Electronic Diesel Control
Repair Manual

EDC M(S) 5 - D 2866 LUE 602

Foreword

These instructions are intended to help you to repair the electronic diesel control system properly.

In writing these instructions, we have assumed that you have the necessary knowledge of control systems for working on and with the electronic diesel control.

Best regards
MAN Nutzfahrzeuge Aktiengesellschaft
Nuremberg Plant

Since our products are in continuous development, we reserve the right to make technical modifications.

MTDA Technical status: 09.1996 51.99493–8449

Contents

General

Important safety regulations are summarized in this quick-reference overview and arranged by topic to effectively convey the knowledge necessary to avoid accidents causing injury, damage or environmental hazard.
The engine operating manual contains further information.

Important:
Should an accident occur despite all precautionary measures, particularly one involving contact with corrosive acid, penetration of fuel under the skin, scalding by hot oil, antifreeze splashing into the eyes etc. **you must seek medical assistance immediately.**

1. Instructions for avoiding accidents causing injury

Only authorized and qualified personnel are permitted to carry out inspection, adjustment and repair work

- Secure and chock vehicles to prevent the vehicle rolling

- Firmly secure units and assemblies on disassembly
- Only authorized personnel are permitted to start and operate the engine
- Do not stand too close to rotating parts while the engine is running
  Wear close-fitting working clothes

- Do not touch hot engine with bare hands:
  Danger of injury by burning

- Keep area surrounding engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.
- Only work with tools which are in good condition. Damaged or worn spanners and wrenches can slip off: Danger of injury!
- Persons must not stand under an engine suspended on a crane hook. Keep lifting gear in perfect condition.

- Only open coolant circuit once the engine has cooled down. Follow the instructions given under “Care and Maintenance” in the Operating Manual exactly if it is not possible to avoid opening the coolant circuit with the engine at operating temperature.
- Do not tighten or undo pipes and hoses under pressure (lubricating oil circuit, coolant circuit and any downstream hydraulic oil circuits). Danger of injury caused by liquids escaping under pressure!

- Do not hold hands under the fuel jet when checking injection nozzles. Do not inhale fuel mist.
- Always disconnect battery when working on the electrical system

- Do not use rapid charger to start the engine. Rapid charging of batteries is only permitted with the positive and negative leads disconnected!
- Disconnect batteries only with the “ignition” turned off
- Observe manufacturer’s instructions for handling batteries.
  Caution: Battery acid is toxic and corrosive. Battery gasses are explosive

- Only use suitable measuring instruments to **measure voltages**! The minimum input resistance of a measuring instrument should be 10 MΩ.
- Only disconnect or connect wiring harness connectors on electronic control units only with the **“ignition” turned off**!

Disconnect batteries and connect the positive lead to the negative lead such that they are electrically conductive before carrying out any electric welding work. Earth the welding set as close to the weld as possible. Do not place cables of welding set parallel to electrical lines in the vehicle.

Refer to the “Welders’ Code of Practice” for further accident prevention measures.

- **When carrying out repaint jobs**, electronic components may be subject to high temperatures (max. 95˚C) for only very short periods; a period of up to approx. 2 hours is permissible at a max. temperature of 85˚C, disconnect batteries.

Limitation of liability for parts and accessories

In your own interest, we strongly recommend you use only accessories and original MAN parts expressly approved by MAN for your MAN engine. The reliability, safety and suitability of these parts and accessories have been tested specially for MAN engines. Despite us keeping a constant eye on the market, we cannot assess and be held responsible for these properties in other products, even if they bear TÜV (German testing and inspection institute) approval or any other official approval in any particular case.

Laying-up or storage

Special measures must be implemented in accordance with MAN Company Standard M 3069 Part 3 if engines are to be laid up or placed into storage for more than 3 months.

Electronic diesel control EDC

General

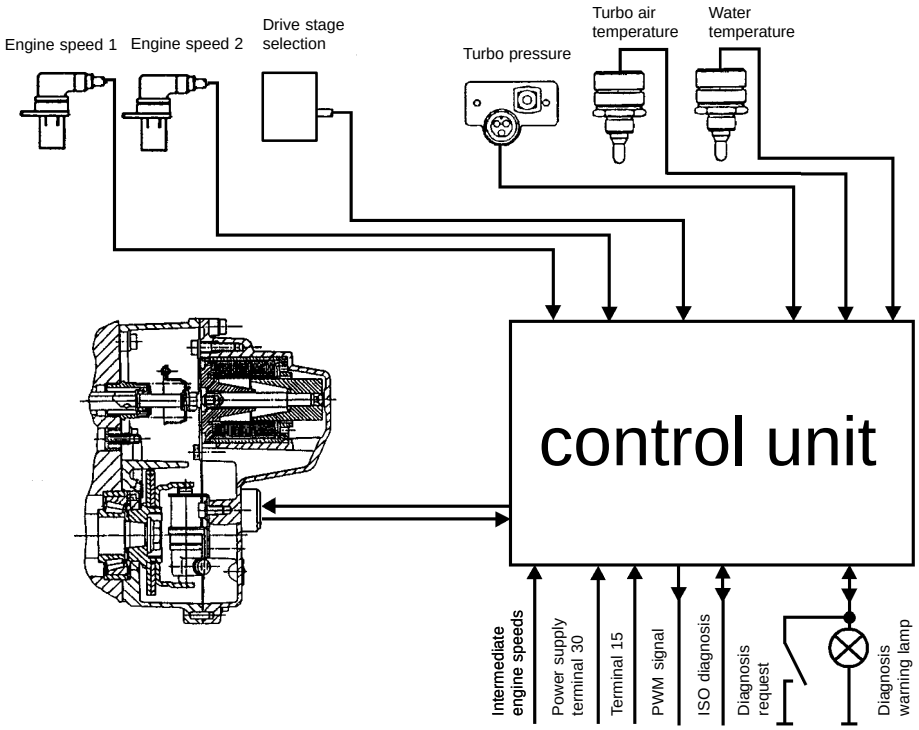
The requirements set by customers and legislation in respect of fuel consumption, exhaust emission and noise characteristics etc. on diesel engines have grown over the years and will be even more stringent in the future.

The fact that conventional mechanical injection systems have reached their capacity limits has made electronically controlled fuel injection systems necessary.

Such systems increase engine efficiency, improve driving comfort and lessen the burden on the environment.

The **E**lectronic **D**iesel **C**ontrol (EDC) fulfils all these requirements.

System description EDC M(S) 5



The controller contains

– the linear solenoid
– the control rod position transducer

The linear solenoid is driven by the electronic control unit.
The control unit processes information which it receives via

– the control rod position transducer
– drive stage selection
– turbo pressure sensor
– coolant temperature sensor
– turbo air temperature sensor
– intermediate engine speed setpoint
– and the rpm sensors.

The diagnosis request pushbutton and the EDC indicator lamp are used in detecting faults and signalling them through a code.

An ISO interface provides a communication with the MAN-cats test and diagnostic computer.

The control unit, with its program adapted to the engine model concerned, determines the optimum setting of the control rod from all the measured values.

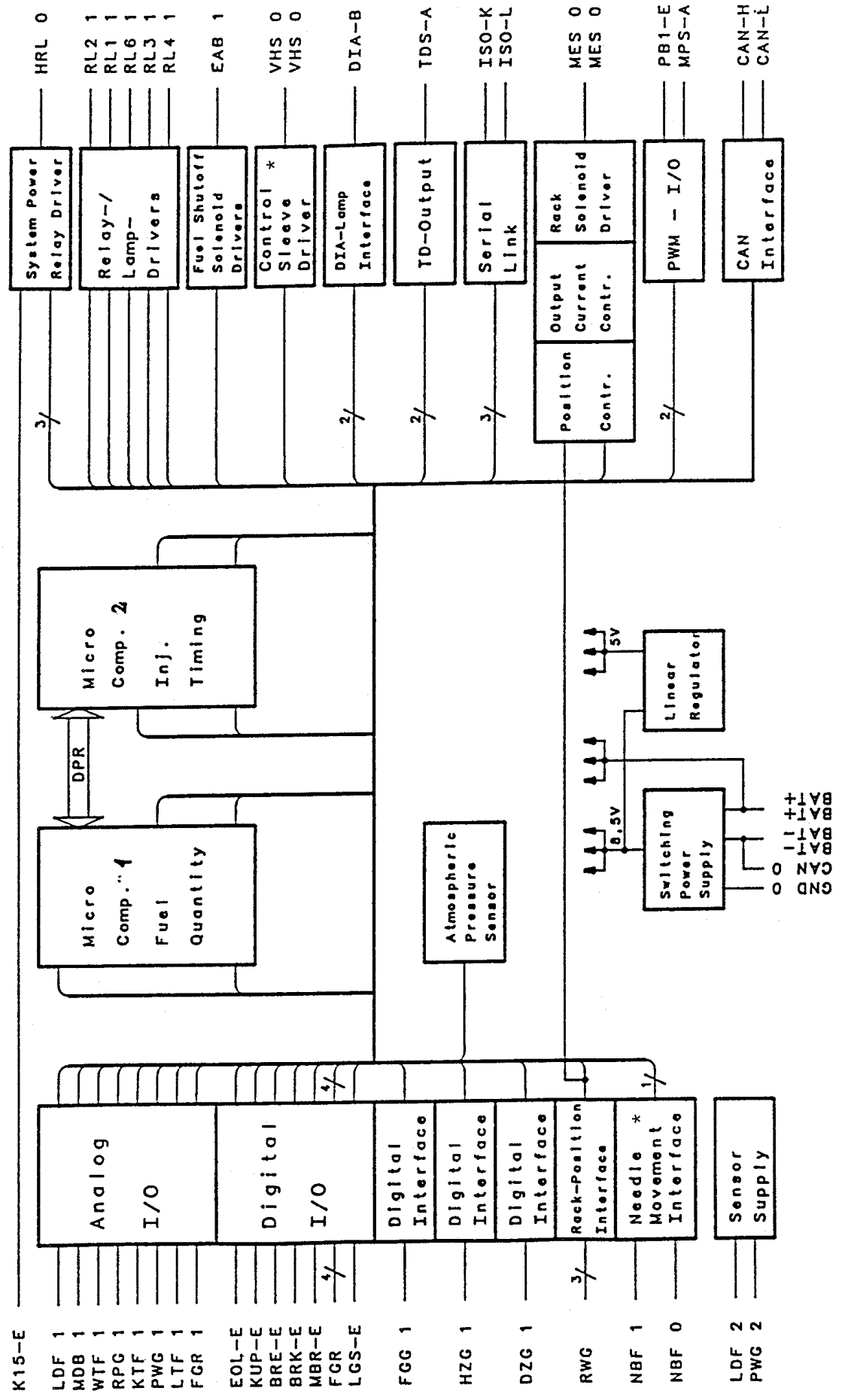
To ensure the vehicle can still be driven to the nearest workshop in the event of one or several sensors failing, an emergency drive function is integrated in the control unit which, depending on the situation, makes it possible to continue driving with restricted functions.

When the brakes are applied, the system operates as an intermediate engine speed controller with a cyclic irregularity (P-degree) of 0, i.e. a set intermediate engine speed is maintained exactly provided the engine develops sufficient power output for this purpose.

The idle speed control operates in the same way as the intermediate engine speed control. The idle speed is maintained exactly by the idle speed control provided the engine output is sufficient for this purpose. The controlled idle speed can be varied within certain limits.

Starting-fuel delivery is output when either a lower start recognition speed is exceeded or the throttle is opened up completely. The starting-fuel delivery and cold idle speed are limited as a function of the coolant temperature to avoid impermissible smoke emission and unnecessary revving of the engine after starting.

Block Diagram M(S) 5

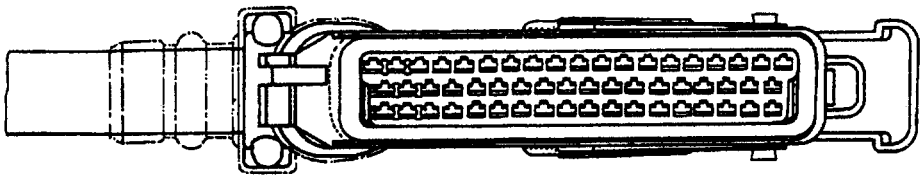


* for M(S) 5 not connected, not in operation

Control unit plug connector

Pin arrangement

19 1
37 20
55 38



Pin assignments of control unit plug connector

Pin	Connection to component (O=Output, I=Input)
1	Injection pump controller pin 8 **O** Jumper to pin 2 (activation of fuel-delivery regulator) **O**
2	Jumper to pin 1 (activation of fuel-delivery regulator) **O**
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used
8	Not used
9	Injection pump controller pin 5 (control rod position transducer, instrument coil)
10	Injection pump controller pin 1 (control rod position transducer, reference coil)
11	Injection pump controller pin 6 (control rod position transducer, centre pick-off)
12	Not used
13	Negative from control unit for – rpm sensor – turbo pressure sensor – drive stage selection – turbo air temperature sensor – coolant temperature sensor – resistor bank
14	Electrohydraulic shut-off valve EHAB **O**
15	Control unit power supply batt. + (via main relay and fuse) **I**
16	Control unit power supply batt. + (via main relay and fuse) **I**
17	Ground for auxiliary rpm sensor
18	Power supply batt. –
19	Power supply batt. –
20	EDC indicator lamp and diagnostic lamp **O**
21	RPM sensor (twisted with cable pin 13) **I**
22	Auxiliary rpm sensor (twisted with cable pin 17) **I**
23	Intermediate engine speed control ZDR 1 **I**

Pin assignments of control unit plug connector

Pin	Connection to component (O=Output, I=Input)
24	Not used
25	Not used
26	Not used
27	Drive stage selection (signal) **I**
28	Engine speed signal output from control unit (square-wave pulses) **O**
29	Multiplex signal **O**
30	Not used
31	Not used
32	Not used
33	Turbo pressure sensor (supply) pin 2 **O**
34	Turbo air temperature sensor pin 3 **I**
35	Resistor bank 511 Ω
36	Turbo pressure sensor (signal) pin 1 **I**
37	Not used
38	Not used
39	Not used
40	Not used
41	Intermediate engine speed control ZDR 2
42	Not used
43	Request button (brake)
44	Analog idle speed control unit **I**, normally connected to 685 Ω (resistor bank)
45	Drive stage selection (supply)
46	Relay power supply batt.+ (main relay) **O**
47	Relay power supply n/o contact **I**
48	Diagnostic connection (K-link)
49	Diagnostic connection (L-link)
50	Not used
51	Resistor bank 3 kΩ
52	Assigned to batt.+ (to enable multiplex signal)
53	Coolant temperature sensor pin 3 **I**
54	Resistor bank 511 Ω
55	Not used

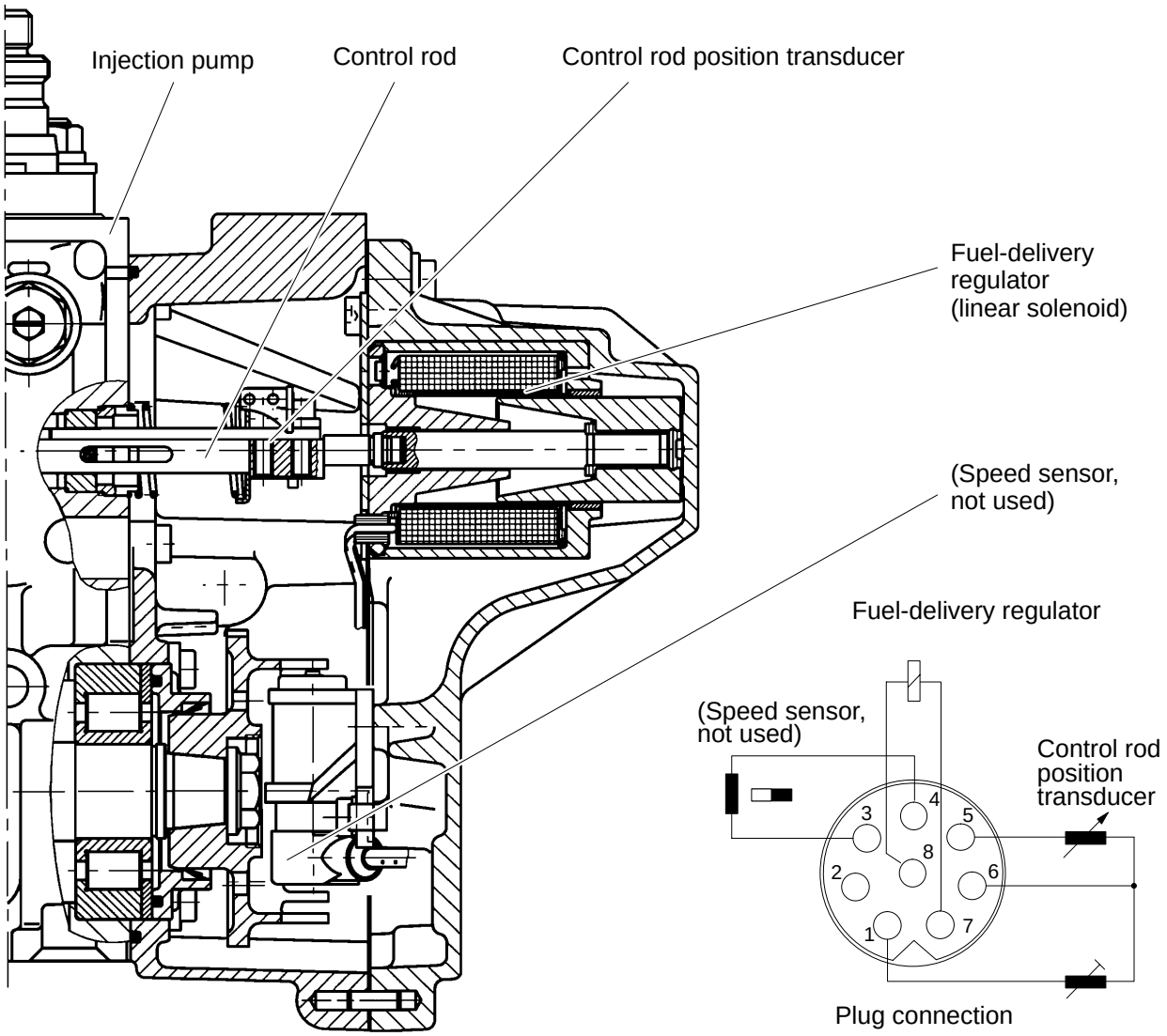
Injection pump

The EDC injection pump consists of a heavyduty version of a conventional injection stage of the well-known Bosch P-pumps and, instead of the mechanical regulator, a flange-mounted electromagnetic fuel-delivery regulator with a control rod position transducer.

Electromagnetic fuel-delivery regulator

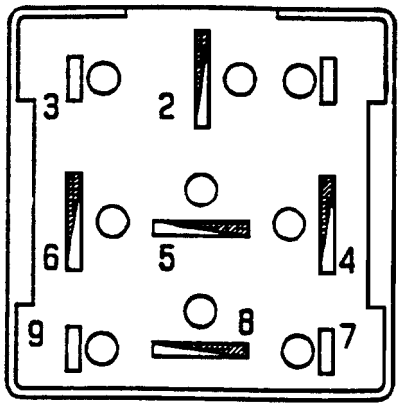
Description:
The fuel-delivery regulator operates in conjunction with the P-pump. The most important component part of the fuel-delivery controller is a linear solenoid in which the armature acts directly on the control rod thus determining the injection volume by means of the control position. When no power is applied, the control rod is held in the stop position by means of a spring.

The other important component in the controller is a control rod position transducer.

