFUN_CRA = 2 (CRA over CAN)
Associated record label: caw070...

Storage layout:

Message: Airbag 1								**Identifier: 050H,** repeater. = 20ms/crash bit								
S_CRINT					S_ROLL	S_SEB	S_SEF	S_HECK	S_FRONT	0						
S_GUWB	S_GUSB	S_GUWF	S_GUSF			free		S_KIND	S_DEAKT	S_LAMP	8					
COUNT								free 16								
CHKSM																24

The fields with a gray background are not supported.

Description:

S_FRONT: front crash;
Bit addr. 0, bit no. 1, initial value 0
will not be processed

S_HECK: rear crash;
Bit addr. 1, bit no. 1, initial value 0
will not be processed

S_SEF: side crash driver;
Bit addr. 2, bit no. 1, initial value 0
will not be processed

S_SEB: side crash passenger;
Bit addr. 3, bit no. 1, initial value 0
will not be processed

S_ROLL: rollover;
Bit addr. 4, bit no. 1, initial value 0
will not be processed

S_CRINT: crash intensity;
Bit addr. 5, bit no. 3, initial value 0
Assignment of the crash levels croCR_STAT:

CAN Bits 5-7	Crash level	Crash designation
0 0 0	0	no crash
0 0 1	1	belt tensioners
0 1x	2	U.S
1xx	3	RDW

S_LAMP: airbag lamp;
Bit addr. 8, bit no. 1, initial value 1
will not be processed

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S_DEAKT: airbag deactivated; Bit addr. 9, bit no. 1, initial value 0 is not processed

S_KIND: child seat recognition; Bit addr. 10, bit no. 1, initial value 0 is not processed

S_GUSF: Driver seat belt switch; Bit addr. 12, bit no. 1, initial value 0 is not processed

S_GUWF: seat belt warning driver; Bit addr. 13, bit no. 1, initial value 0 is not processed

S_GUSB: Passenger seat belt switch; Bit addr. 14, bit no. 1, initial value 0 is not processed

S_GUWB: Passenger seat belt warning; Bit addr. 15, bit no. 1, initial value 0 is not processed

COUNT: Message counter for live detection; Bit addr. 20, bit no. 4, initial value 0 is not processed

CHKSM: checksum; Bit addr. 24, bit no. 8, initial value 0 is not processed

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8/10/20 **Message received - BSG_Last**

Activation of the evaluation with: cowVAR_BSG = 2 (evaluation BSG_Last)
Associated record label: caw100...

Storage layout:

Message: BSG_Last		**Identifier: 570H,** repetition rate = 100 ms bit				
S_KLM_L free		S_ZAS_50 S	ZAS_X S	ZAS_15 S	ZAS_S 0	
free					S_LLBSG 8	
U_BAT_BSG 16						
S_KLIAUS	free	S_HZSI S	HZAU S	HZR S	HZHE 24	

The fields with a gray background are not supported.

Description:

S_ZAS_S: ZAS_Klemme_S is not processed;
Bit addr. 0, bit no. 1, initial value 0
Ignition lock S-contact (key inserted)

S_ZAS_15: ZAS_Klemme_15 is not processed;
Bit addr. 1, bit no. 1, initial value 0
Ignition lock terminal 15 (ignition on)

S_ZAS_X: ZAS_Klemme_X is not processed;
Bit addr. 2, bit no. 1, initial value 0
Ignition switch X (starting process)

S_ZAS_50: ZAS_Klemme_50 is not processed;
Bit addr. 3, bit no. 1, initial value 0
Ignition lock terminal 50

S_KLM_L: Terminal_L is not processed;
Bit addr. 7, bit no. 1, initial value 0
Terminal L (charge control lamp)

S_LLBSG: target idle speed increase;
Bit addr. 8, bit no. 1, initial value 0
The bit is set when load management in the BSG requests an increase in the target idle speed.
RCOS message mrmBSG_Anf

U_BAT_BSG: battery voltage, is not processed;
Bit addr. 16, bit no. 8, initial value 0
Voltage measurement from load management

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S_HZHE: Turn off heated_rear_window, is not processed; Bit addr. 24, bit no. 1, initial value 0 The bit is set when load management in the BSG requests the heated rear window to be switched off.

S_HZFR: Switch off heated_window, is not processed; Bit addr. 25, bit no. 1, initial value 0 The bit is set when load management in the BSG requests the heated windscreen to be switched off.

S_HZAU: Switch off heated_outside mirrors, is not processed; Bit addr. 26, bit no. 1, initial value 0 The bit is set when load management in the BSG requests the heated exterior mirrors to be switched off.

S_HZSI: Turn off heated_seats is not processed; Bit addr. 27, bit no. 1, initial value 0 The bit is set when load management in the BSG requests that the heated seats be switched off.

S_KLIAUS: switch off air conditioning; Bit addr. 31, bit no. 1, initial value 0 The bit is set when load management in the BSG shutdown of the air conditioning requires RCOS message: mrmBSG_KLI

In the event of a message timeout or inconsistent message, the replacement data from caw100_DTx is processed.

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10.8.21 Message received - Clima 1

Activation of the evaluation with: cowFUN_KLI = 2 (air conditioning with CAN)
Associated record label: caw110...

Storage layout:

Message: Climate 1			**Identifier: 5E0H,** repetition rate = 20 ms bit				
free	A_KHL	S_KPZ	S_HFS	S_HHS	S_FZH	S_KLB	0	
T_AU_UGF 8								
P_KLD								16
L_KPR 24								
L_GBL								32
KL_ANST								40

The fields with a gray background are not supported.

Description:

S_KLB: Signal for idling speed increase
Bit addr. 0, bit no. 1, initial value 0
RCOS message mrmCAN_KLI.0

S_FZH: Driver request additional heater
Bit addr. 1, bit no. 1, initial value 0
RCOS message mrmCAN_KLI.1

S_HHS: Heated rear window, is not processed;
Bit addr. 2, bit no. 1, initial value 0
RCOS message mrmCAN_KLI.2

S_HFS: Heated windscreen, is not processed;
Bit addr. 3, bit no. 1, initial value 0
RCOS message mrmCAN_KLI.3

S_KPZ: Compressor status, signal for idling speed increase
Bit addr. 4, bit no. 1, initial value 0
RCOS message mrmCAN_KLI.4

A_KHL: No heating output required
Bit addr. 5, bit no. 1, initial value 0
no heating means that the temperature control is set to 'blue'
RCOS message mrmCAN_KLI.5

T_AU_UGF: outside temperature unfiltered, is not processed;
Bit addr. 8, bit no. 8, initial value 0

P_KLD : climate pressure signal
Bit addr. 16, bit no. 8, initial value 0

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RCOS message mrmKMD, in the event of an error (P_KLD = error code 0xFFh) is used as a substitute value of the default value mrwKKL_VGW

L_KPR: compressor load bit
addr. 24, bit no. 8, initial value 0 RCOS message
mrmMD_KLKr, in the event of an error (L_KPR = error code 0xFFh) is used as a substitute value of the default value mrwKPR_VGW

L_GBL: fan load, not processed; Bit addr. 32, bit
no. 8, initial value 0

KL_ANST: Cooling fan control bit addr.
40, bit no. 8, initial value 0 RCOS message
mrmKLI_LUE, in the event of an error (KL_ANST = error code 0xFFh) is used as a substitute value of the default value mrwKL_VGW.

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10.8.22 Message received - GRA

Activation of the evaluation with: mrwMULINF0 = 6. Associated record label: caw060...

Storage layout:

Embassy: GRA								Identifier: 388H								bit
Z_Count																0
free	F_BTL	ZU_BES	ZU_VER	T_WAB	T_SEV	T_AUS	S_MAIN	8								
CHKSM																16

The fields with a gray background are not supported.

Description:

Z_Count: Message counter
Bit addr. 0, bit no. 8, initial value 0 Valid value range 0x00..0xFF

S_MAIN: GRA/ADR - main switch
Bit addr. 8, bit no. 1, initial value 0
0 switched off, 1 switched on
RCOS message: mrmGRA

T_AUS: GRA/ADR - Tip switch "Off"
Bit addr. 9, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

T_SEV: GRA/ADR - tip switch "set/decelerate"
Bit addr. 10, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

T_WAB: GRA/ADR - tip switch "resume/accelerate"
Bit addr. 11, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

ZU_VER: delay GRA/ADR; will not be processed
Bit addr. 12, bit no. 1, initial value 0
0 Don't accelerate, 1 Accelerate
RCOS message: mrmGRA

ZU_BES: Accelerate GRA/ADR; will not be processed
Bit addr. 13, bit no. 1, initial value 0
0 Do not decelerate, 1 Delay
RCOS message: mrmGRA

F_BTL: GRA/ADR - control unit error
Bit addr. 14, bit no. 1, initial value 0
0 OK, 1 error control lever
RCOS message: mrmGRA

CHKSM: checksum
Bit addr. 16, bit no. 8, initial value 0
Valid value range 0x00..0xFF

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10.8.23 Message received - GRA_New

Activation of the evaluation with: mrwMULINF0 = 9 or 11.
Associated record label: caw060...

Storage layout:

Message: GRA_New				Identifier: 38AH				bit
CHKSM								0
free	F_BTL	ZU_BES	ZU_VER	T_BES	T_VER	T_AUS	S_MAIN 8	
Z_Count				COD_SND	T_WA	T_SET 16		
F_BTLT	free		ZU_LIM	T_DST	T_TUP	T_TDN 24		

The fields with a gray background are not supported.

Description:

CHKSM: checksum
Bit addr. 0, bit no. 8, initial value 0
Valid value range 0x00..0xFF

S_MAIN: GRA/ADR - main switch
Bit addr. 8, bit no. 1, initial value 0
0 switched off, 1 switched on
RCOS message: mrmGRA

T_AUS: GRA/ADR - Tip switch "Off"
Bit addr. 9, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

T_VER: GRA/ADR - "Decelerate" tip switch
Bit addr. 10, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

T_BES: GRA/ADR - "Accelerate" tip switch
Bit addr. 11, bit no. 1, initial value 0
0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

ZU_VER: delay GRA/ADR; will not be processed
Bit addr. 12, bit no. 1, initial value 0
0 Don't accelerate, 1 Accelerate
RCOS message: mrmGRA

ZU_BES: Accelerate GRA/ADR; will not be processed
Bit addr. 13, bit no. 1, initial value 0
0 Do not decelerate, 1 Delay
RCOS message: mrmGRA

F_BTL: GRA/ADR - control unit error
Bit addr. 14, bit no. 1, initial value 0
0 OK, 1 error control lever
RCOS message: mrmGRA

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T_SET: GRA/ADR - tip switch "set" bit addr. 16,
bit no. 1, initial value 0 0 tip switch not actuated, 1
tip switch actuated RCOS message: mrmGRA

T_WA: GRA/ADR - tip switch "resume" bit addr. 17, bit no. 1,
initial value 0 0 tip switch not actuated, 1 tip switch actuated
RCOS message: mrmGRA

COD_SND: Sender coding bit addr.
18, bit no. 2, initial value 0 00 on-board power
supply control unit 01 steering column module
10 motor SG 11 not used RCOS message:
mrmGRA

Z_Count: Message counter bit
addr. 20, bit no. 4, initial value 0 Valid value range 0x0..0xF

T_TDN: Tip Down; is not processed Bit Addr. 24,
Bit Num. 1, initial value 0 0 tip switch not actuated,
1 tip down

T_TUP: tip up; is not processed Bit Addr. 25,
Bit Num. 1, initial value 0 0 tip switch not
actuated, 1 tip up

T_DST: ADR - tip switch distance request; is not processed Bit Addr. 26, Bit
Num. 1, initial value 0 00 button not pressed 01 desired distance none 10
desired distance greater than 11 not assigned

ZU_LIM: limiter on; is not processed Bit Addr. 28, Bit
Num. 1, initial value 0 0 tip switch not actuated, 1 tip
up

F_BTLT: Tiptronic control unit error; is not processed Bit Addr. 31, Bit
Num. 1, initial value 0 0 tip switch not actuated, 1 tip up

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10.8.24 Message received - ADR 1

Activation of the evaluation with: cowVAR_ADR = 2 (evaluation ADR 1)
Associated record label: caw090...

Storage layout:

Embassy: ADR 1	Identifier: 52CH, repetition rate = 20 ms bit	
MD_ADR		0
V_SA | S_ADR | F_ADR	Z_Count	8th
OBJ_ERF	T_SET | DIFF_V F_MD 16	
V_WISH		24
free	ONTO | UP_U ANZ_T 32	
free	B_ADR PL_LS B_FAHR 40	
DISTANCE		48
CHKSM		56

The fields with a gray background are not processed (only for calculating the checksum).

description

MD_ADR: Torque request ADR
Bit addr. 0, bit no. 8, initial value 0
Value range 0-0xFE, error code. 0xFF
RCOS message: mrmACC_roh

Z_Count: Message counter
Bit addr. 8, bit no. 4, Valid Initial value 0
value range 0x01..0x0F

F_ADR: Defective ADR
Bit addr. 12, bit no. 1, 0 Initial value 0
ADR i. O.; 1 ADR defective

S_ADR: Status ADR
Bit addr. 13, bit no. 2.00 Initial value 0
ADR not active
01 ADR active
10 ADR passive
11 ADR in initialization mode

V_SA: Prevent overrun fuel cut-off
Bit addr. 15, bit no. 1, initial value 0
will not be processed

F_MD: Enable torque request
Bit addr. 16, bit no. 1, initial value 0
0 moment start not released; 1 moment start Approved

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DIFF_V: Difference between desired and actual speed
Bit addr. 17, bit no. 1, initial value 0
will not be processed

T_SET: Set time gap
Bit addr. 18, bit no. 4, will not be processed Initial value 0

OBJ_ERF: Object recorded
Bit addr. 22, bit no. 2, will not be processed Initial value 0

V_WUNSCH: Desired speed
Bit addr. 24, bit no. 8, initial value 0
will not be processed

ANZ_T: Time gap display
Bit addr.32, bit no. 1, will not be processed Initial value 0

UP_U: Request to take over
Bit addr. 33, bit no. 1, will not be processed Initial value 0

UP_S: Switch request
Bit addr. 34, bit no. 2, initial value 0
will not be processed

B_FAHR: Driver brakes
Bit addr. 40, bit no. 1, will not be processed Initial value 0

PL_LS: Release switch implausible
Bit addr. 41, bit no. 1, will not be processed Initial value 0

B_ADR: ADR braking
Bit addr. 42, bit no. 1, initial value 0
will not be processed

DISTANCE: distance
Bit addr. 48, bit no. 8, initial value 0
will not be processed

CHKSM: checksum
Bit addr. 56, bit no. 8, initial value 0
For definition, see CAN specifications V2.0

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8/10/25 Message received - listening channel

Storage layout:

Message: eavesdropping channel	Identifier: 200H - 21FH (dynamic), Refresh rate = asynchronous	bit
DESTINATION		0
OPCODE		8th
CHANNEL_ID		16

Description:

DESTINATION: Recipient of the message;
01H means engine control unit.

OPCODE: type of message;
C0H Request
D0H Reply (positive answer),
D8H Negative Reply.

CHANNEL_ID: channel identifier for data transmission;
Channel identifier offset to 700H (local broadcast channel).

10.8.26 Received message - transport channel1

Storage layout:

Message: Transport Channel1	Identifier: 7B4H, repetition rate = asynchronous bit	
TPCI1		0
TPCI2 / Data1		8th
T1 / Data 2		16
T2 / Data 3		24
T3 / Data 4		32
T4 / Data 5		40
data 6		48
data 7		56

Description:

see sent message MSG_Transportkanal1

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10.8.27 Received Message - Level1

Activation of the evaluation with: cowVAR_NIV = 2 (NIV intervention)

Associated record label: caw130...

Storage layout:

Message: Level1								**Identifier: 590H,** repetition rate = 48 ms bit								
CHKSM_NIV1																0
ES_MSG	ES_ESP	S_WRNL	free	free				B_COUNT_NIV1								8th
			NIV_PK	NIV_ZW	ST_NIV	16										
VER_HL	VER_HR	VER_VL	VER_VR	ABS_FZ	ANH_FZ	VER_AK	VER_IK	24								
S_FSPE	ST_SYS	FZA_RES	FZA_NIV	TEXT	32											
ZU_BEL																40

The fields with a gray background are not supported.

Description:

CHKSM_NIV1: checksum
Bit addr. 0, bit no. 8, initial value 0
For definition, see CAN specifications V2.0

B_COUNT_NIV1: message counter;
Bit addr. 8, bit no. 4, initial value 0 valid; Value range 0x00..0x0F
definition see CAN specifications V2.0

S_WRNL: warning lamp;
Bit addr. 13, bit no. 1, initial value 0
will not be processed

ES_ESP: ESP constraint;
Bit addr. 14, bit no. 1, initial value 0
will not be processed

ES_MSG: MSG constraint;
Bit addr. 15, bit no. 1, initial value 0,
RCOS message mrmHGB_Anf.0
High level speed limit request.

ST_NIV: level status;
Bit addr. 16, bit no. 1, initial value 0
will not be processed

NIV_ZW: intermediate level;
Bit addr. 20, bit no. 1, initial value 0
will not be processed

NIV_PK: parking level;
Bit addr. 21, bit no. 1, initial value 0
will not be processed

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VER_IK: Adjustment coming soon;
Bit addr. 24, bit no. 1, initial value 0 is not processed

VER_AK: Adjustment active; Bit addr. 25, bit no. 1, initial value 0 is not processed

ANH_FZ: increase vehicle; Bit addr. 26, bit no. 1, initial value 0 is not processed

ABS_FZ: vehicle lowering; Bit addr. 27, bit no. 1, initial value 0 is not processed

VER_VR: VR adjustment; Bit addr. 28, bit no. 1, initial value 0 is not processed

VER_VL: adjustment VL; Bit addr. 29, bit no. 1, initial value 0 is not processed

VER_HR: Adjustment HR; Bit addr. 30, bit no. 1, initial value 0 is not processed

VER_HL: Adjustment HL; Bit addr. 31, bit no. 1, initial value 0 is not processed

TEXT: text bits; Bit addr. 32, bit no. 1, initial value 0 is not processed

FZA_NIV: vehicle type level; Bit addr. 36, bit no. 1, initial value 0, RCOS message mrmHGB_Anf.1

FZA_RES: vehicle type reserve; Bit addr. 37, bit no. 1, initial value 0 is not processed

ST_SYS: system status; Bit addr. 38, bit no. 1, initial value 0 is not processed

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S_FSPE: error memory entry;
Bit addr. 39, bit no. 1, initial value 0
will not be processed

ZU_BEL: loading condition;
Bit addr. 40, bit no. 1, initial value 0
will not be processed

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8/10/28 **Received message - Allrad1**

Activation of the evaluation with: cowVAR_ALR = 2 (ALR intervention)

Associated record label: caw020...

Storage layout:

Message: Allrad1				**Identifier: 2C0H,** repetition rate = 8 ms bit				
EH_KUPS V	BEG S_WRNL	NOTL	O_KUP	F_KUPS	UET_SCH	F_KUP_A	0	
KUPS_M 8								
GANG_PNG				AB_PNG	AZ_PNG 16			
free						SCH_VW	SCH_AK 24	
KUPS_H								32

The fields with a gray background are not supported.

Description:

F_KUP_A: All-wheel clutch error
Bit addr. 0, bit no. 1, initial value 0
will not be processed

UET_SCH: over -temperature protection;
Bit addr. 1, bit no. 1, initial value 0
will not be processed

F_KUPS: error status clutch stiffness;
Bit addr. 2, bit no. 1, initial value 0
will not be processed

O_KUP: clutch completely open;
Bit addr. 3, bit no. 1, initial value 0
will not be processed

NOTL: emergency run;
Bit addr. 4, bit no. 1, initial value 0
will not be processed

S_WRNL: 4WD warning lamp;
Bit addr. 5, bit no. 1, initial value 0
will not be processed

V_BEG: speed limit
Bit addr. 6, bit no. 1, initial value 0
RCOS message: mrmHGB_Anf.4
Requirement of speed limit in case of reduction by PNG.

EH_KUPS: Coupling stiffness unit;
Bit addr. 7, bit no. 1, initial value 0
will not be processed

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KUPS_M: middle coupling stiffness (actual value); Bit addr. 8, bit no. 8, initial value 7FH is not processed

AZ_PNG: PNG display; Bit addr. 16, bit no. 3, initial value 0 is not processed

AB_PNG: PNG display flashing; Bit addr. 19, bit no. 1, initial value 0 is not processed

GANG_PNG: Gang info (PNG); Bit addr. 20, bit no. 4, initial value 0 is not processed

SCH_AK: circuit active; Bit addr. 24, bit no. 1, initial value 0 is not processed

SCH_VW: circuit pre-warning; Bit addr. 25, bit no. 1, initial value 0 is not processed

KUPS_H: rear clutch stiffness (actual value); Bit addr. 32, bit no. 1, initial value 0 is not processed

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10.9 CAN interpreters

The CAN interpreter has the task of converting the received CAN objects into RCOS messages and carrying out error handling for the received messages.

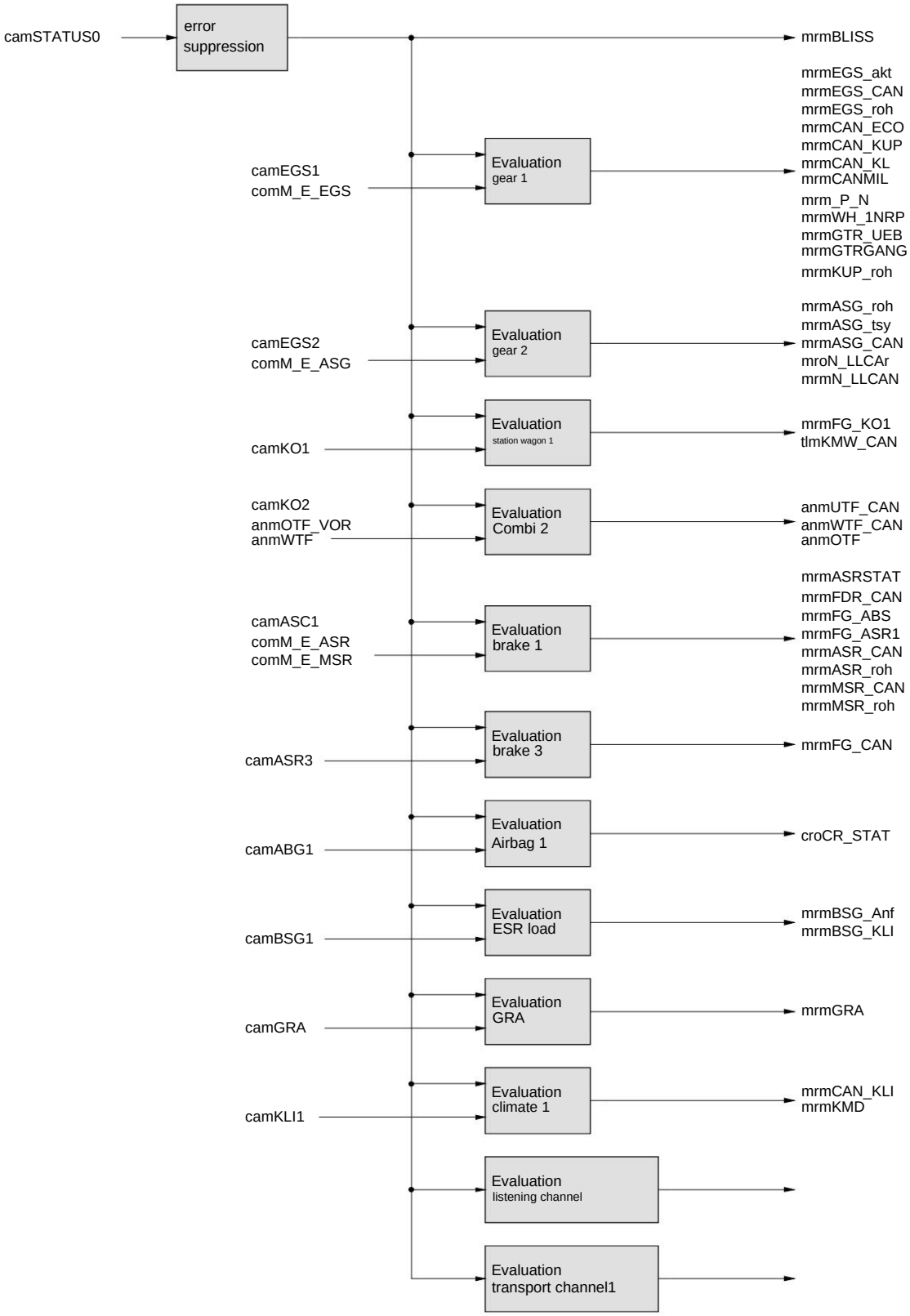


Figure CAN_04: CAN interpreter

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10.10 Standardization of messages

All quantities that are sent from the control unit to the CAN bus must first be in a Torque are converted to correspond to the standardization of the CAN bus.

The normalization moment (mrwMULINF3) is normalized to a 6-bit value via the CAN bus sent (in motor 2: MUX_INFO). The conversion takes place via the following relationship:

$$md_{Max\ddot{y}F}[\,] \quad \frac{mrwMULINF\,Nm[\,]}{10[\,]Nm}$$

All other moments that are received or sent via the CAN bus are on this one maximum moment related and can assume values in the range from 0 to 0xFE, the value 0xFF means that the conversion from quantity to torque is incorrect. The conversion takes place in both directions via the following relationship:

$$\frac{md_{is}[\,]}{255} = \frac{MD\,Nm[\,]}{mrwMULINF\,Nm[\,]}$$

The current speed dzoNmit is xcwUMRCS_N with the slope and the offset xcwUMRCO_N converted and limited to 0x7FFF. In the case of a defective DZG path fboSDZG the value 0xFFFF is transmitted.

The PWG message mrmPWGPBM is xcwUMRCS_P with the slope and the offset xcwUMRCO_P converted and limited to 0xFE. If PWG path is defective fboSPWG or fboSPGS the value 0xFFH is transmitted.

The water temperature anmWTF is xcwUMRCS_T with the slope and the offset xcwUMRCO_T converted and limited to 0xFE. If the water temperature sensor is defective (path fboSWTF) and anwWTFSCH ÿ 0, the value 0xFFH is transferred. Is the KTF replacement at defective WTF (anwWTFSCH = 0), then if the WTF is defective, the KTF is transmitted or 0xFF, if the KTF is also defective (path fboSKTF).

The current driving speed fgmFGAKT is xcwUMRCS_V with the slope and the Offset xcwUMRCO_V converted and limited to 0xFE. With a defective FGG path fboSFGG the value 0xFFH is transmitted.

The GRA target speed mrmFG_SOLL is xcwUMRCS_V with the slope and the Offset xcwUMRCO_V converted and limited to 0xFE. If the FGR control panel is defective path fboSFGA the value 0xFFH is transferred.

The target idle speed mrmN_LLBAS is xcwUMRCS_8 with the slope and the offset xcwUMRCO_8 converted and limited to 0xFE.

The outside temperature is anmUTF with the gradient xcwUMRCSLT and the offset xcwUMRCOLT converted and limited to 0xFE.

The atmospheric pressure anmADF is xcwUMRCS_D with the slope and the offset xcwUMRCO_D converted and limited to 0xFE. If the ADF path fboSADF is defective, the Transfer value 0xFFH.

The generator load khmGENLAST is xcwUMRCSLA with the slope and the offset xcwUMRCOLA converted and limited to 0x=FE. With a defective generator load path fboSKW2 the value 0xFFH is transmitted.

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10.10.1 Received Moments

The intervention moments mroMD_EGS, mroMD_ASR and mroMD_MSR are also sent as indexed moments from external control devices. These moments are evaluated in the sub-task "External quantity intervention".

10.10.2 Sent Moments

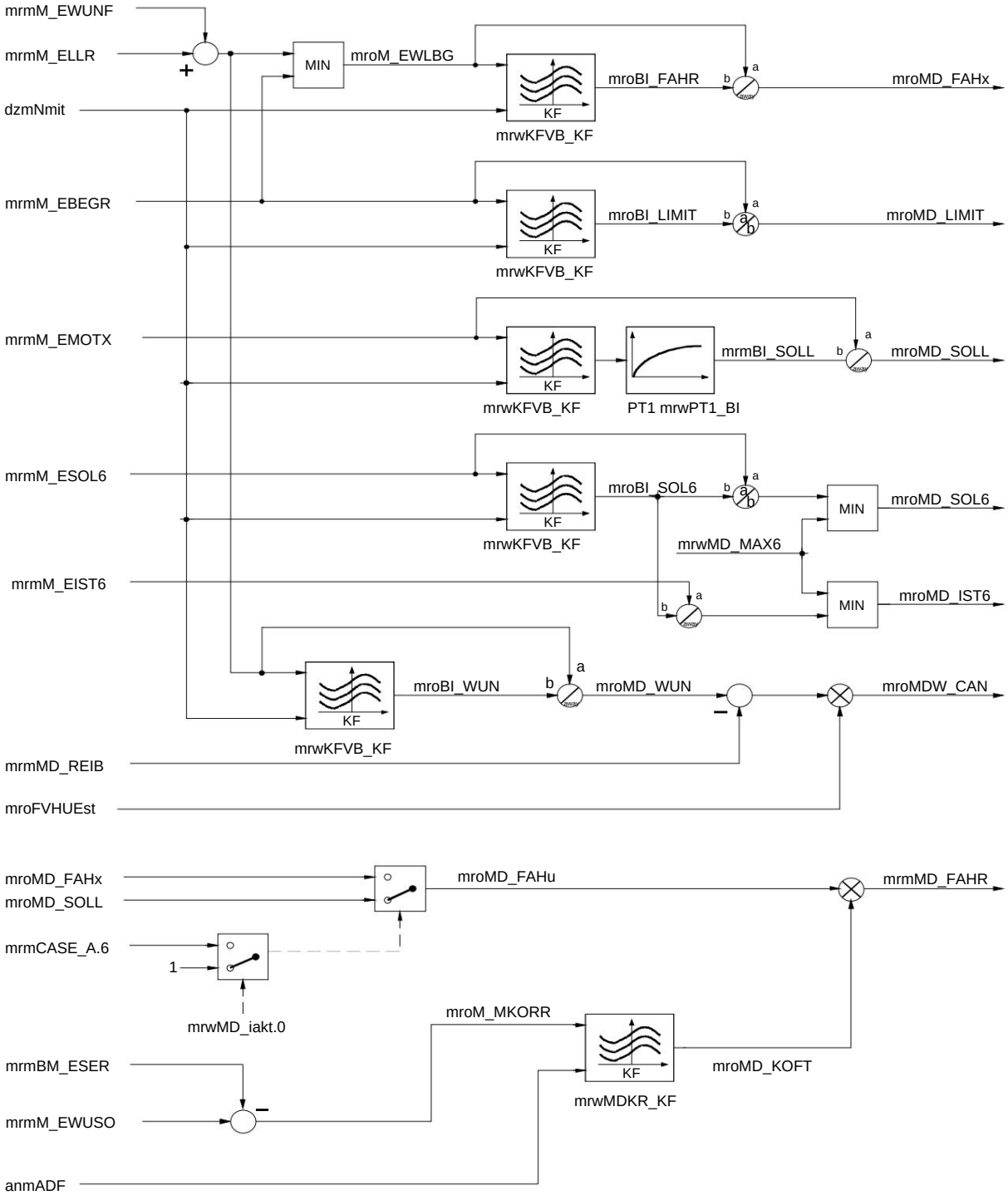


Figure CAN_01: Conversion of the transmitted moments

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MroMD_FAHx or mroMD_SOLL are corrected (reduced) via a factor map to mrmMD_FAHR quantities/ pressure in order to send a realistic moment when starting at higher altitudes (lower anmADF).

10.10.2.1 Calculation of the climate loss torque

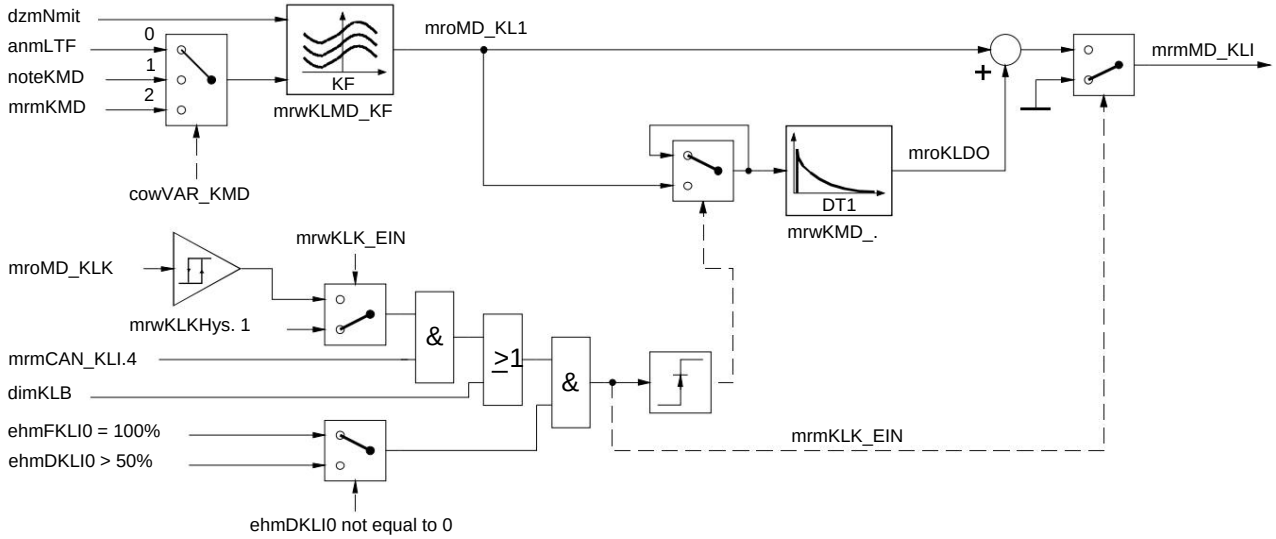


Figure CAN_11: Calculation of the climate loss torque

The climate loss torque mrmMD_KLI simulates the short-term engine load when switching on the air conditioning compressor and the load in continuous operation. The torque requirement of the air conditioning compressor is made up of the stationary torque and a dynamic component. In the map mrwKLMD_KF the stationary moment mroMD_KL1 is calculated. In order to cover the additional torque requirement when switching on, a dynamic component mroKLDO is also calculated.

With a positive edge of mrmKLK_EIN the dynamic branch is activated. The memory of the DT1 member is mrwKMD_. deleted, read the current value of mroMD_KL1 and led to the DT1 member. This creates a step response at the output mroKLDO, which covers the additional demand when the air conditioning is switched on.

The function is dimKLB = 1, or set bit compressor status mrmCAN_KLI.4 (CAN Clima1 message bit 1.4) and the output of the hysteresis mrwKLKHys. on upper hysteresis threshold mrwKLKHys2 (if this condition is applicable via SW switch mrwKLK_EIN = 1), and ehmFKLI0 = 100% or ehmDKLI0> 50% (if ehmDKLI0 is not equal to 0) active.

With the software switch cowVAR_KMD the input for the map mrwKLMD_KF is selected:

Decimal value	Message	Comment anmLTF Air
0	temperature [°C]	anmKMD Refrigerant
1	pressure via PWM [bar]	mrmKMD Refrigerant pressure
2	via CAN [bar]	

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10.10.2.2 Calculation of the transmitted friction torque

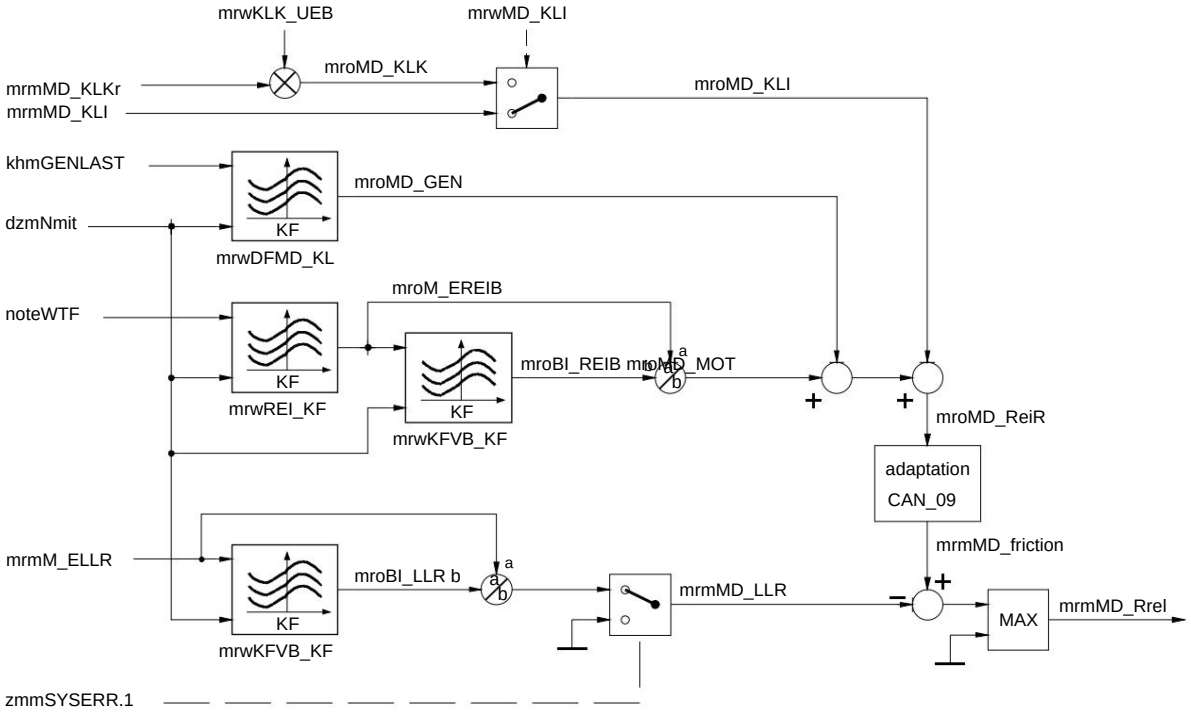


Figure CAN_07: Calculation of the transmitted friction torque

The moments mroMD_SOLL, mrmMD_FAHR and mroMD_BEGR are indicated - ie with a certain amount of fuel theoretically achievable moments (including the engine torque loss mroMD_REIB).

The indicated engine torque mroMD_SOLL is determined from the limited current amount mrmM_EMOTX, which is present before the influence of the smooth-running controller and is limited by the fuel cutoff. The effective torque delivered by the motor is calculated accordingly:

MD effective = mroMD_SOLL - mrmMD_REIB.

The indicated driver's desired torque mrmMD_FAHR is from the amount mroM_EWLBG, which results from the sum of the driver's desired amount mrmM_EWUNF (the maximum of the amount from the driving behavior map mrmM_EPWG and the FGR desired amount mrmM_EFGR) and the idle controller mrmM_ELLR with subsequent limitation by the limiting amount mroM_EBEGR, determined.

If there is no external quantity intervention (mrmCASE_A.6 = 0), mrmMD_FAHR is applied with the internal engine torque mroMD_SOLL. This function can be switched off via the label mrwMD_iakt.0 = 0. Furthermore, it is multiplied by a correction factor from the map mrwMDKR_KF that has as input parameters speed and lambda value (formed via air mass and injection quantity).

The indexed limiting torque mroMD_BEGR is determined from the limiting quantity mroM_EBEGR and corresponds to the operating point-dependent maximum torque from the quantity limiting path.

The engine friction losses (mroMD_MOT) are determined from the friction quantity map mrwREI_KF on water temperature anmWTF and speed dzmNmit.

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The engine torque loss through the generator load mroMD_GEN (determined in map mrwDFMD_KF) is non-linearly dependent on the speed and directly proportional to the generator load khmGENLAST (0 to 100%, is read as a PWM signal). About the SW switch mrwMD_KLI

either the calculated in the MSG climate loss torque mrmMD_KLI or received via CAN compressor load mrmMD_KLKr (Clima1 message, byte 4) multiplied by the translation ratio mrwKLK_UEB used as climate loss torque (mrwMD_KLI = 0: mrmMD_KLI, = 1: mroMD_KLK).

The sum of the engine torque loss, the air-conditioning torque loss and the generator load torque loss results in the total torque loss mroMD_REIR. The adapted torque loss mrmMD_REIB is sent via CAN.

For the driving speed-dependent driving characteristics map, a friction torque mrmMD_Rrel reduced by the idle controller component is also calculated. This is determined from the friction torque mrmMD_Reib - idle controller torque mrmMD_LLR (= f (mroBI_LLR, mrmM_ELLR). In addition, mrmMD_Rrel is limited down to 0. If the speed signal cannot be evaluated (zmmSYSERR.1=1; see monitoring concept-"summarized system errors"), is mrmMD_LLR set to zero.

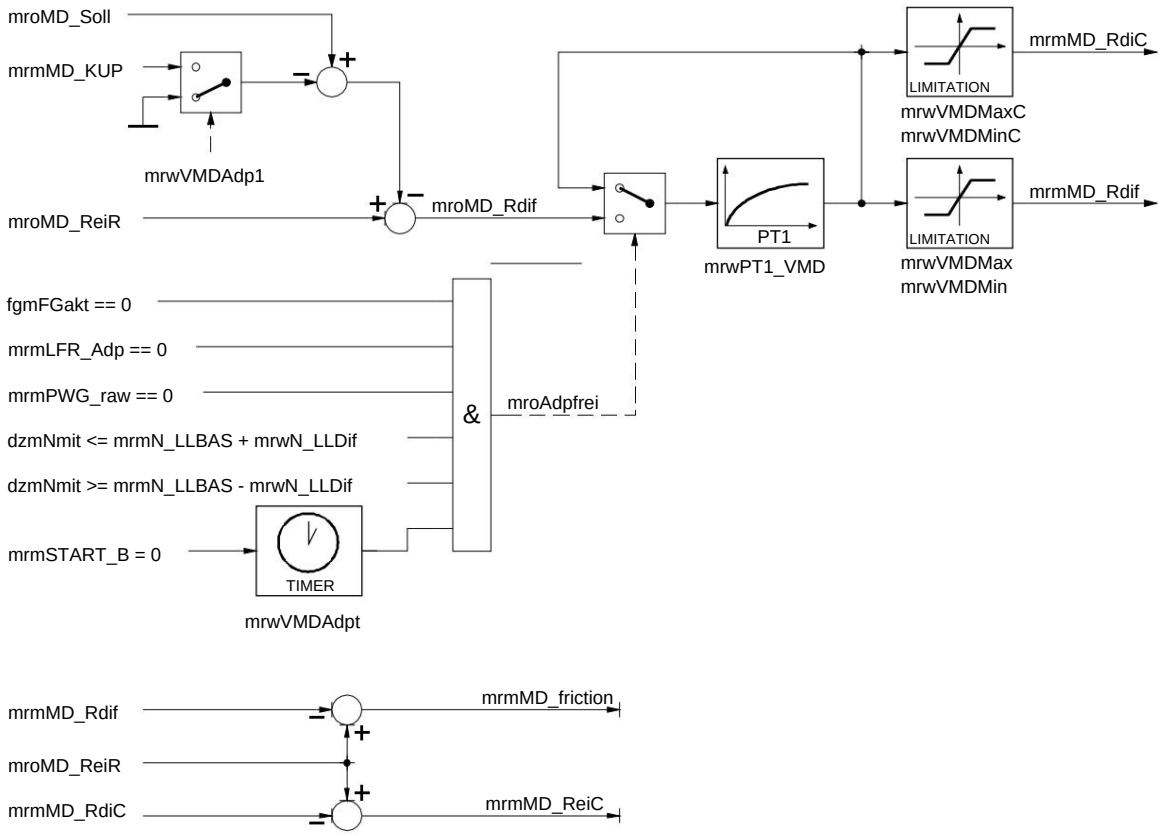


Figure CAN_09: Adaptation of the torque loss

When idling, the indicated engine torque mroMD_Soll is equal to the actual friction torque. Therefore, the raw value mroMD_ReiR (from the fuel consumption KF) is adapted with a differential torque mrmMD_Rdif in the LL.

Differential torque = friction torque raw value - (indicated engine torque - converter torque loss (from gear 1 - message))

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mroMD_Rdif = mrmMD_ReiR - (mrmMD_Soll - mrmMD_KUP)

The differential torque mroMD_Rdif is filtered (mrwPT1_VMD) and limited (mrwVMDMin, mrwVMDMax). The output is switched off for transmission on the CAN (motor 1 – message). the PT1 member with the limits mrwVMDMinC, mrwVMDMaxC limited.

The raw value mroMD_ReiR is increased by the adapted differential torque mrmMD_Rdif or mrmMD_RdiC corrected and sent as a friction torque mrmMD_Reib or mrmMD_ReiC.

