Technical Information

Electronic Diesel Control
Repair Manual

EDC M(S) 5 - D 2842 LE 6..

Dear Customer

These instructions are intended to help you properly carry out repairs on the electronically controlled diesel injection system described in this document.

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: 02.2002 51.99598–8049

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 likely to cause 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 a hot engine with bare hands:
  Risk of burns

- 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: Risk 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 loosen pipes and hoses that are under pressure (lubricant circuit, coolant circuit and any downstream hydraulic oil circuits): Risk of injury caused by liquids escaping under pressure

- Do not place 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 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

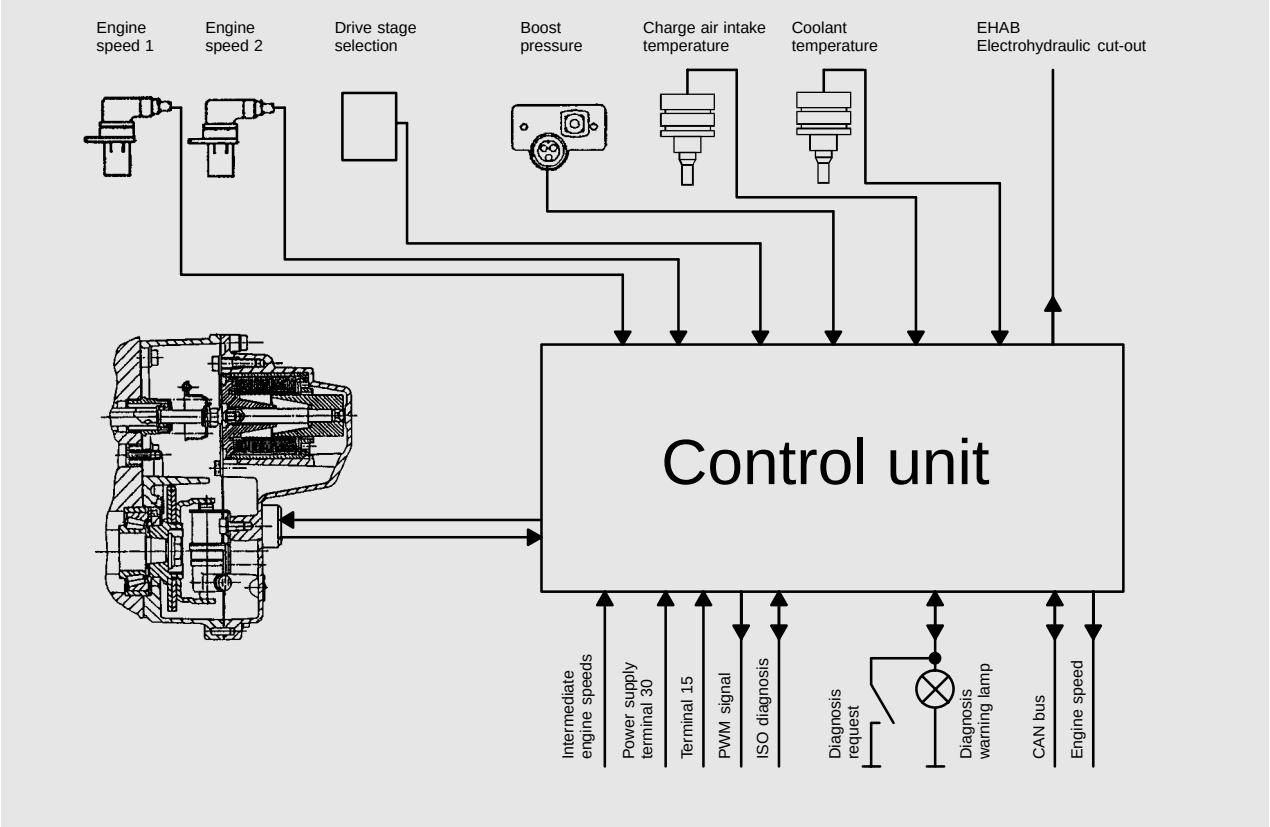
The requirements set by customers and legislation in respect of fuel consumption, exhaust emission and noise characteristics etc. on diesel engines have grown over the years and will be even more stringent in the future.

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

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

EDC (**E**lectronic **D**iesel **C**ontrol) meets these requirements.

System description EDC M(S) 5



The controller contains

– the linear solenoid
– the control rod position transducer

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

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

The diagnosis request push button 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.

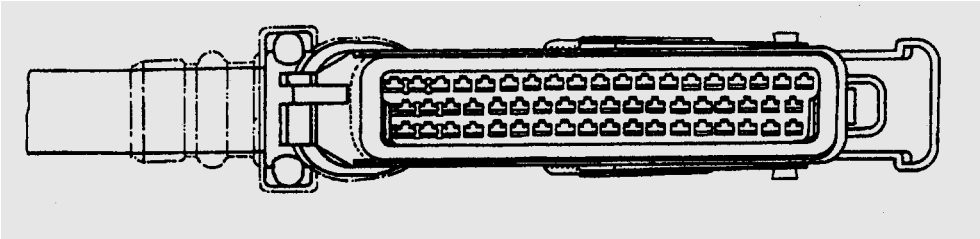
The idle speed control operates in the same way as the intermediate engine speed control. The idle speed is exactly maintained by means of the idle speed governor as long as the engine output is sufficient for this. The regulated idle speed can be varied within certain limits.

Starting-fuel delivery is output when either a lower start recognition speed is exceeded. The starting fuel volume 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.

Control unit plug connector

Pin arrangement

19 1
37 20
55 38



Pin assignments of control unit plug connector

EDC Pin	**Connection to component** (**O**=Output**, I**=Input)
1	Injection pump controller pin 8 **O** Jumper to pin 2 (activation of fuel volume 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 sensor, instrument coil)
10	Injection pump controller pin 1 (control rod position sensor, reference coil)
11	Injection pump controller pin 6 (control rod position sensor, centre pick-off)
12	Not used
13	Negative from control unit for (Sensor ground) – 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 battery + (via main relay and fuse) **I**
16	Control unit power supply battery + (via main relay and fuse) **I**
17	Ground for auxiliary rpm sensor
18	Power supply battery –
19	Power supply battery –
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**
24	Not used
25	Not used

EDC Pin	**Connection to component** (**O**=Output**, I**=Input)
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	CAN-L
31	CAN-H
32	Not used
33	Turbo pressure sensor (supply) **O**
34	Turbo air temperature sensor I
35	Resistor bank
36	Turbo pressure sensor (signal) **I**
37	Not used
38	Not used
39	Empty fuel switch signal
40	External engine cut-out
41	Intermediate engine speed control ZDR 2 **I**
42	Not used
43	Not used
44	Speed control device **I**
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) **I**
53	Coolant temperature sensor **I**
54	Not used
55	Not used