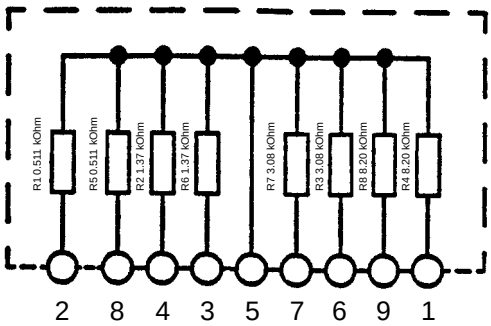


Resistor bank

On commercial vehicles, certain items of data are fed to the EDC which are not required for railway operation.
An example of such data is a signal from the tachograph (speedometer, tachograph) which is used for controlling or limiting the driving speed (see Page 38).
Some unused EDC connections must be closed by resistors since the EDC constantly conducts a signal-range check, as described on Page 22.

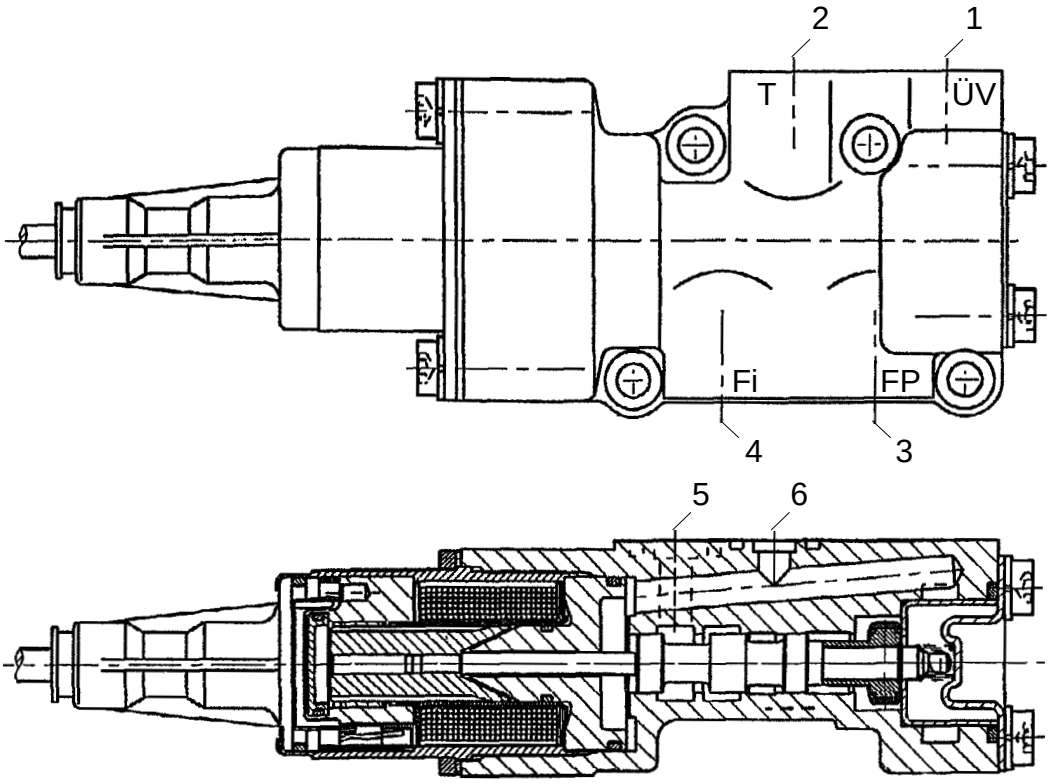


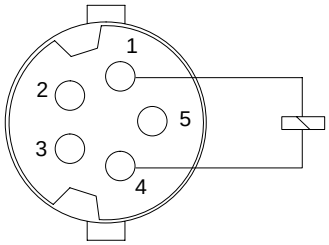
Interior circuit



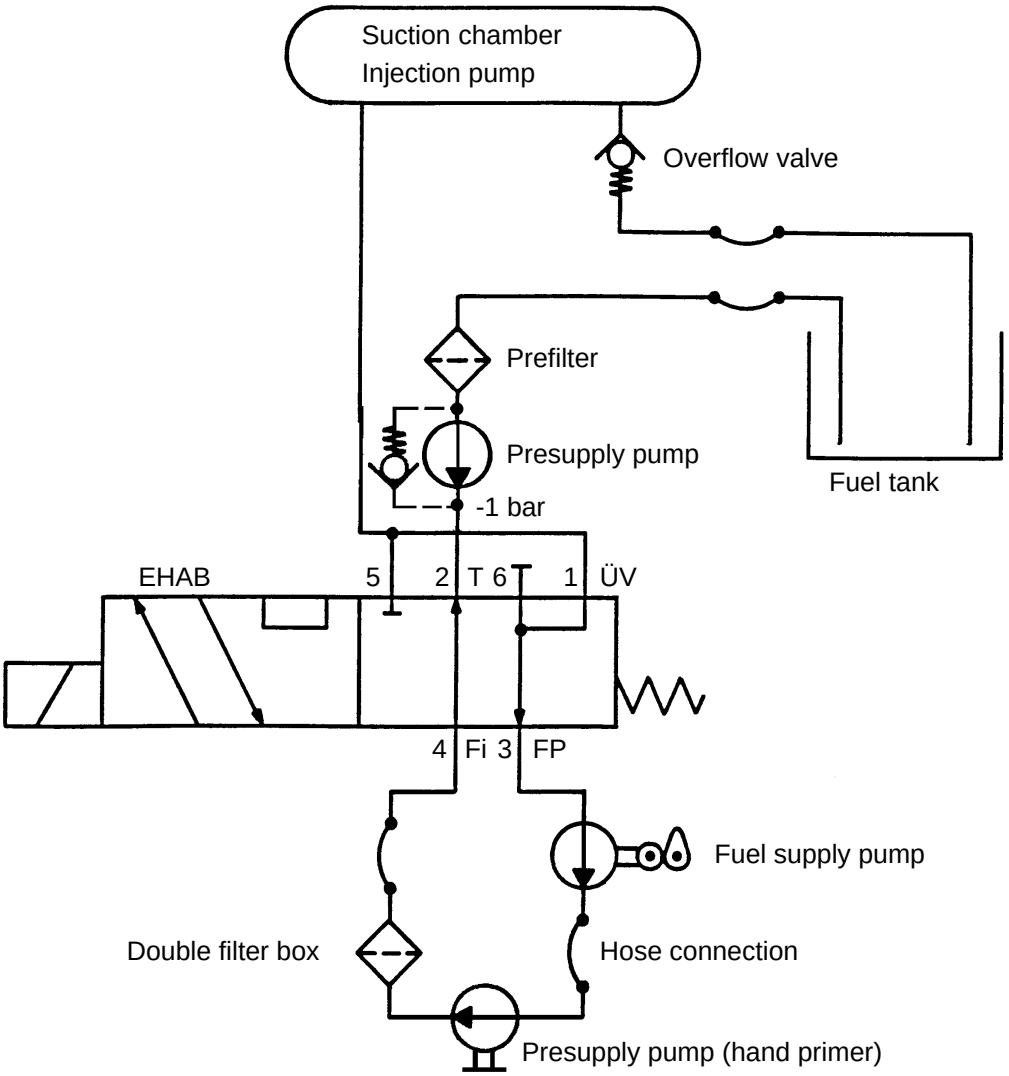
Electrohydraulic shut-off device EHAB

The EHAB (electrohydraulic shut-off device) is a safety-relevant component.
The EHAB shuts off the fuel supply to the injection pump in the event of certain faults occurring in the EDC system. The EHAB is connected in the fuel supply system between the delivery pump and pump suction chamber. The EHAB reverses the delivery direction of the delivery pump so that the pressure in the suction chamber is reduced rapidly thus interrupting the filling procedure.
Power is always applied to the EHAB during operation. The power circuit is interrupted by the EDC control unit in order to activate the EHAB (e.g. for emergency engine shutdown).
For this reason, the **“ignition” must be turned on** when **bleeding the fuel system** by means of the presupply pump.





Plug connection



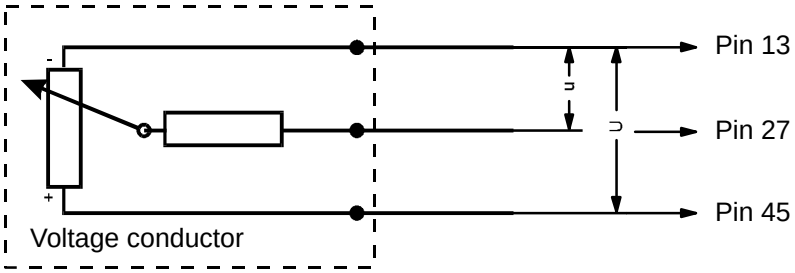
Caution:
Presupply pump integration in the fuel circuit should be checked according to pump type.

Drive stage selection

Function

The drive stage selection device transfers driver’s requests in the form of voltages to the control unit. The control unit then derives the corresponding engine speed or volumetric charge from these voltages.

Block diagram

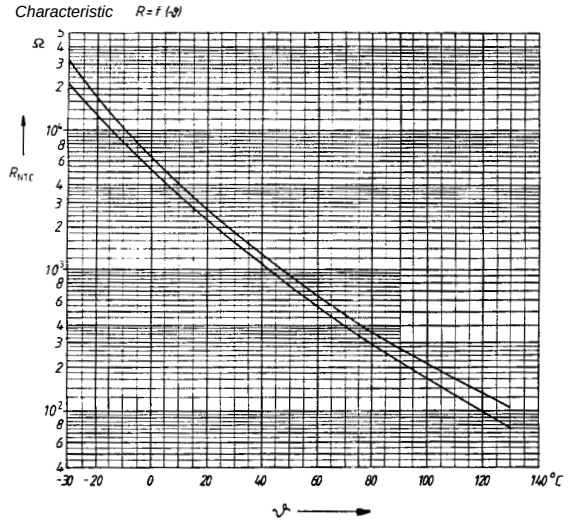


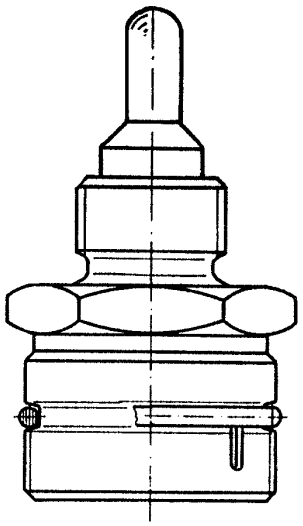
U = Reference voltage, approx. 5 V from the EDC control unit
u = Setpoint

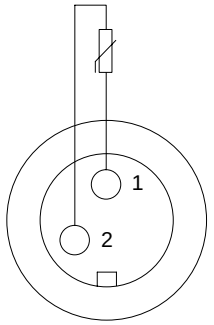
In this specific case, the voltage “u” is generated electronically as the drive stage selection.

Turbo air and coolant temperature sensors

Turbo air

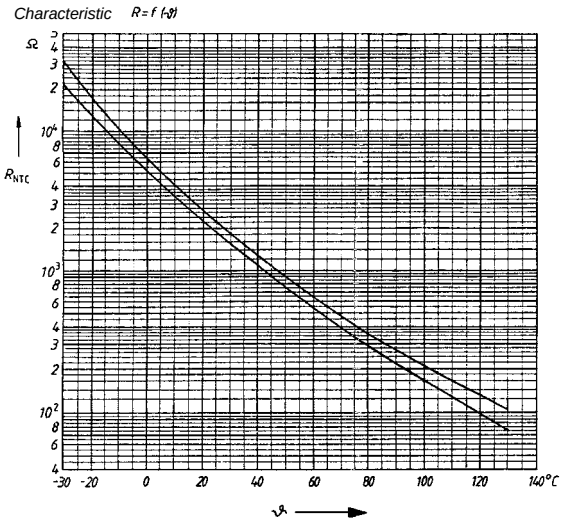


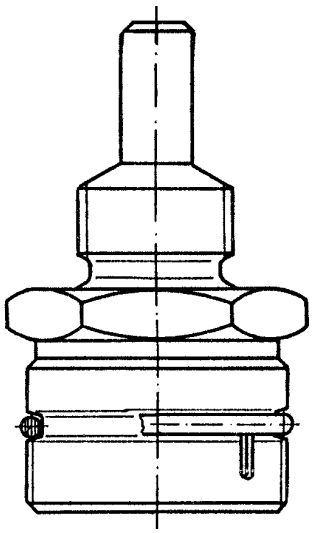


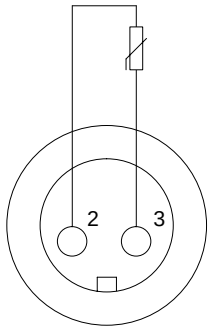


Plug connection

Coolant





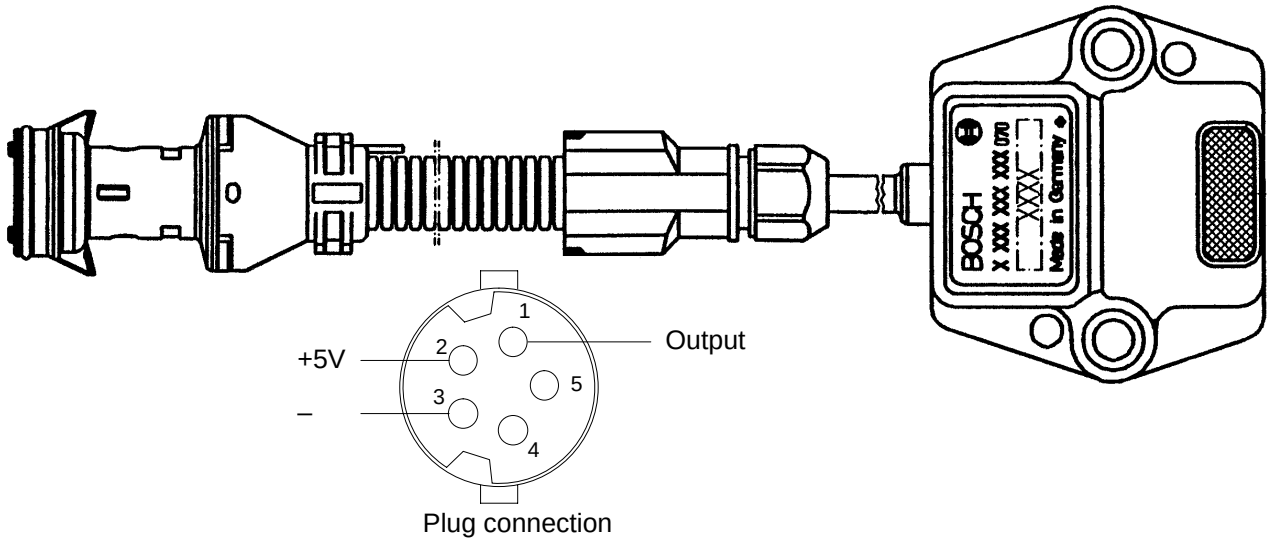


Plug connection

Function

The turbo air and coolant temperature sensors are NTC resistors. The coolant temperature sensor is located in the coolant circuit and the turbo air temperature sensor in the turbo air circuit after the intercooler. They supply the control unit with information relating to the coolant and turbo air temperature.

Turbo pressure sensor

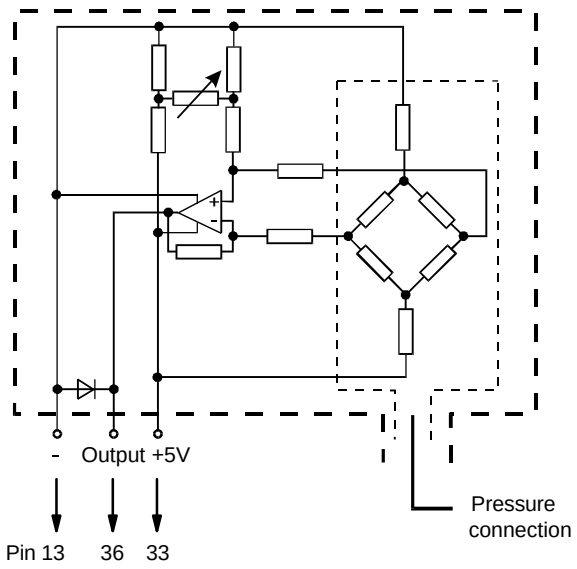


Plug connection

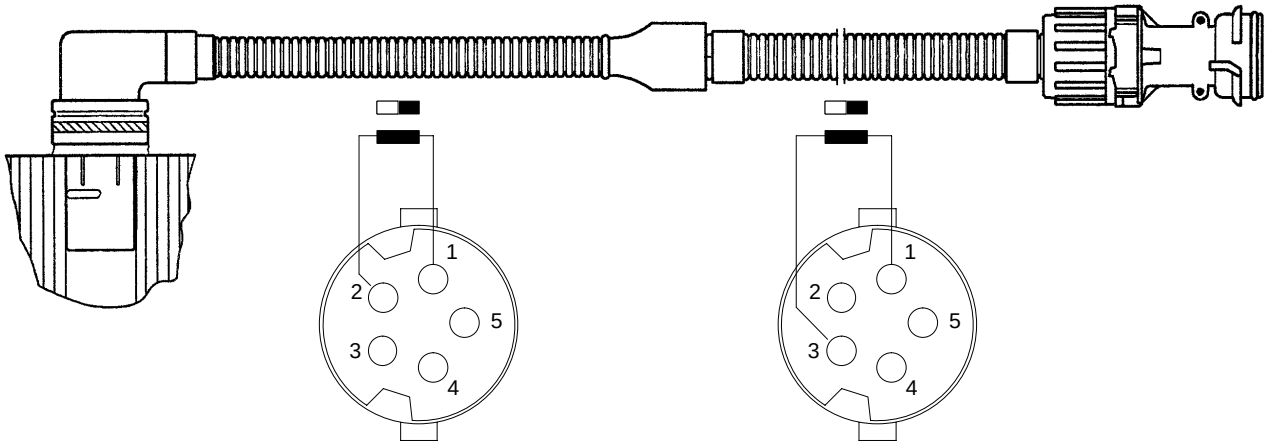
Function

The pressure sensor element consists of an Si diaphragm which contains several piezo-resistive (pressure-sensitive) semiconductor resistors. The pressure to be measured “deflects” the sprung diaphragms. As a result, extended or compressed zones are created on the surface of the diaphragms. The action of these forces changes the electrical ratings of semiconductor resistor arrays arranged in these zones. These values are a measure for the pressure to be measured.

Circuit diagram



RPM sensor



Plug connection
RPM sensor (1)

Plug connection
Auxiliary rpm sensor (2)

Function

The rpm sensor consists of a permanent magnet and a coil with a high number of windings. The magnet “touches” the rotaring component to be measured, normally a crown gear or grooved ring gear, with its magnetic field.
In the case of the EDC-M(S) 5 system, grooves are arranged on the flywheel.
6 grooves for the 6-cylinder engine.
When a groove moves past the sensor, the magnetic flux increases and, conversely, decreases in the gaps between the grooves. This generates an induction voltage in the sensor coil which is measured by the electronic control. The distance between the sensor and the grooved ring gear is approx. 1 mm.

Two rpm sensors are required to ensure reliable operation of the EDC system.
Both rpm sensors are installed in the flywheel housing.
A distinction is made between the rpm sensor and the auxiliary rpm sensor.
The rpm sensor is installed in the flywheel housing such that an rpm pulse is triggered 10° after TDC.
The auxiliary rpm sensor is installed in the flywheel housing such that an auxiliary rpm pulse is triggered 18° after TDC. The signals of the auxiliary rpm sensor are used only for redundant engine speed sensing.