The adaptation is carried out if :

Driving speed fgmFGAKT = 0 AND
PWG position mrmPWG_roh = 0 AND
dzmNmit <= mrmN_LLBAS + mrwN_LLDif AND
dzmNmit >= mrmN_LLNAS - mrwN_LLDif AND
mrmSTART_B = 0 (debounced with mrwVMDAdpt) AND
Adaptation lock bit from the transmission mrmLFR_Adp = 0

When transitioning to driving, the output values are mrmMD_Rdif and mrmMD_RdiC frozen.

In the aftermath, the friction torques mrmMD_Reib and mrmMD_ReiC are set to 0.

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10.11 Transport Protocol

10.11.1 overview

A transport protocol is implemented for data exchange with other control units. This is used for the dynamic assignment of bidirectional transport channels between control units. It is a modification of the transport protocol of OSEK communication (OSEK = Open Systems and their interfaces for the electronics in the motor vehicle).

Each control unit has a fixed request or response channel for dynamic agreement assigned, which must be heard by all. A CAN node shares in this request message its outbound channel, which it has selected from a list of identifiers. gets as an answer he delivered a return channel from the addressed control unit.

According to the transport protocol, each control unit is assigned 4 transmission channels. For the MSG these are:

1st channel	Identifier 7A1H
2nd channel	identifier 781H
3rd channel	Identifier 761H
4th channel	Identifier 741H.

At the moment only the first channel can be used by the MSG.

10.11.2 protocol handler

The protocol handler is used for communication between an application of the MSG and to be handled by a second control unit. To do this, it builds a channel at the request of the application up, transmits the transferred data, receives the data from the second control unit and delivers them back to the application. At the end of the transfer, the handler closes the channel. The current Status of a transport channel is visible in the OLDA caoOSK.Sta.

Value range of the OLDA caoOSK.Sta (decimal coded):

– 0	=	channel free
– 1	=	Initialize reception
– 2	=	receive data
– 3	=	Data direction change from receiving to sending, fast response required
– 4	=	Data direction change from receiving to sending, Acknowledge required
– 5	=	Initialize sending
– 6	=	Send
– 7	=	Data direction change from sending to receiving
– 8	=	Initialize Channel Setup
– 9	=	Perform channel setup
– 10	=	Initialize Connection Setup
– 11	=	Perform connection setup
– 12	=	Initialize Channel Acknowledge
– 13	=	Perform Channel Acknowledgment
– 14	=	Initialize Connection Acknowledge
– 15	=	Perform Connection Acknowledgment
– 16	=	Initialize Disconnect
– 17	=	Perform disconnect

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The protocol handler communicates with the application via a 4-byte long IOMessage that has the following structure:

high word		Low Word	
high byte	low bytes	high byte	low bytes
buffer address		error code	status bits

Value range of the status bits (bit-coded):

	bit set	bit cleared
- 0x01 = -	Activity Monitor	disconnect
0x02 = - 0x04	Send request of the application	remote request
= - 0x08 = -	Quick answer required	Slow data direction change
0x10 = - 0x20	Initiate connection setup	Connection established
= - 0x40 = -	Received data ready	Sending or receiving active
0x80 =	Error occurred	
	Clear connection with disconnect	Clear connection with timeout
	broadcast mode	receive mode

If an error occurs, the type of error is displayed in the error code. Value range:

- 0x01 = -	No channel free
0x02 = - 0x04	Negative response from the other controller
= - 0x11 = -	Data length exceeds buffer length
0x12 = - 0x13	Channel setup timed out
= - 0x14 = -	Connection setup timed out
0x15 = - 0x16	Timeout sending data
= - 0x17 =	Timeout when changing data direction
	Remote channel setup timed out
	Remote connection setup timed out
	Timeout while receiving data

The IOMessage for the communication of the MSG with the immobilizer control unit is camXCO2IMM. The high word is the low word on the OLDA caoIMM2XCH caoIMM2XCL visible. For communication Immobilizer with MSG camIMM2XCO used. The OLDAs are caoXCO2IMH and caoXCO2IML.

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11 caster

11.1 Overview

When the ignition is off, run-on is started, which performs the following functions:

Shutdown via *nlmZUMEAUS* (AUS pin, Y select on cylinder 8), SHS pin test, AUS pin test,
Voltage stabilizer test, monitoring module test, immobilizer lock via EEPROM,
Fan run-on, thermostat run-on, EEPROM storage of the MAR data block and the
filtered NW-KW twist angle *dzmNWfi,* turn off error storage and main relay.

The following state diagram shows the sequence of these functions. The functions OFF pin test, voltage stabilizer test, monitoring module test and fan run-on are included in the
described in the corresponding subchapters and are only shown here as a status.

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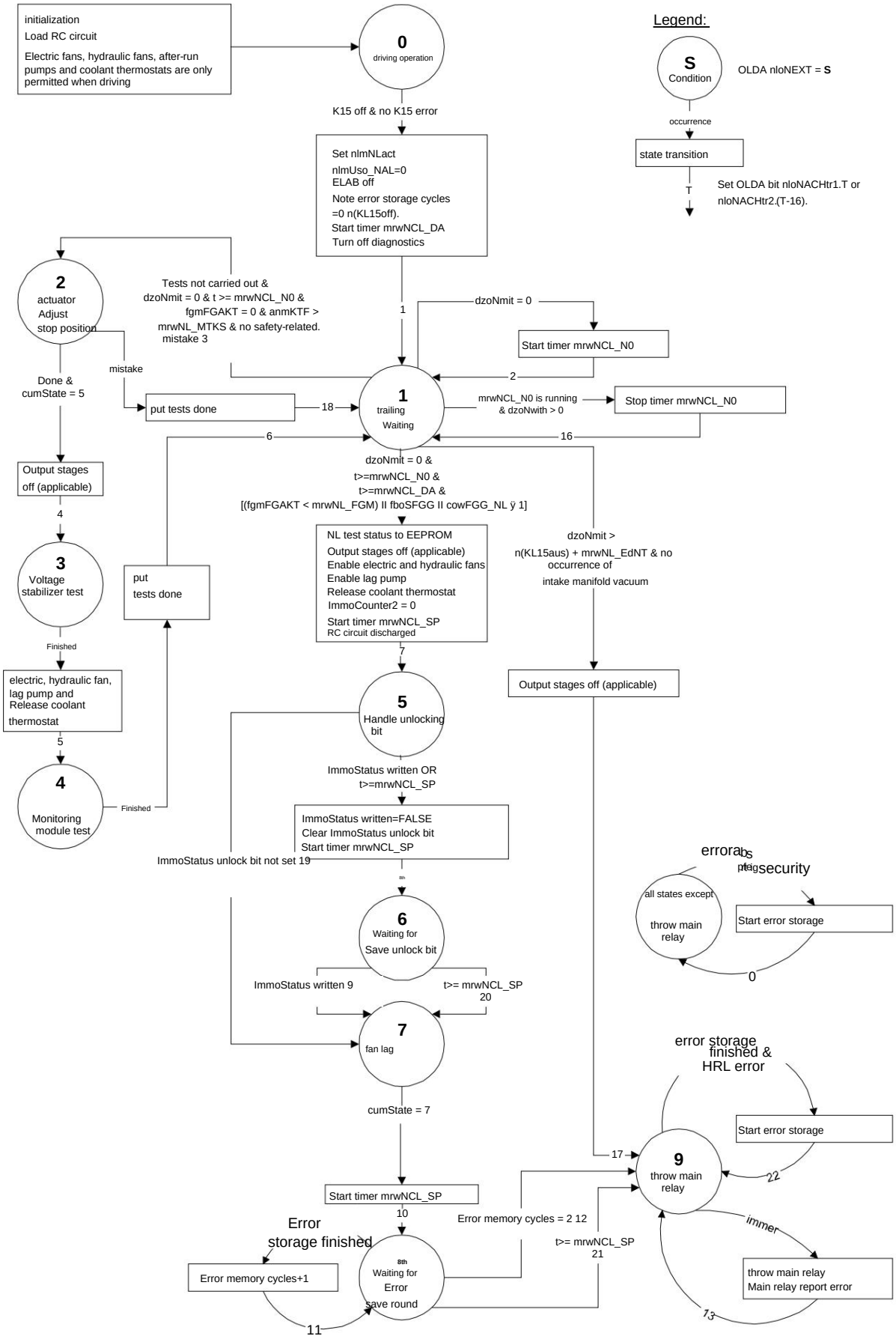


Figure SONSNL01: Overrun

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0 Driving mode: As long as the ignition is switched on, *nlmZUMEAUS* remains unset . The solenoid valves can be controlled. The RC element is constantly loaded. Only when the ignition is off, ie *dimK15* = 0, the after-run is started, provided no error *fbbEK15_P* in terminal 15 - evaluation circuit was found. In the run-on, the engine is switched off via *nlmZUMEAUS* and the diagnostic function is aborted via the K line. With nlmNLact = 1, other functions are informed that overrun is now active (state transition 1). Monitoring in the after-run can also be prevented via the application for each error (see chapter Error handling).

1 follow-up waiting: As soon as the speed = 0, the minimum waiting *time mrwNCL_N0* is started for shutoff (state transition 2). If the speed increases again before reaching the minimum waiting *time mrwNCL_N0 ,* the waiting time must be reset (state transition 16). Once the waiting time *mrwNCL_N0 has* expired, the vehicle is stationary, the fuel temperature is greater than *mrwNL_MTKS* and there are no safety-related errors, SHS pin test, OFF pin test, voltage stabilizer test and monitoring module test can be carried out. In these tests, the ASIC's access to the solenoid valve output stage is tested. None of the following safety-related errors may be present: *fboSFGG, fboSUBT, fboSDZG, fbbERUC_R, fbbERUC_S, fbbERUC_U, fbbERUC_K* and *fboSKTF* (state transition 3). After at least the time *mrwNCL_DA has* passed, the speed = 0 and the time *mrwNCL_N0 has* elapsed, except for the cooling fan, all power stages (applicatively via *ehwEST_...) are* switched off. In the EEPROM, the immobilizer counter 2 is set to 0 and the RC element begins to discharge. If no run-down tests have taken place, the fan motor is only released now (state transition 8).

2 Test of the function of the SHS pin: If the MV output stage is successfully controlled by the ASIC, an edge change must be recognizable at the SHS pin. If the correct function of the SHS pin cannot be proven, the error *fbbENLF_S* is reported defective (without debouncing) and the follow-up test is immediately canceled (state transition 18). If the function is correct, a branch is made to the "push-through OFF pin test" (state transition 4).

3 Punch-through OFF pin test: After the test has been completed, there is a wait until the fan is no longer activated (cumulative state = 5=) (possibly still activation from driving operation). Then the output stages are switched off (applicative via *ehwEST_).* This is necessary because during the voltage stabilizer test that follows, all output stages are switched off twice in rapid succession (state transition 5).

4 Voltage stabilizer test: When the test is complete, the monitoring module test is carried out. The fan control with the fan run-on is now enabled. (state transition 6). **5 Monitoring**

module test: If the test is finished, is waited in the post-run state until the times *mrwNCL_DA* and *mrwNCL_N0 have* elapsed. (state transition 7).

6 Handle the unlocking bit: If the immobilizer is still locked according to the EEPROM, the fan run-on is carried out immediately. (state transition 19). If the immobilizer is unlocked according to the EEPROM, you must check whether the immobilizer status is already stored in the EEPROM. At best , it must be waited for with timeout *mrwNCL_SP .* Only then can the unlocking bit in the immobilizer status be deleted. (state transition 9).

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7 Save wait for unlocking bit: Again you have to wait until the immobilizer status and thus the unlocking bit is saved in the EEPROM. (state transition 10). The timeout for saving is again *mrwNCL_SP.* (state transition 20).

8 Fan run-on: The end of the fan run-on or thermostat run-on is recognized with kumState = 7. (state transition 11).

9 Waiting for EEPROM storage: To save the MAR data and the filtered NW KW twist angle *dzmNWfi ,* there is a wait until either the status ('MAR data block saved' (edmEEMAREn = ONES) AND 'filtered NW-KW twist angle saved' (edmEENWEn = ONES)) OR the maximum time for EEPROM storage *mrwNL_EE* is exceeded. (state transition 12).

10 Waiting for error storage round: After error storage is constantly restarted in statuses 0 to 8 (status transition 0), a new error must be tested again to see whether all errors have been stored. (state transition 13). Only when this is done can the main relay be switched off. (state transition 14). The timeout for error storage is again *mrwNCL_SP.* (state transition 21).

11 Throw main relay: The error debounce time begins to run immediately when the main relay is switched off. (state transition 15). If the control unit remains switched on, the error is debounced and defective. Error storage must now be allowed again. (state transition 22).

Control of the throttle valve in the run-on:

The throttle valve is closed in the run-on (nlmNLact = 1) to prevent switch-off impact. However, it is only closed under the following conditions:

(dzmNmit < nlwDKABn) AND (ldmP_Llin < nlwDKABp) AND (mrmM_EMOT < nlwDKABME)

If these conditions are met, nlmDK_ZU=1 causes the ARF function to close the throttle valve.

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11.2 Punch-through test of OUT pin

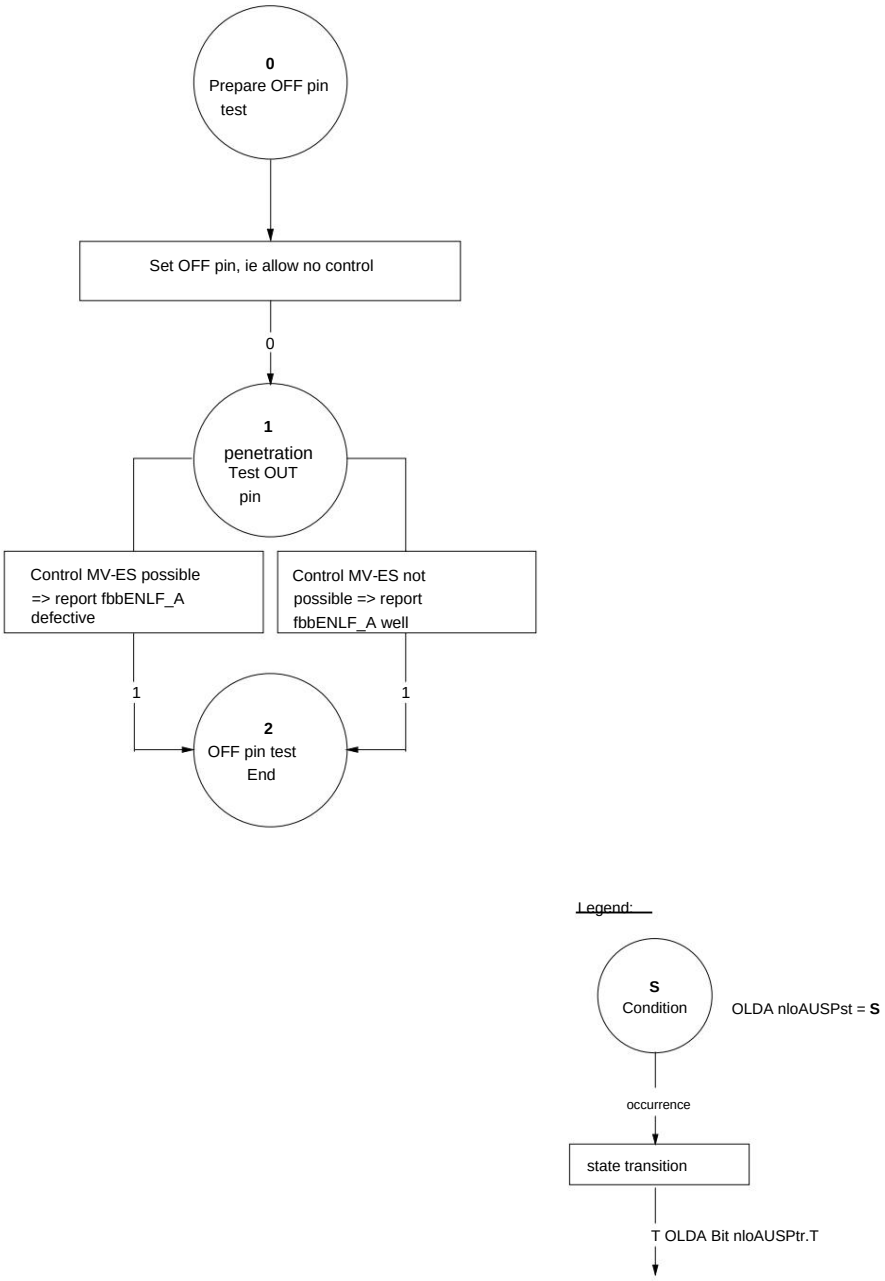


Figure SONSNL02: OFF pin test

The OUT pin test checks the pass-through of the OUT pin to the MV output stage.

0 Prepare the OUT pin test: First, the OUT pin is set by the µC. If the function is correct, the ASIC now has no access to the MV output stage.

1 Test punch-through OUT pin: An attempt is now made to control the MV output stage via the ASIC. If the software detects an edge change at the SHS pin, the error *fbbENLF_A* is reported defective.

2 OUT pin test end: After the OUT pin test has been completed, the stability test can be carried out.

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11.3 Voltage Stabilizer Test

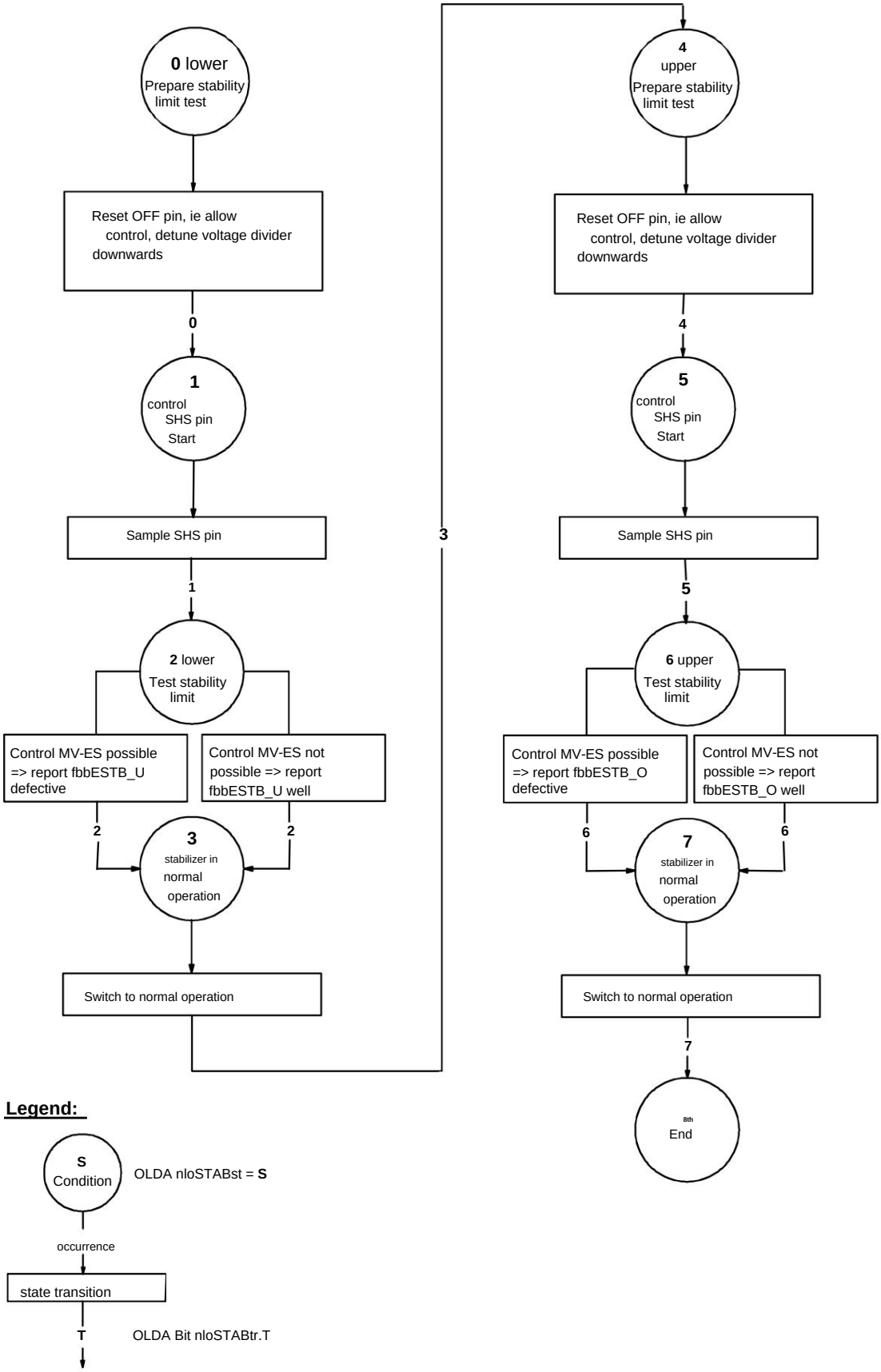


Figure SONSNL03: Voltage stabilizer test

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The voltage stabilizer test checks the stabilizer monitoring circuit in the CY08.
In doing so, the reference voltages are shifted in the positive and negative direction (“down” and “up”), which must cause the MV output stages to be switched off by the hardware.

0 Prepare lower stability limit test: After resetting the OFF pin, the CY08 is put into test mode and the voltage divider, which monitors the supply voltage, is detuned downwards. As soon as the voltage divider output and a reference voltage do not match, the CY08 switches off the MV output stages and all other output stages.

(state transition 0).

1 Start control of the SHS pin: The SHS pin is scanned during control. If an edge change was detected at the SHS pin, the ASIC control has access to the MV output stage, otherwise not.

2 Testing the lower stability limit: If an edge change occurs at the SHS pin when the MV output stage is controlled by the ASIC, the error *fbbESTB_U .defekt* is reported (state transition 1).

3 Stabilizer in normal operation: The CY08 is switched to normal operation (state transition 2).

4 Prepare upper stability limit test: The CY08 is put into test mode and the voltage divider, which monitors the supply voltage, is detuned upwards. As soon as the voltage divider output and a reference voltage do not match, the CY08 switches off the MV output stages and all other output stages. (state transition 3).

5 Start activation of the SHS pin: The SHS pin is scanned during activation. If an edge change was detected at the SHS pin, the ASIC control has access to the MV output stage, otherwise not.

6 test the upper stability limit: If there is an edge change at the SHS pin when the MV output stage is controlled by the ASIC, the error *fbbESTB_O .defekt* is reported (state transition 4).

7 Stabilizer in normal operation: The CY08 is switched to normal operation (state transition 5).

8 End: The stability test is complete.

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11.4 Monitoring module test (gate array test)

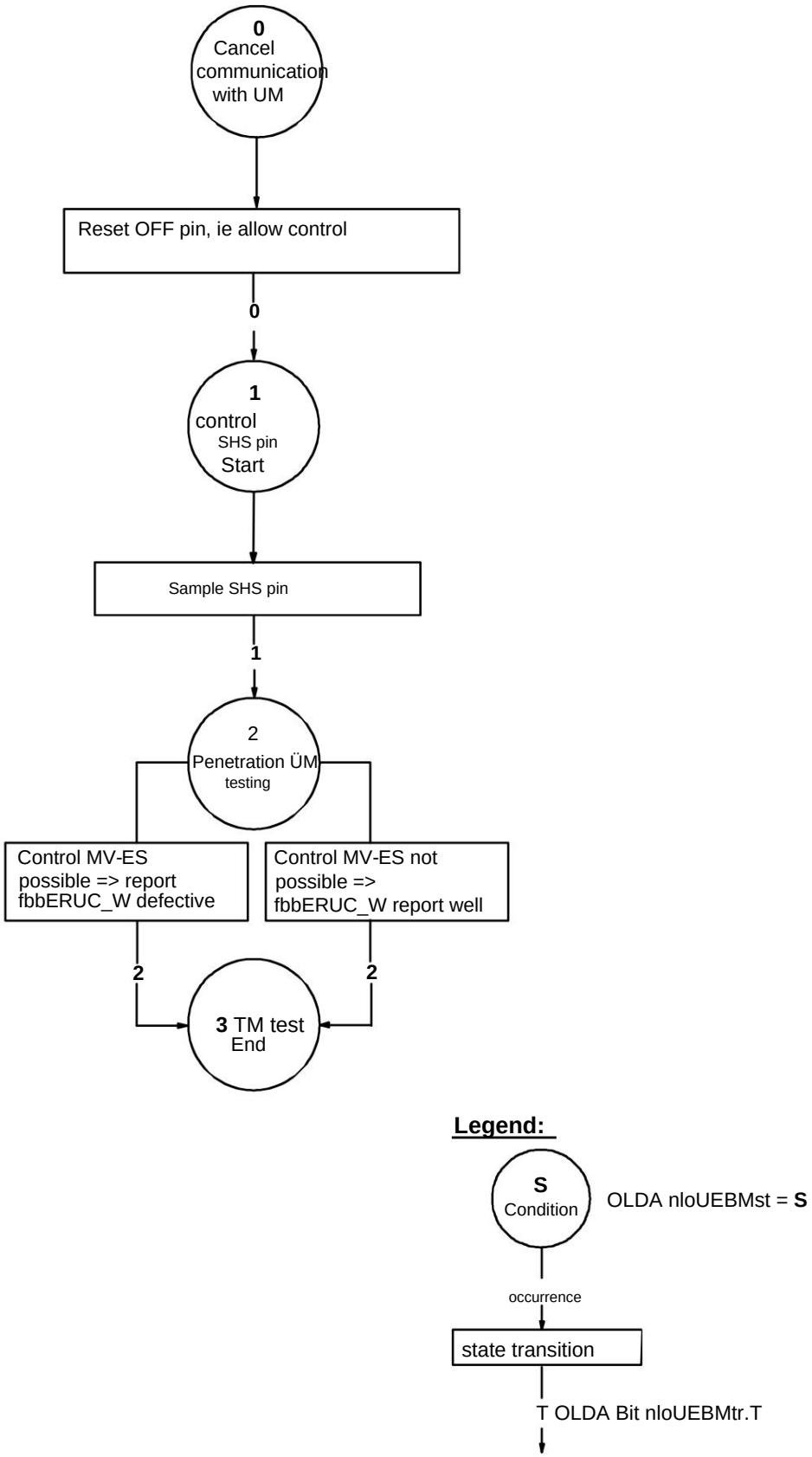


Figure SONSNL04: Monitoring module test

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During the monitoring module test, the monitoring circuit (monitoring module) of the ASIC is checked. The communication with the ASIC is stopped, which must cause the MV output stage to be switched off by the ASIC.

0 Interrupt communication with ÜM: Communication with the ASIC is terminated via the message nlmM_E_AUS (status transition 0).

1 Start control of the SHS pin: The SHS pin is scanned during control. If an edge change was detected at the SHS pin, the ASIC control has access to the MV output stage, otherwise not.

2 Test ÜM penetration: If an edge change occurs at the SHS pin when the ASIC attempts to control the MV output stage, the error *fbbERUC_W* defective is reported.
The OFF pin is then set, ie no further activation of the MV output stages and communication with the ASIC is permitted again.
(state transition 1).

3 End: The monitoring module test has ended.

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12 pump control

12.1 Overview

The functions of fuel temperature correction, solenoid valve control, delivery duration calculation and BIP recording are system-dependent. The following description applies to unit injectors.

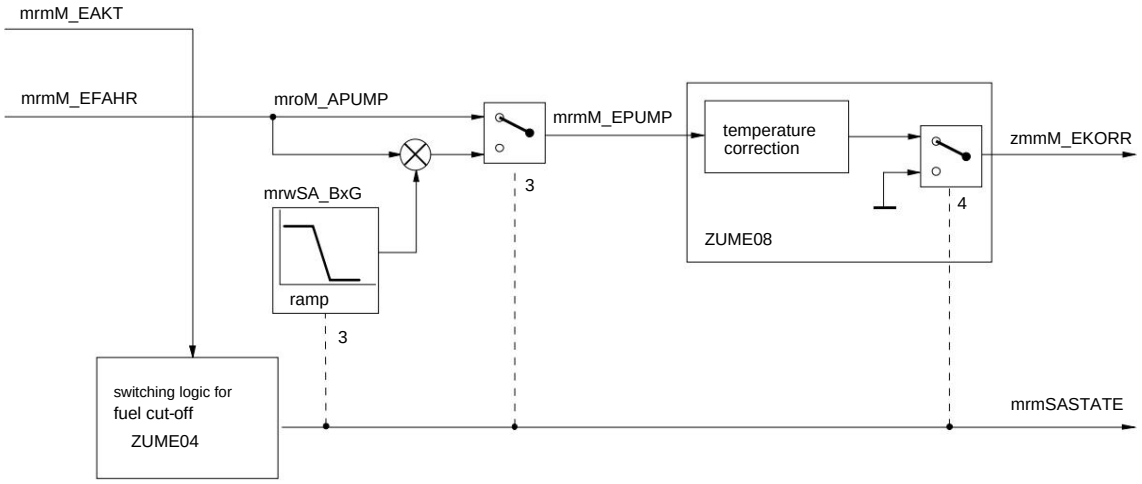


Figure ZUME07: Overview

After the addition of the speed-synchronous partial results of the LLR, ARD and LRR, after the fuel quantity correction, the desired quantity is converted into delivery times. Since the LRR quantity specifications <0 can occur, they must be limited to 0 at mroM_APUMP.

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12.2 Fuel temperature correction

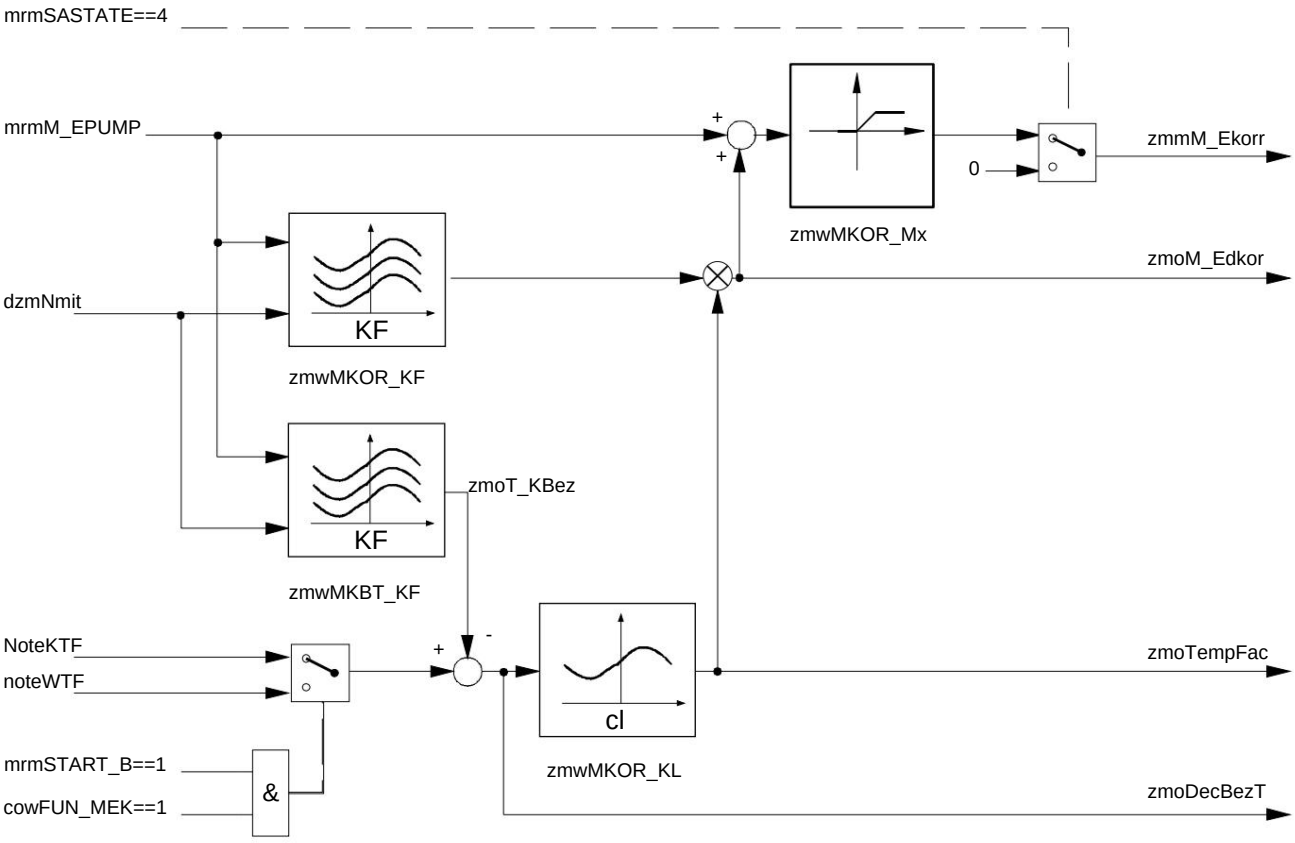


Figure ZUME08: Fuel temperature correction

The funding duration map is recorded at certain reference temperatures, which depend on the sizes *dzmNmit* and *mrmM_EPUMP* and are stored in the map *zmwMKBT_KF .*
The delivery time results from the delivery time map as a function of the speed *dzmNmit* and the mass to be injected. In order to be able to deliver the correct amount even if the fuel *temperature anmKTF* deviates from the reference temperature, the mass included in the delivery duration map must be temperature-corrected. For this purpose, a correction value is determined from the correction *map zmwMKOR_KF* depending on the current injection *mass mrmM_EPUMP* and the speed *dzmNmit* (in addition to the influence of temperature, the correction value also includes the leakage losses of the injection pump). This correction value corresponds to a mass change per 100K and is converted to the correction *mass zmoM_Edkor* according to the following formula :

zmoM_Edkor = correction value * *zmoTempFak.*

The additional correction factor *zmoTempFak* follows from the characteristic *zmwMKOR_KL,* with the help of which non-linear dependencies on the fuel temperature can be taken into account.
Input variable of this characteristic is the deviation of the fuel temperature from a reference temperature, ie *zmoAbwBezT = anmKTF - zmoT_KBez.* The fuel reference temperature is calculated using the map *zmwMKBT_KF* from the average speed *dzmNmit* and the injection *quantity mrmM_EPUMP.*

If the state *mrmSASTATE* = 4 is active (overrun cut-off), *zmmM_Ekorr* is set to zero, and there is no activation of the solenoid valves (see chapter Delivery duration calculation). Otherwise, the temperature-corrected mass *zmmM_Ekorr* is used as an input variable in the pump duration map.

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She arises from

zmmM_Ekorr = mrmM_EPUMP + zmoM_Edkor

and is limited to the *zmwMKOR_Mx* value .

During the startup process (mrmSTART_B = 1) for temperature-dependent amount correction instead of the fuel temperature anmKTF, the water temperature anmWTF can also be used. The selection is made with the function switch cowFUN_MEK.
Description of the software switch cowFUN_MEK:

decimal value	comment
0	Fuel temperature anmKTF
1	Water temperature anmWTF

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12.3 Correction for twisted camshaft

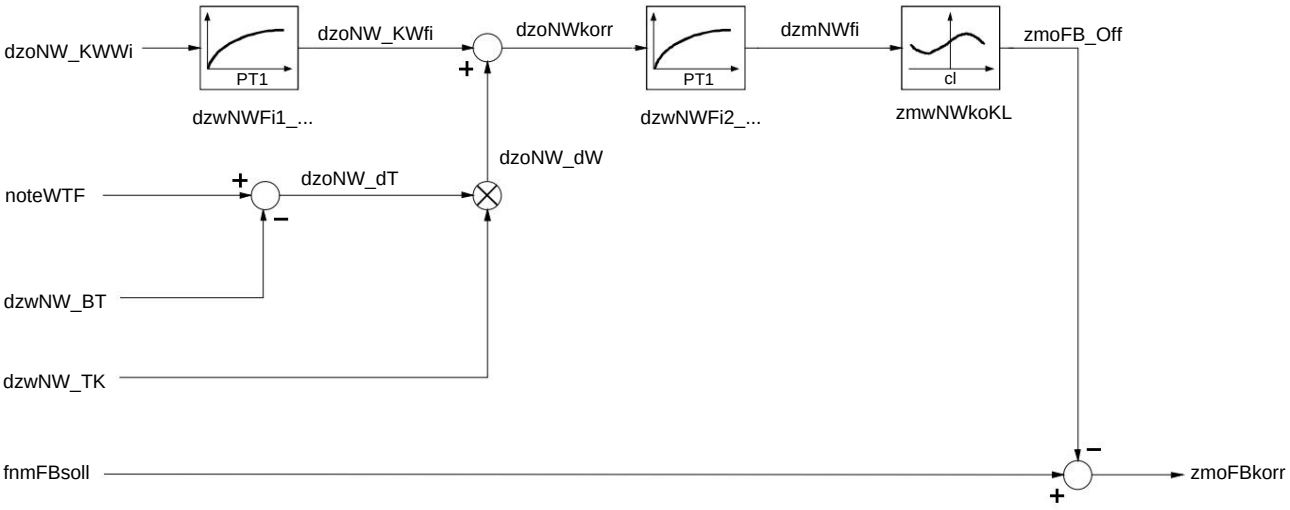


Figure ZUME_03: Correction for twisted camshaft

Twisting the camshaft changes the delivery behavior of the PDE. In order to compensate for this, the start of delivery input value is adapted to the twist in the selection characteristic of the pump characteristic diagrams. As a result, the assignment of the cam angle to the actuation angle of the solenoid valve used when creating the pump characteristic maps is retained and the position of the start of delivery with respect to engine TDC remains unchanged.

The raw value of the NW-KW twist angle *dzoNW_KWWi* is filtered using a speed-synchronous PT1 element with the memory *factor coefficients dzwNWFi1 _*... To compensate for the thermal expansion of the engine block, a correction *angle dzoNW_dW* is calculated from the deviation *dzoNW_dT* of the cooling water temperature *anmWTF* from a reference temperature *dzwNW_BT .*
The temperature-corrected torsion angle *dzoNWkorr* is output on the VAG tester.

The torsion angle is heavily dependent on load and speed. Since these influences are already taken into account in the pump characteristics, the correction must be related to a specific operating point. Idling with a warm engine is ideal for this. The temperature-corrected torsion angle is therefore only in the near-idling range, ie when applies

• *dzwWTmin* < *anmWTF* AND

• *dzwM_Emin* < *mrmM_EMOT* < *dzwM_Emax* AND

• *dzwNmin* < *dzmNmit* < *dzwNmax*

and learned via a slow speed-synchronous PT1 filter with the memory *factor coefficients dzwNWFi2_...* This learned *value dzmNWfi* is subsequently stored in the EEPROM and read from it during initialization. If the above conditions are not met, *dzoNW_KWfi, dzoNW_dT, dzoNW_dW* and *dzoNWkorr are* not calculated.

The evaluation *characteristic zmwNWkoKL* is used to determine the offset *zmoFB_Off* on the start of funding *fnmFBsoll .* Here you can enter at which torsion angles a correction is to be made and by what amount. The corrected start of delivery *zmoFBkorr* serves as an input value in the selection characteristic for the pump characteristics.

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12.4 Funding Duration Calculation

Based on the corrected start of delivery setpoint, the KW angle range within which the MV is completely closed is determined by the delivery duration setpoint angle *zmmFDsoll .*

The delivery duration setpoint angle results depending on the corrected delivery start setpoint *zmoFBkorr,* the temperature -corrected quantity setpoint *zmmM_Ekorr* and the average speed *dzoNmit* from a four-dimensional characteristic space that is defined by the characteristic *zmwP_KL_P* (input *zmoFBkorr)* and the delivery duration *characteristics zmwP_KF_P[k],* k=0. ..5, (inputs *zmmM_Ekorr* and *dzoNmit)* is simulated.

Depending on the corrected start-of-delivery target value, the characteristic curve determines which two delivery duration characteristics are used to interpolate the delivery duration target angle.
Within the two selected funding duration characteristics, the funding durations result from a first interpolation as a function of *zmmM_Ekorr* and *dzoNmit.*

The correct application of the values of the *zmwP_KL_P* characteristic should be illustrated in the following example:

zmoFBkorr [°CA before TDC]	**-36**	**-24**	**-15**	**-9**	**-4**
characteristics - Values	0 (ÿ map 0)	1 (ÿ map 1)	2 (ÿ map 2)	3 (ÿ map 3)	4 (ÿ map 4)

zmoFBkorr [°CA before TDC]	**+1**
characteristics - Values	5 (ÿ map 5)

In the above example, the output values of the delivery duration *characteristics zmwP_KF_P2* and *zmwP_KF_P3* are used for the interpolation with a specified corrected start of delivery target value of *zmoFBkorr* =-12 °KW and are weighted equally. About the OLDA *zmoP_KF_Nr* the output from the characteristic *zmwP_KL_P* is displayed.

When *zmmFDsoll* = 0, the current is interrupted just when the MV hits the seat. To represent very small quantities, negative delivery durations must therefore be applied in the delivery duration characteristic diagrams so that the MV energization is already interrupted before the MV is completely closed. The MV then flies purely ballistic and may no longer hit the seat.

With zero quantity request, ie *zmmM_Ekorr* = 0, the solenoid valves are not activated.

In the remote control mode, the delivery duration target value is specified directly via *xcmFSTFDHE* (see chapter "Remote control via diagnostic interface").

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12.5 Solenoid valve control

12.5.1 Metering with the crankshaft - IWZ

The implementation of the start and duration of delivery in signals for controlling the solenoid valves is based on the incremental - angle - time - system (IWZ).

The increment signal is processed outside of the controller in an ASIC. The controller has the option of being woken up at desired increments on the KW by an interrupt generated by the ASIC (so-called wake-ups (WUP)). These WUP's have a system specific location. There are 5 different types of WUPs. Two fixed WUPs within a cylinder segment emulate the KW speed sensor signal analogous to MSA15. You will see the labels

ÿ *dzwK_WP1st* - INK for the 1st static Wup

and

ÿ *dzwK_WP2st* - INK for the 2nd static Wup

fixed. At these points, speed-synchronous calculations, such as the speed and quantity calculation, are carried out.

In addition to the static WUPs, a dynamic WUP is generated to control the MV.
Its position is calculated by the system during runtime in order to calculate corrections for the following injection when it occurs.

The DUMMY-WUP and the start - WUP exist for the start, both of which are only generated once.

The dummy – WUP can have a label

ÿ *dzwK_WPDum*

be applied to an increment after the first detected gap.

The position of the start - WUP's is about the label

ÿ *dzwK_WPSta*

fixed. In this case, it must be taken into account that at this point in time the synchronous tooth that is furthest away from the associated segment tooth must be recognized.

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12.5.2 Time-synchronous request to block the injection Various

monitoring functions are able to prevent the energization of the solenoid valve. This is time-synchronously a quantity shutdown - Message *mrmZUMEAUS* sent, which leads to the shutdown of the solenoid valve control in the speed-synchronous processing, regardless of an injection quantity other than zero.

When Ecomatic intervention is active *ecmUso_ECO* = 0 or

there is no start bit and one of the following errors or a switch-off condition are met

- Zero speed detected *dzmNmit* = 0
- Speed *sensor error fboSDZG*
- Defective communication with ASIC detected in the wake *fbbERUC_W*
- Error redundant thrust monitoring *fbbERUC_S* •

Monitoring module - defect detected in the periodic test *fbbERUC_U*

injections are prevented by the time-synchronous requirement *mrmZUMEAUS* = 1.

