Electronic Diesel Control
EDC M(S) 5 - D28 V marine engines

Description, testing, interfaces,
4-20 mA engine triggering system and electric gearbox triggering system,
Link to MMS (BEW 1) engine monitoring system

Dear Customer

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: 04.2000 51.99598–8021

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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, anti-freeze 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

- Put gearbox of ship into neutral, if necessary unhinging gearshift lever (disconnect via remote control)

- 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 route cable of welding apparatus parallel to electric lines on board the ship.

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

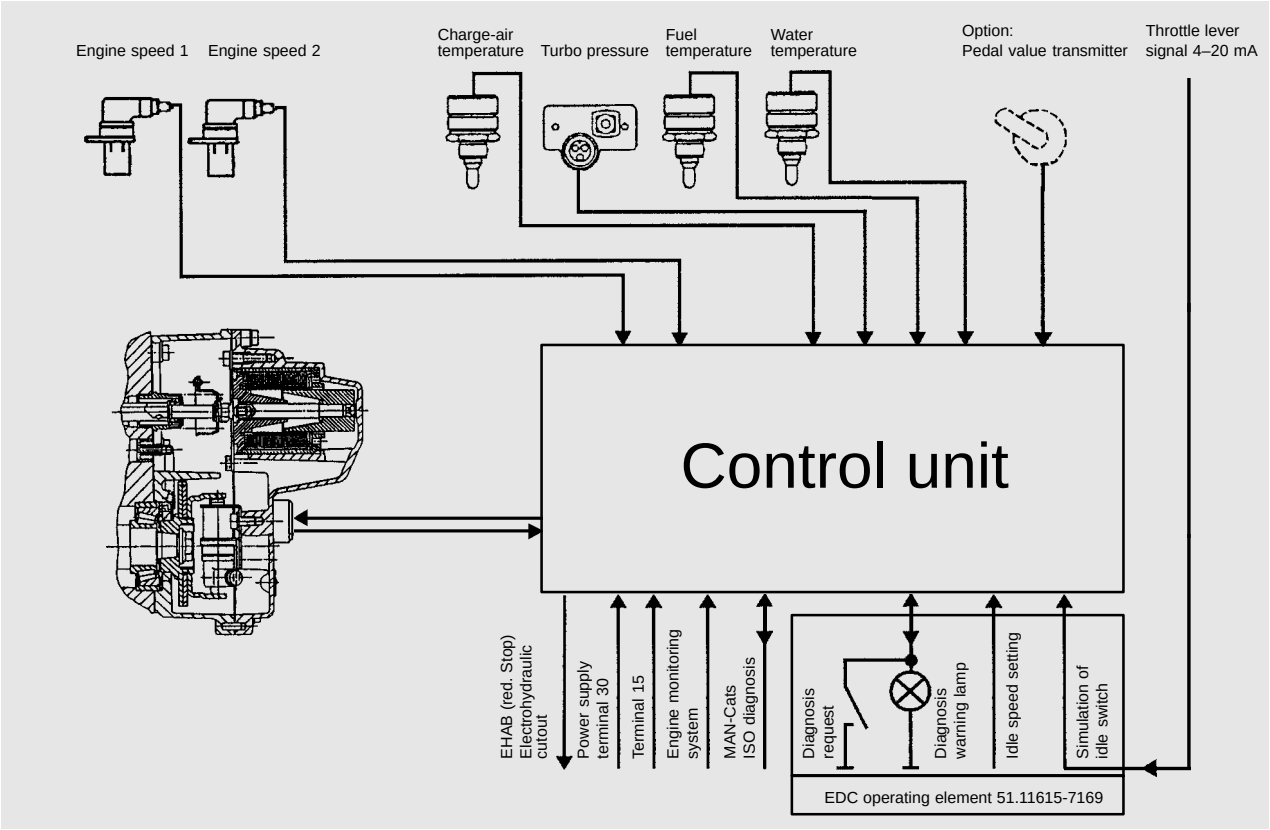
The requirements set by customers and legislation in respect of fuel consumption, exhaust emission and noise characteristics etc. on diesel engines have grown over the years and will be even more stringent in the future.

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 engine can be triggered

– mechanically with the pedal value transmitter or alternatively
– electrically with the 4–20 mA signal.

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
– the pedal value transmitter (throttle lever signal) or from the 4–20 mA throttle lever triggering system
– turbo pressure sensor
– coolant temperature sensor
– turbo air temperature sensor
– Pedal value transmitters
– Fuel temperature sensor (in injection pump)

The expanded EDC control box 51.11615–7169 contains the following functions:

– EDC fault diagnosis with LED and flashcode
– Idle speed adjustment
– Conversion of 4–20 mA input signal into a voltage signal
– Galvanic separation of the 4–20 mA input signal from the EDC control unit
– Simulation of the idle switch if the 4–20 mA triggering system is used

Communication with the MAN-Cats checking and diagnostic computer is possible via an ISO interface also integrated in the terminal box.

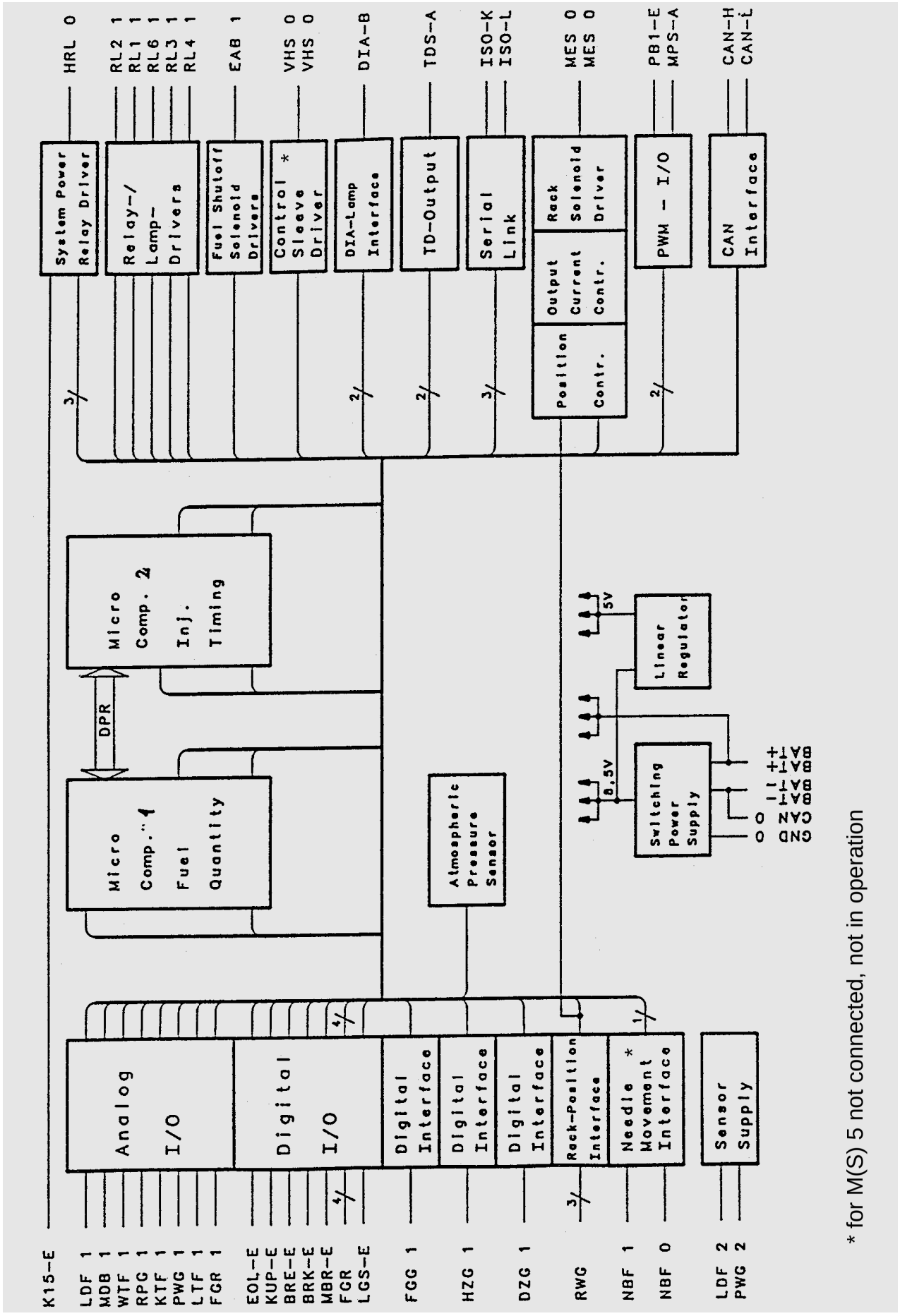
The control unit, with its program adapted to the engine model concerned, determines the optimum setting of the control rod from all the measured values.

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.

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 altered within certain limits. The idle speed set ex works is 600 rpm. However, it can be varied via the EDC operating element in the range from 600 to 750 rpm.

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

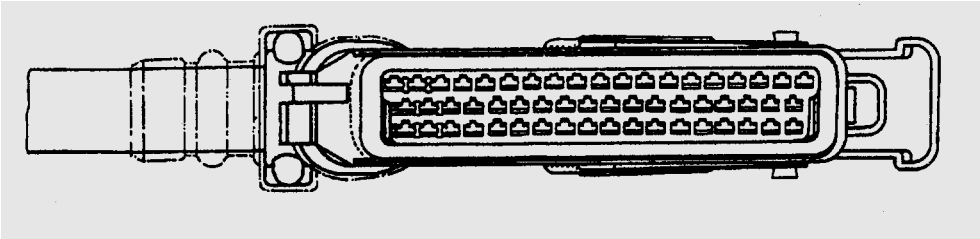
Block Diagram M(S) 5



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-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 (Sensor ground) – Speed sensor – boost pressure sensor – pedal value transmitter (hand throttle signal) – boost air temperature sensor – coolant temperature sensor – resistor bank (in the EDC operating element) – Fuel temperature sensor
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	Not used

Pin assignments of control unit plug connector

EDC Pin	Connection to component (O=Output, I=Input)
24	Not used
25	Not used
26	Not used
27	Pedal value transmitter (throttle lever) – signal
28	Engine speed signal output from control unit (square-wave pulses) **O**
29	Not used
30	Not used
31	Not used
32	Not used
33	Boost pressure sensor (supply) – Pin 2 on the charge-air pressure sensor **O**
34	Fuel temperature sensor
35	To the EDC operating element with resistors for reduction in the event of external faults
36	Charge-air pressure sensor (Signal) – pin 1 on the charge-air pressure sensor **I**
37	Not used
38	Not used
39	Pedal value transmitter (idle speed switch)
40	Not used
41	Not used
42	Not used
43	Request button (brake) – Pin 7 in the EDC operating element **I**
44	Idle speed adjustment – pin 5 in the EDC operating element
45	Pedal value transmitter (supply)
46	Relay for voltage supply (main relay) K1 coil **O**
47	Ignition system “On”, terminal 15
48	Diagnostic connection (K line) for MAN-Cats
49	Diagnostic connection (L line) for MAN-Cats
50	Input for external engine stop (engine room panel with round instruments)
51	Not used
52	Assigned to batt.+ (to enable multiplex signal)
53	Coolant temperature sensor – Pin 3 on temperature sensor **I**
54	Not used
55	Boost air temperature sensor – Pin 1 on temperature sensor **I**

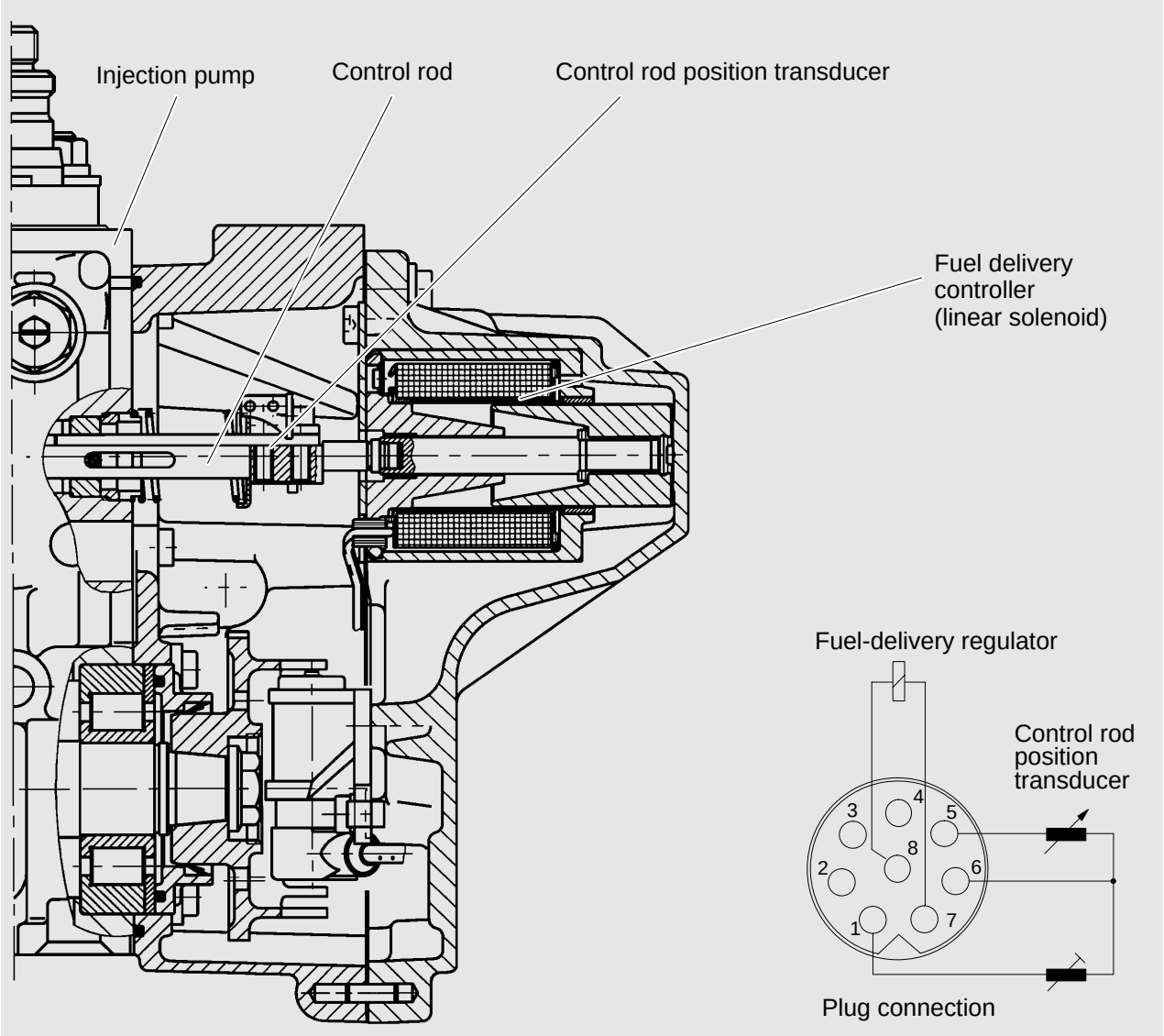
Injection pump

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

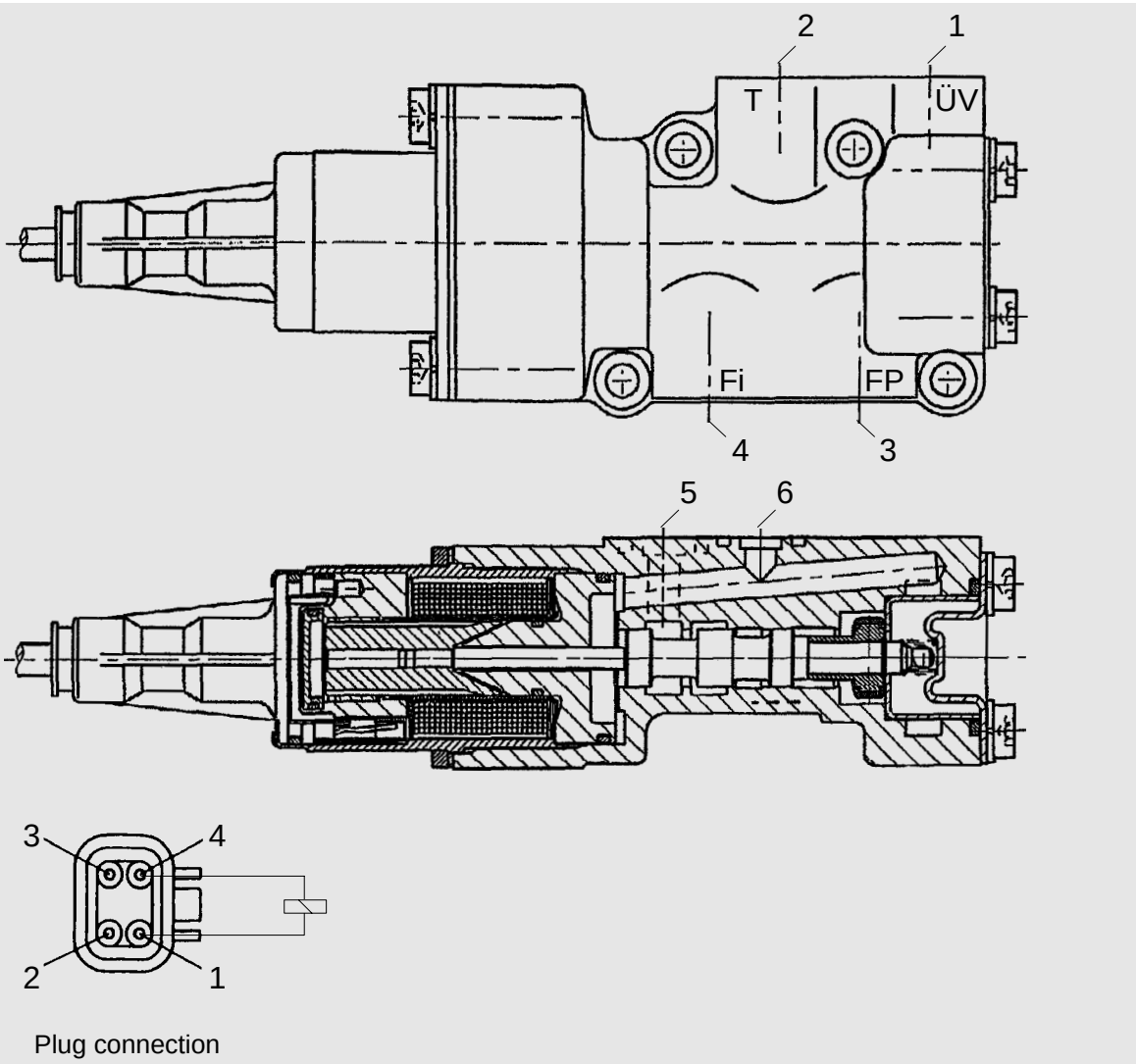
Description:
The fuel-delivery regulator operates in conjunction with the P-pump. The most important component part of the fuel-delivery controller is a linear solenoid in which the armature acts directly on the control rod thus determining the injection volume by means of the control position. When 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.

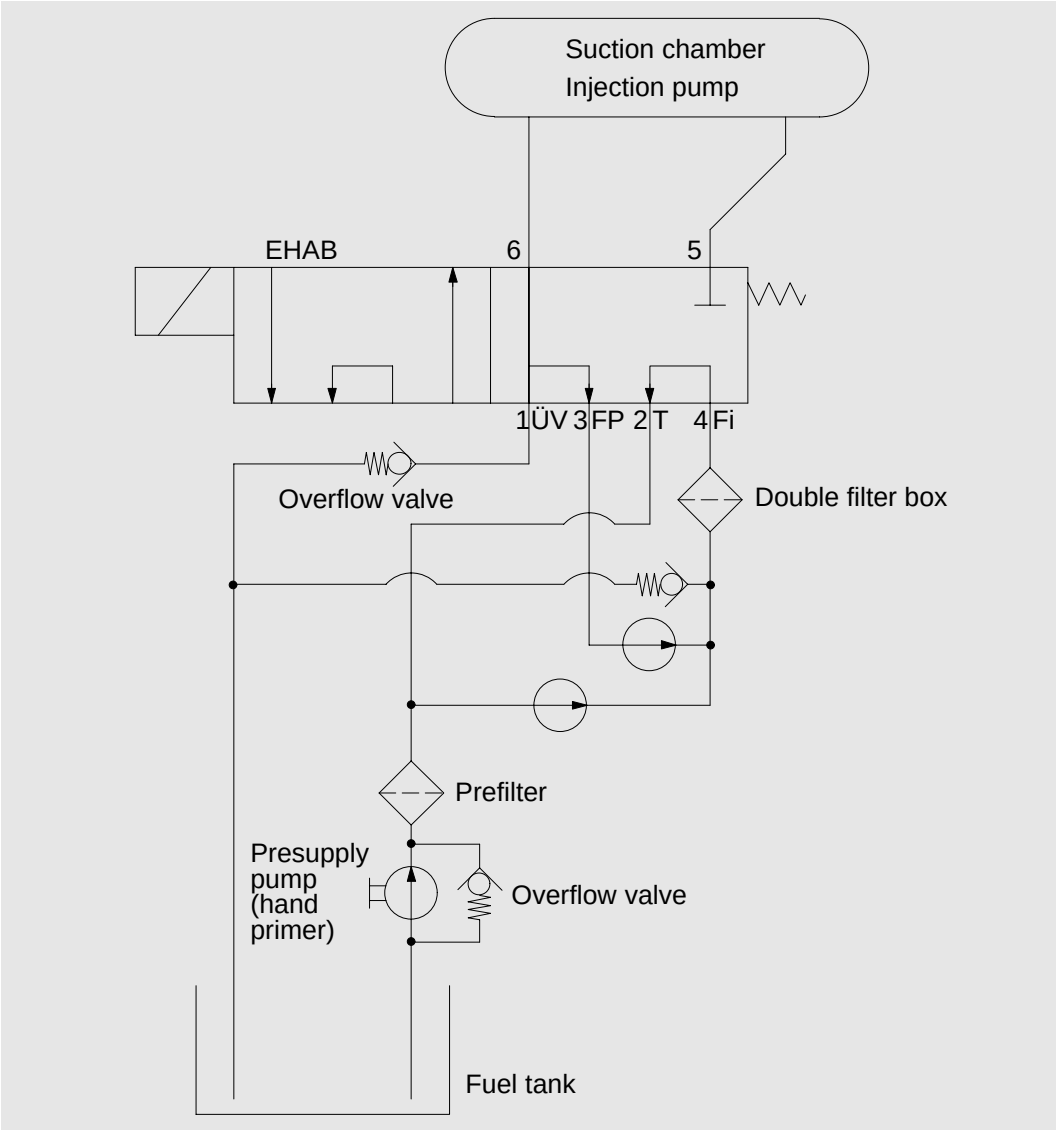


Electrohydraulic shut-off device EHAB

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 shut-down).
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.

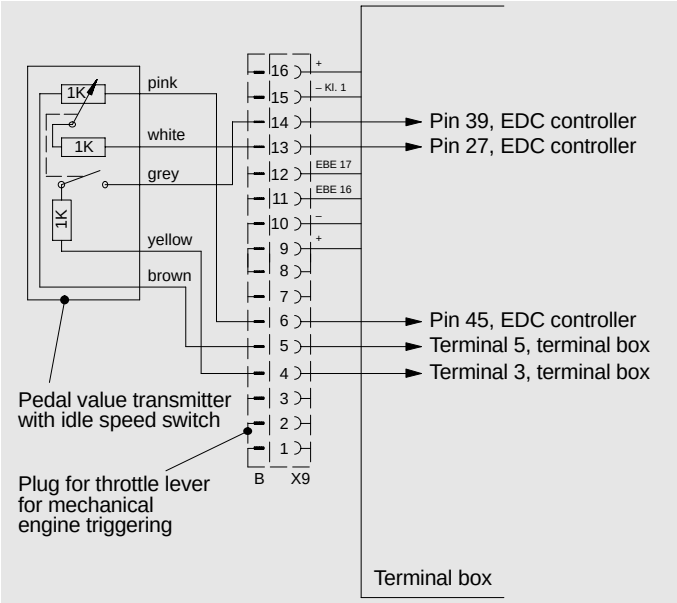
Pedal value transmitter or 4–20 mA throttle lever signal

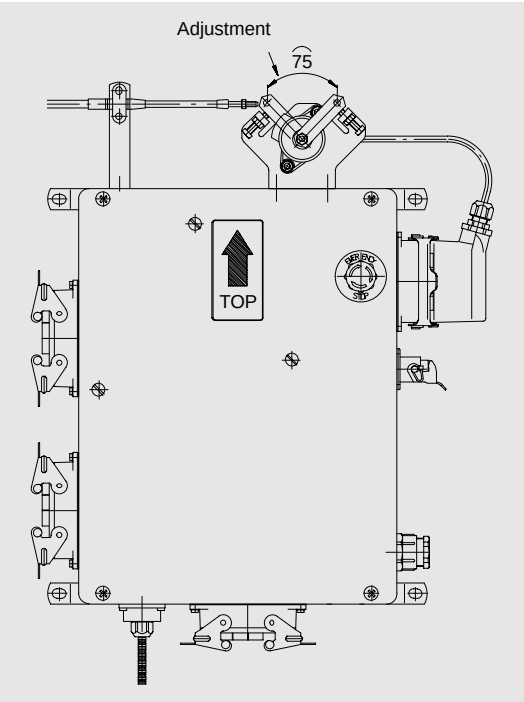
Function

The pedal value transmitter or the 4–20 mA signal from the electrical throttle lever trigger transmit the driver's request to the control unit. Then control unit uses these inputs to calculate the correct injection quantity.

a) Mechanical engine triggering with pedal value transmitter

The mechanically (e.g. via bowden cable) triggered pedal value transmitter is plugged into the MAN terminal box.





b) Electric engine triggering with 4–20 mA signal

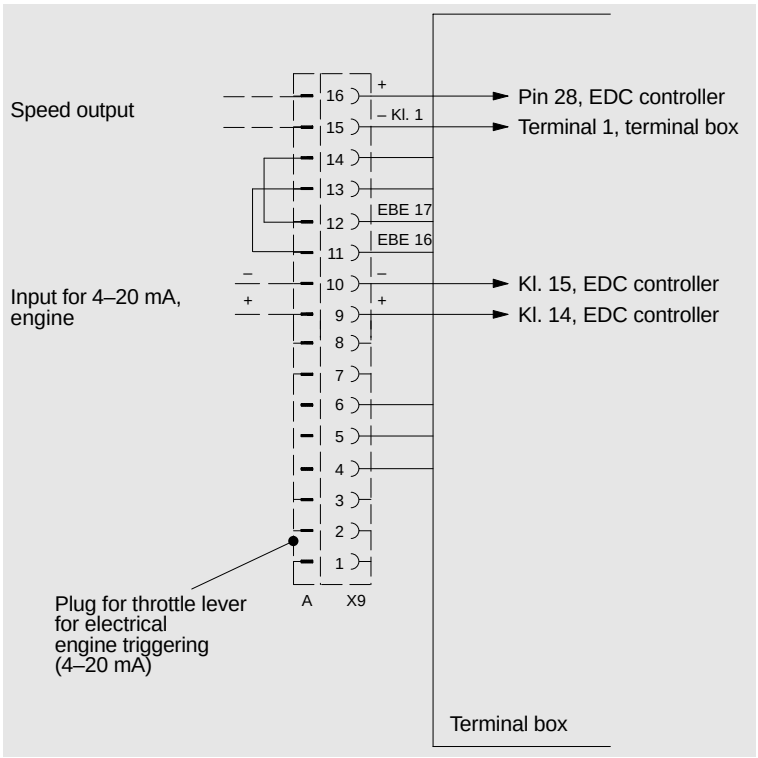
Alternatively the engine can be triggered with a 4–20 mA current signal from an electrical throttle lever control system (4–20 mA ≙ idling – full-load).

If the 4–20 mA signal fails, the engine will continue to run at idling speed.
⇒ Alarm “Electronic – failure” at the BE1 engine monitor (EDC continuous light fault)

The EDC speed signal (see also page 99) can be read into the throttle lever control system and used for engine synchronisation.

Plug A supplied for socket X9 (on the terminal box) has internal screw clamps so that the boatyard will not need crimping tools.

Plug assignment X9:	Pin 9:	Input for 4–20 mA signal (+)
	Pin 10:	Input for 4–20 mA signal (–)
	Pin 15:	Output for speed signal (+)
	Pin 16:	Output for speed signal (–)

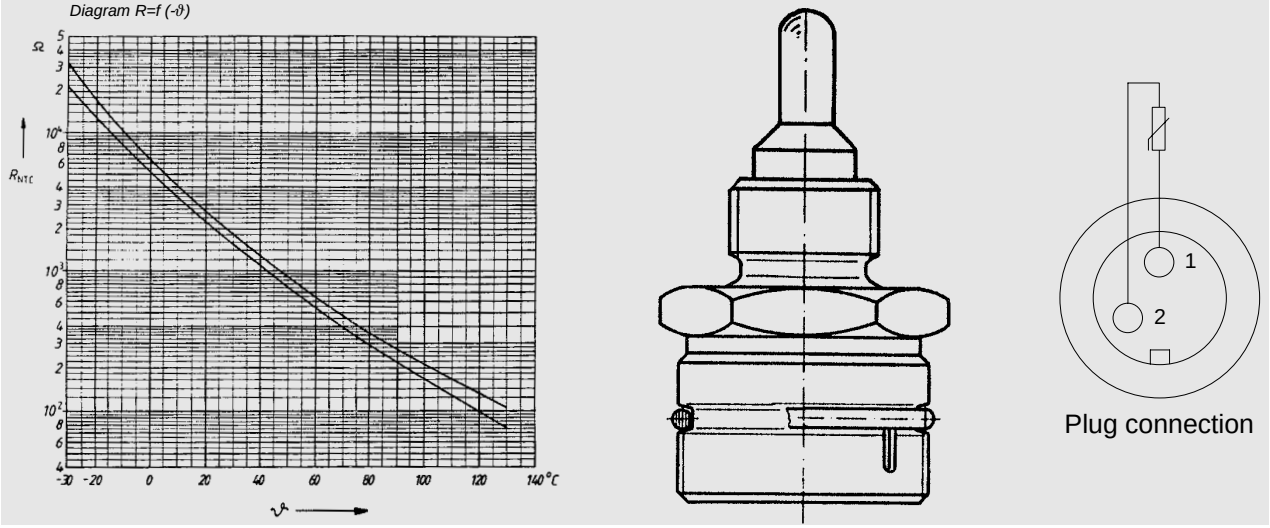


The 4–20 mA input (terminals 9+10, EDC control box) is an isolated input.