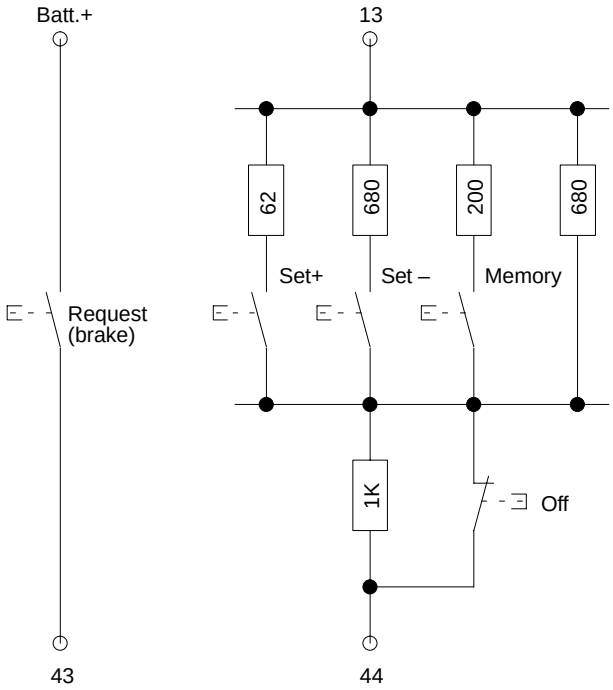
Caution:
Do not confuse installation locations of the rpm sensor (1) and the auxiliary rpm sensor (2), nor the “+” and “–” wires of the sensors.

Start procedure

A drive stage must not be selected for the start procedure.

Changing idle speed (operating unit)

The idle speed is set to 700 rpm in the works. If necessary, the idle speed can be set anywhere between 700 rpm and 800 rpm with the engine at operating temperature (from approx. 30°C) .



Engine running:

- Press and hold request button (brake) during the entire following procedure
- Press and hold memory button for at least 5 seconds
- Press SET+ button
- The idle speed increases by approx. 10 rpm every time the SET+ button is pressed
- Press and hold memory button for 5 seconds once more
- Release button

The set idle speed is now retained even after turning off the ignition.

Proceed as follows to reset the works idle speed of 700 rpm:
After pressing the request button (brake), press and hold the memory button for approx. 5 seconds.
The idle speed now drops back to 700 rpm.
Then press and hold the memory button for a further 5 seconds while still pressing the request button (brake).
The works idle speed of 700 rpm is now reset.

Intermediate engine speed control

Different intermediate engine speeds can be programmed by means of MAN-Cats:

- ZDR 1, ZDR 2 and ZDR 3
  These intermediate engine speeds are set by corresponding pin connection.

If the corresponding functions are activated by means of MAN-Cats, the intermediate engine speeds can be manually corrected up or down within a fixed range using the operating unit (SET+ or SET–). The engine speeds corrected in this way can also be stored. If they are not stored, the originally programmed value is assumed when the corresponding intermediate engine speed is reactivated.

A 4th intermediate engine speed “ZDRS” can be set by means of MAN-Cats (currently not active).

General

The EDC system continuously checks itself by means of a signal-range check. During this check, all signals are scanned for presence and plausibility within a certain time frame (determined by the software).
The control unit itself is also checked during the entire program run. The first check is always carried out when the “ignition” is turned on.
Any faults occurring during operation are stored for the purpose of subsequent diagnosis. A maximum of 5 faults can be stored simultaneously in the fault code memory. The faults are stored in the same order in which they occurred. If more than 5 faults occur, the least significant fault is deleted.

Fault storage includes

- allocation of fault priority,
- identification of the type of fault,
- recording of fault frequency.

Sporadic faults are recorded by a frequency counter the first time they occur. This means that a certain frequency number is set which is decremented by one during every start procedure. If the fault no longer occurs, it is deleted when the counter reaches zero.
The diagnostic lamp lights steadily or goes out depending on the fault significance for the purpose of fault signalling. If several faults are stored, the **steady light** has priority over **OFF**.
Only faults currently present are indicated. Faults which are stored but are not currently present are not indicated.

There are two fault code memories:

- Fault code memory for diagnosis via ISO interface. This memory can be read and deleted with MAN-Cats.

- Fault code memory for diagnosis via flash code. The flash code memory can be read out and deleted with the aid of the diagnosis button.

Faults are always entered in both fault code memories simultaneously and persist after the ignition has been switched off and on again.

Indicator lamp check:
The EDC indicator lamp lights for approx. 2 seconds after turning on the ignition as a lamp test.

The following measures are implemented automatically depending on the significance of the fault:

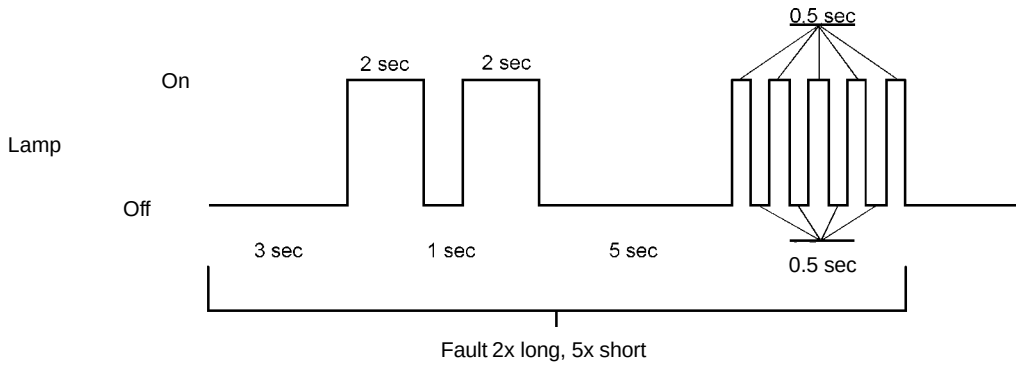
- Changeover to suitable substitute function to enable continued yet restricted operation.
- Reduction of engine speed to idle speed (drive stage 0).
- Immediate shutdown of the engine if required for safety reasons. Depending on the type of fault, engine shutdown takes place by reducing the fuel delivery volume to zero or by way of emergency shutdown with EHAB.

Flash code

To read out fault code memory

- With the engine stationary or running and the “ignition” switched on, press and hold the diagnosis request button for at least 2 seconds. Diagnosis lamp does not come on.
- The flash procedure starts after a pause of approx. 3 seconds. The flash code is divided into long and short pulses.
- The diagnostic system always outputs only one fault at a time. In order to check whether several faults are stored, the fault scanning procedure must be repeated until the fault last indicated reappears.

Example of flash code outputs



OFF phase before output:	3 seconds
ON duration of a long pulse:	2 seconds
OFF phase between two long pulses:	1 second
OFF phase between long and short pulses:	5 seconds
ON duration of a short pulse:	0.5 seconds
OFF phase between two short pulses:	0.5 seconds

To delete fault code memory

1. Press request button
2. Turn on “ignition”
3. Press and hold request button for a further 3 seconds but not longer than 10 seconds.

Fault code output MAN M(S)5 EDC

Indication			Description	See Page
Type	Light pulse sequence			
	Long	Short		
Steady light fault		1	Drive stage selection	33
		4	Engine speed sensing (rpm sensor)	34
		5	Turbo pressure sensing	35
		6	Control rod position sensing	36
		7	Coolant temperature sensing	37
		8	Resistor bank	38
		10	Fuel-delivery regulator monitoring	39
		14	Engine speed sensing (auxiliary rpm sensor)	40
	1	1	Turbo air temperature sensing	41
	1	6	Processor coupling defective	43
	1	7	Overrevving	44
	1	13	Operating unit	45
	2	7	Resistor bank	38
	2	8	Atmospheric pressure sensing	47
	3	2	EEPROM processor 1 error	49
	3	3	EEPROM processor 2 error	49
	3	9	Afterrunning watchdog error	49
No light fault	1	3	Battery voltage sensing	42
	1	4	Request button (brake)	50
	1	12	Resistor bank	38
	2	5	Main relay sticking	46
	3	8	Afterrunning not completed	48
	–	–	PBM interface	51
	–	–	EHAB fault	52

Quick check list EDC M(S) 5

All the checks described in the following are carried out with a socket box and a multimeter. The actual values are measured between the specified pins and compared with the setpoints.
This check method also includes the wiring and plug connections. The circuit diagram should therefore always be used as part of the troubleshooting procedure.

1. Resistance checks

Check preconditions

– "Ignition" off, control unit **not** connected
– Socket box connected
– Engine temperature approx. 30°C

Check	Measurement between	Setpoint	Actual value
Control rod position transducer	11 and 9	18 – 25 Ω	
	18 and 9	>10 MΩ	
	11 and 10	18 – 25 Ω	
	18 and 10	>10 M Ω	
RPM sensor	21 and 13	500 – 700 Ω	
Auxiliary rpm sensor	22 and 17	500 – 700 Ω	
Fuel-delivery regulator	15 and 1	0.7 – 1.3 Ω	
	18 and 1	>10MΩ	
	16 and 2	0.7 – 1.3 Ω	
EHAB	14 and 19	30 – 70 Ω	
Ground	13 and 18 17 and 19	>10 MΩ >10 MΩ	
Coolant temperature sensor	53 and 13	1.3 – 3.6 kΩ*	
Turbo air temperature sensor	34 and 13	1.3 – 3.6 kΩ*	
Turbo pressure sensor	33, 36 and 13	Resistance measurement not appropriate	
Operating unit			
Resistor bank	35 and 13	500 – 520 Ω	
	44 and 13	600 – 700 Ω	
	51 and 13	2.8 – 3.2 kΩ	
	54 and 13	500 – 520 Ω	

* Resistance approx. 230 – 460 W with engine at operating temperature (approx. 80°C)

2. Voltage checks

– **Check preconditions**
– Control unit connected
– Socket box connected

Check	Measurement between PIN (+) and PIN (–)	Setpoint	Actual value	Remarks
Control unit power supply	15 and 18 47 and 19	U_{batt} U_{batt}		"Ignition" ON "Ignition" ON
Main relay *	47 and 18 47 and 18 46 and 18 46 and 18	U_{batt} 0 V 0 V U_{batt}		"Ignition" ON "Ignition" ON "Ignition" ON "Ignition" OFF
"Ignition" ON				
Reference voltage	45 and 13 33 and 13	4.95 – 5.05 V 4.95 – 5.05 V		
Drive stage selection	27 and 13 27 and 13	0.30 – 0.50 V 3.90 – 4.10 V		Lower idle speed Upper idle speed
Charge air temperature	34 and 13	4.17 – 2.62 V		at 10 – 50°C
Coolant temperature	53 and 13	3.46 – 1.22 V		at 30 – 90°C
Turbo pressure sensor (engine running)	36 and 13 36 and 13	0.94 – 1.20 V 1.10 – 1.40 V		Lower idle speed Upper idle speed
Intermediate engine speed Input 1	23 and 18 23 and 18	0 V U_{batt}		Not activated Activated
Intermediate engine speed Input 2	41 and 18 41 and 18	0 V U_{batt}		Not activated Activated
Operating unit	44 and 13	3.15 – 3.55 V		Not activated
Resistor bank	35 and 13	0.75 – 1.25 V		
Resistor bank	54 and 13	0.75 – 1.25 V		
Request button (brake)	43 and 19	0 V U_{batt}		Not activated Activated
Resistor bank	51 and 13	>0.6 V		

* Pin 46 (main relay activation) must switch to U_{batt} with a delay of 0.5 to 5 seconds after "ignition" is switched off.

3. Flash code diagnosis check

Check preconditions
– Control unit connected
– Socket box connected
– Engine running

Check procedure
– Short-circuit rpm sensor; connect pin 21 to pin 13 to do this
– Diagnosis lamp lights up.
– Engine speed is measured by auxiliary rpm sensor.
– Disconnect connection between pin 21 and pin 13.
– Press diagnosis button for at least 3 seconds but no more than 10 seconds.
– Check flash code (4x short = rpm sensor)
– Delete fault code memory; do this by turning off ignition pressing diagnosis button, turning on ignition, pressing and holding button for at least 3 seconds but not longer than 10 seconds.

4. EHAB check

Check preconditions
– Control unit connected
– Socket box connected
– Engine running

Check procedure
– Disconnect pin 14
– Engine should shut down after no more than 10 seconds.

5. Capacitance reserve check

The power capacitance of the line leading to the control rod position transducer must not exceed the specified maximum capacitance. The capacitance increases if the line is dirty or moist. This check is designed to establish how much capacitance reserve is still available.

Check preconditions
– Control unit connected
– Socket box connected

Check procedure
– Connect capacitance decade between pin 11 and pin 13
– Connect additional capacitance until the engine no longer starts
– Record value

Setpoint:
>400 pF without wiring harness adapter (capacitance of wiring harness adapter approx. 100 pF),
(wiring harness dry at approx. 25°C)

To delete fault code memory

The fault code memory must be deleted on completion of the checks.
No fault must be stored when the “ignition” is turned on again. If this is not the case, the fault must be located and eliminated in accordance with the troubleshooting procedure.

1. EDC self-diagnosis or flash code output	2. Starter turns over engine only slowly or not at all	3. Starter turns, engine does not start, engine does not start/difficult to start when cold	4. Engine stalls (dies) during operation, no longer starts (starter turns), engine does not start/starts with difficulty when hot	5. Sudden, temporary engine shutdown, engine does not reach full revs	6. Engine only runs at idle speed, no throttle response	7. Engine only runs at increased idle speed, no throttle response	8. Rated engine speed distinctly reduced (even under no load)	9. Reduced output in all ranges	10. Irregular engine operation, traction loss	11. Unstable idle speed, engine hunting, misfiring, knocking in engine	12. Engine judder	13. Unusual combustion noise	14. Excessive smoke emission: White smoke/blue smoke	15. Excessive smoke emission: Black smoke	16. Engine temperature too high (coolant loss)	17. Intermediate engine speed control cannot be activated/does not switch off, engine revs too high	18. Fuel consumption too high	19. Lubricating oil pressure too low	20. Lubricating oil pressure too high	21. Lubricating oil consumption too high	22. Engine too "loud"/mechanical noise	23. Idle speed cannot be adjusted with idle speed operating unit	**Possible causes**
	x	x																				Batteries discharged, battery lead connections loose or corroded, break in power circuit
	x																					Crank gear blocked
	x	x																				Starter solenoid switch sticks (clicks)/defective, cable connection loose or damaged
	x	x																				Starter/starter interlock relay defective (carbon brushes worked loose/worn, winding defective, short to ground)
	x												x	x	x							Engine oil viscosity unsuitable, not suitable for ambient temperature, lubricating oil quality does not correspond to specifications
						x									x							Oil level in sump too high
													x									Oil level in sump too low, oil in sump too thin (mixed with condensate or fuel)
													x									Engine temperature too high
													x									Oil filter clogged
													x	x								Oil pressure gauge defective
													x									Safety valve in oil circuit defective (does not close, spring fatigued or broken)
													x			x						Bearing wear
													x									Oil pump gears worn
																x						Crankshaft timing gears worn, tooth flank backlash too great
								x		x				x								Engine cold
										x												Lubricating oil entering combustion chamber (piston rings worn, piston rings broken) – valve stem guide worn – overpressure in crankcase (crankcase vent clogged)
														x								Relief valve in oil circuit defective (does not open), oil lines/oil galleries clogged
															x							Leaks in lubricating oil circuit, particularly at turbocharger and oil cooler
								x							x							Piston rings heavily worn, broken
								x								x						Piston pin or crankshaft bearing loose
															x							Valve stems worn, bent
		x						x								x						Valve clearance not correct
		x						x														Valves jam
		x	x				x	x														Compression deficient, or more than 3 – 4 bar pressure difference between individual cylinders
		x						x				x										Valve seats leaking
	o			x								x										Increased power intake due to defective secondary consumers such as hydraulic pumps, fan etc., power take-off engaged

x = Possible
o = Probable

1. EDC self-diagnosis or flash code output	2. Starter turns over engine only slowly or not at all	3. Starter turns, engine does not start, engine does not start/difficult to start when cold	4. Engine stalls (dies) during operation, no longer starts (starter turns), engine does not start/starts with difficulty when hot	5. Sudden, temporary engine shutdown, engine does not reach full revs	6. Engine only runs at idle speed, no throttle response	7. Engine only runs at increased idle speed, no throttle response	8. Rated engine speed distinctly reduced (even under no load)	9. Reduced output in all ranges	10. Irregular engine operation, traction loss	11. Unstable idle speed, engine hunting, misfiring, knocking in engine	12. Engine judder	13. Unusual combustion noise	14. Excessive smoke emission: White smoke/blue smoke	15. Excessive smoke emission: Black smoke	16. Engine temperature too high (coolant loss)	17. Intermediate engine speed control cannot be activated/does not switch off, engine revs too high	18. Fuel consumption too high	19. Lubricating oil pressure too low	20. Lubricating oil pressure too high	21. Lubricating oil consumption too high	22. Engine too ”loud”/mechanical noise	23. Idle speed cannot be adjusted with idle speed operating unit	**Possible causes**
			x			x					x		x			x							Air cleaner soiled or clogged, turbo air system leaking, air inlet/exhaust line clogged/leaking
	x	x	x	x		x	x		x		x			x									Fuel low pressure system: Fuel tank, prefilter, water trap faulty/clogged/mould/ fungal attack, fuel unsuitable/contaminated (paraffin added)
	x	x	x			x	x	x		x			x										Fuel low pressure system: Fuel lines leaking, broken, clogged
	x	x	x			x	x		x		x												Fuel low pressure system: Air in system (turn on ignition when bleeding system)
	x	x	x			x	x	x	x		x			x									Fuel low pressure system: Fuel pump, overflow valve, main filter
	x					x		x	x	x	o	x		x									Fuel high pressure system: Jets defective/clogged/leaking/coked
						x		x	x	x				o									Fuel high pressure system: Pressure lines – constriction, cavitation, leaking
		x				x		o	x	x	x	x		o									Fuel high pressure system: Injection pump worn/set incorrectly
						o			x	o				o									Fuel high pressure system: Injection pump constant-pressure control valve/return flow restrictor defective
	x	x	x			o	x																EHAB defective, drive faulty
	o	o				o		x		o	x	x		x									Injection pump-engine allocation: Start of delivery incorrect (basic installation), start of delivery set incorrectly
x	x	x	x			o		x	o														Injection pump – controller: Stiff movement – fuel delivery controller (control deviation)
x	x	x	x				o																Control rod position transducer in controller: Connection lines, break, short-circuit
	o					o					o												Control rod position transducer in controller: Set incorrectly
x	x		o																				Control rod position transducer in controller: Capacitance reserve of wiring harness too low (e.g. water penetrated wiring harness)
						x		o	x	o		o											Injection pump: Delivery set incorrectly/uniform delivery, lower idle speed set too low
x	o	x	x										x										Delivery actuating solenoid in controller: Connection lines, break, short-circuit
x				x		x	x	x	o														Drive stage selection defective: Connection lines, short-circuit, break
x																							EDC rpm sensor defective, implausible with auxiliary rpm sensor, line defective
									x	o													EDC rpm sensor, polarity reversed
x																							EDC auxiliary rpm sensor defective, implausible with rpm sensor, line defective
x	x	x	x	o				o	o					o									EDC detects incorrect engine speed (interference signal on rpm sensor line)
x	x	x	x							o													Both rpm sensors defective, line defective
x							x					x											EDC turbo pressure sensor: Defective, incorrect, implausible with atmospheric pressure sensor, line defective
							x		x			o	x										Exhaust turbocharger leaking or defective
																					x		Turbine and compressor rotor in turbocharger dirty (out-of-balance, irregular running)

x = Possible
o = Probable

1. EDC self-diagnosis or flash code output	2. Starter turns over engine only slowly or not at all	3. Starter turns, engine does not start, engine does not start/difficult to start when cold	4. Engine stalls (dies) during operation, no longer starts (starter turns), engine does not start/starts with difficulty when hot	5. Sudden, temporary engine shutdown, engine does not reach full revs	6. Engine only runs at idle speed, no throttle response	7. Engine only runs at increased idle speed, no throttle response	8. Rated engine speed distinctly reduced (even under no load)	9. Reduced output in all ranges	10. Irregular engine operation, traction loss	11. Unstable idle speed, engine hunting, misfiring, knocking in engine	12. Engine judder	13. Unusual combustion noise	14. Excessive smoke emission: White smoke/blue smoke	15. Excessive smoke emission: Black smoke	16. Engine temperature too high (coolant loss)	17. Intermediate engine speed control cannot be activated/does not switch off, engine revs too high	18. Fuel consumption too high	19. Lubricating oil pressure too low	20. Lubricating oil pressure too high	21. Lubricating oil consumption too high	22. Engine too "loud"/mechanical noise	23. Idle speed cannot be adjusted with idle speed operating unit	**Possible causes**
												x										Intercooler leaking, defective
	x										x											Flame starting system defective
x	o					x	x				o		x									EDC coolant temperature sensor: Defective, line defective
x						x	x															EDC turbo air temperature sensor: Defective, line defective
o						x							x									Radiator dirty or failure of cooling system (temperatures too high)
													x									Coolant level too low, air in coolant circuit
													x									V-belt for water pump drive not tensioned correctly
													x							x		Incorrect V-belt tension
													x									Water pump leaking, defective/thermostat defective, does not open
													x									Coolant lines leaking, clogged or twisted
											x											Coolant entering combustion chamber (cylinder head/gasket leaking)
							x						o									Resistor bank EDC control unit pin 51
x		x	x	o				o														Power supply to EDC control unit interrupted or battery voltage too low
		x	x	o				o														Line terminal 15 to EDC control unit (pin 47) interrupted/loose contact
														x								Line defective: Pin 23 or 41
x																					x	Operating unit for setting idle speed/resistor bank pin 44: Voltage values incorrect/implausible, operating unit switched off
x		o	o	o																		EDC control unit defective (internal fault)
		x			x	x	x		o	o		o	x									Incorrect EDC control unit (check MAN part number)
					x	x								o								Intermediate engine speed activated
		x																				EOL programming terminated/voltage interrupt
x																						Afterrunning not completed (e.g. shutdown via EMERGENCY STOP)
														x							x	EOL programming: Configuration incorrect
							x					x										Thermostat NT circuit defective
									x													Engine bearings worn

x = Possible
o = Probable

The following troubleshooting program contains all faults which can be detected by the diagnostic system.