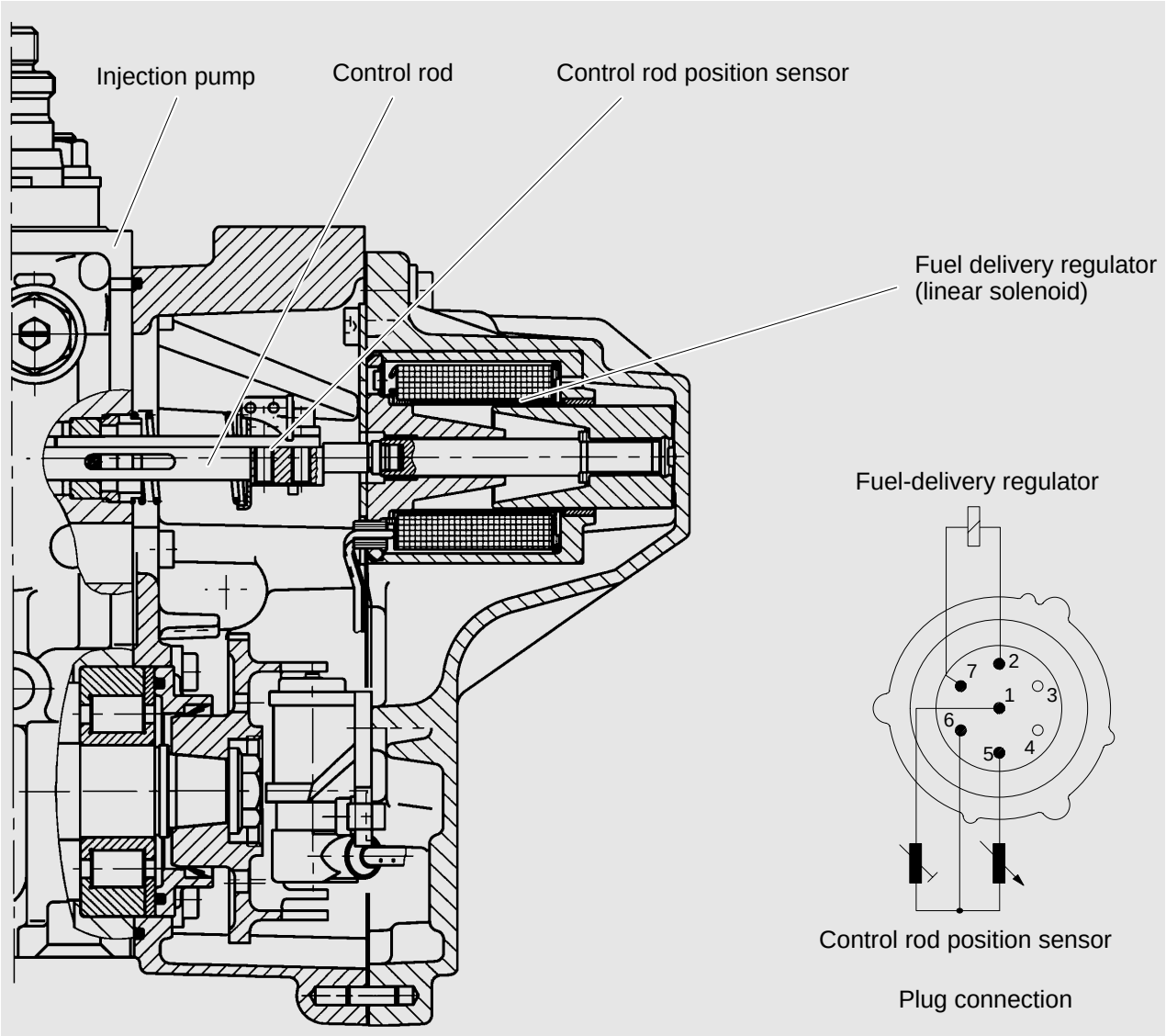
Injection pump

The EDC injection pump consists of a heavy-duty 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 of the fuel-delivery regulator is a linear solenoid whose 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 regulator is a control rod position sensor.

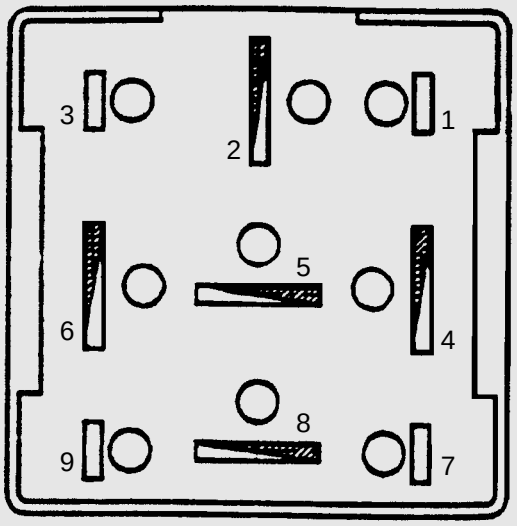


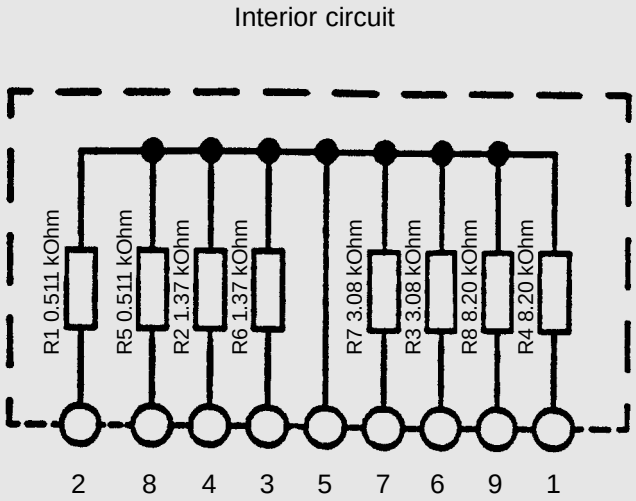
Resistor bank

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 36).

Some unused EDC connections must be closed by resistors since the EDC constantly conducts a signal-range check, as described on Page 21.



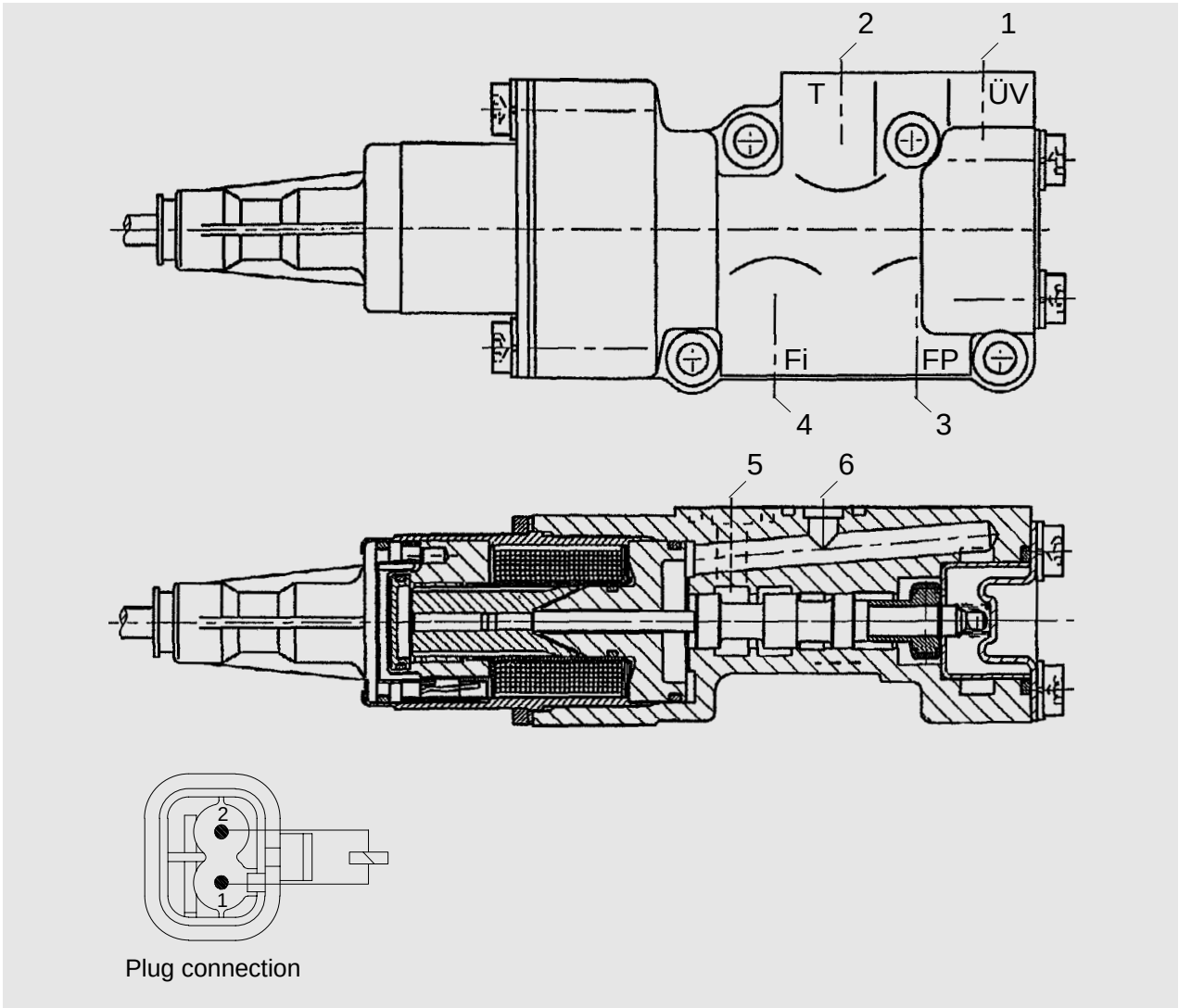


Electrohydraulic shut-off device EHAB

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 into 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.