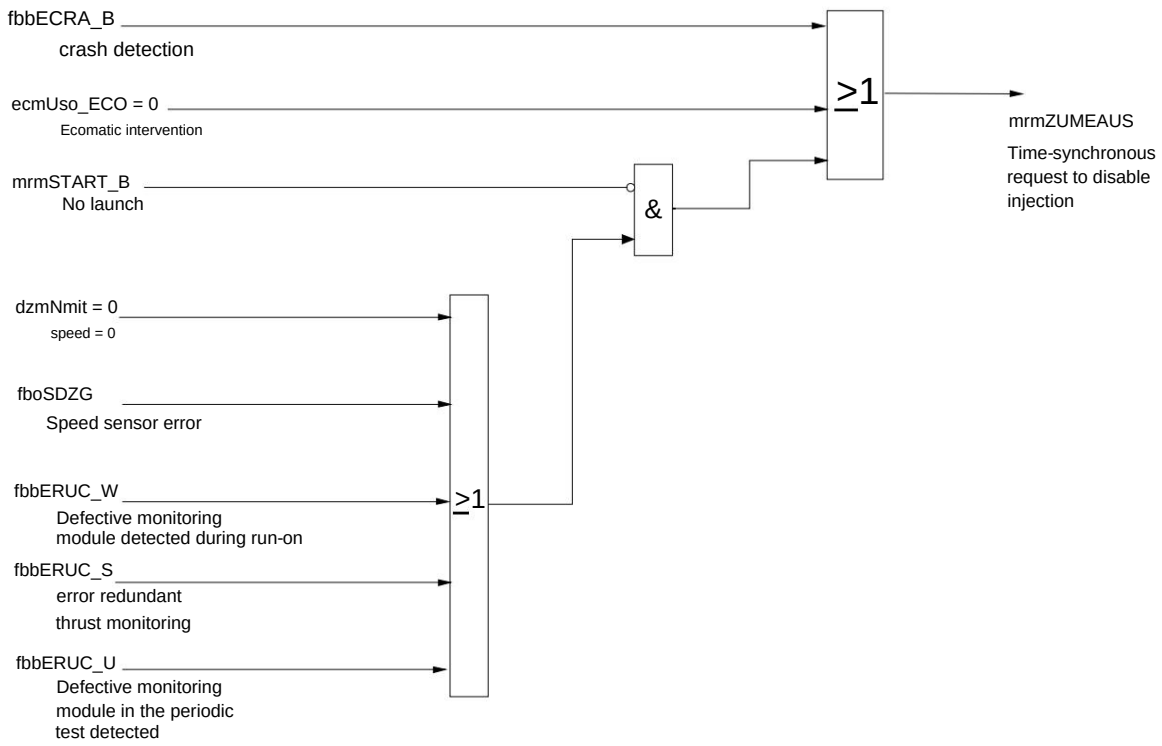


Figure ZUME01: Time-synchronous request to disable injection

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12.5.3 Control of the solenoid valves

The values for the start and end of the solenoid valve energization (MVon and MVoff), in crankshaft degrees, are entered into the ASIC by the controller. If these angles are reached on the crankshaft, the downstream hardware generates the signals for controlling the solenoid valves. The angle clock works with a resolution of one increment / 256 (6 °CA / 256). The current status of the MV control is announced via the *zmmMVS_ANS* message. The following states exist [VS100 message]:

ÿ Control OK [00]: Entry MVon -/ MVoff - Angle in dyn. WUP
(Control starts at the desired KW angle)
ÿ intermediate status [01]: Is used in the 2nd stat. WUP set and in dyn. WUP reset
(normal control, constant change between 00 and 01)
ÿ No control [02]: rotation KW to NW, *fbbESEK_P* set
ÿ No activation [03]: Minimum injection *quantity (mrmM_EMOT* < *zmoM_Emin* [f(n)])
ÿ No activation [04]: Delivery duration (main injection) converted into time < *zmwMV_Tmin*

ÿ No activation [40]: Delivery duration (additional injection) converted into time < *zmwMV_TmZE*

ÿ No activation [44]: Delivery duration converted into time (main injection)
< *zmwMV_Tmin* and (additional injection) < *zmwMV_TmZE*
ÿ No activation [05]: *nlmZUMEAUS* = 1 (from run-on)
ÿ No activation [06]: deactivation by overrun cut-off
(mrmSASTATE = mreLAST_AB)
ÿ No activation [0C]: *xcmSt_frei* = 0, immobilizer active
ÿ No control [0D]: Invalid speed
ÿ No control [0E]: *mrmZUMEAUS* = 1 (from monitoring)
ÿ No activation [0F]: MV - output stages - error
ÿ Initialization [FF]

In the "No control" status, no MVon / MVoff angles are entered. In addition, cylinder 8 is selected and the off signal is applied to the MV output stage.

Deactivation of the solenoid valve control via hysteresis characteristics for minimal injection quantity

The function is used for more precise metering in the case of small injection quantity requirements in the range between zero quantity and the smallest quantity that can be represented. Furthermore, it is prevented that the LRR correction quantity can lead to the metering being switched off via the pump characteristic diagrams. Using the speed-dependent characteristic *zmwMEmi0KL* for the lower threshold and *zmwMEmi1KL* for the upper threshold, the minimum *injection quantity zmoM_Emin is* specified via hysteresis. If the amount *mrmM_EMOT falls below* the lower threshold, no control of the MV output stages is made after the start shedding *(mrmSTART_B* = 0) *(zmoMVS_ANS* = 3). A renewed activation only takes place with a quantity *mrmM_EMOT* greater than the upper threshold.

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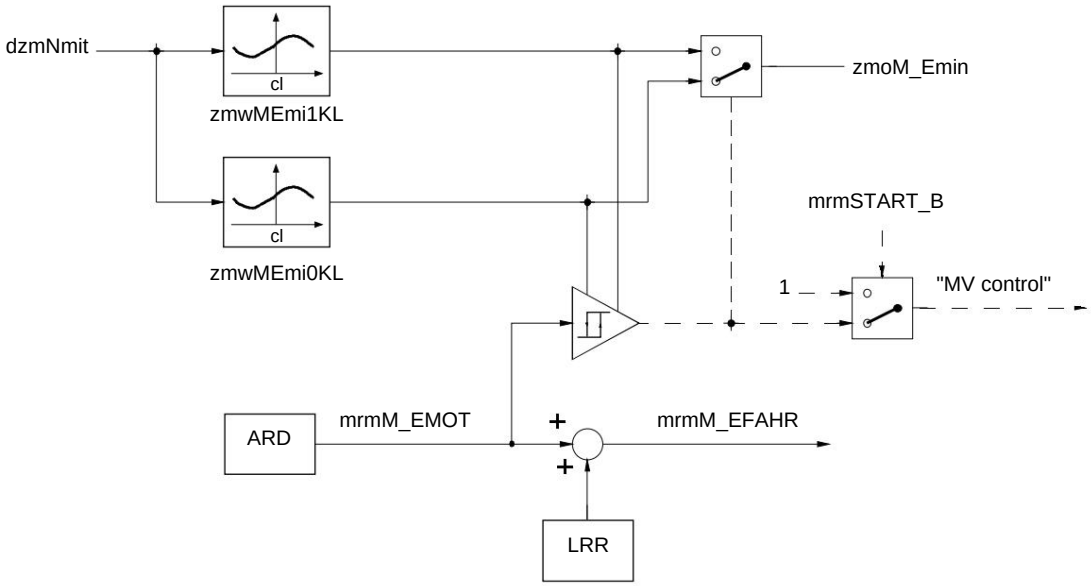


Figure ZUME_AB: Minimum injection quantity

Application note: Each

time the pump maps are changed, the characteristics of the minimum injection *quantity zmwMEmi0KL* and *zmzMEmi1KL* must be reapplied !

12.5.3.1 Calculation of the solenoid valve - switch-on angle (MVon)

Shortly before the switch-on time for the solenoid valve is reached, the closing time of the MV (BIP - time, *zmmBPTvoHE)* must be converted into a crankshaft angle using the current increment period. This value must be subtracted from the start of delivery.

"BIP - angle" [°KW] = BIP - time / current increment period

MVon - Angle = *zmmFBsoll* - "BIP - Angle"

This calculation is carried out in the "dynamic Wup". The position of this Wup's is placed before the switch-on time, taking into account the maximum possible acceleration of the motor.

12.5.3.2 **Solenoid valve switch-off angle (MVoff)** calculation

The target value of the MVoff angle is calculated by adding the target values for the start of delivery *(zmmFBsoll)* and duration *(zmmFDsoll) :*

MVoff - angle = *zmmFBsoll* + *zmmFDsoll*

It is possible to enter "negative" delivery times - angles in order to achieve small injection quantities. This means that the off time occurs before the solenoid closes (BIP). The BIP is thereby delayed or no longer occurs (ballistic flight). If the activation duration (with the current increment period duration converted into a time) falls below the value *zmwMV_Tmin ,* no more injection is carried out (ie no values for MVon and MVoff are entered in the gate array).

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12.6 GDP - Registration

(start of funding - regulation)

The recording of the MV - closing time or the start of production (BIP: Begin of Injection Period) serves to compensate for the MV - closing time spreads1 (copy to copy), which arise in the manufacturing or over lifetime. This is just a correction of the MV closing time (BIP time) already calculated from characteristic diagrams or characteristic curves Expected value *zmmBPTerw.* Only through this correction is an equality of all MV with regard to the start of delivery - actual value and thus an exact metering is achieved.

The aim of the start of delivery control is therefore to set the solenoid valve switch-on angle MVon (or *zmoCMVONHE)* set so that the solenoid valve closes as precisely as possible when the current KW - angle with the start of funding - target value *zmmFBsoll* matches.

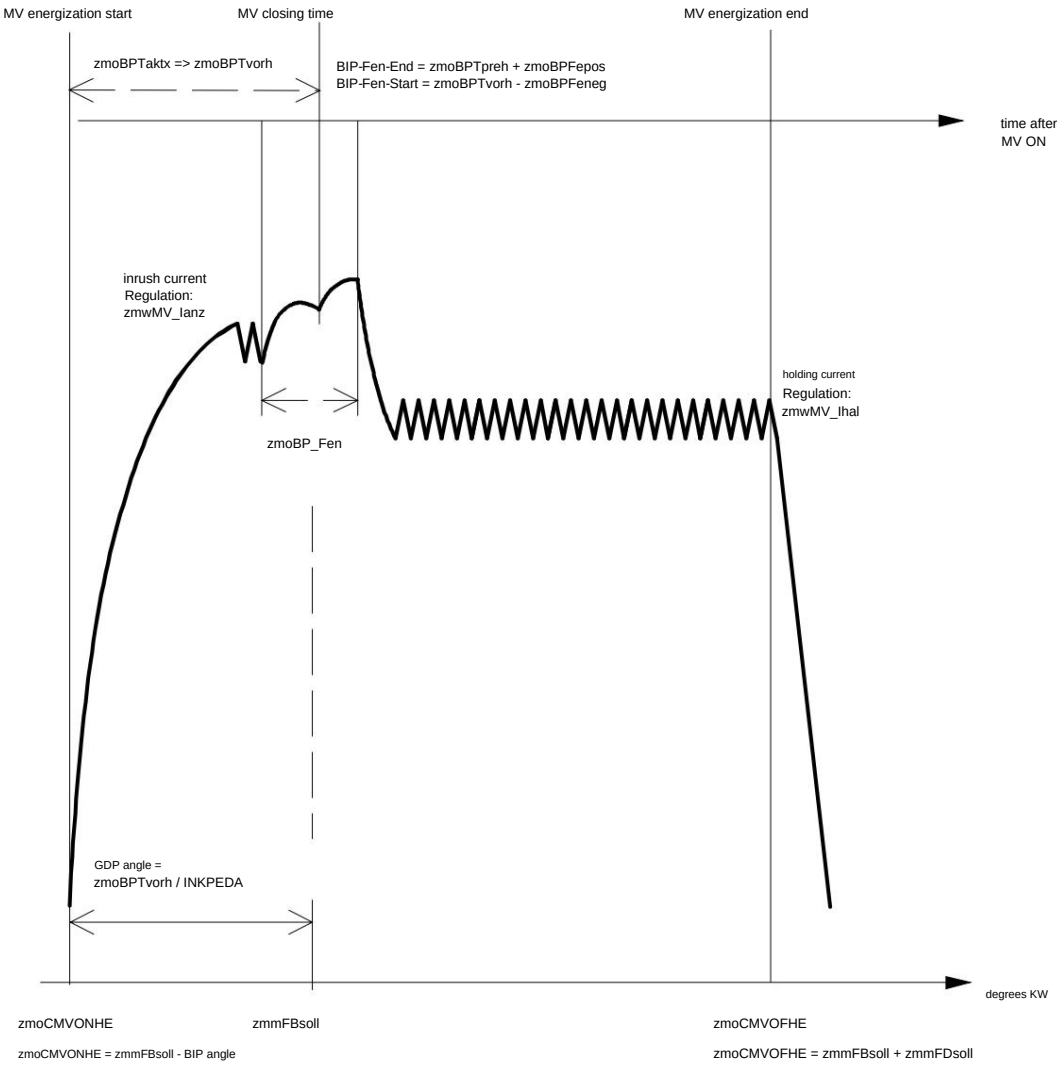


Figure FN_REG1: MV - Current - History

[1] Closing time: Time from the start of energization until the solenoid valve closes

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Feedback on the actual start of delivery - actual value is obtained by sampling the solenoid valve current (see figure FN_REG1). The analog channel of the solenoid valve current can be applied via the *zmwBP_IKAN* label (value depends on the hardware used!). If the voltage is kept constant (with BIP in free run-up: *zmwBP_Fe_U* = 17.5 V) in a certain range around the expected BIP - point in time (BIP - window), the change in the inductance of the coil when the valve hits the seat can cause a significant change in the Current flow can be determined.

This is achieved by calculating the second derivative for the measured values of the current measurement series that were measured during the BIP window. A BIP is recognized at the point in the series of measurements where the maximum of the second derivative lies. However, this point in time within the BIP window is only recognized as a BIP if a minimum bandwidth *zmwBP_BaBr* is exceeded. This bandwidth is calculated from the difference between the absolute maximum of the calculated 2nd derivatives and the maximum of the minima before and after the absolute maximum. The calculated bandwidth is output via the OLDA *zmoBP_BaBr .* Accordingly, the following condition must be met for a clear BIP entry: *zmoBP_BaBr* > *zmwBP_BaBr.*
The current MV - closing time (= current BIP - time *zmoBPTactx,* x = 1..5 for MV1..MV5), ie the time from MV - start of current application until the valve hits the seat, can be determined here. From the current MV - closing time, the MV to be kept available for the next activation is calculated - closing time *zmmBPTvoHE* (see BIP - recording and processing). The MV - switch-on angle MVon then results as a function of the specified start of delivery - setpoint *zmmFBsoll as* follows:

zmoCMVONHE = *zmmFBsoll* - BIP - Angle

The BIP angle is obtained by converting the MV to be kept available - closing time *zmmBPTvoHE,*

BIP - angle = *zmmBPTvoHE* / current increment period duration * normalization constant.

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12.6.1 GDP - Time - Expected Value Determination

The BIP - time - expected value *zmmBPTerw* describes the MV - closing time (BIP - time) only taking into account the variable environmental conditions battery voltage, speed, start of delivery and fuel or water temperature. It is calculated in three steps before each injection using the current input variables:

1. The basic value results from the basic *characteristic zmwBPGndKL* depending on the battery voltage . If there is a defect in the battery voltage detection (error path *fboSUBT* signals a defect), the default value *zmwBPUBVOR* is used to calculate the basic characteristic.

2. The first multiplicative correction of the basic value takes place depending on the speed *(dzoNmit)* and the start of delivery *(zmmFBsoll)* using the correction *map zmwBPKorKF.*

3. The second multiplicative correction depends on the fuel temperature *anmKTF* from the correction *characteristic zmwBPKorKL*.

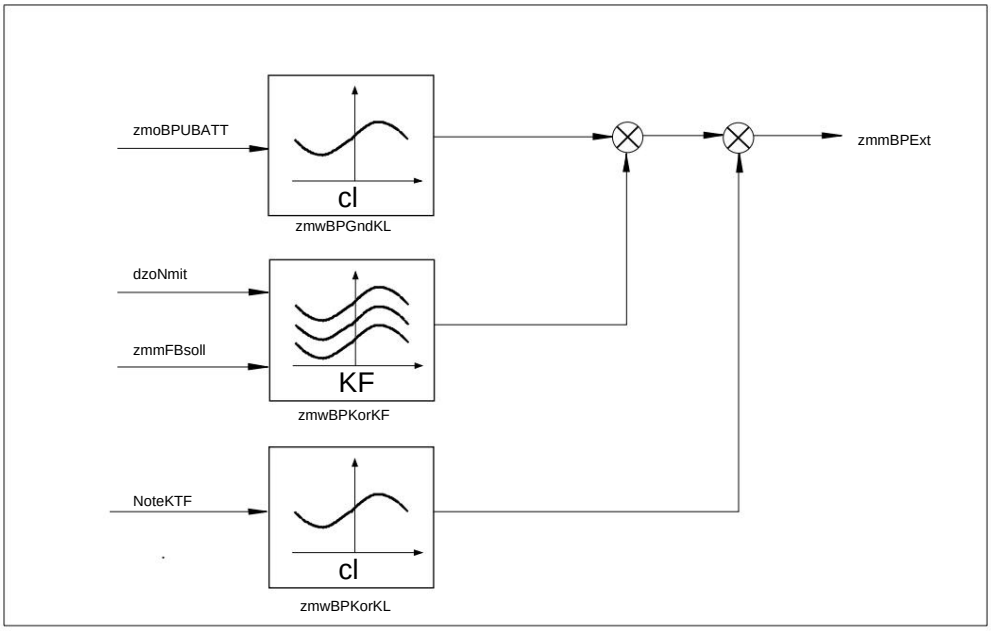


Figure FN_REG2: BIP - time - expected value determination

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12.6.2 BIP Collection and Processing

For the description of the function of the BIP - recording it is assumed as an example that during activation[i] on the MVx the current BIP time and thus the current BIP time *zmoBPTaktx* as described above. Given GDP - Time - Expected Value *zmmBPTerw* can then use the current BIP - time expectation value deviation (act. BIPEWAbw = current BIP - time - *zmmBPTerw)* are determined (see image FN_REG3). Through the filtering

*zmoBPEwAbx,[i] = zmwBP_GewF * zmoBPEwAbx,[i-1] + (1-zmwBP_GewF)* * curr. BIPEWDev

the filtered current deviation zmoBPEwAbx,[i] is obtained from the current deviation and the filtered deviation during the last injection *zmoBPEwAbx,[i-1].*

With a given, filtered current deviation, the BIP time to be kept available for the next Control [i+1] on the MVx can be calculated as follows:

zmmBPTvoHE[i+1] = zmmBPTerw[i+1] + zmoBPEwAbx,[i] * *(zmmBPTerw[i+1]* / *zmmBPTerw[i]).*

The factor *(zmmBPTerw[i+1] / zmmBPTerw[i])* is used to determine the [i] during activation filtered current deviation *zmoBPEwAbx,[i]* to the possibly changed environmental conditions (Battery voltage, speed, start of delivery or temperature) adapted to the control [i+1]. *zmmBPTerw[i+1]* is the GDP - time - expected value, which results from the Ambient conditions shortly before activation [i+1] on the MVx. *zmmBPTerw[i]* is the BIP - time - expected value calculated during the previous activation [i] of the MVx.

In order to be able to detect the BIP at the new injection [i+1], the BIP window around the predicted BIP - point in time (see figure FN_REG3 and FN_REG4). Analogous to the MV - Switch -on *angle zmoCMVONHE* the BIP to be kept available - time *zmmBPTvoHE* is used for this.

The size and type of BIP window *zmoBP_Fen* is described below.

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12.6.3 BIP - Control Strategy

The BIP window size depends on the BIP mode. Basically three modes distinguished:

- BIP - Startup - Mode
- BIP - control in sweep mode
- GDP control

12.6.3.1 GDP - on the run

The BIP window will depend on the battery voltage and the measured Solenoid valve current after the start only slowly opened to a current overshoot and the to avoid the resulting shutdown of the solenoid valve output stage.

The start-up function is only active under one of the following conditions:

- Flawless BIP detection *(zmoBPSdefx* = zmeBP_OK)
- GDP error suppression *(zmoBPSdefx* = zmeBPSTFno)

If the start-up mode is active for an MV, an MV-specific bit is set in *zmmBPAnAkt .* is the start-up mode ends, the corresponding bit is deleted.

zmmBPAnAkt	Condition
111xxxx1	MV1 in startup mode
111xxx1x	MV2 in startup mode
111xx1xx	MV3 in startup mode
111x1xxx	MV4 in startup mode
1111xxxx	MV5 in startup mode

Start BIP window size

After synchronization, the BIP window is opened to the start window size *zmwBPAnFSt .*

Application note:

It must be ensured that no HW shutdown occurs with the applied value of the start window size, but the current measurement series does
can be evaluated.
The start window size must also be at least large enough that a
A short to ground will result in a hardware shutdown and an MS error
can be recognized.

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current measurement

If the current measurement series was started in the BIP window, the maximum current in the BIP window *(zmoBPIFenE) is* measured. This is compared in start-up mode with the battery voltage-dependent maximum *threshold zmoBPAnIMx* from the characteristic *zmwBPAnIKL .*

If the measured current is less than or equal to the maximum current from the characteristic curve, a MV-specific bit is set in *zmmBPAnIok .*

zmmBPAnIok	Condition
000xxxx1	Current MV1 <= Max Current
000xxx1x	Current MV2 <= Max Current
000xx1xx	Current MV3 <= Max Current
000x1xxx	Current MV4 <= Max Current
0001xxxx	Current MV5 <= Max Current

Application note:

The maximum permissible current *zmoBPAnIMx* must be far enough away from the cut-off current of 28 A. It must be ensured in the application that when the applied maximum value of the current is reached, a further widening of the window by an increment does not lead to a hardware switch-off!

GDP window size

ÿ If the bit is set in *zmmBPAnIok ,* the BIP window is widened by the increment *zmwBPAnFin* for the next injection into the associated cylinder .

The window is enlarged until the BIP window width from *zmwBP_Fen* is reached as the final value. This ends the start-up mode and changes to the SWEEP mode.

ÿ If the bit is not set in *zmmBPAnIok ,* the BIP window is reduced by the increment *zmwBPAnFde .*

The reduction of the BIP window can be prevented with *zmwBPAnFde* = 0. If the window size is to be reduced back to the start window size, *zmwBPAnFde* > window end size *zmwBP_Fen* is to be applied.

If no current readings are available, the BIP window size remains unchanged.

If the BIP window final size *zmwBP_Fen is* reached and the sweep mode was switched to, the measured current *zmoBPIFenE* from the BIP window is compared with the maximum current *zmoBPAnIMx* until the fuel *temperature anmKTF* has reached or exceeded the threshold *zmwBP_TkAn .*

If the measured current is greater than the maximum current, the affected solenoid valve is switched back to start-up mode. The MV-specific bit in *zmmBPAnAkt* is set again.

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During startup, the negative BIP window size *zmoBPFeneg corresponds* to the positive BIP window Size *zmoBPFepos.*

The general rule:

zmoBP_Fen = zmoBPFeneg + zmoBPFepos

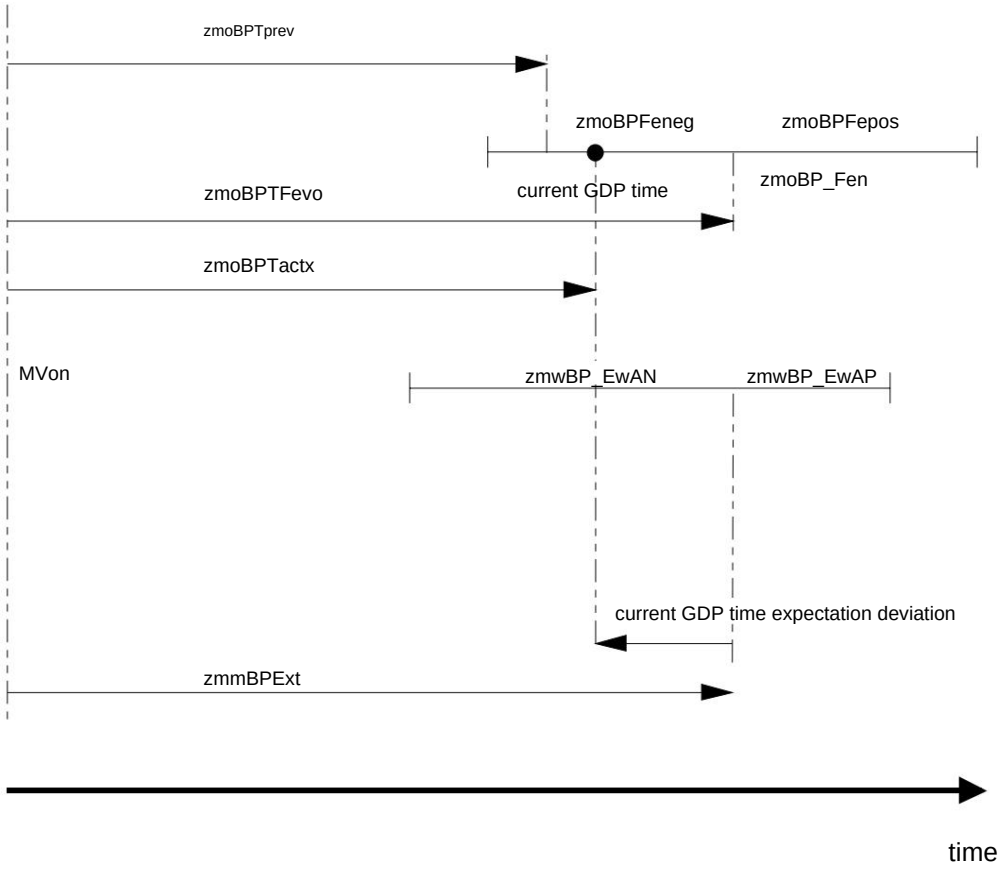


Figure FN_REG3: BIP - window in start-up mode *(zmwBPAnMod* = 1)

Control / rules during the start-up

With the SW switch *zmwBPAnMod ,* the BIP can be regulated or controlled during startup, or the BIP regulated and the GDP window controlled.

Description of the *zmwBPAnMod* software switch :

decimal value	comment	Explanation
0	Regulate GDP on start-up	Control: *zmmBPTvoHE* = *zmmBPTerw* + corr. expectation deviation GDP window: *zmoBPTFevo* = *zmmBPTvoHE*
1	Regulate GDP on start-up and control GDP windows	Control: *zmmBPTvoHE* = *zmmBPTerw* + corr. expectation deviation GDP window: *zmoBPTFevo* = *zmmBPTerw*
2	Control GDP during start-up	correct mean deviation = 0 Control: *zmmBPTvoHE* = *zmmBPTerw* + corr. expectation deviation GDP window: *zmoBPTFevo* = *zmmBPTvoHE*

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12.6.3.2 BIP - control in sweep mode

As described above, the BIP control can engage in the bouncing of the MV needle when the tank has been run dry or there are ventilation problems. In addition, jumps in the solenoid valve switching time cannot be ruled out. Switching time jumps of up to 100 µs can occur, particularly at very low temperatures and with waxy fuel.

In order to prevent snapping on a bouncer and also to tolerate jumps in switching times, the BIP window in sweep mode is constantly shifted by the current BIP time.

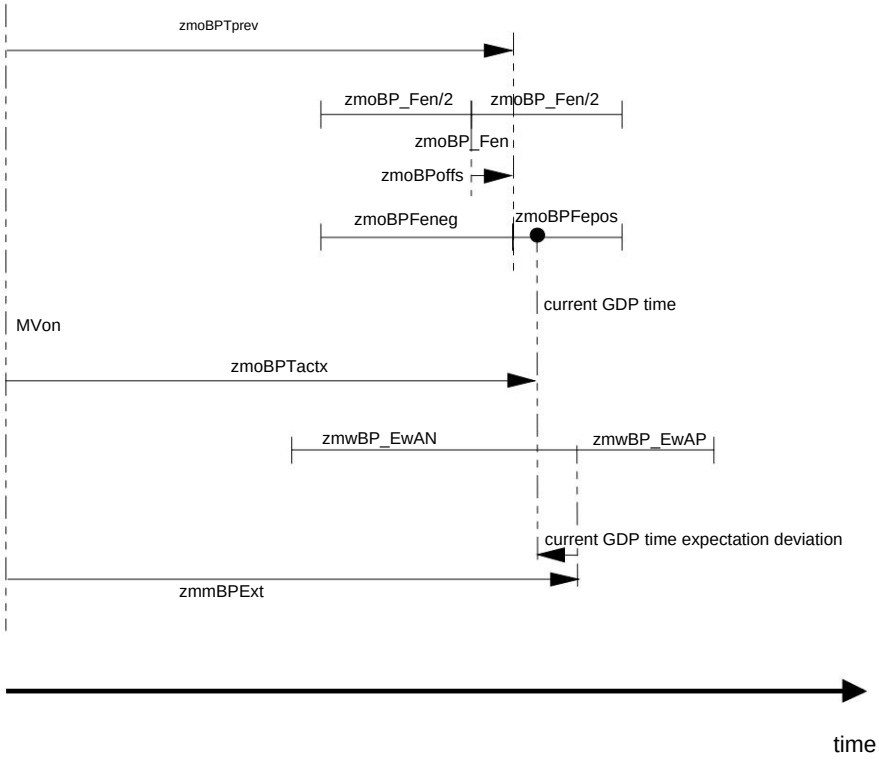


Figure FN_REG4: Asymmetric displacement of the BIP window in sweep mode

The size of the BIP window results from the fixed *value zmwBP_Fen.* At the start of the BIP control in sweep mode, the BIP window of this size is spanned symmetrically. Switching from BIP during startup to sweep mode begins with the end of the startup *(zmmBPAnAkt(x)* =0). After that, the GDP window is shifted towards early. The OLDA *zmoBPoffsx* shows the asymmetrical shift of the BIP window. As the BIP window is advanced, the OLDA displays *zmoBPFeSwP=0* . The BIP window is shifted by *zmwBP_step* per load cycle if either a BIP was detected during the last control *(zmoBPSdefx = zmeBP_OK)* or a BIP error was suppressed *(zmoBPSdefx = zmeBPSTFno).* In all other cases, the movement is stopped. The shift in the BIP window is calculated on a solenoid valve-specific basis.

If the asymmetrical offset of the BIP - window reaches the maximum shift in the early direction *(zmoBPoffsx* ÿ *zmwBPnasym),* the BIP window is shifted in the late direction from the next activation on this solenoid valve *(zmoBPFeSwP* = 255).

If the asymmetrical offset of the BIP window reaches the maximum shift in the late direction *(zmoBPoffsx* ÿ *zmwBPpasym),* the BIP window is shifted in the early direction from the next activation on this solenoid valve *(zmoBPFeSwP* = 0). If the BIP window has now been shifted earlier and then later, error storage is activated. The OLDA *zmoBPswit* = 255 indicates this.

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The size of the "negative and positive" GDP window is then calculated as follows (see Figure FN_REG4):

zmoBPFeneg = zmwBP_Fen/ 2 - zmoBPoffsx

zmoBPFepos = zmwBP_Fen/ 2 + zmoBPoffsx

The maximum size of the BIP window early and late is calculated as follows:

zmoBPFenegMAX = zmwBP_Fen/ 2 - zmwBPnasym

zmoBPFeposMAX = zmwBP_Fen/ 2 + zmwBPpasym

Sweep mode example:

For a BIP window size of *zmoBP_Fen* = 370µs, a maximum negative shift of *zmwBPnasym* = -65µs, a maximum positive shift of *zmwBPpasym* = 30µs and a sampling time of 12.2µs below are the samples of the current in the BIP window sweep mode drawn.

Behavior with air in the pump:

If the BIP control has snapped onto a bouncer when the pump is ventilated, the negative asym. BIP shift can be reliably detected if the bounce period between BIP and Preller falls below 190µs.

Maximum positive expectation value deviation at the start:

If the MV switching time of a pump is greater than the expected value, but less than the is the maximum permissible positive expected value deviation, it must be ensured that even in Start the switching time of this pump can be recorded.

With the values drawn, a maximum positive expected value deviation of 150 µs can be tolerated.

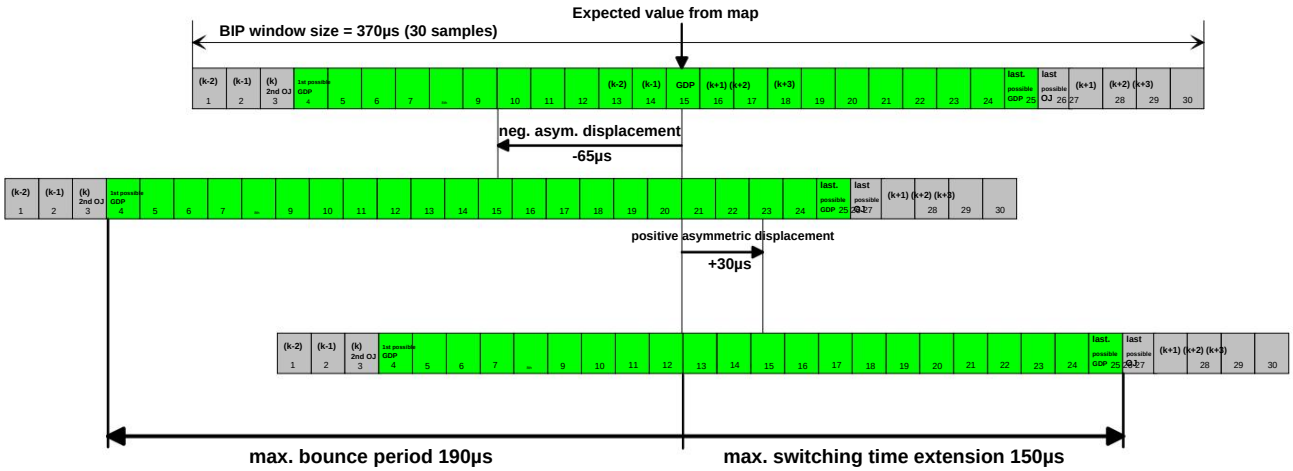


Figure FN_REG5: example BIP window in sweep mode

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12.6.3.3 BIP - control at maximum speed

To avoid computer overload of the control unit EDC15P 5.x (and older HW versions) with high To avoid speeds, the BIP control can be switched off at high speeds.

If the speed exceeds the *zmwBP_NMx* value , the BIP window is not set up and evaluated. At the same time, the current expected value deviation is frozen *(zmoBPEwAbxeinfrozen)* and used for BIP control as long as the speed is above the threshold *zmwBP_NMx* remains.

12.6.3.4 BIP - Undervoltage control

At low voltages, the switching time of the solenoid valves increases. At the same time, the GDP - expression in the course of electricity. Therefore, at too small voltages on GDP - control changed. The last measured (and valid) GDP - time - expected value deviation is frozen and immediately used again when battery voltage ÿ *zmwBP_UBMn.*

Immediate transition to BIP - control from the map: *zmmBPTvoHE* = *zmmBPTerw*

12.6.3.5 BIP - Overvoltage control

In order to avoid excessively high currents with BIP during free run-up, there is no BIP window put on. If the UBAT acquisition is defective, no BIP window is set either. Simultaneously In this case, the voltage value is used to calculate the BIP basic characteristic *zmwBPUBVOR* used.

The last measured (and valid) GDP - time - expectation value deviation is frozen and used again immediately if battery voltage ÿ *zmwBP_UBMx* and there is no defect in the UBAT detection.

Immediate transition to BIP - control from the map: *zmmBPTvoHE* = *zmmBPTerw*

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12.6.4 Monitoring of the BIP - registration (formation of the BIP - statuses)

Due to venting problems, especially when the tank has been run dry, the MV closing time can be reduced so much at the start that the expected value does not match the actual switching time of the solenoid valve "in air". Since the GDP window is stretched around the expected value at the beginning of the GDP regulation, the GDP can be ahead of the GDP window. In this case, the BIP control can "snap" to a bouncing of the solenoid valve needle or no BIP and thus start the defect classification. All error entries are suppressed during BIP control during startup. If there is a BIP error whose error entry is currently being suppressed, the BIP status OLDA assumes the value *zmoBPSdefx* = zmeBPSTFno. The error suppression is active for the duration of the start-up.

[As soon as the start-up is complete *(zmmBPAnAkt(x)* = 0) and the BIP window in sweep mode has been moved once over the entire displacement range *zmwBPnasym* to *zmwBPpasym ,* error storage is permitted *(zmoBPswit* = 255).]

Since the solenoid valve switching time depends on the fuel temperature, switching time deviations occur if the fuel temperature sensor is defective due to the influence of the KTF specification value. In order to avoid additional error entries of the BIP detection in the case of a defective KTF, the BIP error entries are suppressed as long as there is a KTF defect (error path *fboSKTF* indicates defective).

The BIP monitoring announces the status of the BIP registration via the BIP status - OLDA *zmoBPSdefx .* During the state *zmoBPSdefx* = zmeBP_OK and *zmoBPSdefx* = zmeBPSTFno, the BIP acquisition/processing is carried out as described above; the BIP errors (bit *fbbEMVxBP, fbbEMVxBF* and *fbbEMVxBS* in the error path *fboSMVx)* are then classified as intact. All states that deviate from this result in certain effects on the BIP recording/processing.

All states, the associated values of the OLDA *zmoBPSdefx* and the effects on the BIP recording are listed in the table below.

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12.6.4.1 GDP error

There are basically three different BIP errors and error reactions per solenoid valve:

1. **Falling below the minimum GDP level**
   By specifying the minimum bandwidth *zmwBP_BaBr ,* it can be determined how strong the expression of the BIP in the course of the current must be at least in order to be clearly recognized as a BIP. This distinguishes the actual GDP from interferers. The calculated bandwidth is output via the OLDA *zmoBP_BaBr .* Accordingly, the following condition must be met for a clear BIP entry: *zmoBP_BaBr > zmwBP_BaBr.*
   If the BIP recording is initially in an error-free state *(zmoBPSdefx* = zmeBP_OK) and then the minimum bandwidth is undershot due to a malfunction of MVx, the error debouncing of the BIP error starts (bit *fbbEMVxBP* in the error path *fboSMVx).* After *fbwEMVxBPA* successive activations of the MV with implausible BIP, the BIP error is classified as definitively defective. The BIP - Status - OLDA then assumes the value *zmoBPSdefx* = zmeBP_NO. During the provisional defect classification, the last measured (and valid) BIP - time - expectation value deviation is frozen and used for the lead value until a valid BIP is found again or a final defect classification is available.

   Error - reaction: It is not possible to classify this error as intact in this driving cycle. The date *fbwEMVxBPB* is therefore ineffective. In the next driving cycle, the BIP control starts again with *zmoBPSdefx* = zmeBP_OK until an error is detected again, if necessary.
   With the final defect classification of this BIP error, the BIP control on this MV is switched off, switched to BIP control and the BIP window is switched off. The lead value for the BIP control is calculated as follows: *zmmBPTvoHE = zmmBPTerw - zmwBP_Fen/ 2 - zmwBPnasym* Was the last measured and valid expected value *deviation zmoBPEwAbxeingefr.* negative and larger in amount than the size of the BIP window early (|zmoBPEwAbxeingefro.|>(zmwBP_Fen/2 - *zmwBPnasym)) ,* the lead value is calculated as follows:

   zmmBPTvoHE = zmmBPTerw - zmoBPEwAbxeingefro.

   By correcting the lead value for the negative BIP window size or the frozen expected value deviation, it is ensured that the BIP control cannot result in an unwanted increase in quantity.

2. **Falling below the maximum negative expected value - deviation:**
   Despite manufacturing tolerances and changes over the service life, the BIP time may only deviate by a certain amount from the expected value *zmmBPTerw .* For this purpose, it is checked whether the amount of the current BIP - time - expected value - deviation is smaller than the maximum permitted negative BIP - time - expected value - deviation *zmwBP_EwAN* (see figure FN_REG3, FN_REG4).
   If the BIP - registration is initially in an error-free state *(zmoBPSdefx* = zmeBP_OK) and then the switching time is so much reduced that the maximum negative expected value - deviation *zmwBP_EwAN* is undershot, the error debouncing of the BIP - error starts (bit *fbbEMVxBF* in the error path *fboSMVx) .* After *fbwEMVxBFA* consecutive activations of the MV with too short a switching time, the BIP error is classified as definitively defective. The BIP - Status - OLDA then assumes the value *zmoBPSdefx* = zmeBPnegEW. During the preliminary defect classification, the mean value deviation is set to the maximum negative mean value deviation

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zmwBP_EwAN limited and used for the lead value until it falls below again or there is a final defect classification.

Error - reaction: It is not possible to classify this error as intact in this driving cycle. The date *fbwEMVxBFB* is therefore ineffective. In the next driving cycle, the BIP control starts again with *zmoBPSdefx* = zmeBP_OK until an error is detected again, if necessary.
With the final defect classification of this BIP error, the BIP control on this MV is switched off, switched to BIP control and the BIP window is switched off. The lead value for the BIP control is calculated as follows: *zmmBPTvoHE = zmmBPTerw - zmwBP_EwAN* By correcting the lead value by the maximum negative expected value deviation, it is ensured that the BIP control does not result in an unwanted increase in quantity.

3. **Exceeding the maximum positive expected value - deviation:**
For this purpose, it is checked whether the current BIP - time - expected value - deviation is smaller than the maximum permitted positive BIP - time - expected value - deviation *zmwBP_EwAP* (see figure FN_REG3, FN_REG4).
If the BIP - registration is initially in an error-free state *(zmoBPSdefx* = zmeBP_OK) and then the switching time increases so much that the maximum positive expected value - deviation *zmwBP_EwAP* is exceeded, the error debouncing of the BIP - error starts (bit *fbbEMVxBS* in the error path *fboSMVx) .*
After *fbwEMVxBSA* successive activations of the MV with too long a switching time, the BIP error is classified as definitively defective. The BIP - Status - OLDA then assumes the value *zmoBPSdefx* = zmeBPposEW. During the provisional defect classification, the expected value deviation is limited to the maximum positive expected value deviation *zmwBP_EwAP* and used for the lead value until this is undershot again or a final defect classification is available.

Error - reaction: It is not possible to classify this error as intact in this driving cycle. The date *fbwEMVxBSB* is therefore ineffective. In the next driving cycle, the BIP control starts again with *zmoBPSdefx* = zmeBP_OK until an error is detected again, if necessary.
With the final defect classification of this BIP error, the BIP control on this MV is switched off, switched to BIP control and the BIP window is switched off. The lead value for the BIP control is calculated as follows: *zmmBPTvoHE = zmmBPTerw* Since the switching time of the solenoid valve in this case is significantly longer than the expected value, the expected value is used as the lead value. This also ensures that no unwanted increase in quantity can occur as a result of the BIP control.

If one of the faults explained below is detected in an MV, there is no intact classification in this driving cycle. All BIP errors are thus irreversible. If one type of error is detected and error debouncing for this error type is started, error debouncing for the other two error types is stopped. If no BIP expression can be found in the current measurement series, it is also not possible to check the maximum expected value deviations.

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state of zmoBPSdefx	value [hex (dec)]	description	impact
zmeBP_OK	00	BIP - error (bit *fbbEMVxBP* and bit *fbbEMVxBF* and bit *fbbEMVxBS* in the error path *fboSMVx)* was recognized as intact, error-free BIP detection	Normal execution of the BIP - registration: *zmoBPEwAbx = zmwBP_GewF * zmoBPEwAbx last control* (1- *zmwBP_GewF)*akt.* GDP - Time - Mean Deviation *zmmBPTvoHE = zmmBPTerw + zmoBPEwAbx * (zmmBPTerw / zmmBPTerw last control)* The BIP - window size is calculated from the fixed *value zmwBP_Fen*
zmeBP_NINI	02	State of the system after initialization/recovery, none Impact on BIP - error detection	BIP - control from the map with active BIP window: *zmmBPTvoHE = zmmBPTerw*
zmeBP_NSIG	04	No or too few current samples were recorded => BIP recording not possible (e.g. MVoff in the BIP window, ie very short funding period), no impact on GDP – error detection	The last measured (and valid) BIP - time - expectation value deviation is frozen and reused, Adaptation to ambient conditions is carried out: *zmmBPTvoHE = zmmBPTerw + zmoBPEwAbx* frozen. * *(zmmBPTerw / zmmBPTerw* frozen); the GDP window will still set up
zmeBPSTFno	06	A BIP error occurs during start-up or during KTF Defect (error path *fboSKTF* indicates defective).	The BIP window is still set up but transition to BIP - control from the map plus last measured Expected value – deviation. There is a different one for each type of error that is currently being suppressed Expected value - deviation and thus also a different lead value: 1. GDP - expression too low: *zmmBPTvoHE = zmmBPTerw+ zmoBPEwAbxeinfrozen.* 2. Maximum negative expected value - deviation undercut: *zmmBPTvoHE = zmmBPTerw - zmwBP_EwAN* 3. Maximum positive expected value - deviation exceeded: *zmmBPTvoHE = zmmBPTerw + zmwBP_EwAP*
zmeBP_NUEB	07	Transition to BIP control with frozen expected value deviation *(zmoBPEwAbxeingefroz.)* when the speed *zmwBP_NMx* exceeds	The last measured (and valid) GDP - time - expectation value deviation is frozen and used, Adaptation to ambient conditions is carried out: *zmmBPTvoHE = zmmBPTerw + zmoBPEwAbx* frozen; the BIP window is not set up
zmeBP_USPG	08	Battery voltage < *zmwBP_UBMn*, no effect on BIP - error detection	At low voltages, the switching time of the solenoid valves increases. At the same time, the GDP decreases in the course of the current. Therefore, if the voltages are too low, the system switches to BIP control. The last measured (and valid) BIP - time - Expected value deviation is frozen and immediately used again if Battery voltage ÿ *zmwBP_UBMn.* Immediate transition to BIP - control from the map: *zmmBPTvoHE = zmmBPTerw*
zmeBP_UeSP	A (10)	Battery voltage > *zmwBP_UBMx* or defect of the UBAT Detection (error path *fboSUBT* signals a defect), none Impact on BIP - error detection	In order to avoid excessively high currents with BIP in free run-up, no BIP window is set up. In case of defective UBAT acquisition is also not set up a BIP window. At the same time, in this case, for the calculation the BIP basic characteristic of the voltage *value zmwBPUBVORP* used. The last measured (and valid) BIP - time - expectation value deviation is frozen and immediately again used when battery voltage ÿ *zmwBP_UBMx* and there is no defect in the UBAT detection. Immediate transition to BIP - control from the map: *zmmBPTvoHE = zmmBPTerw*

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state of zmoBPSdefx	value [hex (dec)]	description	impact
zmeBP_MS	E (14)	Avoidance of multiple error entries (ie no entry BIP – error) if bit *fbbEMVxMS* in error path *fboSMVx* final was classified as defective	Immediate transition to BIP - control from the map with active BIP window: *zmmBPTvoHE = zmmBPTerw* (In the event of a short circuit to ground, the defective MV is energized in parallel with each activation => BIP with none MV detectable)
zmeBP_NO	f (15)	The BIP error (bit *fbbEMVxBP* in the error path *fboSMVx)* was classified as definitively defective.	Immediate transition to pure BIP - control from the map: *zmmBPTvoHE = zmmBPTerw - zmwBP_Fen/ 2 - zmwBPnasym* Was the last measured and valid expectation value *deviation zmoBPEwAbxeingefr*. Negative and greater in magnitude as the size of the BIP window early (|*zmoBPEwAbxeingefroz*.|> *zmoBPFeneg)* the lead value is calculated as follows: *zmmBPTvoHE = zmmBPTerw - zmoBPEwAbxeingefro.* BIP – window is switched off.
zmeBPnegEW	1F (31)	The GDP error maximum negative mean deviation fallen below (bit *fbbEMVxBF* in the error path *fboSMVx)* was considered definitively classified as defective.	Immediate transition to pure BIP - control from the map: *zmmBPTvoHE = zmmBPTerw - zmwBP_EwAN* BIP – window is switched off.
zmeBPposEW	2F (47)	The GDP error maximum positive mean deviation exceeded (bit *fbbEMVxBS* in the error path *fboSMVx)* as definitively classified as defective.	Immediate transition to pure BIP - control from the map: *zmmBPTvoHE = zmmBPTerw* BIP – window is switched off.