The order corresponds to the numerical sequence of the flash code, irrespective of the significance of the fault.
It is therefore not arranged on the basis of “fault is indicated by EDC indicator lamp” or “fault is not indicated by EDC indicator lamp”.

The entire fault code memory should always be read out and all stored fault codes noted down before starting the engine test.
This is important because lines or components need to be disconnected during troubleshooting in the system this can cause the corresponding fault codes to be set and stored.
For this reason, the fault code memory should always be deleted after intermediate checks.

The “check lines” test step must always be worked through as follows:

– Break or contact resistance
  Setpoint: approx. 0 Ω
– Short to negative
  Setpoint: ∞ Ω
– Short to positive
  Setpoint: ∞ Ω
– Short to adjacent lines
  Setpoint: ∞ Ω
– Loose contacts

After rectifying faults and checking, repeat test and delete fault code memory.

All checks which refer to the control unit plug connector are conducted with the aid of the socket box. The pin designations at the control unit plug connector are identical to those of the test sockets on the socket box.

Note:
The connection to the control unit must be disconnected at the socket box when conducting resistance measurements.

Drive stage selection

Flash code: 1x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Drive stage selection
– Signal too high
– Signal too low

Effect of fault: Engine assumes lower idle speed

Possible cause: Line break, short-circuit, power supply interrupted, drive stage selection defective, control unit defective

Test precondition: EDC control unit connected
Socket box connected
“Ignition” switched on

Test	Measurement	Corrective measures
Power supply	Measure voltage at socket box across pin 45 (+) and pin 13 (–) **Setpoint:** 4.95 – 5.05 V	– Check lines – Check plug connections – If no fault found, replace control unit
Drive stage selection 0.5 – 4.0 V	Measure voltage at socket box across pin 27 (+) and pin 13 (–) **Setpoints:** Idle speed setting: 0.3 – 0.5 V Full load setting: 3.9 – 4.1 V	– Check lines – Check plug connections – Replace drive stage selection
Drive stage selection 0.8 – 4.0 V	Measure voltage at socket box across pin 27 (+) and pin 13 (–) **Setpoints:** Idle speed setting: 0.3 – 0.8 V Full load setting: 3.9 – 4.1 V	– Check lines – Check plug connections – Replace drive stage selection

RPM sensor

Flash code: 4x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

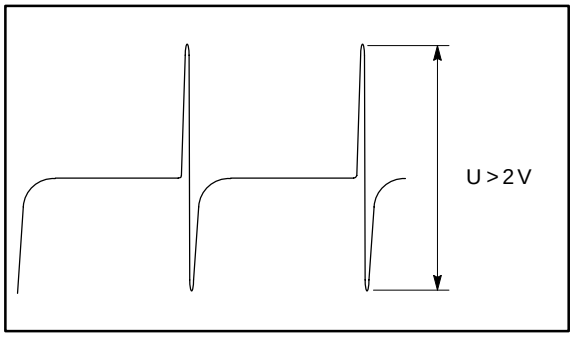
Fault path: RPM sensor
– Statically implausible
– Dynamically implausible
– Implausible with auxiliary rpm sensor

Effect of fault: If the auxiliary rpm sensor also fails, the engine will be shut down by EHAB

Possible cause: Line break, short to ground, rpm sensor defective, control unit defective

Test precondition: Disconnect EDC control unit to ensure the engine cannot start up
Socket box connected

Test	Measurement	Corrective measures
Resistance	Measure resistance at socket box across pin 21 and pin 13 **Setpoint:** 500 – 700 Ω	– Check lines – Check plug connections – If no fault found, replace rpm sensor
Engine speed signal	Check signal at socket box at starting speed across pin 21 (+) and pin 13 (–) with oscilloscope **Setpoint:** See figure	



Turbo pressure sensor

Flash code: 5x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Turbo pressure sensor
– Signal too high
– Signal too low
– Signal implausible with atmospheric pressure sensor (in control unit)

Effect of fault: Reduced full load delivery volume (engine runs only with intake delivery volume)

Possible cause: Line break, short-circuit, boost pressure sensor defective, control unit defective

Test precondition: EDC control unit connected
Socket box connected
“Ignition” switched on

Test	Measurement	Corrective measures
Power supply	Measure voltage at socket box across pin 36 (+) and pin 13 (–) **Setpoint:** 4.95 – 5.05 V	– Check lines – Check plug connections – If no fault found, replace control unit
Signal voltage	Measure voltage at socket box across pin 36 (+) and pin 13 (–) **Setpoints:** Lower idle speed: 0.94 – 1.20 V Upper idle speed: 1.10 – 1.40 V	
	If all values are OK, the atmospheric pressure sensor in the control unit may be defective	– Replace control unit

Control rod position transducer

Flash code: 6x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Control rod position transducer
– Signal too high
– Signal too low

Effect of fault: This fault results in the engine being shut down by setting the control travel to 0. The engine cannot be started if this fault is currently present (EDC control lamp permanently on).

Possible cause: Line break, short-circuit, too little capacitance reserve (see page 27), control rod position transducer set incorrectly, injection pump defective

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement	Corrective measures
Test coil	Measure resistance at socket box across pin 11 and pin 9 **Setpoint:** 18 – 25 Ω	– Check lines – Check plug connections – If no fault found, repair injection pump
Reference coil	Measure resistance at socket box across pin 11 and pin 10 **Setpoint:** 18 – 25 Ω	
	In addition to the possibility of an electrical fault, the fault described here may also be caused by incorrect setting of the control rod position transducer	– Remove injection pump – Adjust control rod position transducer

Coolant temperature sensor

Flash code: 7x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Coolant temperature sensor

Effect of fault:

The substitute value provided in the control unit for such cases results in a reduction in power output (e.g. in the event of radiator contamination or failure of cooling system).

Possible cause: Line break, short-circuit, temperature sensor defective, control unit defective, failure or contamination of cooling system.

Test precondition: EDC control unit disconnected/connected
Socket box connected

Test	Measurement	Corrective measures
Sensor resistance (control unit disconnected)	Measure resistance at socket box across pin 53 and pin 13 **Setpoints:** 1.3 – 3.6 KΩ at 15 – 30°C 230 – 460 Ω at 75 – 80°C	– Check lines – Check plug connections – Replace temperature sensor – Check cooling system – If no fault found, replace control unit
Sensor voltage (control unit connected)	Measure voltage at socket box across pin 53 and pin 13 **Setpoint:** 3.46 – 1.22 V at 30 – 90°C	– Check lines – Check plug connections – Replace temperature sensor – Check cooling system – If no fault found, replace control unit

Resistor bank

The sensors not provided in this application for

Pin		Flash code		Fault indicated by steady light at EDC indicator lamp
		Long	Short	
51	Driving speed	–	8	Yes
54	Maximum speed limitation	2	7	Yes
35	Torque limitation and	1	12	No
44	Operating unit for engine speed and driving speed	1	13	Yes

must be terminated with a resistor.

These resistors are provided in the resistor bank.

Fault path: Resistor bank defective, resistance values incorrect

Effect of fault: Reduced final engine speed

Possible cause: Line break, short-circuit, resistor bank defective

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement		Corrective measures
Resistor bank	Measure resistance across	**Setpoint**	– Check lines – Check plug connections – If no fault found, replace resistor bank
	Pin 13 and pin 35	500 – 520 Ω	
	Pin 13 and pin 44	600 – 700 Ω	
	Pin 13 and pin 51	2.8 – 3.2 kΩ	
	Pin 13 and pin 54	500 – 520 Ω	

Fuel-delivery regulator

Flash code: 10x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Fuel delivery controller control deviation

Effect of fault: The setpoint – actual value comparison for activating the fuel delivery regulator has resulted in a control deviation which has exceeded a specified time threshold. This fault results in the engine being shut down. The engine can only be restarted when the fault is no longer present and the “ignition” is switched off and on again once.

Possible cause: Line break, short-circuit, injection pump defective (internal fault in control unit or stiff movement), capacitance reserve of line leading to control rod position transducer too low (see page 27)

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement	Corrective measures
Actuating solenoid	Measure resistance at socket box across pin 15 and pin 1 and pin 16 and pin 2 **Setpoints:** 0.7 – 1.3 Ω Measure resistance at socket box across pin 18 and pin 1 **Setpoint:** > 10 MΩ	– Check lines – Check plug connections – If no fault found, replace injection pump

Auxiliary rpm sensor

Flash code: 14x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

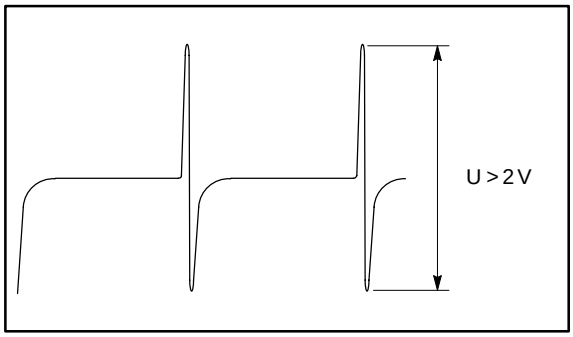
Fault path: Auxiliary rpm sensor
– Statically implausible
– Dynamically implausible
– Implausible with rpm sensor

Effect of fault: If the rpm sensor also fails, the engine will be shut down

Possible cause: Line break, short to ground, auxiliary rpm sensor defective, control unit defective

Test precondition: Disconnect EDC control unit to ensure the engine cannot start up
Socket box connected

Test	Measurement	Corrective measures
Resistance	Measure resistance at socket box across in 22 and pin 17 **Setpoint:** 500 – 700 Ω	– Check lines – Check plug connections – If no fault found, replace auxiliary rpm sensor
Engine speed signal	Check signal at socket box at starting speed across pin 22 (+) and pin 17 (–) with oscilloscope **Setpoint:** See figure	



Turbo air temperature sensor

Flash code: 1x long, 1x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Turbo air temperature sensor

Effect of fault: The substitute value provided in the control unit for such cases results in a reduction in power output (e.g. in the event of radiator contamination or failure of cooling system).

Possible cause: Line break, short-circuit, turbo air temperature sensor defective, control unit defective, failure or contamination of cooling system.

Test precondition: EDC control unit disconnected/connected
Socket box connected

Test	Measurement	Corrective measures
Sensor resistance (control unit disconnected)	Measure resistance at socket box across pin 34 and pin 13 **Setpoint:** 1.3 – 3.6 KΩ at 15 – 30°C	– Check lines – Check plug connections – Replace temperature sensor – Check cooling system – If no fault found, replace control unit
Sensor voltage (control unit connected)	Measure voltage at socket box across pin 34 and pin 13 **Setpoint:** 4.17 – 2.62 V at 10 – 50°C	

Undervoltage

Flash code: 1x long, 3x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Control unit power supply (battery voltage too low)

Effect of fault: The EDC system or the engine can behave in various ways depending on the magnitude of the voltage drop:
– No power
– Highly irregular engine operation
– No engine operation
– Excessive smoke emission
– Contradictory fault code memory entries

Possible cause: Battery discharged or defective, alternator defective, line break, short-circuit, main relay defective

Test precondition: EDC control unit disconnected
Socket box connected
“Ignition” switched on

Test	Measurement	Corrective measures
Power supply	To activate the main relay, connect jumper across pin 46 and pin 19 Measure voltage at socket box across pin 15/16 (+) and pin 18/19 (–) **Setpoint:** 24 – 28 V	– Check lines – Check plug connections – Replace main relay

Control unit

Flash code: 1x long, 6x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Control unit defective (processor coupling)

Effect of fault: Engine is shut down by “no power applied to fuel delivery output stage” and thus control position 0.
If this fault occurs only temporarily, the engine can be restarted by switching the “ignition” off and on again.

Possible cause: Undervoltage (loose contact), control unit defective

Test precondition: EDC control unit connected

Test	Measurement	Corrective measures
Control unit	This fault signal can also occur in the event of extremely low power supply (loose contacts or undervoltage)! Internal fault in control unit	– Check lines – Check plug connections – Replace control unit

Engine overspeed

Flash code: 1x long, 7x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Engine overspeed

Effect of fault: Fuel delivery is interrupted. EHAB is deactivated.
If no other fault is applicable, fuel delivery is continued on exiting engine overspeed.

Possible cause: Control rod moves stiffly. Injection pump defective, control unit defective, wiring harness defective

Test	Measurement	Corrective measures
Injection pump	If no other faults exist, no further action is necessary	– Delete fault code memory
	If the fault occurs frequently, check injection pump, control unit and lines	– Replace lines – Replace control unit – Replace injection pump

Operating unit for setting idle speed

Flash code: 1x long, 13x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Operating unit defective
– Voltage values incorrect or implausible

Effect of fault: Idle speed control can no longer be activated.
If the fault was only temporary (e.g. operating unit activated several times) the system will be ready for operation after switching the “ignition” off an on again.

Function The operating unit is resistor-coded, i.e. the control unit recognizes each switching state according to the voltage level supplied. Faults are detected when incorrect values are output over a certain period of time; e.g. electrical fault or multiple operation (incorrect operation) of the operating unit.

Possible cause: Line break, short-circuit, operating unit defective, incorrect operation

Test precondition: EDC control unit connected
Socket box connected
“Ignition” switched on

Test	Measurement	Corrective measures
Operating unit	Measure voltage at socket box across pin 44 and pin 13 Switch through all settings of the operating unit and determine relevant voltage value **Setpoints:** SET+: 0.65 – 0.97 V SET–: 2.31 – 2.75 V MEMORY: 1.41 – 1.81 V OFF: 4.00 – 4.32 V Not activated: 3.15 – 3.55 V	– Check lines – Check plug connections – Replace operating unit – If no fault found, replace control unit as a check

Main relay

Flash code: 2x long, 5x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Main relay
Contact sticks or jams (does not open)

Effect of fault: Under certain conditions this fault may not be detected

Function: The negative pole of the main relay is addressed by the EDC control unit through the control unit output pin 46. The main relay switch off is delayed after the “ignition” is switched off (afterrunning).
During the afterrunning phase, various processor functions are checked and any faults stored in the fault code memory.

Possible cause: Short to ground, main relay defective

Test precondition: EDC control unit connected
Socket box connected

Test	Measurement	Corrective measures
Main relay	Measure voltage at socket box across pin 47 and pin 18 **Setpoints:** 0 V at “ignition” off U_{batt} at “ignition” on Measure voltage at socket box across pin 46 and pin 18 **Setpoints:** U_{batt} at “ignition” off 0 V at “ignition” on	– Check lines – Check plug connections – If line OK, replace main relay

Note: Pin 46 must switch to U_{batt} with a delay of up to 5 seconds after turning off the “ignition” (processor afterrunning)

Atmospheric pressure sensor (in control unit)

Flash code: 2x long, 8x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Atmospheric pressure sensor in control unit defective

Effect of fault: No direct effect
In some cases, this may be accompanied by a turbo pressure sensor fault being signalled

Possible cause: Control unit defective

Test	Measurement	Corrective measures
Control unit	If only this fault code is stored in the memory, testing is not possible as the sensor is located in the control unit. If, however, a faulty turbo pressure sensor is also detected, it should be checked first in accordance with the turbo pressure sensor test (page 35).	– Replace control unit

Control unit (processor afterrunning)

Flash code: 3x long, 8x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Control unit
– Processor afterrunning did not take place

Effect of fault: No direct effect

Function Every time the engine is turned off, afterrunning takes place automatically for the purpose of checking the various processor functions.

Possible cause: Control unit defective, main relay defective, battery voltage switched off before “ignition” off

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement	Corrective measures
Control unit	Test same as for undervoltage (page 42) and main relay (page 46)	– Switch “ignition” on and off again, delete fault code – Same as pages 42 and 46 – Replace control unit

Other possible causes

– Engine was shut down via battery + (e.g. by disconnecting the battery or removing the fuse).
– Power supply fault (e.g. undervoltage, main relay defective, loose contact)

Control unit

Flash code: 3x long, 2x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Processor 1 in control unit defective

Possible cause: Control unit defective, EOL programming not completed (voltage supply interrupted)

Effect of fault: Engine is shut down
Engine will not start

Test	Measurement	Corrective measures
Power supply	No further test necessary	– Complete EOL programming, delete fault code – Replace control unit
Control unit		

Flash code: 3x long, 3x short

Fault indication: Fault indicated by steady light EDC indicator lamp

Fault path: Processor 2 in control unit defective

Possible cause: Control unit defective, EOL programming not completed (voltage supply interrupted)

Effect of fault: Engine is shut down
Engine will not start

Test	Measurement	Corrective measures
Power supply	No further test necessary	– Complete EOL programming, delete fault code – Replace control unit
Control unit		

Flash code: 3x long, 9x short

Fault indication: Fault indicated by steady light at EDC indicator lamp

Fault path: Control unit defective (watchdog test)

Effect of fault: Reduced full load delivery volume
Reduced final engine speed

Test	Measurement	Corrective measures
Control unit	No further test necessary	– Replace control unit

Request button (brake)

Flash code: 1x long, 4x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Request button

Effect of fault: This fault has no direct effect

Possible cause: Line break, request button defective

Test precondition: EDC control unit connected
Socket box connected
“Ignition” switched on

Test	Measurement	Corrective measures
Request button (brake)	Measure voltage at socket box across pin 43 (+) and pin 19 (–) Button depressed: U_{batt} Button not depressed: 0	– Check lines – Check plug connections – Replace button

PBM interface

Flash code: No code

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Control unit input pin 52
– Faulty
– Interrupted

Effect of fault: No PBM signal at pin 29 (steady voltage U_{batt})

Possible cause: short to negative, line break

Test precondition: EDC control unit connected
Socket box connected
“Ignition” switched off

Test	Measurement	Corrective measures
Lines	Measure resistance at socket box across pin 52 and pin 19 **Setpoint:** ∞ Ω	– Check lines – Check plug connections
	Measure resistance at socket box across pin 29 and pin 19 **Setpoint:** ∞ Ω	– Check lines – Check plug connections

Note:
Battery voltage must be applied at pin 52 against pin 18/19 with the “ignition” switched on.