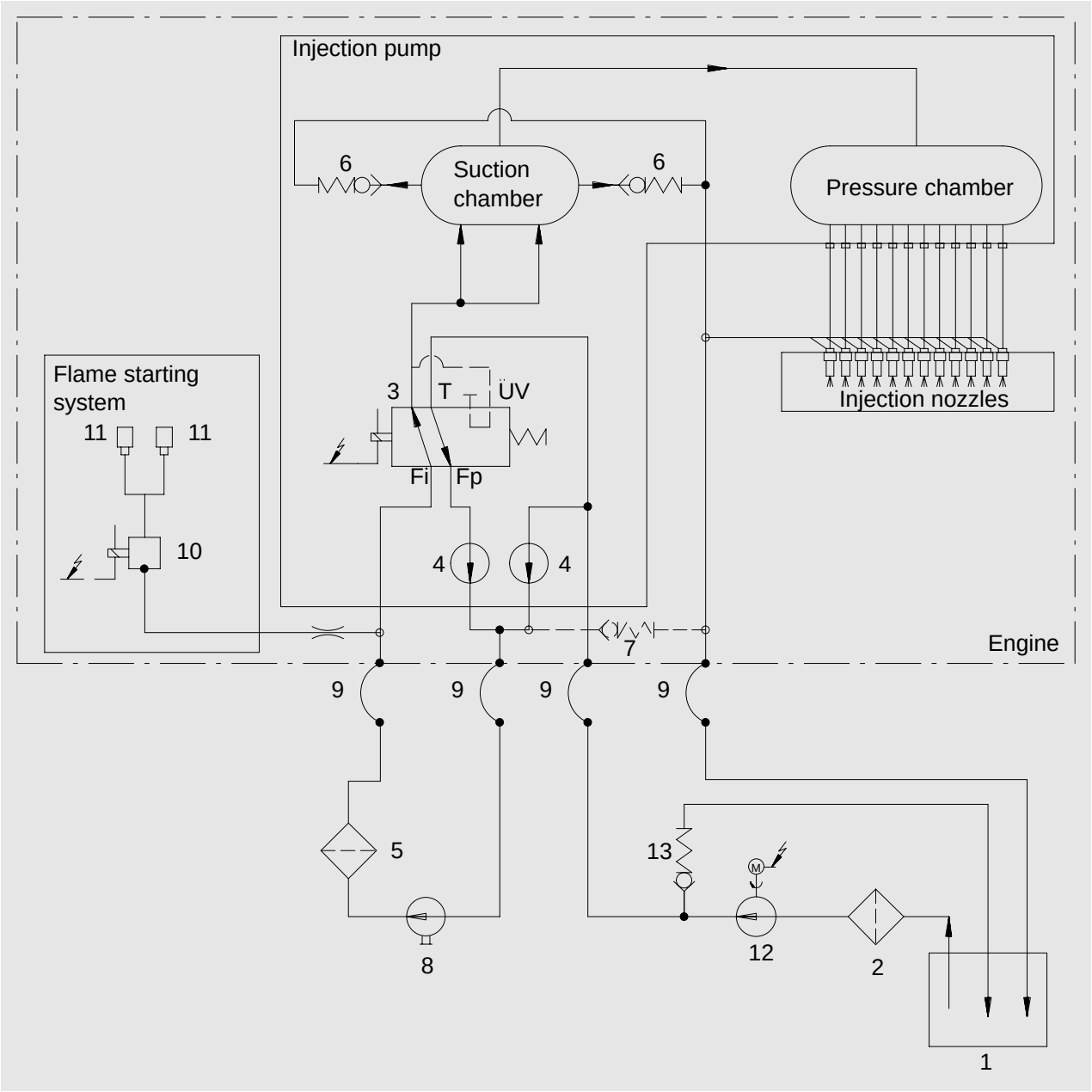
Power is always applied to the EHAB during operation. The power circuit is interrupted by the EDC control unit in order to activate the EHAB (e.g. for emergency engine shut-down).

For this reason, the **ignition must be turned on** when **bleeding the fuel system** by means of the presupply pump.



Plug connection

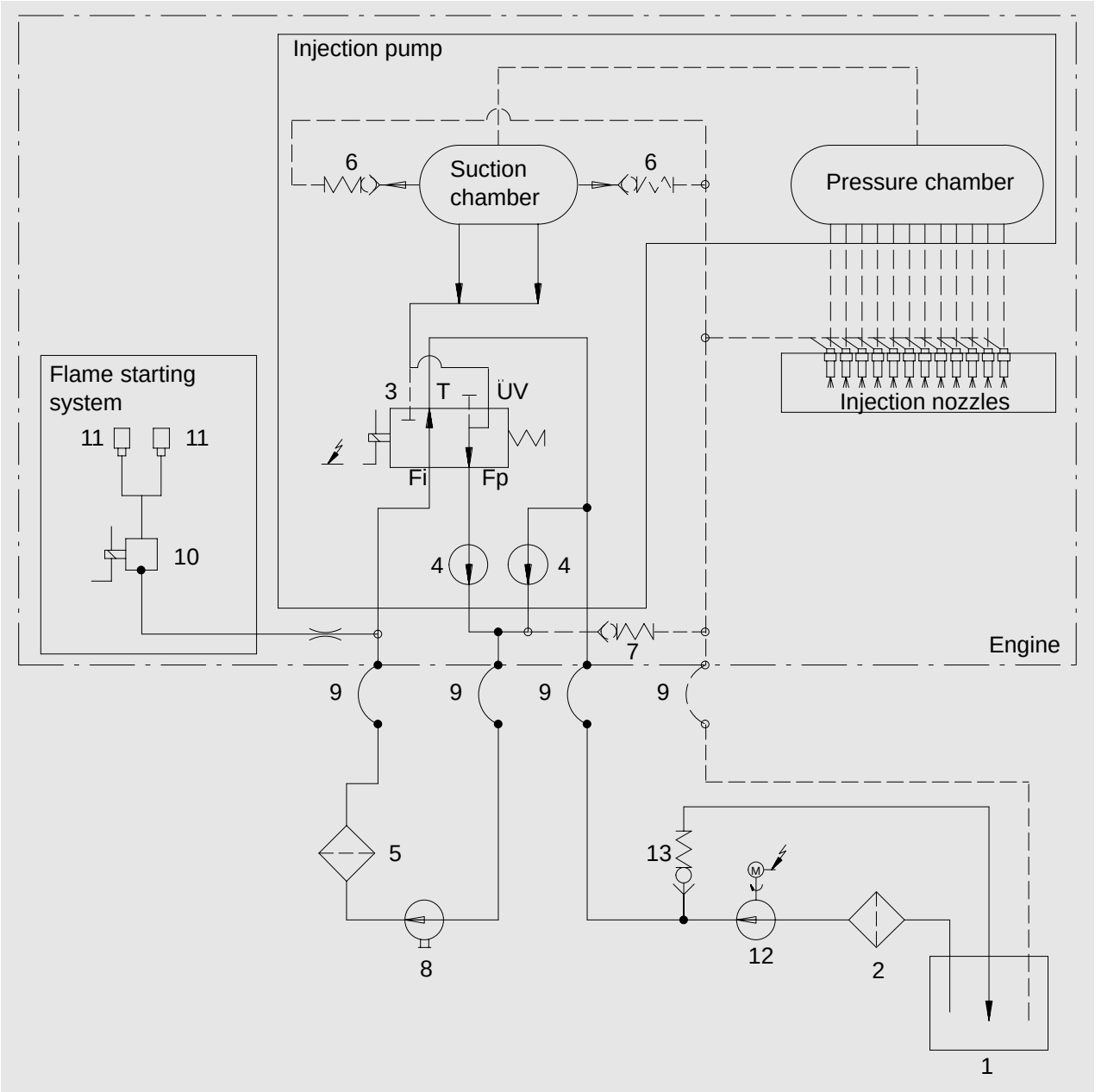
Fuel circuit diagram – Engine running



1 Fuel tank
2 Prefilter
3 Electrohydraulic shut-off device (EHAB) (overrevving protection)
4 Delivery pump (double acting)
5 Fuel filter
6 Overflow valve 2.0–2.5 bar
7 Overflow valve 3.7–4.3 bar
8 Pre-delivery pump (hand primer)
9 Fuel hose NW12
10 Magneto valve
11 Flame heater plugs
12 Electric fuel pump
13 Overflow valve 1.0 bar

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

Fuel circuit diagram – engine shutoff using EHAB



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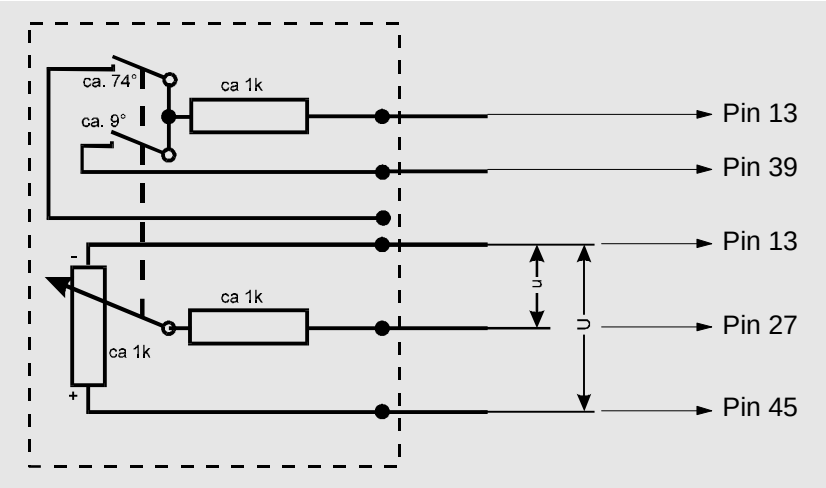
Caution:
Presupply pump integration in the fuel circuit should be checked according to pump type.

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.