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13 Start of Funding Calculation

The start of funding (FN) is derived from the input variables shown in Figure FN_BER1 calculated. The task is performed synchronously with the speed.

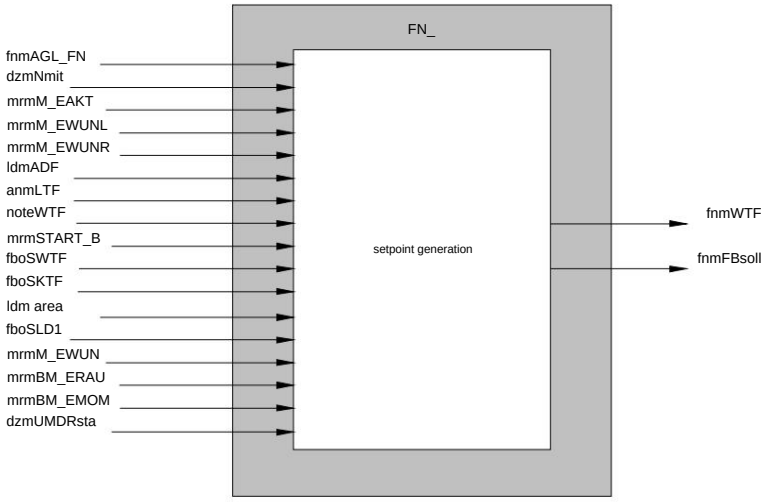


Figure FN_BER1: Structure of the start of funding calculation

dzmNmit rotational speed

mrmM_EAKT Current injection quantity

mrmM_EWUNL Desired amount + idle amount

mrmM_EWUNR Desired amount raw + idle amount

ldmADF atmospheric pressure

anmLTF air temperature

anmWTF water temperature

fnmAGL_FN Adjustment value start of delivery

mrmBM_EMOM torque limit amount

mrmBM_ERAU amount of smoke

mrmM_EWUN time-synchronous desired quantity

ldm area Shutdown condition of the LDR

fboSWTF Error path water temperature sensor WTF (cylinder head outlet)

fboSKTF Error path fuel temperature sensor KTF

fboSLD1 LD1 error path

dzmUMDRsta Revolutions since takeoff

mrmSTART_B start bit

fnmWTF Water temperature for start of delivery calculation

fnmFBsoll Start of delivery target value, is sent by start of delivery calculation

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13.1 Application Note

The reference point of the setpoint value for the start of delivery calculation described here is the angle clock position of the incremental angle time system (IWZ).

The angular clock position results from the KW - speed sensor signal. The analog signals from the KW speed sensor are converted into a digital signal (XDZI) in the control unit, which is fed to the ASIC. The angular clock position is formed by evaluating the rising edges of this XDZI signal. The input circuit of the KW - speed signal in the control unit has a certain input impedance. If you consider the sensor as a source with an internal resistance, the entire circuit (KW sensor and input impedance) has a low-pass behavior. The consequence of this is that the phase shift between the actual crank angle and the internal digital signal (and angle clock position) increases with increasing engine speed.

The control unit software cannot recognize this phase shift independently, since the angle clock itself represents the reference point for the metering software. Since this phase progression characteristic curve remains constant, this connection must be taken into account when applying the start of delivery setpoint.

13.1.1 Procedure

The phase shift must be determined for the entire speed range with the aid of an external, high-resolution angle marker encoder.

- The FB correction angle characteristic *zmwNWkoKL* must be applied to this so that the Start of delivery - setpoint *fnmFBsoll* no correction angle is added *(zmoFB_Off* = 0).

- Measure the actual start of delivery with an external, high-resolution angle mark encoder signal and compare it with the start of delivery setpoint *fnmFBsoll .*

- Set the start of delivery offset over the entire speed range so that the external Measuring means of the desired, real start of delivery is reached

  fnmFBsoll = real-desired start of delivery (external measuring equipment) + offset (speed)

- If a new sensor type is used, this correction must be applied again

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13.2 Setpoint formation

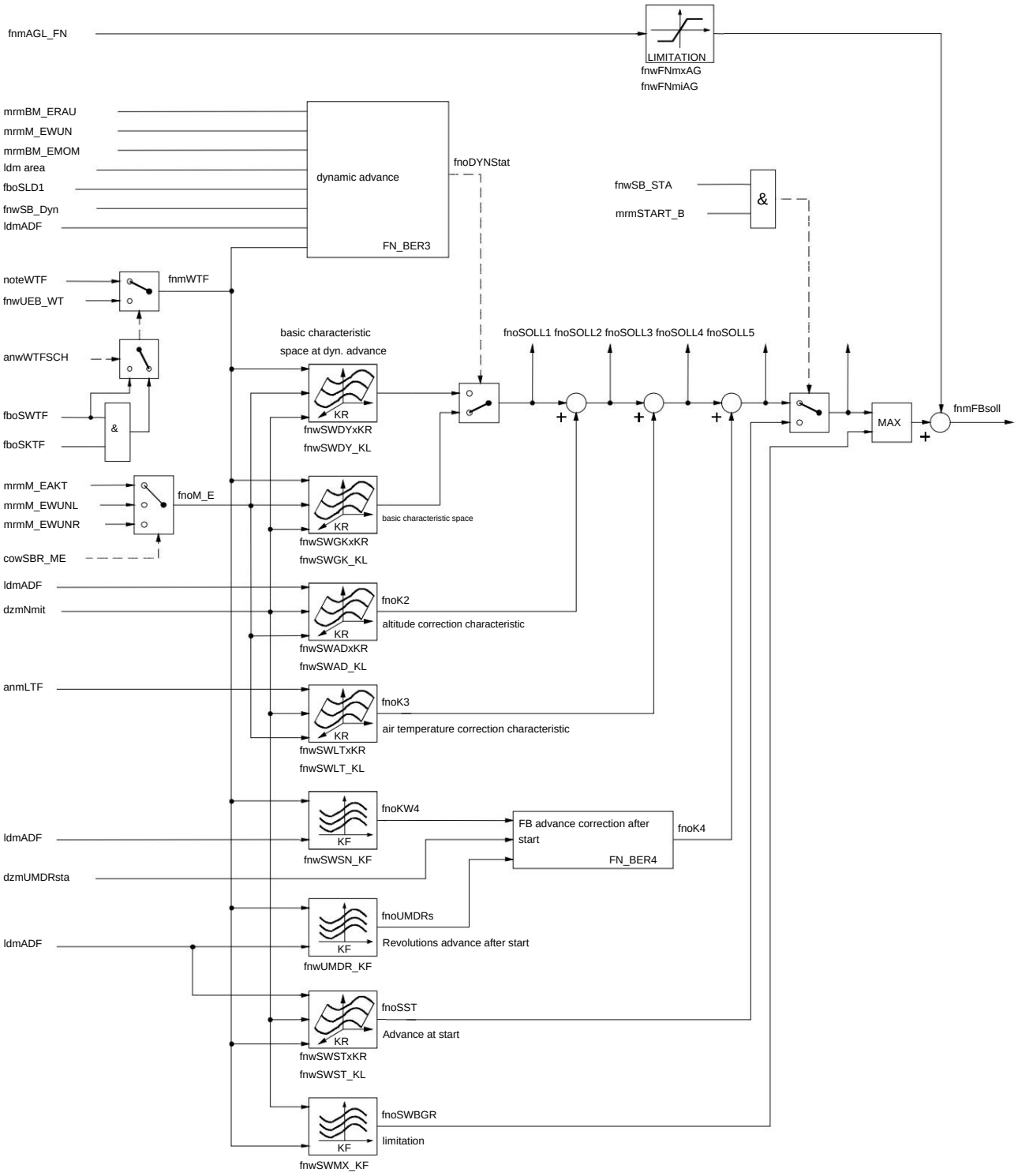


Figure FN_BER2: Setpoint formation

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The setpoint of the start of delivery calculation fnmFBsoll is a function of speed, quantity, water temperature, atmospheric pressure and air temperature.

The switch cowSBR_ME can be used as input variable fnoM_E either mrmM_EAKT or mrmM_EWUNL or mrmM_EWUNR are chosen.

Description of the software switch quantity input request cowSBR_ME:

decimal value comment	
1	current injection quantity (mrmM_EAKT)
2	Desired quantity + idle quantity (mrmM_EWUNL)
3	Desired amount raw + idle amount (mrmM_EWUNR)

The characteristic spaces are realized with group characteristic diagrams. The node distribution names that The associated characteristic spaces and the input variables can be seen from the following table.

Support point distribution name	Input variable	identification space
fnwDZstzv	dzmNmit	fnwSWDYxKR fnwSWGKxKR fnwSWADxKR fnwSWLTxKR fnwSWSTxKR
fnwSTDZstzv	dzmN with	fnwSWSTxKR
fnwMEstzv	fnoM_E	fnwSWDYxKR fnwSWGKxKR fnwSWADxKR fnwSWLTxKR
fnwWTstzv	fnmWTF	fnwSWDYxKR fnwSWGKxKR fnwSWSTxKR

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13.2.1 Dynamic Advance

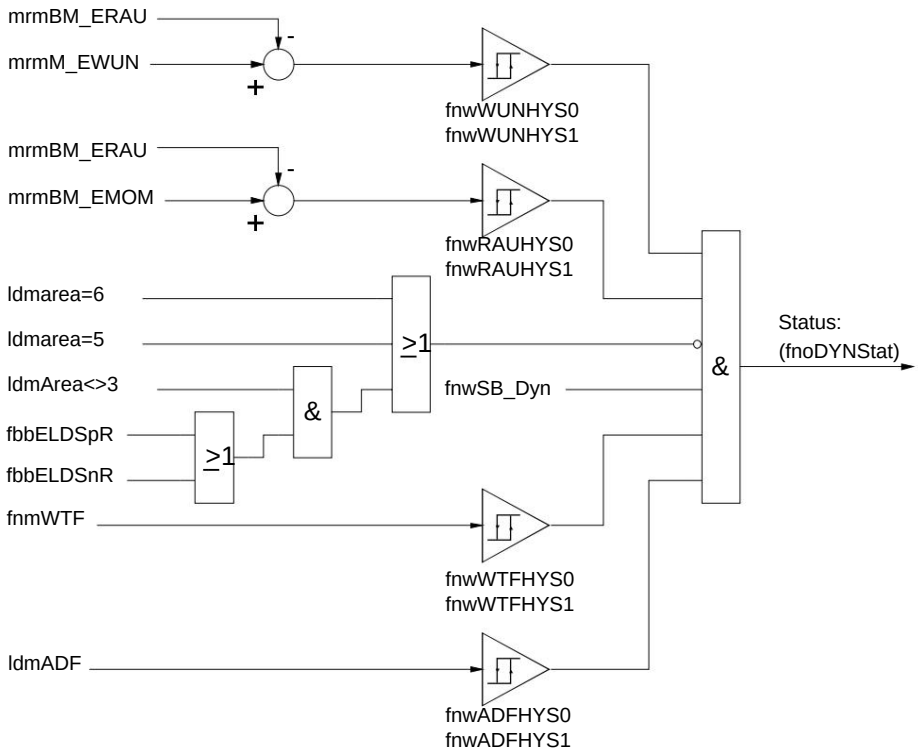


Figure FN_BER3: dyn. advance

Dynamic advance is performed when all of the following conditions are met:

(mrmM_EWUN - mrmBM_ERAU) > fnwWUNHYS.	AND
(mrmBM_EMOM - mrmBM_ERAU) > fnwRAUHYS.	AND
(fnmWTF > fnwWTFHYS.)	AND
(ldmADF > fnwADFHYS.)	AND
(fnwSB_Dyn = 1)	AND NOT
((ldmArea = 6) OR (ldmArea = 5)	OR
((fbbELDSnR OR fbbELDSpR) AND (ldmArea not equal to 3)))	

As a result, the value from the characteristic space for the dynamic advance adjustment is used for further calculations. The status of the dynamic advance is output in the Olda fnoDYNStat. (0 = no dyn. advance, 1 = dyn. advance is carried out)

The dynamic advance adjustment can be switched off with the application label fnwSB_Dyn by applying the label to zero.

The software switch cowSBR_ME selects whether the current injection quantity mrmM_EAKT, the desired quantity + idle quantity mrmM_EWUNL, or the desired quantity raw + idle quantity mrmM_EWUNR is to be used as the quantity. The set amount is sent via the Olda fnoM_E.

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13.2.2 Setpoint corrections

The basic value fnoSOLL1 is determined from the basic characteristics fnwSWGKxKR (or fnwSWDYxKR depending on whether dynamic advance adjustment is being carried out). This basic value is corrected using the following variables:

- ÿ The correction value 1 fnoK2 is obtained from the characteristic space fnwSWADxKR, and to fnoSOLL1 added.
- ÿ The correction value 2 fnoK3 is obtained from the characteristic space fnwSWLTxKR, and to fnoSOLL2 added.
- ÿ The correction value 3 fnoK4 is formed from the map fnwSWSN_KF and fed additively after start shedding for a water temperature-dependent number of engine revolutions fnoUMDRs. After this time has elapsed, the correction value that is current at this point in time is saved and brought to zero via the ramp gradient fnwKW4_Ramp.

If during the starting phase (mrmSTART_B = 1) the label fnwSB_STA is applied to 1, the value fnoSST is used for fnoSOLL5, which was determined from the identification space fnwSWSTxKR.
If the label is applied to zero, no advance adjustment is made at the start.

Through the characteristic fnwSWMXxKF, a minimum start of delivery is output depending on the water temperature and speed, regardless of quantity and height.

The comparison value fnmAGL_FN (initialized with cowAGL_SBR) is added via a limit.

If the error path fboSWTF is set and the fuel temperature sensor is not applied as a substitute value for the water temperature sensor (anwWTFSCH=1), the default value fnwUEB_WT is used.

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13.2.3 Advance after start

In order to achieve an even idling at a low temperature after the start, the start of delivery can be adjusted for a period dependent on the water temperature. The correction value 3 fnoK4 for the start of delivery setpoint is water temperature-dependent (fnmWTF) and atmospheric pressure-dependent from the map fnwSWSN_KF formed and after the start shedding (mrmSTART_B = 0) a water temperature-dependent (fnmWTF) number of engine revolutions fnoUMDRs long additively fed.

The message dzmUMDRsta provides the number of engine revolutions since the start drop. This value is compared with the water temperature-dependent threshold fnoUMDRs from the map fnwUMDR_KF. When the threshold is reached, the current correction value is saved and brought to zero via the ramp gradient fnwKW4_Ramp.

In addition, at the same time the blue smoke is reduced at altitude after the start, since the atmospheric pressure is now also included in the map.

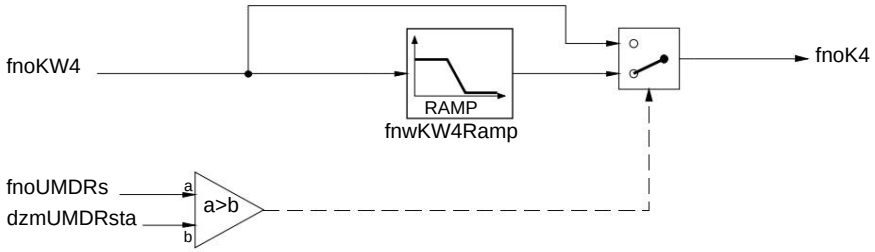


Figure FN_BER4: advance after start

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Appendix A Reprogramming Guide

Engine specific data

Description of the damos switch number of cylinders cowVAR_ZYL:

decimal value	comment
3	3 cylinders
4	4 cylinders
5	5 cylinders
6	6 cylinders

The number of cylinders affects the following program parts and data (example): den Smooth running controller, segment counter, the calculation constant the DZG speed, Air flow meter normalization constant (arwLMBNORM).

Description of the software switch data record variant cowFUN_DSV:

decimal value	comment
0	application data set
1 ... 32750	variant number
32750 ... 32767	reserved

When the control unit (SG) is initialized, the first data record in the EPROM checked how the switch cowFUN_DSV is.

If this is at the value zero, then this data set is considered to be selected and the function switch of this data set come into effect. This position covers the case of one Application control device or a non-programmable control device with only one record from.

If the word cowFUN_DSV in the first record in the EPROM contains a non-zero value, then is searched for in the EPROM for that record whose switch cowFUN_DSV has the same value contains. This data set is set and the function switches come from the EEPROM to effect.

After correct coding, the error memory of the SG must be deleted.

Description of the software switch transmission type cowVAR_GTR:

decimal value	comment
1	Manual transmission (under braking is dealt with in the LLR)
2	Automatic hydraulic
3	Automatic electric

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data for metering

crankshaft encoder wheel

Starting with software version V70, engine operation is only possible with quick-start encoder wheels.

Cylinder number independent data

The following data for the speed signal/INK plausibility check were calculated for the currently known engines.

Preliminary values that are used below the speed *threshold dzwK_N_PLF* = 700 rpm:

ÿ *dzwKUPLFUI* = 0.1016

ÿ *dzwKUPLFOI* = 1.6992

ÿ *dzwKUPLFUL* = 1.7773

ÿ *dzwKUPLFOL* = 9.0

Above the speed threshold dzwK_N_PLF 400 rpm:

ÿ *dzwKOPLFUI* = 0.6563

ÿ *dzwKOPLFOI* = 1.6992

ÿ *dzwKOPLFUL* = 1.7773

ÿ *dzwKOPLFOL* = 9.0

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4 cylinder

For the 4-cylinder, the 60-tooth gear with two gaps is used:

ÿ *dzwK_CZLue* = 28

The location of the WUPs is determined by:

ÿ *dzwK_WP1st* = 144

ÿ *dzwK_WP2st* = 234

ÿ *dzwK_WPSta* = 84

The following data apply for determining the position of the segment and synchronous teeth:

ÿ *dzwKDoS2Sy* = 0

ÿ *dzwKNr0SY1* = - 12

ÿ *dzwKNr0SY2* = 0

ÿ *dzwKNr0SYZ* = 3

ÿ *dzwKNr1SY1* = 6

ÿ *dzwKNr1SY2* = 18

ÿ *dzwKNr1SYZ* = 0

ÿ *dzwKNr2SY1* = - 30

ÿ *dzwKNr2SY2* = - 18

ÿ *dzwKNr2SYZ* = 1

ÿ *dzwKSegZa1* = - 48

ÿ *dzwKSegZa2* = - 36

ÿ *dzwKNoSYZY* = 2

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The following values must be set to check the synchronization.

ÿ *dzwPulMIN* = 7

ÿ *dzwPulMAX* = 7

The following values must be set for redundant synchronization.

ÿ *dzwKMaxQ* = 0.8516

ÿ *dzwKQcNmax* = 1.2031

ÿ *dzwKQcNmin* = 0.8594

ÿ *dzwKRedZyl* = 0

The following applies to the intact classification of the INK signal from dzeVoPlaus to dzeOK:

ÿ *dzwKCWPsok* = 9

The labels for forming the DZG error must be applied as follows:

ÿ *fbwEDZG_DA* = 29

ÿ *fbwEDZG_DB* = 0

ÿ *fbwEDZG_DT* = 0

ÿ *fbwEDZG_SA* = 40

ÿ *fbwEDZG_SB* = 0

ÿ *fbwEDZG_ST* = 0

ÿ *fbwEDZG_UA* = 655350000us

ÿ *fbwEDZG_UB* = 48000us

ÿ *fbwEDZG_UT* = 1

The labels for releasing the classification of the errors *fbbEDZG_D, fbbEDZG_S* and *fbbESEK_S* have the following values:

ÿ *dzwKNFeMin* = 50 rpm

ÿ *dzwKUFeMin* = 9004.6 mV (additional condition for the classification of the error *fbbEDZG_D)*

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3 cylinder

For the 3-cylinder quick start, the 60-tooth gear with three gaps is used:

ÿ *dzwK_CZLue* = 18

The location of the WUPs is determined by:

ÿ *dzwK_WP1st* = 126

ÿ *dzwK_WP2st* = 246

ÿ *dzwK_WPSta* = 90

The following data apply for determining the position of the segment and synchronous teeth:

ÿ *dzwKDoS2Sy* = 1

ÿ *dzwKNr0SY1* = - 96

ÿ *dzwKNr0SY2* = - 84

ÿ *dzwKNr0SYZ* = 0

ÿ *dzwKNr1SY1* = - 60

ÿ *dzwKNr1SY2* = - 48

ÿ *dzwKNr1SYZ* = 2

ÿ *dzwKNr2SY1* = - 60

ÿ *dzwKNr2SY2* = - 48

ÿ *dzwKNr2SYZ* = 2

ÿ *dzwKSegZa1* = - 114

ÿ *dzwKSegZa2* = - 102

ÿ *dzwKNoSYZY* = 1

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The following values must also be set to check the synchronization.

ÿ *dzwPulMIN* = 5

ÿ *dzwPulMAX* = 5

The following values must be set for redundant synchronization.

ÿ *dzwKMaxQ* = 0.8516

ÿ *dzwKQcNmax* = 1.2031

ÿ *dzwKQcNmin* = 0.8594

ÿ *dzwKRedZyl* = 0

ÿ *dzwLSP_Max* = 3

The following applies to the intact classification of the INK signal from dzeVoPlaus (h07) to dzeOK (h00):

ÿ *dzwKCWPsok* = 7

The labels for forming the DZG error must be applied as follows:

ÿ *fbwEDZG_DA* = 21

ÿ *fbwEDZG_DB* = 0

ÿ *fbwEDZG_DT* = 0

ÿ *fbwEDZG_SA* = 35

ÿ *fbwEDZG_SB* = 0

ÿ *fbwEDZG_ST* = 0

ÿ *fbwEDZG_UA* = 655350000us

ÿ *fbwEDZG_UB* = 48000us

ÿ *fbwEDZG_UT* = 1

The labels for releasing the classification of the errors *fbbEDZG_D, fbbEDZG_S* and *fbbESEK_S* have the following values:

ÿ *dzwKNFeMin* = 50 rpm

ÿ *dzwKUFeMin* = 9004.6 mV (additional condition for the classification of the error *fbbEDZG_D)*

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5 cylinder

For the 5-cylinder, the 60-tooth gear is used with a gap:

ÿ *dzwK_CZLue* = 58

The location of the WUPs is determined by:

ÿ *dzwK_WP1st* = 72

ÿ *dzwK_WP2st* = 144

ÿ *dzwK_WPSta* = 66

The following data apply for determining the position of the segment and synchronous teeth:

ÿ *dzwKDoS2Sy* = 1

NW sensor wheel version 1.0 ***cowFUN_5NW = 0***	NW sensor wheel version 2.0 ***COWFUN_5NW = 1***
ÿ *dzwKNr0SY1* = 6	ÿ *dzwKNr0SY1* = 12
ÿ *dzwKNr0SY2* = 18	ÿ *dzwKNr0SY2* = 24
ÿ *dzwKNr0SYZ* = 1	ÿ *dzwKNr0SYZ* = 4
ÿ *dzwKNr1SY1* = -12	ÿ *dzwKNr1SY1* = 30
ÿ *dzwKNr1SY2* = 0	ÿ *dzwKNr1SY2* = 42
ÿ *dzwKNr1SYZ* = 4	ÿ *dzwKNr1SYZ* = 1
ÿ *dzwKNr2SY1* = -12	ÿ *dzwKNr2SY1* = 30
ÿ *dzwKNr2SY2* = 0	ÿ *dzwKNr2SY2* = 42
ÿ *dzwKNr2SYZ* = 4	ÿ *dzwKNr2SYZ* = 1
ÿ *dzwKSegZa1* = -30	ÿ *dzwKSegZa1* = -24
ÿ *dzwKSegZa2* = -18	ÿ *dzwKSegZa2* = -12
ÿ *dzwKNoSYZY* = 1	ÿ *dzwKNoSYZY* = 4

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The following values must also be set to check the synchronization.

ÿ *dzwPulMIN* = 3

ÿ *dzwPulMAX* = 3

The following values must be set for redundant synchronization.

ÿ *dzwKMaxQ* = 0.8516

ÿ *dzwKQcNmax* = 1.2031

ÿ *dzwKQcNmin* = 0.8594

ÿ *dzwKRedZyl* = 0

ÿ *dzwLSP_Max* = 3

The following applies to the intact classification of the INK signal from dzeVoPlaus (h07) to dzeOK (h00):

ÿ *dzwKCWPsok* = 11

The labels for forming the DZG error must be applied as follows:

ÿ *fbwEDZG_DA* = 40

ÿ *fbwEDZG_DB* = 0

ÿ *fbwEDZG_DT* = 0

ÿ *fbwEDZG_SA* = 40

ÿ *fbwEDZG_SB* = 0

ÿ *fbwEDZG_ST* = 0

ÿ *fbwEDZG_UA* = 655350000us

ÿ *fbwEDZG_UB* = 48000us

ÿ *fbwEDZG_UT* = 1

The labels for releasing the classification of the errors *fbbEDZG_D, fbbEDZG_S* and *fbbESEK_S* have the following values:

ÿ *dzwKNFeMin* = 50 rpm

ÿ *dzwKUFeMin* = 9004.6 mV (additional condition for the classification of the error *fbbEDZG_D)*

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control engineering functions

The control unit initially distinguishes between routines that are processed with a constant (time-synchronous) and those with a variable (speed-synchronous) call period.

Time-synchronous algorithms are processed in a fixed time frame (daeHPPER). The program structure ensures that the call period for the speed-synchronous parts remains between 6 ms (computer time load) and 32 ms (mathematics interpretation).

The following control algorithms are made available to the system:

- ÿ P controller with non-linear coefficients
- ÿ I controller with non-linear coefficients, time-synchronous
- ÿ I controller with non-linear coefficients, speed-synchronous
- ÿ Differentiator (DT1 element), time-synchronous
- ÿ Differentiator (DT1 element) with non-linear coefficients, time-synchronous
- ÿ Differentiator (DT1 element), speed-synchronous
- ÿ Low-pass filter (PT1 element), time-synchronous
- ÿ Low-pass filter (PT1 element), speed-synchronous
- ÿ PT2 element, time-synchronous (currently not used)
- ÿ D2T2 element, speed-synchronous (currently not used)
- ÿ PDT1 element, time-synchronous
- ÿ PDT1 element, speed-synchronous
- ÿ PDT1 element, speed-synchronous, with gradient limitation in a definable range

Normalization exponents:

All controller coefficients KP, KI and KD/T1 are provided with a factor 2^normalization exponent in the internal representation, by which the result must be corrected again at runtime.
The normalization exponent is a function of the quantization of the input and output variables of the controller and the required maximum value of the controller coefficient (in the case of DT1 elements, also the required minimum value of the time constant T1). However, since the value is also included in the conversion of the individual coefficients, its value cannot be applied.

The data structures and their application for the individual routines are explained below.

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P controller, I controller (time and speed synchronous)

The coefficients KP [output/input] and KI [output/(input * s)] are respectively given by following structure determined:

..._FEN Small signal window width
..._SIG small signal
..._NEG negative large signal
..._POS positive large signal
..._NEX normalization exponent

If the amount of the control difference (set value - actual value) is smaller than the window width, then the value Small signal ..._SIG used as coefficient. In the case of larger control differences, it becomes dependent of the sign between negative large signal ..._NEG and positive large signal ..._POS distinguished. The transition between large and small signals is continuous, ie does not cause any jump in the initial size.

Given: P window width, KPsmall, KPbigneg, KPbigpos or
I window width, KIsmall, KIbigneg, KIbigpos

Application: Input in physical quantities

Application (example):

P controller: arwPR_..	ARF
ldwPR_..	LDR
mrwADP_..	ADR
mrwLRP_..	LRR
mrwFP2_..	FGR hold
mrwFRP_..	FGR Ramp ON+
mrwFRM_..	FGR Ramp ON
mrwF1W_..	FGR ramp WA
mrwF2W_..	FGR final phase WA
I controller: arwIR_..	ARF
ldwIR_..	LDR
mrwADI_..	ADR
mrwFI2_..	FGR hold
mrwFIW_..	FGR final phase WA

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Time-synchronous DT1 element

Structure:

..._KOF coefficient .._NEX
normalization exponent .._GF memory
factor

For technical reasons, the coefficient _KOF and the memory factor _GF are to be entered instead of the parameters of the differentiator KD [(output * s)/input] and T1 [s], which are to be applied as follows:

Given: KD, T1, (T = constant = daeHPPER)

Application:

..._KOF = KD /
T1 .._GF = eT/T1

Danger! When changing the time constant T1, the corresponding coefficient is .._KOF
to change too!

Application:

ldwDR_.. LDR (for PIDT1 controller)

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Time-synchronous DT1 element with non-linear coefficients

Structure:

..._GFP Memory factor with positive pre-control
..._FEP Small signal window width with positive pre-control
..._SIP positive small signal
positive large signal
..._POS ..._GFN Memory factor with negative pre-control
..._FEN Small signal window width with negative pre-control
..._SIN negative small signal
..._NEG negative large signal
..._NEX normalization exponent

This algorithm uses a transfer function divided into four regions. the
Transitions are continuous. For positive and negative input variable change can be different
Memory factors ..._GFP and ..._GFN are specified. (Zero is considered positive
change in input variable.) Depending on the sign of the input variable, ..._GFP
or ..._GFN used to determine whether the small signal coefficient ..._SIP or ..._SIN or
the large signal coefficient ..._POS or ..._NEG should be used. (Caution: when jumping
at the input, the D gain depends on the direction and size of the jump. Of the
Memory factor and thus the time constant is therefore of the sign of the current
dependent on the input variable after the jump).

Given: KDpossmall, KDposbig, KDnegsmall, KDnegbig, T1pos, T1neg, (T = constant = daeHPPER)

Application:

..._GFP = eT/T1pos
..._FEP = input in physical size
..._SIP = KDposklein / T1pos
..._POS = KDposgross / T1pos
..._GFN = eT/T1neg
..._FEN = input in physical size
..._SIN = KDnegsmall / T1neg
..._NEG = KDnegbig / T1neg

Application:

arwDV_..	ARF pre-tax
ldwWDV_..	LDR pre-tax

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Speed-synchronous DT1 element

Structure:

..._KOF coefficient
..._NEX normalization exponent
quadratic factor
..._a ..._b linear factor
..._c constant

At runtime, this algorithm determines the memory factor eT/T1 as a function of the sampling time. For runtime reasons, the value is approximated by calculating a quadratic polynomial a T2 + b * T + c, whose coefficients must be entered under ..._a, ..._b and ..._c. the
Calculation gives the memory factor in internal representation. The coefficients for
Time constants T1 > 20 ms are optimized according to the smallest square deviation to e (-T/T1), for time constants T1 < 20 ms optimized according to ideal trend behavior with large
Sampling times (ie 1st derivative of approximation = 1st derivative of eT/T1 at T = Tmax = 32 ms). *

Given: KD, T1 Application:..._KOF = KD / T1

Application (example)

mrwLLGWK_..., mrwLLGKK_. LLR hot/cold clutch

T1[s]			.. a
0.0100			8645
0.0123	..._c22099 25127	..._b-9536-10009	8595
0.0151	27524	-9943	7996
0.0185	29303	-9437	7024
0.0228	31552	-9652	7531
0.0280	32034		5781
0.0344	32333	-8322-7063	4323
0.0423	32515	-5924	3162
0.0519	32622	-4926	2273
0.0638	32685		1609
0.0784	32721	-4070-3347	1125
0.0963	32742	-2744	779
0.1183	32753	-2245	535
0.1454	32760	-1833	365
0.1786	32763	-1495	248
0.2194	32765		167
0.2696	32766	-1219-993	112
0.3312	32767		75
0.4070	32767	-809-658	50
0.5000	32767	-536	33

Table 1: Approximate polynomial coefficients for calculating the speed-synchronous Memory factor in internal representation

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Time-synchronous PT1 element

Structure:

.._GF memory factor

Given: T1, (T = constant = daeHPPER)

Application:

.._GF = eT/T1

Exemplary application:

fgwFGF_GF	FGG speed filter
fgwBEF_GF	FGG acceleration filter
fgwVNF_GF	FGG V/N - Filter
mrwPT1_ZPO	PWG - Filter rise above
mrwPT1_ZPU	PWG - Filter rise below
mrwPT1_ZNO	PWG - Filter waste above
mrwPT1_ZNU	PWG - Filter waste below
ldwLDF_GF	LDF filters
kmwPT1_ZP	Thermostat filter rise ATTENTION: T=100ms
kmwPT1_ZN	Thermostat filter waste ATTENTION: T=100ms

Speed-synchronous PT1 element

Structure:

.._a quadratic factor

.._b linear factor

.._c constant

Given: T1

Application:

.._a, .._b, .._c The coefficients closest to the desired time T1 are the
Taken from Table 1 and can only be changed together.

Application: dzwNWFi1_...

dzwNWFi2_...

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Time-synchronous PT2 element

Structure:

.._b2 initial assessment b2

.._b1 initial assessment b1

.._a2 memory factor a2

.._a1 memory factor a1

Given: T1, T2, (T = sampling time = daeHPPER)

Application: non-oscillating PT2

.._b2 = (T2 * eT/T1 * (1-eT/T2) - T1 * eT/T2 * (1-eT/T1)) / (T1-T2)

.._b1 = (T1 * (1-eT/T1) - T2 * (1-eT/T2)) / (T1-T2)

.._a2 = -eT/T1 * eT/T2

.._a1 = eT/T1 + eT/T2

Given: T1 (time constant) =1/ÿ0,

D (damping factor) < 1

T (sample time) = daeHPPER

ÿ = sqrt(1 - D2) / T1

Application: Overshooting PT2

.._b2 = $ED^{* T/T1} * (eD$ - cos(ÿ* T) + sin(ÿ* T) * D/(ÿ* T1))

.._b1 = $1 - eD$ * T/T1 * (cos(ÿ* T) + sin(ÿ* T) * D/(ÿ* T1))

.._a2 = $-e-2^{*D*T/T1}$

.._a1 = $2* eD$ * T/T1 * cos(ÿ* T)

Application: currently not activated

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Speed-synchronous D2T2 element

Structure:

.._T2 time constant adjustment value

.._KD differential amplification factor

.._NEX normalization exponent

Given: KD, T1, T2

Application:

.._T2 = 1/T2 - 1/T1

.._KD = KD * T1 / (T2)2

Application: currently not activated

Time-synchronous PDT1 element (Lead Lag)

Structure:

....._KOF coefficient
....._NEX normalization exponent
....._GF memory factor

Laplace transfer function: $F(s) = \frac{1 + t_z s}{1 + T_1 s}$

Given:

TZ, T1 (T = constant = daeHPPER)

Application:

....._GF = $e^{-T/T1}$

....._KOF = TZ / T1

Application: currently none

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Speed-synchronous PDT1 element (Lead Lag)

Structure:

- ....._KOF coefficient
- ....._NEX normalization exponent
- quadratic factor
- ....._a ....._b linear factor
- ....._c constant

Laplace transfer function: $F(s) = \frac{1 + ts_2}{1 + Ts_1}$

Application:

....._KOF = TZ / T1

.._a, .._b, .._c The coefficients closest to the desired time T1 are the Taken from Table 1 and can only be changed together.

Speed-synchronous PDT1 element (lead lag) with gradient limitation in one definable area

Structure:

- ....._KOF coefficient
- ....._NEX normalization exponent
- quadratic factor
- ....._a ....._b linear factor
- ....._c constant

Input variables:

- max ramp gradient
- upper limit of the range
- lower limit of the range

Laplace transfer function: $F(s) = \frac{1 + ts_2}{1 + Ts_1}$

Application:

....._KOF = TZ / T1

.._a, .._b, .._c The coefficients closest to the desired time T1 are the Taken from Table 1 and can only be changed together.

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power amplifiers

power amp building blocks

The label ehwCJ4_ANZ specifies the number of available power stages. The building block CJ920 has 14 physical plus 2 dummy power amplifiers; it carries than 16 logical output stages. Of the The CJ420 component has 4 logical output stages. If fewer power amplifiers are used, then nevertheless the number of equipped power amplifiers can be applied, otherwise not all Output stage errors can be diagnosed.

ehwCJ4_ANZ Number of output stages	
20	20 logical output stages available

The labels ehwCJ4_Nxx define the connection between the computer port pin and the power stage for the final stage diagnosis.

Application for EDC15P+:

	value EDC15P+	port EDC15P+	SG pin EDC15P+	Pin code designation	meaning	PWM parameter
ehwCJ4_N01	C0h	7.0	81	DKS-0	PWM capable	ehwuCP0_FR ehwuCP0_TEÿ1
ehwCJ4_N02	C2h	7.1	61	ARS-0	PWM capable	ehwuCP1_FR ehwuCP1_TEÿ1
ehwCJ4_N03	7Ah	XP0.13	60	KTH-0	PWM	ehwGA_PWM2
ehwCJ4_N04	86h	XP1.3	42	GRL-0	digital	
ehwCJ4_N05	88h	XP1.4	40	SYS-0	digital	
ehwCJ4_N06	2Ah	2.5	22	TAV-0	PWM capable	ehwEST_T1
ehwCJ4_N07	2Eh	2.7	21		PWM capable	ehwEST_T1
ehwCJ4_N08	52h	3.9	43	KSK-0	PWM capable	ehwEST_T1
ehwCJ4_N09	8Ah	XP1.5	24	MIL-0	digital	
ehwCJ4_N10	C4h	7.2	62	LDS-0	PWM capable	ehwuCP2_FR ehwuCP2_TEÿ1
ehwCJ4_N11	38 hours	2.12	11	HYL-0	PWM capable	ehwEST_T1
ehwCJ4_N12	3Ah	2.13	41	GSK2-0	PWM capable	ehwEST_T1
ehwCJ4_N13	A6h	XP2.3	80	EKP-0-0	digital	
ehwCJ4_N14	A0h	XP2.0	29	KLI-0	digital	
ehwCJ4_N15	FFh	-	-	-	-	-
ehwCJ4_N16	FFh	-	-	-	-	-
ehwCJ4_N17	7h	XP0.14	23 MML1-0 79		PWM	ehwGA_PWM3
ehwCJ4_N18	78h	XP0.12		GEN-0	PWM	ehwGA_PWM1
ehwCJ4_N19	A4h	XP2.2	21	RL1-0	digital	
ehwCJ4_N20	A2h	XP2.1	77	RL2-0	digital	
-	CEh	7.7	9	GRS-0	PWM	ehwEST_T8

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The number of power stages that cannot be diagnosed is specified in ehwNDIG_NO:

	EDC15P+
ehwNDIG_NO	0

Machine port pin values:

Port 1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	1.11 1.12 1.13 1.14 1.15			
Value 00 02 04			06	08 0A 0C 0E				10	12	14	16	18 1A 1C		1E
Port 2.0 2.1		2.2 2.3 2.4 2.5				2.6 2.7		2.8	2.9	2.10 2.11 2.12 2.13 2.14 2.15				
Value 20 22 24 26				28 2A 2C 2E				30	32	34	36	38 3A 3C 3E		
Port 3.0 3.1 value 40		3.2 3.3 3.4			3.5 3.6 3.7 3.8 48 4A 4C 4E				3.9	3.10				
42 44 46				50					52	54				
port				4.4 4.5 4.6 4.7										
value				68 6A 6C 6E										
port												X0.12 X0.13 X0.14		
value												78 7A 7C		
Port X1.0 X1.1 X1.2 X1.3 X1.4 X1.5 X1.6 X1.7 X1.8 X1.9 X1.10 X1.11 X1.12 X1.13 X1.14														
value 80	82	84	86	88 8A 8C 8E				90	92	94	96	98 9A 9C		
Port X2.0 X2.1 X2.2 X2.3 X2.4 X2.5 X2.6 X2.7 xPWM1 xPWM2 xPWM3														
Value A0 A2 A4 A6 A8 AA AC AE B0									B2	B4				
Ports 7.0 7.1 7.5 7.7		7.2 7.3 7.4				7.6								
Value C0 C2 C4 C6 C8 CA CC CE														
Ports 8.0 8.1 8.3 8.5 8.7	8.2			8.4		8.6								
Value E0 E2 E4 E6 E8 EA EC EE														

In addition, the possibility of early initialization (i.e. before a
Consideration of ehwEST_xxx.12) granted:

	15	14	13	12	11	10	9				8th	7	6		5	4		3	2	1	0
cowP2INEST				GK2	KVS							EKP			TAV						
cowP3INEST										KSK											
cowP7INEST												GRS						GDP PWM	LDS	AR1	DKS
cowP8INEST																			TDS	PBM	TQS

If the corresponding bit is set, the corresponding output is activated during initialization
set to +Ubatt; if the bit is not set, to -Ubatt .
Fields with a gray background are ignored.

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Encoder passwords ehwEST_..

There is an encoder password ehwEST_.. for each logical output stage. Any logical final stage that is used must be applied. In the low byte, the value of the physical
Power stage ehwCJ4_N.. entered. This is the link between logical and
physical power amplifier applied. More encoder passwords are applied than logical output stages are present, a restart takes place.

The type
of use are applied:

meaning	bit value	value
amp not used	0100h	0
Output stage uses		1
digital output stage	0200h	0
PWM - output stage		1
output stage not UBatt - corrected	0400h	0
output stage UBatt - corrected PWM-		1
TV not limited PWM-TV limited	0800h	0
between 5 and 95% Initialization level		1
UBatt Initialization level -UBatt Output not	1000 hours	0
inverted Output inverted Driving software		1
has access to the output stage Output	2000h	0
stage in the run-on Set the level of bit 15		1
to -Ubatt for bit 14 in the run-on. Set to +Ubatt	4000 hours	0
for bit 14 in the run-on		1
	8000h	0
		1

Application example:

record label	**SG pin** HW21.1 (20.1)	**EDC15P+ FEDCBA 9 8**								
ehwEST_AR1	ARS-0	0FC2H					1	1	1	1
ehwEST_AR2	DKS-0	EFC0H 1		1	1		1	1	1	1
ehwEST_AR3	GEN-0 (RL1-0)	0178H								1
ehwEST_DIA	SYS-0	4188H		1						1
ehwEST_GAZ	-	0088H								
ehwEST_GER	KVS-0	3138H			1	1				1
ehwEST_GK1	ZH1-0	41A6H		1						1
ehwEST_GK2	ZH2-0	413AH		1						1
ehwEST_GK3	ZHB-0	0000H								
ehwEST_GRS	GRL-0	4986H		1			1			1
ehwEST_KLI	KLI B	21A0H			1					1
ehwEST_KSK	KSK-0	0152H								1
ehwEST_LDS	LDS-0	6FC4H		1	1		1	1	1	1
ehwEST_MIL	MIL-0	418AH		1						1
ehwEST_ML1	MML1-0	017CH								1
ehwEST_ML2	RL2-0	01A2H								1
ehwEST_TST	KTH-0	017AH								1
ehwEST_TAV	TAV-0	002AH								
	EKP-0	00A6H								

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Special features for the ASIC PWM unit

The frequency for the three ASIC PWM generators is applied via the label *ehwGA_PWMx .*
The generators are assigned to the output stages via the encoder password.