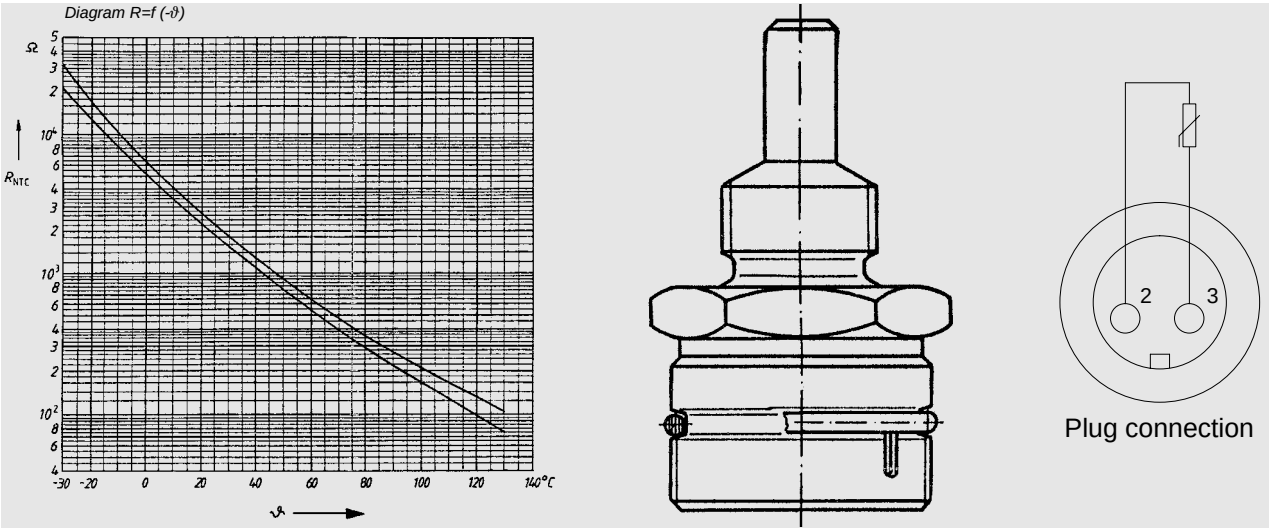
If the speed signal is used it must be ensured that the signal is either processed isolated or that the same negative potential is used as for the EDC control unit.

Temperature sensors for charge air, coolant and fuel

Turbo air (51.27421–0077)



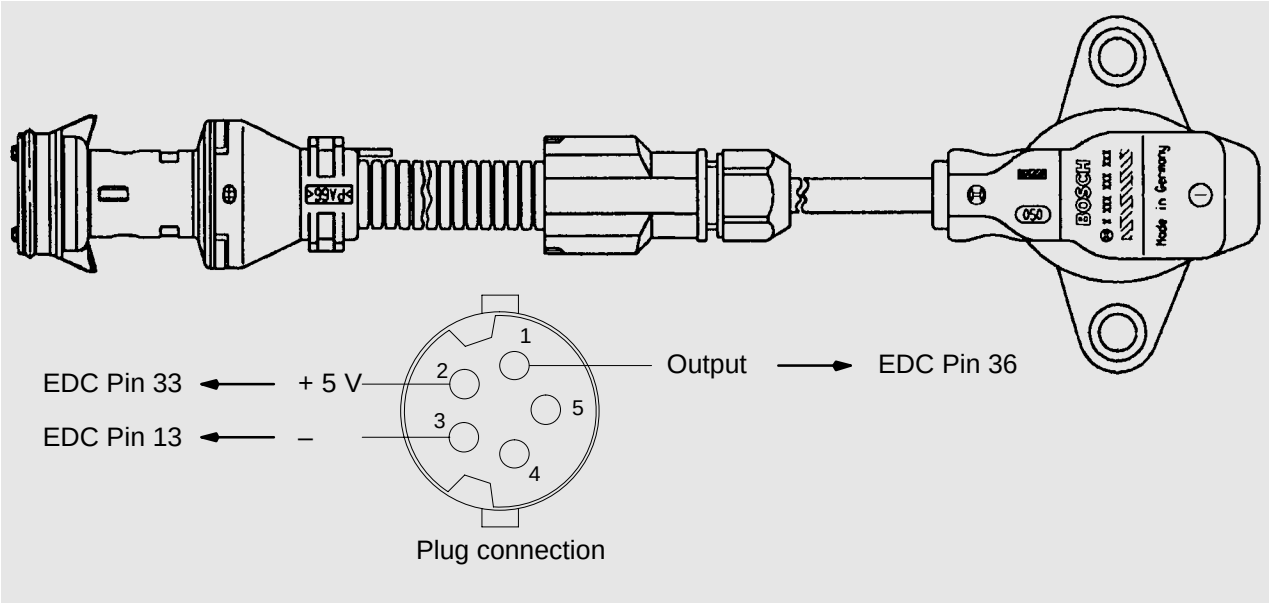
Coolant temperature sensor, Fuel temperature sensor (51.27421–0113)



Function

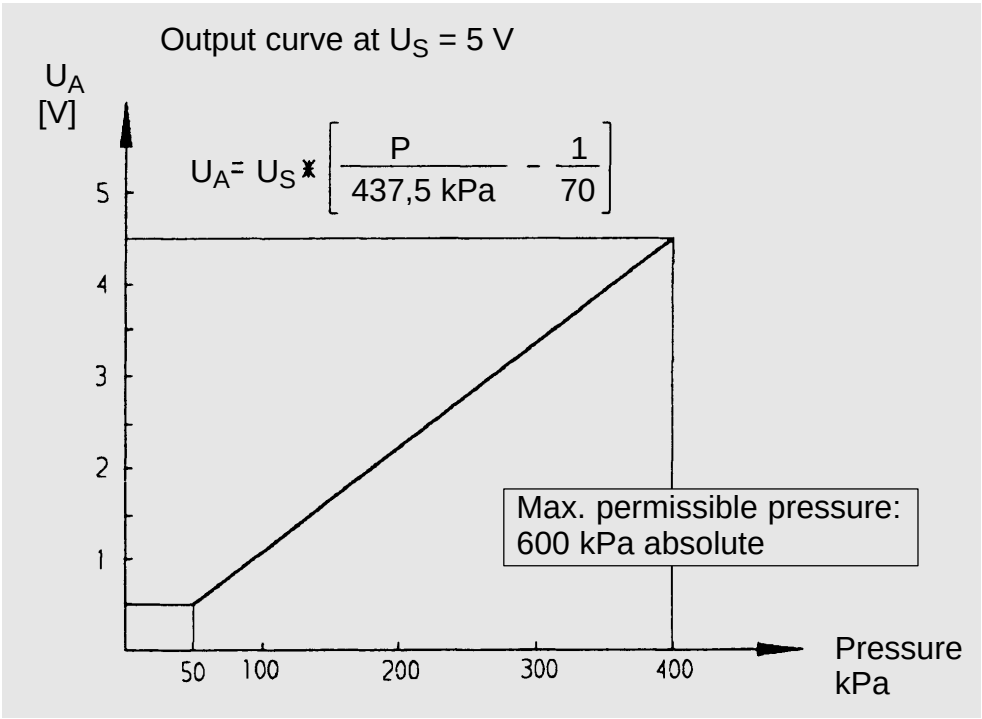
The temperature sensors for charge air, coolant and fuel are NTC resistors. The coolant temperature sensor is in the coolant circuit below the heat exchanger. The charge air temperature sensor is in the charge air circuit downstream of the intercooler. The fuel temperature sensor is in the fuel circuit at the injection pump. They supply the control unit with information on the coolant, fuel and charge-air temperatures.

Turbo pressure sensor (51.27421–0128)

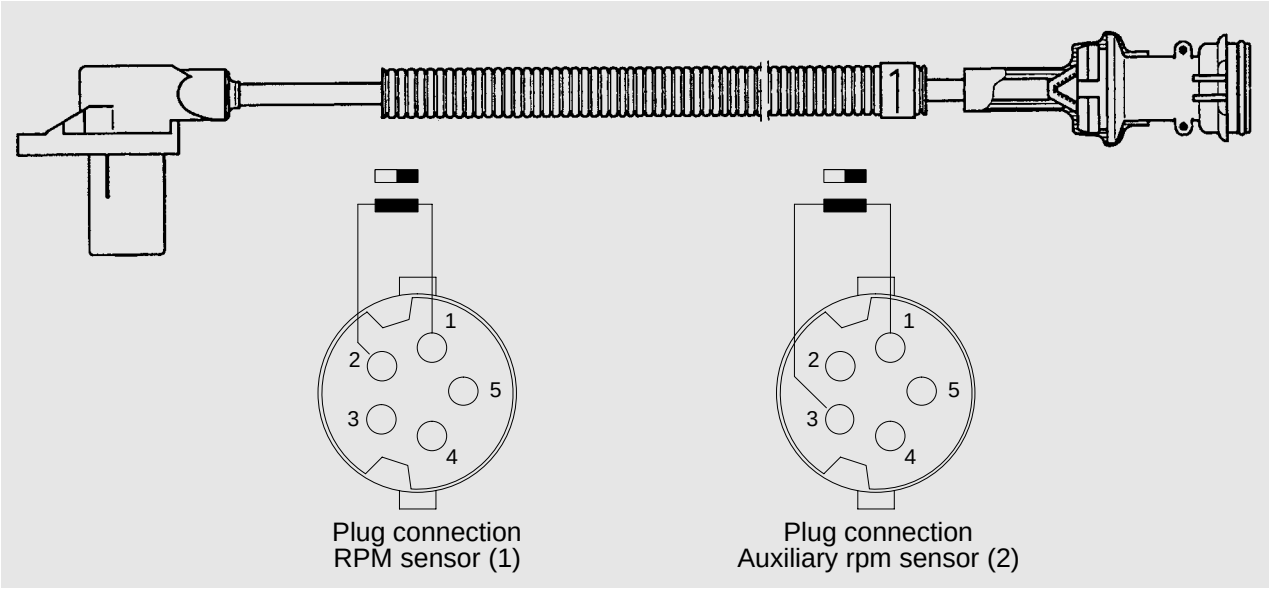


Function

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.



RPM sensor (51.27120–0008 / –0009)



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.
If the EDC-M(S) 5 system is fitted, the marine engine is provided with 6 rivets on the flywheel.
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 signals of the auxiliary rpm sensor are used only for redundant engine speed sensing.

Caution:
The locations of the speed pickup (1) and the auxiliary speed pickup (2) must not be mixed up!

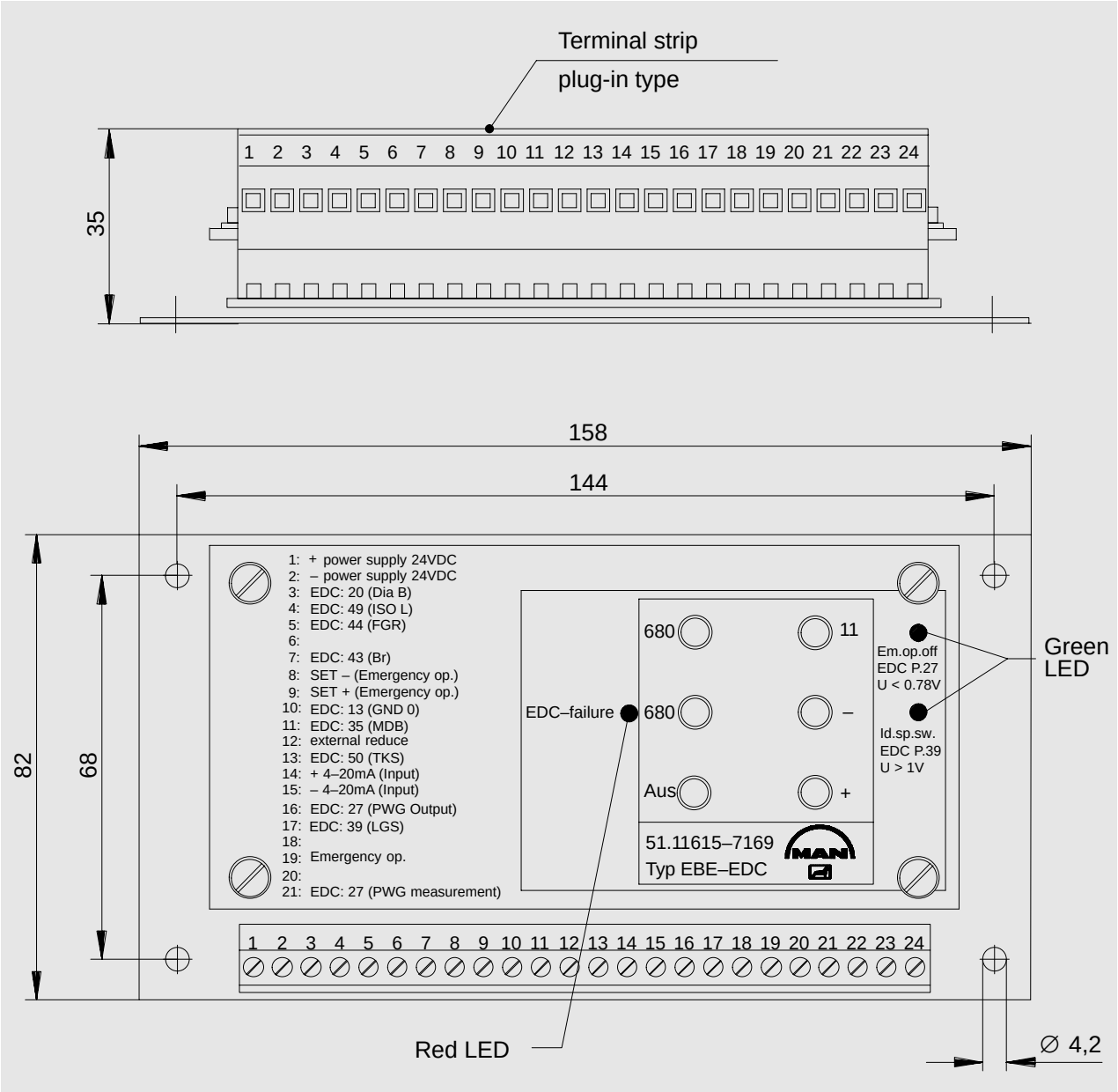
EDC operating element (51.11615–7169)

Function

The EDC control box has the following functions:

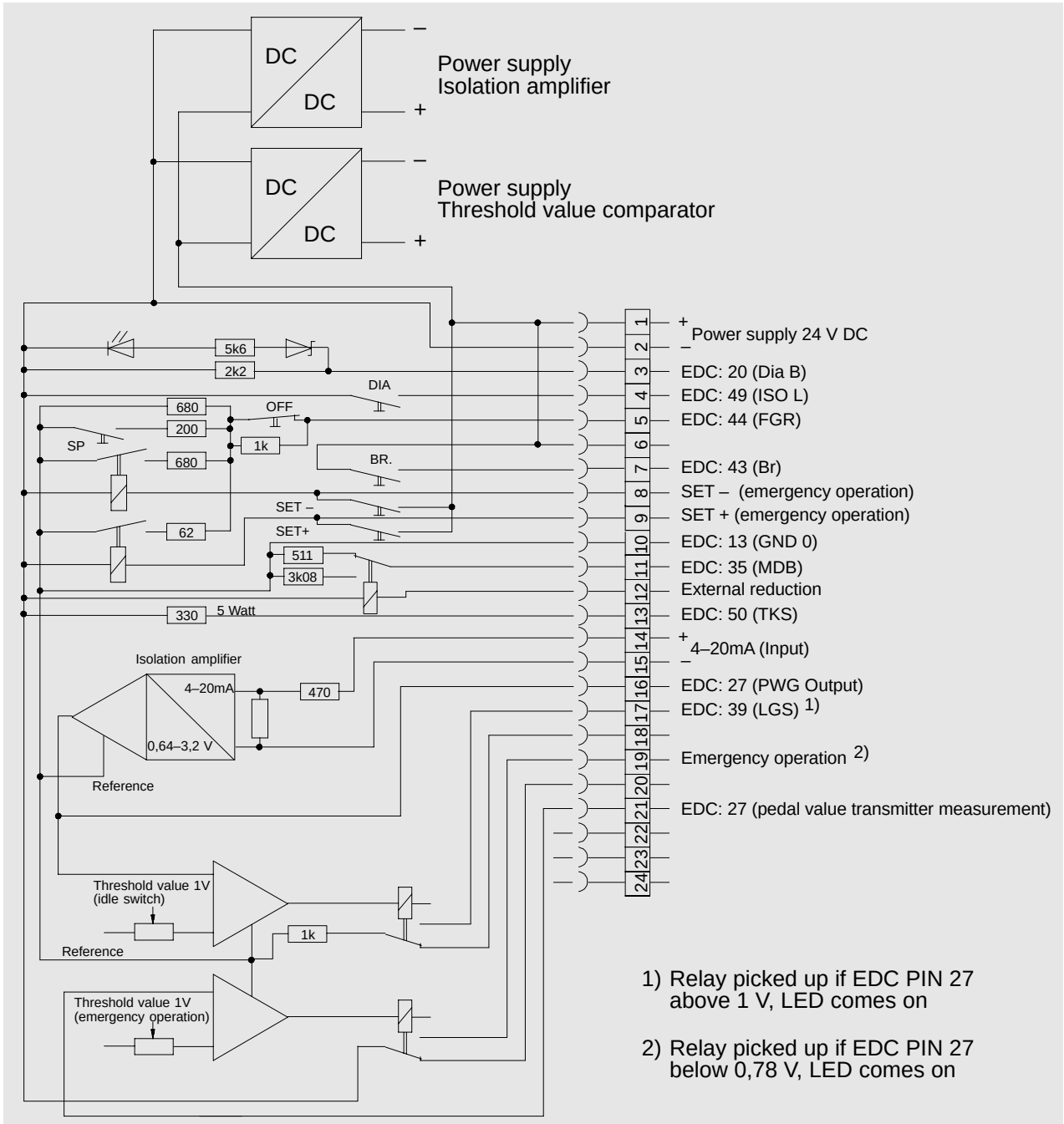
– EDC fault diagnosis with LED and flashcode
– Idle speed adjustment
– Conversion of 4–20 mA input signal into 0.64–3.2 volt
– Galvanic separation of the 4–20 mA throttle lever input signal from the EDC control unit
– Simulation of the idle switch (if the 4–20 mA triggering system is used)

The control box is also an interface to the engine monitoring system.



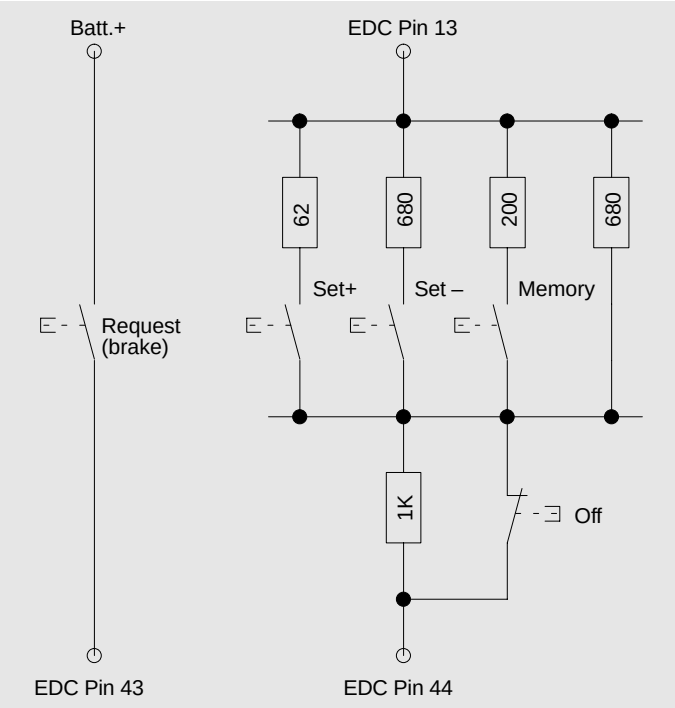
Dia – Diagnosis request button
Aus – OFF
Br – Brake contact
Sp – Memory
\+ – Button for increasing idle speed
– – Button for reducing idle speed

Block circuit diagram



Changing idle speed – EDC operating element

The idle speed is set to 600 rpm in the works. If necessary, the idle speed can be set anywhere between 600 rpm and 750 rpm with the engine at operating temperature (from approx. 30°C).



The circuitry shown is realised in the EDC control box (51.11615–7169).

Engine running:

- **Press and hold** request button (Br="brake") **during the entire following procedure**
- Press and hold memory button (Sp) for at least 5 seconds
- Idle speed is dropping to 600 rpm
- Press SET+ button
- The idle speed increases by approx. 10 rpm every time the SET+ button is pressed
- Actuating SET+ six times sets a speed of 660 rpm
- Press and hold memory button (Sp) for 5 seconds once more
- Release Br button

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

Proceed as follows to reset the works idle speed of 600 rpm:
After pressing the request button (Br=“brake”), press and hold the memory button for approx. 5 seconds.
The idle speed now drops back to 600 rpm.
Then press and hold the memory button for a further 5 seconds while still pressing the request button (Br=“brake”). Release Br button.
The works idle speed of 600 rpm is now reset.

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.
The diagnostic check lamp on the EDC operating element will come on for about 2 seconds.
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.
At every starting procedure in which the fault is no longer present the associated frequency count is set back by one.
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:

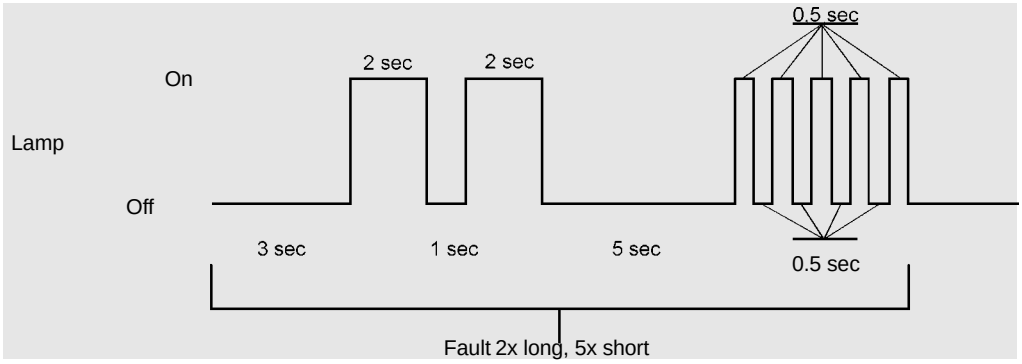
- Switching over to suitable replacement function for continued but restricted engine operation, ie engine speed reduced to approx. 1500–1700 rpm
- Reduction of engine speed to idle speed
- Immediate shut-down of the engine if required for safety reasons.
  Depending on the type of fault, engine shut-down takes place by reducing the fuel delivery volume to zero or by way of emergency shut-down with EHAB.

Flash code

To read out fault code memory

- If engine is stationary or running and “ignition system” is switched on, press diagnosis request button (Dia button on the EDC operating element) 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 and keep request button depressed
2. Turn on “ignition”
3. Keep request button depressed for another 3 seconds, but not longer than 10 seconds

Now only the fault memory of the flashcode diagnosis is deleted.
The second fault memory can be read and deleted only with MAN-Cats.

Fault code output MAN M(S) 5 EDC

Overview of flashcodes				
Number of flashes		Description	Steady light fault	See Page
Long	Short			
0	0	No fault stored		
	1	Pedal value transmitter (hand throttle signal)	yes	36
	3	Boost air temperature sensing	No	40
	4	Engine speed sensing (rpm sensor, DZG, 1)	yes	41
	5	Boost pressure sensing	yes	42
	6	Control rod position sensing	yes	43
	7	Coolant temperature sensing	yes	44
	10	Fuel-delivery regulator monitoring	yes	45
	14	Engine speed sensing (auxiliary rpm sensor, HZG, 2)	yes	46
1	1	Fuel temperature reader	No	47
1	3	Undervoltage	No	48
1	4	Request button (brake)	No	49
1	6	Control unit (Computer coupling)	yes	50
1	7	Overrevving	yes	51
1	12	Multistage switch for engine speed	yes	52
1	13	EDC operating element for idle speed setting	No	53
2	5	Main relay sticking	No	54
2	8	Atmospheric pressure sensing	yes	57
3	1	Redundant cutout device (EHAB)	yes	58
3	2	Control unit EEPROM computer, 1 fault	yes	59
3	3	Control unit EEPROM computer, 2 faults	yes	60
3	4	Stop button on engine room panel	No	61
3	8	Afterrunning not completed	yes	62
3	9	Control unit, after-running watchdog fault	yes	63
3	10	Control rod travel transmitter – loose contact	No	64

List of checking procedures for EDC M(S) 5 stage 3

with control box model EBE–EDC (51.11615–7169)

1. Checks while engine is stationary (Ignition off, control unit not connected)

– Engine temperature approx. 25°C
– **Control unit not (!!!)** connected, cable harness adapter connected
– Measure resistance between PIN+ and PIN– with multimeter

	PIN+	PIN–	Set-point value	Measured value
Control rod position transducer[1)]	11	9	18–25 Ω	. . . . . Ω
	11	10	18–25 Ω	. . . . . Ω
	18	9	>10 M Ω	. . . . . MΩ
	18	10	>10 M Ω	. . . . . MΩ
RPM sensor (DZG)	21	13	0.8–1.0 kΩ	. . . . . kΩ
Auxiliary rpm sensor (HZG)	22	17	0.8–1.0 kΩ	. . . . . kΩ
Fuel-delivery regulator	15	1	0.7–1.3 Ω	. . . . . Ω
	18	1	>10 M Ω	. . . . . MΩ
	16	2	0.7–1.3 Ω	. . . . . Ω
Ground	13	18	>10 M Ω	. . . . . MΩ
	17	19	>10 M Ω	. . . . . MΩ
EHAB		Relay K2		
	14	Pin 24	30–70 Ω	. . . . . Ω
	19	Pin 21	≈0 Ω	. . . . . Ω
The following checks may be carried out in addition to the voltage measurements (see below).				
Coolant temperature sensor	53	13	1.3–3.6 kΩ [2)]	. . . . . kΩ
Fuel temperature sensor	34	13	1.3–3.6 kΩ	. . . . . kΩ
Boost air temperature sensor	55	13	1.3–3.6 kΩ	. . . . . kΩ
Boost pressure sensor	33, 36	13	Resistance measurement not appropriate	
Multistage switch	35	13		
No reduction active			500–520 Ω	. . . . . Ω
Operating element for idle speed adjustment	44	13		
Non-actuated			550–700 Ω	. . . . . Ω
“Sp” button actuated			125–160 Ω	. . . . . Ω
“OFF” button actuated			930–1940 Ω	. . . . . Ω

1) Exact measurements are possible only at defined temperatures.
2) Resistance approx. 230–460 W with engine at operating temperature (approx. 80°C)

2. Checks while engine is running and ship is stationary (gearbox in neutral)

– Engine temperature approx. 30°C
– Cable harness adapter is connected up to control unit
– Measure speed at the following operating points
– Check with MAN-Cats Monitoring 2

	Set-point value	Measured value	Remark	MAN-Cats
RPM sensor (DZG)	n lower idle speed	n=.....rpm	PWG Min (low. idle speed)	Engine speed
	n top idle speed	n=.....rpm	PWG Max (top idle speed)	(Monitoring 2)
Auxiliary rpm sensor (HZG)	n lower idle speed	n=.....rpm	PWG Min (low. idle speed)	Engine speed
	n top idle speed	n=.....rpm	PWG Max (top idle speed)	(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)
Supply of control unit (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	
Accelerator (pedal value transmitter input) with pedal value transmitter	27	13	0.50–0.70 3.05–4.00	. . . .	Accel. min Accel. max	idle speed Top idle s.	0% 100%
Accelerator (pedal value transmitter input) with 4–20 mA triggering	27	13	≈0.64V/4mA ≈3.2V/20mA	. . . .	Accel. min Accel. max	idle speed Top idle s.	0% 100%
Idle speed switch (LGS, normally open)	39	13	4.75–5.25 0–2.00	. . . .	Accel. min Accel. max	idle speed Top idle s.	open closed
Fuel temperature sensor (KTF)	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
Charge-air temperature sensor (LTF)	55	13	4.17–2.62	. . . . . .	10–50°C	idle speed	10–50°C
Charge-air pressure sensor (LDF)	36	13	0.94–1.20 1.10–1.70	. . . .	Accel. min Accel. max	idle speed Top idle s.	0–100 mbar 300–600 mbar
Multistage switch (MSS) No reduction active Speed reduction active Speed reduction active	35	13	0.75–1.25 1.75–2.25 2.75–3.25 3.75–4.25	. . . .	Pos 0 Pos 1 Pos 2 Pos 3	idle speed	Cruising characteristic Multistage switch pos1 Multistage switch pos2 Multistage switch pos3
Brake contact switch (normally open) *	43	19	0.0–2.0 U-Batt	. . . .	non-act. actuated	idle speed	open closed
Operating unit for setting idle speed	44	13	3.15–3.55 1.41–2.30 0.65–0.97 2.30–2.75 3.72–4.33	. . . .	non-act. Spact . SET+ act. SET– act. Aus act.	idle speed	Neutral Memory SET+ SET– Off

* “Br” button on EDC operating element for idle engine speed adjustment (51.11615–7169)

– Check main relay

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

* Pin 46 (main relay activation) must switch to U-Batt with a delay of 0.5 to 5 seconds after “ignition” is switched off

– **EHAB check**
  - Accelerator max., engine at upper idle speed
  - Interrupt voltage supply to EHAB (EDC pin 14), engine stops (max. 10 seconds)

– **Checking the emergency stop function (only for first-time commissioning)**
  a) Engine idling, n = 1500–2000 rpm
  b) Press emergency stop switch on terminal box. Engine switches off (max. 10 seconds)
  c) Actuate starter motor via ignition switch → starter motor must not turn!
  d) Unlock emergency stop switch. Start engine. Because the emergency stop function has been actuated there may be slight delays in starting

  Steps a), b) and d) must repeated for every switch in the emergency stop circuit

– **Check start blocking system, if fitted**
  - Switch engine off and move gearbox switch to “On” position
  - Actuate starter motor via ignition switch → engine must not start!

– **Check flashcode diagnosis:**
  - Engine at idle speed; connect EDC pins 21 and 13 (short-circuit speed pickup)
  - EDC check lamp must come on (permanently illuminated); engine continues to run
  - Query flashcode (connect EDC pins 49 and 19 for at least 2 seconds or actuate diagnosis button for at least 2 seconds but not longer than 10 seconds)
  - Flashcode for “pickup defective” must be indicated (4 x brief flashes) **or**
  - Read out fault memory with MAN-Cats (defect in speed pickup momentarily present)
  - Disconnect pins 21 and 13 again
  - Delete fault memory: switch off ignition system, actuate diagnosis button, switch on ignition system, actuate button for at least 3 seconds but not longer than 10 seconds

– **Checking of capacity reserve of resonant circuit of control rod travel transmitter:**
  - Connect decade capacitor between pins 11 and 13 (on cable harness adapter)
  - Add auxiliary capacity until engine no longer starts and note down value
  - The capacity reserve of the resonant circuit of the control rod travel transmitter is to be at least 400 pF. If a Bosch cable harness adapter with approx. 100 pF is used, the set-point value of the additional capacity is to be > 300 pF.

– **Deleting of fault memory**

  After completion of the checks the fault memory must be deleted with MAN-Cats. Once the ignition system has been switched on again there must be no fault stored; otherwise the fault must be traced and eliminated according to the troubleshooting plan.

