Workshop Manual

Group 30 Electrical system

B
2(0)

Volvo Penta IPS
EVC-C

Group 30 Electrical system

Marine Diesel engines

IPS 350 • IPS 400 • IPS 500 • IPS 600
D4-260D-B • D6-310D-B • D6-370D-B • D6-435D-A

Contents

Safety information 4
Introduction 4
Important 4
General information 7
About this Workshop Manual 7
Spare parts 7
Certified engines 7
Repair instructions 8
Our common responsibility 8
Tightening torques 8
Special tools 9
Design and function 10
System description EDC7 10
EVC system 11
Component location **13**
Component description 17
PCU 17
SHCU 17
SUS 17
Identification of the PCU and SHCU 18
Control 19
Solenoid valves, transmission 19
Resolver 20
Starter motor 20
Alternator 20
Injectors 21
Sensor, engine speed (flywheel) 21
Sensor, camshaft position 21
Sensor, boost air pressure/
boost air temperature 22
Sensor, lube oil pressure, engine 22
Coolant temperature sensor 23
Fuel temperature sensor 23
Sensor, common rail pressure (fuel) 23
Magnetically controlled
proportional valve (MPROP) 24
Supercharger 24
Water switch, secondary fuel filter 24
Engine control unit, EDC7 25
Switch, coolant level 25
Extra stop button 26
Fuses 26
Voltage converter DC/DC, 12 V 26
Repair instructions 27
General advice on working with EVC engines 27
Electric welding 27
Fault tracing of cables and connectors 28
Fault tracing of the starter motor and windings 29
Rail pressure measurements 30
Changing the engine control unit 31
Identifying the engine control unit 32
Reprogramming the control unit 33
Programming an empty control unit 34
Malfunctions 34
Fault code information 34
FMI table 34
SAE standard 34
General advice 35
System introduction, EVC 36
Starting sequence 36
Network 37
Manual fault tracing in bus cables 37
Fault tracing the EVC system 38
Checking the instruments 39
Alarm display 40
Time delay on alarm indication 40
Coolant level monitor 41
Measurements 42
Checking the coolant monitor 43

Diagnostic Trouble Codes 44

MID 128, PID

MID 128, PID 91 Throttle control position 44
MID 128, PID 97 Water switch, fuel filter 46
MID 128, PID 100 Oil pressure sensor 49
MID 128, PID 105 Boost air temperature sensor 56
MID 128, PID 106 Boost air pressure sensor 61
MID 128, PID 108 Atmospheric pressure sensor 67
MID 128, PID 110 Coolant temperature sensor .. 69
MID 128, PID 158 Battery voltage 74
MID 128, PID 164 Fuel pressure 77
MID 128, PID 174 Fuel temperature sensor 83
MID 128, PID 190 Engine speed, excess speed / calculation 88

MID 128, SID

MID 128, SID 1/2/3/4/5/6 Injectors 1–6 93
MID 128, SID 21 Camshaft position sensor (speed sensor, camshaft) 96
MID 128, SID 22 Speed sensor (flywheel) 100
MID 128, SID 26 Output, compressor coupling . 104
MID 128, SID 40 Output, starter motor 107
MID 128, SID 57 Output, fuel pump (MPROP), fault 110
MID 128, SID 218 ECM main relay 114
MID 128, SID 231 SAE J1939 Data link 116
MID 128, SID 251 Supply voltage 118
MID 128, SID 254 Engine control unit EDC7 119

MID 128, PSID

MID 128, PSID 50 Fuel pressure, monitoring (MPROP) 120
MID 128, PSID 51 Redundant Shut-off Path 127
MID 128, PSID 53 Monitoring the pressure relief valve 128
MID 128, PSID 54 Booster voltage (high bank 1) 130
MID 128, PSID 55 Booster voltage (high bank 2) 132

MID 164, PPID

MID 164, PPID 390 Lever 1 position relative to potentiometer supply failure ... 134
MID 164, PPID 391 Lever 2 position relative to potentiometer supply failure ... 140
MID 164, PPID 392 Lever potentiometer supply failure 142
MID 164, PPID 393 Data bus power input 239
MID 164, PPID 394 Key supply 144
MID 164, PPID 397 Main panel communication failure 147
MID 164, PPID 424 Steering wheel position 245

MID 164, SID

MID 164, PSID139 Auto pilot fault 150
MID 164, SID 226 Neutral switch and lever position mismatch 152
MID 164, SID 231 Sync bus communication fault 155
MID 164, SID 240 Program memory fault 210
MID 164, SID 250 SAE J1708 / J1587 data link . 157
MID 164, SID 253 Calibration Memory Failure 211
MID 164, SID 254 Internal CPU faults 214