Electrohydraulic shut-off device EHAB

Flash code: No code

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: EHAB function

Effect of fault: Engine is shut down
Engine will not start
(In this case, it is assumed that the fuel supply is OK)

Function: The EHAB performs an important safety function in its capacity as an independent, higher-ranking (redundant) engine shut-off device. The EHAB is activated in certain emergency situations when the engine can no longer be shut off by controlling fuel delivery to zero – e.g. control rod jammed.
The EHAB reduces the pressure in the suction chamber of the injection pump thus interrupting filling.

Possible cause: Line break, short-circuit, EHAB defective, faulty activation from control unit (control unit defective)

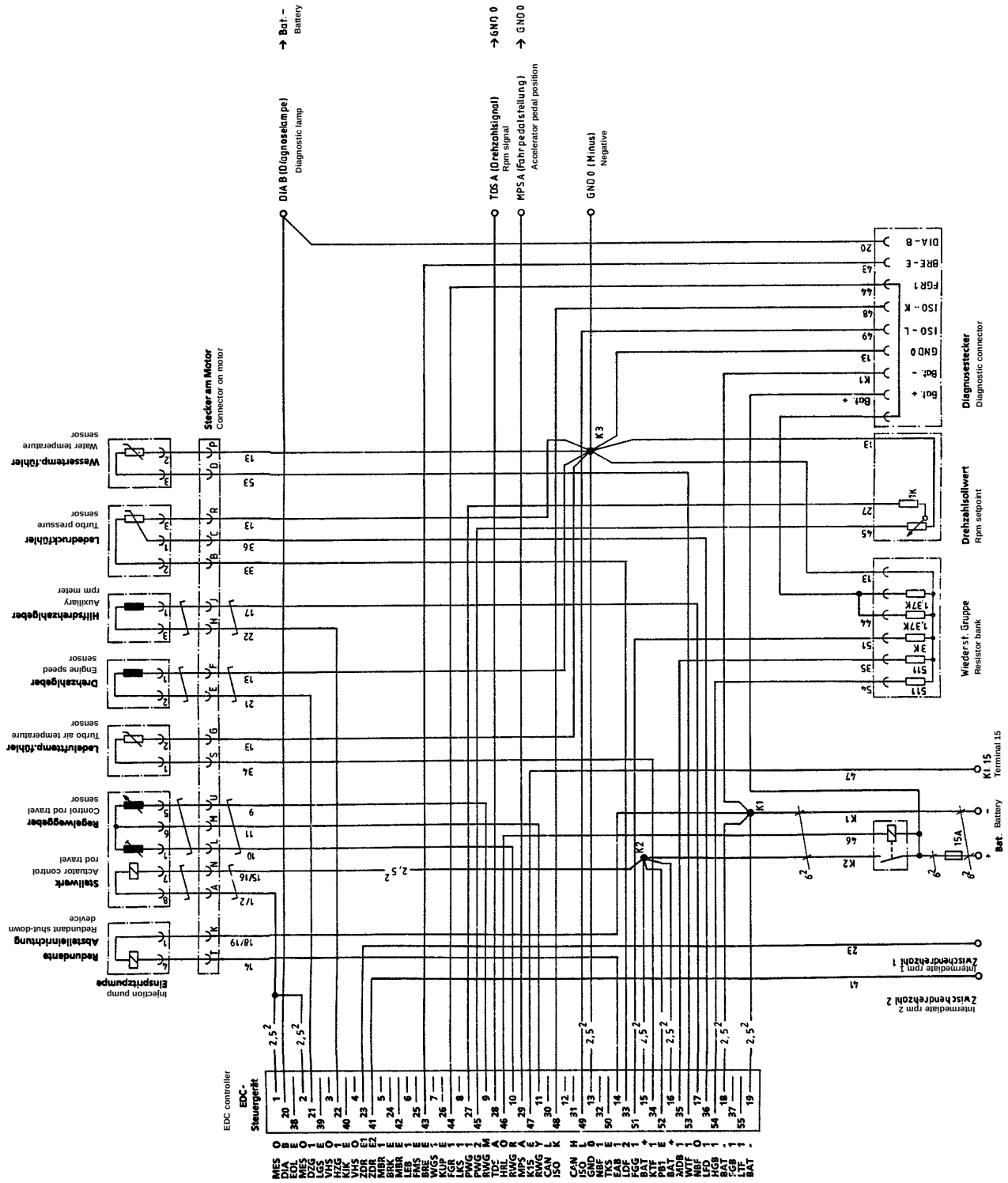
Test precondition: EDC control unit connected
Socket box connected

Test	Measurement	Corrective measures
Coil resistance	"Ignition" switched off Control unit disconnected Measure resistance at socket box across pin 14 and pin 19 **Setpoint:** 30 – 70 Ω	– Check line – Check plug connection – Replace EHAB
Power supply	Turn on "ignition" Measure voltage at socket box across pin 14 (+) and pin 19 (–) **Setpoint:** U_{batt}	– Check line – Check plug connection – Replace EHAB If no fault is found: – Replace control unit

Note:
Power must be applied to the EHAB when bleeding the fuel system by means of presupply pump, i.e. **the fuel system cannot be bled without the "ignition" being switched on!**
See page 27 for function test.

Pin No.	Abbreviation	Description		
1	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	I_{max} 11 A temporarily, on average 4.5 A, against batt.+, pulsed f=variable, pulse-width modulated
2	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	
3	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit	I_{max} 6 A temporarily, on average 3 A, against batt.+, pulsed, f approx. 200 Hz, pulse-width modulated
4	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit	
5	MBR 1	Engine brake actuator	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt.–,
6	LEB 1	Air injection	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt. –,
7	WGS 1	Waste gate	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
8	LKS 1	Intercooler bypass	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
9	RWG M	Control rod position transducer measuring coil (RWG 2)	Control rod position evaluator circuit	
10	RWG R	Control rod position transducer reference coil (RWG O)	Control rod position evaluator circuit	
11	RWG Y	Control rod position transducer centre pick-off (RWG 1)	Control rod position evaluator circuit	
12	CAN O	Reference ground for CAN H/L		
13	GND-A	Sensor ground		
14	EAB 1	Electrical shut-down	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
15	Batt +	Batt.+ via main relay	Input battery +	I with engine stationary 0.9 A, idle speed 1.5 A, operation 4.5 A, temporarily 16 A
16	Batt +	Batt.+ via main relay	Input battery +	
17	NBF 0, HZGO	Needle movement sensor and auxiliary rpm sensor	Reference ground	
18	Batt.–	Battery negative	Input battery –	Same as batt.+ (terminals 15 and 16)
19	Batt.–	Battery negative	Input battery –	
20	DIA-B	Diagnosis lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
21	DZG 1	RPM sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. XN sec.$^{-1}$
22	HZG 1	Auxiliary rpm sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. XN sec.$^{-1}$
23	ZDR-E1	Intermediate engine speed control 1	‹Input, static	Batt. +
24	BRK-E	Brake switch signal	Input, static	Batt. +
25	FMS-E	Function-mode switch FGR/FGB	Input, static	Batt. +
26	KUP-E	Clutch switch signal	Input, static	Batt. +
27	PWG 1	Pedal position sensor signal	Input, analog	Direct voltage, U approx. 0.4 to 4 V
28	TDS-A	Engine speed signal	Output	$U_{batt.}$ against batt. –, square-wave signal, f=number of cyl. X N sec.$^{-1}$
29	MPS-A	Multiplex signal	Interfaces	
30	CAN-L	Controller Area Network	Interfaces	
31	CAN-H	Controller Area Network	Interfaces	
32	NBF 1	Needle movement sensor	Input, dynamic	U_{pp} approx. 2 V
33	LDF 2	Turbo pressure sensor	Output, supply	Controlled direct voltage, U approx. 5 V
34	KTF 1	Fuel temperature sensor (used for turbo air temperature)	Input, analog	

Pin No.	Abbreviation	Description		
35	MDB 1	Multi-stage input (torque limitation)	Input, analog	Input by change in resistance
36	LDF 1	Boost pressure sensor signal	Input, analog	
37	FGB 1	Driving speed limit lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –
38	EOL E	Input, static		
39	LGS-E	Idle speed switch signal	Input, static	against GND-O (terminal 13)
40	KIK-E	Kick-down switch	Input, static	Batt. +
41	ZDR-E2	Intermediate engine speed control 2	‹Input, static	Batt. +
42	MBR-E	Engine brake signal	Input, static	Batt. +
43	BRE-E	Brake switch signal	Input, static	Batt. +
44	FGR 1	Analog driving speed operating unit	Input	Input by change in resistance
45	PWG 2	Pedal position sensor	Output, supply	Controlled direct voltage, U approx. 5 V
46	HRL O	Main relay	Output (switch)	I_{max} 0.3 A, batt. – against batt.+
47	K15-E	Terminal 15, digit. Data for control unit	Input, static	Batt. +
48	ISO-K	ISO-K link to ISO protocol	Interfaces	
49	ISO-L	ISO-L link to ISO protocol	Interfaces	
50	TKS-E	Door contact switch	Input, static	Batt. +
51	FGG 1	Driving speed sensor signal	Input, dynamic	Square-wave voltage U_{pp} 8.5 V, f=variable
52	PB1-E	Pulse-width modulated input signal 1	Interface	
53	WTF 1	Coolant temperature sensor	Input, analog	
54	HGB 1	Multi-stage input, maximum speed limitation	Input, analog	Input by change in resistance


→ Bat. -
Battery
→ GND 0
→ GND 0
DIA B (Diagnoselampe)
Diagnostic lamp
TOS A (Drehzahlsignal)
Rpm signal
MPS A (Fahrpedalstellung)
Accelerator pedal position
GND 0 (Minus)
Negative
Stecker am Motor
Connector on motor
Diagnosestecker
Diagnostic connector
Drehzahlsollwert
Rpm setpoint
Wiederst. Gruppe
Resistor bank
Terminal 15
Bat. Battery
Intermediate rpm 1
Intermediate rpm 2
EDC controller
EDC-Steuergerät
Einspritzpumpe
Injection pump
Redundanz Abstelleinrichtung
Redundant shut-down device
Stellwerk
Actuator control rod travel
Regelweggeber
Control rod travel sensor
Ladelufttemp.fühler
Turbo air temperature sensor
Drehzahlgeber
Engine speed sensor
Hilfsdrehzahlgeber
Auxiliary rpm meter
Ladedruckfühler
Turbo pressure sensor
Wassertemp.fühler
Water temperature sensor

Electronic Diesel Control
Rating data sheet

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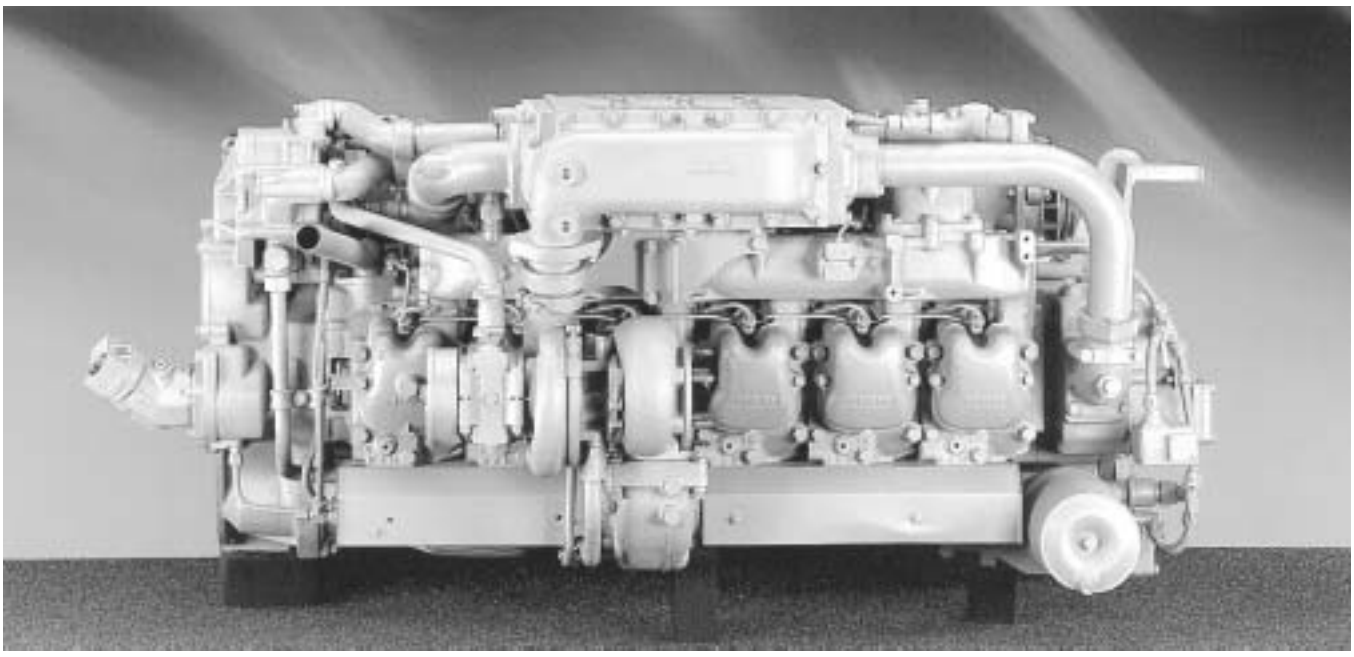


Contents Page

1. Revision list

No.	Date	Revisions
0	30.05.94	First issue

2. Scope

This data sheet comprises the specifications and tests for the electronic control unit EDC – M(S) 5 required to guarantee the functions listed in the following under the specified ambient conditions.

3. General features

3.1	Place of installation:	Frame (chassis)
3.2	Electrical connection:	55-pin plug connection
3.3	Weight:	approx. 1.4 kg
3.4	Degree of protection	
	Protection against shock-hazard and foreign bodies	in accordance with DIN 40 050, Part 9; IP 54 A
	Protection against water ingress with connector plugged in	in accordance with DIN 40 050, Part 9; IP 54 A

4. Temperature range

Ta: Temperature of mounting surface
Tu: Temperature of ambient air

4.1 Storage temperature

Permanent, not installed	–40°C ... +85°C
Temporary, max. 1h in installed position	–40°C ... +100°C

4.2 Operating temperature

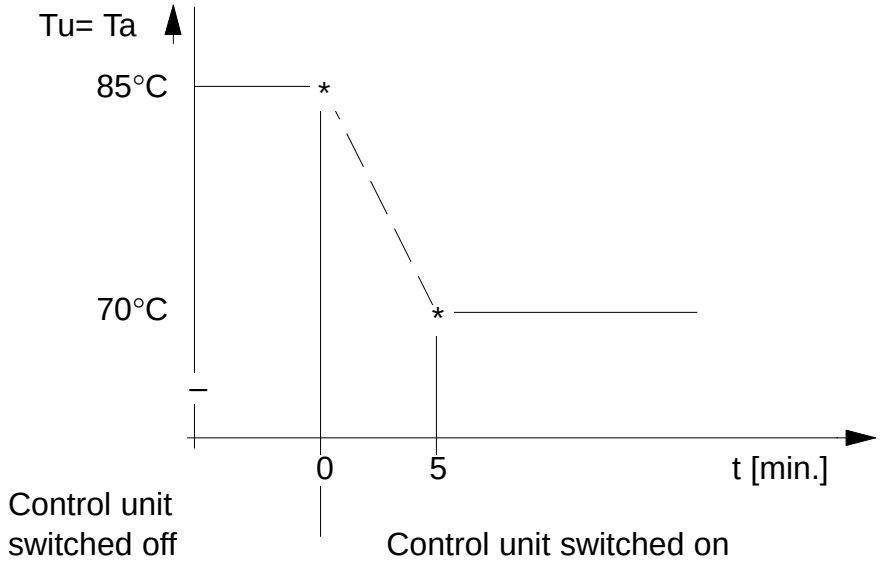
Still air:

Ambient temperature Tu, permanent	–40°C ... +65°C
Mounting surface Ta, permanent	–40°C ... +65°C

Moving air:

Ambient temperature Tu, permanent	–40°C ... +70°C
Mounting surface Ta, permanent	–40°C ... +70°C

Tu =Ta, temporary –40°C ... –85°C
See diagram:



5. Mechanical characteristics:

5.1 Vibration stress:

5.1.1	Sinusoidal vibration test in accordance with	DIN 40046 Part 8 ,Fc (IEC 68-2-6)
	Max. acceleration amplitude	50 m/s^2
	Frequency range:	10 Hz ... 200 Hz
	Frequency change rate:	1 oct./min.
	Test duration:	24 h per main coordinate
5.1.2	Broadband noise test in accordance with	DIN 40046 Part 22 ,Fd (IEC 68-2-34)
	Total acceleration (effective value):	45 m/s^2
	Frequency range:	10 Hz ... 1000 Hz
	Test duration:	24 h per main coordinate

5.2 Shock stress

Test in accordance with	DIN 40046 Part 7, (IEC 68-2-27)
Acceleration amplitude	max. 1000 m/s^2
Shock form:	Semi-sinusoidal
Duration of nominal shock:	6 ms
Test duration	3 shocks per main coordinate in both directions (18 shocks)

The frequency and acceleration value specified in 5.1 and 5.2 apply to the vibration testing table.

6. Electrical ratings

6.1 Supply voltage range

6.1.1	Rated voltage:	24 V
6.1.2	Permissible supply voltage (measured at the batt.+, batt.– terminals of the control unit)	7.0 ... 32 V normal operation min. 16 V for 50 ms after switching on the control unit

The definition provided in Section 7 applies to the voltages $U_{batt+} \leq 7$ V or $U_{batt-} \geq 32$ V.

6.1.3 Residual ripple of supply voltage:

Operation without battery not permitted.

Effective value of supply voltage: U-batt eff = 500 mV max.

(Measured at the batt+, batt– terminals of the control unit with the control unit switched on and the engine running.
The value need not be maintained during the start procedure)

6.2	Power loss, control unit (idle speed, engine at operating temperature)	approx. 18 W
6.3	Polarity reversal protection:	By coded control unit connector, polarity reversal of battery does not result in destruction of control unit when the main relay is activated by the control unit.

6.4 Short-circuit strength

Conditions: Max. 1 short-circuit simultaneously, Ta and Tu ≤65°C, U-batt ≤28V, control unit is powered with U-batt.	For all plug connections against batt+, batt– and against one another except for: BATT+, BATT–, GND 0. NBF 0. CAN H and L Restricted: RWGR. RWGM. RWGY short-circuit at max. 26 V permissible for max. duration of 1 min.

7. Immunity to interference

Pulses in accordance with ISO 7637-2 are permitted on the batt+/batt– line if they are within the following rated values.
The control unit can switch off as a precautionary measure in the case of supply voltages outside the range 7 V ≤ U_{batt+} ≤ 32 V.
The function is resumed on returning to the permissible voltage range.

7.1 ISO pulses 1 to 4

Test pulse	Vs [Volt]	Ri [Ohm]	tl [s]	Number of pulses	Test duration [h]
1a	–200	10	5	5 000	–
2	+100	10	0.5	5 000	–
3a	–200	50	100µ	–	1
3b	+200	50	100µ	–	1

7.2 ISO pulse 5 (load dump)

Vs = 57 V Ri = 2 Ω td = 200 ms (at +Ubatt = 28V)

Set-up temperature: Ta ≤ 65°C
Ambient air: Tu ≤ 65°C

Minimum wait time between subsequent pulses: 1 min

Number of pulses: 10

Voltage limitation by the internal load dump feature cuts in at min. 34 V.

7.3 EMC:

7.3.1 Irradiation immunity:

Frequency range:	100 kHz ... 1000 MHz (measure up to 400 MHz)
Field strength:	100 V/m sinusoidal, non-modulated (stripline measurement)
Criterion:	Engine overrevving or shutting down not permitted. Accuracy deviation permissible.