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. Fuel consumption too high					
																	18. Lubricating oil pressure too low				
																		19. Lubricating oil pressure too high			
																			20. Lubricating oil consumption too high		
																				21. Engine too “loud” / mechanical noise	
																					22. 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 / Emergency stop switch on terminal box is actuated
	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																				Emergency stop switch at bridge / flybridge is actuated
	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			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										Fuel low pressure system: Fuel tank, prefiltro, water trap faulty / clogged / mould / fungal attack, fuel unsuitable / contaminated (paraffin added)

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 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. Fuel consumption too high	18. Lubricating oil pressure too low	19. Lubricating oil pressure too high	20. Lubricating oil consumption too high	21. Engine too “loud” / mechanical noise	22. Idle speed cannot be adjusted with idle speed operating unit	**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 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		x	o	x															EHAB defective, drive faulty, Relay K2 defective
	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														Pedal value transmitter (hand throttle signal) defective: connecting cables, short-circuit, interruption With 4–20 mA throttle lever signal: – Connection cable for 4–20 mA throttle lever signal interrupted – Throttle lever system defective (no 4–20 mA signal present) – Wire jumpers at Pins 11/13, 12/14 in plug X9 are missing – EDC control box 51.11615–7169 is defective
x					x																	EDC rpm sensor defective, implausible with auxiliary rpm sensor, line defective
					x			x	o													EDC rpm sensor, polarity reversed
x					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										Intercooler leaking, defective
	x										x											Charge-air preheater defective

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 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. Fuel consumption too high	18. Lubricating oil pressure too low	19. Lubricating oil pressure too high	20. Lubricating oil consumption too high	21. Engine too “loud” / mechanical noise	22. Idle speed cannot be adjusted with idle speed operating unit	**Possible causes**
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	x	x				o									Resistor bank EDC control unit pin 35
x		x	x	o					o													Power supply to EDC control unit interrupted or battery voltage too low / Relay K1 defective
		x	x	o					o													Line terminal 15 to EDC control unit pin 47 interrupted / loose contact / Relay K2 defective
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																				EOL programming terminated / voltage interrupt
x																						Afterrunning not completed
																				x		EOL programming: Configuration incorrect
							x						x									Thermostat defective
										x												Engine bearings worn

x = Possible
o = Probable

The following troubleshooting program contains all faults which can be recognised by EDC diagnosis.

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.

Mechanical engine triggering with pedal value transmitter (PWG, throttle lever signal)

Flash code: 1x short

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

Fault path: Pedal value transmitter (PWG, hand throttle signal)
– Signal too high
– Signal too low
– Signal implausible with idle speed switch (in pedal value transmitter)

Effect of fault: Engine assumes lower idle speed
Driving with idle speed switch:
– Hand throttle in idle speed position: idle speed
– Hand throttle in full-load position: slow increase in engine speed o approx. 1500–1700 rpm

Possible cause: Line break, short-circuit, power supply interrupted, Pedal value transmitter 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:** 4.75–5.25 V	– Check lines – Check plug connections – If no fault found, replace control unit
Potentiometer signal PWG Min. 0 % PWG Max. 100 %	Measure voltage at socket box across pin 27 (+) and pin 13(–) **Setpoints:** Idle speed setting: 0.5–0.7 V Full load setting: 3.05–4.0 V	– Check lines – Check plug connections – Check mechanical connection between hand throttle and pedal value transmitter – Check idle-speed and full-load stops of the pedal value transmitters – Exchange pedal value transmitter

Idle speed switch	Measure voltage at socket box across pin 39 (+) and pin 13 (–)	– Check lines – Check plug connections – Check mechanical connection between hand throttle and pedal value transmitter – Check idle-speed and full-load stops of the pedal value transmitters – Exchange pedal value transmitter
	Setpoints:	
PWG Min. 0 %	Idle speed setting: 4.75–5.25 V	Switch open
PWG Max. 100 %	Full load setting: 0.0–2.0 V	Switch closed

Electrical engine triggering with 4–20 mA throttle lever signal

Flash code: 1x short

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

Fault path: 4–20 mA throttle lever signal
– Signal too high
– Signal too low
– Signal implausible
– No idle switch signal
– Control box defective

Effect of fault: Engine assumes lower idle speed

Possible cause: Cable interrupted, control box defective, failure of voltage supply at control box, throttle lever control system defective, control unit defective

Test precondition: EDC control unit connected
"Ignition" switched on
Throttle lever control system connected up and switched on

Test	Measurement	Corrective measures
Control box	Control box voltage supply between terminal 1 and terminal 2 **Setpoint:** U-Batt	– Check lines – Check control box – Check plug
Throttle lever signal Throttle lever position Min. 0 % Max. 100 %	Measure voltage at socket box across pin 27 (+) and pin 13 (–) alternative: Measure voltage at control box across terminal 10 and terminal 16 **Setpoints:** Idle speed setting: ≈0.64 V Full load setting: ≈3.2 V	– Check lines – Check plug connections – Check wire jumpers at Pins 11/13, 12/14 in plug X9 – Check throttle lever control system – Fit new control box

Throttle lever signal Throttle lever position Min. 0 % Max. 100 %	Measure voltage at control box across terminal 14 and terminal 15 **Setpoints:** Idle speed setting: 1.92 V Full load setting: 9.6 V	– Check lines – Check plug connections – Check throttle lever control system – Fit new control box
Simulation of idle switch in control box Throttle lever position Min. 0 % Max. 100 %	Measure voltage at socket box across pin 39 (+) and pin 13 (–) alternative: Measure voltage at control box across terminal 17 and terminal 10 At control box check green LED “Id. Sp. Sw” **Setpoints:** Idle speed setting: 4.75–5.25 V, Green LED: off Full load setting: 0.0–2.0 V, Green LED: on	– Check lines – Check plug connections – Fit new control box

Boost air temperature sensor

Flash code: 3x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Turbo air temperature sensor

Effect of fault: This fault has no direct effect.
The substitute value specified for such instances in the control unit may lead to a slight reduction in output

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	Measure resistance at socket box across pin 55 and pin 13 **Setpoint:** 3.8–0.8 kΩ at 10-50°C	– Check lines – Check plug connections – Replace temperature sensor – If no fault found, replace control unit
Sensor voltage	Measure voltage at socket box across pin 55 and pin 13 **Setpoints:** 4.17–2.62 V at 10-50°C	

Speed sensor

Flash code: 4x short

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

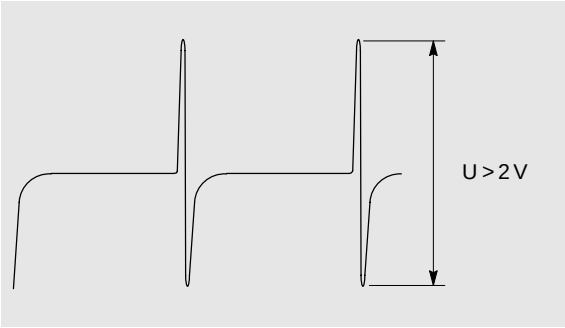
Fault path: RPM sensor
– Statically implausible
– Dynamically implausible
– Implausible with auxiliary rpm sensor

Effect of fault: Reduced full load delivery volume
Reduced final engine speed n = 2000–2100 rpm
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:** 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 figure	



Boost 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 PWG Min. 0 % PWG Max. 100 %	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 See curve on page 19	
	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 31), 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	
	Measure resistance at socket box across pin 18 and pin 9 **Setpoint:** > 10 MΩ	
	Measure resistance at socket box across 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 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
An increased quantity of white smoke may be discharged during cold start

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 – 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	

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 31)

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

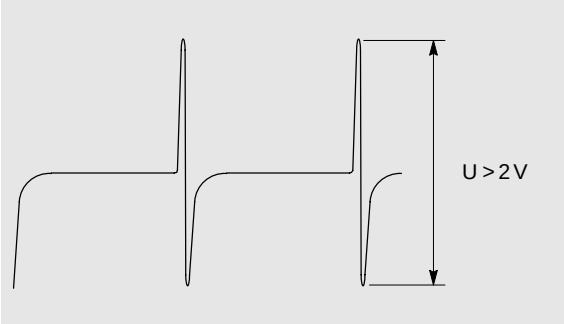
Fault path: Auxiliary rpm sensor
– Statically implausible
– Dynamically implausible
– Implausible with rpm sensor

Effect of fault: Reduced full load delivery volume
Reduced final engine speed n = 2000–2100 rpm
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:** 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 figure	



Fuel temperature sensor

Flash code: 1x long, 1x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Fuel temperature sensor

Effect of fault: This fault has no direct effect.
The substitute value specified for such instances in the control unit may lead to a slight reduction in output

Possible cause Line break, short-circuit, Fuel 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 – 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 – Check battery, generator and circuit breaker F1 on engine

Request button (brake)

“Br” button on EDC operating element

Flash code: 1x long, 4x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Request button

Effect of fault: Idle speed adjustment cannot be activated

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

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 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)!	– Check lines – Check plug connections
	Internal fault in control unit	– 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
	If no other faults exist, no further action is necessary	– Delete fault code memory
Injection pump	If the fault occurs more frequently check injection pump, control unit and cables.	– Replace lines – Replace control unit – Replace injection pump

Multistage switch for engine speed

Flash code: 1x long, 12x short

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

Fault path: Multistage switch for engine speed reduction
– Voltage too high
– Voltage too low
– Wrong voltage

Effect of fault: No engine speed reduction possible

Function: Voltage signals are ascertained via the multistage input (control unit pin 35); their values are determined by external resistor interrupters in the EDC operating element

Possible cause Line interruption, short circuit, resistor group in the EDC operating element defective (eg cold junction)

Test precondition: EDC control unit disconnected
Socket box connected

Test	Measurement	Corrective measures
Resistor bank	Measure resistance at socket box across pin 35 and pin 13 **Setpoint:** No engine speed reduction activated: 0.4–0.7 kΩ Engine speed reduction activated: 6.2–11.6 kΩ The fault occurs even if the resistance is 0 Ω or ∞ Ω	– Check lines – Check plug connections – Exchange EDC operating element

EDC operating element for idle speed setting

Flash code: 1x long, 13x short

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: EDC control box (idle speed adjustment function) 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: 3.72–4.33 V Not activated: 3.15–3.55 V	– Check lines – Check plug connections – Exchange EDC operating element – If no fault found, replace control unit as a check

Main relay (K1)

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 K1 switch off is delayed after the “ignition” is switched off (afterrunning). Green LED goes out.
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 K1 defective

Test precondition: EDC control unit disconnected / 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 K1 relay If U-Batt is not present when “ignition is on” – check relays K2 and K3

Note: Pin 46 must switch to U-Batt with a delay of up to 5 seconds after turning off the “ignition” (processor afterrunning).

Relay (K2)

Flash code: No

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Emergency stop actuation, relay K3 defective, relay K2 defective

Effect of fault: Engine does not start or switches itself off

Function:
– Switch-on of ignition signal at Pin 47 for the EDC control unit
– Negative switch for EHAB
– K2 picks up if the LED at K3 is red. % LED at K2 is green.

Possible cause Supply voltage U–Batt is not present at A1/A2.
Relay does not close

Test precondition: Ignition on, emergency stop relay closed

Test	Measurement	Corrective measures
Supply voltage	between Pin A1 and Pin A2 **Setpoints:** U-Batt	If U-Batt is not present – Check relay K3
Switching voltage from terminal 15	between Pin 11 (K2) and terminal 1 Pin 14 (K2) and terminal 1 **Setpoints:** U-Batt	If U-Batt is not present between Pin 14 (K2) and terminal 1 but is present between Pin 11 (K2) and terminal 1 – Change relay K2
Switching resistance	Measure resistance between terminal 1 and Pin 21 (K2) **Setpoints:** 0 Ω	If resistance is not 0 Ω – Change relay K2
Switching resistance	Measure resistance between terminal 1 and Pin 24 (K2) **Setpoints:** 0 Ω	If resistance is not 0 Ω – Change relay K2

Time-lag relay (K3)

Flash code: No

Fault indication: Fault is not indicated by EDC indicator lamp

Fault path: Relay does not work, emergency stop actuated

Effect of fault:
– Engine does not start
– EDC control unit does not get any voltage
– Engine stops

Function:

Battery main switch:	Green LED
Ignition on	Red LED
Ignition off	After 8 seconds LED changes from red to green

Battery voltage U-Batt is connected up via the emergency stop relay A1–A2. When the control contact B1 closes the relay moves immediately to working position. The returning time (approx. 8 seconds) begins when the control contact B1 opens. When the emergency stop circuit opens the relay drops out immediately.

Possible cause
– Ignition not present at control contact B1
– Supply voltage not present at A1/A2
– Relay does not close

Test precondition: Ignition on, emergency stop relay closed

Test	Measurement	Corrective measures
Supply voltage	between Pin A1 (K3) and Pin A2 (K3) **Setpoints:** U-Batt	If U-Batt is not present – Check battery main switch – Check emergency stop button
Switching voltage	between B1 (K3) and terminal 1 **Setpoints:** U-Batt	If U-Batt is not present – Check starter lock
Measure resistance	between Pin 18 (K3) and terminal 1 **Setpoints:** 0 Ω	If specified value is not available – Change relay K3

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 42).	– Replace control unit

Electrohydraulic shut-off device EHAB

Flash code: 3x long, 1x short

Fault indication: Fault indicated by steady light at 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)
Reduced full load delivery volume
Reduced final engine speed n = 2000–2100 rpm

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, relay K2 defective, 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 a) Pin 14 and Pin 24 (Relay K2) **Setpoint:** 30–70 Ω b) Pin 19 and Pin 21 (Relay K2) **Setpoint:** ≈0 Ω	– Check line – Check plug connection – Replace EHAB
Check relay K2	See Page 55	See Page 55
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 31 for function test.

Control unit EEPROM computer, 1 fault

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), e.g. during EDC tracking

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
Control unit		

Caution:
Do not change the control unit if the entries in the fault memory occurred in the following way:

1. Entry made when ignition is switched off.
   When the ignition is switched on again the fault which caused this entry to be made is cancelled again and therefore has no effect on operation.
2. Entry after use of MAN-Cats (EOL programming).
   If this entry in the fault memory was generated through use of MAN-Cats, the engine can no longer be started. In this case do not change the control unit but repeat the previous work with MAN-Cats.

Note:
If one of these fault memory entries occurs together with the entry
Main relay (flashcode: 2x long, 5x short) or
Control unit computer tracking (flashcode 3x long, 8x short)
the reason should be sought not in the control unit but in the power supply for the control unit. See also page 54 (main relay) and page 62 (control unit computer tracking).

Control unit EEPROM computer, 2 faults

Flash code: 3x long, 3x short

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

Fault path: Processor 2 in control unit defective

Possible cause Control unit defective, EOL programming not completed (voltage supply interrupted), e.g. during EDC tracking

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		

Caution:
Do not change the control unit if the entries in the fault memory occurred in the following way:

1. Entry made when ignition is switched off.
   When the ignition is switched on again the fault which caused this entry to be made is cancelled again and therefore has no effect on operation.
2. Entry after use of MAN-Cats (EOL programming).
   If this entry in the fault memory was generated through use of MAN-Cats, the engine can no longer be started. In this case do not change the control unit but repeat the previous work with MAN-Cats.

Note:
If one of these fault memory entries occurs together with the entry

Main relay (flashcode: 2x long, 5x short) or

Control unit computer tracking (flashcode 3x long, 8x short)

the reason should be sought not in the control unit but in the power supply for the control unit. See also page 54 (main relay) and page 62 (control unit computer tracking).

Stop button on engine room panel

Flash code:	3x long, 4x short
Fault indication:	Fault is not indicated by EDC indicator lamp
Fault path:	Stop button (control unit Pin 50)
Possible cause	This fault is used only for recording stops using external switches
Effect of fault:	With the stop button the engine is switched off

Control unit (processor afterrunning)

Flash code: 3x long, 8x short

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

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

Effect of fault: Reduced full load delivery volume
Reduced final engine speed n = 2000–2100 rpm

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 48) and main relay (page 54)	– Switch “ignition” on and off again, delete fault code – Same as pages 48 and 54 – 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 K1 defective, loose contact)

Control unit, after-running watchdog fault

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 n = 2000–2100 rpm

Test	Measurement	Corrective measures
Control unit	No further test necessary	– 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 K1 defective, loose contact)

Control rod travel transmitter – loose contact

Flash code: 3x long, 10x short

Fault indication: Fault is not indicated by EDC indicator lamp

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

Effect of fault: This check is designed to recognise a loose contact in the connection to the control rod travel transmitter

Possible cause Line break, short-circuit, too little capacitance reserve (see page 31), 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	
	Measure resistance at socket box across pin 18 and pin 9 **Setpoint:** > 10 MΩ	
	Measure resistance at socket box across 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 transducer	– Remove injection pump – Adjust control rod position transducer

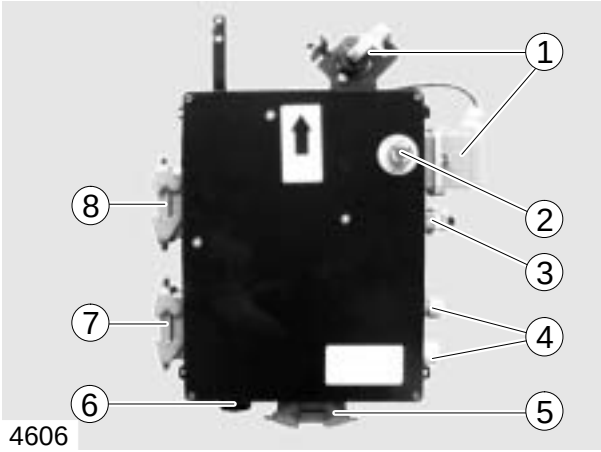
EDC Pin No.	Abbreviation		Description	
1	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	I_{max} 11 A temporarily, on average 4.5 A, against batt.+, pulsed f=variable, pulse-width modulated
2	MES O	Activation for fuel-delivery actuator	Output, fuel-delivery control circuit	
3		Not used		
4		Not used		
5		Not used		
6		Not used		
7		Not used		
8		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		Not used		
13	GNDA	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	Sensor ground HZG	Reference ground	
18	Batt.–	Battery negative	Input battery –	Same as batt.+ (EDC Pin 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=6 x engine speed $sec.^{-1}$
22	HZG–1	Auxiliary rpm sensor signal	Input, dynamic	Alternating voltage U_{pp} idle speed approx. 2 V, max. 80 V, f=6 x engine speed $sec.^{-1}$
23		Not used		
24		Not used		
25		Not used		
26		Not used		
27	PWG–1	Pedal value transmitter (throttle lever) – signal	Input, analog	Direct voltage, U approx. 0,6 to 3,2 V
28	TDS–A	Engine speed signal	Output	U-Batt against Batt. – square-wave signal, f=6 x engine speed $sec.^{-1}$
29		Not used		
30		Not used		
31		Not used		
32		Not used		
33	LDF–2	Turbo pressure sensor (supply)	Output, supply	Controlled direct voltage, U approx. 5 V
34	KTF–1	Fuel temperature sensor	Input, analog	
35	MDB–1	Multi-stage input (torque limitation)	Input, analog	Circuit of various resistors for external faults (integrated in EDC operating element)
36	LDF–1	Boost pressure sensor signal	Input, analog	
37		Not used		
38		Not used		
39	LGS–E	Idle speed switch signal (Pedal value transmitter)	Input, static	against GND-O (EDC-Pin 13)

EDC Pin No.	Abbreviation		Description	
40		Not used		
41		Not used		
42		Not used		
43	BRE–E	Brake switch signal	Input, static	Batt. +, Br=button in the EDC operating element
44	FGR–1	Analog operating element for idle speed adjustment	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	Diagnostic connection for MAN-Cats
49	ISO–L	ISO-L link to ISO protocol	Interfaces	Diagnostic connection for MAN-Cats
50	TKS–E	STOP	Input, static	Batt. +, Input for engine stop – button in engine room panel
51		Not used		
52	PB1–E	Pulse-width modulated input signal 1	Interface	Batt. +
53	WTF–1	Coolant temperature sensor	Input, analog	
54		Not used		
55	LTF–1	Turbo air temperature sensor	Input, analog	

Engine terminal box with connection for mechanical engine triggering (pedal value transmitter + bowden cable)

Fig. 1

① Pedal value transmitter, item no. 81.25970–6072 with plug X9 for mechanical engine triggering (bowden cable)
② Emergency stop button (attached)
③ Plug for electric gearbox triggering (X8)
④ Compression gland
⑤ Connecting plug for engine electrics and alarm system from engine (X1)
⑥ Connecting plug for engine room instrument panel, engine room panel
⑦ Connecting plug for alarm system BE1 to bridge (X2)
⑧ Connecting plug for EDC from engine (X10)



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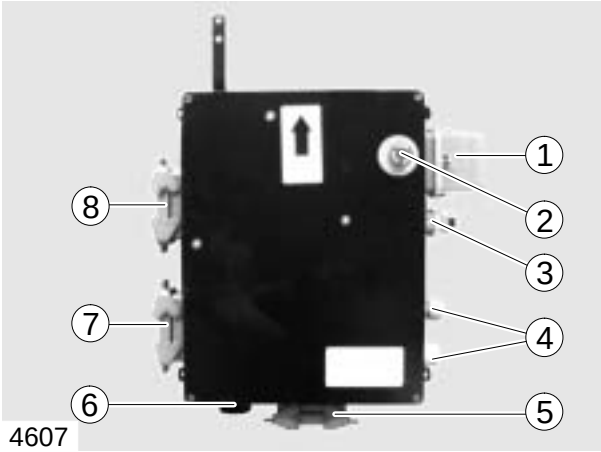
Engine terminal box with connection for electrical engine triggering (4–20 mA)

Fig. 2

① Connecting plug for electrical engine triggering with 4–20 mA signal (X9)
② Emergency stop button (attached)
③ Plug for electric gearbox triggering (X8)
④ Compression gland
⑤ Connecting plug for engine electrics and alarm system from engine (X1)
⑥ Connecting plug for engine room instrument panel, engine room panel
⑦ Connecting plug for alarm system BE1 to bridge (X2)
⑧ Connecting plug for EDC from engine (X10)



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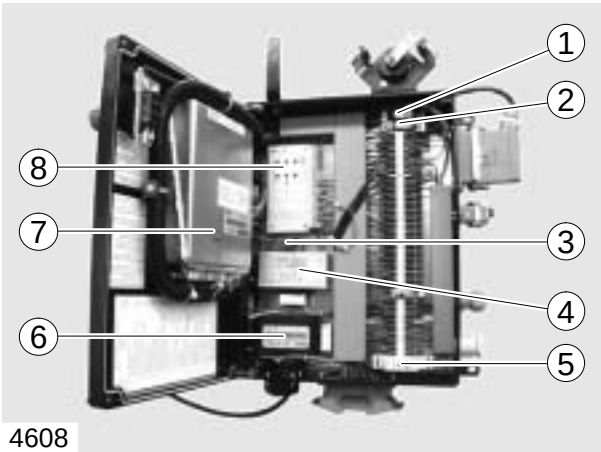
Engine terminal box with components

Fig. 3

① EDC-relay (K1), item no. 51.25902–7008
② Relay K2
③ MAN-cats diagnose plug
④ Option:
Glow plug timer control unit for electrical boost air preheating system, item no. 51.26802–0003
⑤ Time-lag relay K3
⑥ Starter interlock relay item no. 81.25902–0454
⑦ EDC-control unit
(ECU, ordering with engine no. only)
⑧ EDC operating element item no. 51.11615–7169



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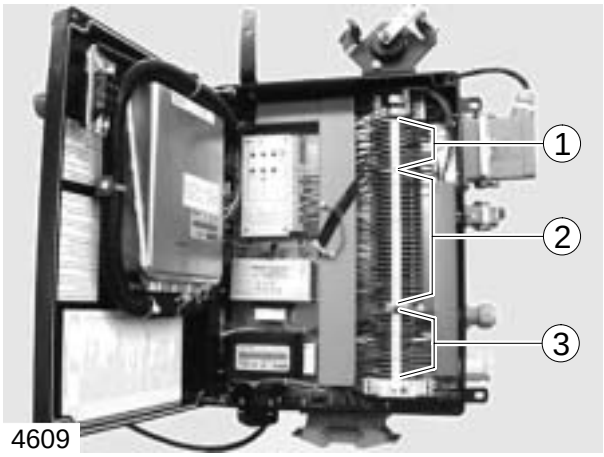
Engine terminal box with clamps

Fig. 4

① Clamps for EDC

② Terminals for instruments and monitoring system

③ Terminals for starter motor and supply voltage



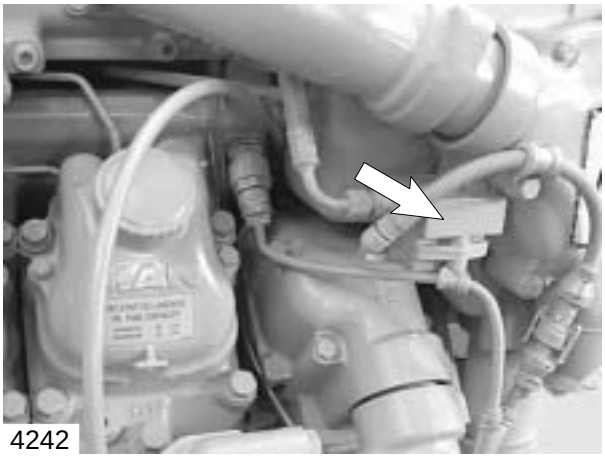
4 4609

Boost air pressure sensor for EDC-system

Fig. 1

Item no. 51.27421–0128

Location: right engine side,
heatexchanger / cylinder no. 1 area



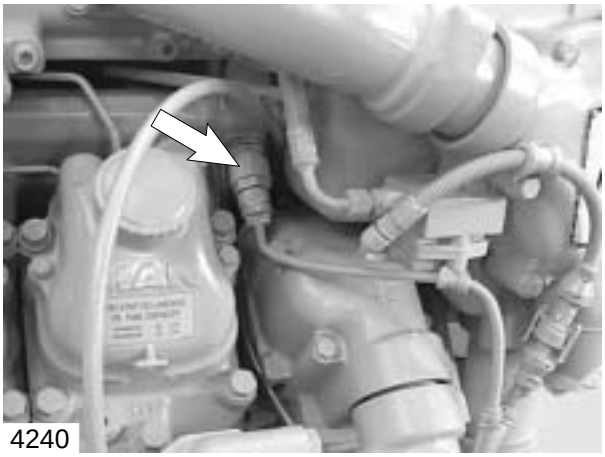
1 4242

Boost air temperature sensor for EDC-system

Fig. 2

Item no. 51.27421–0077

Location: right engine side,
heatexchanger / cylinder no. 1 area



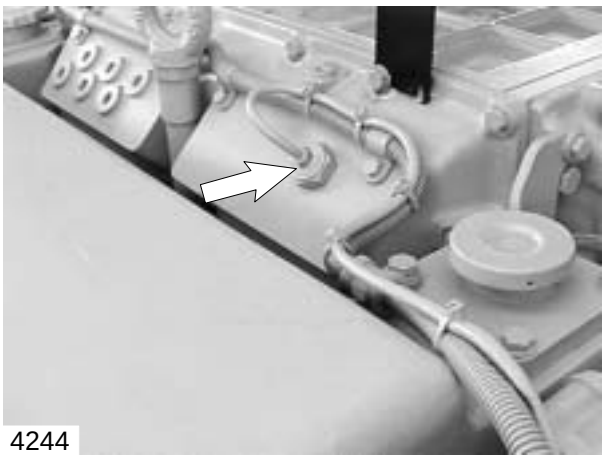
2 4240

Boost air temperature sensor for alarm system BE1

Fig. 3

Item no. 51.27421–0103

Location: Intercooler elbow (after intercooler),
left engine side



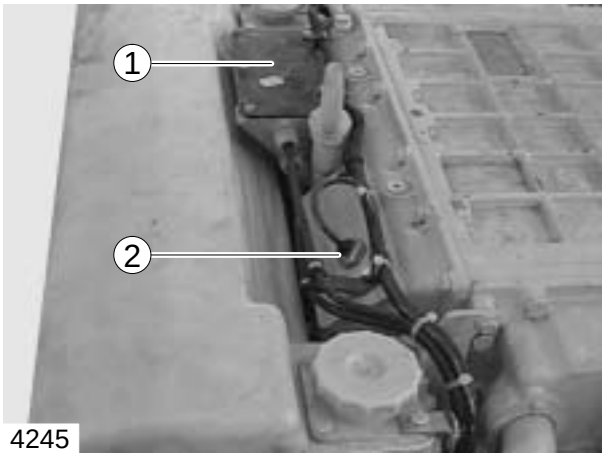
3 4244

Boost air temperature sensor for alarm system BE1 (Boost air preheating installed)

Fig. 4

① Glow plug box for electrical charge air preheating

② Boost air temperature sensor
Item no. 51.27421–0103



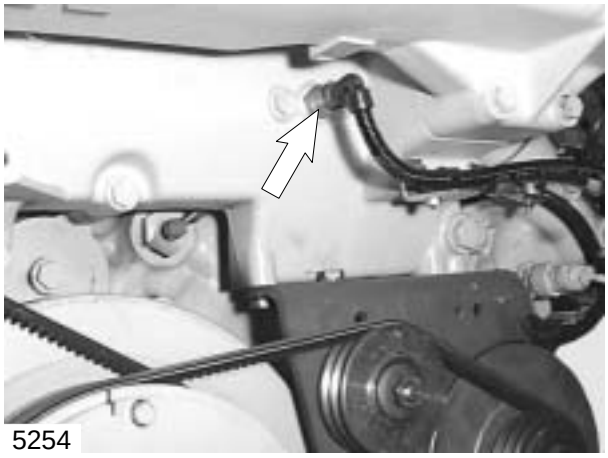
4 4245

Temperature switch for electrical boost air pre-heating system

Fig. 5

Item no. 51.27420–0054

Location: engine front side below heatexchanger opens above 45°C



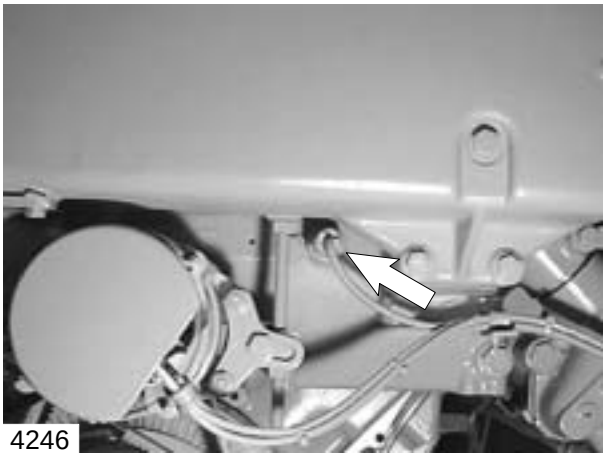
5 5254

Coolant temperature sensor (WTF1) for EDC-system

Fig. 1

Item no. 51.27421–0113

Location: engine front side below heatexchanger



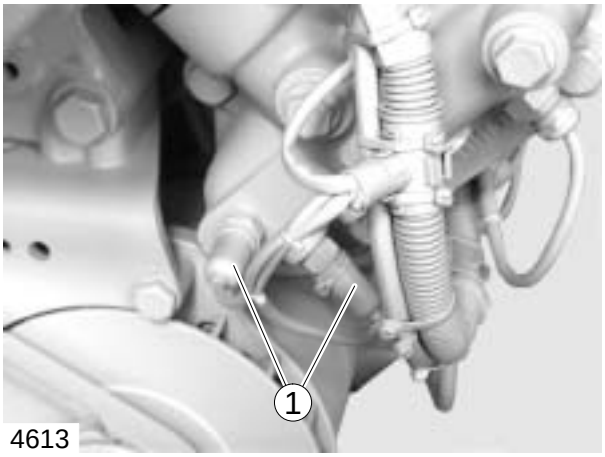
1 4246

Coolant temperature sensors for instruments and for alarm system BE1

Fig. 2

Location: left engine side, front cover of water-cooled exhaust manifold

① Coolant temperature sensor for instruments
Double sensor: Item no. 50.61344–1000
Single sensor: Item no. 50.27421–0034