MID 164, PSID

MID 164, PSID 64 Joystick fault 159
MID 164, PSID 65 Joystick on-button 161
MID 164, PSID 66 Joystick hi-button 162
MID 164, PSID 67 Joystick sync fault 163
MID 164, PSID 95 Lever detection 164
MID 164, PSID 96 Calibrated lever travel too small 166
MID 164, PSID 97 Lever calibration procedure 167
MID 164, PSID 98 Lever(s) not calibrated 168
MID 164, PSID 99 Data bus network configuration fault 237
MID 164, PSID 103 Neutral button 169
MID 164, PSID 104 Lighting button (multifunction button) 171
MID 164, PSID 105 Active station button 173
MID 164, PSID 106 Start 175
MID 164, PSID 107 Stop 177
MID 164, PSID 133 Steering wheel data link 179
MID 164, PSID 134 Steering wheel module 181
MID 164, PSID 135 Steering wheel brake 182
MID 164, PSID 136 Steering wheel controller 183
MID 164, PSID 137 Rudder angle 184
MID 164, PSID 138 Steering position divergence .. 186
MID 164, PSID 140 Incompatible sync bus version 187
MID 164, PSID 218 Data bus passive / active helm communication failure 188
MID 164, PSID 226 SHCU communication failure with other helm 190
MID 164, PSID 231 Incompatible Chassie ID 192
MID 164, PSID 232 Data bus communication warning 234

MID 187, PID
MID 187, PID 96 Fuel level 192
MID 187, PID 127 Transmission oil pressure sensor 196
MID 187, PID 177 Transmission oil temperature . sensor 200

MID 187, PPID
MID 187, PPID 393 Data bus power input 239
MID 187, PPID 400 Transmission sensor supply .. 203

MID 187, SID
MID 187, SID 231 J1939 Communication warning / fault 206
MID 187, SID 240 Program memory fault 210
MID 187, SID 253 Calibration Memory Failure 211
MID 187, SID 254 Internal CPU faults 214

MID 187, PSID
MID 187, PSID 10 Incompatible engine type 215
MID 187, PSID 17 Data bus network configuration fault 237
MID 187, PSID 18 Data bus power output 216
MID 187, PSID 20 Primary solenoid (high side switch) 219
MID 187, PSID 22 Secondary solenoid (high side switch) 223
MID 187, PSID 32 Data bus communication with active helm failure 225
MID 187, PSID 200 No data on engine bus 228
MID 187, PSID 226 SHCU communication failure with other helm 231
MID 187, PSID 231 Incompatible Chassie ID 192
MID 187, PSID 232 Data bus communication warning 234

MID 250, PID
MID 250, PID 168 Battery input 242

MID 250, PPID
MID 250, PPID 55 ECU temperature 249
MID 250, PPID 393 Data bus power input 239
MID 250, PPID 424 Steering wheel position 245
MID 250, PPID 426 Rudder angle 247
MID 250, PPID 427 Servo motor temp. 250

MID 250, SID
MID 250, SID 240 Program memory fault 210
MID 250, SID 253 Calibration Memory Failure 211
MID 250, SID 254 Internal CPU faults 214

MID 250, PSID
MID 250, PSID 1 Data bus network configuration fault 237
MID 250, PSID 2 Data bus power output 252
MID 250, PSID 3 Servo motor 254
MID 250, PSID 4 Electro mechanical rudder brake 259
MID 250, PSID 6 Data bus communication with active helm failure 262
MID 250, PSID 232 Data bus communication warning 234

Wiring diagrams 266
Engine D4, D6 266
Controls 268
Pin configuration, PCU 269
Pin configuration, SHCU 270

Calibration before start 271
General 271
Calibration mode 272
Auto configuration 272
Combinations of control levers for EVC. Summary, calibration 274
Lever calibration 276
Idling speed calibration 278

Checking the charging system 279

Technical data 281

References to Service Bulletins 283

Index 284

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Safety information

Introduction

This workshop manual contains technical data, descriptions and repair instructions for the Volvo Penta products or product versions noted in the table of contents. Check that you have the correct Workshop Manual for your engine.

Read the available safety information, “General information” and “Repair instructions” in the workshop manual before you start to do any service work.

Important

In this book and on the product you will find the following special warning symbols.

WARNING! Warns for the risk of personal injury, major damage to product or property, or serious malfunctions if the instruction is ignored.

IMPORTANT! Is used to call attention to things which could cause damage or malfunctions to product or property.

NOTE! Is used to call attention to important information, to facilitate work processes or operation.