PWM generator	Pin (for encoder password)	Frequency [Hz] applicable via ...
1	78H	*ehwGA_PWM1*
2	7AH	*ehwGA_PWM2*
3	7CH	*ehwGA_PWM3*

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Appendix B Definition of group numbers

The assignment of display group - measuring channel can be applied. The representation of the individual channels can be seen as an example (on the VAG tester, individual channels or measured values may be missing or be applied differently):

channel 00

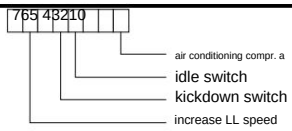
Display group number 00									
engine speed	conveyor beginning	pedal value giver	A spritz amount	suction pipe pressure	atmospheric pressure	water temperature	suction tube temperature	power fabric tem temperature	ARF actual value

Channel 01 amount adjustment

Display group number 01			
engine speed	injection quantity	Delivery duration target value	water temperature

Channel 02 idle speed

Display group number 02			
engine speed	pedal sensor	Switch positions 1	water temperature



Channel 03 exhaust gas recirculation

Display group number 03			
engine speed	ARF_setpoint	ARF_actual value	duty cycle ARF

Channel 04 activation of solenoid valves

Display group number 04			
engine speed	Delivery start target value	Delivery duration target value	Twisting angle NW

Channel 05 starting set

Display group number 05			
engine speed	starting amount	Start synchronization	water temperature

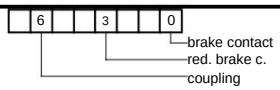
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Channel 06 switch position

Display group number 06			
Driving speed	Switch positions 2 pedal value sensors		FGR mode



00 = FGR not working
01 = OFF
02 = ON+
04 = ON
08 = resume
16 = brake
32 = hold
64 = transition from ON+
128 = transition from ON
255 = FGR locked

Channel 07 temperatures

Display group number 07			
Fuel temperature	Fuel circuit final stage	Intake pipe temperature	Water temperature

Channel 08 limiting quantities 1

Display group number 08		
engine speed	Driver's desired amount of torque limit.	smoke control

Channel 09 limiting quantities 2

Display group number 09			
engine speed	quantity GRA	Transmission intervention quantity	Limitation quantity

Channel 10 air sizes

Display group number 10		
air volume	Atmospheric pressure boost pressure actual value	pedal sensor

Channel 11 charger control

Display group number 11		
engine speed	Boost pressure target value Boost pressure actual value	duty cycle LDR

Channel 12 preheat

Display group number 12			
glow status	Preheating time [s]	battery voltage	water temperature

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Channel 13 smooth running control

Display group number 13			
LRR injection rate cylinder 1	LRR injection rate cylinder 2	LRR injection rate cylinder 3	LRR injection rate cylinder 4

Channel 14 smooth running control

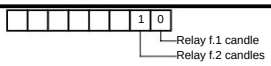
Display group number 14			
LRR injection rate cylinder 5	LRR injection rate cylinder 6		

Channel 15 consumption

Display group number 15		
engine speed	injection quantity	Fuel consumption driver's desired amount

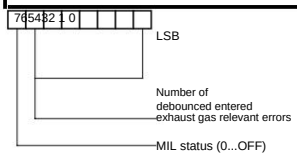
Channel 16 cooling water heater

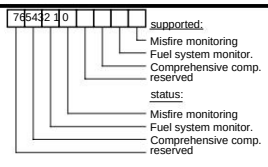
Display group number 16		
averaged generator	Switch-off conditions switching output KWH battery voltage last	

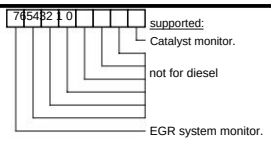


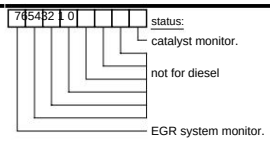
Channel 17 CARB Mode 01, PID 01 Data A, B, C, D (Readiness)

Display group number 17			
Data A	Data B	Data C	Data D









Channel 18 status solenoid valves

Display group number 18			
cylinder 1	cylinder 2	cylinder 3	cylinder 4

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Channel 19 status solenoid valves

Display group number 19			
cylinder 5	cylinder 6		

Channel 20 Injection quantity intervention by ABS via CAN

Display group number 20			
engine speed	engine torque	Brake intervention ASR brake intervention MSR	

Channel 21 status drive CAN

Display group number 21			
engine control unit	Transmission control unit brake status ASR brake status MSR		

Channel 22 Shutdown Status

Display group number 22			
FGR switch-off status exhaust gas recirculation	Boost pressure control switch-off status climate		

channel 23

Display group number 23			

Channel 24 exhaust gas recirculation

Display group number 24			
ARF setpoint	ARF actual value	Duty Cycle ARF ARF Status	

Channel 25 boost pressure control

Display group number 25			
LDR setpoint	LDR actual value	Duty Cycle LDR LDR Status	

Channel 26 master checksum

Display group number 26			
		master checksum	

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Channel 27 ADR ramp-up time

Display group number 27			
Variable ADR maximum speed	Fixed ADR speed		

Channel 28 variable ADR maximum speed

Display group number 28			
Variable ADR maximum speed	Fixed ADR speed		

Channel 29 fixed ADR speed

Display group number 29			
Variable ADR maximum speed	Fixed ADR speed		

Attention: The output to the VAG tester only occurs after the calculation is complete! Shows the Tester gives the value 0, so the calculation is not yet complete. The calculation will only carried out when the speed is zero. If the speed is greater than zero during the calculation the calculation is stopped. It will continue when the speed returns to zero reached.

Channel 80 ECU identification

Display group number 80			
factory code	manufacturing date	change status	PAM node fld. No.

Change status ... xcwSGBlk3

Channel 125 CAN info

Display group number 125							
drink	0/1 ABS	0/1	station wagon	0/1	climate	0/1	

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Assignment of the messages switch positions x (xcmSCHALTx):

xcmSCHALT1 Message		
Bit 0:	mrmCAN_KLI.4	Compressor condition from climate 1
Bit 3:	dimLGS	idle switch
Bit 4:	dimKIK	Kickdown switch
Bit 6:		increased idle speed (mrmN_LLBAS> mrmLL_ZIEL)
xcmSWITCH2		
Bit 0:	dimBRE	brake contact
Bit 3:	dimBRK	redundant brake contact
Bit 6:	dimKUP	coupling
xcmSWITCH3		
Bit 0:	dimBRE	brake contact
Bit 1:	dimBRK	redundant brake contact
Bit 2:	dimKUP	coupling
Bit 3:	dimKIK	kickdown signal
Bit 4:	dimKLI	air conditioning
Bit 5:	dimLGS	idle switch
Bit 6:		increased idle speed (mrmN_LLBAS> mrmLL_ZIEL)
xcmSWITCH4		
Bit 0:	dimBRE	brake contact
Bit 1:	dimBRK	redundant brake contact
Bit 2:	dimKUP	coupling
Bit 3:	comFGR_opt	FGR/ACC enabled via login (comFGR_opt non-zero)
xcmSWITCH5		
Bit 0:	dimADP	ADR Plus
Bit 2:	dimADM	ADR minus
Bit 3:	dimHAN	handbrake contact
Bit 6:	dimADR	ADR a
Bit 7:	dimADW	ADR recovery (LT2 keypad)

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Appendix C Scheduling

The timing of the software (the scheduling) is already in this document for some functions have been briefly mentioned. However, there is one for the detailed consideration of temporal processes Overview of the different activation grids required. All functions are divided into software sub-functions (tasks), which clearly follow a specific activation grid assigned (see table below).

activation grid

function	activation period	
Function distributor BIP synchronous	interrupt	100µs
Function distributor WUP synchronous	interrupt	1.5ms
Speed-synchronous VBS generation	interrupt	1.5ms
BIP evaluation for 2nd switch-off threshold direct interrupt		1.5ms
analog value acquisition	time	1ms
DZG timeout monitoring	time	2ms
communication handler	time	2ms
Function distributor segment synchron	interrupt	3.5ms
speed-synchronous speed calculation and monitoring	Function distributor Segm. Snc.	5ms ... 32ms
speed-synchronous analog value evaluation	Function distributor Segm. Snc.	5ms... 32ms
speed-synchronous part LLR	Function distributor Segm. Snc.	5ms ... 32ms
speed-synchronous part ARD	Function distributor Segm. Snc.	5ms ... 32ms
speed-synchronous part LRR	Function distributor Segm. Snc.	5ms... 32ms
misfire detection	Function distributor Segm. Snc.	5ms ... 32ms
speed-synchronous quantity calculation	Function distributor Segm. Snc.	5ms ... 32ms
speed-synchronous PDE functions	Function distributor Segm. Snc.	5ms... 32ms
McMess speed-synchronous output	Function distributor Segm. Snc.	5ms ... 32ms

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Software timer handler	time	10ms
periodic test	time	10ms
McMess interpreter	time	10ms
GSK3 - diagnosis	time	10ms
fast analog value evaluation	time	20ms
digital inputs	time	20ms
Time-synchronous segment processing (Assembl.) Time		20ms
FGG calculation and recording	time	20ms
starting amount	time	20ms
Quantity request_PWG	time	20ms
Quantity request_FGR	time	20ms
Quantity request_HGB	time	20ms
Quantity request_ADR	time	20ms
limit quantity	time	20ms
CAN station management	time	20ms
CAN interaction layer: receive task	time	20ms
Evaluate CAN messages	time	20ms
External crowd intervention	time	20ms
Ecomatic	time	20ms
CAN output engine messages	time	20ms
CAN interaction layer: Send task	time	20ms
Parameter selection for ARD/LLR	time	20ms
Combustion detection in boost	time	20ms
tracking and monitoring	time	20ms
follow-up control	time	20ms
ARF setpoint calculation air mass	time	20ms
ARF actual value acquisition air mass	time	20ms
ARF control, monitoring, output	time	20ms
Boost pressure setpoint calculation	time	20ms
Charging, intake manifold pressure calculation	time	20ms
Charge, intake manifold pressure control/monitoring time		20ms
A/C compressor shutdown fast	time	20ms

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power amplifier output	time	20ms
Command interpreter immobilizer	time	20ms
Command interpreter RB diagnosis	time	20ms
Command interpreter KP2000 (CARB)	time	20ms
cycle management	time	20ms
MUX signal calculation	time	20ms
Error handling OBDII	time	20ms
Runtime Determination	time	20ms
slow analog value evaluation	time	100ms
Power stage error detection	time	100ms
Diagnosis lamp control	time	100ms
glow time control	time	100ms
cooling water heating	time	100ms
hour meter	time	100ms
A/C compressor shutdown	time	100ms
Radiator Fan Control	time	100ms
Calculation for consumption signal (VBS)	time	100ms
engine mount control	time	100ms
slow diagnosis	time	100ms
Target idle speed calculation	time	100ms
Coolant thermostat control	time	100ms
flexible service interval display	time	100ms
fuel cooling	time	100ms
electronic fuel pump	time	100ms
EPROM test	Background < 100ms	
EEPROM handler	Background < 100ms	
PWM handler	time	750ms
GDP tracking	time	750ms

The largest part of the software sub-functions is time-controlled and is located in the 20 ms activation grid ("main program disc"). This is shown in the table above processed in the order that can be seen. The basic rule for the order is to minimize the Throughput times through the sequence: inputs - preparation - processing - outputs.

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The activation "Function distributor segment synchronous" is actually about the
"Speed-synchronous disc" ("N_SYNC"). However, the tasks become dependent on the
Function distributor executed. In principle, this is synchronous to the speed sensor pulses -
however, the operating system deliberately restricts software activation with a minimum period of 6 ms. This is mainly used to limit the
computer load. With this construction, depending on the speed, the following results
Behavior:

Activation of the "speed-synchronous disc" at different speeds on the 4-cylinder
Engine (4 DZG impulses / crankshaft revolution):

rotational speed	period	activation	activation rate
0 - 468 rpm 32ms		timed	(1/32ms)
468 - 2500 rpm 32 ms	- 6 ms	DZG-synchronous (prescaler 1)	2 * fign
2500 - 5000 rpm 12 ms	- 6 ms	DZG-synchronous (advance 2)	1 * fign
5000 - 7500 rpm 9 ms	- 6 ms	DZG-synchronous (advance 3)	0.66 * fign
7500 -10000 rpm 8 ms	- 6 ms	DZG-synchronous (prescaler 4)	0.5 * fign
>10000 rpm 6ms		timed	(1/6ms)

maximum throughput times of "critical paths"

For the reactions of various control unit functions (e.g. controller) to external events
different maximum throughput times result according to the scheduling. For some
relevant, selected examples ("critical paths") should be used in the following paragraphs
The (maximum) throughput time caused by the ECU software can be specified (without taking filters into account).
The throughput times are made up of different parts:

- Latency: Delay time for a "pending" event (interrupt) until it occurs
  editing
- Period: Repeat time for periodic activations (corresponds to time-controlled
  tasks of the max. latency time)
- Runtime: Execution time for processing a task cycle

The times specified below (in particular latency and run times) are based on experience
of the previous generation of control units (EDC15) and therefore do not represent "exact" values
rather upper limits.

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Path: HFM analog input ARF output stage

fast analog value evaluation period	20.0ms
+ main program slice run time =	15.0ms
maximum run time	35.0ms

Path: pedal position sensor CAN output (engine 1 message)

Analog value acquisition period * 3 (analog multiplexer)	3.0ms
+ fast analog value evaluation period	20.0ms
+ main program slice run time =	15.0ms
maximum run time	38.0ms

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Appendix D List of environmental conditions

Message numbers are used to apply measured values in data record parameters (e.g environmental conditions for signal path parameters). Each message number is fixed with one Provide conversion parameters that convert from the internal representation to an external one appearance. These conversion parameters are also used for all those values that be transmitted via an external interface and for which no conversion characteristic is present (e.g. external quantity intervention - CAN).

The conversion using the conversion parameter is carried out according to the following formulas:

Slope not equal to 0:

from internal to external: EXT = slope * INT + offset

from external to internal: INT = (EXT - Offset) / Slope

Slope equal to 0:

Instead of multiplication, the following shift operation is used:

EXT = INT shifted by OFFSET.

If OFFSET is positive, it is shifted to the right. This conversion was specially designed for Error storage of status words introduced.

The following also applies to conversions for diagnosis (xcwUMRD...), output via KW71 protocol:

If the gradient is 0, the high byte is truncated.

If the gradient is not 0, the limit is set to a minimum of 0 and a maximum of 255.

The following also applies to conversions for CAN (xcwUMRC...):

If the gradient is 0, the value is accepted indefinitely provided it is in the available Transmission size fits.

If the slope is not equal to 0, it is limited to the respective minimum and maximum values.

The conversion parameters have the following structure:

Surname	description
xcwUMRFS..	Gradient for error memory
xcwUMRFO ..	Offset for error memory
xcwUMRDS ..	gradient for diagnosis
xcwUMRDO ..	Offset for diagnostics
xcwUMRCS ..	slope for CAN
xcwUMRCO ..	Offset for CAN

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The following parameters are used to convert the PIDs according to SAE J1979:

Surname	description
xcwCARFS..	Gradient for error memory
xcwCARFO..	Offset for error memory
xcwCARDS..	gradient for diagnosis
xcwCARDO..	Offset for diagnostics
xcwCARCS ..	slope for CAN
xcwCARCO ..	Offset for CAN

The following conversions ("..") are defined:

xcwCAR..D	Conversion of pressures for OBD II output
xcwCAR..dT	Conversion of temperature difference for output according to OBD II
xcwCAR..L	Conversion of air mass in g/s for output according to OBD II
xcwCAR..M	Conversion of quantities for output according to OBD II
xcwCAR..N	Conversion of speeds for output according to OBD II
xcwCAR..P	Conversion of accelerator pedal position for OBD II output
xcwCAR..T	Conversion of temperatures for output according to OBD II
xcwCAR..UD	Conversion of digital voltages for output according to OBD II
xcwCAR..V	Conversion of speeds for OBD II output
xcwCAR..W	Conversion angle according to OBD II
xcwCAR..Z	Conversion software timer for output according to OBD II
xcwUMR.._1	Conversion 1 to 1
xcwUMR. .256	Conversion "high byte"
xcwUMR.._B	Conversion acceleration
xcwUMR.._D	Conversion pressures
xcwUMR.._E	Conversion of output stage specifications
xcwUMR.._I	Conversion currents
xcwUMR..KT	Conversion of fuel temperature for non-normalized measured value output
xcwUMR.._L	Air mass conversion
xcwUMR..LA	conversion load
xcwUMR..LT	Conversion of air temperature for non-standard output of measured values
xcwUMR.._M	Conversion quantities
xcwUMR..MD	Conversion difference quantity
xcwUMR.._N	Conversion of speeds
xcwUMR.._8	8-bit speed conversion
xcwUMR..nD	Conversion of pressure for non-normalized measured value output
xcwUMR..nL	Conversion of air mass for non-normalized measured value output
xcwUMR..nW	Conversion of angles for non-normalized measured value output
xcwUMR.._P	Conversion of accelerator pedal position
xcwUMR.._T	Conversion temperatures
xcwUMR..UA	Analog voltage conversion (=supply voltage)
xcwUMR..UD	Conversion of voltages to digital
xcwUMR.._V	conversion speeds
xcwUMR..VB	Conversion consumption
xcwUMR.._W	Conversion angle
xcwUMR.._WR	Conversion angle relative to TDC
xcwUMR..WT	Conversion of water temperature for non-normalized measured value output

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xcwUMR.._Y Conversion v to N
xcwUMR.._Z Conversion software timer

The following list contains all defined message numbers (hexadecimal) and their conversion xcwUMR..(see above) and their designation:

0x0004 mrmCLV	xcdCARBM Calculated load value	
0x0005 anmWTF	xcdCARBT water temperature	
0x000B ldmP_Llin xcdCARBD Charge or intake manifold pressure ACTUAL VALUE		
0x000C dzmNmit 0x000D	xcdCARBN speed	
fgmFGAKT 0x000F anmLTF	xcdCARBV Current driving speed ACTUAL	
	xcdCARBT air temperature	
0x0010 xcmM_List xcdCARBL Current air mass ACTUAL in mg/s		
0x0011 anmPWG	xcdCARBP analog value pedal value sensor	
0x0E00 edmRSTCD	xcdUMR1	restart code
0x0E02 mrmN_LLBAS xcdUMRN 0x0E80 ehmFARS		Target idle speed
xcdUMRE		Exhaust gas recirculation actuator1
0x0E81 ehmFLD_DK xcdUMRE 0x0E82 ehmFLDK		Boost pressure / throttle valve actuator
xcdUMRE		exhaust gas recirculation actuator2
0x0E87 ehmFGRS	xcdUMRE	glow relay actuator
0x0E88 ehmFAR3	xcdUMRE	3. EGR valve
0x0E8A ehmFTAV	xcdUMRE	tank shut-off valve
0x0E8F ehmFZWP	xcdUMRE	lag pump
0x0E91 ehmFKLI0	xcdUMRE	Climate control output 0
0x0E96 ehmFDIA 0x0E98	xcdUMRE	diagnostic lamp
ehmFGER 0x0E99	xcdUMRE	electric fan
ehmFGSK1 0x0E9A	xcdUMRE	Gluehstift1 (cooling water heater)
ehmFGSK2 0x0E9B ehmFMIL	xcdUMRE	Gluehstift2 (cooling water heater)
0x0E9C ehmFGSK3 0x0E9D	xcdUMRE	MIL lamp
ehmFHYL 0x0E9F ehmFML1	xcdUMRE	3. EGR valve
0x0EAA ehmFKSK	xcdUMRE	hydrofan
	xcdUMRE	End stage motor bearing1
	xcdUMRE	Fuel cooling final stage
0x0EAC ehmFTST	xcdUMRE	coolant thermostat
0x0EB0 ehmSARS	xcdUMR256 exhaust gas recirculation actuator	
0x0EB1 ehmSLD_DK xcdUMR256 boost pressure / throttle actuator		
0x0EB2 ehmSLDK	xcdUMR256 Throttle Positioner	
0x0EB7 ehmSGRS	xcdUMR256 glow relay controller	
0x0EB8 ehmSAR3	xcdUMR256 3. EGR valve	
0x0EB9 ehmSEKP	xcdUMR256 EKP	
0x0EBA ehmSTAV	xcdUMR256 TAV	
0x0EBD ehmSHYL	xcdUMR256 hydro fan	
0x0EBF ehmSZWP	xcdUMR256 lag pump	
0x0EC1 ehmSKLI0	xcdUMR256 climate control output 0	
0x0EC6 ehmSDIA	xcdUMR256 diagnostic lamp	
0x0EC8 ehmSGER	xcdUMR256 electric fan	
0x0EC9 ehmSGSK1	xcdUMR256 Gluehstift1 (cooling water heater)	
0x0ECA ehmSGSK2	xcdUMR256 Gluehstift2 (cooling water heater)	
0x0ECB ehmSMIL	xcdUMR256 MIL lamp	
0x0ECF mrmM_EPUMP xcdUMRM		M_E injection quantity before pump map
0x0ED0 ehmFARSi xcdUMRE		ARS inverted
0x0ED1 ehmFLD_DKi xcdUMRE		LDS inverted
0x0ED2 ehmD_FARS xcdUMRE 0x0ED4		ARS
xcmD_F_ML1 xcdUMRE 0x0ED5 xcmD_F_ML2		ML1
xcdUMRE 0x0ED6 xcmD_F_MIL xcdUMRE 0x0ED7		ML2
xcmD_F_LDK xcdUMRE xcdUMR1 0x0EE0		MIL
aroREG_2 0x0EE1 klmSTAT		AR2
		ARF status regulation / control / shutdown
	xcdUMR1	KLMS shutdown status
0x0EE2 klmSTAT	xcdUMR256 KLMS shutdown status	
0x0EE4 kumNL_akt xcdUMR1		Cooler fan run-on

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0x0EE8 ehmFEKP		xcdUMRE	Electric Fuel Pump
0x0EFA ehmSTST		xcdUMR256 coolant thermostat	
0x0F00 anmWTF		xcdUMRT	water temperature
0x0F01 anmLTF		xcdUMRT	air temperature
0x0F02 anmKTF		xcdUMRT	fuel temperature
0x0F03 anmWTF		xcdUMRWT water temperature	
0x0F04 anmLTF		xcdUMRLT Air temperature	
0x0F05 anmKTF		xcdUMRKT fuel temperature	
0x0F06 anmWTK		xcdUMRT	water temperature (at the radiator outlet)
0x0F07 anmOTF		xcdUMRT	oil temperature sensor
0x0F08 fgmFGAKT Current driving speed ACTUAL		xcdUMRV	
0x0F09 mrmFG_SOLL xcdUMRV driving speed TARGET			
0x0F0A fgmBESCH xcdUMRB acceleration			
0x0F0B fgm_VzuN Ratio of driving speed to N		xcdUMRY	
0x0F0C mrmV_SOLHN xcdUMRV HGB: Follow-up target speed			
0x0F0D mrmV_SOLEE xcdUMRV HGB: maximum speed			
0x0F0E anmWTK xcdUMRT		xcdUMRWT water temperature (at the cooler outlet)	
0x0F0F anmHZA 0x0F10	Heating request		
dzmNwith xcdUMRN speed			
0x0F11 dzmNSEG xcdUMRN Secondary speed			
0x0F1F zmmSINKsyn xcdUMR1 N signal processing sync status			
0x0F2D armM_LBiT xcdUMRL Current air mass ACTUAL			
0x0F30 armM_List xcdUMRL 0x0F32 armM_Lsoll			Current air mass ACTUAL
xcdUMRL 0x0F40 ldmP_Llin xcdUMRD 0x0F42			Target value for ARF control
ldmP_Lsoll xcdUMRD 0x0F45 ldoRG_BER xcdUMR1			Charge or intake manifold pressure ACTUAL VALUE
0x0F46 ldoRG_BER xcdUMR256 LDR status			Target value for ATL/DK (loader)
			LDR status
0x0F4A ldmGLTV Start of		xcdUMRE	loader adjustment
0x0F54 fnmWTF	injection water temperature	xcdUMRT	
0x0F56 zmmFBsoll xcdUMRWR Start of conveyor target angle			
0x0F57 zmmFDsoll xcdUMRW			Delivery time target angle
0x0F58 zmoCMVONHE xcdUMRWR start of current			
0x0F59 zmoCMVOFHE xcdUMRWR end of current			
0x0F5A zmoBPSdef1 xcdUMR1			BIP defect status cyl.1
0x0F5B zmoBPSdef2 xcdUMR1			BIP defect status cyl.2
0x0F5C zmoBPSdef3 xcdUMR1			BIP defect status cyl.3
0x0F5D zmoBPSdef4 xcdUMR1			BIP defect status cyl.4
0x0F5E zmoBPSdef5 xcdUMR1			BIP defect status cyl.5
0x0F5F zmoBPSdef6 xcdUMR1 BIP defect status cyl.6			
0x0F60 anmPWG		xcdUMRP	analog value pedal value transmitter
0x0F61 anmLMM		xcdUMRP	analog value air flow meter/HFM
0x0F62 anmLDF		xcdUMRD	Analog value charge/intake manifold pressure
0x0F63 anmADF		xcdUMRD	atmospheric pressure
0x0F65 anmUBATT		xcdUMRUA	battery voltage
0x0F67 armM_List xcdUMRnL Analog value air flow meter/HFM			
0x0F68 anmADF		xcdUMRnD Analogue value of atmospheric pressure	
0x0F6A anmKMD		xcdREVERSE	Refrigerant pressure climate
0x0F70 dimDIGpre1 xcdUMR1			Digital_Inputs_debounced
0x0F71 dimDIGpre1 xcdUMR256 Digital_Eingaenge_debounced high			
0x0F72 dimDIGpre2 xcdUMR1			Digital_Inputs_debounced
0x0F73 dimDIGpre2 xcdUMR256 Digital_Eingaenge_debounced high			
0x0F74 camSTATUS0 xcdUMR1			CAN controller status
0x0F7F mrmSTATUS xcdUMR1			Application status
0x0F80 mrmM_EAKT xcdUMRM 0x0F81			Current injection quantity
mrmM_EAG4 xcdUMRM 0x0F82 mrmM_ESTAR			AG4 intervention set
xcdUMRM 0x0F83 mrmPWGfi xcdUMRP			starting amount
			Filtered PWG position
0x0F84 mrmM_EPWG xcdUMRM 0x0F85			Desired quantity_PWG
mrmM_EFGR xcdUMRM 0x0F86 mrmM_EWUNF			Desired quantity_FGR
xcdUMRM 0x0F87 mrmPWGPBM xcdUMRP			Desired quantity_driver
			PWG for AG4 recalculated
0x0F88 mrmFGR_roh xcdUMRM			Desired quantity_FGR_unlimited

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0x0F89 mrmM_EMSR xcdUMRM 0x0F8A		Desired quantity MSR
mrmM_EBEGR xcdUMRM 0x0F8B mrmM_EWUN		limit quantity
xcdUMRM 0x0F8C mrmM_EMOT xcdUMRM		Desired quantity_t_synchronous
0x0F8D mrmM_ELLR xcdUMRM 0x0F8E		engine torque amount
mrmM_EKORR xcdUMRM 0x0F8F mrmBM_ERAU		Quantity of idle regulator
xcdUMRM 0x0F90 anmPW2 xcdUMRUA Speisung		Correction quantity FUEL
Pedalwertgeber		amount of smoke
0x0F91 anmLM2	xcdUMRUA supply air flow meter/HFM	
0x0F92 anmLD2	xcdUMRUA charging/intake manifold pressure supply	
0x0F93 anmU_REF xcdUMRUA Analog value U_ref		
0x0F94 gsmGS_Pha xcdUMR1		glow phase display
0x0F95 gsmGS_t_VG xcdUMRZ		Pre-glow time after IPO3
0x0F96 mrmBM_EMOM xcdUMRM		torque limit quantity
0x0F97 mrmADR_SOL xcdUMRN		working target speed
0x0F98 mrmADR_SAT xcdUMR1		condition ADR
0x0F99 mrmADRPWG2 xcdUMRN		Filtered speed value from PWG
0x0F9A mrmF_STA1 xcdUMR1 0x0F9B mrmF_STA2		FGR status 1
xcdUMR1 0x0F9D mrmKLI_LUE xcdUMRP 0x0FA0		FGR status 2
xcmSCHHALT1 xcdUMR1 0x0FA1 xcmSCHHALT2		Fan performance specification of air conditioning
xcdUMR1		Switch 1 (0:KLI, 3:LGS, 4:KIK, 6:rec.LL)
		Switch 2 (0:BRE, 3:BRK, 6:KUP)
0x0FA2 xcmSWITCH3 xcdUMR1		Switch 3 (0:BRE, 1:BRK, 2:KUP, 3:KIK, 4:KLI, 5: LGS, 6: increased LL)
0x0FB0 mrmM_ELD2 xcdUMRMD Difference quantity cyl. 1 to cyl. 2		
0x0FB1 mrmM_ELD3 xcdUMRMD Difference quantity cyl. 1 to cyl. 3		
0x0FB2 mrmM_ELD4 xcdUMRMD Difference quantity cyl. 1 to cyl. 4		
0x0FB3 mrmM_ELD5 xcdUMRMD Difference quantity cyl. 1 to cyl. 5		
0x0FB4 mrmM_ELD6 xcdUMRMD Difference quantity cyl. 1 to cyl. 6		
0x0FB6 khmGENLOAD xcdUMRLA Generator load		
0x0FB7 khmNORAB xcdUMR1 shutdown conditions KWH		
0x0FB8 khmRELAIS xcdUMR1 switching outputs		
0x0FB9 mrmMFAVER xcdUMRVB additional heater correction. fuel consumption		
0x0FBE xcmFGG_GRA xcdUMR1 0x0FBF		FGG,GRA Status
mrmVERB xcdUMRVB Fuel consumption		
0x0FD3 ehmFML2	xcdUMRE	ML2
0x0FDA khmNORAB	xcdUMR256 shutdown conditions KWH	
0x0FDB mrmF_STA3 xcdUMR1		FGR Status 3
0x0FDC xcmSWITCH4 xcdUMR1		Switch 4 (0:BRE, 1:BRK, 2:KUP, 3:FGR/ACC)
0x0FDD xcmSWITCH5 xcdUMR1		Switch 5 (0:ADP, 2:ADM, 3:HAN, 6:ADR, 7:ADW) ***BA570 LEW82WI
0x0FFA xcoStatus xcdUMR1		Immobilizer status
0x0FFB xcoStatus xcdUMR256 Immobilizer Status		
0x0FFC camRCSTAT0 xcdUMR1		embassy status
0x0FFD camRCSTAT0 xcdUMR256 Message status		
0x0FFE mrmPWGPBI xcdUMRP		PWG taking into account real estate status
0x1001 fbmRDYNES xcdUMR1 0x1002 fbmRDYNES		Readiness counter LB
xcdUMR256 Readiness counter HB		
0x1003 fbmRyBits xcdUMR1		Readiness bits indicator
0x100A fbmCPID1AB xcdUMR256 CARB Mode 01 PID 01 Data A		
0x100B fbmCPID1AB xcdUMR1		CARB Mode 01 PID 01 Data C
0x100C fbmCPID1CD xcdUMR256 CARB Mode 01 PID 01 Data B		
0x100D fbmCPID1CD xcdUMR1		CARB Mode 01 PID 01 Data D
0x1200 edmBarre xcdUMR1 0x1E80 zmoBPEwAb1		Login lock counter
xcdUMRBP GDP expectation deviation cylinder 1		
0x1E81 zmoBPEwAb2 xcdUMRBP GDP expectation deviation cylinder 2		
0x1E82 zmoBPEwAb3 xcdUMRBP GDP expectation deviation cylinder 3		
0x1E83 zmoBPEwAb4 xcdUMRBP GDP expectation deviation cylinder 4		
0x1E84 zmoBPEwAb5 xcdUMRBP GDP expectation deviation cylinder 5		
0x1E85 zmoBPEwAb6 xcdUMRBP GDP expectation deviation cylinder 6		
0x1F0A dimKLI	xcdUMR1	air conditioning input
0x1F80 mroLRRI1	xcdUMRMD absolute quantity LRR cylinder 1	
0x1F81 mroLRRI2	xcdUMRMD absolute quantity LRR cylinder 2	

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0x1F82 mroLRRI3		xcdUMRMD absolute quantity LRR cylinder 3	
0x1F83 mroLRRI4		xcdUMRMD absolute quantity LRR cylinder 4	
0x1F84 mroLRRI5		xcdUMRMD absolute quantity LRR cylinder 5	
0x1F85 mroLRRI6		xcdUMRMD absolute quantity LRR cylinder 6	
0x1F88 mroM_EASR xcdUMRM 0x1F90			ASR intervention torque
mrmEGSSTAT xcdUMR1			EGS status
0x1F91 mrmEGSSTAT xcdUMR256		EGS status	
0x1F92 mrmASRSTAT xcdUMR1			ASR status
0x1F93 mrmASRSTAT xcdUMR256		ASR status	
0x1F94 mrmMSRSTAT xcdUMR1			MSR status
0x1F95 mrmMSRSTAT xcdUMR256		MSR status	
0x1F96 ecoECO_STA xcdUMR1 0x2050			ECO status
mrmLDFUAGL xcdUMRD			Adjustment value SU monitoring
0x2051 mrmLDFU from xcdUMR1			Status intake manifold vacuum detection.
0x2052 mroLDFASTA xcdUMR1 Status LDF-ADF comparison			
0x2108 mroMD_SOLL xcdUMRMO internal engine torque			
0x2161 phmVBSTH xcdUMRVB Consumption of high level duration			
0x2F50 dzoNW_KWWi xcdUMRW Angle of rotation of the NW encoder wheel			
0x2F51 dzoNWkorr xcdUMRW Temperature-corrected NW-KW twist angle			
0x3F60 mrmPWG_lwo xcdUMRP Pedalwertgeber idle travel optimized			
0x4000 mrmASG_roh xcdUMR1 ASG raw value desired speed. low bytes			
0x4001 mrmASG_roh xcdUMR256 ASG raw value desired speed. high bytes			
0x4002 mrmASG_tsy xcdUMRZ 0x4003			ASG synchronization time
mrmM_EASG xcdUMRM ASG desired amount			
0x4004 mrmASGSTAT xcdUMR1			ASG status bits low byte
0x4005 mrmASGSTAT xcdUMR256		ASG status bits high byte	
0x4010 simOEL_BEL xcdUMR1			Oil load low byte
0x4011 simOEL_BEL xcdUMR256 Oil load high byte			
0x4012 anmOTF_VOR xcdUMRT 0xA10B			Substitute value oil temperature
mroM_EEGS xcdUMRM 0xA10D anmUTF			EGS amount
xcdUMRT			ambient temperature
0xA10F camSTATUS0 xcdUMR256 CAN masking			
0xA120 comVAR_FZG xcdUMR1			Variant message UTF
0xA202 edmMACHSUL xcdUMR1			Master checksum low word
0xA20F edoKMZ_STA xcdUMR1 0xA210			status mileage
edoKMZ_L xcdUMR1 0xA211 edoKMZ_H		xcdUMR1	Low -Word km Stand low byte
0xA213 edoKMZ_H xcdUMR256 High word km stand high byte		xcdUMR256	Low -Word km stand high byte
		xcdUMR1	High word km Stand low byte
0xDF08 mroFGR_ABN xcdUMR1			FGR Shutdown Status
0xDF09 mroFGR_ABN xcdUMR256 FGR shutdown status			
0xDF0E aroIST_5 0xDF20		xcdUMRL	M_L after conversion and normalization
ehmFLDKi xcdUMRE			LDK inverted
0xDF21 ehmFML1i xcdUMRE			ML1 inverted
0xDF22 ehmFML2i xcdUMRE			ML2 inverted
0xDF23 ehmFMILi xcdUMRE			MIL inverted
0xDF30 xcmDFLD_DK xcdUMRE 0xE4E5			LDS
mrmT_SOLEE xcdUMR1 0xE4E6 mrmADR_Neo			ADR: Ramp-up time
xcdUMRN 0xE4E7 mrmADR_Nfe xcdUMRN			upper switch-on threshold (N) var. ADR
0xE4E8 mrmCAN_KLI xcdUMR1			fixed working speed
			Status air conditioning via CAN

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Error path error	bit	F.Location	F.Type	Monitored states

Appendix E List of Error Codes

fboSABS CAN bus failed. Message from the ABS SG				
	fbbEASR_Q 4689	23		RB: Message timeout Bremse1 oder Message inconsistency Bremse1 VAG: Drive data bus missing message from ABS-SG
	fbbEAS3_Q ???		???	RB: Message timeout Bremse3 oder Message inconsistency brake3 VAG: Drive data bus missing message from ABS-SG
	fbbEMSR_P 4689	23		RB: MSR functionally implausible VAG: Drive data bus missing message from ABS-SG
	fbbEMSR_H 4755	23		RB: Open circuit/short circuit to ground VAG: Drive data bus implausible message from ABS-SG

fboSACC cruise control via CAN				
	fbbEACC_A ???	???		RB: General plausibility error VAG: ???
	fbbEACC_P ???		???	RB: Implausible moment request VAG: ???
	fbbEACC_B ???		???	RB: Message counter error VAG: ???
	fbbEACC_Q ???		???	RB: CAN error (timeout, incons.) VAG: ???
	fbbEACC_F ???		???	RB: Error detection via CAN VAG: ???
	fbbEACC_D ???		???	RB: ADR defective via CAN VAG: ???
	fbbEACC_C ???		???	RB: checksum error VAG: ???
	fbbEACC_V ???		???	RB: Request below V threshold VAG: ???

fboSADF altitude sensor				
	fbbEADF_L 4583	23		RB: Open circuit/short circuit to ground VAG: Control unit defective
	fbbEADF_H 4583	23		RB: Short circuit to plus VAG: Control unit defective

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Error path error	bit	F.Location	F.Type	Monitored states

fboSARF exhaust gas recirculation control difference				
	fbbEARSpR	4593	23	RB: pos. deviation VAG: exhaust gas recirculation system control difference
	fbbEARSnR	4593	23	RB: neg. control deviation VAG: exhaust gas recirculation system control difference

fboSAR1 Exhaust gas recirculation valve - N18				
	fbbEAR1_K	4592	23	RB: Short circuit to plus VAG: Exhaust gas recirculation valve -N18 Short circuit to positive
	fbbEAR1_O	45B9	23	RB: Open circuit/short circuit to ground VAG: Exhaust gas recirculation valve -N18 Open circuit/short circuit to ground
	fbbELDK_S	0503	23	RB: Control valve status line defective VAG: Nothing on the display
	fbbELDK_D	0503	23	RB: Control valve defective VAG: Nothing on the display

fboSAR2 changeover valve for intake manifold flap - N239				
	fbbELDK_K	05021	C	RB: short circuit of the output stage VAG: short circuit to plus
	fbbELDK_O	05021	F	RB: Power amp idle VAG: Open circuit/short to ground

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Error path error	bit	F.Location	F.Type	Monitored states
fboSASG Automatic manual gearbox				
	fbbEASG_L 4672	23		RB: Transfer function SRC VAG: data bus drive missing message from gearbox SG
	fbbEASG_M ???		???	RB: EGS coding in the MSG not OK VAG: ???
	fbbEASG_G 4672	23		RB: Gait plausibility VAG: data bus drive missing message from gearbox SG
	fbbEASG_H 4672	23		RB: Torque integral exceeded VAG: data bus drive missing message from gearbox SG
	fbbEASG_Q 4672	23		RB: Message timeout gear 2 or Message inconsistency gear 2 VAG: data bus drive missing message from gearbox SG
	fbbEASG_P 4672	23		RB: Plausibility with clutch VAG: data bus drive missing message from gearbox SG
	fbbEASG_S ???		???	RB: Group error transmission error VAG: ???
	fbbEASG_U 4672	23		RB: Transfer function implausible VAG: data bus drive missing message from gearbox SG
fboSBSG CAN data onboard power supply control unit				
	fbbEBSG_Q 4664	23		RB: Embassy timeout VAG: engine control unit incorrectly coded
fboSCRA crash detection				
	fbbECRA_A 4682	23		RB: Crash threshold GRA shutdown VAG: Please error memory of Read airbag SG
	fbbECRA_B 4682	23		RB: Crash Threshold Fuel Shutdown VAG: Please error memory of Read airbag SG
	fbbECRA_P 4682	23		RB: implausible PWM signal VAG: Please error memory of Read airbag SG
	fbbECRA_Q 4682	23		RB: Embassy timeout VAG: Please error memory of Read airbag SG

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Error path error bit		F.Location	F.Type	Monitored states
fboSCVT CVT transmission				
	fbbECVT_L 46EA	23		RB: Speed too low VAG: supply voltage for solenoid valves electr. Error in the circuit
	fbbECVT_H 46EA	23		RB: Speed too high VAG: supply voltage for solenoid valves electr. Error in the circuit
	fbbECVT_Q 46EA	23		RB: Timeout VAG: supply voltage for solenoid valves electr. Error in the circuit
fboSDZG Engine speed sensor - G28				
	fbbEDZG_U 0000	23		RB: Overspeed VAG: Nothing on the display
	fbbEDZG_L 0000	23		RB: Plausibility with boost pressure sensor VAG: Nothing on the display
	fbbEDZG_D 4141	23		RB: Dynamic plausibility VAG: Engine speed sender - G28 implausible signal
	fbbEDZG_S 4142	23		RB: Static plausibility VAG: Engine speed sender - G28 no signal
fboSEP1 control unit incorrectly coded				
	fbbEEEP_V 4664	23		RB: Invalid record variant VAG: engine control unit incorrectly coded
	fbbEEEP_F 0414	09		RB: GRA and speedometer on default value VAG: Adaptation limit exceeded
boSEXM CAN bus failed. Message from the gearbox SG				
	fbbEEGS_A ???		???	RB: Embassy failure ASG VAG: ???
	fbbEEGS_1 4672	23		RB: Message timeout Gear1 or Message inconsistency Gear1 VAG: data bus drive missing message from gearbox SG
	fbbEAG4_L 470D	23		RB: AG4 switching signal timeout VAG: Torque reduction signal Open circuit/short circuit to ground
	fbbEECO_L0221	23		RB: ECOMATIC switching signal message VAG: Nothing on the display

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Error path error	bit	F.Location	F.Type	Monitored states
	fbbEEGS_F ???		???	RB: Clutch error from transmission SG VAG: ???
	fbbEASG_I ???		???	RB: Transmission2 message inconsistency VAG: ???

fboSEMI error lamp (MIL request)				
	fbbEMIL_L 4666	23		RB: Open circuit/short circuit to ground VAG: Error lamp request on implausible signal
	fbbEMIL_H 4666	23		RB: Short circuit to plus VAG: Error lamp request on implausible signal

fboSFGA switch for GRA - E45				
	fbbEFGA_X029F	19		RB: LT2 2 contacts active VAG: undefined switch state
	fbbEFGA_P029F	19		RB: LT2 no series contact VAG: undefined switch state
	fbbEADRnR 029F	11		RB: ADR neg. control deviation VAG: control difference
	fbbEADRpR029F	11		RB: ADR pos. deviation VAG: control difference
	fbbEFGA_A 029F	19		RB: LT2 series contact only VAG: undefined switch state
	fbbEFGA_F 029F	19		RB: Plausibility FRG_L VAG: undefined switch state

fboSFGC ground speed controller via CAN				
	fbbEFGC_B ???	???		RB: Message counter error VAG: ???
	fbbEFGC_C ???		???	RB: checksum error VAG: ???
	fbbEFGC_Q ???		???	RB: CAN error (timeout, incons.) VAG: ???
	fbbEFGC_P ???		???	RB: FGL implausible digital/CAN VAG: ???
	fbbEFGC_S ???		???	RB: Encoding mismatch VAG: ???
	fbbEFGC_Y ???		???	RB: CAN error (timeout, incons.) VAG: ???

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Error path error	bit	F.Location	F.Type	Monitored states
fboSFGG speed signal				
	fbbEFGG_H 461C	23		RB: signal range VAG: Vehicle Speed Signal signal too big
	fbbEFGG_F 461C	23		RB: frequency domain VAG: Vehicle Speed Signal signal too big
	fbbEFGG_Q 41F5	23		RB: FGG via CAN: Message timeout VAG: Vehicle Speed Signal implausible signal
	fbbEFGG_S 41F5	23		RB: FGG high level duration implausible VAG: Vehicle Speed Signal implausible signal
	fbbEFGG_C 41F5	23		RB: FGG over CAN: error detection VAG: Vehicle Speed Signal implausible signal
	fbbEFGG_P 41F5	23		RB: Plausibility speed and quantity VAG: Vehicle Speed Signal implausible signal
fboSGRS relay for glow plugs - J52				
	fbbEGRS_K 466A	23		RB: Open circuit/short circuit to ground VAG: Glow plug relay - J52 Short circuit to positive
	fbbEGRS_O 466B	23		RB: Short circuit to plus VAG: Glow plug relay - J52 Open circuit/short circuit to ground
	fbbEGZS_I ???		???	RB: short circuit to plus / ground VAG: ???
fboSGZS glow plug monitoring				
	fbbEGSK_1 ???		???	RB: Glow plug 1 defective VAG: ???
	fbbEGSK_2 ???		???	RB: Glow plug 2 defective VAG: ???
	fbbEGSK_3 ???		???	RB: Glow plug 3 defective VAG: ???