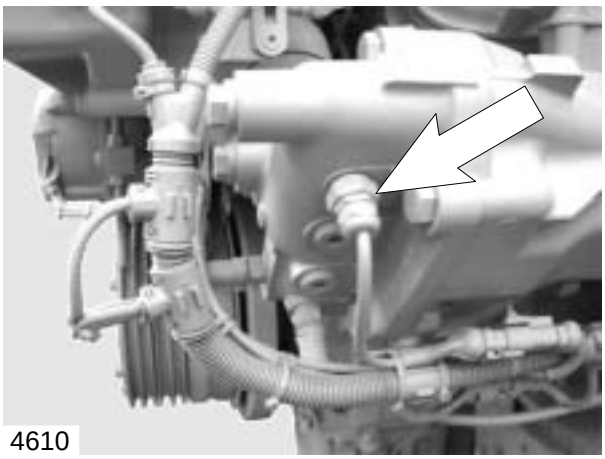
2 4613

Coolant temperature sensors for alarm system BE1

Fig. 3

Location: left engine side,
front cover of watercooled exhaust manifold

Item no. 51.27421–0150
wrench size: 24 mm



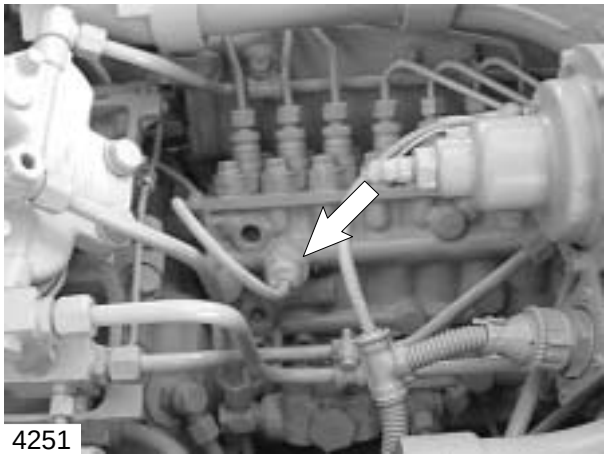
3 4610

Fuel temperature sensor for EDC-system

Fig. 1

Item no. 51.27421–0113

Location: Injection pump

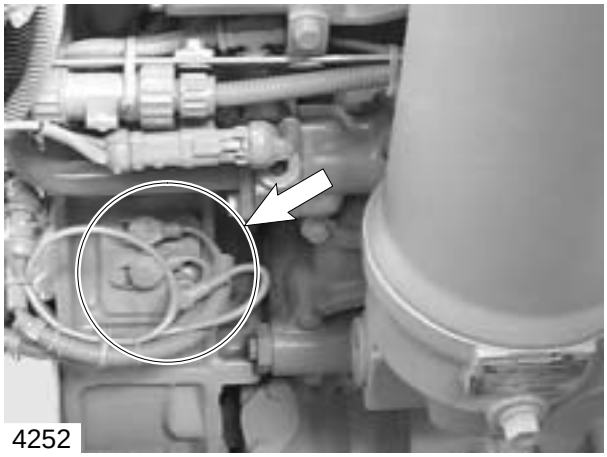


1 4251

Speed pickup sensors for EDC and alarm system BE1

Figs. 2 and 3

Location: right engine side, flywheel housing, approx. 4 o'clock by view from engine back side

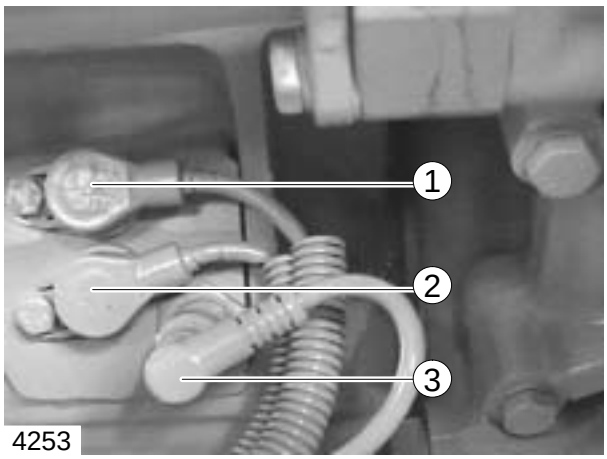


2 4252

① Engine auxiliary speed sensor HZG1 for EDC-system, Item no. 51.27120–0009, Cable no. (2)

② Engine speed sensor DZG1 for EDC-system Item no. 51.27120–0008, Cable no. (1)

③ Engine speed sensor for alarm system, Item no. 51.27120–0010



3 4253

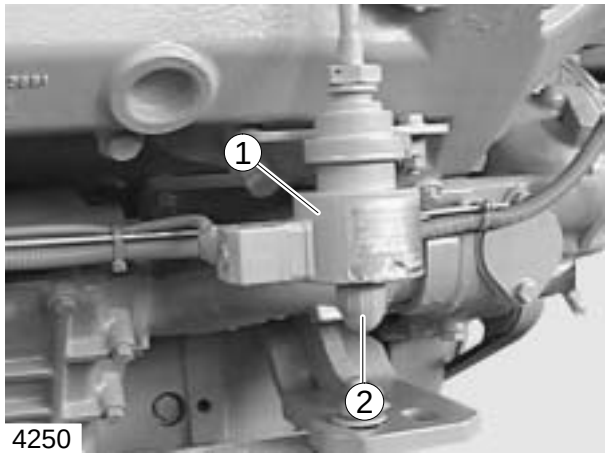
Engine speed monitor for instruments

Fig. 4

Location: right engine side, underneath water-cooled exhaust manifold

① engine speed monitor for instruments, Item no. 51.27120–7030

② Connection for mechanical drive (E2–M22x1.5)



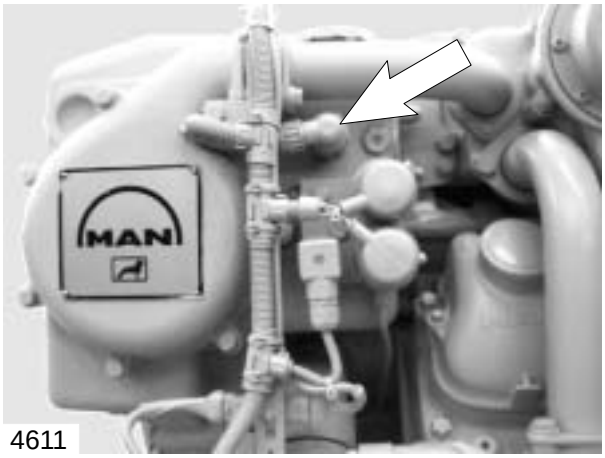
4 4250

Coolant level sensor

Fig. 1

Item no. 51.27421–0116

Location: on both sides of the expansion tank



1 4611

Oil pressure sensors for instruments and alarm system

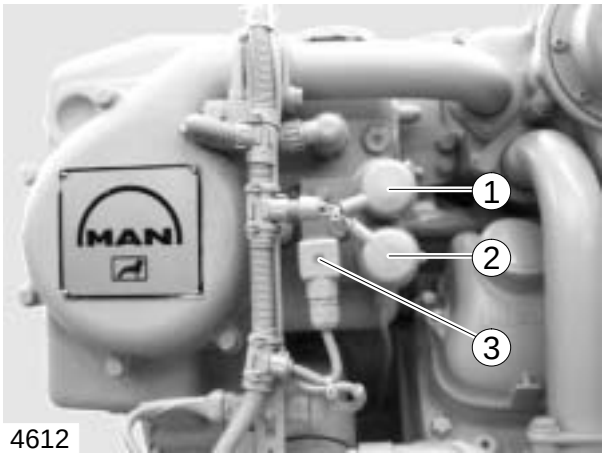
Fig. 2

Location: left engine side between heatexchanger and intercooler

① Oil pressure sensor (M10x1) for engine room control panel, Item no. 51.76034–0007

② Oil pressure sensor for instruments
Single (M10x1): Item no. 50.76034–0007
Double (M18x1,5): Item no. 50.27421–0033

③ Oil pressure sensor for alarm system, Item no. 51.27421–0126



2 4612

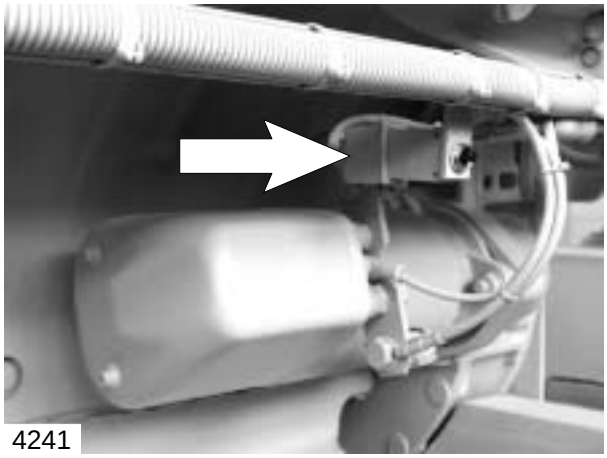
Main automatic fuse switch (F1)
USA version

Fig. 1

F1, automatic fuse device 16A (switch)

Item no. 51.25437–0002

Location: left engine side, starter motor area



1 4241

Main fuse switch

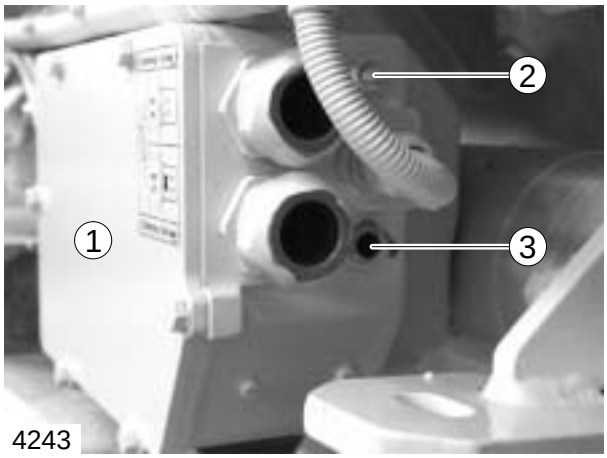
Figs. 2 and 3

Location: left engine side, starter motor

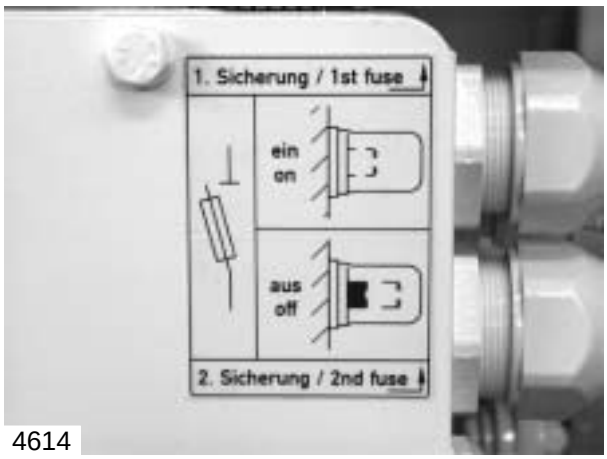
① Fuse box, see drawing 51.25431–6115

② Automatic fuse switch, plus line

③ Automatic fuse switch, minus line



2 4243



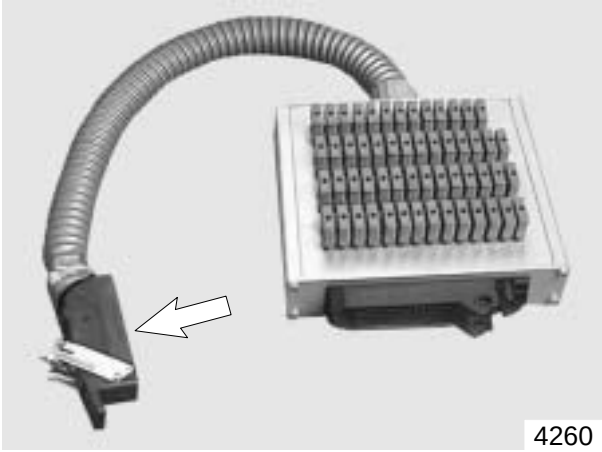
3 4614

Bosch pin adapterbox

Fig. 1

Connection between control unit and EDC cable to control unit in terminal box for test purposes

Arrow: Control unit plug



1 4260

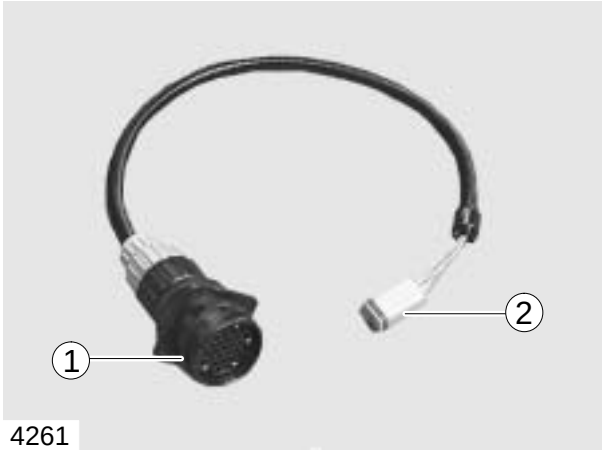
MAN-Cats diagnose system

Adapter cable
(Connection between diagnose plug in terminal box and ISO-interface)

Fig. 2

① Connection plug for plug ① in fig. 3

② Connection plug for terminal box



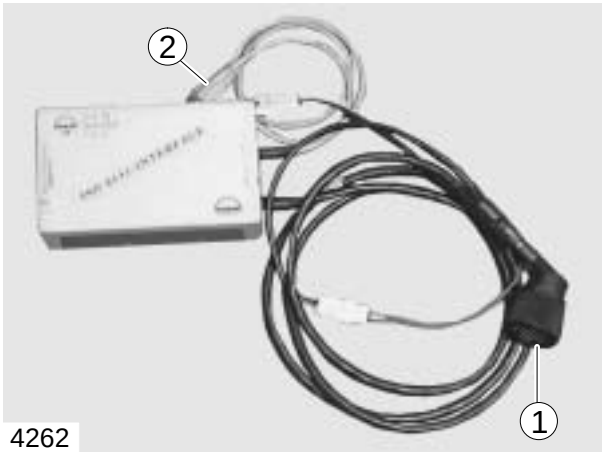
2 4261

MAN-CATS interface
(Connection between adapter cable and note book)

Fig. 3

① Connection plug for plug ① in fig. 2

② Connection plug for note book computer



3 4262

Note book computer
minimum equipment:

Fig. 4

- 386 processor
- 4 MB RAM
- RS 232 Com 1 interface
- MS-DOS 5.0

4 4263

An engine electronic diagnostic system, which works with a laptop computer and is called MAN-Cats.

The following functions are possible:

1. Reading EDC errors in text format

2 Deletion of stored errors

3. Monitoring the following operational parameters:
   - Boost pressure
   - Rack Travel
   - Engine speed
   - Coolant temperature
   - Charge air intake temperature
   - Fuel temperature
   - Throttle position
   - Battery voltage
   - Additional EDC-parameters

However, the monitoring data cannot be stored or printed.

The following equipment is necessary to work with the laptop:

- **Interface, white**
  MAN Item no. 93.09000–6015
- **Adapter cable for Interface**
  (Connection between diagnostic plug in terminal box and interface)
  MAN Item no. 51.25435–8002
- **Software MAN-Cats**
  Operating System Disc D1 DM
  MAN Item no. 81.99298–8130 German
  81.99298–8071 French
  81.99298–8082 English
  81.99298–8033 Spanish
  81.99298–8014 Italian
- **Diagnostic software**
  EDC Bosch M (S) 5, Disc D 12
  MAN ltem no. 81.99298–8300 German
  81.99298–8231 French
  81.99298–8222 English
  81.99298–8193 Spanish
  81.99298–8134 Italian

Please note!
An existing laptop should, as minimum, fulfil the following criteria for EDC:

- 386er processor
- 4 MB RAM memory
- Serial port

Operating the MAN-CATS software is only possible using MS-DOS 5.0 or higher.

With regard to the future diagnostic system, a suitable laptop must be acquired at the appropriate time.

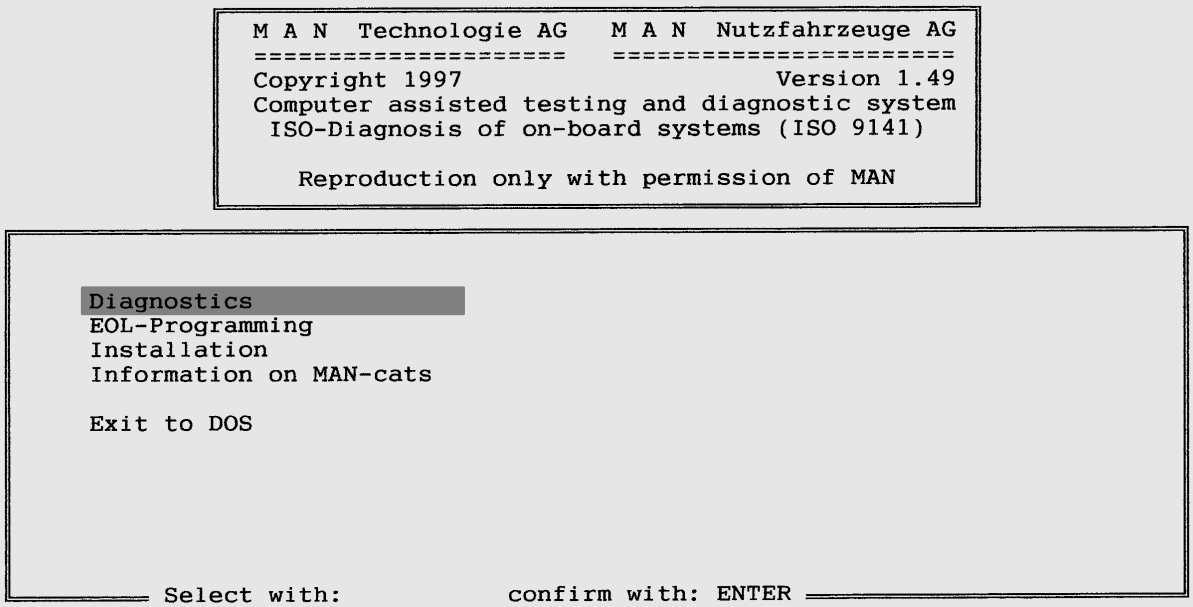
Laptop with the following features

Suitable for the proposed diagnostic system BE 3 for MAN marine engines:

- Processor 266 MHz
- Memory 32 MB RAM
- Hard drive min. 1,0 G Byte
- CD-ROM drive
- Disc drive
- Lithium battery charger (without memory effect)
- Track ball or touch pad
- Serial interface, cable-based
- TFT Display (active matrix), resolution 800 x 600 (width x height), min. 256 colour

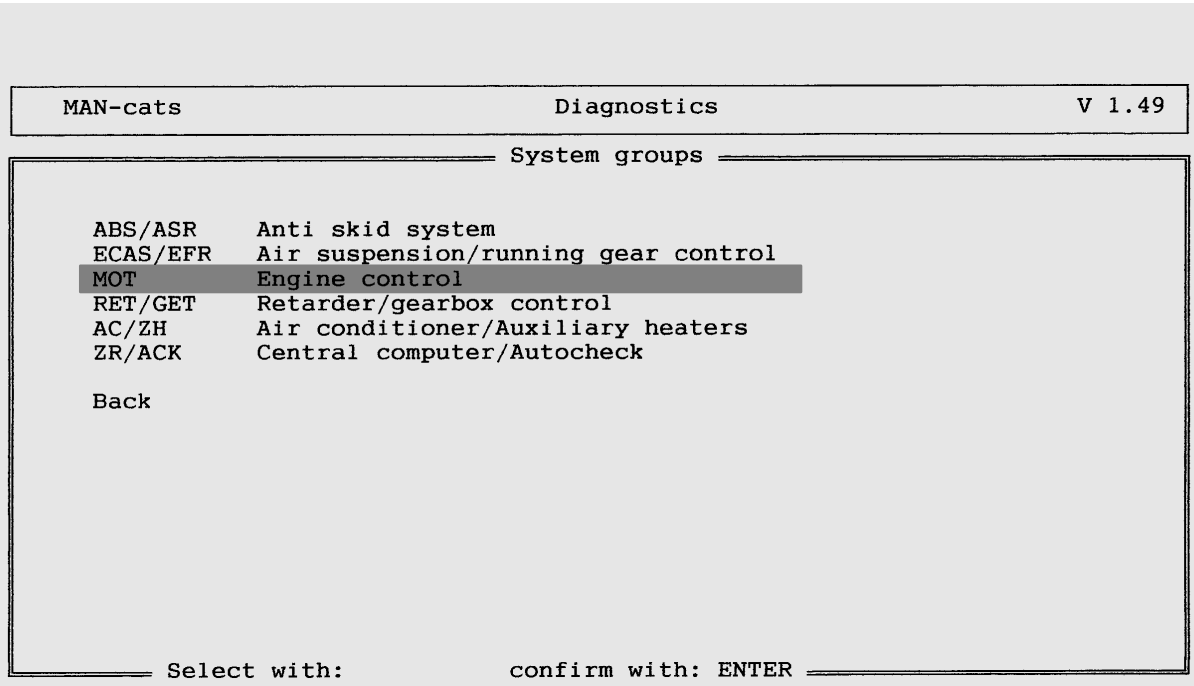
To install the software DOS (version 5.0) or Windows can be used. As on independent program the software will be on the harddrive “C:”. To get to it enter “C:man_cats diagnostics”.

On the screen you’ll see:



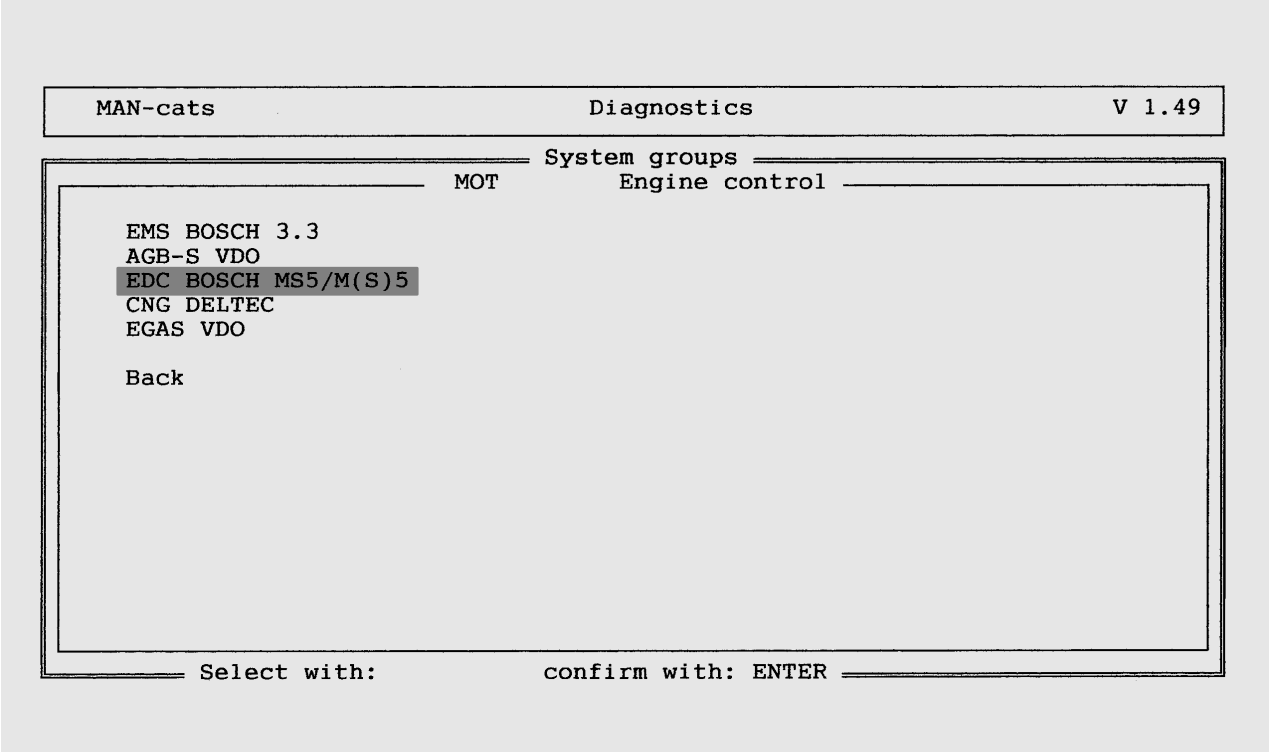
Use arrow key to go to “Diagnostics” and press “Enter”.

You’ll see:



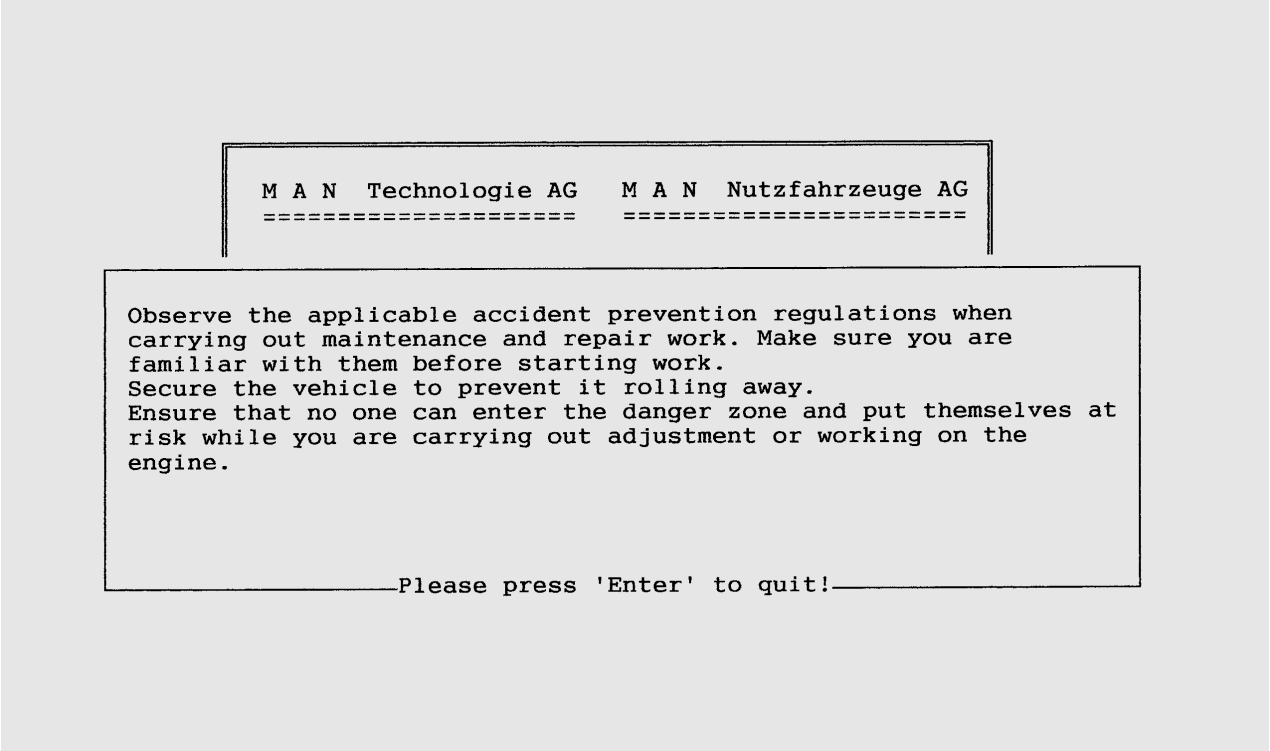
Use arrow key to go to “Mot” engine control.

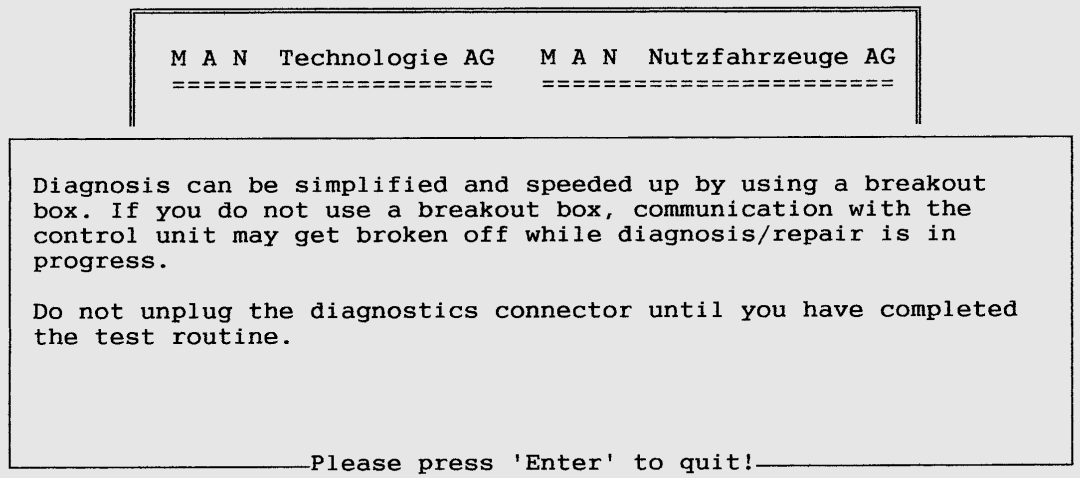
You’ll see:

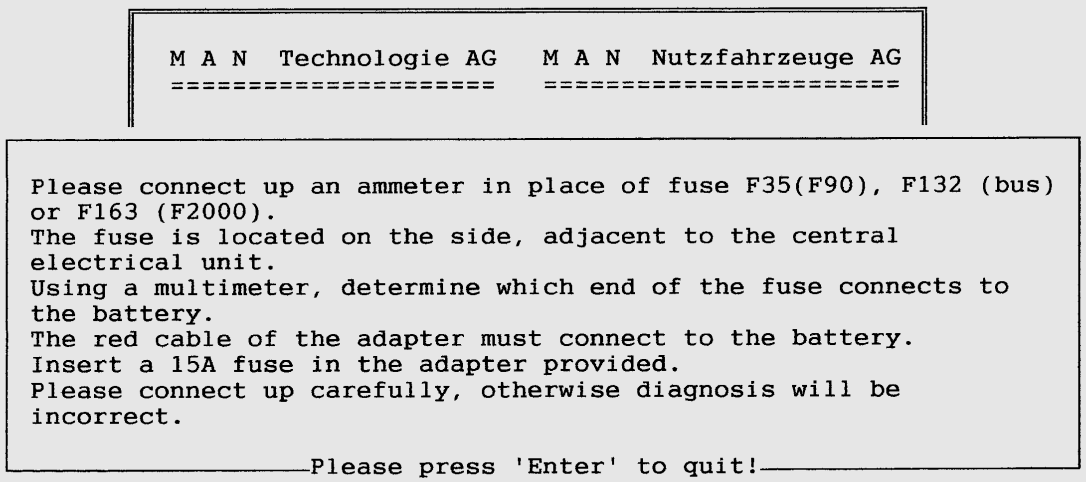


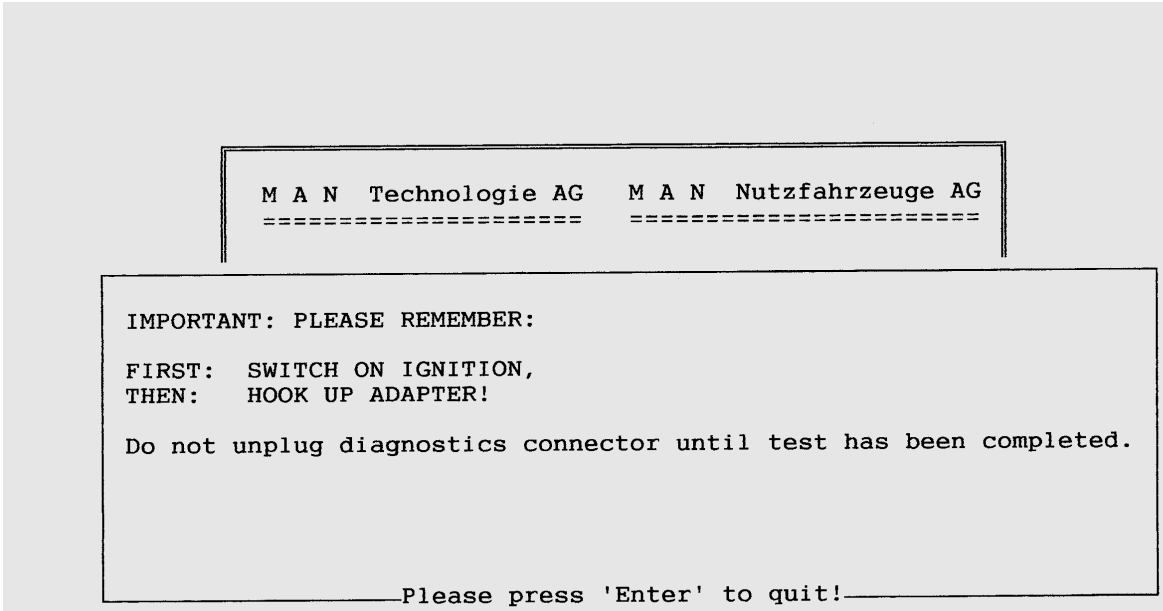
Use arrow key to go to “EDC Bosch MS5/M(S)5.