Below is a summary of the risks involved and safety precautions you should always observe or carry out when operating or servicing the engine.

Make it impossible to start the engine by cutting system current with the main switch(es) and lock it (them) in the off position before starting service work. Set up a warning notice by the helm station.

As a general rule all service operations must be carried out with the engine stopped. Some tasks, such as adjustments, need the engine to be running, however. Approaching an engine which is operating is a safety hazard. Remember that loose clothing or long hair can fasten in rotating parts and cause serious personal injury.

If work is done adjacent to a running engine, a careless movement or a dropped tool can lead to personal injury in the worst case.

Take care to avoid contact with hot surfaces (exhaust pipes, turbocharger, air intake pipe, starter heater etc.) and fluids in pipes and hoses in an engine which is running or has just been stopped. Reinstall all protective parts removed during servicework before starting the engine.

Never start the engine with the valve cover removed. Apart from the risk of spilling oil, there is a risk of personal injury. The voltage supplied to the injectors can be as high as 80 V.

Check that the warning or information labels on the product are always clearly visible. Replace labels which have been damaged or painted over.

Never start the engine without installing the air cleaner filter. The rotating compressor turbine in the turbocharger can cause severe injury. Foreign objects entering the intake ducts can also cause mechanical damage.

Never use start spray or similar products as a starting aid. They may cause an explosion in the inlet manifold. Danger of personal injury.

Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out and the system pressure will be lost. Open the filler cap slowly, and release the pressure in the cooling system if the filling cap or tap has to be opened, or if a plug or coolant hose has to be removed when the engine is hot. It is difficult to anticipate in which direction steam or hot coolant can spray out.

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before carrying out any work. Never start or operate the engine with the oil filler cap removed, otherwise oil could be ejected.

Stop the engine and close the sea cocks before doing any work on the cooling system.

⚠ Only start the engine in a well-ventilated area. When operated in a confined space, exhaust fumes and crankcase gases must be ventilated from the engine bay or workshop area.

⚠ Always use protective glasses or goggles when carrying out work where there is a risk of splinters, grinding sparks, acid splashes or where other chemicals are used. Your eyes are extremely sensitive, injury could cause blindness!

⚠ Avoid getting oil on your skin! Repeated exposure to oil or exposure over a long period can result in the skin becoming dry. Irritation, dryness and eczema and other skin problems can then occur.

Used oil is more dangerous than fresh oil from a health aspect. Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before eating. There are special skin creams which counteract drying out of the skin and make it easier to clean off dirt after work is completed.

⚠ Most chemicals intended for the product (e.g. engine and transmission oils, glycol, petrol (gasoline) and diesel oil) or chemicals for workshop use (e.g. degreasers, paints and solvents) are hazardous. Read the instructions on the product packaging with care! Always follow the safety precautions for the product (for example use of protective mask, glasses, gloves etc.). Make sure that other personnel are not inadvertently exposed to hazardous chemicals, for example in the air. Ensure good ventilation in the work place. Follow the instructions provided when disposing of used or leftover chemicals.

⚠ Exercise extreme care when leak detecting on the fuel system and testing the fuel injector nozzles. Use eye protection. The jet which comes from a fuel injector has very high pressure and considerable penetrationability. Fuel can force its way deep into body tissue and cause severe injury. Danger of blood poisoning (septicemia).

⚠ All fuels, and many chemicals, are flammable. Do not allow naked flame or sparks in the vicinity. Petrol (gasoline), some thinners and hydrogen gas from batteries are extremely flammable and explosive when mixed with air in the correct ratio. No smoking! Ensure that the work area is well ventilated and take the necessary safety precautions before starting welding or grinding work.

Always ensure that there are fire extinguishers at hand when work is being carried out.

⚠ Make sure that oil and fuel soaked rags, and used fuel and oil filters are stored in a safe place. Rags soaked in oil can spontaneously ignite under certain circumstances.

Used fuel and oil filters are polluting waste and must be handed to an approved waste management facility for destruction, together with used lubrication oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.

⚠ Batteries must never be exposed to open flames or electric sparks. Never smoke close to the batteries. The batteries generate hydrogen gas when charged, which forms an explosive gas when mixed with air. This gas is easily ignited and highly volatile. A spark, which can be caused by incorrect battery connection, can cause a single spark which is sufficient to cause an explosion with resulting damage. Do not move the connections when you attempt to start the engine (risk of sparking), and do not stand and lean over one of the batteries.

⚠ Always ensure that the Plus (positive) and Minus (negative) battery cables are correctly installed on the corresponding terminal posts on the batteries. Incorrect installation can result in serious damage to the electrical equipment. Refer to the wiring diagram.