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Error path error	bit	F.Location	F.Type	Monitored states
	fbbEGSK_4 ???		???	RB: Glow plug 4 defective VAG: ???
	fbbEGSK_5 ???		???	RB: Glow plug 5 defective VAG: ???
	fbbEGSK_6 ???		???	RB: Glow plug 6 defective VAG: ???
	fbbEGZS_H ???		???	RB: Overcurrent on any GSK VAG: ???
	fbbEGZS_P ???		???	RB: Transmission error VAG: ???

fboSHZA heating request				
	fbbEHZA_L ???		???	RB: Open circuit/short circuit to ground VAG: ???
	fbbEHZA_H ???		???	RB: Short circuit to plus VAG: ???

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Error path error	bit	F.Location	F.Type	Monitored states
fboSIMM engine control unit locked				
	fbbEIMM_F 463A	23		RB: Immobilizer VAG: engine control unit blocked
	fbbEIMM_C 463A	23		RB: Immobilizer VAG: engine control unit blocked
	fbbEIMM_P 463A	23		RB: Immobilizer VAG: engine control unit blocked
fboSKBI CAN bus failed. Message from the station wagon				
	fbbEKO1_Q 4688	23		RB: Embassy timeout combination 1 or Message inconsistency combo 1 VAG: Drive data bus malfunction
	fbbEKO2_Q 468A	23		RB: Embassy timeout combination 2 or Message inconsistency combination 2 VAG: Drive data bus missing message from instrument cluster
	fbbEKO2_W 468A	23		RB: WTF about combo 2 mistakes VAG: Drive data bus missing message from instrument cluster
fboSKIK kickdown switch				
	fbbEKIK_A 467A	23		RB: Plausibility with PWG VAG: Accelerator pedal position sender 2 - G185 signal too big
fboSKW2 load signal generator KI. DF				
	fbbEKWH_L 045D	1B		RB: generator load 0% VAG: implausible signal

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Error path error bit		F.Location	F.Type	Monitored states
fboSLDF Intake manifold pressure sender - G71				
	FbbELDF_L 449C	23		RB: Open circuit/short circuit to ground VAG: Intake manifold pressure sender - G71 Open circuit/short circuit to ground
	FbbELDF_H 449B	23		RB: Short circuit to plus VAG: Intake manifold pressure sender - G71 Short circuit to positive
	fbbELD2_L 449D	23		RB: Feed too small VAG: Intake manifold pressure sender - G71 supply voltage
	fbbELD2_H 449D	23		RB: Feed too big VAG: Intake manifold pressure sender - G71 supply voltage
	fbbELDF_P 449E	23		RB: Plausibility with ADF VAG: Intake manifold pressure sender - G71 implausible signal
fboSLD1 intake manifold pressure				
	fbbELDSpR 4626	23		RB: pos. deviation VAG: boost pressure control difference
	fbbELDSnR 4626	23		RB: neg. control deviation VAG: boost pressure control difference
fboSLDS boost pressure control solenoid valve - M76				
	fbbELDS_K 4622	23		RB: Open circuit/short circuit to ground VAG: Charge pressure control solenoid valve Short circuit to positive
	fbbELDS_O 4625	23		RB: Short circuit to plus VAG: Charge pressure control solenoid valve Open circuit/short circuit to ground

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Error path error	bit	F.Location	F.Type	Monitored states
boSLMM Mass Air Flow Sensor - G70				
	fbbELMM_L 4490	23		RB: Open circuit/short circuit to ground VAG: Mass Air Flow Sensor - G70 Open circuit/short circuit to ground
	fbbELMM_H 4491	23		RB: Short circuit to plus VAG: Mass Air Flow Sensor - G70 Short circuit to plus
	fbbELM2_L 4492	23		RB: Feed too small VAG: Mass Air Flow Sensor - G70 supply voltage
	fbbELM2_H 4492	23		RB: Feed too big VAG: Mass Air Flow Sensor - G70 supply voltage
	fbbELM5_L 4490	23		RB: Open circuit/short circuit to ground VAG: Mass Air Flow Sensor - G70 Open circuit/short circuit to ground
	fbbELM5_H 4491	23		RB: Short circuit to plus VAG: Mass Air Flow Sensor - G70 Short circuit to plus
	fbbELM5_P 4065	23		RB: Plausibility with RPM VAG: Mass Air Flow Sensor - G70 implausible control value
fboSLTF Intake manifold temperature sender - G42				
	fbbELTF_L 44A0	23		RB: Open circuit/short circuit to ground VAG: Intake manifold temperature sender - G72 Short circuit to ground
	fbbELTF_H 44A1	23		RB: Short circuit to plus VAG: Intake manifold temperature sender - G72 Interruption/short circuit to plus

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Error path error	bit	F.Location	F.Type	Monitored states

boSPWG Accelerator position sender - G79				
	fbbEPWG_L 4676	23		RB: Open circuit/short circuit to ground VAG: Accelerator pedal position sender - G79 signal too small
	fbbEPWG_H 4677	23		RB: Short circuit to plus VAG: Accelerator pedal position sender - G79 signal too big
	fbbEPW2_L 4678	23		RB: Feed too small VAG: Accelerator pedal position sender - G79 supply voltage
	fbbEPW2_H 4678	23		RB: Feed too big VAG: Accelerator pedal position sender - G79 supply voltage
	fbbEPWP_L 0000	23		RB: Plausibility idle switch VAG: Nothing on the display
	fbbEPWP_P0000	23		RB: Plausibility potentiometer VAG: Nothing on the display
	fbbEPWP_B 0000	23		RB: safety case plausibility potentiometer VAG: Nothing on the display
	fbbEPWP_A 467F	23		RB: Plausibility General VAG: Sender ½ for accelerator position -G79+G185 implausible signal

fboSPGS redundant pedal sensor				
	fbbEPGS_L 4679	23		RB: red. Pedal position sensor SRC low VAG: Accelerator pedal position sender 2 - G185 signal too small
	fbbEPGS_H 467A	23		RB: red. Pedal position sensor SRC high VAG: Accelerator pedal position sender 2 - G185 signal too big
	fbbEFPG2_L 4678	23		RB: feeding red. PWG SRC low VAG: Accelerator pedal position sender 2 - G185 supply voltage
	fbbEPG2_H 4678	23		RB: feeding red. PWG SRC high VAG: Accelerator pedal position sender 2 - G185 supply voltage

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Error path error	bit	F.Location	F.Type	Monitored states
fboSTAD AD converter				
	fbbETAD_L 425E	23		RB: Reference voltage SRC low VAG: Control unit defective
	fbbETAD_H 425E	23		RB: Reference voltage SRC high VAG: Control unit defective
	fbbETAD_D 425E	23		RB: Ram cell monitoring VAG: Control unit defective
	fbbETAD_T 425E	23		RB: Empty Gas Test Pulse Error VAG: Control unit defective
boSWTK Coolant temperature sender				
	fbbEWTK_L ???		???	RB: Open circuit/short circuit to ground VAG: ???
	fbbEWTK_H ???		???	RB: Short circuit to plus VAG: ???
fboSWTF Coolant temperature sender - G82				
	fbbEWTF_L 44FF	23		RB: Open circuit/short circuit to ground VAG: Coolant temp. - G62 Short circuit to ground
	fbbEWTF_H 44FE	23		RB: Short circuit to plus VAG: Coolant temp. - G62 Short circuit to plus
	fbbEWTF_S 4074	23		RB: operating temperature VAG: Coolant temp. - G62 implausible signal
	fbbEWTF_D 4074	23		RB: Dynamic plausibility VAG: Coolant temp. - G62 implausible signal

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fboSAR3 valve for exhaust gas recirculation				
	fbbEAR3_K ???		??? Short circuit to plus	
	fbbEAR3_O ???		??? Open circuit / short circuit to ground	

fboSAUZ Combustion misfires detected				
	fbbEAUZ_M ???		??? RB: Misfiring multiple cylinders VAG: ???	
	fbbEAUZ_1	???	??? RB: misfiring cylinder 1 VAG: ???	
	fbbEAUZ_2	???	??? RB: misfiring cylinder 2 VAG: ???	
	fbbEAUZ_3	???	??? RB: misfiring cylinder 3 VAG: ???	
	fbbEAUZ_4	???	??? RB: misfiring cylinder 4 VAG: ???	
	fbbEAUZ_5	???	??? RB: misfiring cylinder 5 VAG: ???	
	fbbEAUZ_6	???	??? RB: misfiring cylinder 6 VAG: ???	

fboSBRE brake pedal monitoring				
	fbbEBRE_L ???		??? RB: Open circuit/short circuit to ground	
	fbbEBRE_H ???		??? RB: Short circuit to plus	
	fbbEBRE_I ???		??? RB: Plausibility brake after initialization VAG: ???	
	fbbEBRE_P	???	??? RB: Plausibility brake VAG: ???	

fboSCAN data line defective				
	fbbECA0_O ???		??? RB: Communication CAN VAG: ???	
	fbbECA0_W ???		??? RB: Communication CAN VAG: ???	
	fbbECA0_S	???	??? RB: Communication CAN VAG: ???	

fboSDIA control lamp for preheating time				
	fbbEDIA_K ???		??? Short circuit to plus	
	fbbEDIA_O fbbEDIA_P	???	??? Open circuit/short circuit to ground	
		???	??? implausible signal	

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fboSEKP Electric fuel pump				
	fbbEEKP_K ???		???	RB: short circuit of the output stage VAG: ???
	fbbEEKP_O	???	???	RB: Power amp idle VAG: ???

fboSEEP control unit defective				
	fbbEEEP_A ???		???	RB: VAG: ???
	fbbECAN_D ???		???	RB: CAN component defective VAG: ???
	fbbEEEP_K	???	???	RB: EEPROM communication VAG: ???

fboSGAZ control lamp for preheating time			
	fbbEGAZ_K ???		??? Short circuit to plus
	fbbEGAZ_O ???		??? Open circuit/short circuit to ground

fboSGER relay for blower			
	fbbEGER_K ???		??? Short circuit to plus
	fbbEGER_O ???		??? Open circuit/short circuit to ground

fboSGK3 relay for small heating power			
	fbbEGK3_K ???		??? Short circuit to plus
	fbbEGK3_O ???		??? Open circuit/short circuit to ground

fboSHRL on-board voltage KL 30				
	fbbEHRL_S	???	???	RB: Shutdown of EDC VAG: ???

fboSHYL hydraulic fan				
	fbbEHYL_K ???		???	RB: short circuit of the output stage VAG: ???
	fbbEHYL_O ???		???	RB: Power amp idle VAG: ???

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fboSK15 supply voltage				
	fbbEK15_P	???	??? implausible signal	

fboSKLI engine/air conditioning. - Shutdown electr. connection				
	fbbEKLI_Q ???		??? Clima1 timeout / inconsistency	
	fbbEKLI_K ???		??? Short circuit to plus	
	fbbEKLI_O ???	???	Open circuit/short circuit to ground	

fboSKMD refrigerant pressure sensor				
	fbbEKMD_L ???		???	RB: Open circuit/short circuit to ground VAG: ???
	fbbEKMD_H ???		???	RB: Short circuit to plus VAG: ???

fboSKSK fuel cooling				
	fbbEKSK_K ???		??? Short circuit to plus	
	fbbEKSK_O ???		??? Open circuit/short circuit to ground	

fboSKTF Fuel temperature sender				
	fbbEKTF_L	???	??? short to ground	
	fbbEKTF_H ???		??? Interruption/short circuit to plus	
	fbbEKTF_P	???	??? Implausible signal	

fboSKW1 Relay for large heating power				
	fbbEGK2_K ???		??? RB: short circuit of the output stage VAG: ???	
	fbbEGK2_O ???		??? RB: Power amp idle VAG: ???	

fboSKWH relay for small heating power				
	fbbEGK1_K ???		??? RB: short circuit of the output stage VAG: ???	
	fbbEGK1_O ???		??? RB: Power amp idle VAG: ???	

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fboSMIL Error Lamp (MIL)			
	fbbEMIL_K ???	fbbEMIL_O ???	??? Short circuit to plus
			??? Open circuit/short circuit to ground

fboSML1 valves for stage 1 engine mounts			
	fbbEML1_K ???		??? Short circuit to plus
	fbbEML1_O ???		??? Open circuit / short circuit to ground

fboSML2 valves for stage 2 engine mounts			
	fbbEML2_K ???		??? Short circuit to plus
	fbbEML2_O ???		??? Open circuit/short circuit to ground

fboSMV1 solenoid valve 1			
	fbbEMV1BP ???		??? RB: BIP - error VAG: ???
	fbbEMV1MS ???		??? RB: short circuit ground/load drop VAG: ???
	fbbEMV1BF ???		??? RB: neg. control deviation VAG: ???
	fbbEMV1BS ???		??? RB: pos. deviation VAG: ???

fboSMV2 solenoid valve 2			
	fbbEMV2BP ???		??? RB: BIP - error VAG: ???
	fbbEMV2MS ???		??? RB: short circuit ground/load drop VAG: ???
	fbbEMV2BF ???		??? RB: neg. control deviation VAG: ???
	fbbEMV2BS ???		??? RB: pos. deviation VAG: ???

fboSMV3 solenoid valve 3			
	fbbEMV3BP ???		??? RB: BIP - error VAG: ???
	fbbEMV3MS ???		??? RB: short circuit ground/load drop VAG: ???
	fbbEMV3BF ???		??? RB: neg. control deviation VAG: ???
	fbbEMV3BS ???		??? RB: pos. deviation VAG: ???

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fboSMV4 solenoid valve 4				
	fbbEMV4BP ???		??? RB: BIP - error VAG: ???	
	fbbEMV4MS ???		??? RB: short circuit ground/load drop VAG: ???	
	fbbEMV4BF ???		??? RB: neg. control deviation VAG: ???	
	fbbEMV4BS ???		??? RB: pos. deviation VAG: ???	

fboSMV5 solenoid valve 5				
	fbbEMV5BP ???		??? RB: BIP - error VAG: ???	
	fbbEMV5MS ???		??? RB: short circuit ground/load drop VAG: ???	
	fbbEMV5BF ???		??? RB: neg. control deviation VAG: ???	
	fbbEMV5BS ???		??? RB: pos. deviation VAG: ???	

fboSMV6 solenoid valve 6				
	fbbEMV6BP ???		??? RB: BIP - error VAG: ???	
	fbbEMV6MS ???		??? RB: short circuit ground/load drop VAG: ???	
	fbbEMV6BF ???		??? RB: neg. control deviation VAG: ???	
	fbbEMV6BS ???		??? RB: pos. deviation VAG: ???	

fboSMV quick release solenoid valves				
	fbbEMVKU ???		??? Short circuit to plus	
	fbbEMVSL ???		??? RB: Quick delete error all MV's VAG: ???	

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fboSNLF monitoring follow-up tests			
	fbbESTB_U	???	??? RB: voltage stabilizer switches off at undervoltage (lower stability limit) VAG: ???
	fbbESTB_O	???	??? RB: Voltage stabilizer switches off in the event of overvoltage (upper stability limit) VAG: ???
	fbbENLF_A	???	??? RB: no punch through off pin VAG: ???
	fbbENLF_S	???	??? RB: SHS pin defective VAG: ???
	fbbERUC_W ???		??? RB: Breakthrough monitoring module defective VAG: ???

fboSOTF sensor for oil temperature			
	fbbEOTF_L ???	???	RB: Open circuit/short circuit to ground VAG: ???
	fbbEOTF_H ???		??? RB: Short circuit to plus VAG: ???
	fbbEOTF_S	???	??? RB: OTF over CAN error or inaccurate VAG: ???
	fbbEOTF_P	???	??? RB: OTF over CAN error VAG: ???

fboSRUC monitoring microcontroller			
	fbbERUC_R ???		??? RB: Recovery occurred VAG: ???
	fbbERUC_S	???	??? RB: Redundant thrust monitoring VAG: ???
	fbbERUC_A ???		???
	fbbERUC_U ???		??? RB: Monitoring Module VAG: ???
	fbbERUC_K ???		??? RB: Monitoring module not debounced VAG: ???

fboSSEK secondary speed sensor			
	fbbESEK_S ???	???	RB: Static plausibility VAG: ???
	fbbESEK_R	???	??? RB: Interfering signals on SEG input logic. VAG: ???
	fbbESEK_P	???	??? RB: twist KW / NW VAG: ???

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fboSSTF intake manifold temperature sensor				
	fbbESTF_L ???		??? RB: SRC hurt down	
	fbbESTF_H	???	??? RB: SRC hurt upstairs	

fboSTAV tank shut-off valve				
	fbbETAV_K ???		??? RB: short circuit of the output stage VAG: ???	
	fbbETAV_O ???		??? RB: Power amp idle VAG: ???	

fboSTST coolant thermostat				
	fbbETST_K	???	??? RB: Open circuit/short circuit to ground VAG: ???	
	fbbETST_O	???	??? RB: Short circuit to plus VAG: ???	

fboSUBT on-board voltage KL 30				
	fbbEUBT_L ???		??? signal too small	
	fbbEUBT_H ???		??? signal too large	

fboSURF reference voltage (2.5 V)				
	fbbEURF_L ???		??? RB: reference voltage too small VAG: ???	
	fbbEURF_H ???		??? RB: Reference voltage too high VAG: ???	

fboSUTF ambient temperature sensor				
	fbbEUTF_L ???		??? RB: SRC_Low error VAG: ???	
	fbbEUTF_H ???		??? RB: SRC_High error VAG: ???	
	fbbEUTF_P	???	??? RB: UTF no data telegram VAG: ???	

fboSZWP lag pump				
	fbbEZWP_K ???		???	RB: short circuit of the output stage VAG: ???
	fbbEZWP_O ???		???	RB: Power amp idle VAG: ???

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Appendix F List of Error Bits

PathOL Err PathNo	Path Name	80h/Bit7	40h/Bit6	20h/Bit5	10h/Bit4	08h/Bit3	04h/Bit2	02h/Bit1	01h/Bit0
fboS_00 D800		00	fboSRUC fbbERUC_K fbbERUC_U fbbERUC_A fbbERUC_S - fboSDZG - fbbEDZG_S fbbEDZG_D fbbEDZG_L -					-	-	fbbERUC_R
D860	D801	01	fbbEASR_Q -					-	fbbEDZG_U -	
	D802	02	fboSABS fbbEMSR_P fbbEAS3_Q - fboSADF - fboSARF - fboSAR1					-	fbbEMSR_H -	
	D803	03	fbbELDK_D - fboSAR2 -	-	-	-	-	-	fbbEADF_H fbbEADF_L	
	D804	04		-	fbbEARSnR fbbEARSpR - fbbELDK_S -			-	-	-
	D805	05			fbbEARS_O fbbEARS_K - fbbELDK_O fbbELDK_K fboSASG fbbEASG_U fbbEASG_P fbbEASG_G					-
	D806	06		-	-	-	fbbEASG_Q fbbEASG_M fbbEASG_S fbbEASG_H			-
	D807	07	fbbEASG_L							
	D808	08	fboSBRE fbbEBRE_P fbbEBRE_I - fbbEBRE_H fbbEBRE_L			-	-	-		
	D809	09	fboSCAN - fbbECA0_S - fbbECA0_W fbbECA0_O	-	-			-		
	D80A	10	fboSEEP - fbbEEEP_K - fbbECAN_D fbbEEEP_A -	-	-					
	D80B	11	fboSEP1 - fbbEEEP_F fbbEEEP_V - fboSEXM fbbEEGS_A fbbEECO_L fbbEASG_I fbbEEGS_F fbbEAG4_L fbbEEGS_1 - fboSFGA fbbEFGA_F fbbEFGA_A fbbEADRnR	-	-					-
	D80C	12	fbbEADRpR fbbEFGA_P fbbEFGA_X - fboSFGC fbbEFGC_P fbbEFGC_Y fbbEFGCGC_QB fbbEFGCGC_QB fbbEFEFEFS							-
	D80D	13								-
	D80E	14						-		
	D80F	15	fboSHUN fbbENIV_P fbbEALR_Q fbbENIV_B fbbENIV_Q - fbbENIV_C -					-		
fboS_02 D810		16	fboSFGG fbbEFGG_P fbbEFGG_C fbbEFGG_S fbbEFGG_Q fbbEFGG_F - fbbEFGG_H -							
D862	D811	17	fboSGER - fbbEGER_2	-						-
	D812	18	fboSGRS fbbEGZS_ - fboSGZS fbbEGZS_P	-	-					-
	D813	19	fbbEGZS_H fbbEGSK_6 fbbEGSK_5 fbbEGSK_4 fbbEGSK_3 fbbEGSK_2 fbbEGSK_1							
	D814	20	fboSHRL - fboSHYL -	-	-	-	-	-	fbbEHRL_S -	
	D815	21		-	-	-	fbbEHYL_O fbbEHYL_K - fbbEIMM_P fbbEIMM_C			-
	D816	22	fboSIMM -	-	-	-	-	fbbEIMM_F		
	D817	23	fboSK15 fbbEK15_P - fboSKBI - fbbEKO2_W		-	-	-	-	-	-
	D818	24	fbbEKO1_Q fbbEKO2_Q - fboSKLI - fbbEKLI_Q	fbbEKLI_O fbbEKLI_K - fboSKTF fbbEKTF_P - fbbEKTF_H fbbEKTF_L				-	-	-
	D819	25		-						-
	D81A	26			-	-	-	-		
	D81B	27	fboSKW2 - fbbEKWH_L - fboSLDF fbbELDF_P - fboSLD1 - fboSLDS -			-	-	-	-	-
	D81C	28	fboSLMM -		-	-	fbbELD2_H fbbELD2_L fbbELDF_H fbbELDF_L			
	D81D	29		-	fbbELDSnR fbbELDSpR - fbbELDS_O fbbELDS_K			-	-	-
	D81E	30		-	-	-	- fbbELM5_P fbbELM5_H fbbELM5_L fbbELM2_H			-
	D81F	31		fbbELM2_L fbbELMM_H fbbELMM_L						

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fboS_04 D820		32	fboSLTF -		-	-	-	-	-	fbbELTF_H fbbELTF_L	
D864	D821	33	fboSOTF -		fbbEOTF_P fbbEOTF_S -			-	-	fbbEOTF_H fbbEOTF_L	
	D822	34	fboSPWG fbbEPWP_A fbbEPWP_B fbbEPWP_P fbbEPWP_L fbbEPW2_H fbbEPW2_L fbbEPWG_H fbbEPWG_L								
	D823	35	fboSPGS - fbbEPG2_H	fbbEPG2_L fbbEPGS_H fbbEPGS_L	-	-	-				
	D824	36	fboSTAD - fbbETAD_T	fbbETAD_D - fbbETAD_H fbbETAD_L	-				-		
	D825	37	fboSTST - fbbETST_O	fbbETST_K - fbbEWTF_S fbbEWTF_H fbbEWTF_L	-	-	-				-
	D826	38	fboSWTF - fboSWTK -		-	fbbEWTF_D -		-			
	D827	39	fboSHZA - fboSUTF		-	-	-	-	-	fbbEWTK_H fbbEWTK_L	
	D828	40	fbbEUTF_P - fboSKIK		-	-	-	-	-	fbbEHZA_H fbbEHZA_L	
	D829	41	fbbEKIK_A - fboSCRA fbbECRA_Q fbbECRA_P			-	-	-	-	fbbEUTF_H fbbEUTF_L	
	D82A	42	fbbECRA_B fbbECRA_A - fboSBSG - fbbEBSG_Q			-	-	-	-	-	-
	D82B	43	- fboSDIA fbbEDIA_P - fbbEDIA_O fbbEDIA_K - fboSCVT - fbbECVT_O - fbbECVT_H fbbECVT_L						-	-	-
	D82C	44			-	-			-	-	-
	D82D	45				-	-				-
	D82E	46					-	-	-		
	D82F	47	fboSACC fbbEACC_A fbbEACC_P fbbEACC_B fbbEACC_Q fbbEACC_F fbbEACC_D fbbEACC_C fbbEACC_V								
fboS_06 D830		48	fboSKMD - fbbEKMD_H	fbbEKMD_L	-	-	-	-	-		
D866	D831	49	fboSSEK fbbESEK_P fbbESEK_R fbbESEK_S - fboSUBT - fboSURF - fboSSTF -					-	-	-	-
	D832	50			-	-	-	-	-	fbbEUBT_H fbbEUBT_L	
	D833	51			-	-	-	-	-	fbbEURF_H fbbEURF_L	
	D834	52			-	-	-	-	-	fbbESTF_H fbbESTF_L	
	D835	53	fboSKWH -		-	-	-	fbbEGK1_O fbbEGK1_K - fbbEGK2_O fbbEGK2_K			-
	D836	54	fboSKW1 - fboSZWP -		-	-	-	- fbbEZWP_O fbbEZWP_K - fbbEML1_O			-
	D837	55	fboSML1 - fboSML2 -		-	-	-	fbbEML1_K - fbbEML2_O fbbEML2_K - fbbEGAZ_O			-
	D838	56			-	-	-	fbbEGAZ_K - fbbEMIL_O fbbEMIL_K - fbbEAR3_O			-
	D839	57			-	-	-	fbbEAR3_K - fbbEGK3_O fbbEGK3_K -			-
	D83A	58	fboSGAZ -		-	-	-	fbbERUC_W - fbbENLF_S fbbENLF_A fbbESTB_O			-
	D83B	59	fboSMIL - fboSAR3		-	-	-	fbbESTB_U			-
	D83C	60	fboSGK3 fboSNLF -	-	-	-	-				-
	D83D	61		-	-	-	-				-
	D83E	62			-						
	D83F	63	fboSAUZ -		fbbEAUZ_6 fbbEAUZ_5 fbbEAUZ_4 fbbEAUZ_3 fbbEAUZ_2 fbbEAUZ_1 fbbEAUZ_M						

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fboS_08 D840		64	fboSEKP -		-	-	-	fbbEEKP_O fbbEEKP_K - fbbETAV_O fbbETAV_K			-
D868	D841	65	fboSTAV - fboSKSK	-	-	-	-	- fbbEKSK_O fbbEKSK_K - fbbEMV1BS			-
	D842	66	fboSMV1 - fboSMV2	-	-	-	-	fbbEMV1BF fbbEMV1MS fbbEMV1BP			-
	D843	67	fboSMV3		-	-	-				
	D844	68			-	-	-	fbbEMV2BS fbbEMV2BF fbbEMV2MS fbbEMV2BP			
	D845	69		-	-	-	-	fbbEMV3BS fbbEMV3BF fbbEMV3MS fbbEMV3BP			
	D846	70	fboSMV4 - fboSMV5	-	-	-	-	fbbEMV4BS fbbEMV4BF fbbEMV4MS fbbEMV4BP			
	D847	71	fboSMV6 - fboSMV		-	-	-	fbbEMV5BS fbbEMV5BF fbbEMV5MS fbbEMV5BP			
	D848	72			-	-	-	fbbEMV6BS fbbEMV6BF fbbEMV6MS fbbEMV6BP			
	D849	73		-	fbbEMVSL -		-	-	fbbEMVKU -		-

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Appendix G List of OLDAs

A	
anmADF	P_ATM atmospheric pressure
noteBRE	battery voltage
anmBSTZiO Operating hours counter at KTF test start E2PROM low word	
anmFPM_EPA debouncing dual analog PEG	
anmFPM_LTI Empty throttle test pulse active	
noteHZA	heating requirement
noteK15	K15 filtered value K15
anmK15_ON K15 current status of the hysteresis	
noteKMD	Refrigerant pressure via PWM
NoteKTF	T_K fuel temperature
anmKTF_Int Total KTF change E2PROM	
anmKTF_PT Temp for KTF good notification via abs. Change E2PROM	
anmKTF_Td Duration of the last KTF-P test	
anmLDF	P_L Charge / intake manifold pressure
noteLMM	air mass flow filtered (HFM5 1ms)
anmLMM_1	U_% Penultimate analog value for air flow meter KLM / HFM
anmLTF	T_L air temperature from LTF
anmOTF	T_O oil temperature
anmOTF_VOR Default value oil temperature	
anmPG2	PGS power supply voltage
anmPGS	PGS redundant pedal sensor
anmPW2	Voltage supply PWG
anmPWG	PWG Pedal Sensor Position (unfiltered)
NoteSTF	intake manifold temperature
noteTTF	Temperature TTF
anmT_MOT	T_W motor temperature
anmUBATT	U_BAT battery voltage
anmUBATT_N U_BAT current battery voltage of the injection	
anmUBATT_Z Battery voltage synchronous	
anmUTF	T_U Ambient temperature from UTF data telegram
anmUTF_ANA T_U Ambient temperature of analog input	
anmUTF_CAN UTF value from CAN	
anmUTF_DIG Digital value outside temperature	
anmUTF_STA Status UTF signal (0:OK/1:Error)	
anmU_PGS	Redundant pedal sensor voltage
anmU_PWG	Pedal sensor voltage
anmU_REF	U_REF reference voltage
anmWTF	T_W water temperature
anmWTF_CAN T_W CAN coolant temperature T_WTF	
noteWTK	Water temperature 2 (at the cooler outlet)
anmZHB_CNT Consumption signal auxiliary heater: period counter (T=anmZHB_CNT*20ms)	
anoBSTZiOH Operating hours counter at KTF test start Hi byte	
anoBSTZiOL Operating hours counter at KTF test start low word	
anoBST_ZSH Operating hours counter for initialization Hi-Byte	
anoBST_ZSL Operating hours counter for initialization low word	
anoKMD_roh Refrigerant pressure raw value [%TV]	
anoKTF_Ini KTF at initialization	
anoKTF_Int Total KTF change	
anoKTF_PT Temp for KTF good notification via abs. Modification	
anoKTF_akt current KTF reference for plausibility check	
anoPBM_T5H High level duration refrigerant pressure signal	
anoPBM_T5P Period of refrigerant pressure signal	
anUTF_DIG Digital value outside temperature (relevant bits 0-8)	
anoU_ATM	Raw value atmospheric pressure sensor
anoU_BRE	Raw value voltage BRE

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anoU_HZA	Raw value heating demand
anoU_K15	Raw value terminal 15
anoU_LDF	Raw value boost pressure sensor
anoU_LDF2	Raw value supply voltage LDF
anoU_LMM	Raw value air mass meter
anoU_LMM1	Raw value air mass meter (old)
anoU_LMM1S	HFM5 1ms mean value over 1 segment (linearis)
anoU_LMM2	Raw value supply voltage LMM
anoU_LMM2S	HFM5 1ms mean value over 2 segments (linearized, input value f. anmLMM filter)
anoU_LMM51	Proc. raw value/supply HFM5 1ms
anoU_PGS	raw value red. Pedal value transmitter anoU_PGS2 raw
value supply red. Pedal value transmitter anoU_PGSLT	Raw value PGS- LTI
anoU_PWG	Raw value pedal value transmitter
anoU_PWG2	raw value supply voltage PWG
anoU_TAD	raw value AD test voltage anoU_TK raw value
fuel temperature	
anoU_TL	Raw air temperature value
anoU_TO	raw value oil temperature ***VW688 Ma
anoU_TS	raw value intake manifold temperature sensor
anoU_TW	Raw water temperature
anoU_TWK	raw value water temperature 2 (at the cooler outlet)
anoU_UBAT	raw value supply voltage PWG
anoU_UREF	raw value supply voltage PWG
anoU_UTF	Raw value UTF
anoVORHEIZ	difference anmWTF - anmOTF for auxiliary heating compensation
anWTFkomp	Compensation value for WTF with auxiliary heating
armARF_AGL	ARF match value from diagnostics
armIST_4	MLt air mass flow after linearization + averaging
armM_E	Amount for ARF
armM_LBiT	M_L current air mass 2nd HFM
armM_List	M_L current air mass
armM_Lsoll	M_L setpoint for ARF control
aro2ST1	WTF corrected rule value
aro2ST2	WTF and Pkorr corrected rules value
aro2STEU_B	Control actuator 1 from actuator 2
aroAB_VGW1	Shutdown status when controlled with VGW
aroARFAGL	matching value limited
aroAUS_B	ARF shutdown
aroE	controller deviation
aroEmax	Allowed deviation = f(n,M_Lsoll)
aroEmaxF	Allowed deviation factor = f(n,M_Eakt)
aroEmaxG	Basic value Allowed deviation = f(n,M_Lsoll)
aroEueb	Monitoring RA (0:vorl.negRA/1:vorl.posRA/2:UEaktiv)
aroFARFAB1	Shutdown bits in the event of errors
aroFARFAB3	Shutdown bits in the event of errors
aroIST_1	U_LMM after switch-on correction
aroIST_5	M_L after conversion and normalization.
aroLTF_aus	Output ARF switch-off hysteresis via LTF
aroML_aus	Output ARF switch-off hysteresis via air mass
aroPSKW	M_L Air volume from altitude correction
aroPkorr	Corrected ADF
aroREG3pt1	PT1 filtered ARF adjuster1
aroREG_1	Control value+regulation value before monitoring
aroREG_2	shutdown status
aroREG_3	TV ARF controller 1 after KF arwREG1KF ***AC106 bn
aroREG_4	TV ARF actuator 2 after KF arwREG2KF ***AC106 bn
aroREG_B	Regulation on because of quantity threshold
aroRGIAnt	ARF-I share
aroRGPant	ARF-P portion
aroRGpi	rule value
aroRGst	control value after hysteresis

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aroRGteu tax value	
aroRKSTAT control flap status aroSOLL_0 basic	
value aroSOLL_1 setpoint after adjustment	
aroSOLL_10 M_L air volume from height correction after	
ramp aroSOLL_11 M_L air setpoint after height correction aroSOLL_2 setpoint after air pressure	
correction. aroSOLL_3 target value according to air temp. corr. aroSOLL_4 setpoint according to	
water temp. corr. aroSOLL_5 Target value after limitation aroSOLL_6 Correction value of the	
dynamic control aroSOLL_8 Air pressure correction = f(P_ATM) * f(n,M_E) aroSOLL_9 Water	
temperature correction = f(n,T_W) * f(M_E)	
aroST1	Alignment-corrected control value Alignment and WTF-
the limitation aroTi_Ad [illegible]	[illegible]
shutdown ARF rotation threshold EGR correction at height aroUMDRp aroWTF_aus Output	
ARF shutdown hysteresis via WTF	
C	
camRCSTAT0 CAN0 receive status for all messages camSTATUS0 CAN0 status +	
masking caoIMM2XCH OSEK IO IMM2XCO low word	
caoIMM2XCL OSEK IO IMM2XCO Low Word	
caoM01_B0 CAN Object 1 - Data 0 caoM01_B1 CAN	
Object 1 - Data 1 caoM01_B2 CAN Object 1 - Data 2	
caoM01_B3 CAN Object 1 - Data 3 caoM01_B4 CAN	
Object 1 - Data 4 caoM01_B5 CAN Object 1 - Data 5	
caoM01_B6 CAN Object 1 - Data 6 caoM01_B7 CAN	
Object 1 - Data 7 caoM02_B0 CAN Object 2 - Data 0	
caoM02_B1 CAN Object 2 - Data 1 caoM02_B2 CAN	
Object 2 - Data 2 caoM02_B3 CAN Object 2 - Data 3	
caoM02_B4 CAN Object 2 - Data 4 caoM02_B5 CAN	
Object 2 - Data 5 caoM02_B6 CAN Object 2 - Data 6	
caoM02_B7 CAN Object 2 - Data 7 caoM03_B0 CAN	
Object 3 - Data 0 caoM03_B1 CAN Object 3 - Data 1	
caoM03_B2 CAN Object 3 - Data 2 caoM03_B3 CAN	
Object 3 - Data 3 caoM03_B4 CAN Object 3 - Data 4	
caoM03_B5 CAN Object 3 - Data 5 caoM03_B6 CAN	
Object 3 - Data 6 caoM03_B7 CAN Object 3 - Data 7	
caoM04_B0 CAN Object 4 - Data 0 caoM04_B1 CAN	
Object 4 - Data 1 caoM04_B2 CAN Object 4 - Data 2	
caoM04_B3 CAN Object 4 - Data 3 caoM04_B4 CAN	
Object 4 - Data 4 caoM04_B5 CAN object 4 - Data 5	
caoM04_B6 CAN object 4 - Data 6 caoM04_B 7 CAN	
object 4 - data 7 caoM05_B0 CAN object 5 - data 0	
caoM05_B1 CAN object 5 - data 1 caoM05_B2 CAN	
object 5 - data 2 caoM05_B3 CAN object 5 - data 3	

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caoM05_B4 CAN Object 5 - Data 4 caoM05_B5
CAN Object 5 - Data 5 caoM05_B6 CAN Object
5 - Data 6 caoM05_B7 CAN Object 5 - Data 7
caoM06_B0 CAN Object 6 - Data 0 caoM06_B1
CAN Object 6 - Data 1 caoM06_B2 CAN Object
6 - Data 2 caoM06_B3 CAN Object 6 - Data 3
caoM06_B4 CAN Object 6 - Data 4 caoM06_B5
CAN Object 6 - Data 5 caoM06_B6 CAN Object
6 - Data 6 caoM06_B7 CAN Object 6 - Data 7
caoM07_B0 CAN Object 7 - Data 0 caoM07_B1
CAN Object 7 - Data 1 caoM07_B2 CAN Object
7 - Data 2 caoM07_B3 CAN Object 7 - Data 3
caoM07_B4 CAN Object 7 - Data 4 caoM07_B5
CAN Object 7 - Data 5 caoM07_B6 CAN Object
7 - Data 6 caoM07_B7 CAN Object 7 - Data 7
caoM08_B0 CAN Object 8 - Data 0 caoM08_B1
CAN Object 8 - Data 1 caoM08_B2 CAN Object
8 - Data 2 caoM08_B3 CAN Object 8 - Data 3
caoM08_B4 CAN Object 8 - Data 4 caoM08_B5
CAN Object 8 - Data 5 caoM08_B6 CAN Object
8 - Data 6 caoM08_B7 CAN Object 8 - Data 7
caoM09_B0 CAN Object 9 - Data 0 caoM09_B1
CAN object 9 - Data 1 caoM09_B2 CAN object
9 - Data 2 caoM09_B 3 CAN Object 9 - Data 3
caoM09_B4 CAN Object 9 - Data 4 caoM09_B5
CAN Object 9 - Data 5 caoM09_B6 CAN Object
9 - Data 6 caoM09_B7 CAN Object 9 - Data 7
caoM10_B0 CAN Object 10 - Data 0
caoM10_B1 CAN Object 10 - Data 1
caoM10_B2 CAN Object 10 - Data 2
caoM10_B3 CAN Object 10 - Data 3
caoM10_B4 CAN Object 10 - Data 4
caoM10_B5 CAN Object 10 - Data 5
caoM10_B6 CAN Object 10 - Data 6
caoM10_B7 CAN Object 10 - Data 7
caoM11_B0 CAN Object 11 - Data 0
caoM11_B1 CAN Object 11 - Data 1 caoM11_B2
CAN Object 11 - Data 2 caoM11_B3 CAN Object
11 - Data 3 caoM11_B4 CAN Object 11 - Data
4 caoM11_B5 CAN Object 11 - Data 5
caoM11_B6 CAN Object 11 - Data 6 caoM11_B7
CAN Object 11 - Data 7 caoM12_B0 CAN Object
12 - Data 0 caoM12_B1 CAN Object 12 - Data 1
caoM12_B2 CAN Object 12 - Data 2 caoM12_B3
CAN Object 12 - Data 3 caoM12_B4 CAN Object
12 - Data 4 caoM12_B5 CAN Object 12 - Data
5 caoM12_B6 CAN Object 12 - Data 6
caoM12_B7 CAN Object 12 - Data 7 caoM13_B0
CAN object 13 - Data 0 caoM13_B1 CAN object
13 - Data 1 caoM13_B2 CAN Object 13 - Data 2

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caoM13_B3 CAN Object 13 - Data 3	
caoM13_B4 CAN Object 13 - Data 4	
caoM13_B5 CAN Object 13 - Data 5	
caoM13_B6 CAN Object 13 - Data 6	
caoM13_B7 CAN Object 13 - Data 7	
caoM14_B0 CAN Object 14 - Data 0	
caoM14_B1 CAN Object 14 - Data 1	
caoM14_B2 CAN Object 14 - Data 2	
caoM14_B3 CAN Object 14 - Data 3	
caoM14_B4 CAN Object 14 - Data 4	
caoM14_B5 CAN Object 14 - Data 5	
caoM14_B6 CAN Object 14 - Data 6	
caoM14_B7 CAN Object 14 - Data 7	
caoM15_B0 CAN Object 15 - Data 0	
caoM15_B1 CAN Object 15 - Data 1	
caoM15_B2 CAN Object 15 - Data 2	
caoM15_B3 CAN Object 15 - Data 3	
caoM15_B4 CAN Object 15 - Data 4	
caoM15_B5 CAN Object 15 - Data 5	
caoM15_B6 CAN Object 15 - Data 6	
caoM15_B7 CAN Object 15 - Data 7	
caoOSK1Sta OSEK channel1 status	
caoOSK2Sta OSEK channel 2 status	
caoXCO2IMH OSEK IO XCO2IMM High Word	
caoXCO2IML OSEK IO XCO2IMM Low Word	
comADF_fun Funct.Sch ADF function	
comARF_fun Funct.Sch ARF function	
comBYP_fun Status universal interface (on/off)	
comCLG_FUN Status activation of functions via login	
comCLG_SIG Status activation of signals via login	
comEFUN	Function switch from EEPROM (Bit:-,-,-,-,-,KSK,FGG,FGR)
comFGR_opt Funct.Sch FGR option	
comKWH_ABS switch to switch off (0: dimKLI / 1: dimKWH)	
comLDR_fun Funct.Sch LDR function	
comM_E_ASG Type of intervention for ASG quantity intervention	
comM_E_ASR Type of intervention for ASR quantity intervention	
comM_E_EGS Type of intervention for EGS quantity intervention	
comM_E_MSR Type of intervention for MSR quantity intervention	
comVAR_FZG function switch UTF	
crmCRSTpwm Crash level via PWM	
croCR_STAT crash level	
croCRzaehl PWM crash signal crash sequence counter	
D	
daoDTx_SA Segment address of the trigger addresses	
dimADM ADR ON dimADP	
dimADR dimADW dimADR	ADDR IN+
dimBRE dimBREPLAUS switch	ADR switch
of implausible dyn. Brake	ADR switch
- E2PROM	Switching signal AG4
	State of the brake after troubleshooting
dimBRK redundant brake contact	
dimDIGpre1 Debounced logic states d. first digit inputs	
dimDIGpre2 Debounced logic states d. second digit inputs	
dimECO	Ecomatic intervention (1=not active, 0=Eco active/engine off)
dimFGA	FGR OFF (digital)
dimFGL	Delete digital input FGR
dimFGM	FGR ON- (digital)
dimFGP	FGR ON+ (digital)
dimFGV	FGR control contact
dimFGW	FGR WA (digital)

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dimGZR	glow time control unit
dimHAN	ADR handbrake
dimK15	clamp 15
dimK15roh	Terminal 15 without debouncing
dimK50	terminal 50 (1=starter ON)
dimKIK	kickdown input
dimKLB	Air conditioning compressor input KLI_B (1=air conditioning ON)
dimKLI	air conditioning compressor input
dimKUP	Condition of the clutch after troubleshooting
dimKWH	Coolant heater shutdown
dimLGF	Status idle switch filtered
dimLGS	idle switch
dimR6_10	still free digital input
dimR6_14	still free digital input
dimR6_15	still free digital input
dimR6_8	still free digital input
dimR6_9	still free digital input
dimRKSTAT	Control damper status line
dioBREPLAU	Number of implausible dyn. braking conditions
dioROH1	Digitale_Eingaenge_roh
dioROH2	Digitale_Eingaenge_roh
duoLFZ	time difference between ther. activation and act. time
duoLFZMAX	maz. from the above edition
dzmABTAS	(McMess) Sampling time of the current DZG segment period
dzmCSGTout	Segment timeout timer
dzmCZylalt	old cylinder value
dzmDNDT	acceleration speed
dzmDNDT2u	Average acceleration value from 2 revolutions
dzmDZGANZ	Number of DZG interrupts between two n-sync. calculations
dzmLRR_ST	Status MAR -> LRR
dzmNSEG	NW speed (substitute speed)
dzmNWfi	filtered NW-KW twist angle
dzmN_ARD	N speed for the ARD (double averaged)
dzmNakt	(McMess) Current speed from the last period (unaveraged)
dzmNmit	(McMess) RPM (simple averaged)
dzmRed_Sta	Start attempt release "Start on SEG failure"
dzmSCHEDUL	Speed synchronous schedule controller
dzmSDRZgue	identifier Speed in valid range
dzmSEGM	(McMess) segment counter for DZG interrupt
dzmSg_Art	Type of segment event (synch.,norm.)
dzmSyncCyl	Cyl. on which was synchronized
dzmTrig1st	First trigger
dzmUMDRK15	revolutions since K15
dzmUMDRsta	Revolutions since takeoff
dzmdMe	Quantity error assessment - input for LRR
dzoABTAS	sampling time
dzoBadapt	Status encoder wheel adaptation
dzoCSY_Pul	SYNC Plaus: Number of SYNC teeth per NW
dzoCSg_Pul	SYNC-Plaus: number of teeth per NW
dzoCSg_n	Forming a SEG speed: Number of SEG signals
dzoCStoPul	Interference signal counter
dzoDXS0	normalized segment deviation
dzoDXS1	normalized segment deviation
dzoDXS2	normalized segment deviation
dzoDXS3	normalized segment deviation
dzoDXS4	normalized segment deviation
dzoDXS5	normalized segment deviation
dzoDXS6	normalized segment deviation
dzoDXS7	normalized segment deviation
dzoDXS8	normalized segment deviation
dzoDXS9	normalized segment deviation
dzoDXSf0	normalized segment deviation filtered
dzoDXSf1	normalized segment deviation filtered