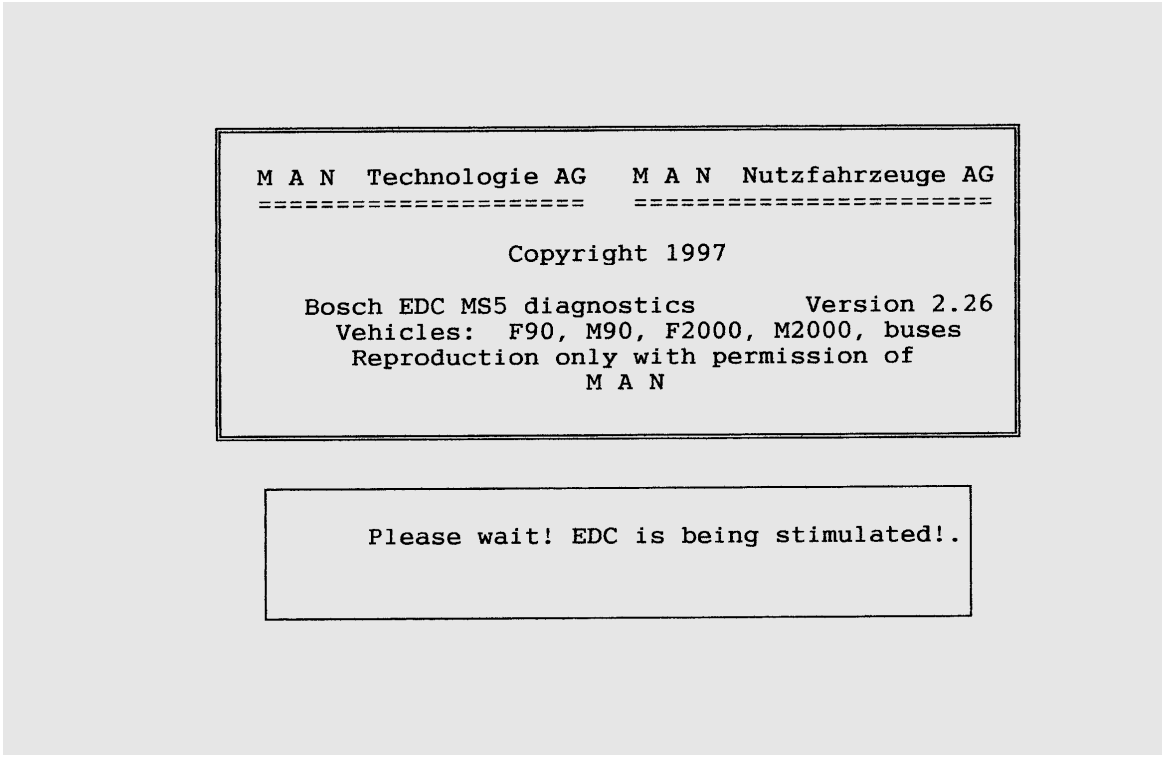
You will see:




M A N Technologie AG
M A N Nutzfahrzeuge AG
Diagnosis can be simplified and speeded up by using a breakout box. If you do not use a breakout box, communication with the control unit may get broken off while diagnosis/repair is in progress.
Do not unplug the diagnostics connector until you have completed the test routine.
Please press 'Enter' to quit!


M A N Technologie AG
M A N Nutzfahrzeuge AG
Please connect up an ammeter in place of fuse F35(F90), F132 (bus) or F163 (F2000).
The fuse is located on the side, adjacent to the central electrical unit.
Using a multimeter, determine which end of the fuse connects to the battery.
The red cable of the adapter must connect to the battery.
Insert a 15A fuse in the adapter provided.
Please connect up carefully, otherwise diagnosis will be incorrect.
Please press 'Enter' to quit!


M A N Technologie AG
M A N Nutzfahrzeuge AG
IMPORTANT: PLEASE REMEMBER:
FIRST: SWITCH ON IGNITION,
THEN: HOOK UP ADAPTER!
Do not unplug diagnostics connector until test has been completed.
Please press 'Enter' to quit!


M A N Technologie AG
M A N Nutzfahrzeuge AG
Copyright 1997
Bosch EDC MS5 diagnostics Version 2.26
Vehicles: F90, M90, F2000, M2000, buses
Reproduction only with permission of
M A N
Please wait! EDC is being stimulated!.

First the contents of the fault memory will be shown (e.g. see list below).

```
 MAN-cats ——— Bosch EDC MS5 diagnostics - Control unit data ———————————
 Part number:       51.11615-7xxx                                Stufe3 V15

                              Instructions/questions
                          ** Fault memory content **

 Code Description/Type of fault          Peripheral conditions       Frequency
 87   Water temperature sensor           Engine speed: 0 1/min             2
      ↓ ' ' ~                            Voltage: 0 mV
 1D   Control lever                      Engine speed: 0 1/min             1
      ? ' '                              Voltage: 4922 mV
 1C   Resistor array SG Pin 35           Engine speed: 0 1/min             1
      ↑ ' '                              Voltage: 4961 mV



 ↑: too large                ↓: too small                -: no signal
 ?: implausible              ': saved                    ': present
 ~: sporadic
 Please press 'Enter' to quit!
```

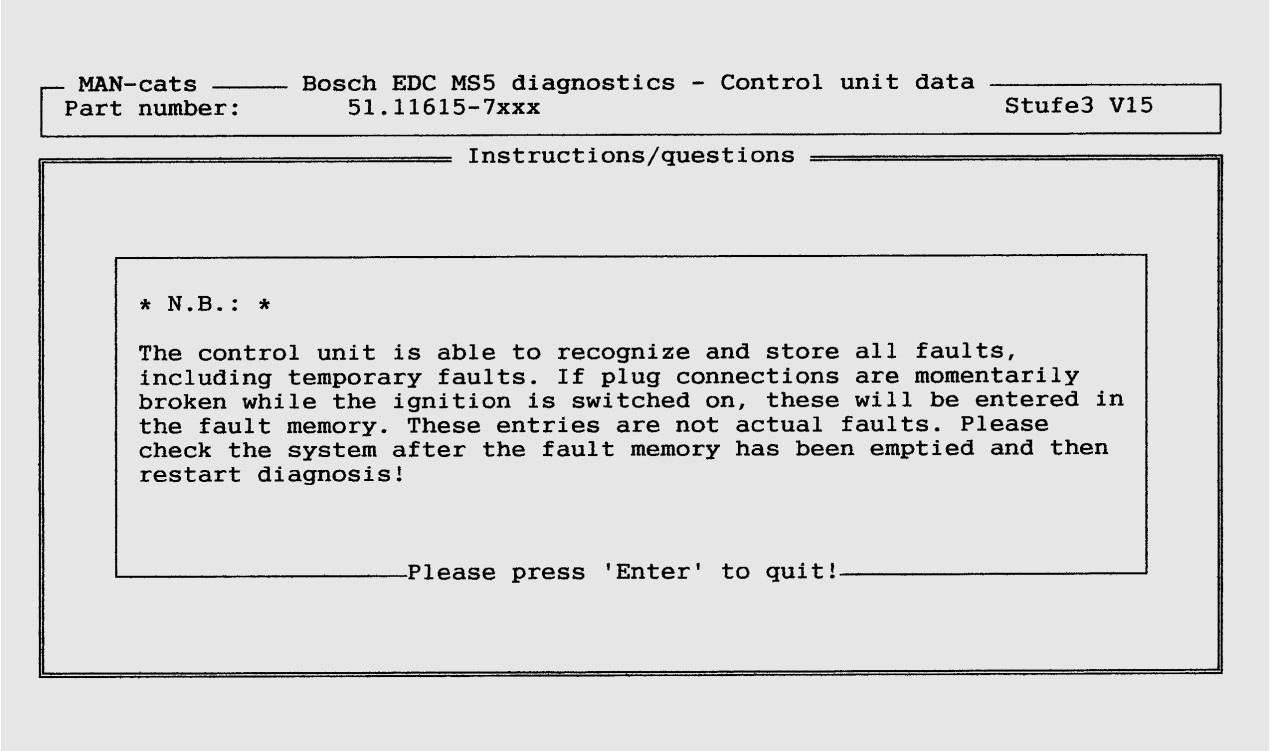
Fault description:

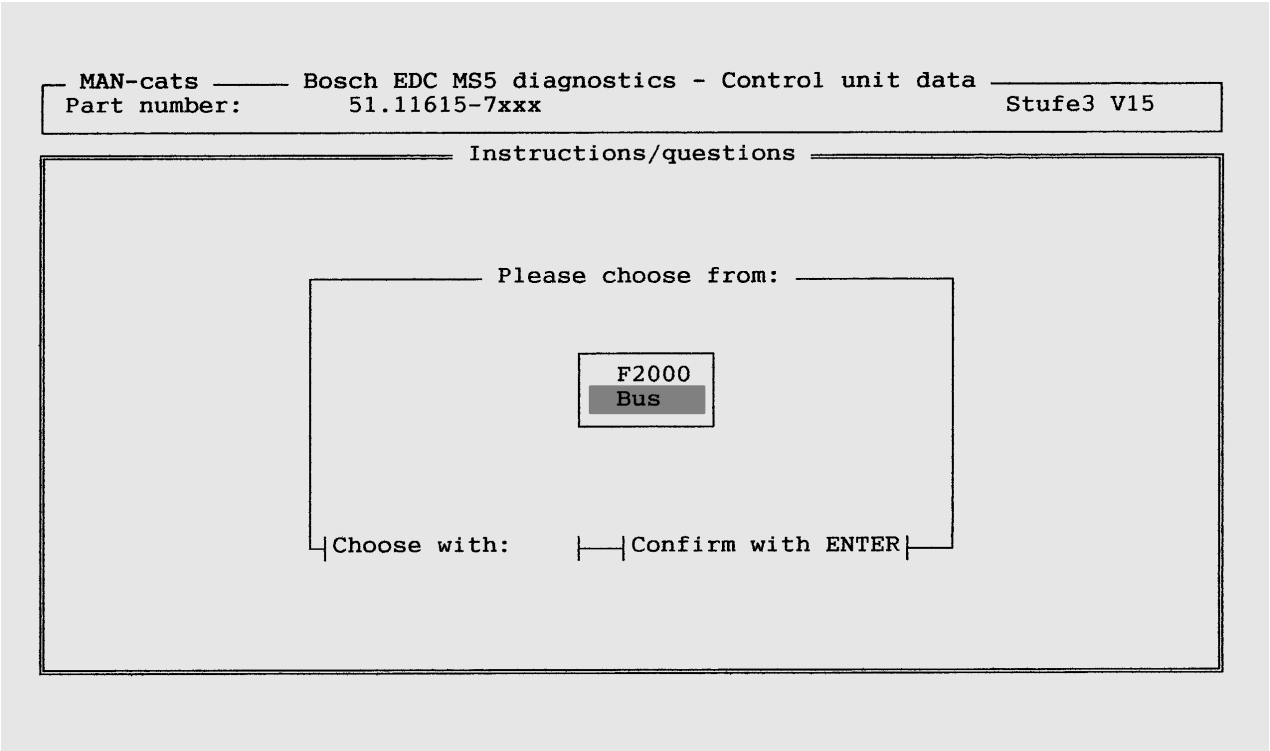
↑	: too large	≙	measured value too high
↓	: too small	≙	measured value too low
–	: no signal	≙	possible wire interruption, sensor fault
?	: implausible	≙	unknown fault
■	: saved	≙	fault is recorded
⌐	: present	≙	fault is still existing
~	: sporadic	≙	momentary fault

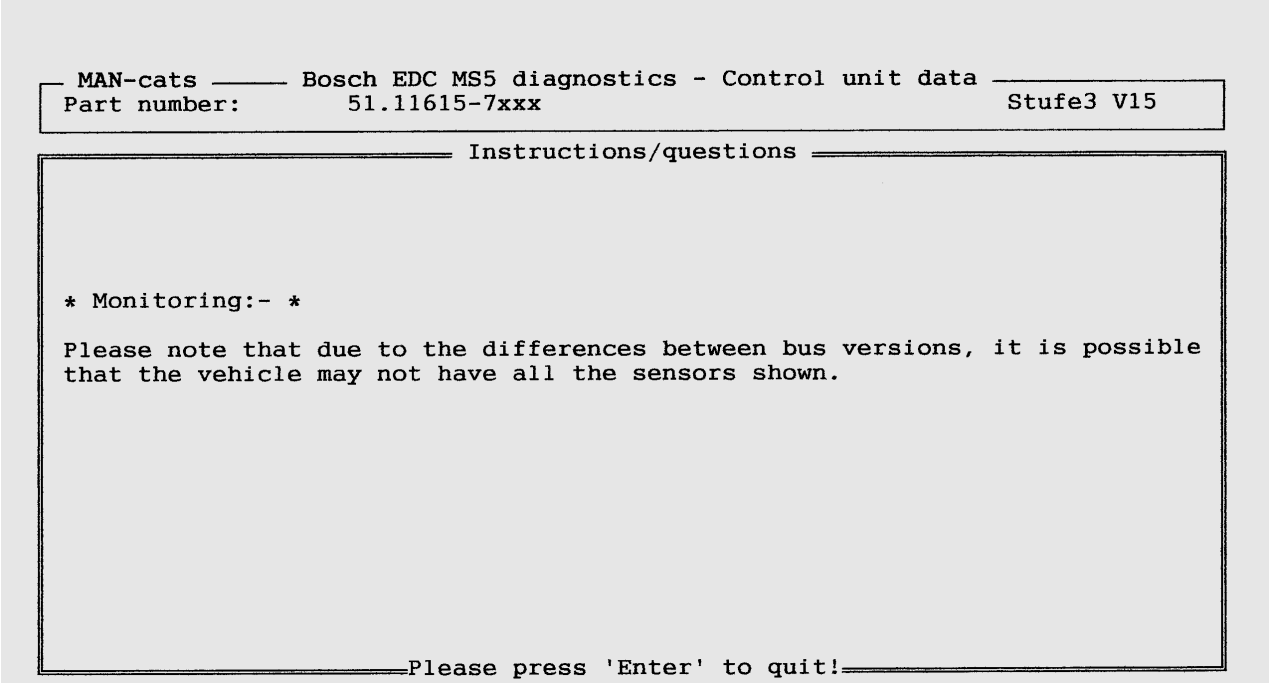
Frequency: Depending on the channel the EDC is recording the faults from 1 to 40 or 1 to 210. If alter a new start a fault doesn’t exist any more the incidence will be set back I x.

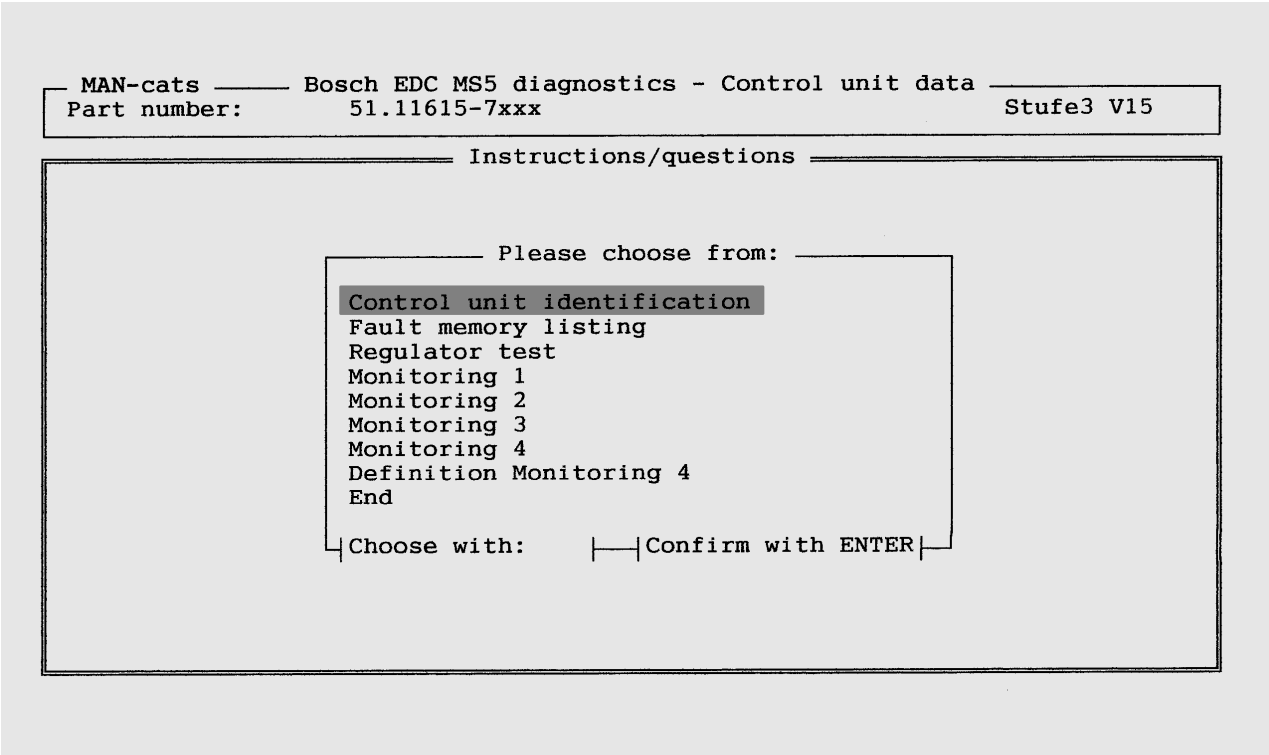
Perripheral conditiong: Showing other, important channels to get more informations; e.g. at what RPM a fault at what value existed.

After checking and recording the fault memory press “Enter” to come to a submenu where you choose the function “Bus”.


MAN-cats
Bosch EDC MS5 diagnostics - Control unit data
Part number:
51.11615-7xxx
Stufe3 V15
Instructions/questions
* N.B.: *
The control unit is able to recognize and store all faults, including temporary faults. If plug connections are momentarily broken while the ignition is switched on, these will be entered in the fault memory. These entries are not actual faults. Please check the system after the fault memory has been emptied and then restart diagnosis!
Please press 'Enter' to quit!


MAN-cats
Bosch EDC MS5 diagnostics - Control unit data
Part number:
51.11615-7xxx
Stufe3 V15
Instructions/questions
Please choose from:
F2000
Bus
Choose with:
Confirm with ENTER





Guided through the menu you come to the window “Instructions/Questions”.

Depending on the software version there are various submenus which are explained at the following pages.

At “control unit identification” you find the engine number which must be checked. If engine and control unit do not match it is very important to inform MAN. Further informations see below:

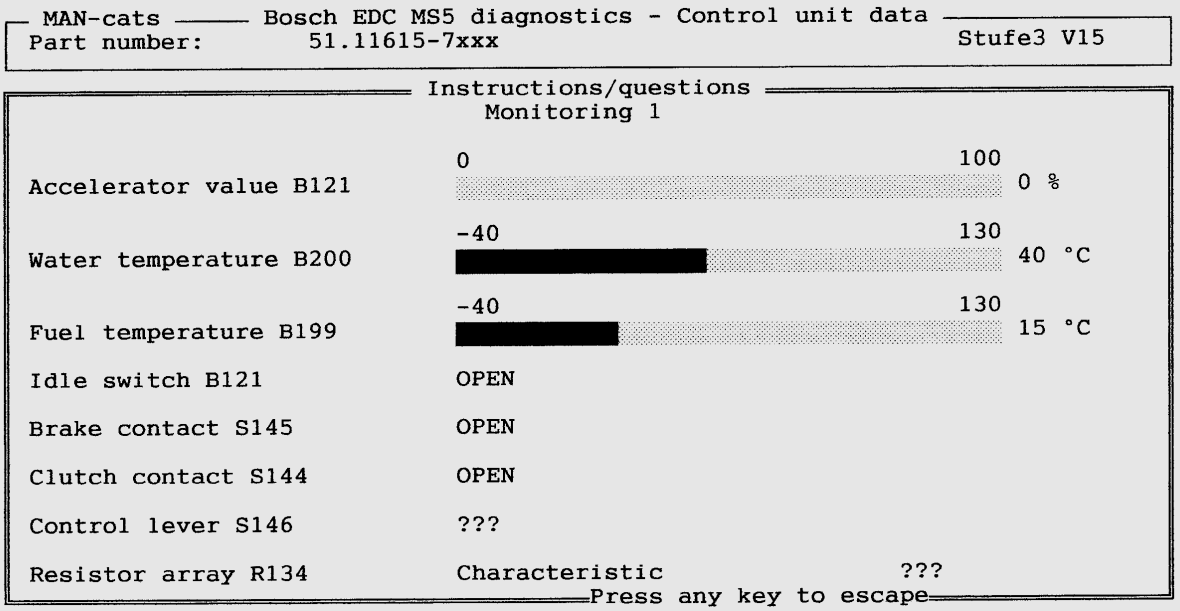
```
MAN-cats ——— Bosch EDC MS5 diagnostics - Control unit data ———————————
Part number:       51.11615-7xxx                              Stufe3 V15

                          Instructions/questions
                        Control unit identification

Bosch EDC MS5 diagnostics  Stufe3 V15

Part number:          51.11615-7180
DAMOS:                M24000.D16
EEPROM:               M240A200.X16
Engine number:        9561080
Chassis number:
Unmachined part no.: 51.11615-1005
MAN-cats Code:        MAABAB

Last programming session carried out with registration no. N

                          Please press 'Enter' to quit!
```

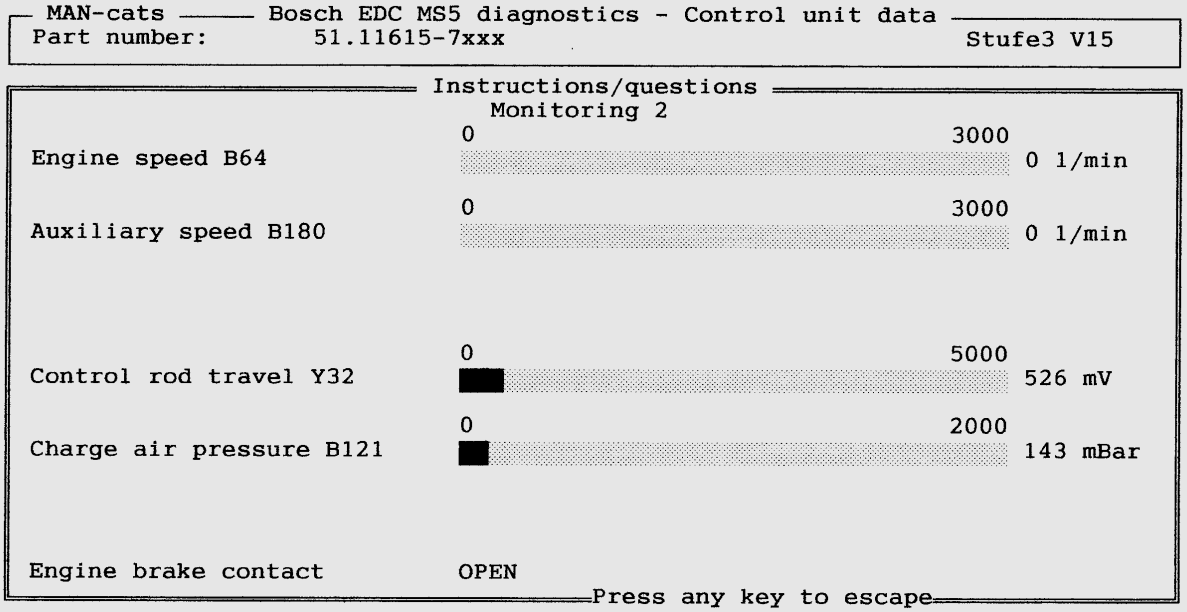
Next in the submenu you find “Fault memory content” which again shows the EDC’s actual fault memory (e.g. see picture below).

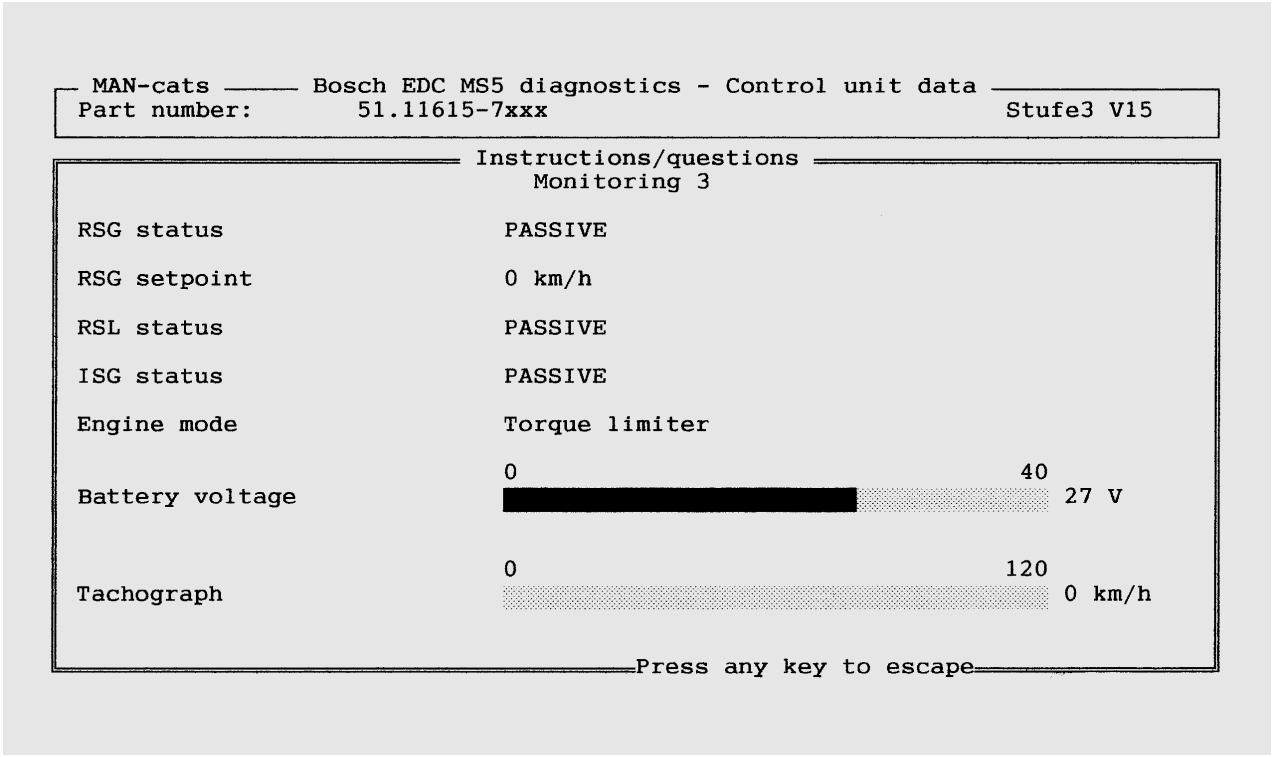
```
MAN-cats ——— Bosch EDC MS5 diagnostics - Control unit data ———————————
Part number:       51.11615-7xxx                              Stufe3 V15

                          Instructions/questions
                        ** Fault memory content **

Code Description/Type of fault          Peripheral conditions      Frequency
87   Water temperature sensor           Engine speed: 0 1/min            2
     ↓ ' ' ~                            Voltage: 0 mV
1D   Control lever                       Engine speed: 0 1/min            1
     ? ' '                              Voltage: 4922 mV
1C   Resistor array SG Pin 35           Engine speed: 0 1/min            1
     ↑ ' '                              Voltage: 4961 mV

↑: too large              ↓: too small              -: no signal
?: implausible            ': saved                  ': present
~: sporadic
Please press 'Enter' to quit!
```

“Control rod test” contains on “EHAB” test which will not be explained here.