Note:
The surface of the control unit housing must be connected to the body ground.

7.4	Interference suppression:	In accordance with VDE 0879 Part 3, interference suppression level 2

8. Resistance to motor vehicle-specific liquids/fluids

The control unit is resistant to diesel fuel, petrol, engine oil, engine cleaner, brake fluid, battery acid, windscreen washer fluid, isooctane/toluene

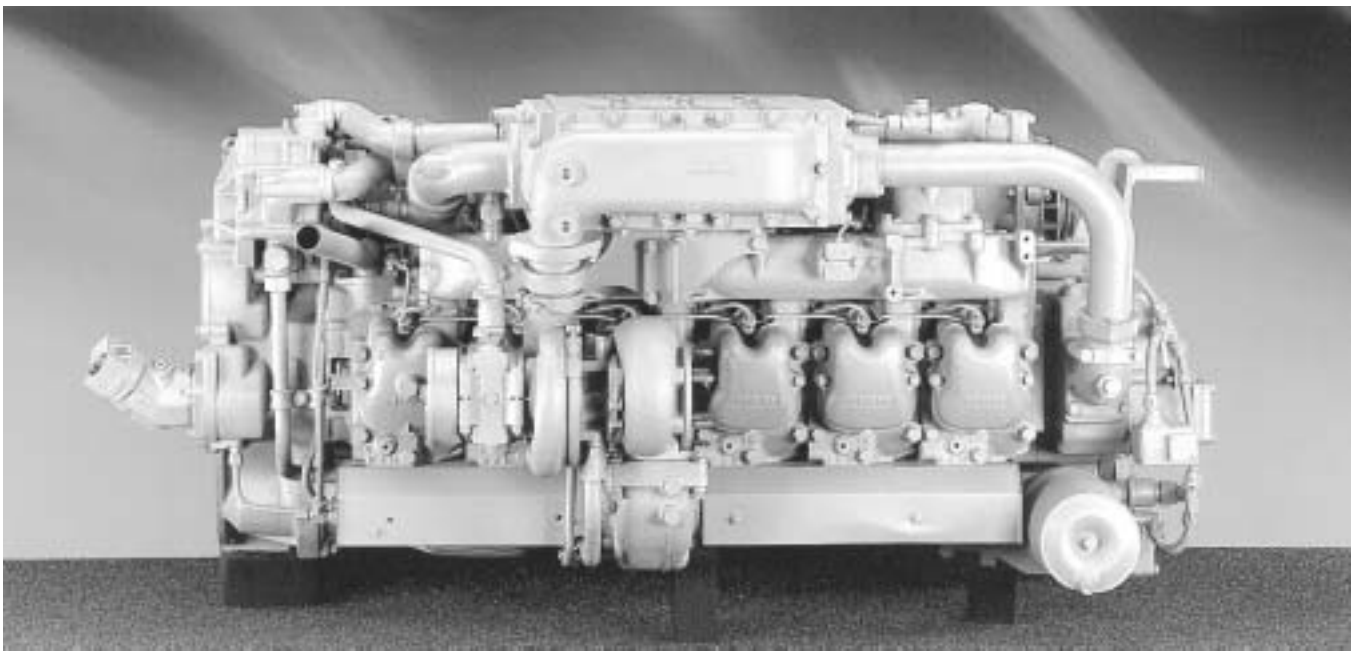
9.	Mechanical test data:	
9.1	Vibration stress:	As Point 1
9.2	Shock stress	As Point 5.2
9.3	Alternating temperature	
	Test Nb in accordance with DIN 40046 Part 14 Clause 3 (IEC 68-2-14 Nb)	
	Lower test temperature:	–40°C
	Upper test temperature:	+85°C
	Number of cycles:	100
	Temperature change rate:	≤ 10 K/min
	Holding time at upper stress temperature:	15 minutes each
9.4	Moisture resistance	
9.4.1	Test in accordance with DIN standard	
	Test Db in accordance with	FW 24 DIN 50016 (IEC 68-2-30)
	Number of cycles:	28
	Function test after	7 cycles
9.4.2	Active moisture-alternating temperature test	
	Rel. humidity	95%
	Normal temperature phase at	40°C
	Duration:	240 h
	Low temperature phase at	–10°C
	Duration:	2 h
	Changeover time:	≤ 3 min

10. Service life test:

The service life test comprises a mechanical test in accordance with Points 5.1 and 5.2 as well as a climatic test in accordance with Points 9.3 and 9.4. Function measurements in accordance with the test and adjustment specifications are conducted after the individual tests.

Electronic Diesel Control
Guidelines for Preparing Wiring Harnesses

EDC M(S) 5



Contents Page

Pin No.	Abbreviation	Description		
1	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	I_{max} 11 A temporarily, on average 4.5 A, against batt.+, pulsed, f=variable, pulse-width modulated
2	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	
3	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit	I_{max} 6 A temporarily, on average 3 A, against batt.+, pulsed, f approx. 200 Hz, pulse-width modulated
4	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit	
5	MBR 1	Engine brake actuator	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt. –,
6	LEB 1	Air injection	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt. –,
7	WGS 1	Waste gate	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
8	LKS 1	Intercooler bypass	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
9	RWG M	Control rod position transducer measuring coil (RWG 2)	Control rod position evaluator circuit	
10	RWG R	Control rod position transducer reference coil (RWG O)	Control rod position evaluator circuit	
11	RWG Y	Control rod position transducer centre pick-off (RWG 1)	Control rod position evaluator circuit	
12	CAN O	Reference ground for CAN H/L		
13	GND-A	Sensor ground		
14	EAB 1	Electrical shut-down	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
15	Batt +	Batt. + via main relay	Input battery +	I with engine stationary 0.9 A, idle speed 1.5 A, operation 4.5 A, temporarily 16 A
16	Batt +	Batt. + via main relay	Input battery +	
17	NBF 0, HZGO	Needle movement sensor and auxiliary rpm sensor	Reference ground	
18	Batt –	Battery negative	Input battery –	Same as batt.+ (terminals 15 and 16)
19	Batt –	Battery negative	Input battery –	
20	DIA-B	Diagnosis lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
21	DZG 1	RPM sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. X N $sec.^{-1}$
22	HZG 1	Auxiliary rpm sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. X N $sec.^{-1}$
23	ZDR-E1	Intermediate engine speed control 1	Input, static	Batt. +
24	BRK-E	Brake switch signal	Input, static	Batt. +
25	FMS-E	Function-mode switch FGR/FGB	Input, static	Batt. +
26	KUP-E	Clutch switch signal	Input, static	Batt. +
27	PWG 1	Pedal position sensor signal	Input, analog	Direct voltage, U approx. 0.4 to 4 V
28	TDS-A	Engine speed signal	Output	$U_{batt.}$ against batt. –, square-wave signal, f=number of cyl. X N $sec.^{-1}$
29	MPS-A	Multiplex signal	Interfaces	
30	CAN-L	Controller Area Network	Interfaces	
31	CAN-H	Controller Area Network	Interfaces	
32	NBF 1	Needle movement sensor	Input, dynamic	U_{pp} approx. 2 V
33	LDF 2	Turbo pressure sensor	Output, supply	Controlled direct voltage, U approx. 5 V
34	KTF 1	Fuel temperature sensor (used for charge air temperature)	Input, analog	
35	MDB 1	Multi-stage input (torque limitation)	Input, analog	Input by change in resistance
36	LDF 1	Turbo pressure sensor signal	Input, analog	
37	FGB 1	Driving speed limit lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –
38	EOL E	Input, static		
39	LGS-E	Idle speed switch signal	Input, static	against GND-O (terminal 13)

Pin No.	Abbreviation	Description		
40	KIK-E	Kick-down switch	Input, static	Batt. +
41	ZDR-E2	Intermediate engine speed control 2	Input, static	Batt. +
42	MBR-E	Engine brake signal	Input, static	Batt. +
43	BRE-E	Brake switch signal	Input, static	Batt. +
44	FGR 1	Analog driving speed operating unit	Input	Input by change in resistance
45	PWG 2	Pedal position sensor	Output, supply	Controlled direct voltage, U approx. 5 V
46	HRL O	Main relay	Output (switch)	I_{max} 0.3 A, batt. – against batt.+
47	K15-E	Terminal 15, digit. Data for control unit	Input, static	Batt. +
48	ISO-K	ISO-K link to ISO protocol	Interfaces	
49	ISO-L	ISO-L link to ISO protocol	Interfaces	
50	TKS-E	Door contact switch	Input, static	Batt. +
51	FGG 1	Driving speed sensor signal	Input, dynamic	Square-wave voltage U_{pp} 8.5 V, f=variable
52	PB1-E	Pulse-width modulated input signal 1	Interface	
53	WTF 1	Coolant temperature sensor	Input, analog	
54	HGB 1	Multi-stage input, maximum speed limitation	Input, analog	Input by change in resistance

2. Key to definitions

C_{EMC}: EMC capacitor

f: Frequency

F_{abs}: Absolute error

I_o: Output current

KS: Short-circuit

LL: Idle speed

R_{pu}: Pull-up resistor
R_q: Shunt
R_{pd}: Pull-down resistor
R_{in}: Input resistance
R_{Gen}: Internal alternator resistance

S_n: Threshold correction

t_r: Rise time
t_f: Fall time
t_0: Dead time for detecting signal 0 passage from high to low between connector pin and processor

τ: Time constant
τ_{AL}: Charge time constant
τ_{EL}: Discharge time constant

U_o: Output voltage
U_L: Switching threshold for logical LOW
U_H: Switching threshold for logical HIGH
U_{Hys}: Hysteresis
U_{Gr}: Basic threshold
U_{LL}: Idle speed voltage
U_R: Reference voltage of ADC, U_R=5V $\pm$ 4%
U_{in}: Input voltage
U_{inz}: Minimum or maximum permissible input voltage
U_{off}: Cutout threshold
U_{oLK}: Short-circuit at output set to logical LOW
U_{oHK}: Short-circuit at output set to logical HIGH

3. General information

The control unit must be connected in accordance with circuit diagram 51.17099-8087 together with the assemblies belonging to the system.

If not otherwise specified, all inputs and outputs are short-circuit-proof to ground and $+U_{batt} \leq 28$ V, $T_U \leq 65°C$.

Operation without the battery is not permitted.

The control unit may be damaged as the result of the increased power loss in the event of a short-circuit in more than two plug connections against on another or against the supply voltage.

Supply voltages and ground connections are not short-circuit-proof and are not protected against polarity reversal.

If not otherwise specified, all values apply in the temperature and voltage range as specified by TKU.

Control unit supply:
BATT+ across pin 15, 16 (connected internally, must be connected externally)
BATT– across pin 18, 19 (connected internally, must be connected externally)

The time constant values τ apply at an internal alternator resistance of 0Ω.

The current directions are defined in accordance with the load count system:
Positive currents flow into the control unit.
Negative currents flow out of the control unit.

If not otherwise specified, the working range for analog inputs is from 0 .. U_R.

Data acquisition accuracy is always referred to $U_{Rnominal}$ =5.000V

4. Description of inputs and outputs

4.1 Analog inputs

Plug connection: 27 Function group: Analog input

Connector designation: PWG 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	97	100	103
Idle speed voltage	U_{LL}		V		GND 0	
Input filter	τ	R_{Gen}=0Ω	m_s	0.9	1.5	2.1
Input voltage						
Evaluation range	U_{inz}		V	0.1		U_R–0.1
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±2

Remarks:

– The data acquisition accuracy is based on radiometric signal processing with sensor supply PEG 2.

Plug connection: 45 Function group: Sensor supply, short-circuit-proof

Connector designation: PWG 2

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage	U_o	$I_{o\leq}$–10 mA	V	U_R–0.01	U_R=5V	U_R+0.01
Output short-circuit current	[I_k]	U_o=0V	mA	10		25

Remarks:

Plug connection: 44 Function group: Analog input

Connector designation: FGR 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	0.301	0.307	0.313
Idle speed voltage	U_{LL}		V		U_R	
Input filter	τ	R_{Gen}=0Ω	m_s	0.9	1.5	2.1
Input voltage						
Evaluation range	U_{inz}		V	0.1		U_R–0.1
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±3.5

Remarks:

Plug connection:	35	Function group:	Analog input
Connector designation:	MDB 1	Reference ground:	GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	2.0	2.05	2.1
Idle speed voltage	U_{LL}		V		U_R	
Input filter	τ	R_{Gen}=0Ω	m_s	0.3	0.5	0.7
Input voltage						
Evaluation range	U_{inz}		V	0.3		U_R
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±2.0

Remarks:

Plug connection: 54 Function group: Analog input

Connector designation: HGB 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	2.0	2.05	2.1
Idle speed voltage	U_{LL}		V		U_R	
Input filter	τ	R_{Gen}=0Ω	m_s	0.9	1.5	2.1
Input voltage						
Evaluation range	U_{inz}		V	0.1		U_R–0.1
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±2.5

Remarks:

Plug connection:	36	Function group:	Analog input
Connector designation:	LDF 1	Reference ground:	GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	Range U_{in}	kΩ	96	100	104
Idle speed voltage	U_{LL}		V		GND 0	
Input filter	τ	R_{Gen}=0Ω	m_s	43	73	100
Input voltage						
Evaluation range	U_{inz}		V	0.1		U_R–0.1
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			+1.3 –2.0

Remarks:

- The data acquisition accuracy is based on radiometric signal processing with sensor supply LDF2 (at LDF 2= U_R)
- The data acquisition accuracy was determined by quadratic addition of individual faults

Plug connection: 33 Function group: Sensor supply, short-circuit-proof

Connector designation: LDP 2

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage	U_o	$I_o \leq -30$ mA	V	$U_R-0.02$	U_R	$U_R+0.02$
Output short-circuit current	$[I_k]$	$U_o=0$V	mA	30		78

Remarks:

Plug connection:	53	Function group:	Analog input
Connector designation:	WTF 1	Reference ground:	GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	0.735	0.752	0.765
Idle speed voltage	U_{LL}		V		U_R	
Input filter	τ	R_{Gen}=0Ω	m_s	0.3	0.5	0.7
Input voltage						
Evaluation range	U_{inz}		V	0.3		U_R
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±0.9

Remarks:

- The data acquisition accuracy is based on radiometric signal processing with sensor applied to GND 0.
- The data acquisition accuracy was determined by quadratic addition of individual faults

Plug connection: 34 Function group: Analog input

Connector designation: KTF 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}	U_{in}	kΩ	0.735	0.75	0.765
Idle speed voltage	U_{LL}		V		U_R	
Input filter	τ	R_{Gen}=0Ω	m_s	0.3	0.5	0.7
Input voltage						
Evaluation range	U_{inz}		V	0.3		U_R
Data acquisition accuracy ΔU_{in} from input pin up to number of processors	F_{abs}	U_{in} is in range of U_{inz}	%			±2

Remarks:

– The data acquisition accuracy is based on radiometric signal processing with sensor applied to GND 0.

4.2 Digital inputs, static

Plug connection: 39 Function group: Digital input

Connector designation: LGS-E Reference ground: BATT– (18, 19)

Description of input

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.2
Input resistance		R_{in}		kΩ	46	50	54
Idle speed voltage		U_{LL}		V		U_R	
Input filter		τ	R_{Gen}=0Ω	m_s		0.8	
Input voltage							
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L			1.85		
	High	U_H					3.15
Switching hysteresis		U_{HYS}				0	

Remarks:

Plug connection: 23 Function group: Digital input

Connector designation: ZDR-E1 Reference ground: BATT– (18, 19)

Description of input

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.2
Input resistance		R_{in}		kΩ	2.4	2.5	2.6
Idle speed voltage		U_{LL}		V		BATT–	
Input filter		τ	R_{Gen}=0Ω	m_s		0.93	
Pull-down against BATT–		R_{pd}		kΩ		2.7	
Input voltage							
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω	V	4.5		
	High	U_H		V			7.0
Switching hysteresis		U_{HYS}	R_{Gen}=0Ω	V		0	

Remarks:

Plug connection:	41	Function group:	Digital input
Connector designation:	ZDR-E2	Reference ground:	BATT– (18, 19)

Description of input

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.2
Input resistance		R_{in}		kΩ	2.4	2.5	2.6
Idle speed voltage		U_{LL}		V		BATT–	
Input filter		τ	R_{Gen}=0Ω	m_s		0.93	
Pull-down against BATT–		R_{pd}		kΩ		2.7	
Input voltage							
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω	V	4.5		
	High	U_H		V			7.0
Switching hysteresis		U_{HYS}	R_{Gen}=0Ω	V		0	

Remarks:

Plug connection: 43 Function group: Digital input

Connector designation: BRE-E Reference ground: BATT– (18, 19)

Description of input

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.2
Input resistance		R_{in}		kΩ	2.4	2.5	2.6
Idle speed voltage		U_{LL}		V		BATT–	
Input filter		τ	R_{Gen}=0Ω	m_s		0.70	
Pull-down against BATT–		R_{pd}		kΩ		2.7	
Input voltage							
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω	V	3.5		
	High	U_H		V			5.5
Switching hysteresis		U_{HYS}	R_{Gen}=0Ω	V		0	

Remarks:

4.3 Digital inputs, dynamic

Plug connection: 21 Function group: Inductive sensor input

Connector designation: DZG 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}		kΩ	4.55	4.65	4.75
Idle speed voltage	U_{LL}		V		GND 0	
Input filter	τ	R_{Gen}=0Ω	m_s		1.5	
Input voltage range	U_{in}	Amplitude at t_p/T=0.1	V_s	0.5		100
Basic threshold	U_{Gr}		V		0.225	
Threshold correction in % of U_{in}	S_n		%		40	
Discharge constant	τ_{EL}		ms		250	
Dead time for detecting 0 passage (H->L) of input signal up to processor	t_o		µs			5

Remarks:

Plug connection: 22 Function group: Inductive sensor input

Connector designation: HZG 1 Reference ground: GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}		kΩ	4.55	4.65	4.7
Idle speed voltage	U_{LL}		V		GND 0	
Input filter	τ	R_{Gen}=0Ω	m_s		1.5	
Input voltage range	U_{in}	Amplitude at t_p/T=0.1	V_s	0.5		100
Basic threshold	U_{Gr}		V		0.4	
Threshold correction in % of U_{in}	S_n		%		40	
Discharge constant	τ_{EL}		ms		250	
Dead time for detecting 0 passage (H->L) of input signal up to processor	t_o		µs			5

Remarks:

Plug connection:	51	Function group:	Digital input
Connector designation:	FGG 1	Reference ground:	GND 0 (13)

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}		kΩ	4.6	4.85	5.1
Idle speed voltage	U_{LL}	$[I_{in}]$=0 mA	V		4.8	
Input filter	τ	R_{Gen}=0Ω	m_s		2	
Pull-up against 8.5 V	R_{pu}		kΩ		5.11	
Input voltage						
Permissible range	U_{in}		V	0		BATT+
Minimum input signal	U_{Emin}	$t_r=t_f<10$ ms	V_{pp}	2		
R_i acquisition						
Short-circuit detection $+U_{Batt}$	U_{in}	R_{Gen}=0Ω	V	8.5	28	
Short-circuit detection – U_{Batt}	U_{in}	R_{Gen}=0Ω	V		0	0.5

Remarks:

4.4 Switch outputs

Plug connection: 14 Function group: Output stage switching to BATT+

Connector designation: EAB 1

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage	U_o	at 2A	V	BATT+		BATT+
Output current	I_o	Output stage enabled	A			2
		Output stage disabled	mA			5
Current limitation	I_{oK}		A			12
Switching edges		I_L=2A				
Rise time	t_r		µs	3		150
Fall time	t_f		µs	3		150

Remarks:

4.5 Interfaces

Plug connection: 29 Function group: Interface

Connector designation: MPS-A Reference ground: GND 0 (13)