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dzoDXSf2	normalized segment deviation filtered
dzoDXSf3	normalized segment deviation filtered
dzoDXSf4	normalized segment deviation filtered
dzoDXSf5	normalized segment deviation filtered
dzoDXSf6	normalized segment deviation filtered
dzoDXSf7	normalized segment deviation filtered
dzoDXSf8	normalized segment deviation filtered
dzoDXSf9	normalized segment deviation filtered
dzoDXSl0	learned normalized segment deviation
dzoDXSl1	learned normalized segment deviation
dzoDXSl2	learned normalized segment deviation
dzoDXSl3	learned normalized segment deviation
dzoDXSl4	learned normalized segment deviation
dzoDXSl5	learned normalized segment deviation
dzoDXSl6	learned normalized segment deviation
dzoDXSl7	learned normalized segment deviation
dzoDXSl8	learned normalized segment deviation
dzoDXSl9	learned normalized segment deviation
dzoDXadapt	adaptation parameter
dzoIDX1	first speed range index that oscillates
dzoIDX_N	current speed range
dzoMAR_ST	Status MAR
dzoNWSi_S2	distance (NW signal - S2)
dzoNW_KWWi	Twisting angle of the NW encoder wheel
dzoNW_KWfi	filtered angle of rotation of the NW encoder wheel
dzoNW_dT	Temperature difference to the reference temperature
dzoNW_dW	Temperature correction correction angle
dzoNWkorr	Temperature-corrected NW-KW twist angle
dzoNakt	Current RPM
dzoNmit	Speed (VSO)
dzoNmitalt	N speed old (simple averaged)
dzoSEGM	Segment Number (Sync at NBF)
dzoSEG_Za	Status SEG tooth found
dzoSYNCPok	Status SYNC plausibility
dzoSYPLver	SYNC plausibility attempts
dzoTS_AKT	current segment time
dzoTSg1SG	segment time (low byte) via segment encoder
dzoTSg2SG	segment time (high byte) via segment encoder
dzonDXSf0	filtered learned values 2
dzonDXSf1	filtered learned values 2
dzonDXSf2	filtered learned values 2
dzonDXSf3	filtered learned values 2
dzonDXSf4	filtered learned values 2
dzonDXSf5	filtered learned values 2
dzonDXSf6	filtered learned values 2
dzonDXSf7	filtered learned values 2
dzonDXSf8	filtered learned values 2
dzonDXSf9	filtered learned values 2
dzopDXSf0	filtered learned values 1
dzopDXSf1	filtered learned values 1
dzopDXSf2	filtered learned values 1
dzopDXSf3	filtered learned values 1
dzopDXSf4	filtered learned values 1
dzopDXSf5	filtered learned values 1
dzopDXSf6	filtered learned values 1
dzopDXSf7	filtered learned values 1
dzopDXSf8	filtered learned values 1
dzopDXSf9	filtered learned values 1

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E	
ecmDK_zu	DK closure by Ecomatic
ecmUso_ECO Usoll	specification of the Ecomatic evaluation
ecoECO_STA Ecomatic	operating status
edmDIA_P	Diagnosis pointer for EEPROM handler
edmEEMARAD	Start address MAR data
edmEEMARen	Storage status of MAR data
edmEEMARSU	status checksum MAR
edmEENWEn	Storage status of filtered NW-KW twist angle
edmIMM_W	propertywrite
edmK15roh	Raw status of terminal 15 after error handling
edmMACHSUH	Master checksum high word
edmMACHSUL	master checksum low word
edmM_E_AUS	Quantity output from self-diagnosis to GA
edmPW_cmax	PWG learned idle position EEPROM
edmPW_dp	PWG measured synchronization tolerance EEPROM
edmPsh_erl	Status message GSK3 protection
edmlock	login lock unit in xcwZBSperr
edmTIM_100	100ms timer synchronization
edmVB_FIL	Calculated consumption (filtered) from/for EEPROM
edoAGL_CS	checksum test for AGL from EEPROM
edoCANESB	CAN stimulus frame counter
edoCAN_F	OLDA output with missing CAN
edoCKETK	ETK Olda edition
edoCRED_WS	trigger write angle synchronous
edoCRED_ZS	Trigger Write synchronously
edoDSVCHK	DSV test results
edoEEDSV	DSV from EEPROM
edoEEFUN	Function switch + test from EEPROM
edoESBANZ	Number of entry conditions
edoGADID	Gate array identification
edoGAFRG	gate array question
edoGASTAT	gate array status 0000 -> OK.
edoGAWHERE	gate array where am I in gatst ???
edoININR	initialization code
edoKMZ_H	High word km stand
edoKMZ_L	Low -Word km stand
edoKMZ_STA	Status bits km status
edoLFZ	time difference between ther. activation and act. time
edoLFZMIN	min. from the output above
edoMSKID0	mask identifier LoWord
edoMSKID1	mask identifier HiWord
edoRSTCD	restart code
edoRSTDZ	Exceeding time [us]
edoRSTSH	Start address_High
edoRSTSL	Startaddress_Low
ehmBW1	diagnostic bits output stages 1...4
ehmBW2	Diagnostic bits output stages 5...9
ehmBW3	Diagnostic bits output stages 17...24
ehmBW4	Output stage diagnosis word 25...32
ehmBW5	Output stage diagnosis word 33...40
ehmDAR3	TV diagnosis ARF controller 3
ehmDARS	exhaust gas recirculation
ehmDDIA	TV diagnosis diagnostic lamp
ehmDEKP	TV Diagnosis Electric Fuel Pump
ehmDGAZ	TV diagnosis glow indicator
ehmDGER	TV diagnosis electric fan
ehmDGRS	TV diagnosis glow relay actuator
ehmDGSK1	TV Diagnostics Gluestift1
ehmDGSK2	TV Diagnostics Gluestift2
ehmDGSK3	TV diagnosis auxiliary heater

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ehmDHYL	TV diagnosis hydraulic fan
ehmDKLI0	TV diagnosis air conditioning compressor output 0
ehmDKSK	TV diagnosis fuel cooling
ehmDLDK	throttle actuator
ehmDLD_DK	TV diagnosis boost pressure / throttle actuator
ehmDMIL	TV control MIL lamp
ehmDML1	TV diagnosis engine position 1
ehmDML2	TV diagnosis alternator excitation / engine mount 2
ehmDMVS	TV diagnosis solenoid valve positioner
ehmDTAV	TV diagnosis tank shut-off valve
ehmDTST	TV diagnosis coolant thermostat
ehmDZWP	TV diagnostics lag pump
ehmD_FARS	TV control exhaust gas recirculation actuator
ehmFAR1	TV control ARF controller 1
ehmFAR2	TV control ARF controller 2
ehmFAR3	TV control ARF controller 3
ehmFARS	Duty cycle ARF controller
ehmFARSi	TV control exhaust gas recirculation actuator inverted
ehmFDIA	TV control diagnostic lamp
ehmFEKP	TV control electric fuel pump
ehmFGAZ	TV control glow display
ehmFGEA	TV control alternator excitation
ehmFGER	TV control electric fan
ehmFGRS	TV control glow relay controller
ehmFGRS_K	TV control glow relay controller, UBatt-corrected
ehmFGSK1	TV Control Gluehstift1
ehmFGSK2	TV control glow stick2
ehmFGSK3	TV control GSK3
ehmFHYL	TV control hydraulic fan
ehmFKLI0	TV control air conditioning compressor output 0
ehmFKSK	fuel cooling
ehmFLDK	Duty ratio LDK actuator
ehmFLDKi	TV control throttle valve inverted
ehmFLDSi	TV control boost pressure controller inverted
ehmFLD_DK	TV control boost pressure / throttle actuator
ehmFLS2	TV activation boost pressure actuator 2
ehmFMIL	TV control MIL lamp
ehmFMILi	TV control MIL lamp inverted
ehmFML1	TV control engine mount 1
ehmFML1i	TV control Motorlager2 inverted
ehmFML2	TV activation of engine mount 2/ ADR lamp
ehmFML2i	TV control Motorlager2 inverted
ehmFTAV	TV control tank shut-off valve
ehmFTST	TV control coolant thermostat
ehmFZWP	TV control after-running pump
ehmGER_O	Electric fan output stage open, unbounced
ehmMST_LMP	TV control glow display in the MST test
ehmSAR1	EST status ARF controller 1
ehmSAR3	EST status ARF controller 3
ehmSARS	Status MVS controller
ehmSDIA	EST status diagnostic light
ehmSEKP	EST status electric fuel pump
ehmSGAZ	EST status glow indicator
ehmSGER	EST status electric fan
ehmSGRS	EST status glow relay actuator
ehmSGSK1	EST Status Glue1
ehmSGSK2	Status glow stick2
ehmSGSK3	EST status GSK3
ehmSHYL	EST status hydraulic fan
ehmSKLI0	EST Status A/C Compressor Output 0
ehmSKSK	EST Status Fuel Cooling
ehmSLDK	Throttle actuator (not MB)
ehmSLD_DK	EST status boost pressure / throttle actuator

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ehmSMIL	EST status MIL lamp
ehmSML1	EST status engine mounts1
ehmSML2	EST status engine position 2/ ADR lamp
ehSTAV	EST Status Tank Shutoff Valve
ehmSTST	EST status coolant thermostat
ehmSZWP	EST status lag pump
ehmUKORR	UBatt correction factor
ehmX0PDIR XP0 shadow register	
ehmX1PDIR XP1 shadow register	
ehoPWMPerh PWM high duration	
ehoTVAR3	TV end value
ehoTVARS	TV final value ARS controller
ehoTVDIA	TV end value diagnosis lamp
ehoTVEKP	TV full scale Electric fuel pump
ehoTVGAZ	TV end value glow display
ehoTVGER	TV full scale electric fan
ehoTVGK1	TV final value Gluehstift1
ehoTVGK2	TV final value Gluehstift2
ehoTVGK3	TV end value
ehoTVGRS	TV end value glow relay actuator
ehoTVHYL	hydrofan
ehoTVKLI	TV full scale air conditioning
ehoTVKSK	TV final value KSK controller
ehoTVLDK	TV final value DKS controller
ehoTVLDS	TV end value diagnosis boost pressure/throttle valve positioner
ehoTVMIL	TV full scale MIL lamp
ehoTVML1	TV end value engine bearing1
ehoTVML2	TV final value Motorlager2/ ADR lamp
ehoTVTAV	TV end value tank shut-off valve
ehoTVTST	TV full scale thermostat
ehoTVZWP	lag pump
f	
fbmCPID1AB Carb Mode 01, Pid 01, Data A, Data B	
fbmCPID1CD Carb Mode 01, Pid 01, Data C, Data D	
fbmDIAL DIA lamp (bit 0: error, 1: NL error, 2: permanent, 3: LT1, 4: LT2, 5: delay. ex.,6:X,7:GAZ)	
fbmMIL	MIL display (bit 0: error, 1: NL error, 2: cont., 3: LT1, 4: LT2, 5: delay. ex.,6:X)
fbmRDYNES Readyness 2 bit counter	
fbmRyBits Readiness bits indicator	
fbmSDIAL request diagnostic lamp from error handling	
fbmSMIL Request MIL from cycle management	
fbmWUC WarmUp Cycle indicator	
fbmZYKAKT cycle update active	
fboFS0FAA FSP error	entry 0 - error type current
fboFS0FAE FSP error	entry 0 - error type debounced
fboFS0FLZ FSP error	entry 0 - FLC counter
fboFS0HFZ FSP error	entry 0 - frequency counter
fboFS0HLZ FSP error	entry 0 - HLC counter
fboFS0PFD FSP error	entry 0 - path number
fboFS0SLZ FSP error	entry 0 - self-deletion counter
fboFS0STA FSP error	entry 0 - status
fboFS0UB1 FSP error	entry 0 - environmental condition 1
fboFS0UB2 FSP error	entry 0 - environmental condition 2
fboFS0UB3 FSP error	entry 0 - environmental condition 3
fboFS0UB4 FSP error	entry 0 - environmental condition 4
fboFS0UB5 FSP error	entry 0 - environmental condition 5
fboFS1FAA FSP error	entry 1 - current error type
fboFS1FAE FSP error	entry 1 - error type debounced
fboFS1FLZ FSP error	entry 1 - FLC counter
fboFS1HFZ FSP error	entry 1 - frequency counter

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fboFS1HLZ	FSP error entry 1 - HLC counter
fboFS1PFD	FSP error entry 1 - path number
fboFS1SLZ	FSP error entry 1 - self-deletion counter
fboFS1STA	FSP error entry 1 - status
fboFS1UB1	FSP error entry 1 - environmental condition 1
fboFS1UB2	FSP error entry 1 - environmental condition 2
fboFS1UB3	FSP error entry 1 - environmental condition 3
fboFS1UB4	FSP error entry 1 - environmental condition 4
fboFS1UB5	FSP error entry 1 - environmental condition 5
fboFS2FAA	FSP error entry 2 - current error type
fboFS2FAE	FSP error entry 2 - error type debounced
fboFS2FLZ	FSP error entry 2 - FLC counter
fboFS2HFZ	FSP error entry 2 - frequency counter
fboFS2HLZ	FSP error entry 2 - HLC counter
fboFS2PFD	FSP error entry 2 - path number
fboFS2SLZ	FSP error entry 2 - self-deletion counter
fboFS2STA	FSP error entry 2 - status
fboFS2UB1	FSP error entry 2 - environmental condition 1
fboFS2UB2	FSP error entry 2 - environmental condition 2
fboFS2UB3	FSP error entry 2 - environmental condition 3
fboFS2UB4	FSP error entry 2 - environmental condition 4
fboFS2UB5	FSP error entry 2 - environmental condition 5
fboFS3FAA	FSP error entry 3 - current error type
fboFS3FAE	FSP error entry 3 - error type debounced
fboFS3FLZ	FSP error entry 3 - FLC counter
fboFS3HFZ	FSP error entry 3 - frequency counter
fboFS3HLZ	FSP error entry 3 - HLC counter
fboFS3PFD	FSP error entry 3 - path number
fboFS3SLZ	FSP error entry 3 - self-deletion counter
fboFS3STA	FSP error entry 3 - status
fboFS3UB1	FSP error entry 3 - environmental condition 1
fboFS3UB2	FSP error entry 3 - environmental condition 2
fboFS3UB3	FSP error entry 3 - environmental condition 3
fboFS3UB4	FSP error entry 3 - environmental condition 4
fboFS3UB5	FSP error entry 3 - environmental condition 5
fboFS4FAA	FSP error entry 4 - current error type
fboFS4FAE	FSP error entry 4 - error type debounced
fboFS4FLZ	FSP error entry 4 - FLC counter
fboFS4HFZ	FSP error entry 4 - frequency counter
fboFS4HLZ	FSP error entry 4 - HLC counter
fboFS4PFD	FSP error entry 4 - path number
fboFS4SLZ	FSP error entry 4 - self-deletion counter
fboFS4STA	FSP error entry 4 - status
fboFS4UB1	FSP error entry 4 - environmental condition 1
fboFS4UB2	FSP error entry 4 - environmental condition 2
fboFS4UB3	FSP error entry 4 - environmental condition 3
fboFS4UB4	FSP error entry 4 - environmental condition 4
fboFS4UB5	FSP error entry 4 - environmental condition 5
fboOABS	Checked path ABS
fboOACC	Checked path ACC via CAN
fboOADF	Check path ADF
fboOAR1	Checked path ARF controller 1 EPW
fboOAR2	Checked path ARF controller 2
fboOAR3	Checked path ARF controller 3
fboOARF	Checked path ARF
fboOASG	Checked path CAN-ASG message
fboOAUZ	Checked path misfire detection
fboOBRE	Checked path brake signal
fboOBSG	Checked path CAN-BSG1 message
fboOCAN	Checked path CAN controller
fboOCRA	Checked path Crash detection
fboOCVT	Checked path CVT transmission
fboODIA	Checked path diagnostic lamp DIA

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fboODZG	Checked path speed sensor DZG
fboOEEP	Checked path EEPROM and configuration
fboOEKP	Checked path EKP
fboOEP1	Checked path EP1
fboOEXM	Checked path External crowd intervention
fboOFGA	Checked path FGR control panel
fboOFGC	Checked path FGR control panel
fboOFGG	Checked path driving speed sensor FGG
fboOGAZ	Checked path glow indicator GAZ
fboOGER	Checked path electric fan
fboOGK3	Checked path auxiliary heater
fboOGRS	Tested path glow relay actuator GRL
fboOGZS	Test path glow plug 3
fboEARL	Test path main relay main relay
fboOHUN	Audit Trail Hunter
fboOHYL	Checked path hydrofan
fboOHZA	Checked path heating request
fboOIMM	Checked Path Immobilizer
fboOK15	Test path terminal 15
fboOKBI	Checked path instrument cluster
fboOKIK	Checked path kickdown switch KIK
fboOKLI	Checked path air conditioning compressor actuator 0 KLI
fboOKMD	Check path KMD
fboOKTF	Tested path fuel temperature sensor KTF
fboOKW2	Checked path KW2
fboOKWH	Checked path cooling water heating
fboOLD1	Checked path LD1
fboOLDF	Tested path boost pressure sensor LDF
fboOLDS	Tested path boost pressure / throttle valve actuator
fboOLMM	Checked path air flow meter LMM
fboOLTF	Checked path air temperature sensor LTF
fboOMIL	Check path MIL
fboOML1	Checked path engine bearing1
fboOML2	Checked path engine mounts2
fboONLF	Checked path follow-up tests
fboOOTF	Checked path OTF
fboOPGS	Checked path red. Pedal value PGS
fboOPWG	Tested path pedal value sensor PWG
fboORUC	Checked path microcontroller uC
fboOSEK	Test path inductive secondary speed sensor (NBF)
fboOSTF	Checked path intake manifold temperature sensor STF
fboOTAD	Test path AD test voltage TAD
fboOTAV	Checked path TAV
fboOTST	Checked path coolant thermostat
fboOUBT	Test path battery voltage BATT
fboOURF	Tested path reference voltage U_REF
fboOUTF	Checked path UTF error path
fboOWTF	Checked path water temperature sensor WTF (cylinder head outlet)
fboOWTK	Checked path water temperature sensor WTK (cooler outlet)
fboOZWP	Checked path lag pump
fboO_00	Checked paths 1 to 16
fboO_02	Checked paths 17 to 32
fboO_04	Checked paths 33 to 48
fboO_06	Checked paths 49 to 64
fboO_08	Checked paths 65 to 80
fboO_10	Checked paths 81 to 96
fboO_CAT_P	Number of paths "catalyst monitoring"
fboO_CAT_T	no. of checked paths "catalyst monitoring"
fboO_COM_P	Number of paths "comprehensive components"
fboO_COM_T	no. the checked paths "compreh.components"
fboO_EGR_P	Number of paths "EGR system monitoring"
fboO_EGR_T	no. of the checked paths "EGR system monitoring"
fboO_FUE_P	Number of paths "fuel system"

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fboO_FUE_T no. of the checked paths "fuel system"	
fboO_MIS_P Number of paths "misfire monitoring"	
fboO_MIS_T no. of checked paths "misfire monitoring"	
fboSABS	ABS error path
fboSACC	Error path ACC via CAN
fboSADF	Error path atmospheric pressure sensor ADF
fboSAR1	Error path ARF controller 1 EPW
fboSAR2	Error path ARF controller 2
fboSAR3	Error path ARF controller 3
fboSARF	ARF error path
fboSASG	Error path CAN-ASG message
fboSAUZ	Error path misfire detection
fboSBRE	Brake signal error path
fboSBSG	Error path CAN-BSG1 message
fboSCAN	Error path CAN controller
fboSCRA	Crash detection error path
fboSCVT	Error path CVT transmission
fboSDIA	Error path diagnostic lamp DIA
fboSDZG	Error path speed sensor DZG
fboSEEP	Error path EEPROM and configuration
fboSEKP	EKP error path
fboSEP1	EP1 error path
fboSEXM	EXM error path
fboSFGA	Error path FGR control panel
fboSFGC	Error path FGR via CAN
fboSFGG	Error path driving speed sensor FGG
fboSGAZ	Error path glow indicator GAZ
fboSGER	Electric fan path
fboSGK3	Error path auxiliary heater
fboSGRS	GRL glow relay actuator error path
fboSGZS	Error path glow plug 3
fboSHRL	Main relay error path Main relay
fboSHUN	Error path Hunter
fboSHYL	Hydrofan path
fboSHZA	Heat request error path
fboSIMM	Path immobilizer
fboSK15	Error path terminal 15
fboSKBI	Error path CAN COMBI message
fboSKIK	Error path kickdown switch KIK
fboSKLI	Error path air conditioner compressor positioner 0 KLI
fboSKMD	Error path KMD
fboSKSK	KSK error path
fboSKTF	Error path fuel temperature sensor KTF
fboSKW1	KW1 error path
fboSKW2	KW2 error path
fboSKWH	Path cooling water heating
fboSLD1	LD1 error path
fboSLDF	Error path boost pressure sensor LDF
fboSLDS	Error path boost pressure / throttle valve actuator
fboSLMM	Error path air flow meter LMM
fboSLTF	Error path air temperature sensor LTF
fboSMIL	Path MIL-A
fboSML1	Error path motor position 1
fboSML2	Error path motor position 2
fboSMV	MV error path
fboSMV1	MV1 error path
fboSMV2	MV2 error path
fboSMV3	MV3 error path
fboSMV4	MV4 error path
fboSMV5	MV5 error path
fboSMV6	MV6 error path
fboSNLF	Error path follow-up tests
fboSOTF	Error path oil temperature sensor OTF

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fboSPGS	error path red. Pedal value PGS
fboSPWG	Error path pedal position sensor PWG
fboSRUC	Error path microcontroller uC
fboSSEK	Error path inductive secondary speed sensor (NBF)
fboSSTF	Error path intake manifold temperature sensor STF
fboSTAD	Error path AD test voltage TAD
fboSTAV	Error path TAV
fboSTST	Path coolant thermostat
fboSUBT	Error path battery voltage BATT
fboSURF	Error path reference voltage U_REF
fboSUTF	UTF error path
fboSWTF	Error path water temperature sensor WTF (cylinder head outlet)
fboSWTK	Error path water temperature sensor WTK (cooler outlet)
fboSZWP	Follow-up pump path
fboS_00	Defective paths 1 to 16
fboS_02	Defective paths 17 to 32
fboS_04	Defective paths 33 to 48
fboS_06	Defective paths 49 through 64
fboS_08	Defective paths 65 through 80
fboS_10	Defective paths 81 to 96
fboS_ND	Number of broken paths
fboS_NP	Number of defined paths
fgmBESCH	A current acceleration
fgmDAT_SF	Distance factor driving speed measurement
fgmEE_SF V	Distance factor for KTG from EEPROM
fgmFGAKT	current speed
fgmFVN_UEB	transmission function drive train
fgm_VzuN	V/N current speed/rpm ratio
fgoHPDA	Current high level duration (only with KTG)
fgoHPDC	High level duration counter (only with KTG)
fgoHPDD	High level duration deviation (abs.) (only with KTG)
fgoHPDF	Filtered high level duration (KTG only)
fgoHPDS	start value high level duration (only with KTG)
fgoSTAT	status bits
fgoCOUNTER	FGG Pulse counter
fgo_GePer	FGG period << NE
fgo_V_roh	FGG raw speed value
fgo_a_roh	Raw acceleration value
fnmAGL_FN	Adjustment value start of injection
fnmFBsoll	delivery start setpoint
fnmWTF	T_W water temperature for FBR
fnoDYNStat	base value
fnoK2	Total correction value 2
fnoK3	Total correction value 3
fnoK4	Total correction value 4
fnoKW4	Correction value 4
fnoM_E	Quantity for setpoint formation
fnoSOLL1	Target value after correction 1
fnoSOLL2	Target value after correction 2
fnoSOLL3	Target value after correction 3
fnoSOLL4	Target value after correction 4
fnoSOLL5	Target value after correction 5
fnoSST	FB after FB-Start-KF
fnoSWBGR	setpoint limitation
fnoUMDRs	rotation threshold
G	
gsmAGL_VGK	adjustment value pre-heating characteristic
gsmCANGL	Pre-glow lamp status via CAN 1=glow
gsmDIA_GAZ	Activation glow indicator (for diagnostic lamp)
gsmER_READ	GSK3 Control error reported
gsmGLUEH	Gluhbit Message 1=glow

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gsmGSK3_ST	GSK3 status of the GSK (errors, data)
gsmGS_Pha	Glue phase display
gsmGS_Vor1	GSK3 1st phase pre-heating active
gsmGS_t_VG	pre-glow time after IPO3
gsmPsh_erl	GSK_3 Feedback from E2PROM dealer
gsoCO_Bit	GSK3 diagnosis bit counter
gsoCO_FL	GSK3 diagnosis flatline counter
gsoCO_TO	GSK3 diagnosis timeout counter
gsoDIA_STA	Status of the GSK3 status recording (WOM-OLDA)
gsoGS_TV4	control duty cycle for the remaining annealing processes
gsoGS_TVx	control duty cycle in the pre-glow phase
gsoGS_t1	control duration of the glow plugs with gswGS_TV1
gsoGS_tGAZ	activation duration of the glow display (only with cowVAR_GAZ = 1)
gsoGS_t_NG	GZS afterglow time after IPO2
gsoWTFAGL	GZS adjusted WTF value for VG map
gsoZG_Erl	intermediate annealing (0:LOCKED 1:PERMITTED)
K	
khmGENLOAD	KWH - filtered generator load
khmKWH_CAN	CAN message for "Engine off" via ECOMATIC not allowed
khmNORAB	KWH - status displays and switch-off conditions
khmN_LLKWH	Increase in idle speed with active KWH
khoHE_AB	KWH - Generator Load Shutdown Threshold
khoHE_ZU	KWH - generator load cut-in threshold
khoRELAIS	KWH - switching status of the individual HE (relays)
khoTL	KWH - air temperature before khwKH_TLKL
khoTMP_AN	Delay time until Ecomatic active
khoTMP_TIM	Timer Delay time until Ecomatic active
khoTWAUS_O	KWH - upper water temperature threshold
khoTWAUS_U	KWH - lower water temperature threshold
kkoSTATE	Fuel cooling status
klmHYS	Air conditioning compressor shutdown hysteresis outputs
klmL_HYS	A/C compressor shutdown hysteresis outputs slow
klmL_STAT	A/C compressor shutdown status bits slow
klmN_LLKLM	Increase in idle speed with air conditioning compressor on
klmSTAT	A/C compressor shutdown status bits
kloTMAX_AN	max. switch-off time of the air conditioning compressor when starting
kloTMIN_AN	min. switch-off time of the air conditioning compressor when starting
kloUTFTemp	klwUTFmn-anmUTF
kloWTFschw	water temperature threshold air conditioning compressor shutdown
kmmKFK_CAN	Bit map cooling
kmmWTF_ra	control deviation
kmmWTFsoll	Water temperature setpoint
kmoTSTreg	limited control duty cycle from regulation
kmoTSTsteu	control duty cycle from control
kmoWTF_so1	Water temperature setpoint 1
kmoWTF_so2	Water temperature setpoint 2
kmoWTF_so3	Water temperature setpoint 3
kmoWTF_so4	Water temperature setpoint 4
kmoWTF_so5	Water temperature setpoint 5
kmoWTF_sor	Water temperature setpoint 6
kmoWTFist	Actual water temperature
kumCAN_LUE	Average TV over HYL and GER for CAN
kumKMDneu	current refrigerant pressure
kumNL_akt	Cooling fan run-on
kumState	Status of cooler fan run-on
kuoANFBA	start-up requirement
kuoEl_KB	Cooling requirement of the electric fan
kuoEl_N	Electric fan base speed
kuoEl_N2	Minimum speed after hysteresis
kuoEl_N3	minimum speed 3
kuoEl_NAbl	Electric fan speed after blanking

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kuoEl_VGW3 default value for electric fans in the run-on	
kuoElnmin minimum speed for El fan from KL	
kuoHy_KB	Cooling requirement of the hydraulic fan
kuoHy_N	Hydrofan base speed
kuoHy_N2	Minimum speed after hysteresis
kuoHy_N3	minimum speed 3
kuoHy_NAbl Hydraulic fan speed after suppression	
kuoHy_VGW3 Default value for hydraulic fans in the run-on	
kuoHynmin minimum speed for Hy fan from KL	
kuoKB_KVM Cooling requirement from climate loss torque KL	
kuoKB_reg Cooling requirement (from regulation)	
kuoKB_steu Cooling requirement (from control)	
kuoKLIBA	climate demand requirement
kuoKLLFT	Cooling request via CAN
kuoKMDgesp stored refrigerant pressure	
kuoSOdyn value for increasing the cooling capacity	
kuoS_1 Control of cooler. driving operation	
kuoS_2 Control of cooler. trailing	
kuoSwitch KMD saved (0:yes/1:no)	
kuoVB_gesp Saved consumption after KL15.	
kuoV_ist driving speed actual value	
kuoV_ist2 driving speed for minimum speed	
kuoWTDIFF water temperature - water temperature at the cooler outlet	
kuoWTFcrit critical water temperature	
kuoWTK_ra control deviation	
kuoWTK_so1 Target water temperature 1	
kuoWTK_so2 target water temperature 2	
kuoWTK_so3 Target water temperature 3	
kuoWTK_so4 Target water temperature 4	
kuoWTK_so5 Target water temperature 5	
kuoWTK_so6 target water temperature 6	
kuoWTKist actual water temperature	
kuoWTKkorr correction factor	
kuoWTKsoll Target water temperature	
kuoZusKB additional cooling requirements	
kuorel1	relative cooling requirement 1
kuorel2	relative cooling requirement 2
L	
ldmADF	P_ATM current atmospheric pressure (from ADF or LDF)
ldmarea Shutdown condition of the LDR	
ldmE	LDR control deviation
ldmGLTV	BiT TV loader adjustment
ldmLDFP_dp LDF/ADF plausibility result	
ldmLDRSTAT LDR status boost pressure control	
ldmM_E	M_E LDR quantity input (current/desired/desired raw)
ldmP_Llin P_L current boost pressure (filtered) / air pressure	
ldmP_Lsoll Boost pressure setpoint	
ldmRGST	LDR area regulation or control
ldmVZ_akt Activation of LDR TV freezing	
ldoFLDRAB1 shutdown bits in the event of errors (bits)	
ldoFLDRAB3 shutdown bits in the event of errors (bits)	
ldoGRmax	upper controller limit
ldoGRmin	lower controller limit
ldoIFRZ	Integrator must not rise
ldoKSTWt	Shutdown time after cold start
ldoLA_DIF Pressure difference LDF/ADF	
ldoLDB_DPN OLDA speed depend. Offset for P_ATM calculation	
ldoLDFP_St Statusolda LDF/ADF plausibility	
ldoM_Est quantity for control	
ldoN_Abs shutdown cold start and speed>S	
ldoREGMXpR OLDA max. pos. LDR Deviation ***BA161 Pc	

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ldoRGDAnt OLDA LDR-D component ldoRGIAnt	
OLDA LDR-I component ldoRGPAnt OLDA LDR-	
P component ldoRGPITV OLDA TV from PI	
controller (without D component) ldoRGSunv OLDA undelayed LDR switching signal	
ldoRG_BER OLDA M_E/N area for monitoring ldoRG_TV TV control component +	
PIDT1 controller component ldoRG_TV2 TV 2nd LS output ldoRG_TVUB TV control	
component + PID before limitation ldoSWPLK1 OLDA correction value1 = f(P_setpoint)	ldoSWPLK1 OLDA correction value1 = f(P_setpoint component
ldoSWPLBEG setpoint after limitation to maximum ldoSWPLGKF OLDA P_L from	
basic map ldoSWPLMAX OLDA Maximum setpoint	
ldoSWPL_K0 OLDA relative pressure corrected with KW0 ldoSWPL_K1 OLDA	
relative pressure corrected with KW1 ldoSWPL_K2 OLDA relative pressure	
corrected with KW2 ldoSWP_L	
	OLDA setpoint P_L
ldoSWTL_K2 OLDA correction value2 = f(T_L) ldoSWTW_K0 OLDA	
correction value0 = f(T_W) ldoSW_TW	
	OLDA temperature input value ldoTV1
	TV control from one of the 2 basic KF
ldoTV2	TV control after ADF correction ldoTVsteu TV control
(final)	
M	
mloEAKTPT1 Filtered current quantity mloStatus Status solda	
mlo_MLTV	Olda for duty ratio
mrmACCDDE2 ACC-DDE2 status	
mrmACC_SAT ACC status	
mrmACC_roh ACC intervention amount	
mrmADRPWG2 Filtered speed value from PWG	
mrmADR_Neo ADR maximum speed (variable) from EEPROM mrmADR_Nfe ADR fixed	
speed from EEPROM mrmADR_SAT ADR status mrmADR_SET stored ADR WA speed	
mrmADR_SOL ADR target speed	
mrmASGSTAT ASG - Status	
mrmASG_CAN status CAN message ASG mrmASG_roh	
raw values ASG desired speed mrmASG_tsy ASG synchronization	
time mrmASRSTAT ASR - status	
mrmASR_CAN CAN message status ASR mrmASR_roh	
Reatives ASR/CAN intervention torque raw CAN error suppression active yes/no	
add. mrmBEGmAGL comparison value mrmBEGmAGL adjustment value mrmSOLL quantity	
quantity consumption mrmBM_ASG M_E limit quantity in ASG ECO mode	
mrmBM_EMOM torque limit quantity mrmBM_ERAU smoke quantity mrmBM_ESER M_E	
limit quantity before quantity comparison mrmBSG_Anf BSG requirement LL target speed	
increase mrmBSG_KLI BSG requirement switch off air conditioning mrmB_DSP switching	
point lowering transmission mrmCANMIL 1 = activation of the mrm CANSAB status lamp	
by CANSAB bit Braking torque intervention mrmCAN_ECO Ecomatic intervention	
(evaluated) by CAN message mrmCAN_KL 1 = switching off the air compressor by CAN	
bit mrmCAN_KLI Info 1 from Clima1 message mrmCAN_KUP converter clutch (evaluated)	
by CAN message	

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mrmCASE_A ARD state bits of the active bucking mrmCASE_A1 ARD state bits	
(extended) of the active bucking mrmCASE_L LLR state bits of the idle control mrmEGSSTAT EGS - Status	
mrmEGS_CAN Status CAN message EGS	
mrmEGS_akt Transmission message: circuit active mrmEGS_roh Relative	
EGS/CAN intervention torque raw mrmEXM_HGB EXME: HGB quantity acts	
on desired quantity mrmFDR_CAN Status vehicle dynamics control (bit-coded)	
mrmFGR_SAT FGR operating state mrmFGR_roh M_E FGR desired quantity	
unlimited mrmFG_ABS driving speed via CAN from the ABS control unit	
mrmFG_CAN driving speed of CAN mrmFG_SOLL V target value driving speed	
for diagnosis mrmFVHUEst transmission function drive train after filtering mrmF_STA1 FGR status	
1 (0: dimFGL, 1: dimFGA, 2: dimFGP/dimFGM, 3: dimFGW, 4: dimBRE, 5: dimKUP, 6: -/ dimFGP,	
7:-/dimFGV) mrmF_STA2 FGR status 2 mrmF_STA3 FGR status 3 (0:S_HAUPT, 1:T_AUS,	
2:T_VER, 3:T_BES, 4:T_SET, 5:T_WA, 6:-, 7:dimFGL) more current Gear EDC	
mrmGANG	
mrmGRA	Info GRA Embassy
mrmGRACoff GRA shutdown due to CAN message errors mrmGRA_UEF GRA from	
errors in the transmission function drive train	
mrmGTRGANG actual gear via message plausibility mrmGTRL_UEB	
transmission function powertrain via CAN from the EGS mrmHGB_Anf	
HGB requirement via CAN (Niveau1 and Allrad1) mrmHGB_Sta HGB status mrmINARD_D ARD - D -	
initialization request from EXME-PBM mrmKLI_LUE cooling requirement from the air conditioning	
mrmKLK_EIN air conditioning compressor /Out of	
mrmKMD	Refrigerant pressure via CAN
mrmKTF_	Fuel temperature for starting amount
mrmKUP_roh clutch torque loss raw mrmLDFUAGL	
comparison value LDF - ADF mrmLDFUaus intake manifold	
vacuum detection active mrmLFR_Adp adaptation lock bit from the	
transmission mrmLLIINIT initialization LLR I-component mrmLLN_ANH	
release for speed increase at idle mrmLLRIAnt M_E I-component of the	
LLR-PI controller mrmLLRPAnt M_E P-component of the LLR-PI Controller mrmLLR_AGL	
N adjustment value for idle speed correction mrmLLR_PWD LL speed increase PWG	
Plaus. (y/n)	
Temp.abh. LL Speed increase by UTF mrmLLUTF water	
mrmLLWTF	
mrmLL_ZIEL N Leerlaufzieldrehzahl mrmMDW_ab	
Moment aus Fahrverhaltenkennfeld mrmMD_BEGR	
Begrenzungsmoment mrmMD_FAHR Fahrerwunschmoment	
mrmMD_KLI Klimaverlustmoment mrmMD_KLKr Kompressorlast	
ueber CAN roh mrmMD_KUP Kupplungsverlustmoment mrmMD_LLR	
Leerlaufmoment mrmMD_RdiC Adaptionswert Reibmoment fuer CAN	
mrmMD_Rdif Adaptionswert Reibmoment mrmMD_ReiC Reibmoment	
fuer CAN mrmMD_Reib Reibmoment mrmMD_Rrel Differenz	
Reibmoment-LLR Moment mrmMSRSTAT MSR - Status	
mrmMSR_AKT MSR activity bit mrmMSR_CAN	
Status CAN message MSR mrmMSR_roh Relative	
MSR/CAN intervention torque raw	

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mrmM_EADR Quantity request all-speed controller mrmM_EAG4 Intervention quantity AG4 mrmM_EAKT (McMess) M_E Current injection quantity (without ARD) mrmM_EARD Current quantity ARD mrmM_EASG External quantity intervention ASG mrmM_EBEGR Limiting quantity mrmM_EEGS External quantity intervention EGS mrmM_EFAHR M_E Driving quantity according to LRR mrmM_EFGR M_E Desired quantity from FGR mrmM_EHMIST6E -ACTUAL moment mrmM_ELD2 difference quantity cyl. 1 to cyl. 2 mrmM_ELD3 difference quantity cyl. 1 to cyl. 3 mrmM_ELD4 difference quantity cyl. 1 to cyl. 4 mrmM_ELD5 difference quantity cyl. 1 to cyl. 5 mrmM_ELD6 difference quantity cyl. 1 to cyl. 6 mrmM_ELLBE Limited idle controller quantity mrmM_ELLR M_E quantity from idle control mrmM_ELRR quantity from smooth running controller mrmM_EMOT M_E injection quantity after ARD mrmM_EMOTX M_E injection quantity after ARD with fuel cutoff mrmM_EMSR external quantity intervention MSR mrmM_EPUMP M_E injection quantity before pump map mrmM_EPWG M_E desired quantity = f(PWG) from driving behavior raw (unfiltered) mrmM_ESOL6 TARGET quantity for Motor6 TARGET torque mrmM_ESTAR M_E resulting starting quantity target value mrmM_EVERB Consumption-relevant quantity mrmM_EWUN M_E time-synchronous desired quantity mrmM_EWUN6 desired desired quantity for Motor6 message synchronously mrmM_EWUNF M_E driver's desired quantity from PWG or FGR mrmM_EWUNL desired quantity plus idle quantity mrmM_EWUNR desired quantity plus idle quantity mrmM_EWUNR mrmM_EWUS6 Desired target quantity for Motor6 message mrmM_EWUSO Limited desired quantity mrmN_LLBAS N target idle speed mrmN_LLBAT LL speed depending on the battery voltage mrmN_LLBSG target idle speed BSG mrmN_LLCAN idle speed specification via CAN (EGS2) mrmN_LLDIA N target idle speed for diagnosis mrmN_LLKLI LL speed depending on the Clima1 CAN mrmNfilt filtered speed mrmPWGPBI PWG value for PBM output taking into account Immostatus mrmPWGPBM PWG value for PBM output AG4 mrmPWG_lwo pedal value sensor idle travel optimized mrmPWG_roh PWG raw value mrmPWGfi PWG filtered value -Position mrmPW_OFFS offset idle travel reduction mrmPW_cmax PWG learned idle position -x times LL PWG measured synchronization tolerance -x times LL mrmPW_dp mrmRMPSLOP GRA target acceleration for ON + / ON / WA mrmSASTATE ARD quantity shut-off with thrust (no thrust bucking) mrmSA_FAKT factor for ramp slope VE mrmSICH_F security case bit mrmSTART_B Start bit mrmSTATUS status engine operating phase mrmSTA_AGL M_E comparison value for starting quantity correction mrmSTW_fr interlocking release for start mrmT_SOLEE ADR start-up time from EEPROM mrmVB_FIL calculated consumption (filtered)	

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mrmV_HGBSW current maximum speed mrmV_SOLEE HGB target speed from	
EEPROM mrmV_SOLHN HGB tracked target speed mrmWH_1NRP selector lever info	
mrmWH_POS selector lever position mrmW_KUP	
	CAN - EGS clutch mrmZUMEAUS
shutdown metering mrm_P_N	
	Gear info from the CAN
mrmdMD_MGB Maximum moment gradient mrmdM_EFF DELTA	
amount of Fuerungsformers	
mroAB	curtailment factor
mroABM_E	quantity factor
mroABN	speed factor
mroACC_A	Plausibility error counter
mroACC_OFF ACC switched off mroADR_ABB ADR	
termination condition mroADR_AUS ADR switch-off condition	
mroADR_HL ADR run-up in gear mroADR_I_A ADR I-share	
mroADR_PSO raw speed value from PWG mroADR_PWG	
filtered speed value from PWG mroADR_P_A ADR P-share	
mroADR_TAS speed value from button query mroADR_TSO target	
mroADR_TSO raw speed value from button query AG4 - status display bits	
mroAKT_SWN HGB state of the maximum speed. mroASG_NRA ASG-	
Regelabweichung mroASG_Nso ASG-Drehzahlsollwert mroASG_Nsy ASG-	
Wunschdrehzahl mroAUSZEZ1 Aussetzerergebnis Z1 mroAUSZEZ2 Aussetzerergebnis Z2	
mroAUSZEZ3 Aussetzerergebnis Z3 mroAUSZEZ4 Aussetzerergebnis Z4 mroAUSZEZ5	
Aussetzerergebnis Z5 mroAUSZEZ6 Aussetzerergebnis Z6 mroAUSZUM1 Anzahl	
bewerteter Motorumdrehungen Puffer1 mroAUSZUM2 Anzahl bewerteter Motorumdrehungen	
Puffer2 mroAUSZUpM Anzahl bewerteter Motorumdrehungen mroAUSZZ1 Aussetzerzaehler	
Z1 mroAUSZZ2 Aussetzerzaehler Z2 mroAUSZZ3 Aussetzerzaehler Z3 mroAUSZZ4	
Aussetzerzaehler Z4 mroAUSZZ5 Aussetzerzaehler Z5 mroAUSZZ6 Aussetzerzaehler Z6	
mroAUSZ_dN Mindestdrehzahlanstieg mroAUSZsta Ueberwachungsstatus (0:aktiv)	
mroAdpfrei Adaption Reibmoment freischalten mroBEG_P mroBEG_T mroBI_BEGR CAN	
- Sollmengenverbrauch mroBI_FAHR CAN - Fahrerwunschmengenverbrauch mroBI_LLR	
LLR Verbrauch mroBI_REIB CAN - Reibmengenverbrauch mroBI_SOL6 Sollmengenverbrauch	
fuer Motor6-Botschaft mroBI_WUN CAN - Desired quantity consumption mroBMEF Me	
Ngenlimitation factor mroBMEFATM Atmospheric pressure protection mroBMEFKOC	
Cooking protection quantity factor after IPO3 mroBMEFKT Quantity limitation over fuel temperature	
mroBMEFOEL Oil temperature protection mroBMEFTT Quantity limitation over tank temperature	
mroBMELFT Quantity limitation over charge air temperature	
	Boost pressure or atmospheric pressure for mroPkorr air temperature from LTF or STF
	for mroPkorr