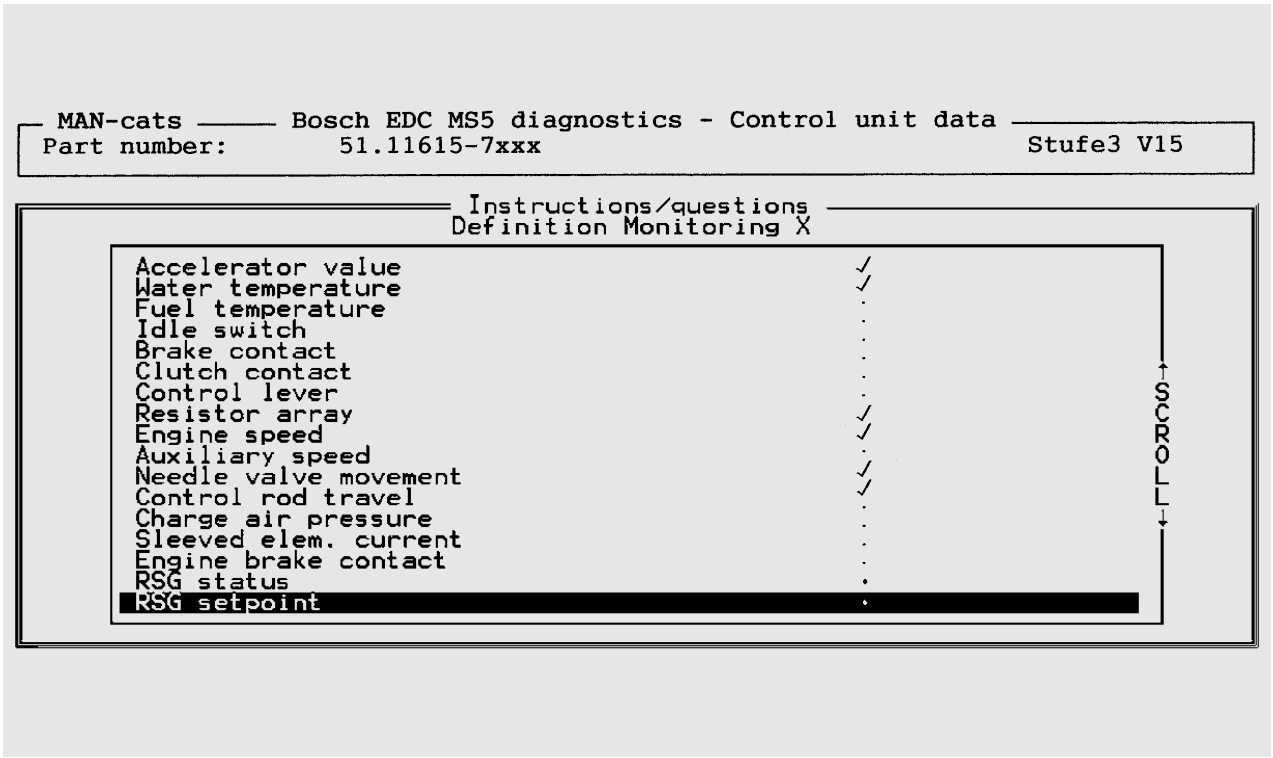
“Monitoring 1 – 3” shows various engine parameter. The measured datas will not be recorded.

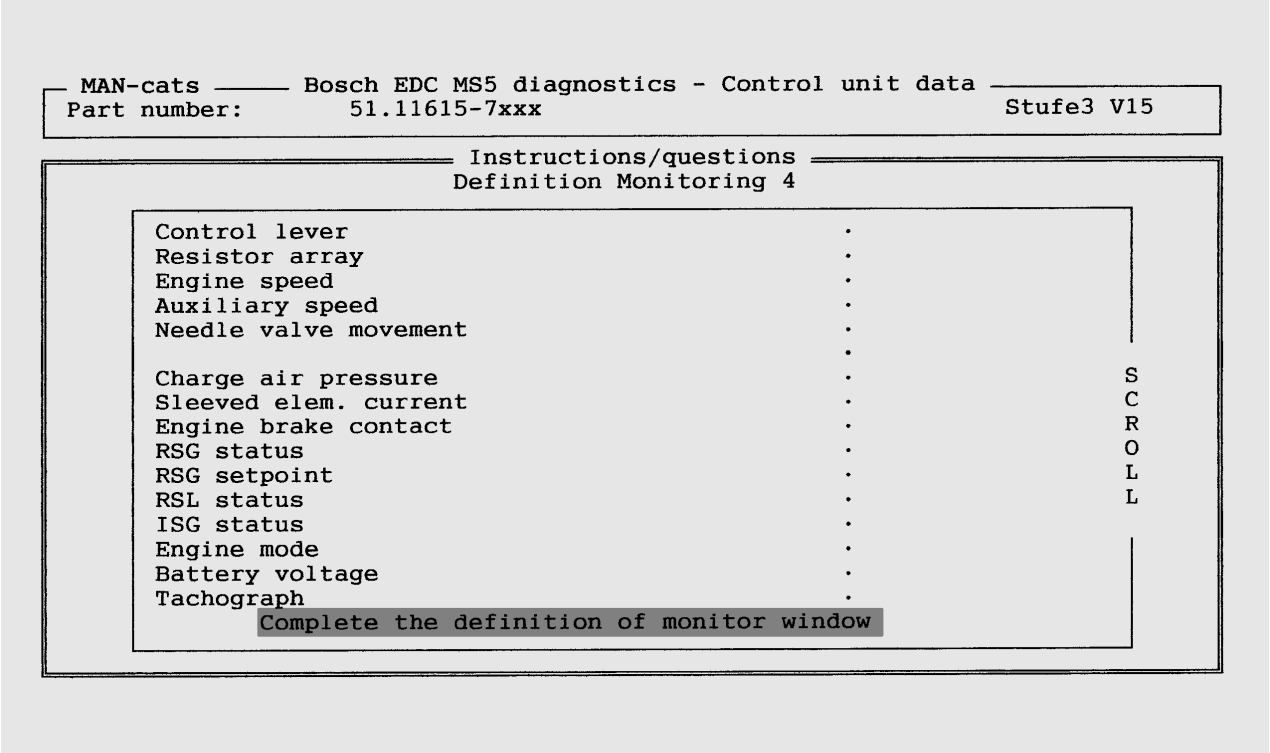






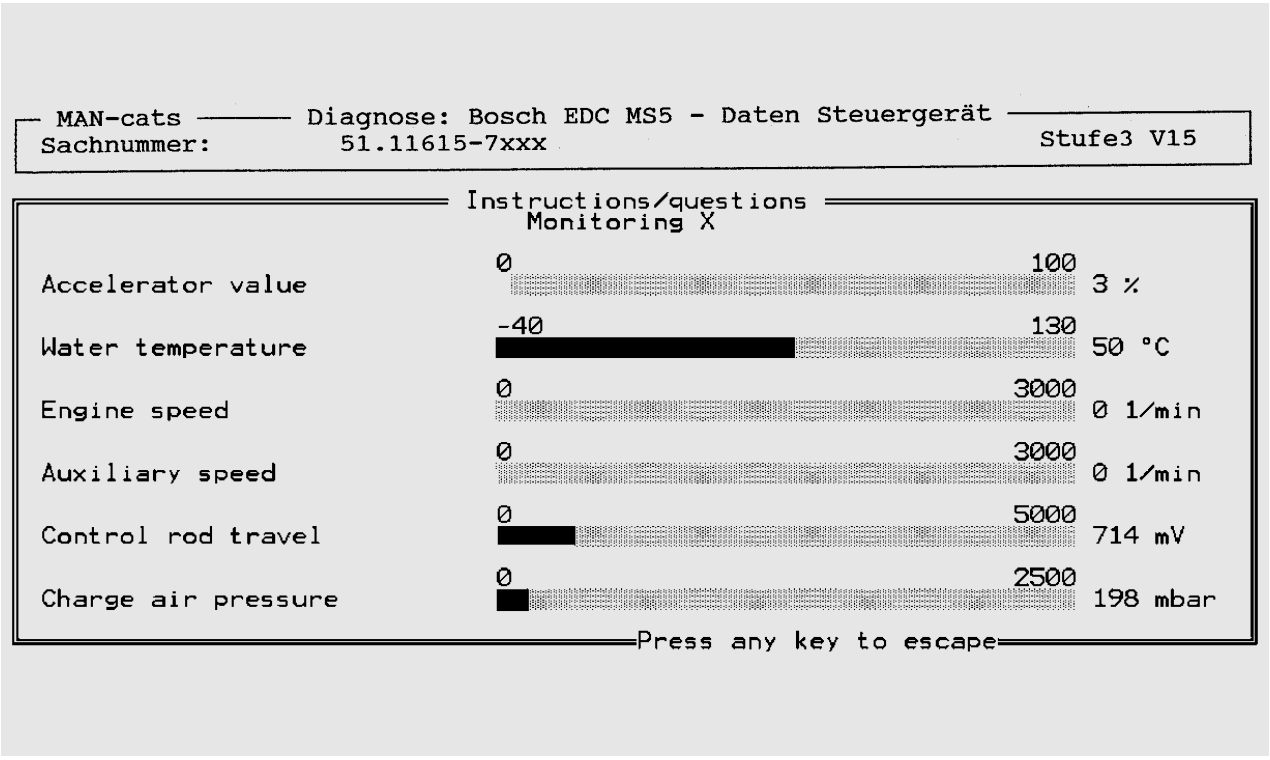
Depending on the software version you can also select “Monitoring 4” or “Definition Monitoring 4”. In the submenu item ”Definition Monitoring 4” up to six freely selectable measuring channels can be selected with the ”Enter” key (see illustration below).



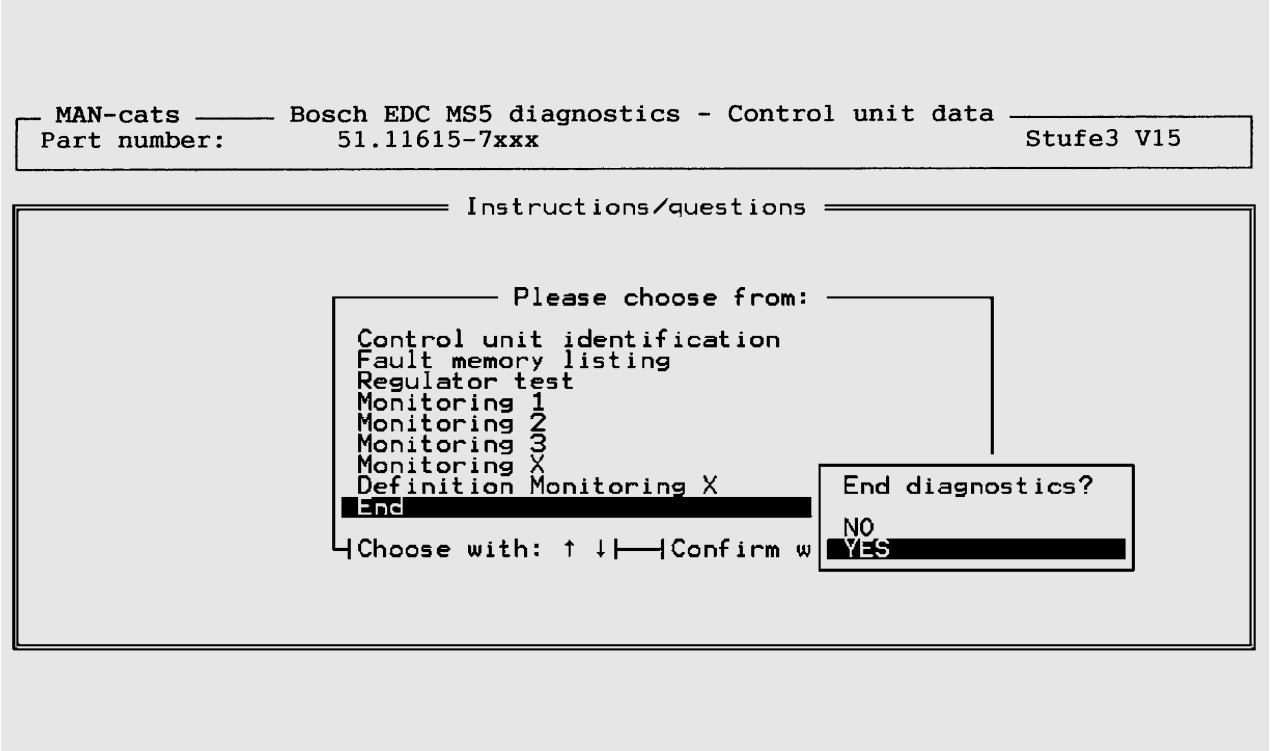


Selection of the measuring channels is completed with ”Complete the definition of monitor window”.

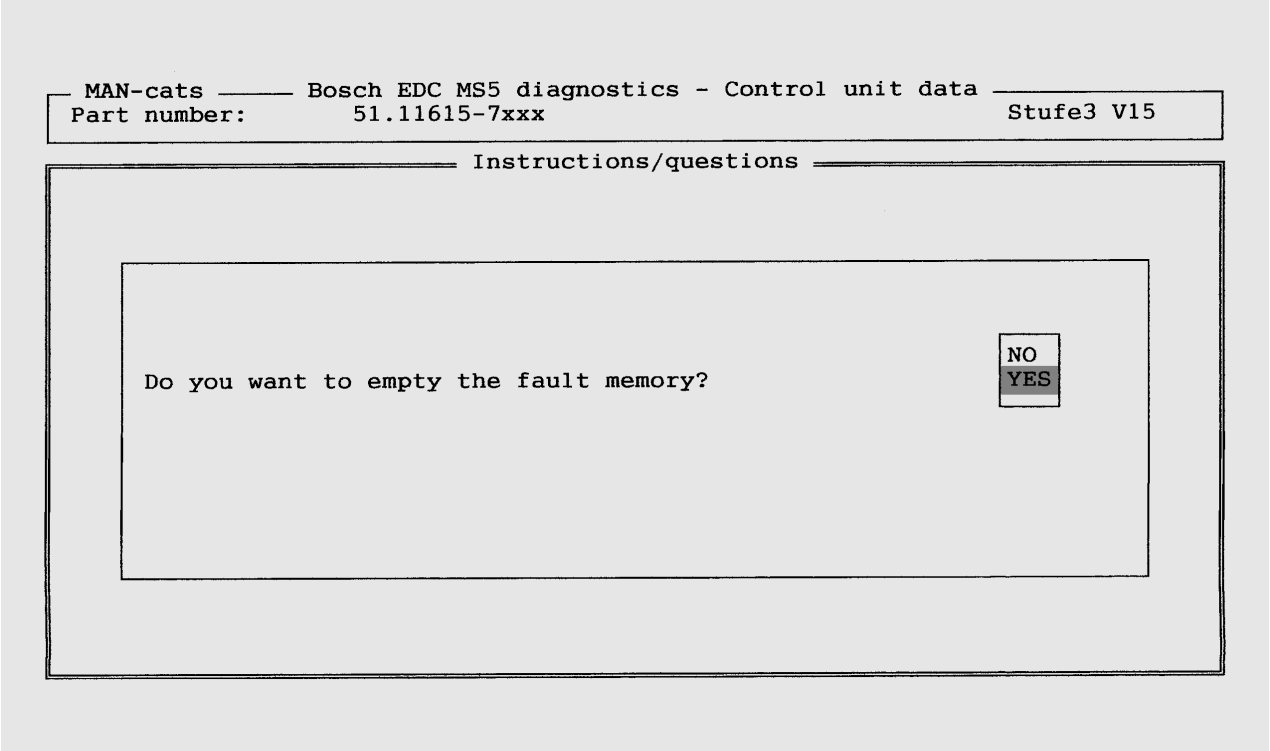
After this you can view the measuring channels you have selected in ”Monitoring 4” (see illustration below).



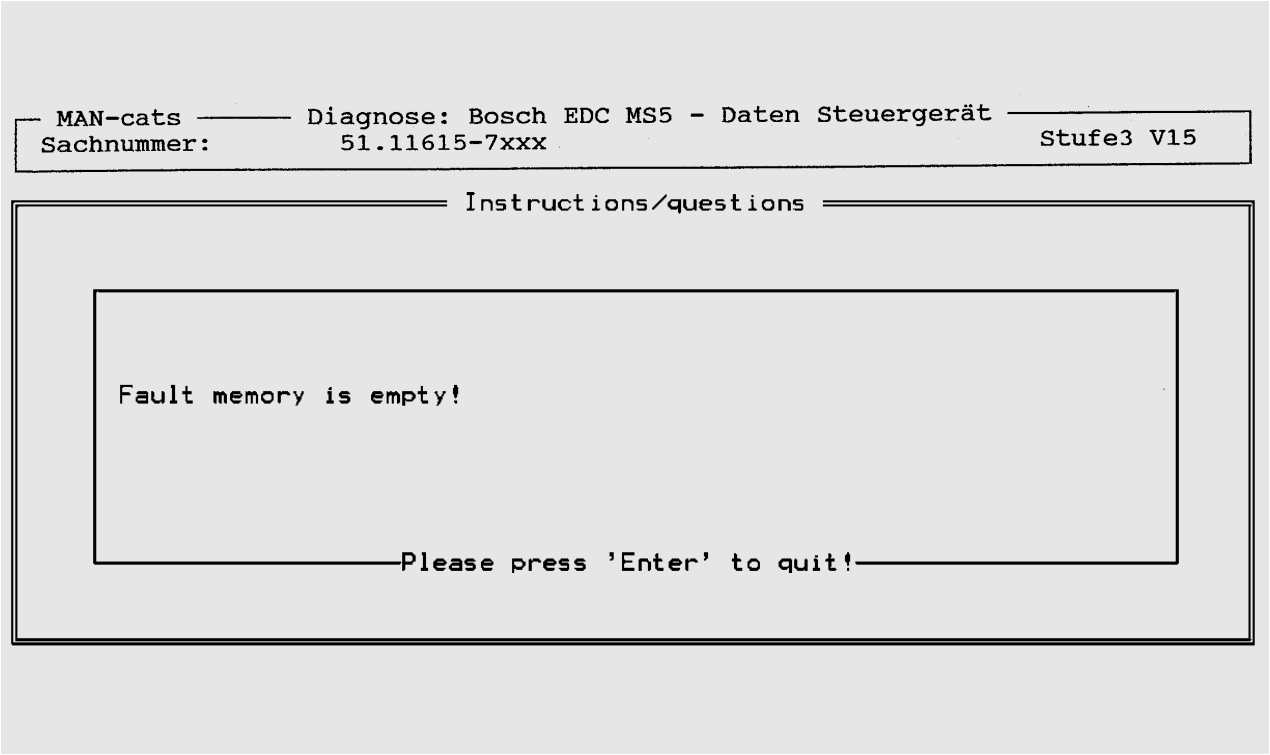
After diagnose and measuring of engine parameter select “End”.

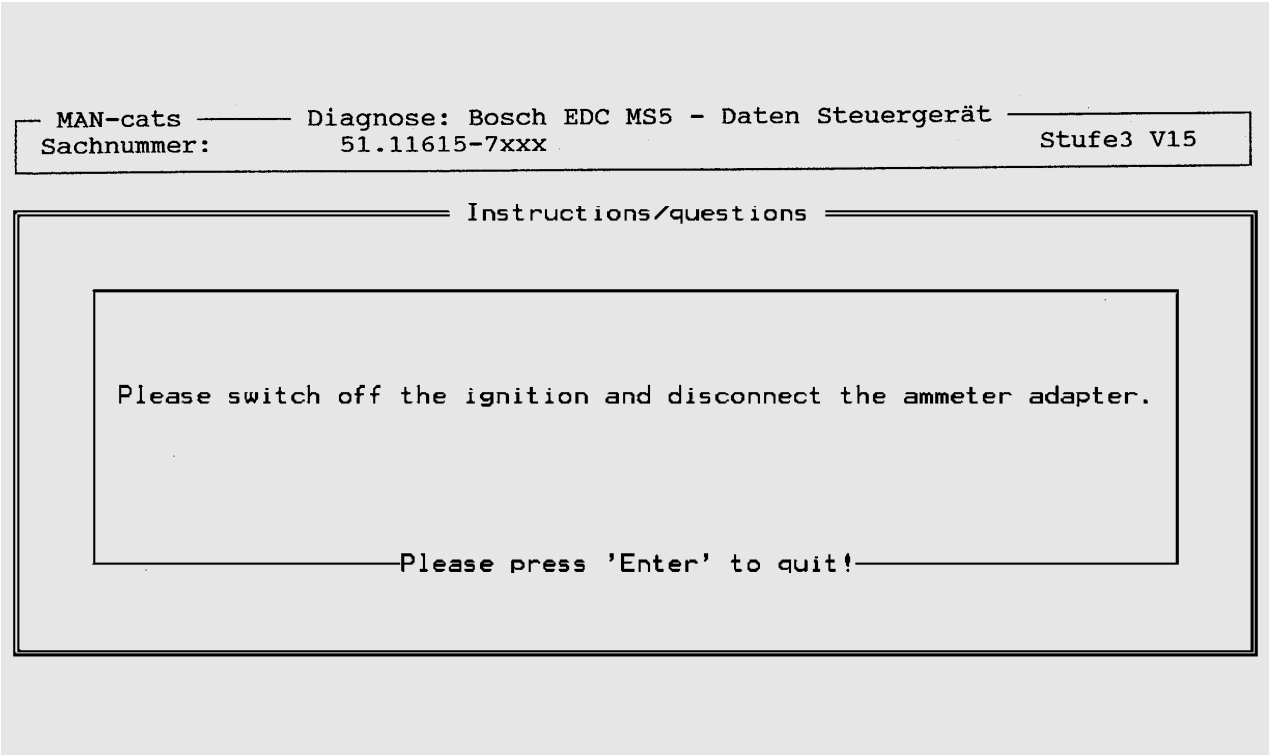


Now you can use “Enter” to leave the main menu “Instructions/Questions”. The following picture will be found on the screen.

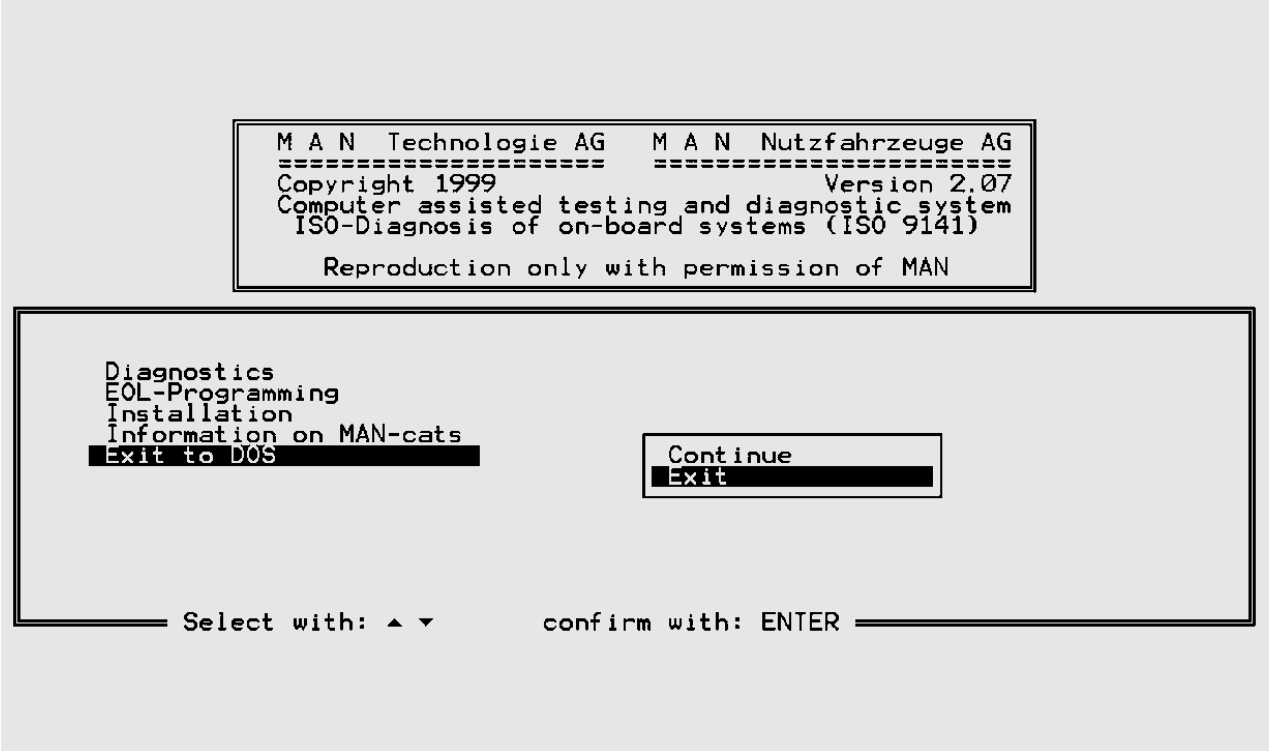


Press “yes” to confirm. Using the “Enter” key you’ll be guided through the menu





Following the instruction above you'll come again to the beginning of the program.



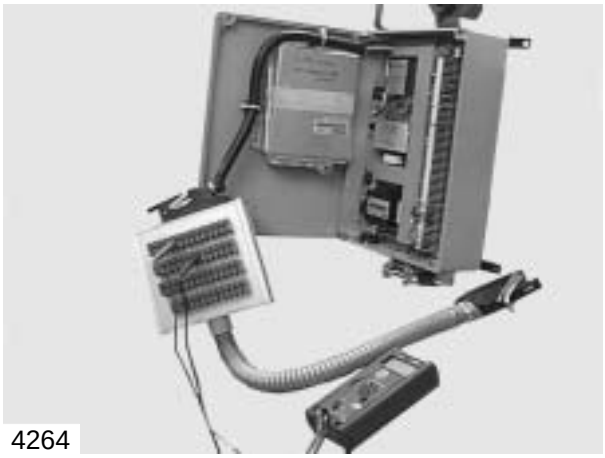
Via "Exit" you can now leave the "MAN_CATS" software.

see also list of checking procedures, page 28

EDC-check with engine stoped

Fig. 1

Ignition off, control unit **not** connected
Reason: Resistance measurement of EDC components



1 4264

EDC-check with engine running, gearbox not engaged

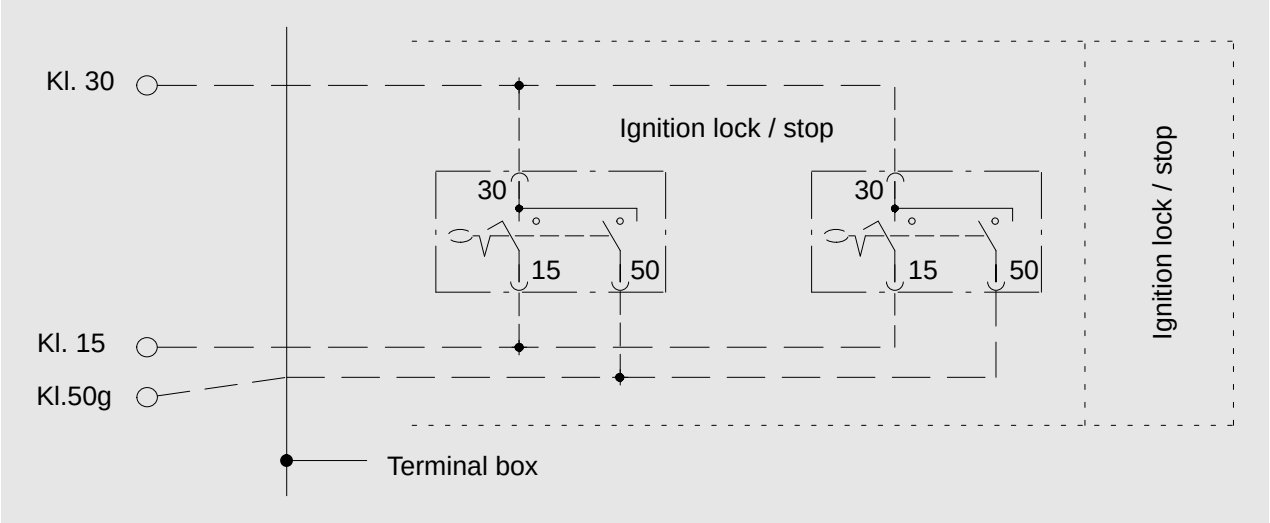
Fig. 2

Reason: Voltage measurement of EDC components

2 4265

The engine should be started and also stopped in the normal way using the ignition switch. Connect this up via terminal 15 and terminal 30 (+).

Fig.



No separate stop switch should be installed apart from the ignition lock and the emergency stop button.

Stopping the engine: normal procedure

1. Turn ignition key from position 1 ⇒ position 0 ⇒ Engine stops
2. Switch off battery main switch

If this procedure is not adhered to and the battery main switch is switched off before the ignition, fault entries may be made in the EDC fault memory and the engine speed will be reduced.

Reason:
The voltage supply to the control unit will be interrupted as the EDC tracks.

a. Ignition lock

In the engine room the engine should be started and stopped using the ignition lock on the engine room panel.

Stopping procedure

1. Turn ignition key from position 1 ⇒ position 0 Engine stops
2. Switch off battery main switch

b. Stop button on engine room panel

In addition to the ignition lock, which should normally be used to stop the engine, the “Stop” button in the engine room panel offers a further way of stopping.
For this the button should be pressed until the engine has come to a complete standstill. This leads to the informal entry “External stop – recording” in the EDC fault memory, but this has no effect on operation of the engine.

Before you switch off the voltage supply at the battery main switch ensure, if you are using the “Stop” button, that the ignition lock is switched off first too (position 1 ⇒ 0).

If this is not done, several entries may be made in the EDC fault memory and the engine speed may be reduced as a result.

Caution:
In general switching off the voltage supply to the EDC engine control system using the battery main switch is to avoided if the ignition is on.

Emergency stop at terminal box

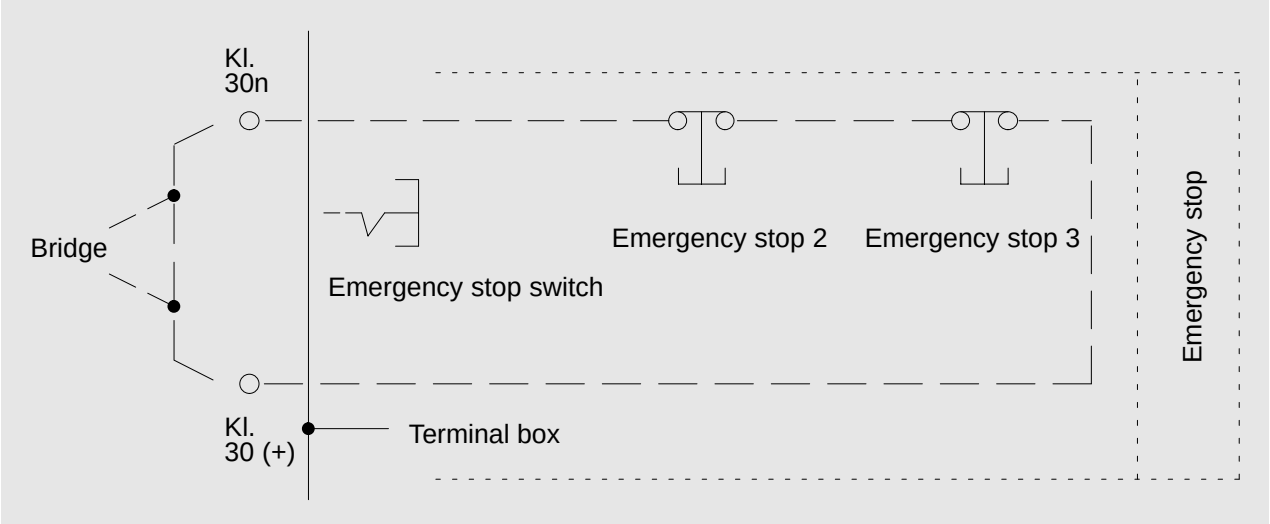
A series feature of the terminal box is an emergency stop switch with detends.
If this switch is actuated the engine switches itself off and the starter motor can no longer be triggered. The switch must be unlocked before the engine is started again.

Connection of emergency stop system at bridge and flybridge

Additional emergency stop switches for the bridge and flybridge can be installed between terminal 30 (+) and terminal 30n. In some cases such emergency stop switches are mandatory in conjunction with electric throttle lever systems.
If no further emergency stop switches are installed, terminal 30 and terminal 30n are to be bridged together. The bridge for this is provided in the terminal box.

If the emergency stop switch is actuated no entry is made in the EDC control unit's fault memory, as tracking of the EDC control unit is ensured even if the emergency stop switch is actuated.