⚠ Always use protective goggles when charging and handling the batteries. Battery electrolyte contains sulfuric acid which is highly corrosive. Should the battery electrolyte come into contact with unprotected skin wash off immediately using plenty of water and soap. If you get battery acid in your eyes, flush at once with a generous amount of water, and get medical assistance at once.

⚠ Turn the engine off and turn off the power at the main switch(es) before carrying out work on the electrical system.

⚠ Clutch adjustments must be carried out with the engine stopped.

⚠ The existing lugs on the engine/reversing gear should be used for lifting the assembly.
Always check that the lifting devises are in good condition and that they have the correct capacity for the lift (the weight of the engine plus the reversing gear and extra equipment).

The engine should be lifted with a customized or adjustable lifting boom for safe handling and to avoid damaging components on top of the engine. All chains or cables should be parallel to each other and should be as square as possible to the top of the engine.
If other equipment connected to the engine has altered its center of gravity, special lifting devises may be needed to obtain the correct balance and safe handling.
Never do any work on an engine which just hangs from a liftingdevise.

⚠ Never work alone when removing heavy engine components, even when using lifting devices such as locking tackle lifts. When using a lifting device two people are usually required to do the work, one to take care of the lifting device and another to ensure that components are lifted clear and not damaged during the lifting operations.
When you work aboard a boat, always make sure that there is enough space for disassembly where you are working, with no risk of personal injury or material damage.

⚠ Components in the electrical and fuel systems on Volvo Penta products have been designed to minimize the risks of explosion and fire. The engine must not be run in areas where there are explosive materials.

⚠ **WARNING!** Fuel delivery pipes must not be bent or straightened under any circumstances. Damaged pipes must be replaced.

⚠ Never use a high-pressure washer to clean the engine. When cleaning other parts with a high-pressure washer, never direct the jet at seals, rubber hoses or electrical components.

⚠ Only use the fuels recommended by Volvo Penta. Refer to the Operator's Manual. Use of fuels that are of a lower quality can damage the engine. Poor fuel can also lead to higher-maintenance costs.

General information

About this Workshop Manual

This workshop manual contains technical data, descriptions and repair instructions for the following marine diesel engines:
D6-310D-B and D6-370D-B.

The workshop manual can illustrate tasks done on any of the engines noted above. This means that the illustrations and photographs which clarify certain details might not correspond with other engines in some cases. Repair methods are similar in all important respects, however. If this is not the case, this is noted. Important differences are noted separately.

The engine designation and number are noted on the number plate and engine decal. The engine designation and number must always be given in all correspondence about any product.

The Workshop Manual is produced primarily for the use of Volvo Penta workshops and service technicians. This assumes that people who use the Manual have basic knowledge of marine drive systems and can do the tasks of a mechanical or electrical nature associated with the trade.

Volvo Penta constantly improves its products, so we reserve the right to make modifications without prior notification. All information in this manual is based on product data which was available up to the date on which the manual was printed. Any material changes introduced into the product or service methods after this date are notified by means of Service Bulletins.

Spare parts

Spare parts for electrical- and fuel systems are subject to various national safety requirements, such as U.S. Coast Guard Safety Regulations. Volvo Penta Original Spare Parts meet these specifications. Any damage, occasioned by use of non-original Volvo Penta spares for the product, will be not be compensated by the warranty offered by Volvo Penta.

Certified engines

When doing service and repair on emission certified engines, it is important to be aware of the following:

Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines made of the same type are equivalent to the certified engine.

This makes special demands on service and repair work, as follows:

- Maintenance and service intervals recommended by Volvo Penta mustbe complied with.
- Only Volvo Penta original spares may be used.
- Service to injection pumps, pump settings and injectors must always be done by an authorized Volvo Penta workshop.
- The engine must not be converted or modified, except for the accessories and service kits which Volvo Penta has approved for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be done.
- No seals may be broken by unauthorized personnel.

The general advice in the instruction book about operation, care and maintenance applies.

⚠ **IMPORTANT!** Delayed or inferior care/maintenance, and the use of non-original spares parts means that Volvo Penta can no longer be responsible for guaranteeing that the engine complies with the certified version.

Damage andd/or costs which arise from this will not be compensated by Volvo Penta.

Repair instructions

The working methods described in the Workshop Manual apply to work carried out in a workshop. For this reason, the engine is lifted out of the boat and mounted on an equipment support. Renovation work which does not need the engine to be lifted out can be done in situ, with the same work methods, unless otherwise specified.

The warning signs which occur in the workshop manual (please refer to “Safety information” for their meanings).

⚠ WARNING!