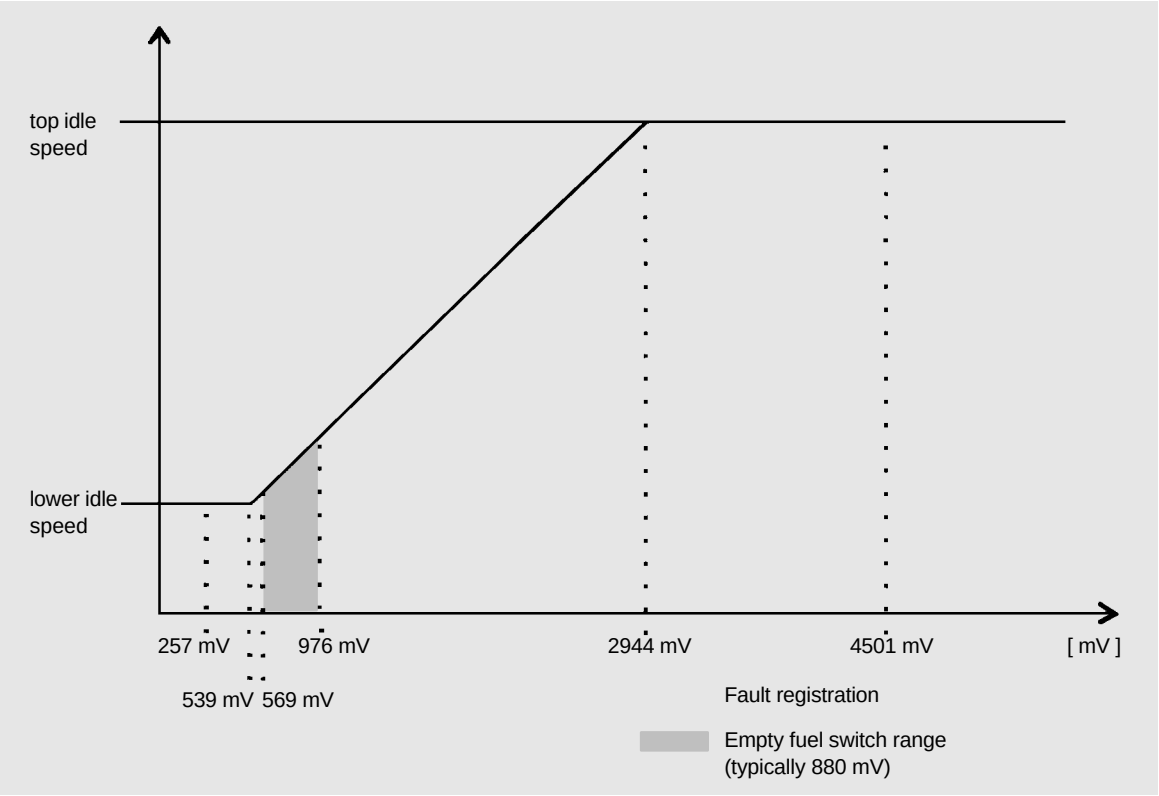
Block diagram



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

Pedal travel sensor simulation values

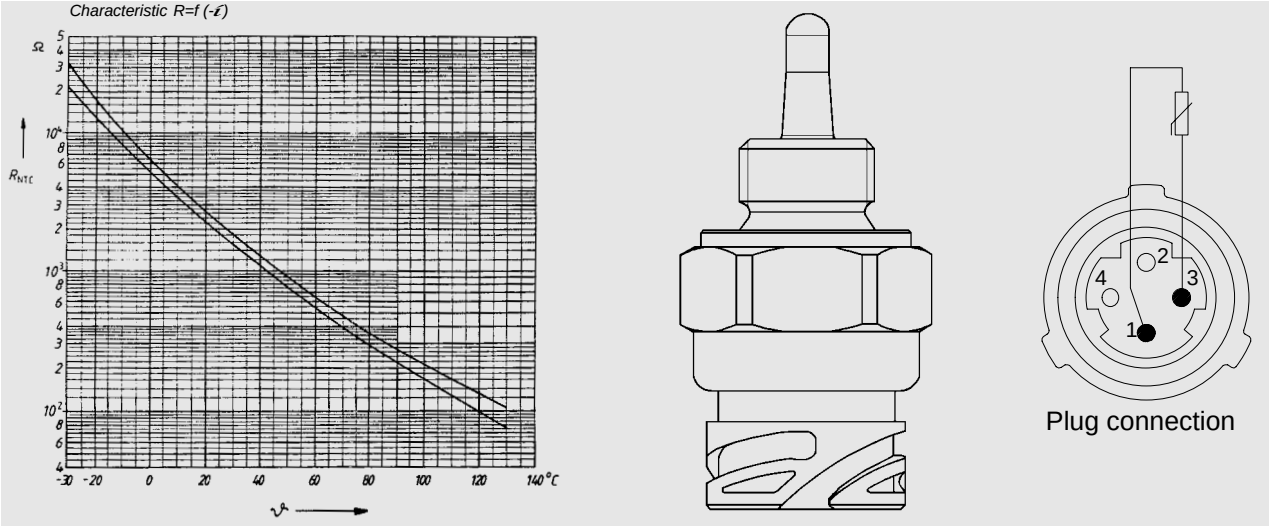
Lower idle speed: 257–539 mV / upper idle speed: 2944–4501 mV
Empty fuel switch: switch-on point at 569–976 mV (typically 800 mV)



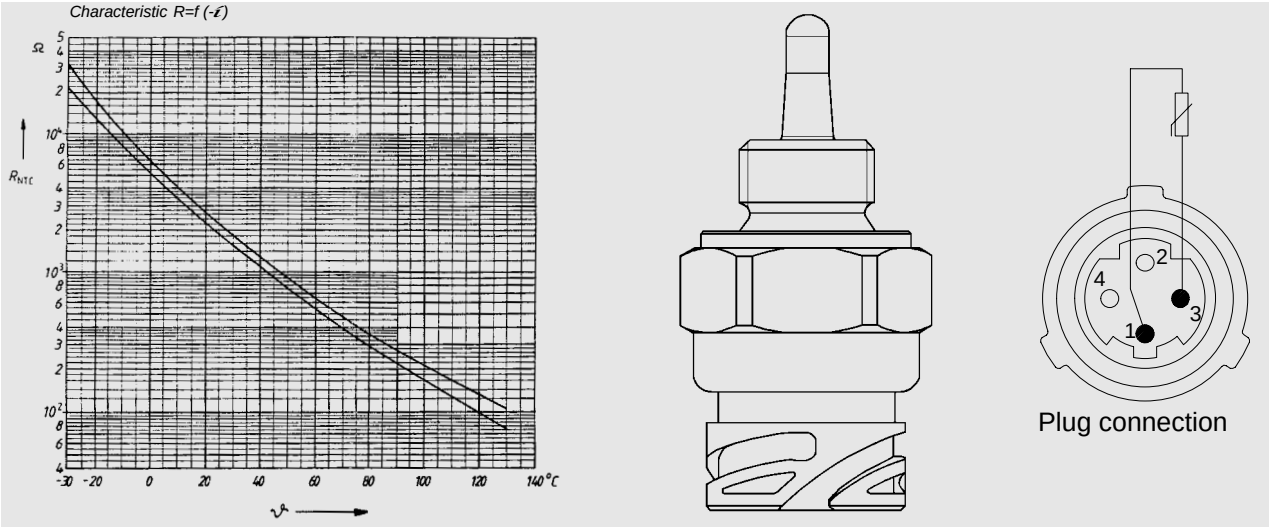
Exceptionally, the voltage "u" is produced electronically as drive position selection, or the setpoint selection (drive position selection) takes place via the CAN bus.

Turbo air and coolant temperature sensors

Turbo air B197 (51.27421–0165)



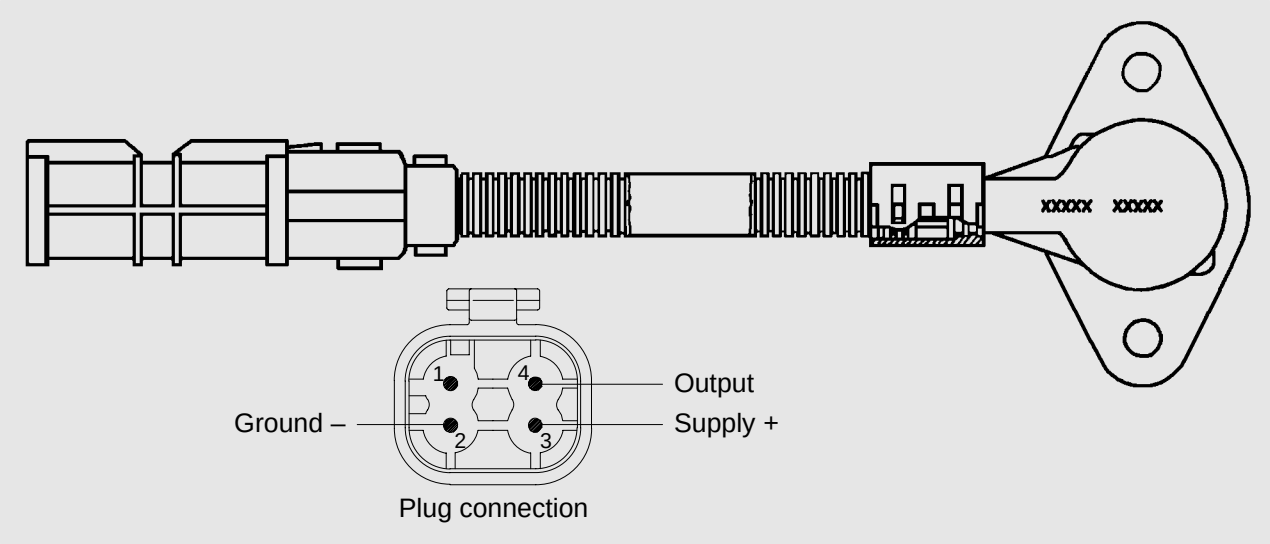
Coolant B124 (51.27421–0172)



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.