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage						
HIGH status	U_o	at R_L=200 ϰΩ		BATT+ –0.5 V		BATT+
LOW status		I_o=20 mA	V			1.3
Pull-up against BATT+	R_{PU}		kΩ	2.4	2.55	2.7
Short-circuit current	I_{oLK}	Short to BATT+	mA	65		150
Switching edges		R_L=10 kΩ C_L=10 nF				
Rise time	t_r		µs		10	70
Fall time	t_f		µs		1	

Remarks:

Plug connection: 20 Function group: Interface

Connector designation: DIA-B Reference ground: BATT– (18, 19)

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
Input						
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}		kΩ	45		125
Idle speed voltage	U_{LL}		V		0.2	0.5
Input filter	τ	R_{Gen}=0Ω	µs		28	
Permissible range	U_{in}		V	0		BATT+
Switching thresholds Low	U_L	R_{Gen}=0Ω	V	4		
High	U_H		V			8
Switching hysteresis	U_{Hys}	R_{Gen}=0Ω	V		1.5	
Output						
Output voltage (Low)	U_o	at 1 A	V	BATT+ –1.5 V		BATT+
Output current	I_o	Output stage enabled	A			1
		Output stage disabled	mA			5
Current limitation	I_{oK}		A			12
Switching edges						
Rise time	t_r	I_L=1A	µs	3		150
Fall time	t_f		µs	3		150

Plug connection:	48, 49	Function group:	Interface
Connector designation:	ISO-K/ISO-L 1	Reference ground:	BATT– (18, 19)

Description ISO K (48)

Input (when Tx=High, i.e. output stage disabled)

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
Input							
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.0
Input resistance		R_{in}		kΩ	20		22
Idle speed voltage		U_{LL}		V		BATT+	
Input filter		τ	R_{Gen}=0Ω	µs		0.08	
Battery voltage range		BATT+		V	8.5		32
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω	%BATT+	40		
	High	U_H		%BATT+			60
Output							
Output voltage		U_o	at 33 mA	V			0.6
Output current		I_o	Output stage enabled	mA			35
			Output stage disabled	mA			0.1
Short-circuit current shut-down		I_{oK}		mA	63		

Description ISO L (49)

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.0
Input resistance		R_{in}		kΩ	20		22
Idle speed voltage		U_{LL}		V		BATT+	
Input filter		τ	R_{Gen}=0Ω	µs		0.08	
Battery voltage range		BATT+		V	8.5		32
Permissible range		U_{in}		V	0		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω	%BATT+	40		
	High	U_H		%BATT+			60

Plug connection: 52 Function group: Interface

Connector designation: PB1-E Reference ground: GND 0 (13)

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Input resistance	R_{in}		kΩ	31.0	31.5	32.0
Idle speed voltage	U_{LL}	BATT+= 28 V	V		0	
Input filter	τ	R_{Gen}=0Ω	µs		7	
Pull-down against BATT–	R_{pd}		kΩ		39.7	
Input voltage						
Permissible range	U_{in}		V	0		BATT+
Switching thresholds Low	U_L	R_{Gen}=0Ω	V	3.0		
High	U_H		V			6.0
Switching hysteresis	U_{Hys}	R_{Gen}=0Ω	V		1.2	
Function range	BATT+		V	10		32

Remarks:

Plug connection:	28	Function group:	Interface
Connector designation:	TDS-A	Reference ground:	GND 0 (13)

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage						
HIGH status	U_o	R_L=200 $\varkappa\Omega$		BATT+ –0.5 V		BATT+
LOW status		I_o=12 mA	V			1.2
Pull-up against BATT+	R_{PU}		kΩ	2.4	2.55	2.7
Short-circuit current	I_{oLK}	Short to BATT+	mA	65		150
Switching edges		R_L=10 kΩ C_L=10 nF				
Rise time	t_r		µs		10	70
Fall time	t_f		µs		1	

Remarks:

4.6 Fuel-delivery control circuit

Plug connection:	1, 2	Function group:	Switching output to BATT–
Connector designation:	MES 0	Reference pin:	BATT– (18, 19)

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	2.4	3.0	4.4
Output voltage	U_{oL}	ON, at 11 A	V		1.2	1.8 V
	U_{oH}	OFF			BATT+	BATT+
LOW status		I_o=20 mA	V			1.5 V
Output current	I_o	Output stage disabled	mA			5
Current limitation	I_{oK}	Peak value	A			18
Switching edges		R_L=10 kΩ C_L=10 nF				
Rise time	t_r		µs		10	70
Fall time	t_f		µs		1	

Remarks:

This output stage is designed for operation together with the fuel delivery regulator of the injection system. The effective current value is determined by the duty factor of the output stage transistor, the battery voltage and the fuel delivery regulator (R, L).

This signal controls the position of the control rod (see RWG M, Y, R).

Plug connection: 9 Function group: Control rod position evaluator circuit

Connector designation: RWG-M

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage		With sensor				
Alternating voltage component	U_{AC}	at 6 mm control rod travel	V_{pp}		2.6	
Direct voltage component	U_{DC}		V		3.0	
Output frequency	f	With sensor	kHz		10	
Short-circuit protection	U_{KS}	max. 1 min.	V	–1		26

Remarks:

– Control rod position transducer with pick-off instrument coil

– A sinusoidal alternating voltage (to RWG-R in phase opposition) with superimposed direct voltage can be measured with the sensor connected.

– The inductive position sensor for the control rod in the injection system is evaluated via the 3 plug connections RWG-M, R and Y. A voltage proportional to the control position is made available in the control unit.

– Regulations concerning the installation of cables – particularly with regard to the capacitance per unit length – must be complied with.

Plug connection: 10 Function group: Control rod position evaluator circuit

Connector designation: RWG-R

Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage		With sensor				
Alternating voltage component	U_{AC}		V_{pp}		2.5	
Direct voltage component	U_{DC}		V		3.0	
Output frequency	f	With sensor	kHz		10	
Short-circuit protection	U_{KS}	max. 1 min.	V	–1		26

Remarks:

– Control rod position transducer with pick-off reference coil

– A sinusoidal alternating voltage with superimposed direct voltage can be measured with the sensor connected.

– The inductive position sensor for the control rod in the injection system is evaluated via the 3 plug connections RWG-M, R and Y. A voltage proportional to the control position is made available in the control unit.

– Regulations concerning the installation of cables – particularly with regard to the capacitance per unit length – must be complied with.

Plug connection: 11 Function group: Control rod position evaluator circuit

Connector designation: RWG-Y

Description of input

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}	Not applicable				
Input filter	τ	R_{Gen}=0Ω	µm		5.5	
Input voltage	U_E	With sensor	V		3	
Input resistance	R_E	U_E=3 V	kΩ	85		95
Short-circuit protection	U_{KS}	max. 1 min.	V	–1		26

Remarks:

– Control rod position transducer centre pick-off

– A direct voltage with a low alternating voltage component can be measured with the sensor connected.

– The inductive position sensor for the control rod in the injection system is evaluated via the 3 plug connections RWG-M, R and Y. A voltage proportional to the control position is made available in the control unit.

– Regulations concerning the installation of cables – particularly with regard to the capacitance per unit length – must be complied with.

4.7 Main relay control

Plug connection: 47 Function group: Digital input

Connector designation: K15-E Reference ground: BATT– (18, 19)

Description of input

Characteristic parameter			Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor		C_{EMC}		nF	1.2	1.5	2.2
Input resistance		R_{in}		kΩ	2.5		
Idle speed voltage		U_{LL}		V			
Input filter		τ	R_{Gen}=0Ω	µs		250	
Input voltage							
Permissible range		U_{in}		V	–26		BATT+
Switching thresholds	Low	U_L	R_{Gen}=0Ω		2.5		
	High	U_H					16
Switching hysteresis		U_{Hys}	R_{Gen}=0Ω	V		5	

Remarks:

The main relay is activated (HRL 0) by the terminal 15 voltage (ignition lock) being applied at K15-E.

If necessary, the control unit can deactivate the main relay with a delay when shutting down the vehicle.

This function can be programmed by way of software.

Plug connection: 46 Function group: Output stage switching to BATT–

Connector designation: HRL 0

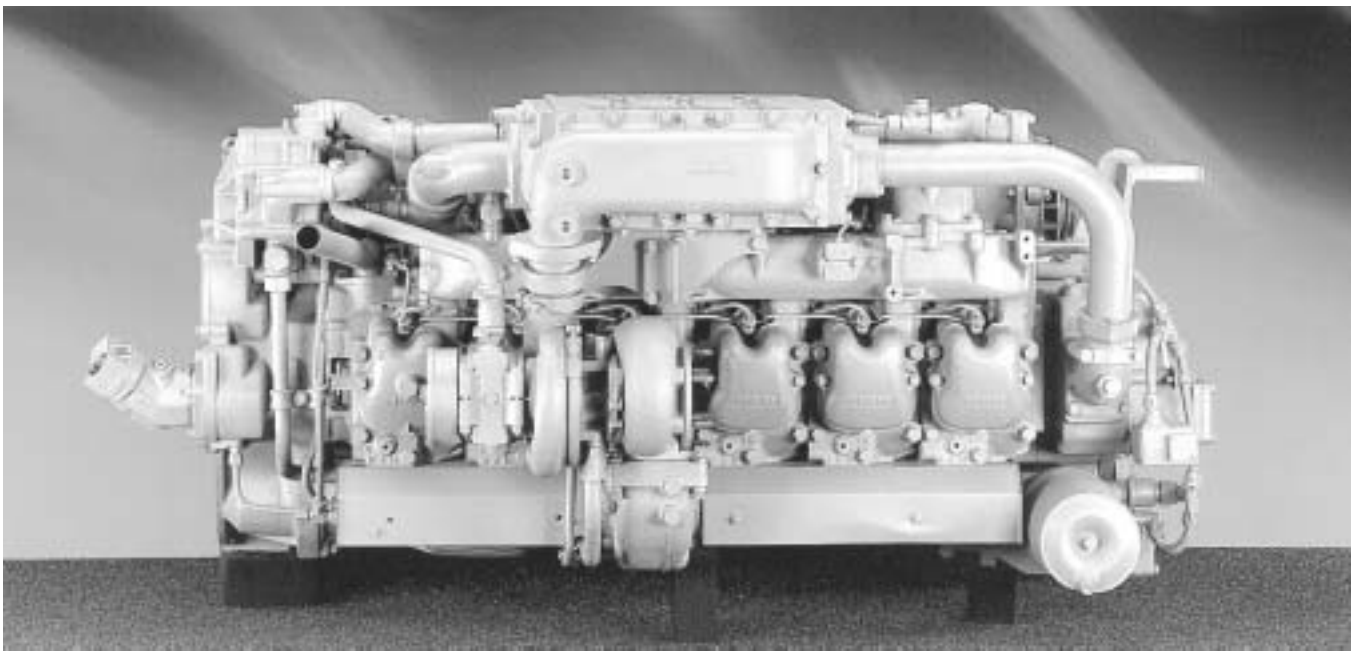
Description of output

Characteristic parameter		Conditions	Dim.	Min.	Typ.	Max.
EMC capacitor	C_{EMC}		nF	1.2	1.5	2.2
Output voltage	U_o	at 0.3 A	V			1.2
Output current	I_o	Output stage disabled	mA			5.0
		Output stage enabled	A			0.3
Short-circuit current shut-down	I_{oK}		A	0.4		0.7
Switching edges						
Rise time	t_r		µs			
Fall time	t_f		µs			
Main relay resistance	R_{HRL}	T_{HRL}=20°C	Ω	160		

Remarks:

Electronic Diesel Control
Description of inputs and outputs

EDC M(S) 5



Contents Page

1. Introduction

In the EDC systems, it is very important to ensure correct connection between the sensors and actuators on the one hand and the control unit on the other.
This is achieved by means of a wiring harness. The system may fail and functions can be impaired if the plug connections and electrical lines are not selected and connected correctly in accordance with specifications.
Malfunctions with their cause in the wiring harness are very difficult to locate, making subsequent inspection and rectification intricate and expensive. Wiring harness and plug connection failures which remain undetected are often mistakenly attributed to unit/component failures.

2. General

The EDC wiring harness is subject to particular requirements with regard to design and environmental influences to ensure it does not interfere with the EDC functions. Individual customer standards are not restricted by this guideline, but rather they are used as the basis for general wiring harness manufacture.
Information is only provided on lines which belong to the EDC system.

The relevant system connector drawings and terminal connection diagrams serve as the basis for wiring harness manufacture. They are compiled specifically for every new EDC system.
The connector drawing with parts list (Annex 1) represents the scope of delivery of the plug connectors used, indicates what wire cross sections are used and where individual connection points are to be planned. The terminal connection drawing with control unit connector assignments (Annex 2) shows in schematic form the connection between control units and actuators as well as sensors. It also indicates what wires are to be shielded or twisted. When assessing a system, the vehicle must be examined for possible irradiation and emission in an electromagnetic compatibility (EMC) test bay with a standard wiring harness.

Measures for the purpose of galvanic, capacitive and inductive decoupling must be implemented to ensure high EMC-specific interference immunity is achieved.
Some of these measures are:

– Isolation of power circuits from sensor lines by separate cable routing

– Avoiding routing wires subject to pulses and sensor wires in parallel

– Shielding of cables and wires

– Twisting wires in pairs

– If possible, maintaining distance between wires and cables of different systems

3. Plug connectors and sockets

Blade and pin terminal plugs are used as the connection elements in EDC systems. Refer to the wiring harness drawing (Annex 1) for the plug connectors used in the relevant project. Any customer-specific plug connectors to be used should be checked in accordance with Bosch connector specifications.
Zinc, silver and gold are used as contact materials. The same materials should always be used for the PIN and socket.

- Mounting contacts in connector housings:
  - The notes on design and assembly (Annex 3) should be used as the basis for producing connectors and wiring harnesses.
  - The contact handling procedure is described in Point A 1.

4. Cable/wires, general

Heat and diesel resistant PVC or PUR insulated copper stranded wires complying with DIN 72551 should be used. For strength reasons, the minimum permissible wire cross section is 0.5 mm^2.
Specified cross sections:

- 0.5 – 1.0 mm^2 for all instrumentation and control lines
- 1.0 – 2.5 mm^2 for all 12 V or 24 V supply lines
- 4.0 – 6.0 mm^2 for supply leads from the battery to the connection points

Observe Points 5.1 and 6. when selecting the cross section.

Cables not subjected to mechanical load can also be designed as leads with reduced insulation thickness.
A low-capacitance special cable (e.g. 3x1.0 mm^2 Radox 125) may be necessary for the control rod position transducer line if this involves a longer wiring harness.

For protection purposes, the lines should be routed in a non-woven PVC tube complying with DIN 40621 which must be diesel and oil-proof in the engine compartment.

4.1 Wiring harnesses

The wires of the EDC system are combined in a wiring harness and must not be routed together with other systems. Malfunctions attributable to the wiring harness are not expected, if the specified limits are complied with. The specified limits should be considered as extreme values, i.e. lower values are to be aimed for. In

addition to the physical limits for wiring harnesses and the corresponding measuring procedure, concrete proposals with regard to the design of the wiring harness are also provided.

- Wiring harnesses which, based on experience, fulfil the physical limits.

  – Length up to 6.0 m, wiring harnesses made up of individual conductors, with loose to close bundling of conductors. The cables leading to the control rod position transducer should be made up of either twisted conductors or a 3-core cable.

  – Length up to 8.0 m, wiring harnesses made up of individual conductors, loosely arranged in a plastic tube, while closely routed wires (bundled every 50 cm, twin wires, twisted wires) are used for supply and return lines to pulsed actuators (inductive coupling) and a 3-core low-capacitance cable is used for the supply leads to the control rod position transducer.

  – Length over 8.0 m, wiring harnesses in which the conductors considered as sources of interference (e.g. pulsed actuator lines) and interference-sensitive lines (sensors) are bundled separately, and a 3-core low-capacitance special cable is used for the supply lines to the control rod position transducer are realized by.

4.2 Manufacture of wiring harnesses

Wiring harnesses are manufactured in accordance with customer-specific guidelines.
Line and insulation crimping must take place together with the correct tools, where machine crimping is to be preferred. The notes provided in Annex 3 under Point A2 – A13 must be observed when producing the wiring harness.

4.3 Installation of wiring harnesses

The EDC wiring harness must be installed separately from other wiring harnesses. If spatial separation is not possible, suitable measures must be implemented to ensure that no interfering pulses can penetrate the system from the outside.
Avoid sharp bends and kinks during installation. Protect the wiring harness from direct water spray.
The quotation drawings should also be used as part of the installation instructions for the relevant wiring harnesses. The information provided under Points B1 – B10 must also be complied with (Annex 3).

5. Physical limits

5.1 Resistance

Permissible resistance for supply and return conductors of the fuel-delivery actuating solenoid

at 20 °C 200 mΩ

For all other supply lines, a line resistance should be selected such that the voltage cannot drop below the minimum setpoint even under extreme conditions.

The leakage resistance R_A at plug connections of sensors and actuators must not exceed a specified limit over the entire service life. The R_A limit values are specified in the TKUs for the sensors and controllers.

5.2 Inductance

Permissible mutual inductance between measuring power circuits and actuator power circuits

$$M_K < 1\ \mu H$$

Explanations

- Interference sources:
  Pulsed actuator line with rates of current rise more than 5000 A/s.
- Faulty lines:
  Sensor supply lines and signal lines, particularly from the control rod position transducer
- Measuring method:
  Impressing a delta or sinusoidal current with current rise rates of approx. 50 000 A/s ($\triangleq$ dI/dt) on two conductors with short-circuited ends. Measurement of the induced voltage U_{ind} at a second loop made up from two conductors with short-circuited ends.

  Mutual inductance:

$$M_K = \left| \frac{U_{ind}}{dI/dt} \right|$$

- Mutual inductance scatter:
  Random scatter of the mutual inductance occurs on cable harnesses made up of non-sorted individual conductors. The maximum possible mutual inductance must therefore be determined by way of statistical evaluation.

- Measurement can be dispensed with if the requirements stipulated in Section 4.1 (wiring harnesses) are fulfilled.

- Special measures for very long wiring harnesses:
  In the case of very long wiring harnesses, the following wiring arrangement of supply and return lines of interference sources ensure that the upper limits are complied with:

  – Bundling of conductors every 50 cm
  – Use of twisted-pair lines
  – Twisting at a rate of approx. 10/m

5.3 Capacitance

Maximum permissible coupling capacitance C_K between interfering and interfered line during EDC operation $C_K \leq 200$ pF

Explanations:

- Interference sources:
  Lines whose signals exceed voltage rise rates of approx. 0.1 V/µs (e.g. pulsed actuator lines, speed sensors)

- Interfered lines:
  Sensor supply lines and other signal lines, in particular the lines leading to
  – control rod position transducer (RWG Y line)
  – rpm sensor (particularly when measuring at flywheel)

- Effective coupling capacitance during EDC operation:
  With the EDC system active (sensor, actuator and control unit connected), low-resistance terminated conductors (e.g. ground lines, actuator lines) act as a shield. For this reason, the coupling capacitance measured during EDC operation is less than the coupling capacitance measured at the non-connected wiring harness (between two conductors).

- Measurement of effective coupling capacitance in the vehicle during EDC operation
  To ensure effective results, measurements in vehicles should be carried out in accordance with the following procedure.

  – Measurement instruments: Capacitance bridge with a measuring frequency of 1...10 kHz

  – Adapter (matching EDC system), e.g.
    EDC 53.1 (M(S)5) Y 462 U00 101

– Measurement arrangement and procedure

a) Disconnect system from power supply.

b) All sensors and actuators remain connected.
Disconnect the plug connector at the injection pump.
(Measurements in laboratory: The wiring harness is connected only on the control unit end. The other lines remain open.)

c) Connect system-dependent test adapter between control unit and wiring harness.

d) Connect control unit signal ground with signal ground of capacitance bridge.