Fig.



The essential connections for the 4–20 mA throttle lever signal have already been described on page 16. The following pages contain a summary of other aspects of the electrical triggering system.

Voltage supply

The boatbuilder can arrange the voltage supply to the throttle lever either via

- ignition terminal 15 (+) / 31 (–) or
- battery terminal 30 (+) / 31 (–).

a) Voltage supply to the throttle lever via ignition (terminal 15/31)

Whether or not this possibility can be used depends on the current build-up (4mA) after the ignition voltage is switched on. The build-up is fast enough if a current of at least 2.5 mA is available 0.2 seconds after the voltage supply has been switched on (e.g. Mathers Clear command).

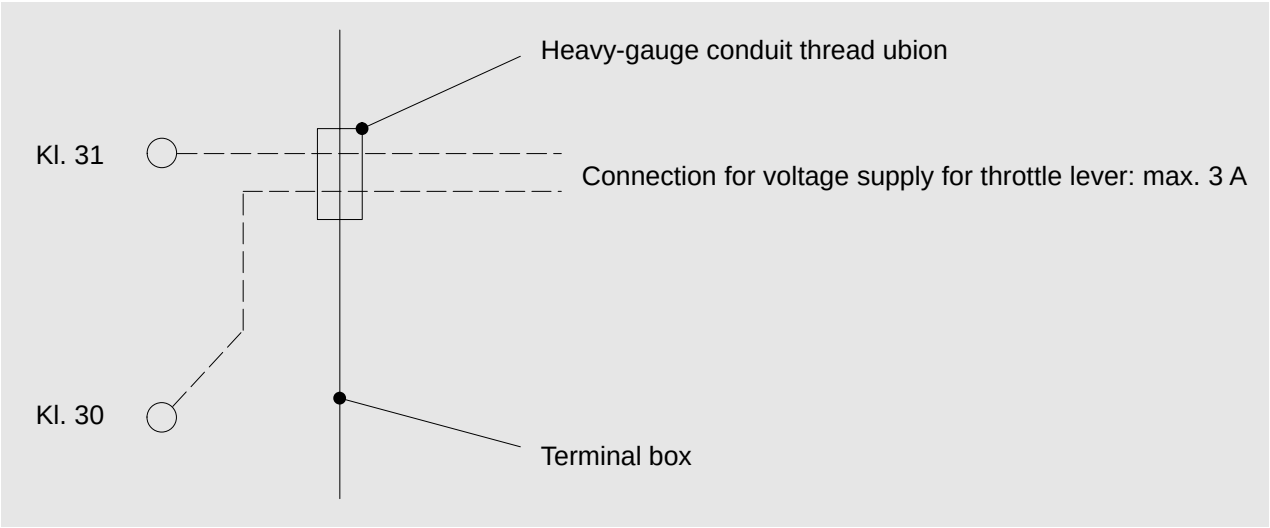
If this requirement is not met
⇒ the pedal value transmitter input defect is classified
an entry is made in the EDC fault memory
⇒ there is an EDC constant light fault (alarm BE1: “Electronics fault”)

In this case the throttle lever control system must be connected up direct to the battery voltage, taking into account the safety measures provided by the manufacturer.

b) Voltage supply to the throttle lever control system via battery terminal 30/31

If the throttle lever systems are connected to the battery voltage the safety measures provided by the manufacturer must be taken into account.
If the current consumption of the deck shiftgear during operation is constantly max. 3 A, terminals 30 (Bat+) and 31 (Bat–) in the terminal box can be used for this (see picture).
However, this assumes that apart from the EDC control unit, the BE1 system and the instruments no other consumers are supplied via the terminal box (16 A fuse).
Otherwise the system is connected direct to the battery.

Illustration – excerpt from 51.17098–8688:



Ensure that the throttle lever control system is disconnected from the battery if the boat is left unattended for a fairly long period (several days). To do this use the battery main switch.
Otherwise the battery may discharge and in unfavourable cases there may be difficulties in starting.

Mini-Marex-C system: current consumption at 24 V supply voltage

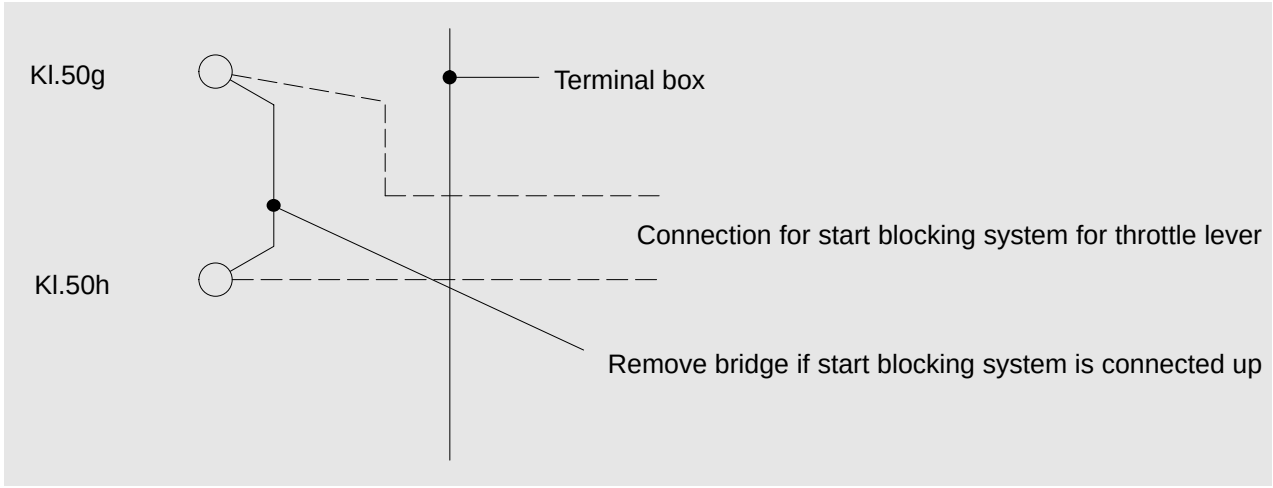
Closed-circuit current consumption with two command initiators (main bridge and flybridge)	approx. 0,6 A
Nominal current consumption with two command initiators Actuator with electric gearbox output	approx. 3 A

c) Connection for start blocking system

The start blocking system ensures that the engine cannot be started when the gearbox is in mesh.
This function is normally realised by an internal relay in the throttle lever control system (e.g. Rexroth Mecman Mini-Marex-C system, Mathers Clear Command, ...).
The connection to the engine is made at terminals 50g and 50h in the MAN terminal box (see diagram).
Here a bridge is fitted as standard; this bridge must be removed when the start blocking system is connected up.
When the gearbox is in mesh the connection between terminals 50g and 50h must be interrupted by the throttle lever control system.
This prevents triggering of the starter lock relay; the starter motor can then not be actuated.

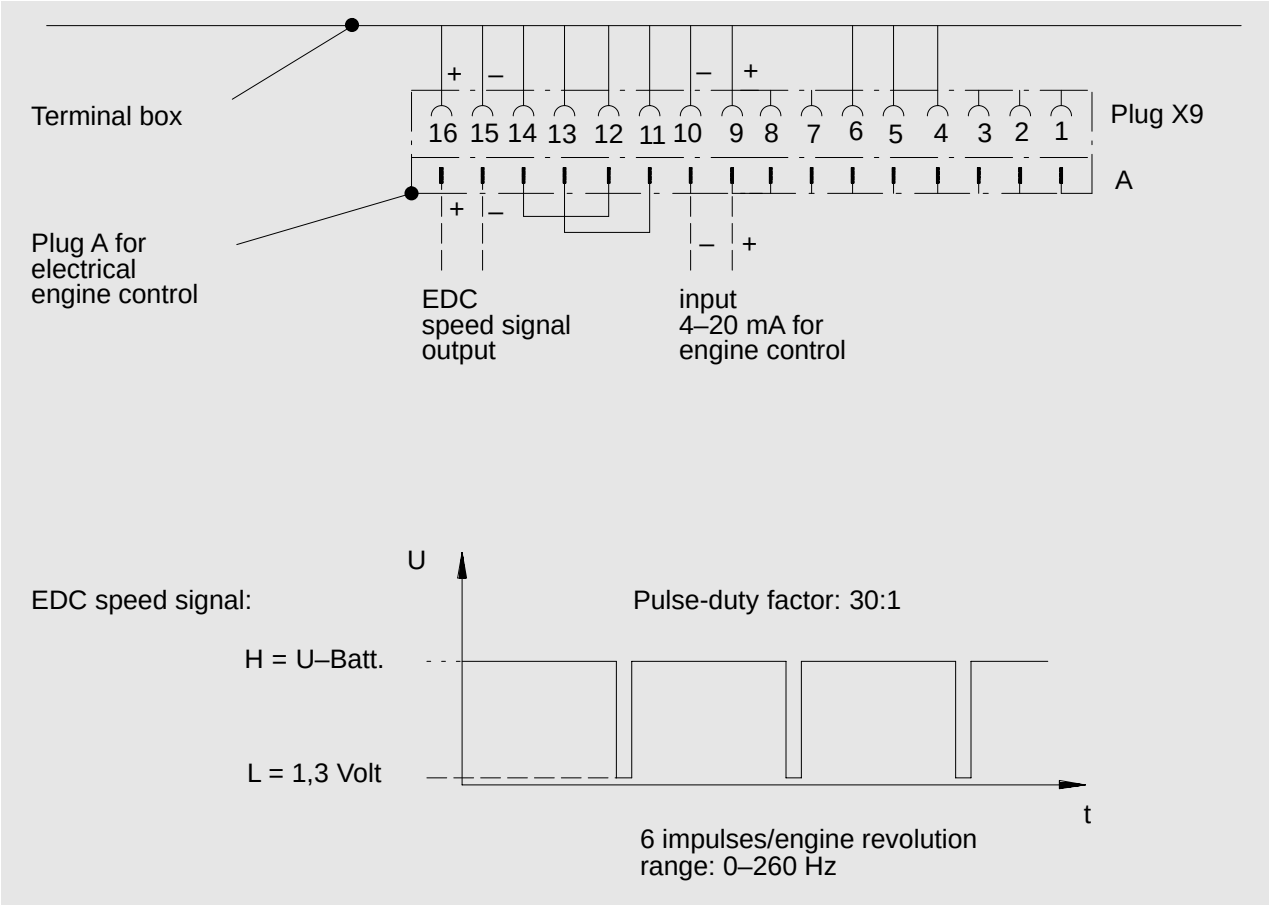
If the throttle lever control system used allows for the start blocking function, we recommend you connect this up for reasons of safety.

Diagram:



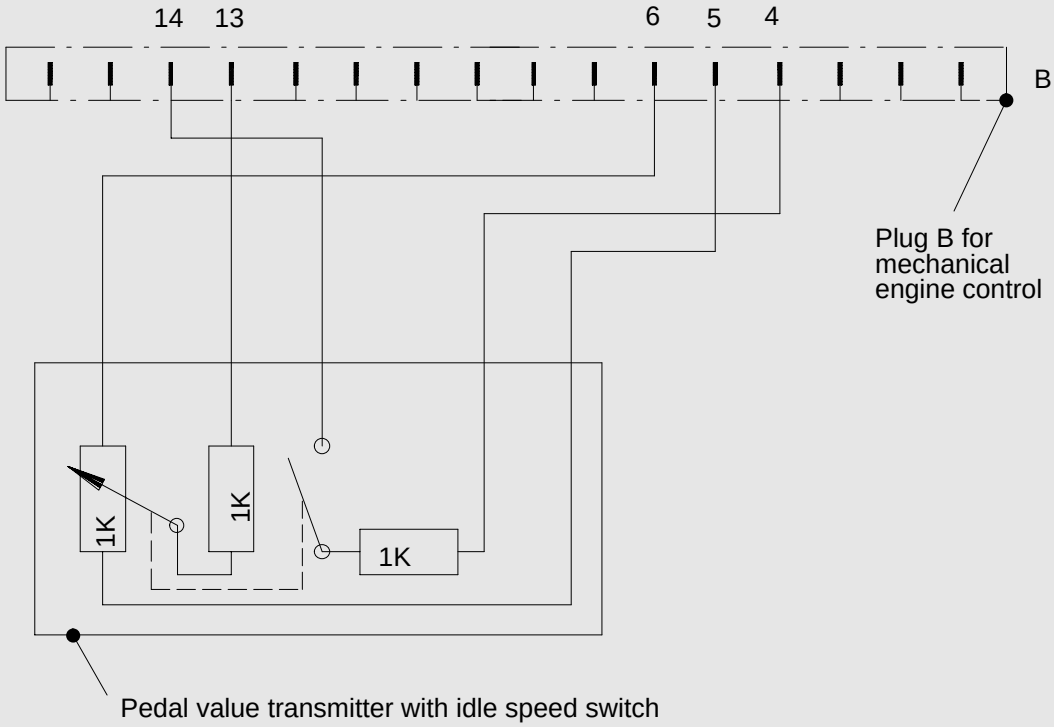
d) EDC speed signal for engine synchronisation

At plug X9, Pin 15 + 16, a speed signal supplied by the EDC is available.
This can be read into the throttle lever control system for engine synchronisation purposes.



e) Engine triggering with pedal value transmitter PWG

If mating plug B with attached pedal value transmitter is plugged into plug X9, the engine can be triggered mechanically, e.g. with a bowden cable.

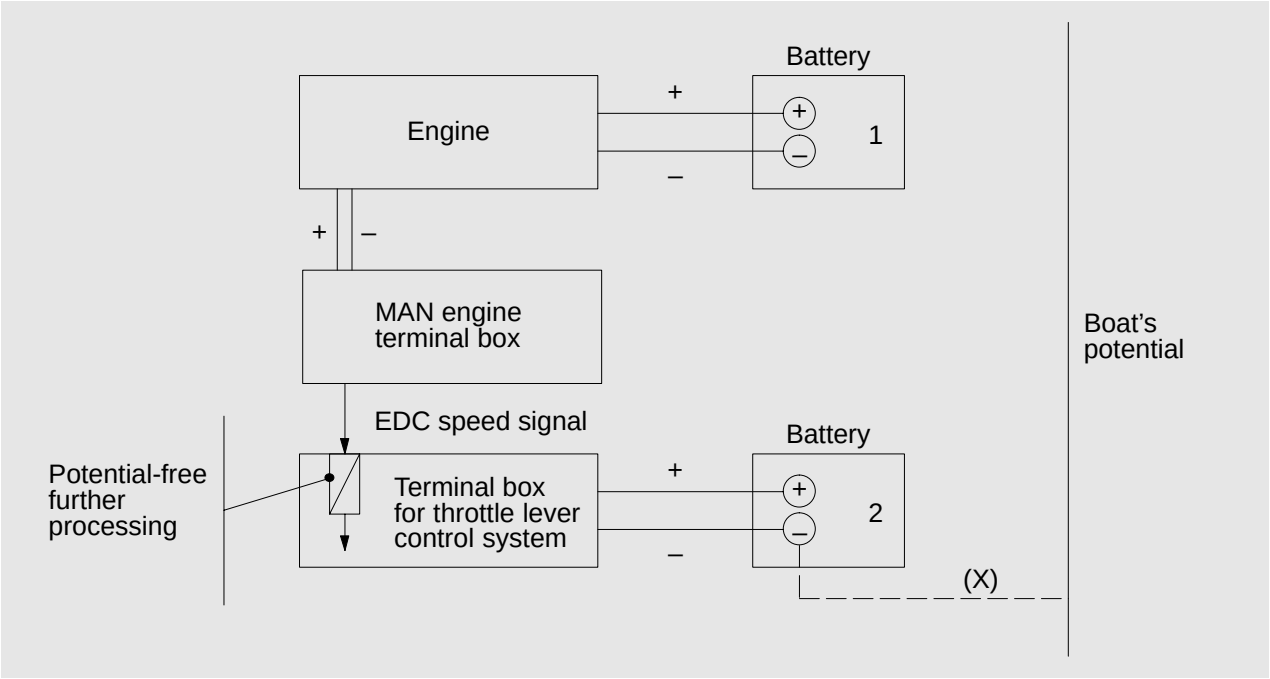


The MAN installation guide-lines stipulate that the engine must be potential-free.
i.e. the battery must never be connected with the boat's potential.
This must also be borne in mind when the throttle lever control system is being connected up.

The 4–20 mA throttle lever signal is galvanically separated from the EDC control box.
The EDC speed signal is not.

If the EDC speed signal is to be used for engine synchronisation and read into the throttle lever control system, take the following points into account:

a) potential-free further processing of the speed signal in the throttle lever control system

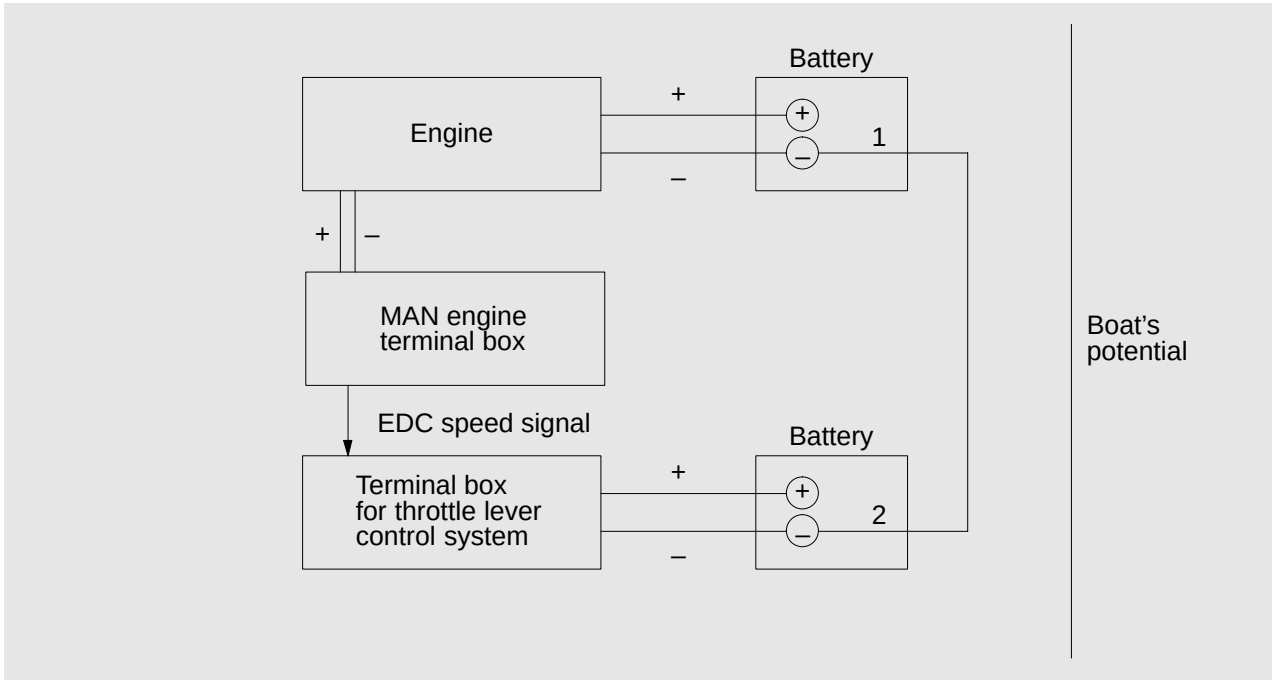


If a separate supply battery (2) is used to supply the throttle lever control system, a link (X) from its negative terminal to the boat's potential is possible.

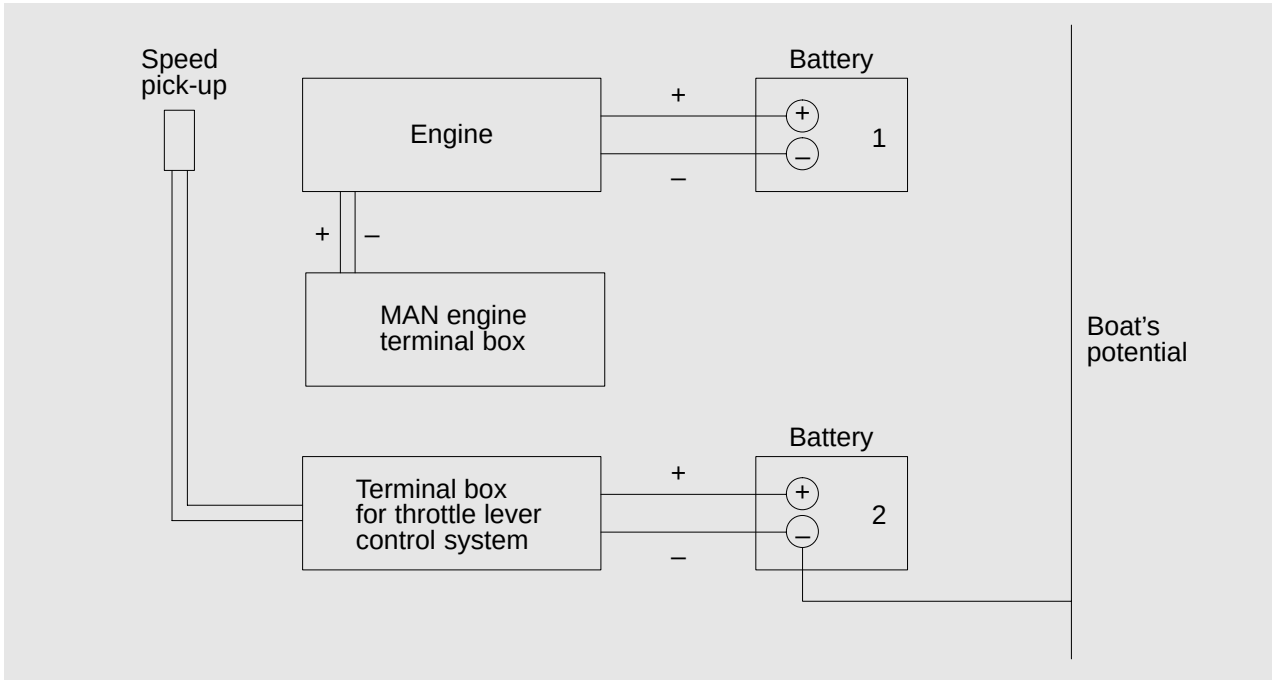
If this is not guaranteed:

b) The throttle lever control system should use the same negative potential as the MAN terminal box with integrated EDC control unit,
i.e. either the throttle lever control system should use the same battery for voltage supply as the starter motor, or the negative potentials of the supply batteries must be linked together.

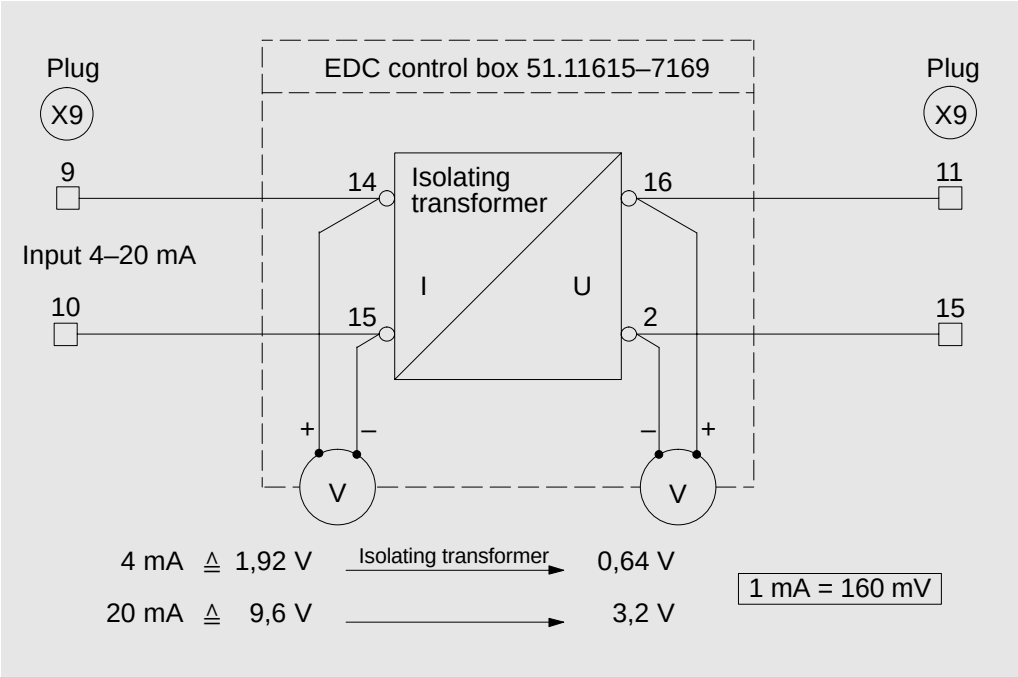
The negative terminal of the battery must not be connected to the boat's potential.



c) If the negative terminals of the throttle lever control system are in contact with the boat's potential or with a different negative potential from that used by the MAN terminal box and if Point a) is not guaranteed, the EDC speed signal cannot be used. A separate speed pick-up must be attached to the engine.



a) Engine triggering with 4–20 mA signal



Via plug X9 and mating plug A it is possible to feed in a 4–20 mA current signal for triggering the engine.

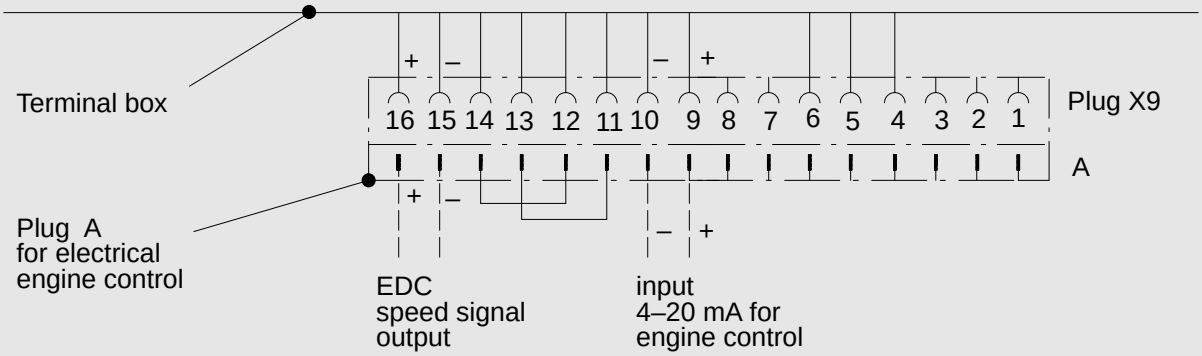
4–20 mA = idle – full load.

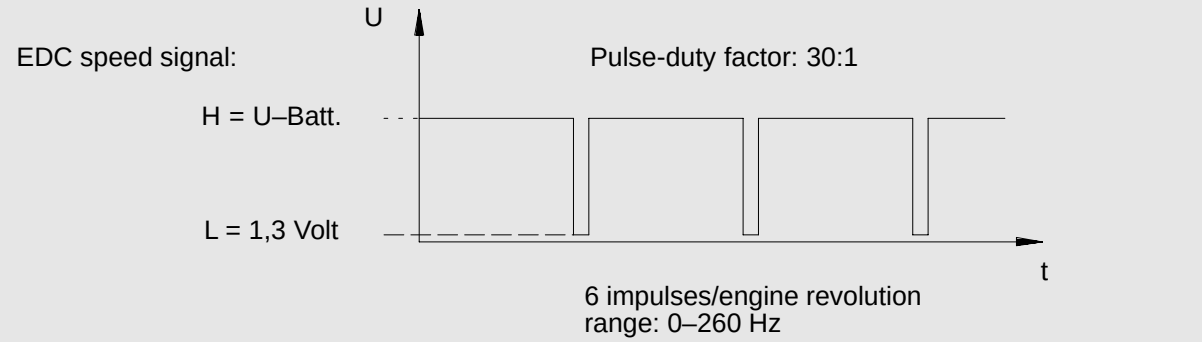
In the EDC control box 51.11615–7169 the 4–20 mA signal is galvanically separated from the EDC and converted into a voltage signal (4–20 mA ≙ 0.64–3.2 Volt).

The mating plug A supplied has screw terminals so that no crimping tools will be needed for connecting it up.

Signal resolution

For sensitive control of the engine speed and for low fluctuations during synchronisation a resolution of at least 8 bits is required for the 4–20 mA current signal.
Better results can be achieved with 10- or 12-bit resolution.





b) Engine triggering with pedal value transmitter (mechanical)

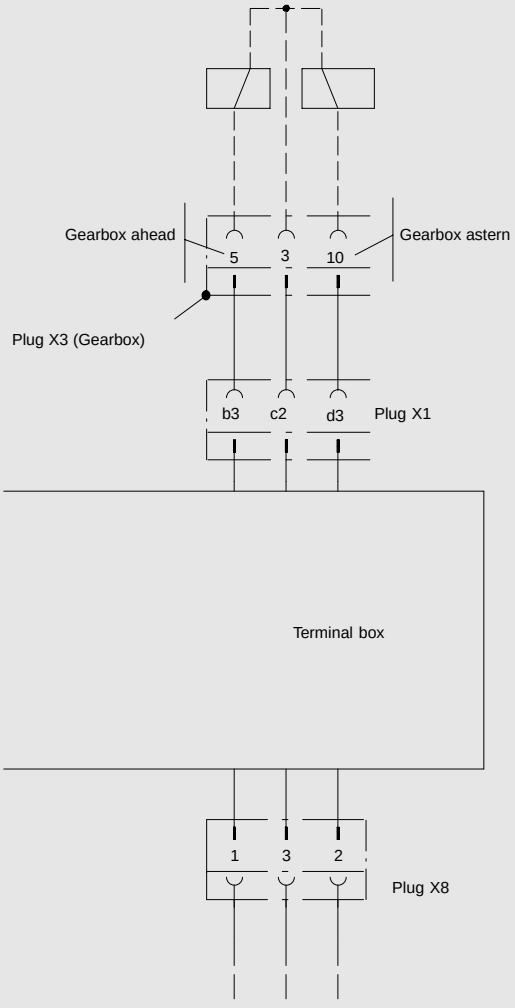
See Page16

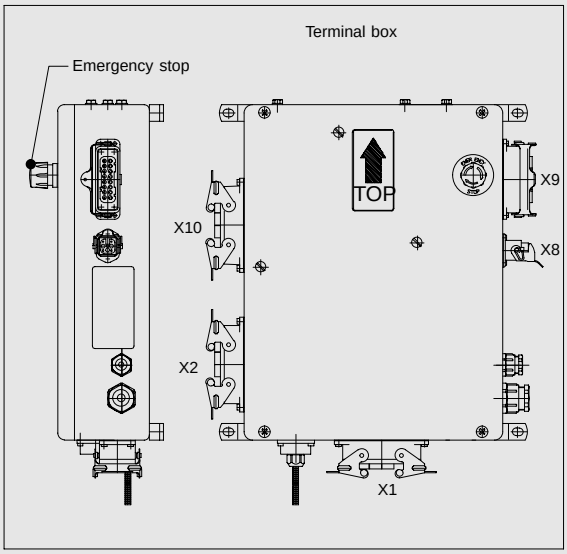
c) Electrical gearbox triggering

The electrical gearbox triggering for ahead and astern can be connected up via plug X8.

Plug X8 is wired up direct to the engine plug X1 and and then to the gearbox plug X3 on the flywheel housing.

The mating plug for X8 is delivered with the system.