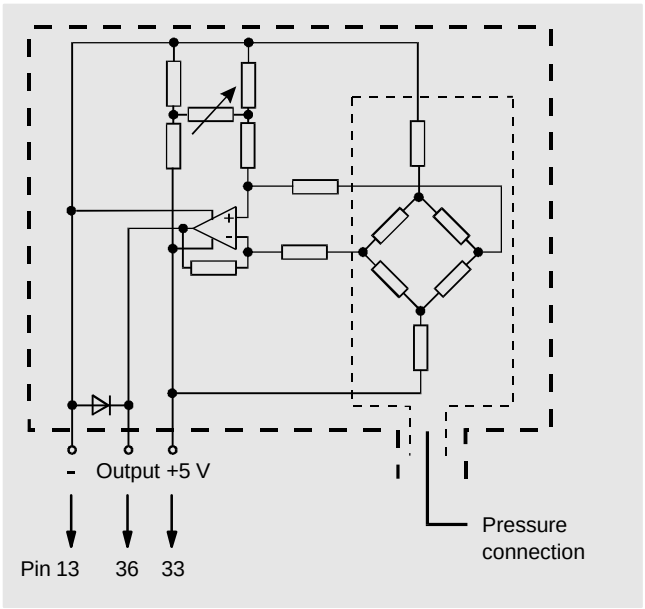
Turbo pressure sensor (51.27421–0181)



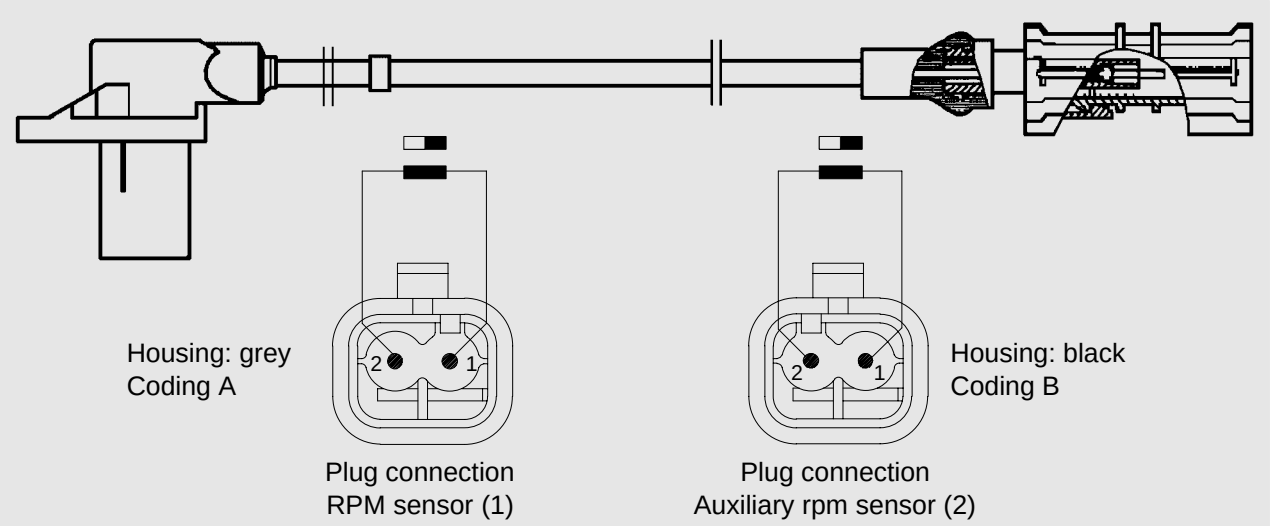
Function

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



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.
With the EDC M(S) 5 system, there are 6 grooves on the flywheel.
When a groove passes the sensor, the magnetic current is reduced. 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 in such a way that an auxiliary speed 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

The gear stage must be selected (idle speed request setpoint specification) to start the engine.

Changing idle speed

Idle speed setting is possible using EOL programming (MAN Cats), but this should only be performed by MAN customer service personnel.

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.

The intermediate engine speeds can be changed using EOL programming (MAN-Cats), but this should only be performed by MAN customer service personnel.

General

The EDC system continuously checks itself by means of a signal-range check. It does this by running 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 constantly checked the whole time the program is running. 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 memory. The faults are stored in the 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.
To report the fault, the diagnostic lamp either comes on permanently or remains off, depending on the significance of the fault. If several faults are stored, the **steady light** has priority over **OFF**.
Only faults currently present are indicated. Faults which are stored but which are not currently present are not indicated.

There are two fault memories:

- Fault memory for diagnosis via ISO interface. This memory can be read out and cleared with MAN-Cats
- Fault memory for diagnosis via flash code. The flash code memory can be read out and cleared with the aid of the diagnosis button

Faults are always entered in both fault memories simultaneously and can be read out even after the ignition has been switched off and back on again.

Indicator lamp check:
The EDC indicator lamp lights as a lamp test for approximately 2 seconds after the ignition is switched on.

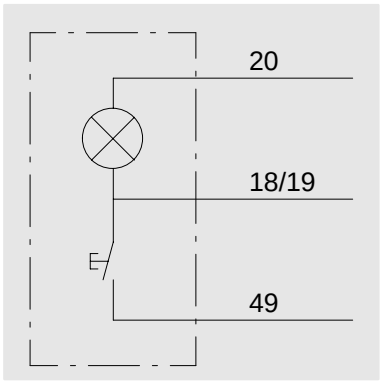
The following measures are implemented automatically depending on the significance of the fault:

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

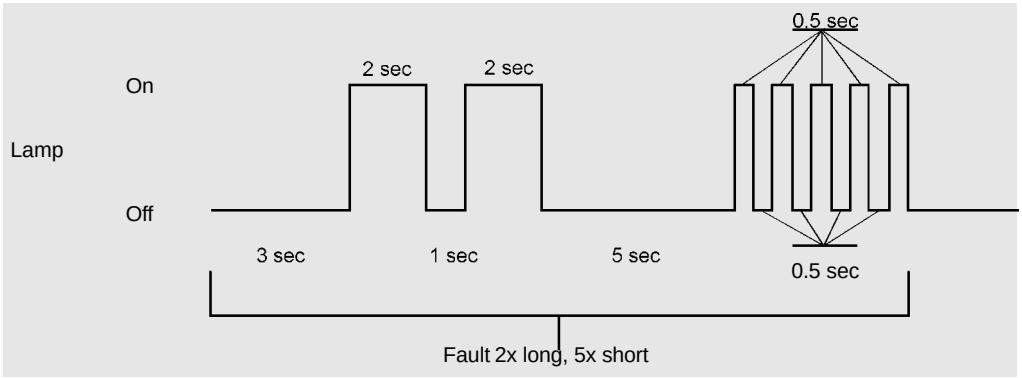
Flash code

To read out the fault memory

- With the engine stationary or running and the “ignition” switched on, press and hold the diagnosis request button for at least 2 seconds. The diagnosis lamp will not come on
- The flash procedure starts after a pause of approximately 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 that was shown first reappears



Example of a flash code output



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 a long and short pulse:	5 seconds.
ON duration of a short pulse:	0.5 seconds.
OFF phase between two short pulses:	0.5 seconds.

To clear fault memory

1. Press request button
2. Switch 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 / MS 5 EDC

Overview of flash codes					
Number of flashes		Fault path	Steady light fault	Main-tained light Reset a) / b)	see page
Long	Short				
0	0	No fault stored			
	1	Drive stage selection	yes	b)	31
	4	Engine speed sensing (rpm sensor)	yes	b)	32
	5	Turbo pressure sensing	yes	b)	33
	6	Control rod position sensing	yes	a)	34
	7	Coolant temperature sensing	yes	b)	35
	8	Resistor bank	no	b)	36
	10	Fuel volume regulator monitoring	yes	a)	37
	14	Engine speed sensing (auxiliary rpm sensor)	yes	b)	38
1	1	Turbo air temperature sensing	yes	b)	39
1	3	Battery voltage sensing	no	–	40
1	6	Processor coupling defective	yes	a)	41
1	7	Overrevving	yes	b)	42
1	12	Resistor bank	yes	a)	36
1	13	Control box	no	b)	43
1	15	CAN system	yes	b)	44
2	5	Main relay sticking	no	–	45
2	8	Atmospheric pressure sensing	yes	b)	46
2	13	TSC1-FM (setpoint selection)	yes	b)	47
3	2	EEPROM processor 1 error	yes	a)	48
3	3	EEPROM processor 2 error	yes	a)	49
3	8	Afterrunning not completed	no	–	50
3	9	Afterrunning watchdog error	no	b)	51
3	10	Control rod position sensor – loose contact	no	–	52
–	–	PBM interface	no	–	53
–	–	Redundant cut-out device (EHAB)	no	–	54

a) Reset by “Ignition” Off / On (cold restart)
b) Reset takes place automatically once the fault is rectified

List of checking procedures EDC MS 5

1. Resistance checks

– “Ignition” off, control unit **not** connected
– Engine temperature □ 25°C
– Socket box connected
– Measure resistance between PIN+ and PIN– with multimeter