– Measurements:

Measure the capacitance between following lines:
e.g.:

NKW systems

Interference source		Interfered line
a) DZG 1	➞	RWG M
b) DZG 1	➞	RWG R
c) DZG 1	➞	RWG Y
d) MES 0	➞	DZG 1
e) MES 0	➞	RWG M
f) MES 0	➞	RWG R
g) MES 0	➞	RWG Y

The test temperature should be T_U = 20 °C ambient cable temperature. The values given above must not be exceeded during these measurements.

Capacitance scatter:

Random scatter of the capacitance occurs on cable harnesses made up of non-sorted individual conductors. Several wiring harnesses should therefore be measured.

Special measures for very long wiring harnesses:

Separate bundling of actuator lines (sources of interference) and sensor lines (interfered lines) reduces coupling capacitance.

In view of capacitive coupling in very sensitive signal lines due to the shield effect of ground lines, it may be appropriate to route the signal line and corresponding signal ground very close to each other (twisted-pair or twisted line). The coupled voltage of sources of interference is reduced in this way.

5.3.1 Requirements relating to supply lines to the inductive control rod position transducer

Permissible capacitive load of supply lines to the control rod position transducer in the wiring harness

Measurement must be conducted in order to determine the permissible capacitive load to the control rod position transducer. The test setup is the same as described under Section 5.3 but the pump connector is connected and the capacitance measuring instrument can be dispensed with. An additional capacitance is connected at the control unit plug connector between the RWG Y line and the signal ground in order to simulate increased capacitive load in the wiring harness. All lines which are routed parallel to the supply lines to the control rod position transducer both at the control unit as well as at the corresponding sensors, actuators etc. must be connected.

- Measurement

  Switch on the EDC system, the additional capacitance is set to 0 pF, the U_{actual} value is approx. 0.5 V.

  Continuously increase the additional capacitance until the U_{actual} value is greater than 1.0 V. The additional capacitance $C_{additional}$ must not drop below following values:

Wiring harness at = 25˚C dry	Wiring harness at = 70˚C dry	Wiring harness at 25˚C, but moist or oily as far as possible in practical applications
$C_{additional}$ = 400 pF	$C_{additional}$ = 300 pF	$C_{additional}$ = 300 pF

- Capacitance scatter:

  The capacitance is subject to strong scatter from wiring harness to wiring harness when the wiring harness is made up of individual conductors. Statistical evaluation is therefore necessary.

- Remedy for excessively high capacitive load of supply lines to the control rod position transducer

  – Twisting of the three individual conductors at a minimum rate of 20/m
  – Use of a 3-core low-capacitance cable

Accuracy of control position evaluation

An evaluation error is caused by the asymmetrical wiring harness capacitance at a fixed control or slide valve position.
This control or slide valve position error is dependent on the evaluator circuit and must be determined for each project.

- Explanations

– Test
  Measurement of a representative batch of wiring harnesses in accordance with 5.3.
  The effective capacitance during EDC operation and its scatter (statistical evaluation) must be determined.

- Remedy for excessively high scatter of the capacitive loads between the supply lines to the control rod position transducer

  – Twisting of the three individual conductors at a minimum rate of 20/m

  – Use of a 3-core low-capacitance cable

6. Voltage supply

The EDC systems should be connected to the general vehicle electrical system in accordance with the terminal connection diagram. Three criteria must be taken into consideration when connecting the supply voltage:

– Low line resistance in the supply and return lines. If this point is disregarded, cold starting difficulties can arise as the minimum voltage of the control unit is below specified values.
  The ground lead should be routed separately and not over the body as high contact resistances can occur at the transition points which change negatively due to ageing and environmental influences.

– Routing EDC supply currents and starter current via common cables/body sections can also result in starting difficulties.

– Major interfering influences caused by switching peaks of motors, switches and relays which can cause malfunctions in the control unit.

The following guidelines should be complied with to ensure these criteria do not have negative effects on the system:

– The supply voltage should be connected directly to the battery at positive and negative terminals.

– If this type of connection cannot be implemented, care must be taken to ensure that the distance between the alternator and battery is as small as possible. This ensures reduced residual ripple in the vehicle electrical system.

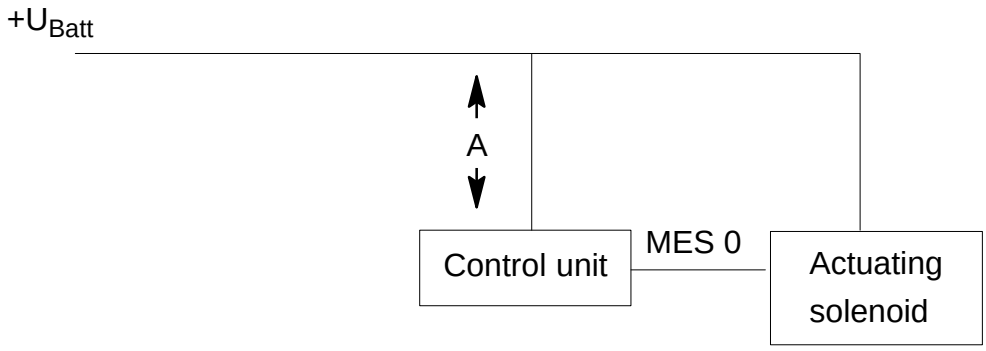
– The supply and return lines should be kept short in order to avoid excessive voltage drops.

Further measures are suggested in order to ensure effective and trouble-free operation with the EDC system:

– The sensor or actuator ground must not be coupled with the vehicle ground otherwise interference voltages can flow into the system.

– The control unit features a no-lead diode for the actuating solenoid. The positive supply line of the actuating solenoid should therefore be positioned electrically “close” to the control unit and electrically “far from” the EDC power supply. Otherwise, the self-induction peak of the solenoid coil can spread relatively unhindered in the vehicle electrical system.

  The distance “A” must be small:

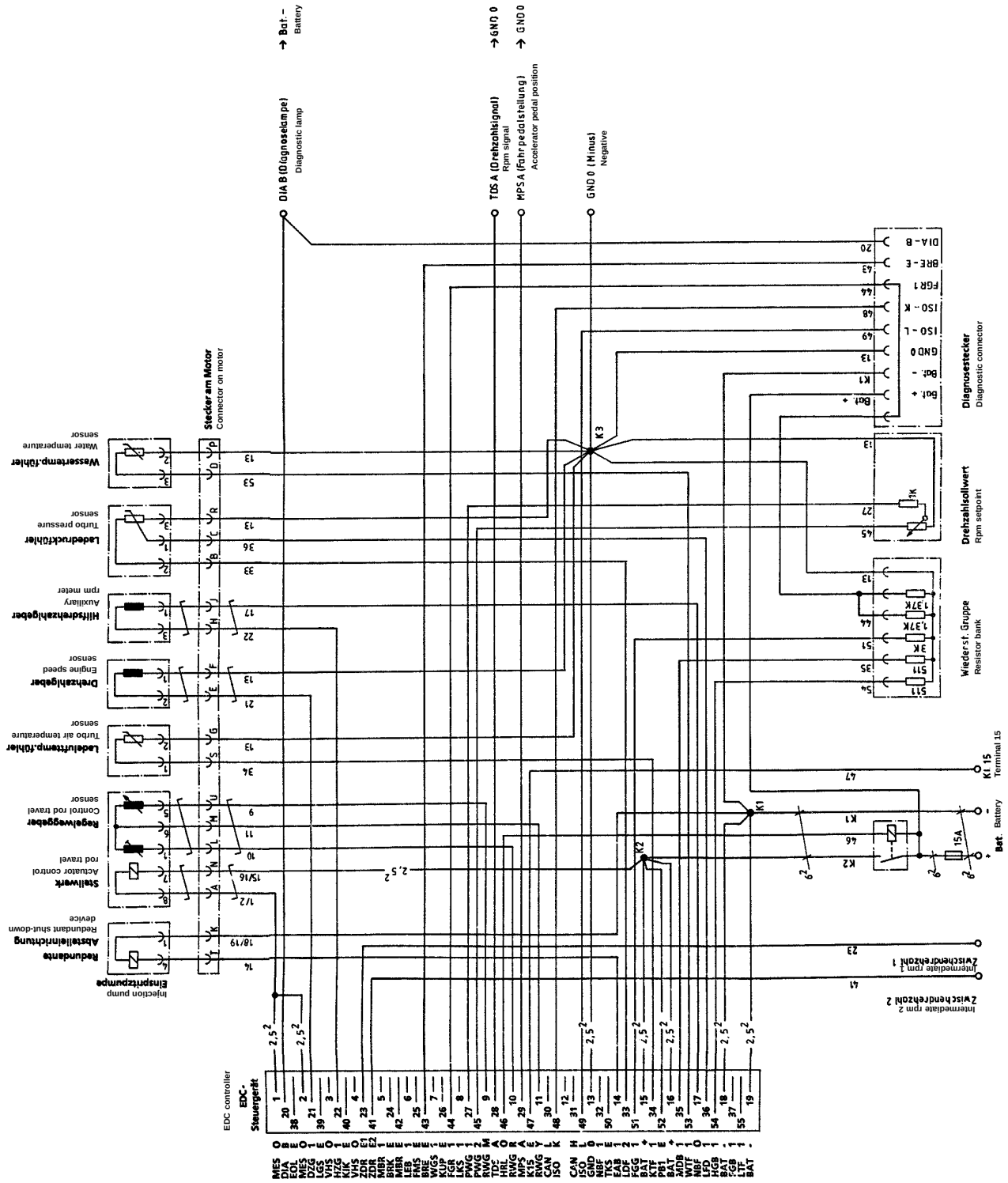


– Inductive loads must not be disconnected by switches, relays etc. from the EDC control unit or battery positive terminal if it cannot be ensured that the inductance is canceled by suitable means. Otherwise, when the switch is opened, contact sparkover would occur which would couple interference onto all neighbouring lines of the wiring harness. The interference could cause the control unit to fail.

If the EDC system is connected to another system (e.g. traction control), a system-dependent coupling ground must be used to ensure that the effects do not cause mutual interferences. These interferences can be triggered by large potential offsets at the ground and pulse peaks.

Pin No.	Abbreviation	Description		
1	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit f=variable, pulse-width modulated	I_{max} 11 A temporarily, on average 4.5 A, against batt.+, pulsded,
2	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	
3	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit f approx. 200 Hz, pulse-width modulated	I_{max} 6 A temporarily, on average 3 A, against batt.+, pulsed,
4	VHS O	Pre-stroke actuator activation	Output, start of delivery control circuit	
5	MBR 1	Engine brake actuator	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt. –,
6	LEB 1	Air injection	Output (switch)	I_{max} 2 A, $U_{batt.}$ against batt. –,
7	WGS 1	Waste gate	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
8	LKS 1	Intercooler bypass	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
9	RWG M	Control rod position transducer measuring coil (RWG 2)	Control rod position evaluator circuit	
10	RWG R	Control rod position transducer reference coil (RWG O)	Control rod position evaluator circuit	
11	RWG Y	Control rod position transducer centre pick–off (RWG 1)	Control rod position evaluator circuit	
12	CAN O	Reference ground for CAN H/L		
13	GND-A	Sensor ground		
14	EAB 1	Electrical shut-down	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
15	Batt.+	Batt. + via main relay	Input battery +	I with engine stationary 0.9 A, idle speed 1.5 A, operation 4.5 A, temporarily 16 A
16	Batt.+	Batt. + via main relay	Input battery +	
17	NBF 0, HZGO	Needle movement sensor and auxiliary rpm sensor	Reference ground:	
18	Batt.–	Battery negative	Input battery –	I Same as batt.+ (terminals 15 and 16)
19	Batt.–	Battery negative	Input battery –	
20	DIA-B	Diagnosis lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –,
21	DZG 1	RPM sensor signal	Input, dynamic N sec.$^{-1}$	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. X
22	HZG 1	Auxiliary rpm sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=number of cyl. X N sec.$^{-1}$
23	ZDR-E1	Intermediate engine speed control 1	Input, static	Batt. +
24	BRK-E	Brake switch signal	Input, static	Batt. +
25	FMS-E	Function-mode switch FGR/FGB	Input, static	Batt. +
26	KUP-E	Clutch switch signal	Input, static	Batt. +
27	PWG 1	Pedal position sensor signal	Input, analog	Direct voltage, U approx. 0.4 to 4 V
28	TDS-A	Engine speed signal	Output	$U_{batt.}$ against batt. –, square-wave signal, f=number of cyl. X N sec.$^{-1}$
29	MPS-A	Multiplex signal	Interfaces	
30	CAN-L	Controller Area Network	Interfaces	
31	CAN-H	Controller Area Network	Interfaces	
32	NBF 1	Needle movement sensor	Input, dynamic	U_{pp} approx. 2 V
33	LDF 2	Turbo pressure sensor	Output, supply	Controlled direct voltage, U approx. 5 V
34	KTF 1	Fuel temperature sensor (used for charge air temperature)	Input, analog	
35	MDB 1	Multi-stage input (torque limitation)	Input, analog	Input by change in resistance
36	LDF 1	Turbo pressure sensor signal	Input, analog	
37	FGB 1	Driving speed limit lamp	Output (switch)	I_{max} 1 A, $U_{batt.}$ against batt. –
38	EOL E	Input, static		
39	LGS-E	Idle speed switch signal	Input, static	against GND-O (terminal 13)

Pin No.	Abbreviation	Description		
40	KIK-E	Kick-down switch	Input, static	Batt. +
41	ZDR-E2	Intermediate engine speed control 2	Input, static	Batt. +
42	MBR-E	Engine brake signal	Input, static	Batt. +
43	BRE-E	Brake switch signal	Input, static	Batt. +
44	FGR 1	Analog driving speed operating unit	Input	Input by change in resistance
45	PWG 2	Pedal position sensor	Output, supply	Controlled direct voltage, U approx. 5 V
46	HRL O	Main relay	Output (switch)	I_{max} 0.3 A, batt. – against batt.+
47	K15-E	Terminal 15, digit. Data for control unit	Input, static	Batt. +
48	ISO-K	ISO-K link to ISO protocol	Interfaces	
49	ISO-L	ISO-L link to ISO protocol	Interfaces	
50	TKS-E	Door contact switch	Input, static	Batt.+
51	FGG 1	Driving speed sensor signal	Input, dynamic	Square-wave voltage U_{pp} 8.5 V, f=variable
52	PB1-E	Pulse-width modulated input signal 1	Interface	
53	WTF 1	Coolant temperature sensor	Input, analog	
54	HGB 1	Multi-stage input, maximum speed limitation	Input, analog	Input by change in resistance


→ Bat. -
Battery
→ GND 0
→ GND 0
DIA B (Diagnoselampe)
Diagnostic lamp
TOS A (Drehzahlsignal)
Rpm signal
MPS A (Fahrpedalstellung)
Accelerator pedal position
GND 0 (Minus)
Negative
Stecker am Motor
Connector on motor
Diagnosestecker
Diagnostic connector
Drehzahlsollwert
Rpm setpoint
Wiederst. Gruppe
Resistor bank
Terminal 15
Bat. Battery
Intermediate rpm 1
Intermediate rpm 2
Einspritzpumpe
Injection pump
EDC-Steuergerät
EDC controller

A. Manufacture

1. Contacts

1.01 Contact material : Tin bronze
Surface : Tinned

1.1 All contacts must be fitted in the correct position in the chambers and locked in a floating arrangement in the connector housings.
Optionally, the contacts can be fitted turned through 180 degrees in the 2-pin to 7-pin connector housings with manual release and not featuring options for ultrasonic caulking (see Page 5).

1.2 Careful handling of the contacts is necessary
Protection against damage is not provided before being fitted in the connector housing.
Damaged contacts: Contact points bent
Latching springs bent
must not be used.

1.3 The specified additional latching elements must be used on multiple connector housings.

2. Line and insulation crimping must take place together with the correct tools. Particular care must be taken to ensure that the fixing tool and the contact match the reduced insulation thickness.

2.1 Withdrawal force of individual conductor out of the crimp connection:

1.0 mm^2	min.	160 N
1.5 mm^2	min.	200 N
2.5 mm^2	min.	250 N
4.0 mm^2	min.	350 N
6.0 mm^2	min.	500 N

3. There must be no insulation in the conductor crimping.

4. The conductor must be crimped over the entire connection point.

4.1 Protruding individual wires only in permissible area (not up to contact point).

5. Insulation crimping of the lines must be continuous (important as protection against bending and as strain-relief).

5.1 The insulation must be crimped over the entire connection point.

6. Cable shoes which are not capable of being crimped must be additionally soldered after connection.
The insulation must not be damaged.

6.1 Additionally solder crimp connection if specified in the drawing.

7. Insulating sleeves must be firmly interconnected at the branch points.
Length of overlap approx. 20 mm

7.1 The transition point must be tightly bonded.

8. The insulating sleeves must be fitted in the rubber grommets up to approx. 20 mm.

8. The insulator sleeve must be secured with the clip on 15-pin, 25-pin, 35-pin, 55-pin and 88-pin connector housings (strain relief).

10. Folds and creases in the diameter between the insulating tube and rubber grommet are not permitted.

11. Protective caps must be fitted in the connector housing.

12. Cable straps must be provided and firmly tightened at the specified points.

13. Refer to page 4 for general information.

B. Installation

1. Preferred position: Connector output facing downward

2. Water ingress in the wiring harness (insulating conduit) must be prevented.

3. Water is not permitted in the area of the plug connector.

4. Protect openings in the wiring harness from direct water.

5. Do not arrange wiring harness branches which could under certain circumstances against the spray direction of water.

6. Implement the following measures if water ingress in the wiring harness cannot be avoided.

6.1 The wiring harness must be set lower in the vicinity of the plug connection.

6.2 In addition, an interruption in the insulating tube is necessary at the lowest point (drip-off point).
- Interruption: approx. 30 – 60 mm.
- Perforation over a length of: approx. 30 – 60 mm.

6.3 Ensure sufficient spacing from the interruption up to the plug connection.

6.4 Protect interruption from direct water.

6.5 A rubber grommet with individual core leadthroughs is required for conditions subject to extreme water load.

7. The fit of the rubber grommet of the plug connection must not be subject to impermissible load when installing the wiring harness.

7.1 Use angled grommets if necessary (more difficult to install).

8. The rubber grommet must not be inclined at the cable outlet.

9. The following points must be observed when using cable cross sections < 0.5 mm^2 (e.g. 0.35 mm^2, 0.5 mm^2):

   Only protected cables should be installed in the engine compartment (e.g. in insulating conduit)
   A right-angled (r < 5 cm) arrangement of the wiring harness is not permitted as, in extreme cases, the maximum permissible tensile force (100 N) may be exceeded at the outer lines.

10. The cable must not be subject to tensile load (e.g. connection to a fixed part) when installing the plug connectors otherwise there may be a risk of chafing corrosion at the plug connection (contact to blade).
    The plug connection must be arranged such that the contacts have sufficient clearance, i.e. “float”.

C. General information

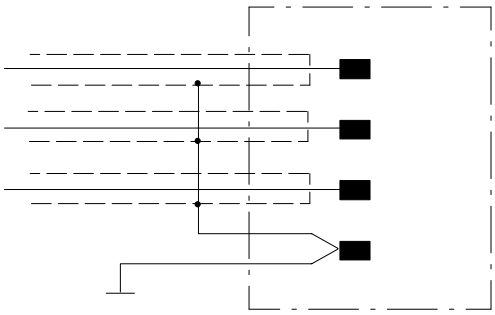
The following remedial measures are recommended in the case of little space in the recessed grip:

1. Use lines with an outside diameter of 0.35 mm^2.

2. Use, multi-pole shielded lines (number of lines 2, e.g. joining several knock sensor lines), min. line cross section 0.35 mm^2.

3. Join the shield potentials outside the recessed grip by means of a connector and lead single feeder line into recessed grip (see diagram).

Block diagram



The proposed measures should always be coordinated with the corresponding circuit and application department (e.g. due to EMC).

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