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mroBM_EERH Erhoehungsmenge	
mroBM_EERS Ersatzmenge mroBM_EKTB	
Differenzmenge zur Begrenzung = f(KTF) mroBM_EMO2 ASG-Drehmomentenkennlinie	
2 mroBM_EMOM Drehmomentbegrenzungsmenge mroBM_ENSU Begrenzungsmenge	
nach sub.Mengenreduktion mroBM_ERAU Rauchmenge mroBM_ERKT	
Begrenzungsmenge nach BM_ERAU=f(KTF) mroBM_ESE1 M_E Begrenzungsmenge vor	
VE Mengenbegrenzung mroBM_ETUK Turbomenge nach KickDown mroBM_ETUR	
Turbomenge mroBM_EVSU Limit quantity before sub. quantity reduction mroBM_KTB delta	
quantity per 100 degrees C (mrwKTB_KF)	
M_E lower threshold M_E minimum quantity mroBSTZh operating hours counter high-word mroBM_VE limit quantity VE	
mroBSTZl operating hours counter low-word mroCASE_FF FF state ARD speed-	
synchronous part mroCASE_LL state LLR speed synchronous part mroCASE_SRSR	
intervention mroDNDmenge AG4 speed gradient mroDZ_phase_mod DZTGLO AG4	
- speed gradient in low phase mroEGSECST EGS-CAN status for Ecomatic evaluation	
mroEGSERR CAN - EGS intervention time exceeded mroEGSINT EGS intervention	
time integral mroFGR_AB1 FGR switch-off conditions bit-coded 0-15 mroFGR_AB2 FGR	
switch-off conditions bit-coded >15 mroFGR_ABN FGR-AUS Cause mroFGR_KUP	
clutch penetration on FGR mroFMEBEG1 quantity limitation for errors (bits) mroFMEBEG3	
quantity limitation for errors (bits) mroFPM_BED PWG condition for status change	
mroFPM_FEN PWG current plausibility window mroFPM_ZAK PWG Plausibility check	
current state Ramp slope mroFRamp mroFSchub Thrust limit mroFVHGTdi Max. Dif.,	
Transfer function mroFVHSTAT Status of the FVHKF evaluation mroFVHUEro Used	
transfer function before PT1 filter mroFZug train limit mroF_VERZ Frequency booster	
signal mroGANG	
	act. gear act.
mroGG	Transmission group mroHGBLLho
limitation active despite the end of the requirement (because of LL) mroHGB_RA HGB control deviation	
mroHGI	
	HGB I component of the PI controller
mroHGP	HGB P component of the PI controller
mroHGmax	HGB controller limitation
mroHYSSTAT hysteresis status of the CAN - interventions mroI_AKT mroKLDO	
	old I component output
	DT1 due to Air conditioning compressor switch-on torque mroLDFASTA Status
of the adjustment mroLDFO_PS Pressure from intake manifold vacuum healing characteristic	
mroLDFU_PS Pressure from intake manifold vacuum healing characteristic mroLDFU_no Monitoring	
on SU not allowed mroLDFUabg Determined value for EEPROM mroLDFUdf1 pressure difference	
LDF-ADF before calibration mroLDFUdf2 adjusted pressure difference LDF-ADF mroLDFUdif intake	
manifold vacuum normalized LLR-DRDFUdif proportioned mroLL	
mroLLUTF	Status LL elevation by UTF

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speed from WTF, ADF map mroLLumdr rotation threshold for idle speed	Idle speed with defective PWG mroLpwg mroLLsoll idle
increase mroLRR1NW filter output 1-fold cam frequency mroLRR2NW filter output 2-	
fold cam frequency mroLRR3NW filter output 3-fold cam frequency mroLRR4NW filter output 4-fold cam	
frequency mroLRRI1 M_E I-part of the 1st LRR PI controller M_E I component of the 2nd LRR PI	
controller M_E I component of the 3rd LRR PI controller M_E I component of the 4th LRR PI controller	
M_E I component of the 5th LRR PI Controller M_E I-part of the 6th LRR PI controller LRR integrator 7	
mroLRRI8 LRR integrator 8 mroLRROFFS Offset ring memory LRR filter speeds mroLRRReg LRR	
control deviation mroLRRZust state smooth-running control mroLRR_BGR LRR limiting quantity	mroLS_akt ARD SR timer activation mroMDASGmix EGS pre-control limitation
mroLRRI2	maximum selection mroMDInAdt ASG integrated torque mroMDIntdt MSR integrated
mroLRRI3	torque mroMDSchRA control deviation = friction torque (without LLR) - max. allowed
mroLRRI4	
mroLRRI5	
mroLRRI6	
mroLRRI7	
	Drag torque
mroMDSchSO Maximum allowed drag torque mroMDW_CAN CAN -	
desired wheel torque mroMDW_PWG corrected PWG torque from v-	
dependent FVHKF mroMDWkorr PWG torque rated with transmission function mroMD_ASG CAN -	
ASG torque mroMD_ASR CAN - ASR torque mroMD_Areg ASG torque from controller mroMD_Arei	
ASG torque + friction torque mroMD_EGS CAN - EGS moment mroMD_FAHu uncorr. Torque f. CAN	
mroMD_FAHx CAN - driving torque mroMD_GEN Calculated generator torque loss mroMD_IST6	
Actual torque for Motor6 message mroMD_KL1 Calculated air-conditioning compressor torque loss	
from KF mroMD_KLI Compressor load torque mroMD_KLK Torque loss over compressor load from	
Clima 1 mroMD_KOFT Correction factor for torque correction. mroMD_MOT Engine torque loss	
(without air conditioning and gen.) mroMD_MSR CAN - MSR moment mroMD_Rakt rated reduced	
friction torque mroMD_Rdif friction torque raw value mroMD_ReiR friction torque over fuel consumption	
KF mroMD_SOL6 target torque for Motor6 message mroMD_SOLL CAN - target torque mroMD_VOR	
EGS pre-control mroMD_VORl EGS pre-control - Idle torque mroMD_VORm EGS pre-control after	
minimum selection mroMD_VORr EGS pre-control - friction torque mroMD_WUN CAN - desired	
torque mroMDabAKT Actual wheel torque without ARD mroMDabBEG Grenzradmoment mroMDabFGR	
Current controller output size wheel torque mroMEVerl loss quantity mroM_APUMP pump quantity	
before zero-quantity correction mroM_ARDFF injection quantity ARD Fuehrungsformer mroM_ARDSU	
quantity stoerungsformer mroM_ARDSU injection quantity mroM_ARDSU after SR unlimited	
mroM_ARDWU current Menage ARD leadership shaper limited	

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mroM_EAKTf Current amount from driving mroM_EASGr ASG	
intervention amount raw mroM_EASR ASR intervention torque	
mroM_EASRr ASR intervention torque raw mroM_EBEGR limit	
amount limit amount before dn/dt limit mroM_EBG mroM_EBGvo	
limit amount before shutdown by dual-mass flywheel mroM_EEGS	
External torque mroM_EEGSr Eingriff Mengeneingriff EGS raw	CAN - Substitute amount for EGS mroM_EMSEEGS_r EGS-
Vorsteuerung mroM_EFAHf Fahrmenge vor Startumschalter mroM_EHKF AG4 - Eingriffsmenge	
Hochschaltkennfeld mroM_ELLBE begrenzte Leerlaufmenge mroM_EMSRr MSR-Eingriffsmoment roh	
mroM_EPWGU PWG-Wunschmenge unbegrenzt mroM_ERAM Oeldruckschalter Rampenwert mroM_EREIB	
CAN - Resultierende Reibmenge aus mrwREI_KF mroM_ERKF AG4 - Eingriffsmenge Rueckschaltkennfeld	
mroM_ESAB Startmengenkorrektur mroM_ESTAG Startmenge nach Mengenabgleich mroM_ESTER	
Startmenge after starting quantity increase mroM_ESTF starting quantity after starting quantity increase	
mroM_ESTIP starting quantity after IPO3 mroM_ESTvo starting quantity before shutdown d urch	
Zweimassenschwungrad mroM_ESchf gefilterte Schleppmenge mroM_ESchu ungefilterte Schleppmenge	
mroM_EWFr Wunschmenge Fahrer unbegrenzt mroM_EWLBG Wunschmenge + Leerlaufmenge, begrenzt	
durch Begrenzungsmenge mroM_EWUBE Wunschbegrenzungsmenge mroM_EXASG ASG-Ersatzmenge	
mroM_EXASR ASR-Ersatzmoment mroM_EXEGS CAN - Externer Mengeneingriff EGS mroM_EXMSR MSR-	
Ersatzmoment mroM_Edndt dn/dt-Begrenzungsmenge mroM_Lk M_L Luftmasse temperaturkorrigiert	
mroM_MKORR Correction amount for CAN-Mom.korr-KF mroN_BAKT Influencing engine speed mroN_Baus	
marker no influence N mroN_LLCA1 max. tolerated LL speed increase mroN_LLCA2 target idle speed via	
CAN (EGS2) mroN_LLCAr raw value N_LL specification via CAN mroODS_bed oil pressure switch status bits	
mroPWGpe Rampe mroPWGBits collected status bits PRWGroPWGP_s status bits Actual state mroPWG_R_S	
status PWG ramp target state mroPWG_Z status PWG mroPWG_Z_H status PWG healing mroPWG_neu	
PWG value before ramp mroPWGinv calculated PWG position mroPWGmin minimal Measured voltage PGS	
mroPWLLPos Idle position 0% PWG mroPW_DAbd Transition conditions DA-LLL mroPW_Hist PWG history	
"Learn idle travel" mroPW_MAX maximum allowed offset mroPW_Stat PWG status "Learn idle travel"	
mroPW_cmax learned idle position mroPW_dp measured synchronization tolerance mroPW_red learned idle	
travel reduction mroPkorr	

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mroTD_Sper ARD-SR status lock timer	
mroTIC	Timer counter
mroTSBKADF TSB slope uncorrected mroTSBKLTF TSB	
slope correction value mroTSB_STG TSB slope corrected	
mroTSBits TSB BitOLDA	
mroUEBakt overspeed detected after time	
mroUEBaus shut-off valve control active because of overspeed mroU_PGSx2 factor 2-corrected red.	
Sensor voltage mroVEB_STA M_E status VE limitation quantity (0: switch-off delay., 1: on, 3: init)	
mroVERBS_h cumulative consumption (hi-word) mroVERBS_I cumulative consumption (lo-word) mroVERB_Z volume	
flow heater mroVGES20 total consumption during the last 20ms mroVZN_STO V/N when activating the FGR function	
mroV_RAMP FGR ramp speed mroV_SOLL FGR target speed mroVzuNfil v/n filtered mroWA_STAT status of the ADR	
WA function mroWTF_TES test status WTF dyn. fun. mro_STBatt Difference of the last mrwSTZUmit UBATT values	
mro_STNBT speed from temperature characteristic for ZMS Temperature-dependent upper N threshold for ZMS	
mro_STNO mro_ZMsta status bits for ZMS mrodM_EMGB Max quantity gradient	
N	
nlmDK_zu nlmEND_AUS Power stage switch-DK closed in the run-on	
off bit	
	Enable fan run-on nlmLUENL
nlmLUENLrd release of fan after-run receipt acknowledgment nlmM_E_AUS quantity	
output from self-diagnosis to GA nlmNLact	
	lag detection bit
nlmZUMEAUS Abortion of metering due to overrun nloAUSPst States	
for OFF pin test	
nloAUSPtr Transitions for AUS pin test	
nloFSP_S	Error storage Status nloNACHst States
for follow-up control nloNACHtr1 Transitions for follow-up control	
nloNACHtr2 Transitions for follow-up control nloNL_TEE Timer EEPROM	
storage: MAR data and filtered NW-KW	
	twist angle
nloNL_TIM timer run-on time measurements nloNL_TN0 timer	
from speed=0 for shutdown nloSHSPst states for SHS-Pin_Test nloSTABst states	
for voltage stabilizer test nloSTABtr1 transitions for voltage stabilizer test nloUEBMst	
states for monitoring module test nloUEBMtr transitions for monitoring module test	
O	
olOLTIME	Runtime OLDA
P	
phmVBSTH	VBS signal high level duration
S	
sbmAGL_SBR adjustment value start of injection	
simOEL_BEL oil load	

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T	
tlmKMW_CAN Fuel quantity warning signal via CAN	
V	
vsoDTW_TA synchronization n-synchronous vsoDTW_TI	
vsoDTW_ZB display table n-synchronous vsoDTW_ZB1	
display table n-synchronous vsoDTW_ZB2 display table	
n-synchronous vsoDTW_ZB3 display table n-	
synchronous vsoDTW_ZB4 display table n-synchronous	
vsoDTW_ZB5 display table n-synchronous vsoDTW_ZB6	
display table n-synchronous vsoDTW_ZB8 display table	
n-synchronous vsoDTW_ZB8 display table n-	
synchronous synchronous vsoDTW_ZB9 display table	
n-synchronous vsoDTW_ZBA display table n-	
synchronous vsoDTW_ZBB display table n-synchronous	
vsoDTW_ZBC display table n-synchronous	
vsoDTW_ZBD display table n-synchronous	
vsoDTW_ZBE display table n-synchronous vsoDTW_ZBF	
display table n-synchronous vsoDTZ_TA synchronization	
t-synchronous vsoDTZ_TI word synchronization t-	
Bsynchronous display table vsoDTZ t-synchron	
vsoDTZ_ZB1 display table t-synchron vsoDTZ_ZB2	
display table t-synchron vsoDTZ_ZB3 display table t-	
synchron vsoDTZ_ZB4 display table t-synchron vsoDTZ_ZB5	
display table t-synchron vsoDTZ_ZB6 display table t-synchron	
vsoDTZ_ZB7 display table t-synchronous vsoDTZ_ZB8 display	
table t-synchronous vsoDTZ_ZB9 display table t-synchronous	
vsoDTZ_ZBA display table t-synchronous vsoDTZ_ZBB display	
table t-synchronous vsoDTZ_ZBC display table t-synchronous	
vsoDTZ_ZBD display table t-synchronous vsoDTZ_ZBE display	
table t-synchronous vsoDTZ_ZBF display table t-synchronous	
X	
xcmBYPSTAN Error status universal interface n-sync xcmBYPSTAT Error status	
universal interface n- and t-sync xcmDATA_Er Status message data from WFS invalid	
xcmDFLD_DK TV control boost pressure actuator xcmD_F_LDK TV control throttle valve	
actuator xcmD_F_MIL TV control MIL lamp xcmD_F_ML1 TV control engine bearing 1	
xcmD_F_ML2 TV control Motor bearing 2 xcmFGG_GRA FGG GRA STATUS	
xcmFSTFBHE funding start (HE) for remote control xcmFSTFBVE funding start (VE) for	
remote control xcmFSTFDHE funding period (HE) for remote control xcmFSTFDVE	
funding period (VE) for remote control	
xcmIHM2DIA Info from HMI to diagnosis about CAN status (NACK,	Switch HMI off for remote control xcmFST_S
lock) xcmImmoSta immobilizer status	
xcmImmoZ2 Immobilizer Zaehler_2 xcmM_List	
Air mass flow rate in mg/s for freeze frame	

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xcmPINDIA PIN from the diagnosis xcmSWITCH1	
switch 1 (0:KLI, 3:LGS, 4:KIK, 6:erh.LL) xcmSWITCH2 switch 2 (0:BRE, 3:BRK, 6:KUP)	
xcmSWITCH3 switch 3 (0:BRE , 1:BRK, 2:KUP, 3:KIK, 4:KLI, 5:LGS, 6:rec.LL) xcmSWITCH4	
switch 4 (0:BRE, 1:BRK, 2:KUP, 3:FGR/ACC) xcmSWITCH5 Switch 5 (0:dimADP, 2:dimADM, 3:dimHAN, 6:dimADR, 7:dimADW)	
xcmSperre Login lock request xcmSt_frei Start release xcmWFS2DIA Info from WFS to diagnosis via CAN status (CNCoRSE)	
xcmWFSDATA Pointer to WFS data read via CAN xcoASW_ZB Start address SG data --> ASCET channel A xcoASW_ZB1	
display table ASCET n-synchronous xcoASW_ZB2 display table ASCET n-synchronous xcoASW_ZB3 display table ASCET n-	
synchronous xcoASW_ZB4 display table ASCET n-synchronous xcoASW_ZB5 display table ASCET n-synchronous	
xcoASW_ZB6 display table ASCET n-synchronous xcoASW_ZB7 display table ASCETn-synchronous synchronous xcoASW_ZB8	
display table ASCET n-synchronous xcoASW_ZB9 display table ASCET n-synchronous xcoASZ_ZB start address SG data -->	
ASCET channel B xcoASZ_ ZB1 Display table ASCET t-synchronous xcoASZ_ZB2 Display table ASCET t-synchronous	
xcoASZ_ZB3 Display table ASCET t-synchronous xcoASZ_ZB4 Display table ASCET t-synchronous xcoASZ_ZB5 Display table	
ASCET t-synchronous xcoASZ_ZB6 Display table ASCET t-synchronous xcoASZ_ZB7 Display table ASCET t-synchronous	
xcoASZ_ZB8 Display table ASCET .t-synchronous xcoASZ_ZB8 Display table ASCET ASCET t-synchronous xcoASZ_ZBA	
display table ASCET t-synchronous xcoASZ_ZBB display table ASCET t-synchronous xcoASZ_ZBC display table ASCET t-	
synchronous xcoASZ_ZBD display table ASCET t-synchronous xcoASZ_ZBE display table ASCET t-synchronous xcoASZ_ZBF	
display table ASCET t-synchronous xcoASZ_ZBGET display table ASCET t-synchronous xcoASZ_ZBHt display -synchronous	
xcoASZ_ZBI Display table ASCET t-synchronous xcoASZ_ZBJ Display table ASCET t-synchronous xcoASZ_ZBK Display table	
ASCET t-synchronous xcoASZ_ZBL Display table ASCET t-synchronous xcoASZ_ZBM Display table ASCET t-synchronous	
xcoASZ_ZBN Display table ASCET t-synchronous xcoASZ_ZBO Display Table ASCET t-synchronous xcoASZ_ZBP Display	
table ASCET t-synchronous xcoBYP_COS Bypass monitoring counter n-sync xcoBYP_COX Bypass monitoring counter t-sync	
Currently processed error bit number xcoFLNR Result F Result G Immo ***AU229 #Hd Result G	
xcoF_MSG	
xcoG_IMS	
xcoG_MSG	
xcoIM3inf WFS 3 information ***AU229 #Hd xcoKWPZUST State of the	
KWP2000 software for Flashprog ###CRQ209 ###CRQ311 #Sh xcoMWBNr	
	OLDA measurement block number
xcoMWNr	OLDA reading number
xcoRND_H	Random number high word
xcoRND_L	Random number Lowword
xcoSKC_H	SKC Highword
xcoSKC_L	SKC Lowword
xcoSKC_M	SKC Middleword
xcoStatus ImmoTestStatus 2 bytes -> must be in RAM !!! xcoTRGID_S Address trigger identifier	
ASCET channel A (S)	

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xcoTRGID_X Address	trigger identifier ASCET channel B (X)
Z	
zmmBPAnAkt Bit-coded	BIP mode statuses (start-up/SWEEP MODE: 1/0) zmmBPAnIok Bit-coded flags for BIP window
current in start-up mode	OK ((I<=Imax)/(I>Imax):1/0)
zmmBPISamp Number	of current samples in the BIP window zmmBPMRVer Delay time until series of
measurements was started	zmmBPTvoHE BIP time HE to be kept available zmmBPTvoVE BIP time VE to be
kept available zmmBP_MES	Bit bar for BIP measurement zmmCWPTout WUP timeout counter zmmC_SgWP
Cylinder counter from	WUP detection
	Control cylinder counter zmmC_Zyl zmmDKTL
	Monitoring throttle valve zmmEINE_NW trigger 1
NW revolution zmmFB	VEso VE start of delivery setpoint zmmFBsoll
start of delivery setpoint	zmmFDVEso VE delivery duration setpoint
zmmFDsoll Funding duration	setpoint
zmmF_KRIT Error criteria	metering zmmHF2_DEF 2.HFM defective
zmmMEminAb quantity	shutdown status zmmMSL_ANS MV control
status of the 2nd SG (	OK, zero quantity, min. FD, DZ, ZUMEAUS, KS
mass/UB) zmmMVS_	ANS MV control status (OK, zero quantity, min .FD, DZ, ZUMEAUS, KS mass/UB) zmmMVtmpMS status byte of the provisional MS defect classification (one bit per MV) zmmM_Ekorr amount of temp. corrected zmmNewSync start new
synchronization zmmSEGM	segment counter 0...2z-1 zmmSEGQuot segment quotient for red. Synchronous. zmmSINKsyn Synchronization
status of the INK processing	zmmSWP_def WUP signal defect status zmmSWUPyet No WUP occurred zmmSYSERR System error intervention
basis zmmStatuWP	WUP status
zmmTINK	INK period duration
zmmTSg_WP Segment	period (Low Word) zmmVE_Stop VE: "Engine off" request
zmoAbwBezT Deviation	from the reference temperature zmoBPAnIMx Maximum
allowed solenoid valve	current in the BIP window zmoBPEwAb1 BIP time expected value
deviation. MV1 zmoBPEwAb2	GDP-time expected value dev. MV2 zmoBPEwAb3 GDP-time expected value dev. MV3
zmoBPEwAb4 GDP-time	expected value dev. MV4 zmoBPEwAb5 GDP-time expected value dev. MV5 zmoBPEwAb6
GDP-time expected value	dev. MV6 zmoBPFeSwP SWEEP MODE of the BIP window
zmoBPFeneg BIP window	early zmoBPFepos BIP
window late zmoBPIFenE	Maximum solenoid valve
current in BIP window	zmoBPSdef1 BIP status MV1
zmoBPSdef2 BIP status	MV2
zmoBPSdef3 BIP Status	MV3
zmoBPSdef4 BIP Status	MV4
zmoBPSdef5 BIP Status	MV5
zmoBPSdef6 BIP Status	MV6
zmoBPTFevo BIP time to be kept available for BIP windows	
zmoBPTakt1 current BIP time	MV1
zmoBPTakt2 current BIP time	MV2
zmoBPTakt3 current BIP time	MV3
zmoBPTakt4 current BIP time	MV4

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zmoBPTakt5 current BIP time MV5 zmoBPTakt6	
current BIP time MV6 zmoBPTerw Olda for BIP	
expected value zmoBPUBATT BIP-UBATT value for	
GndKL calculation zmoBP_BaBr bandwidth zmoBP_Fen BIP window	
zmoBPoffs1 current shift of the BIP window forward MV1 zmoBPoffs2	
current shift of the BIP window after early MV2 zmoBPoffs3 Current	
shift of the BIP window to early MV3 zmoBPoffs4 Current shift of the BIP window to early MV4	
zmoBPoffs5 Current shift of the BIP window to early MV5 zmoBPoffs6 Current shift of the BIP	
window to early MV6 zmoBPswit Switching status for SWEEP mode	
zmoCMVOFHE Angle end of current supply HE	
zmoCMVOFVE Angle end of current supply VE	
zmoCMVONHE Angle start of current supply HE	
zmoCMVONVE Angle start of current supply VE	
zmoC_WUPok WUP counter until plausible zmoDyWPINK	
entered increment of the dyn. WUP zmoDyWPnewly calculated inc.	
of the dyn. WUP rel. to S2 (after hyst.) zmoDyWProh raw ink. of the dynamic WUPs rel. to S2	
zmoFB_Off FB correction angle zmoFBkorr corr. Eingangswinkel fuer PKF-Auswahlkennlinie	
zmoIMV1sel Magnetventilstrom nach Anwahl MV1 zmoIMV2sel Magnetventilstrom nach	
Anwahl MV2 zmoIMV3sel Magnetventilstrom nach Anwahl MV3 zmoIMV4sel Magnetventilstrom	
nach Anwahl MV4 zmoIMV5sel Magnetventilstrom nach Anwahl MV5 zmoIMV6sel	
Magnetventilstrom nach Anwahl MV6 zmoINKPEDA INKPEDA fuer Zumessung zmoM_Edkor	
Differenzmenge aus T_K-Korrektur zmoM_Emin Minimale Einspritzmenge zmoP_KF_Nr	
Pumpen -map no. zmoSINKsyn Synchronization status of INK processing zmoTINKS2	
INKPEDA from $2	
zmoT_KBez Fuel reference temperature zmoTempFak	
quantity correction factor through fuel temperature zmoVE_P_L VE: (frozen) charge	
pressure zmoVE_Schu VE: thrust condition fulfilled, not debounced zmoVE_StRo VE:	
requirement “engine off” raw zmoVE_Stop VE: requirement “engine off” zmoVE_Su_e	
VE: thrust condition fulfilled, debounced zmoVE_TSch VE: thrust debounce time	
zmoVE_Ueb VE: Monitoring active zmoWVORHED BIP lead angle from Dyn.WUP for	
HE zmoWVORVED BIP lead angle from Dyn.WUP for VE	

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Appendix H List of SG PINS

In alphabetical order ...

abbreviation Pin code	function	Chapter / Art	record
ARS-0 K061 ARF controller		Exit	ehwEST_AR1
ARS2-0 K059 exhaust gas recirculation positioner; not equipped		Exit	
ARS-E K074 ARF controller feedback signal; not populated digital inputs			
ATD-E K013 Outside temperature data telegram		Ambient temperature anw	UTF_..
BAT-K004 Supply voltage minus			
BAT- K005 Supply voltage minus			
BAT+ K001 Supply voltage plus			anwBAT_..
BAT+ K002 Supply voltage plus			
BLS-E K032 Brake Light Switch		analog inputs digital inputs	anwBRE_.. diwBRE_..
BTS-E K065 brake test signal		digital inputs	diwBRK_..
CAN10 K008 Controller Area Network Shield 1			
CAN1-H K007 Controller Area Network; High signal; Input 1 CAN			
CAN1-L K006 Controller Area Network; low signal; Input 1 CAN			
CAN20 A084 CAN shield 2; not equipped			
CAN2-H A082 CAN; High signal; entrance 2; not equipped		CAN	
CAN2-L A083 CAN; low signal; entrance 2; not equipped CRA-		CAN	
E K047 crash sensor input signal DKS-0 K081 throttle valve		analog inputs	crw.....
actuator (EPW)		Exit	ehwEST_AR2
DKS-E K075 Throttle Actuator Feedback Signal; not specified Digital inputs DZG0 A102			diwRKS_..
speed sensor, ground			
DZG1 A110 Speed sensor signal DZG2		speed sensor	
A094 Speed sensor supply DZG-A A093		speed sensor	
Digitized KW speed signal; n.		speed sensor	
DZG-S A086 speed sensor; screen connection		speed sensor	
DZS0 A101 speed sensor NW, ground			
DZS1 A109 speed encoder signal NW			
DZS2 A092 5V supply for DZG			
EKP-0 K080 Electric fuel pump relay FGG1 K020		Output	ehwEST_EKP
Vehicle speed sensor signal GEN-0 K079 Generator		speed sensor	fgwDA..
shutdown GEN-E K038 Generator load input signal		quantity calculation	
GRA- K067 Speed control system, SET- GRA-A K046		analog inputs	
Speed control system, OFF GRA-L K014 Speed control		Digital inputs	diwFGM_..
system, Extinguish		Digital inputs	diwFGA_..
		Digital inputs	diwFGV_.. diwFGL_.. diwADR_..
GRA-S K044 speed control system, SET+		digital inputs	diwFGP_.. diwADP_..
GRA-W K045 cruise control system, recovery		digital inputs	diwFGW_.. diwADM_..
GRL-0 K042 Glow Relay		Exit	ehwEST_GRS
GZR-E K033 Glow time feedback		digital inputs	diwGZR_..
HBR-E K064 Handbrake Switch Input; not equipped		digital inputs	diwHAN_..
HFM0 K049 Hot Film Mass Air Flow Sensor, Ground			
HFM1 K068 hot film mass air flow sensor signal		analog inputs	anwLMM_..

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HFM2 K030 hot film mass air flow sensor, supply	Analog inputs	anwLM2 ..
HRL-0 K018 Main Relay	monitoring concept	
HYL-0 K011 Hydro Fan	Exit	ehwEST_HYL
HZA0 K076 Heating request, ground	analog inputs	
HZA1 K017 heating requirement; not equipped	analog inputs	anwHZA ...
INK-E A106 Speed input KW, slave; not equipped		
ISO-K K016 K line according to ISO protocol	diagnosis	
K15-E K037 Terminal 15	analog inputs digital inputs	anwK15_.. diwK15 ..
K50-E A088 Terminal 50, digital start info for SG	quantity calculation	
KIK-E K063 kickdown input signal	digital inputs	diwKIK_.. appPG2 ..
KKD-E A096 A/C Compressor Pressure Sensor Signal	analog inputs	appKMD_..
KLI-B K029 climate signal, bidirectional	digital inputs	ehwEST_KLI diwKLB ..
KLI-E K034 Air conditioning input signal	digital inputs	diwKLI
KMW-E K057 Fuel quantity warning signal; not equipped		
KSK-0 K043 fuel cooling (low side)	Exit	
KTF0 A103 fuel temperature sensor, ground		
KTF1 A111 Fuel temperature sensor signal KTH-0	analog inputs	anwKTF_..
K060 Radiator thermostat - heating KUP-E K066	Exit	ehwEST_TST
Clutch signal KVS-A K009 Electric fan (PC7: possibly	digital inputs	diwKUP ..
GSK3 output)	Exit	ehwEST_GER
LDF0 K052 boost pressure sensor, ground		
LDF1 K071 Boost pressure sensor signal	analog inputs	anwLDF_..
LDF2 K031 Boost pressure sensor, supply LDS-0		anwLD2 ..
K062 Boost pressure controller LDS-E K056 Boost	Exit	ehwEST_LDS
controller feedback signal; not populated digital inputs		
LGS0 K051 Idle switch, ground		
LGS-E K070 Pedal Sensor Idle Switch Input Signal Digital inputs	analog inputs	diwLGF_.. diwLGS_.. appPGS ..
LTF0 K054 Air Temperature Sensor, Ground		
LTF1 K073 Air temperature sensor signal	analog inputs	anwLTF ..
MG1-1 A114 Solenoid valve group 1	Exit	ehwEST_MVS
MG2-1 A115 solenoid valve group 2		
MIL-0 K024 MIL indicator light	Output	ehwEST_MIL
MML1-0 K023 Solenoid valve control engine mount 1; n. Output MV1-0 A116		ehwEST_ML1
Solenoid valve 1 output		
MV2-0 A118 Solenoid valve 2 output		
MV3-0 A121 Solenoid valve 3 output		
MV4-0 A117 Solenoid valve 4 output		
MV5-0 A120 Solenoid valve 5 output		
nc A087 not connected		
nc A095 not connected		
nc A099 not connected		
nc A107 not connected		
nc A100 not connected		
nc A108 not connected		
nc K003 not connected		
nc K010 not connected		

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nc	K025 not connected		
nc	K026 not connected		
nc	K058 not connected		
nc	K077 not equipped		
nc	K078 not connected		
nc	A085 not connected		
nc	A090 not connected		
nc	A091 not connected		
nc	A119 not connected		
ODG-E A098 currently no software function		digital inputs	diwODS_..
OTF0 A105 Oil temperature sensor, ground			
OTF1 A113 oil temperature sensor signal		analog inputs	anwOTF_..
PWG10 K050 Pedal position sensor 1, ground			
PWG11 K069 Pedal position sensor signal 1		analog inputs	anwPWG_..
PWG12 K012 Pedal position sensor 1, supply		analog inputs	anwPW2_..
RES1-E K019 Reserve digital input 1			
RFL-E K048 not equipped			
SYS-0 K040 System lamp TAV-0		Exit	ehwEST_DIA
K041 Tank shut-off valve (low-side)		Exit	ehwEST_TAV
TDS-A K027 speed signal output TLS0 K053		Exit	
tank empty switch, ground; not equipped			
TLS1	K072 tank empty switch, input; not equipped	digital inputs	
TQS-A K028 Speed-synchronous consumption signal		Exit	
TTF10 K055 Tank temperature sensor, ground			
TTF11 K036 Tank temperature sensor signal analog inputs			
WTF10 A104 water temperature sensor, ground analog inputs			
WTF11 A112 Water temperature sensor signal analog inputs WTF20 A089 Water			anwWTF_..
temperature sensor 2, ground; not spec. analog inputs			
WTF21 A097 water temperature sensor 2 (radiator outlet) ; not fitted		Analogue inputs	anwWTK_...
ZH1-0 K021 Additional heating 1, output ZH2-0 K022 Additional heating 2, output			ehwEST_GK1
ZHB-A K035 Additional heating, control relay (low side) output			ehwEST_GK2
ZHB-E K039 additional heating, input digital inputs			
ZHR-E K015 switching input - auxiliary heater control digital inputs			diwKWH_..

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Sorted by pin number...

	Pin code	function	Chapter / Art	record
BAT+ K001 Supply voltage plus BAT+ K002				anwBAT_..
Supply voltage plus				
nc	K003 not connected			
BAT-K004 Supply voltage minus				
BAT- K005 Supply voltage minus				
CAN1-L K006 Controller Area Network; low signal; Input 1 CAN				
CAN1-H K007 Controller Area Network; High signal; Input 1 CAN				
CAN10 K008 Controller Area Network Shield 1				
KVS-A K009 electric fan (PC7: possibly GSK3 output)			Exit	ehwEST_GER
nc	K010 not connected			
HYL-0 K011 Hydraulic fan			Output ehwEST_HYL	
PWG12 K012 Pedal value sensor 1, supply ATD-E			Analog inputs anwPW2_..	
K013 Outside temperature data telegram GRA-L K014			Ambient temperature anwUTF_..	
Speed control system, delete			Digital inputs diwFGV_..	diwFGL_.. diwADR_..
ZHR-E K015 Switching input - auxiliary heater control			digital inputs	diwKWH_..
ISO-K K016 K-line according to ISO protocol HZA1 K017			diagnosis	
Heating request; Not equipped HRL-0 K018 Main relay			Analog inputs	anwHZA_...
RES1-E K019 Reserve digital input 1			monitoring concept	
FGG1 K020 Driving speed sensor signal Driving speed sensor ZH1-0 K021 Additional				fgwDA..
heating 1, output ZH2-0 K022 Additional heating 2, output MML1-0 K023 Solenoid valve			Solenoid valve	ehwEST_GK1
1; n. Output MIL-0 K024 MIL indicator light output K025 not connected				ehwEST_GK2
				ehwEST_ML1
				ehwEST_MIL
nc				
nc	K026 not connected			
TDS-A K027 speed signal output TQS-A K028			Exit	
speed-synchronous consumption signal KLI-B K029 climate			Exit	
signal, bidirectional			digital inputs	ehwEST_KLI diwKLB_..
HFM2 K030 hot film mass air flow sensor, supply			analog inputs	anwLM2_..
LDF2 K031 Boost pressure sensor, supply				anwLD2_..
BLS-E K032 Brake Light Switch			analog inputs digital inputs	anwBRE_.. diwBRE_..
GZR-E K033 Glow time feedback			digital inputs	diwGZR_..
KLI-E K034 Air conditioning input signal			digital inputs	diwKLI
ZHB-A K035 additional heating, control relay (low side) output				
TTF11 K036 Tank temperature sensor signal			analog inputs	
K15-E K037 Terminal 15			analog inputs digital inputs	anwK15_.. diwK15_..
GEN-E K038 Generator Load Input Signal			analog inputs	
ZHB-E K039 Auxiliary heater, entrance			digital inputs	
SYS-0 K040 system lamp			Exit	ehwEST_DIA
TAV-0 K041 Tank shut-off valve (low-side)			Exit	ehwEST_TAV
GRL-0 K042 Glow Relay			Exit	ehwEST_GRS

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KSK-0 K043 fuel cooling (low side)	Exit	
GRA-S K044 speed control system, SET+	digital inputs	diwFGP_.. diwADP_..
GRA-W K045 cruise control system, recovery	digital inputs	diwFGW_.. diwADM_..
GRA-A K046 Speed control system, AUS CRA-	digital inputs	diwFGA_..
E K047 Crash sensor input signal RFL-E K048 not	analog inputs	crw.....
fitted		
HFM0 K049 Hot Film Mass Air Flow Sensor, Ground		
PWG10 K050 Pedal position sensor 1, ground		
LGS0 K051 Idle switch, ground		
LDF0 K052 boost pressure sensor, ground		
TLS0 K053 Tank Empty Switch, Ground; not equipped		
LTF0 K054 Air Temperature Sensor, Ground		
TTF10 K055 tank temperature sensor, ground		
LDS-E K056 charger controller feedback signal; not populated digital inputs		
KMW-E K057 fuel quantity warning signal; not equipped		
nc K058 not connected		
ARS2-0 K059 exhaust gas recirculation positioner; not equipped	Exit	
KTH-0 K060 Radiator Thermostat - Heater	Exit	ehwEST_TST
ARS-0 K061 ARF controller	Exit	ehwEST_AR1
LDS-0 K062 boost pressure actuator	Exit	ehwEST_LDS
KIK-E K063 kickdown input signal	digital inputs	diwKIK_.. appPG2_..
HBR-E K064 Handbrake Switch Input; Not fitted Digital inputs BTS-E K065 brake test		diwHAN_..
signal digital inputs KUP-E K066 clutch signal digital inputs GRA- K067 system, SET-		diwBRK_..
digital inputs HFM1 K068 hot film air mass sensor signal analog inputs PWG11 K069		diwKUP_..
sensor signal 1 analog inputs LGS-E K070 pedal value sensor idle switch digital inputs		diwFGM_..
		anwLMM_..
		anwPWG_..
	analog inputs	diwLGF_.. diwLGS_.. appPGS_..
LDF1 K071 boost pressure sensor signal	Analog inputs	anwLDF_..
TLS1 K072 tank empty switch, input; not equipped	Digital inputs	
LTF1 analog inputs ARS-E K074 ARF control signal feedback signal; not populated digital		anwLTF_..
inputs		
DKS-E K075 Throttle Actuator Feedback Signal; not specified Digital inputs HZA0 K076		diwRKS_..
Heating requirement, ground analog inputs		
nc K077 not equipped		
nc K078 not connected		
GEN-0 K079 Generator shutdown; not equipped	quantity calculation	
EKP-0 K080 Electric Fuel Pump Relay	Exit	ehwEST_EKP
DKS-0 K081 Throttle Actuator (EPW)	Exit	ehwEST_AR2
CAN2-H A082 CAN; High signal; entrance 2; not equipped	CAN	
CAN2-L A083 CAN; low signal; entrance 2; not equipped CAN20	CAN	
A084 CAN shield 2; not equipped		
nc A085 not connected		
DZG-S A086 speed sensor; screen connection	speed sensor	
nc A087 not connected		

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K50-E A088 Terminal 50, digital start information for SG quantity calculation			
WTF20 A089 water temperature sensor 2, mass; not spec. analog inputs			
nc	A090 not connected		
nc	A091 not connected		
DZS2 A092 5V supply for DZG			
DZG-A A093 Digitized KW speed signal; n.		speed sensor	
DZG2 A094 Speed encoder supply A095 not		speed sensor	
nc	connected		
KKD-E A096 A/C Compressor Pressure Sensor Signal		analog inputs	appKMD_..
WTF21 A097 water temperature sensor 2 (radiator outlet) ; not fitted		Analogue inputs	anwWTK_...
ODG-E A098 currently no software function		digital inputs	diwODS_..
nc	A099 not connected		
nc	A100 not connected		
DZS0 A101 speed sensor NW, ground			
DZG0 A102 speed sensor, mass			
KTF0 A103 fuel temperature sensor, mass			
WTF10 A104 water temperature sensor, ground		analog inputs	
OTF0 A105 Oil temperature sensor, ground			
INK-E A106 Speed input KW, slave; not equipped			
nc	A107 not connected		
nc	A108 not connected		
DZS1 A109 speed encoder signal NW			
DZG1 A110 speed encoder signal		speed sensor	
KTF1 A111 fuel temperature sensor signal		analog inputs	anwKTF_..
WTF11 A112 water temperature sensor signal		analog inputs	anwWTF_..
OTF1 A113 oil temperature sensor signal		analog inputs	anwOTF_..
MG1-1 A114 Solenoid valve group 1		Exit	ehwEST_MVS
MG2-1 A115 solenoid valve group 2			
MV1-0 A116 solenoid valve 1		Exit	
MV4-0 A117 solenoid valve 4		Exit	
MV2-0 A118 solenoid valve 2		Exit	
nc	A119 not connected		
MV5-0 A120 solenoid valve 5		Exit	
MV3-0 A121 solenoid valve 3		Exit	

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Appendix I Universal ASCET interface

The universal ASCET interface makes it possible to make adjustments to specific control unit variables. This means that the calculation of a function can be outsourced to an external computer (bypass computer). If the intervention on a specific function is activated, the value sent by the bypass computer will continue to be used as the value of the associated message. The data consistency is achieved by alternatively writing the bypass values in a double buffer.

Any control unit variables can be requested as input values for the bypass computer via a separate display table.

activation

The interface is activated via the software switch cowFUN_BYP. This software switch is only active after an SG reset and a change during operation has no effect on the ASCET interface. The message comBYP_fun is 1 if the interface is currently activated.

Description of the damos switch cowFUN_BYP:

Decimal value comment 0	
	Interface inactive 1
	Interface active

The bypass interventions can be switched on and off individually via the parameters xcwBYP_EIS (switch for n-synchronous intervention) and xcwBYP_EIX (switch for t-synchronous intervention). Changing the switch during operation has an immediate effect on the bypass functionality.

The assignment of the messages to the bit position depends on the software version and can change, for example, if the number or the selection changes.

A maximum of 16 time- and 16 -n-synchronous messages can be considered. However, the selection is fixed for delivered software and must be coordinated with the responsible development department before delivery.

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Description of the bit-coded software switch xcwBYP_EIS - bypass function switch n synchronous:

bit pos.	Decimal value	Message 1	intervention
0		mrmM_EMOT	Absolutely
1	2	mrmM_ELLR	Absolutely
2	4	mrmM_ELRR zmmFBsoll	Absolutely
3	8th		Absolutely
4	16		Absolutely
5	32	zmmFDsoll	Absolutely
6	64	zmmM_Ekorr	Absolutely
7	128	zmmFBVEso	Absolutely
8	256	zmmFDVEso 512	Absolutely
9	zmmBPTvoVE	1024 zmmBPTvoHE	additive
10			additive

Description of the bit-coded software switch xcwBYP_EIX - bypass function switch t synchronous:

bit pos.	Decimal value	Message 1 ehmFARS	intervention
0		ehmFLD_DK	Absolutely
1	2	mrmM_ESTAR	Absolutely
2	32	mrmM_EWUNSCHREIB	Absolutely
3	xcmFSTFBHE		Absolutely
4			Absolutely
5			Absolutely
6	64		Absolutely
7	128		Absolutely
8th	256	xcmFSTFDHE	Absolutely

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addresses

The addresses from which the control unit gets the values calculated by the ASCET are as follows calculated:

Alternating buffer n-sync

Address buffer 1: xcpBYP_BASIS + xceW_S_OFF + 1 + bit pos.

Address buffer 2: xcpBYP_BASIS + xceW_S_OFF + 17 + bit pos.

Exchange buffer t-sync

Address buffer 1: xcpBYP_BASIS + xceW_X_OFF + 1 + bit pos.

Address buffer 2: xcpBYP_BASIS + xceW_X_OFF + 17 + bit pos.

xcpBYP_BASIS	0F0E60h
xceW_S_OFF	04Ah
xceW_X_OFF	06Bh
bit position	according to the table

Interface monitoring

The interface to the ASCET bypass computer is checked by a monitoring counter.
This monitoring counter is incremented by the bypass computer with each write access.
If this monitoring counter does not change within one of the monitoring times, the
Bypass mode irrevocably deactivated (until the control unit is reset). The number of times
successively the monitoring counter may remain unchanged can be applied via xcwBYP_COS (for n-synchronous) or xcwBYP_COX (for t-synchronous).

If a communication error was detected in this way, the bypass main switch
xcmBYP_FUN reset and reported the error fbbERUC_A. This error causes
the engine in V systems on mrmUso_UEB = 0 and in P systems on mrmZUMEAUS = 1
is turned off.

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post injection

An additional electrical post-injection can be carried out via ASCET for test purposes.
For this, the additional injection is to be activated (zmwES_ZUS = 47) and it is on
To switch post-injection (zmwES_VENE = 3). In addition, the activation conditions
for the remote control cannot be fulfilled (this can be guaranteed by setting
xcwFST_ERL = 0). With this software version, the BIP recording takes place in the “additional
Injection activated” takes place on the **1st injection .**

Application for the remote control function and post-injection via bypass

	Post injection via bypass	remote control
xcwFST_ERL	0	1
zmwES_ZUS	47	47
zmwES_VENE	3	0

For post-injection, the additional values for start of delivery and duration of delivery are
Post -injection via the messages *xcmFSTFBHE* and *xcmFSTFDHE* from the ASCET bypass
accepted and the values calculated from them in the correct chronological order in the
Activation register for MVON and MVOFF of the 1st and 2nd injection entered.

The signal paths for the individual switch positions are shown in figure TEMPFS01 in the chapter
"Remote control via diagnostic interface".

Important: When working with ASCET bypass takes place in the control unit software
ASCET values are not monitored.
The user is allowed to set meaningful values
guarantee!!!

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