	PIN+	PIN–	Set-point value	Measured value
Control rod position sensor	11	9	18–25 Ohms	. . . . . Ohms
	11	10	18–25 Ohms	. . . . . Ohms
	18	9	>10 MOhms	. . . . . MOhms
	18	10	>10 MOhms	. . . . . MOhms
RPM sensor (DZG)	21	13	0.8–1.0 kOhm	. . . . . kOhms
Auxiliary rpm sensor (HZG)	22	17	0.8–1.0 kOhm	. . . . . kOhms
Fuel-delivery regulator	15	1	0.7–1.3 Ohms	. . . . . Ohms
	18	1	>10 MOhms	. . . . . MOhms
	16	2	0.7–1.3 Ohms	. . . . . Ohms
Ground	13	18	>10 MOhms	. . . . . MOhms
	17	19	>10 MOhms	. . . . . MOhms
EHAB	14	18/19	30–70 Ohms	. . . . . Ohms
Coolant temperature sensor	53	13	1.3–3.6 kOhms [1)]	. . . . . kOhms
Charge-air temperature sensor	34	13	1.3–3.6 kOhms	. . . . . kOhms
Boost pressure sensor	33, 36	13	Resistance measurement not appropriate	
Resistor bank	35	13	500–520 Ohms	. . . . . Ohms
	51	13	2.8–3.2 kOhms	. . . . . kOhms

[1)] Resistance approximately 230–460 W with engine at operating temperature (approximately 80°C)

2. Test for engine when running and vehicle stationary (gearbox neutral)

– Engine temperature approx. 30°C
– Control unit connected
– Corrective measures

	Set-point value	Measured value	Remark	MAN-Cats
RPM sensor (DZG)	n-lower idle speed	n= ..... rpm	Min (low. idle sp.)	Engine speed
	n-top idle speed	n= ..... rpm	Max (top idle sp.)	(Monitoring 2)
Auxiliary rpm sensor (HZG)	n-lower idle speed	n= ..... rpm	Min (low. idle sp.)	Engine speed
	n-top idle speed	n= ..... rpm	Max (top idle sp.)	(Monitoring 2)

– Measure voltage between PIN+ and PIN– with multimeter

	PIN +	PIN –	Set-point value [V]	Measured value [V]	Remark	Engine speed	MAN-Cats (Monitoring)
Control unit supply (U-Batt)	15 47	18 19	U-Batt U-Batt	. . . .		Idle speed	
Reference voltage (Uref)	45 33	13 13	4.75–5.25 4.75–5.25	. . . .		Idle speed	
Idle speed switch (LGS, NO contact)	39	13	4.75–5.25 0–2.00	. . . .	Throttle lever min. Throttle lever max.	idle speed Top idle sp.	open closed
Charge-air temperature sensor (LTF)	34	13	4.17–2.62	. . . . . .	10–50°C	Idle speed	10–50°C
Water temperature sensor (WTF)	53	13	3.46–1.22	. . . . . .	30–90°C	Idle speed	30–90°C
Boost pressure sensor (LDF)	36	13	0.94–1.20 1.10–1.70	. . . .	Throttle lever min. Throttle lever max.	idle speed Top idle sp.	0–100 mbar 300–600 mbar
Resistor bank	35 51	13 13	0.75–1.25 > 0.6	. . . .	Pos 0	Idle speed	

– **Check main relay**

	PIN+	PIN–	Set-point value [V]	Measured value [V]	Remark
Main relay *	47	18	U-Batt	. . . . .	Ignition on
			0V	. . . . .	Ignition off
	46	18	0V	. . . . .	Ignition on
			U-Batt	. . . . .	Ignition off

* Pin 46 must switch to U-Batt within 0.5 to 5 seconds after ignition has been switched off.

3. Flash code diagnosis check

– EDC 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)
– Deleting the fault 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

– 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.

– 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)

– Deleting the fault memory

After the checks have been completed, the fault memory must be cleared with MAN-Cats.
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 shut-down, 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	**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 faulty
																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 faulty (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 worn
																		x			Valve stems worn
	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 consumption due to faulty secondary consumers such as hydraulic pumps, fan, etc, power take-off engaged
			x			x				x		x								x	Air cleaner soiled or clogged, charge-air system leaking, air inlet / exhaust lines 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 / heavily contaminated (paraffin added)

x = Probable
o = Possible

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 shut-down, 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	**Possible causes**
		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 the system (turn on ignition when bleeding the system)
		x	x	x				x	x	x	x		x				x					Fuel low pressure system: delivery pump, overflow valve, main filter
		x						x		x	x	x	o	x			x					Fuel high pressure system: nozzles faulty / 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 / incorrectly set
								o			x	o					o					Fuel high pressure system: injection pump constant-pressure control valve / return flow constrictor faulty
		x	x	x				o	x													EHAB defective, drive faulty
		o	o					o		x		o	x	x			x					Injection pump / engine synchronisation: start of delivery incorrect (basic installation), start of delivery set incorrectly
x		x	x	x				o		x	o											Injection pump controller: stiff movement – fuel volume regulator (control deviation)
x		x	x	x					o													Control rod position sensor in regulator: connection lines, break, short-circuit
		o						o					o									Control rod position sensor in regulator: set incorrectly
x		x		o																		Control rod position sensor in regulator: capacitance reserve of the wiring harness too low (e.g. water penetrated wiring harness)
								x		o	x	o		o								Injection pump: fuel volume 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, or CAN-Bus
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 faulty, line fault
x								x					x									EDC boost pressure sensor: faulty, incorrect, implausible with atmospheric pressure sensor, line fault
								x		x		o	x									Exhaust turbocharger leaking or faulty
																					x	Turbine and compressor rotor in turbocharger dirty (out-of-balance, irregular running)
													x									Intercooler leaking, faulty
		x										x										Flame starting system defective
x		o						x	x			o		x								EDC coolant temperature sensor: faulty, line fault
x								x	x													EDC charge-air temperature sensor: faulty, line fault
o								x						x								Radiator dirty or cooling system failure (temperatures too high)

x = Probable
o = Possible

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 shut-down, 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	**Possible causes**
														x								Coolant level too low, air in coolant circuit
														x								V-belt for water pump drive not tensioned correctly
																					x	Incorrect V-belt tension
														x								Water pump leaking, faulty / thermostat faulty, does not open
														x								Coolant lines leaking, clogged or twisted
												x										Coolant entering combustion chamber (cylinder head / gasket leaking)
								x														Resistor bank EDC control unit pin 51
x		x	x	o				o														Power supply to EDC control unit interrupted or battery voltage too low / Relay K1 faulty
		x	x	o				o														Line terminal 15 to EDC control unit (pin 47) interrupted / loose contact
															x							Line defective: Pin 23 or 41
x		o	o	o																		EDC control unit faulty (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. shut-down via EMERGENCY STOP)
															x							EOL programming: configuration incorrect
										x												Engine bearings worn

x = Probable
o = Possible

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 when troubleshooting the system and this can cause the corresponding fault codes to be set and stored.
For this reason, the fault memory should always be cleared after intermediate checks.

The “test lines” test stage must always be performed as follows:

– Break or contact resistance
  Set-point value: approximately 0 Ω
– Short to negative
  Set-point value: ∞ Ω
– Short to positive
  Set-point value: ∞ Ω
– Short to adjacent lines
  Set-point value: ∞ Ω
– Loose contacts

After rectifying faults and checking, repeat test and clear 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 on 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 resistance measurements are being carried out.

Drive stage selection

Flash code: 1x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Drive stage selection
– Signal too high
– Signal too low
– Signal implausible with idle speed switch

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: Socket box connected
"Ignition" switched on

Test	Measurement	Corrective measures
Voltage supply	Measure voltage at the socket box across pin 45 (+) and pin 13 (–) **Setpoint:** 4.75–5.25 V	– Check lines – Check plug connections – If no fault found, replace control unit (disconnect the control unit only when the current is switched off)
Drive stage selection PWG Min. 0 % PWG Max. 100 %	Measure voltage at the socket box across pin 27 (+) and pin 13 (–) **Setpoints:** Idle speed setting: 0.3–0.5 V Full load setting: 2.9–3.1 V	– Check lines – Check plug connections – Replace drive stage selection
Idle speed switch PWG Min. 0 % PWG Max. 100 %	Measure voltage on the socket box across pin 39 (+) and pin 13 (–) **Setpoints:** Idle speed setting: 4.75–5.25 V Full load setting: 0.0–2.0 V	– Check lines – Check plug connections Switch open Switch closed

RPM sensor

Flash code: 4x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

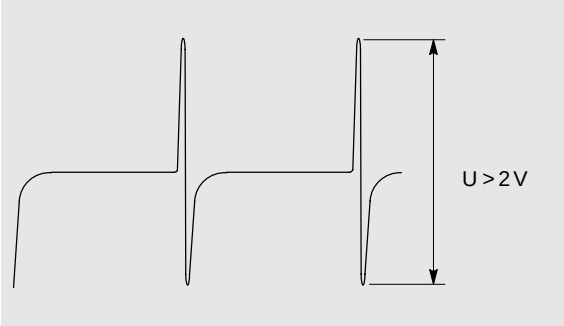
Fault path: RPM sensor
– Statically implausible
– Dynamically implausible
– Implausible with auxiliary rpm sensor

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 faulty, control unit faulty

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:** 800–1000 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 diagram	