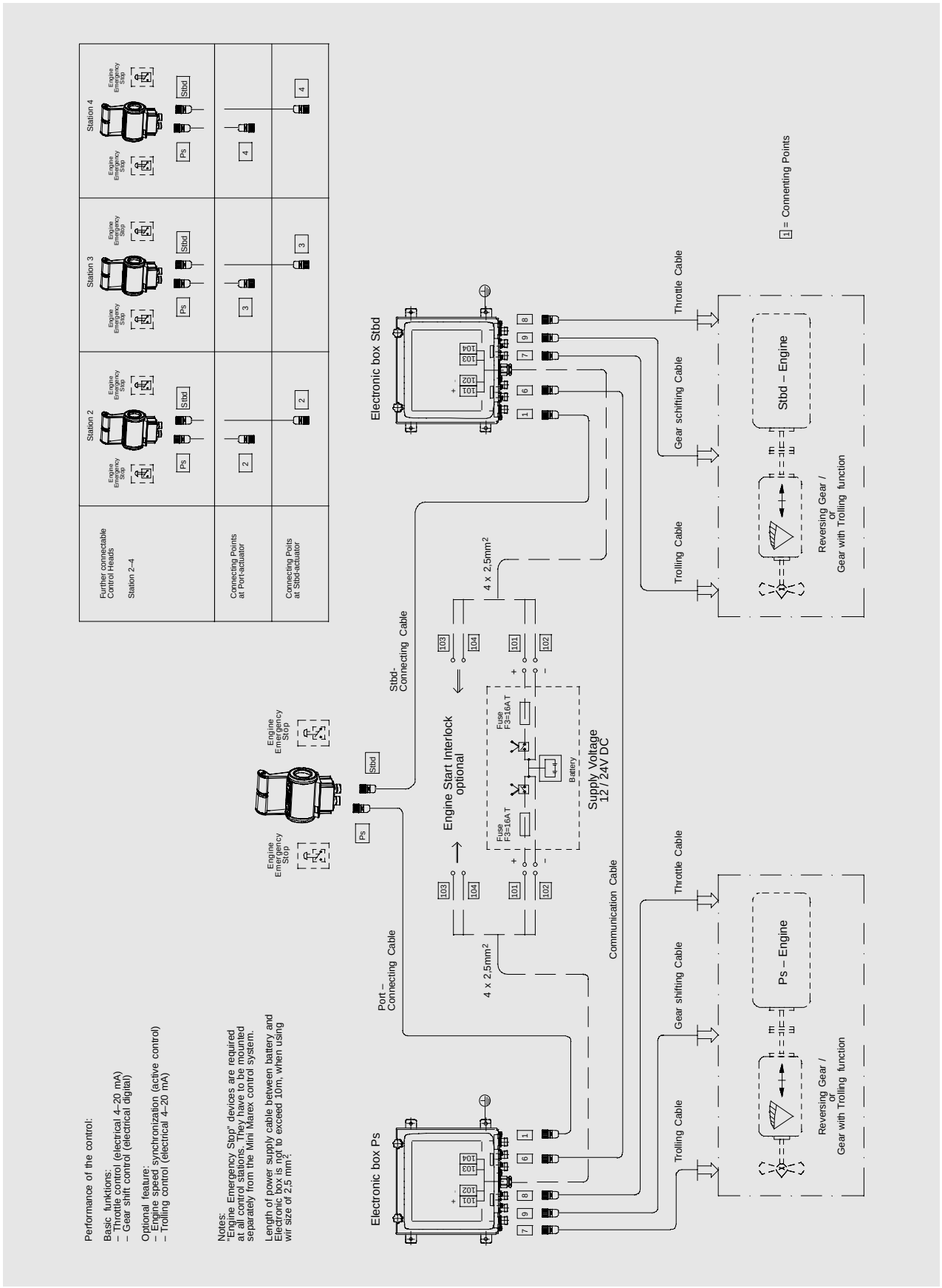
1: Gearbox ahead

2: Gearbox astern

3: ”–” Negative

Brief description of the 4–20 mA throttle lever control system Mini-Marex-C from Rexroth-Mecman; available from MAN Nutzfahrzeuge AG

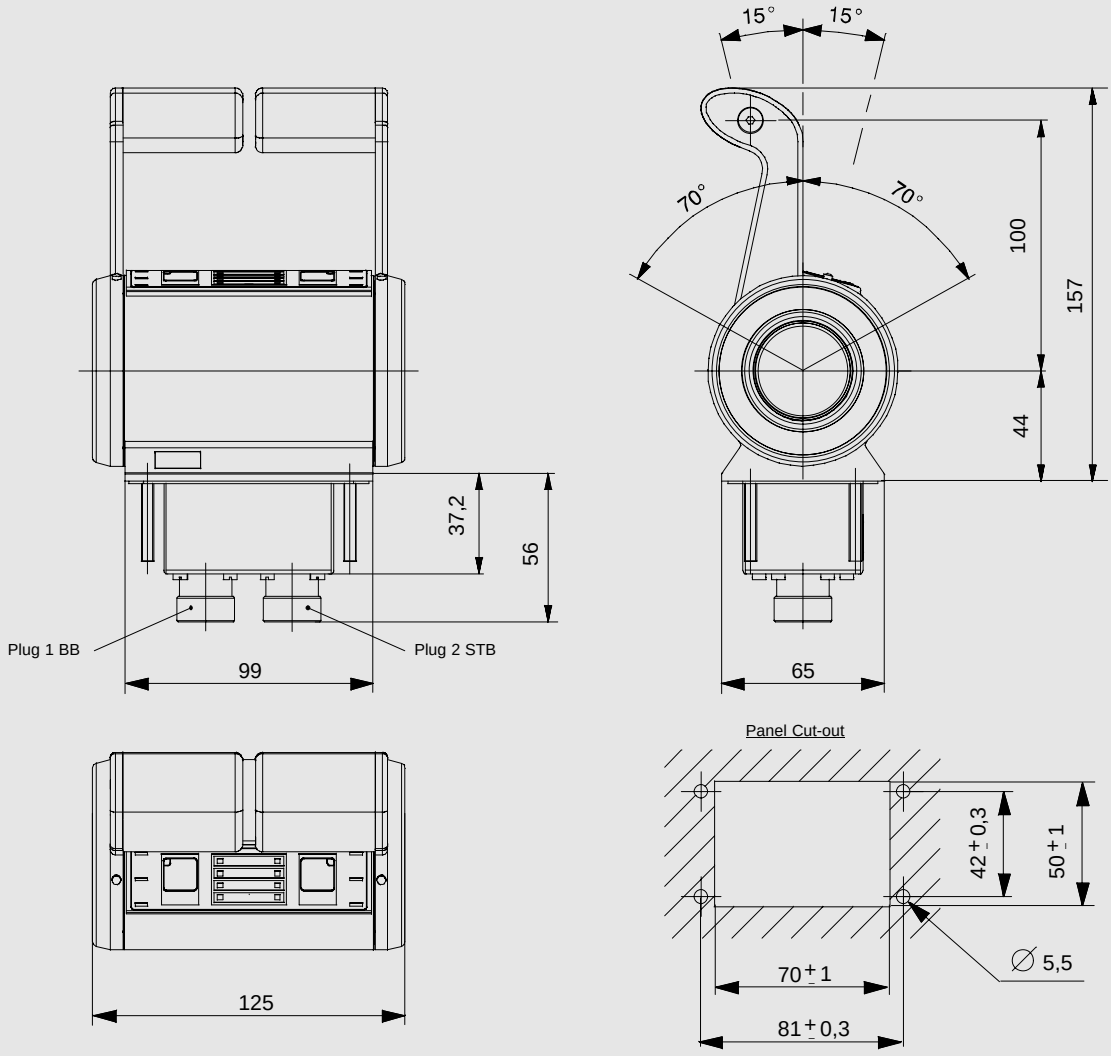
Overview:



System components / individual parts

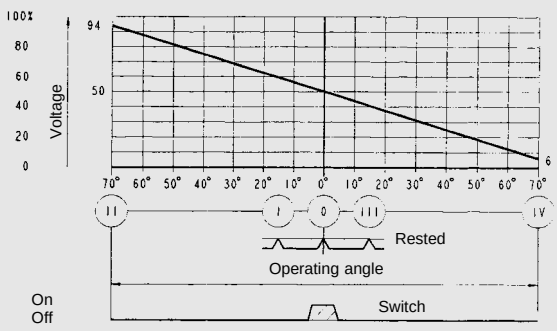
The system consists of the following components and individual parts:

– **Throttle lever station for twin-engine systems** (51.11605–6043)
(for bridge, flybridge, same for all bridges)



Technical Data

Diagram

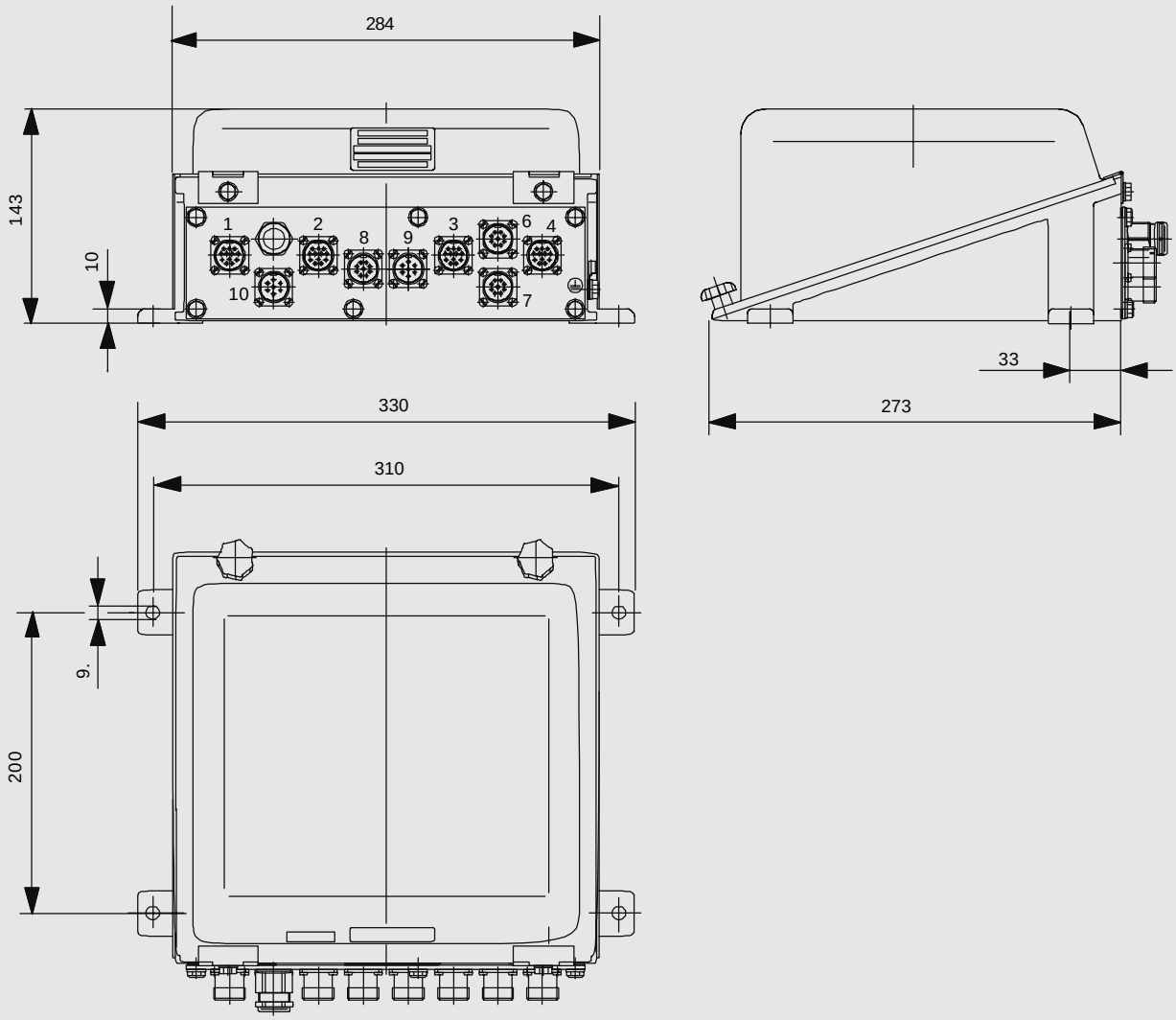


Ambient temperature:		248 K ... 343 K
Protection	above desk-top:	IP 66 – IEC 529 (DIN VDE 0470)
	below desk-top:	IP 66 – IEC 529 (DIN VDE 0470)
Painting	Housing:	Black unpolished
	Lever:	Chrom-plated, high polish
Weight:		2 KG

Potentiometer Data

Resistence:	5 KΩ
Resistence tolerance:	±20% (±1 KΩ)
Linearity tolerance:	±0.5% (±25 KΩ)
Recommendation of working voltage:	< 0.1 µA
Max. electicity at disturb:	10 mA

– **Control electronics (electronics box)** (51.11610–6023)
(one electronics box per engine will be needed)



Technical Data

Supply voltage:		10 V ... 32 V
Current consumption		
	neutral:	approx. 0.4 A
	by rated load:	approx. 7 A
Ambient temperature:		248 K ... 333 K
Degree of protection:		IP 44 – IEC 529 (DIN VDE 0470)
Output:	Rate of revolutions:	4 ... 20 mA
	Trolling:	4 ... 20 mA
	Gear:	10 V ... 32 V (=supply voltage) max. 3 A (per control valve)

Connecting plugs

Nr. 1 – Nr. 4:	Control panels
Nr. 6:	Serial interface
Nr. 7:	Trolling – output
Nr. 8:	RPM – input
Nr. 9:	Solenoid – output
Nr. 10:	External actuator for rate of gear

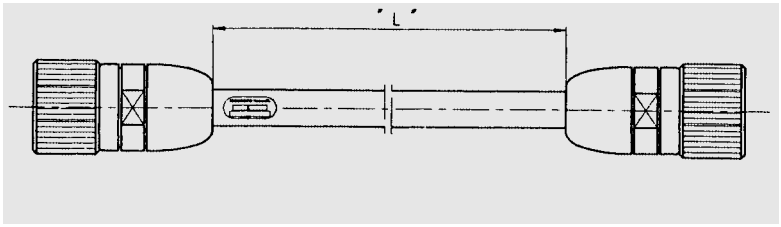
Connecting clumps

Nr. 101:	Power supply (+)
Nr. 102:	Power supply (–)
Nr. 103, 104:	Interlock

Voltage filter intergrated in actuator

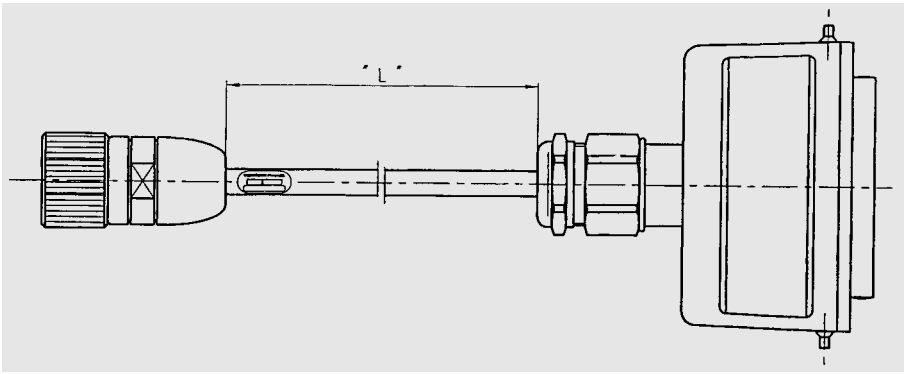
– **Connecting cable from control electronics to throttle lever**
in various lengths with plugs at both ends
(connection from engine room to bridge or flybridge)

10m: 51.25449–0019
15m: 51.25449–0032
20m: 51.25449–0033
30m: 51.25449–0034



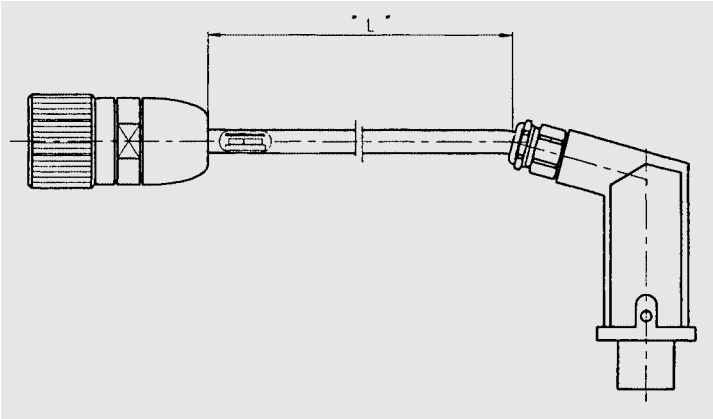
– **Connecting cable from control electronics to MAN engine terminal box for engine speed control with 4–20 mA signal (RPM cable)**
with plugs at both ends

2m: 51.25449–0024
5m: 51.25449–0025
10m: 51.25449–0017
15m: 51.25449–0026



– **Connecting cable from control electronics to MAN engine terminal box for gearbox control (ahead / astern)**
with plugs at both ends

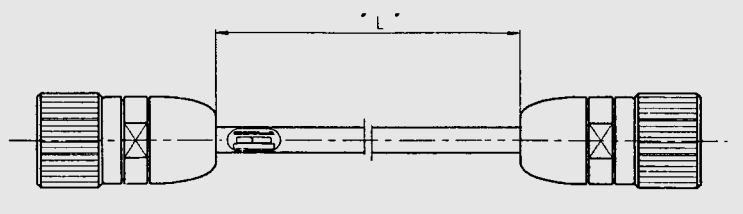
10m: 51.25449–0018
15m: 51.25449–0027



– **Connecting cable from port electronics box to starboard electronics box**

with plugs at both ends (communication cable) for speed synchronisation and master / slave setting for the two engines.

5m: 51.25449–0028
10m: 51.25449–0020
15m: 51.25449–0029
20m: 51.25449–0030



– **Connecting wire for voltage supply to control electronics and connection of gearbox start blocking system**

Must be wired up and configurated by the boatbuilder.
Connection to the MAN terminal box via the heavy-gauge conduit thread wiring is possible.

See overview on page 106.

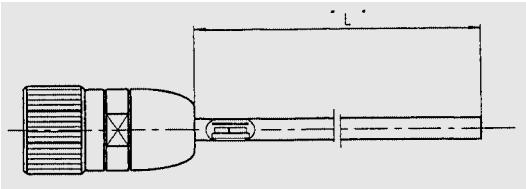
Special accessories:

– **Connecting cable from electronics box to gearbox for triggering electric trolling valve**

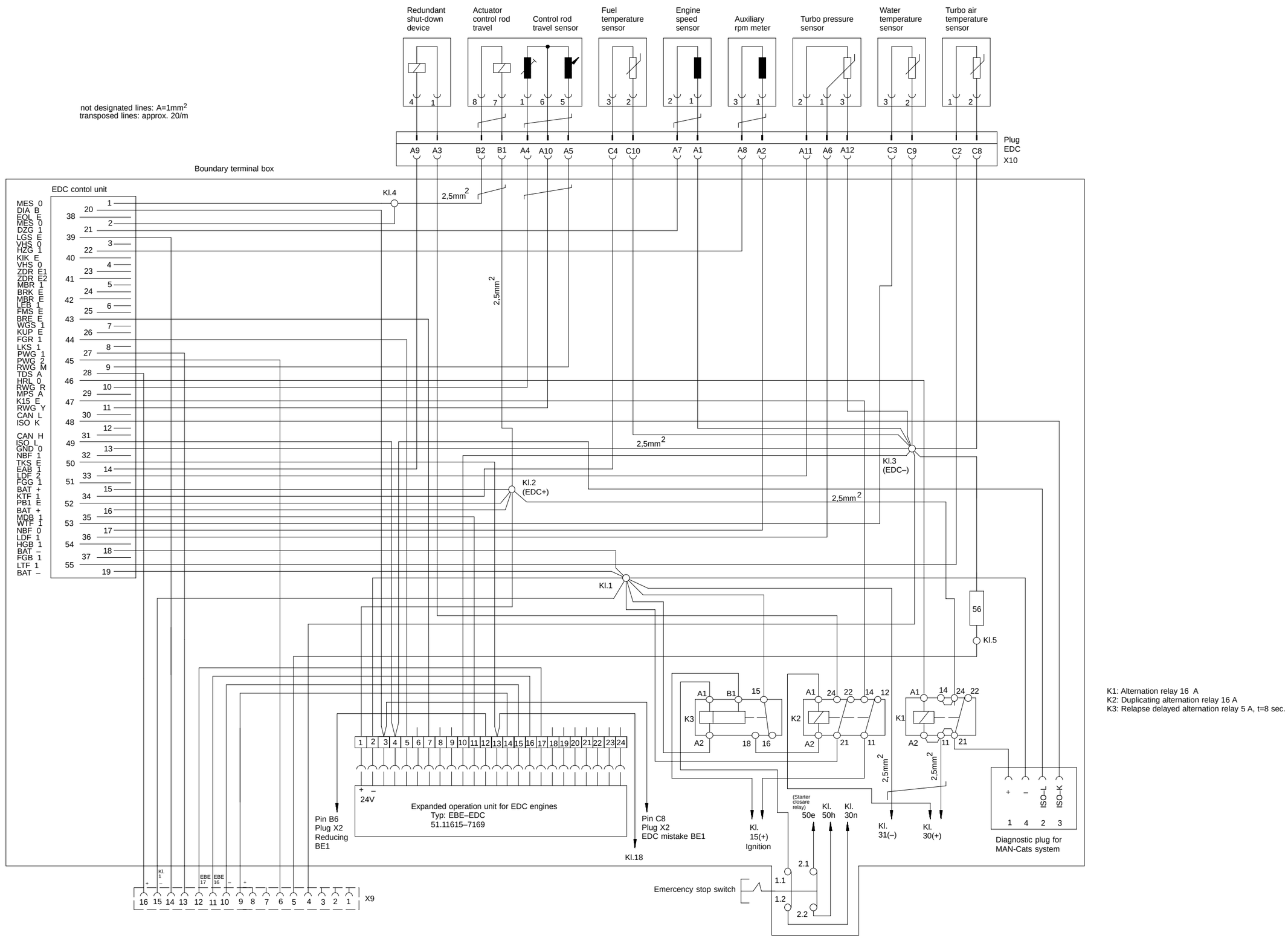
Plugs at both ends, one of which must be removed.

The output for triggering the trolling valve is 4–20 mA.
4 mA: 100 % slip
20 mA: 0 % slip

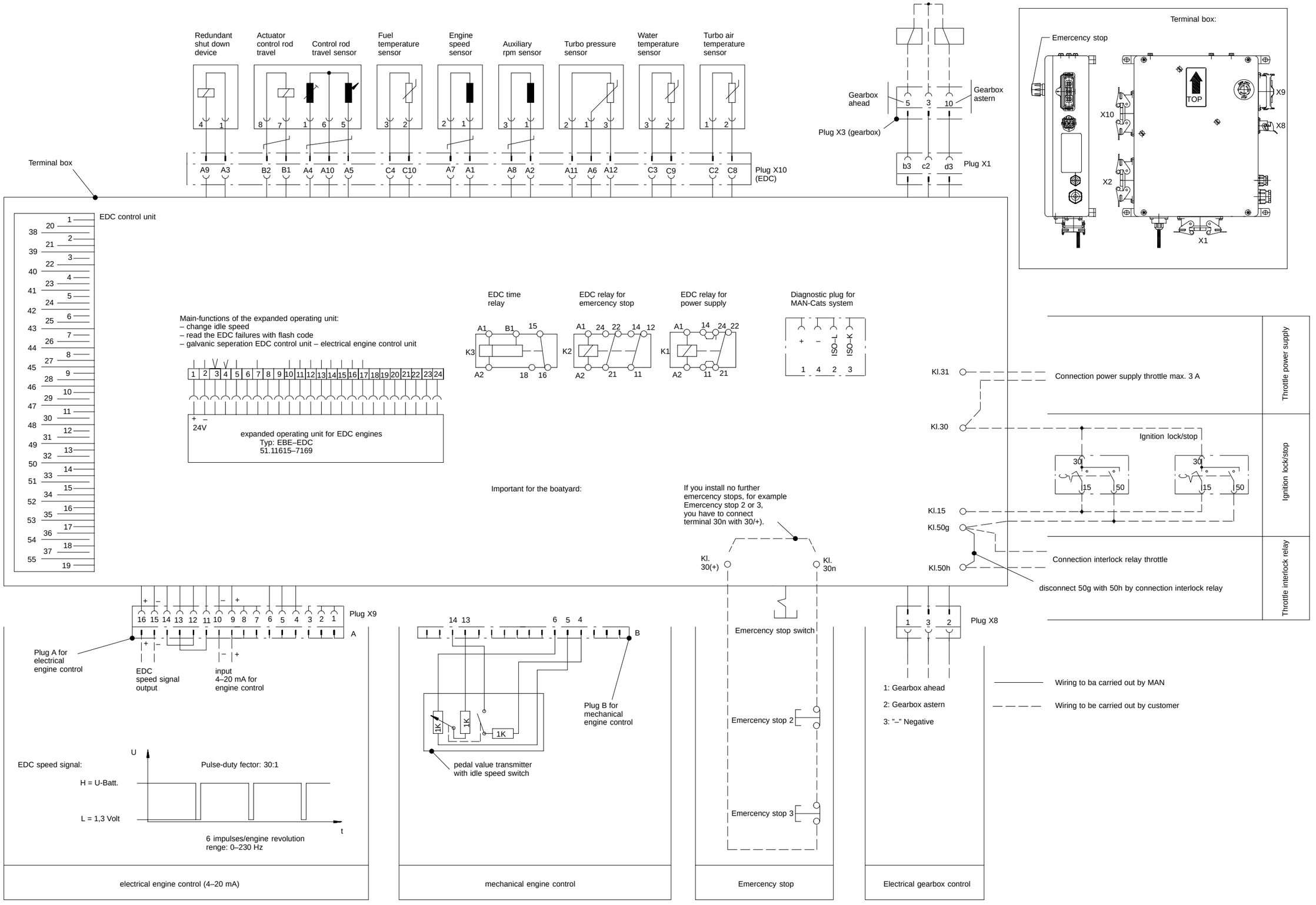
2m: 51.25449–0035
5m: 51.25449–0036
10m: 51.25449–0037
15m: 51.25449–0038

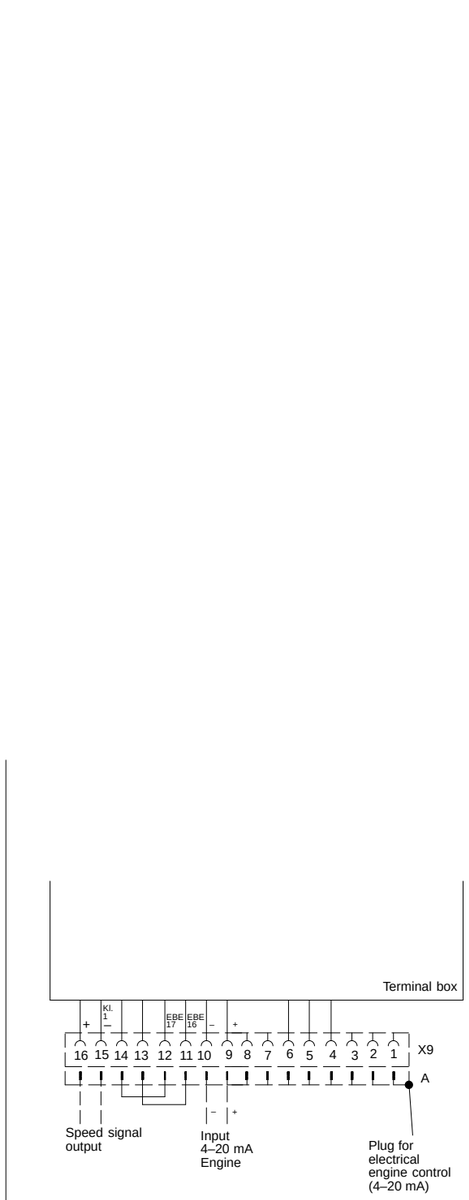


Terminal connection diagram



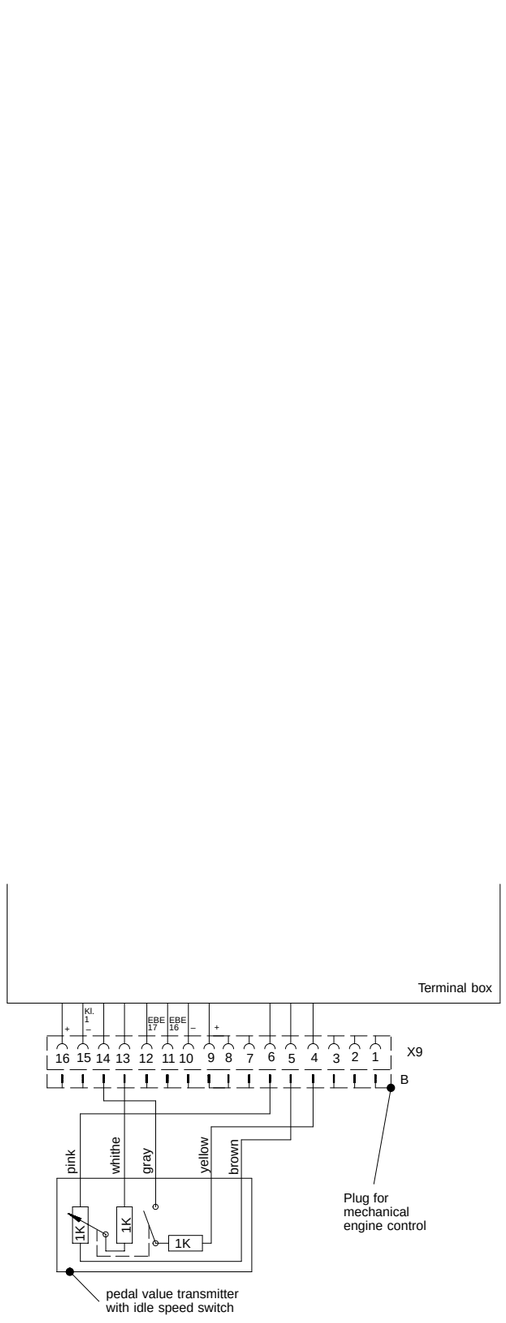
Terminal connection diagram





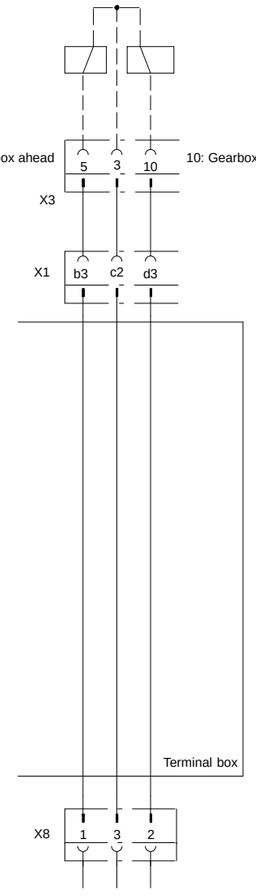
electrical engine control (4–20 mA)

Boatyard



mechanical engine control

Boatyard



electrical gearbox control

Boatyard

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Wiring to be carried out by customer

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