Boost pressure sensor

Flash code: 5x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

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

Effect of fault: 60 to 70 % reduction in power

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

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 33 (+) and pin 13 (–) **Setpoint:** 4.75–5.25 V	– Check lines – Check plug connections – If no fault found, replace control unit (disconnect the control unit only when the current is switched off)
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: 1.10–1.70 V	
	If all the values are OK, the atmospheric pressure sensor in the control unit may be faulty	– Replace control unit (only disconnect control unit once the current is switched off)

Control rod position sensor

Flash code: 6x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

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

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

Possible cause: Line break, short-circuit, too little capacitance reserve (see page 26), control rod position sensor set incorrectly, injection pump faulty

Test precondition: EDC control unit disconnected
Corrective measures

Test	Measurement	Corrective measures
Instrument 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	
	Measure resistance at socket box across pin 18 and pin 9 **Setpoint:** > 10 MΩ	
	Measure resistance at socket box between pin 18 and pin 10 **Setpoint:** > 10 MΩ	
	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 sensor	– Remove injection pump – Adjust control rod position sensor

Coolant temperature sensor

Flash code: 7x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

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 faulty, control unit faulty, 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 the 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 – If no fault found, replace control unit (disconnect the control unit only when the current is switched off)
Sensor voltage (control unit connected)	Measure voltage at socket box between pin 53 and pin 13 **Setpoint:** 3.46–1.22 V at 30–90°C	

Resistor bank

Driving speed

Flash code: 8x short

Fault indication: Fault is not indicated by the EDC indicator lamp

Torque limitation

Flash code: 1x long, 12x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Driving speed / Torque limitation

Fault path: Resistance for the sensors not present – speed of travel (pin 51) and torque limit (pin 35)
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		– Check lines – Check plug connections
		Setpoint:	– If no fault found, replace resistor bank
	Pin 13 and Pin 35	500–520 Ω	
	Pin 13 and Pin 51	2.8–3.2 kΩ	

Fuel volume regulator

Flash code: 10x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Fuel volume regulator control deviation

Effect of fault: The setpoint – actual value comparison for activating the fuel volume 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 faulty (internal fault in regulator or stiff movement), capacitance reserve of line leading to control rod position sensor too low (see page 26)

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, pin 16 and pin 2 **Setpoints:** 0.7–1.3 Ω Measure resistance at socket box between 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 is indicated by the EDC indicator lamp coming on continuously

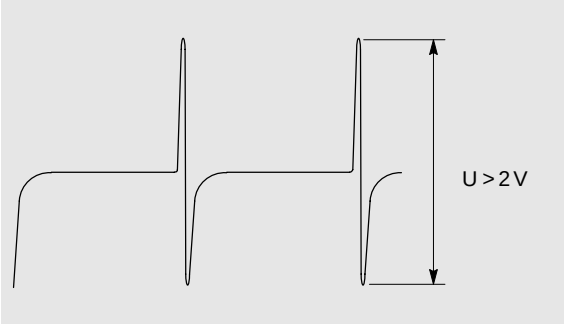
Fault path: Auxiliary rpm sensor
– Statically implausible
– Dynamically implausible
– Implausible with rpm sensor

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 faulty, control unit faulty

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

Test	Measurement	Corrective measures
Resistance	Measure the resistance at the socket box between pin 22 and pin 17 **Setpoint:** 800–1000 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 diagram	



Charge-air temperature sensor

Flash code: 1x long, 1x short

Fault indication: Fault is not indicated by the EDC indicator lamp

Fault path: Charge-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 (only disconnect the control unit once the current is switched off)
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 the 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 memory entries

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

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

Test	Measurement	Corrective measures
Voltage supply	To activate the main relay K1, connect jumper across pin 46 and pin 19 Measure voltage at socket box across pins 15/16 (+) and pins 18/19 (–) **Setpoint:** 24–28 V	– Check lines – Check plug connections – Replace main relay

Control unit

Flashcode: 1x long, 6x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Control unit fault (processor coupling)

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

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

Test precondition: EDC control unit connected

Test	Measurement	Corrective measures
The controller contains	This fault signal can also occur in the event of extremely low power supply (loose contacts or undervoltage)	– Check lines – Check plug connections
	Internal fault in control unit	– Replace control unit (only disconnect the control unit once the current is switched off)

Engine overspeed

Flash code: 1x long, 7x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Engine overspeed

Effect of fault: Fuel delivery is interrupted. EHAB is deactivated.
If no other fault is present, fuel delivery will continue once the engine overspeed range has been left.

Possible cause: Stiff control rod. Injection pump defective, control unit defective, wiring harness defective, engine being towed

Test	Measurement	Corrective measures
	If no other faults are present, no further action is necessary	– Deleting the fault memory
Injection pump	If the fault occurs more frequently, check injection pump, control unit and lines.	– Replace lines – Replace control unit (disconnect control only when current is switched off) – Replace injection pump

EDC control box for idle speed adjustment

Flash code: 1x long, 13x short

Fault indication: Fault is not indicated by the EDC indicator lamp

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

Effect of fault: The idle position 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
Control box	Measure voltage at the 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: 3.72–4.33 V Not activated: 3.15–3.55 V	– Check lines – Check plug connections – Replace the control box – If no fault found, replace control unit as a check (disconnect the control unit only when the current is switched off)

CAN system (control unit)

Flash code: 1x long, 15x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Control unit faulty

Effect of fault: The data exchange has been interrupted. Some engine data (speed, temperature of water and charge air, boost pressure and fuel consumption) no longer displayed.

Possible cause: Line break, short-circuit

Test	Measurement	Corrective measures
Control unit	No further testing necessary	– Replace control unit (only disconnect the control unit once the current is switched off)

Main relay

Flash code: 2x long, 5x short

Fault indication: Fault is not indicated by the 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 side of the relay coil is triggered by the EDC control unit via the control unit output pin 46. The main relay switch-off is delayed after the ignition is switched off (run-on).
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 faulty

Test precondition: EDC control unit connected
Socket box connected

Test	Measurement	Corrective measures
Main relay	Measure voltage at the 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 within 5 seconds of the ignition being switched off (processor run-on).

Atmospheric pressure sensor (in control unit)

Flash code: 2x long, 8x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Atmospheric pressure sensor in control unit faulty

Effect of fault: The power reduction at high altitudes for the protection of the exhaust turbocharger is not activated

Possible cause: Control unit faulty

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 boost pressure sensor is also detected, this should be checked first in accordance with the boost pressure sensor test (page 33).	– Replace control unit (only disconnect the control unit once the current is switched off)

CAN system (TSC1-FM message)

Flash code: 2x long, 13x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: EDC – CAN communication is faulty

Effect of fault: Idle speed

Possible cause: Power interruption

Test precondition: EDC control unit and CAN computer disconnected
Socket box connected to EDC plug

Test	Measurement	Corrective measures
Resistance	Resistance measurement between pin 30 (CAN-L) on the socket box and a downstream computer **Setpoint:** 0 Ω	– Check line – Check plug connection
	Resistance measurement between pin 31 (CAN-H) on the socket box and a downstream computer **Setpoint:** 0 Ω	

Control unit, EEPROM processor 1 fault

Flash code: 3x long, 2x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Processor 1 in control unit faulty (EEPROM 1)

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

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

Test	Measurement	Corrective measures
Voltage supply	No further testing necessary	– Complete EOL programming, clear fault codes – Replace control unit (only disconnect the control unit once the current is switched off)
Control unit		

Control unit, EEPROM processor 2 fault

Flash code: 3x long, 3x short

Fault indication: Fault is indicated by the EDC indicator lamp coming on continuously

Fault path: Processor 2 in control unit faulty (EEPROM 2)

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

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

Test	Measurement	Corrective measures
Voltage supply	No further testing necessary	– Complete EOL programming, clear fault codes – Replace control unit (only disconnect the control unit once the current is switched off)
Control unit		

Control unit (processor run-on)

Flash code: 3x long, 8x short

Fault indication: Fault is not indicated by the EDC indicator lamp

Fault path: Control unit
– Processor run-on did not take place

Effect of fault: No direct effect

Function: Every time the engine is turned off, run-on takes place automatically for the purpose of checking the various processor functions

Possible cause: Control unit faulty, main relay faulty, 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 40) and main relay (page 45)	– Switch ignition on and off again, clear fault code – Same as pages 40 and 45 – Replace control unit (only disconnect the control unit once the current is switched off)

Other possible causes

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

Control unit watchdog run-on fault

Flash code: 3x long, 9x short

Fault indication: Fault is not indicated by the EDC indicator lamp

Fault path: Control unit faulty (watchdog test)

Effect of fault: None

Test	Measurement	Corrective measures
Control unit	No further testing necessary	– Replace control unit (only disconnect the control unit once the current is switched off)

Control rod position sensor – loose contact

Flash code: 3x long, 10x short

Fault indication: Fault is not indicated by the EDC indicator lamp

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

Effect of fault: None

Possible cause: Line break, short-circuit, too little capacitance reserve (see page 26), control rod position sensor set incorrectly, injection pump faulty

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement	Corrective measures
Instrument 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	
	Measure resistance at socket box across pin 18 and pin 9 **Setpoint:** > 10 MΩ	
	Measure resistance at socket box between pin 18 and pin 10 **Setpoint:** > 10 MΩ	
	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 sensor	– Remove injection pump – Adjust control rod position sensor

PBM interface

Flash code: No code

Fault indication: Fault is not indicated by the 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 line – Replace control unit
	Measure resistance at socket box across pin 29 and pin 19 **Setpoint:** ∞ Ω	

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 the 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. when the control rod has 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	Switch off “ignition” Disconnect control unit Measure resistance at socket box across pin 14 and pin 19 **Setpoint:** 30–70 Ω	– Check line – Replace control unit – Replace EHAB
Voltage supply	Switch on “ignition” Measure voltage at socket box across pin 14 (+) and pin 19 (–) **Setpoint:** U-Batt	– Check line – Replace control unit – Replace EHAB If no fault found: – Replace control unit (only disconnect control unit once the current is switched off)

Note:
When bleeding the fuel system using the presupply pump, power must be supplied to the EHAB, i.e. **the fuel system cannot be bled without the “ignition” being switched on**.
See page 26 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	Not used
4	VHS O	Not used
5	MBR 1	Not used
6	LEB 1	Not used
7	WGS 1	Not used
8	LKS 1	Not used
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	Not used
13	GND A	Sensor ground
14	EAB 1	Electrical shut-down – Output (switch) – I_{max} 1 A, $U_{batt.}$ against batt. –,
15	Bat +	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	Bat +	Batt.+ via main relay – Input battery +
17	NBF 0, HZGO	Needle movement sensor and auxiliary rpm sensor – Reference ground
18	Bat –	Battery negative – Input battery – – I same as batt.+ (terminals 15 and 16)
19	Bat –	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	Not used
25	FMS-E	Not used
26	KUP-E	Not used
27	PWG 1	Pedal travel 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

Pin No.	Abbreviation	Description
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	Boost pressure sensor – Output, supply – Controlled direct voltage, U approx. 5 V
34	KTF 1	Fuel temperature sensor (used for turbo air temperature) – Input, analog
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	Not used
38	EOL E	Not used
39	LGS-E	Idle speed switch signal – Input, static – against GND-O (terminal 13)
40	MST-E	External engine cut-out
41	ZDR-E2	Intermediate engine speed control 2 – Input, static Batt.+
42	MBR-E	Not used
43	BRE-E	Not used
44	FGR 1	Speed control device
45	PWG 2	Pedal travel 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
55	LTF 1	Not used

1. Revision list

Date	Revisions
30.05.1994	First issue
26.04.1999	New edition

2. Scope

This data sheet comprises the specifications and tests for the electronic control unit EDC-MS5 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 without protecting sleeve	 in accordance with DIN 40 050, Part 9; IP 54 A in accordance with DIN 40 050, Part 9; IP 30

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

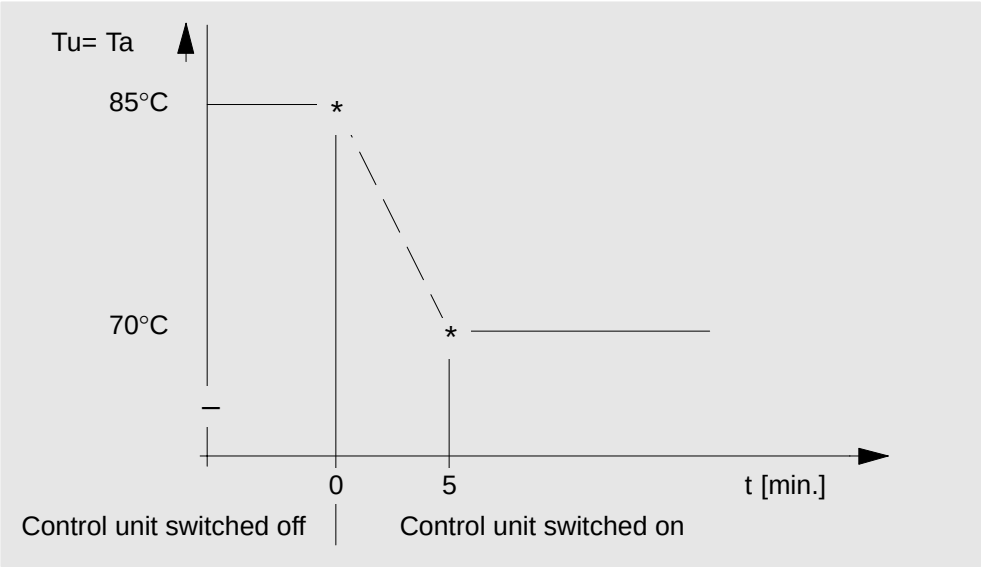
Still air

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 okt./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)
	Max. acceleration amplitude	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.– of the control unit)	7.0 ... 32 V normal operation min. 16 V for 50 ms after switching on terminals the control unit

The definition provided in Section 7 applies to the voltages U-batt+ ≤ 7 V or U-bat– ≥ 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 BAT+, BAT–, 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 7V ≤ U-Bat+ ≤ 32V.
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 = 200ms (at +U-Batt = 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 EMV

7.3.1 Irradiation immunity

Frequency range	1 MHz ... 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.

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

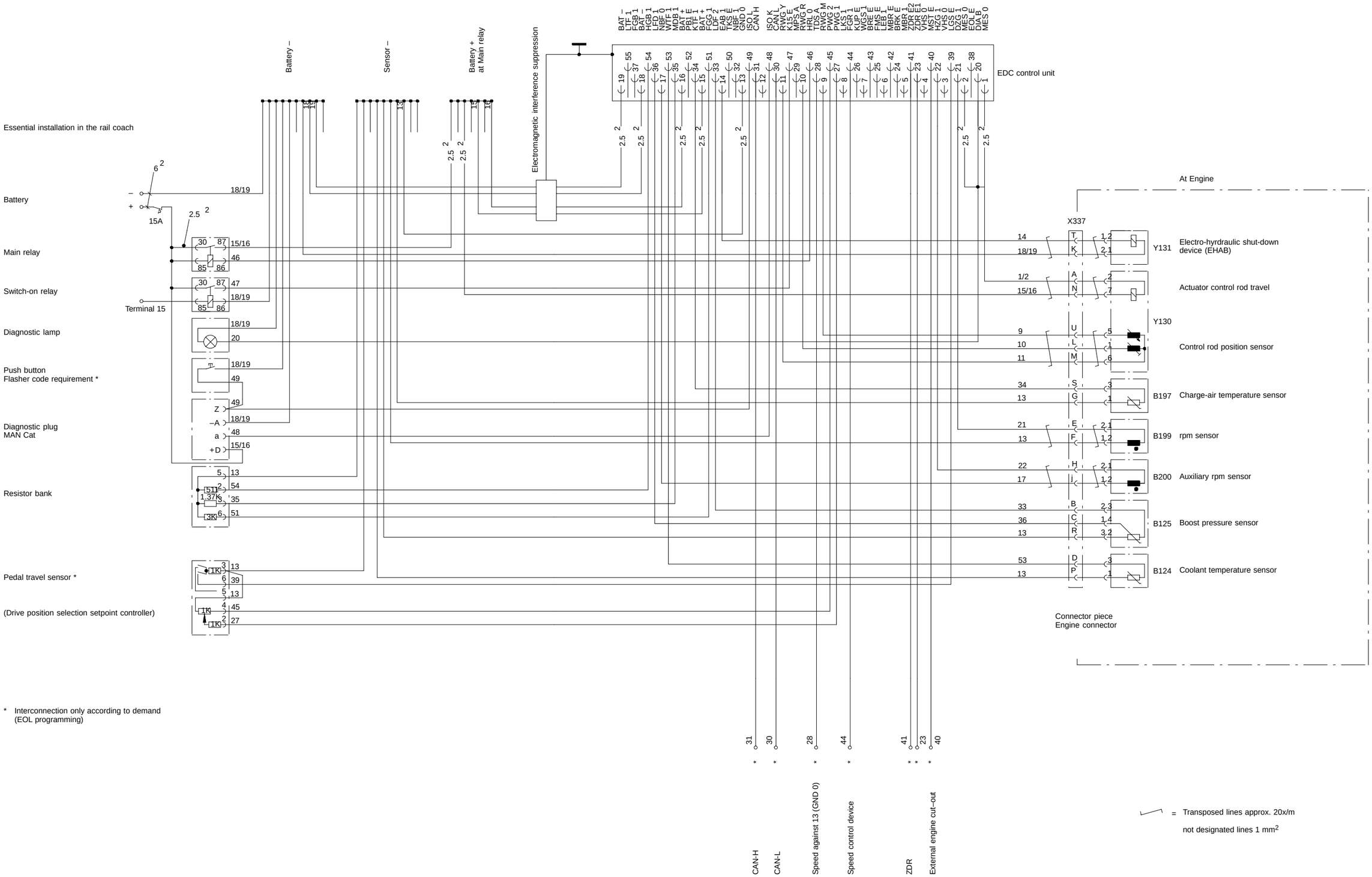
9. Mechanical test data

9.1	Vibration stress	As Point 5.1
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	< 10K/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.

Connection diagram



* Interconnection only according to demand (EOL programming)

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