⚠ IMPORTANT!

NOTE!

are not comprehensive in any way, since we can not of course foresee everything, because service work is done in highly varying circumstances. For this reason, all we can do is to point out the risks which we believe could occur due to incorrect work in a well-equipped workshop, using work methods and tools tested by us.

All operations described in the Workshop Manual for which there are Volvo Penta Special Tools available assume that these tools are used when carrying out the repair. Volvo Penta Special Tools have been developed to ensure the most safe and rational working methods possible. It is therefore the responsibility of anyone using other tools or other working methods than we recommend to determine that there is no risk of personal injury or mechanical damage or malfunction as a result.

In some cases special safety precautions and user instructions may be required in order to use the tools and chemicals mentioned in the Workshop Manual. These rules must always be observed, so there are no special instructions about this in the workshop manual.

By following these basic recommendations and using-using common sense it is possible to avoid most of the risks involved in the work. A clean work place and a clean engine will eliminate many risks of personal injury and engine malfunction.

Above all, when work on fuel systems, lubrication systems, induction systems, turbocharger, bearing caps and seals is done, it is extremely important that no dirt or other kinds of foreign particles are able to get in, since this would otherwise cause malfunctions or shortened repair life.

Our common responsibility

Each engine consists of a large number of collaborating systems and components. Any deviation of a component from its technical specification can dramatically increase the environmental impact of an otherwise good engine. For this reason, it is important that the specified wear tolerances are observed, that systems which are adjustable are correctly adjusted and that Volvo Penta Original Spares are used for the engine. The stated service intervals in the Maintenance Schedule must be observed.

Some systems, such as the components in the fuel system, require special expertise and special testing equipment for service and maintenance. For environmental reasons etc., some components are sealed at the factory. It is only permissible to work on sealed components if you are authorized to do such work.

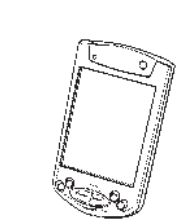
Remember that most chemical products, incorrectly used, damage the environment. Volvo Penta recommends the use of biodegradable degreasers whenever engine components are de-greased, unless otherwise specified in the workshop manual. When working aboard a boat, be careful to ensure that oils, wash residue etc. are processed for destruction, and are not inadvertently discharged with bilge water into the environment.

Tightening torques

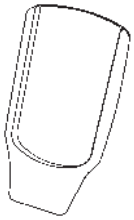
The tightening torque for vital fasteners, which should be tightened with a torque wrench, are listed in “Technical Data: Special tightening torques” and noted in the job descriptions in the book. All torque specifications apply to clean screws, screw heads and mating faces. Torque data stated apply to lightly oiled or dry threads. Iflubricants, locking fluids or sealants are needed on a fastener, the type of preparation to be used will be noted in the job description. For fasteners where specific torque values are not given, please refer to “Technical data: General tightening torques”. General torque specifications are target values and the fastener does not need to be tightened with a torque wrench.

Dimension	Torque Nm
M5	6
M6	10
M8	25
M10	50
M12	80
M14	140
M16	220

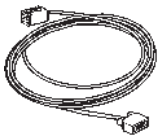
Special tools



3838620



3838621

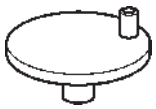


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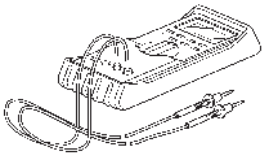
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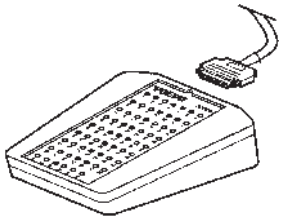
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3812541



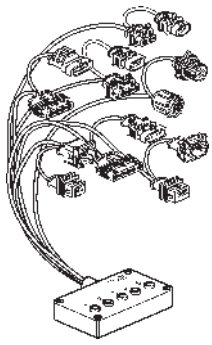
9812519



9998699



88890016



885675

3838619 VODIA complete diagnostic tool.* Components:

- 3838620 VODIA – palmtop computer (PDA) with SD card.
- 3838621 VODIA – docking station. Used with VODIA PDA (3838620).
- 3838622 VODIA – cable with connector. Used with docking station (3838621) on the engine's communication connector.
- 3838623 VODIA – EDC Adapter with external power supply. Used with docking station 3838621 and cable 3838622 connected to the engine's 2-pin connector.

*** Note.** More detailed information about using the VODIA tool can be found in the tool's instruction manual.

3809570 Cranking tool

3812541 Brake release switch

9812519 Multimeter

9998699 Measurebox

88890016 Adapter cable for sensor test

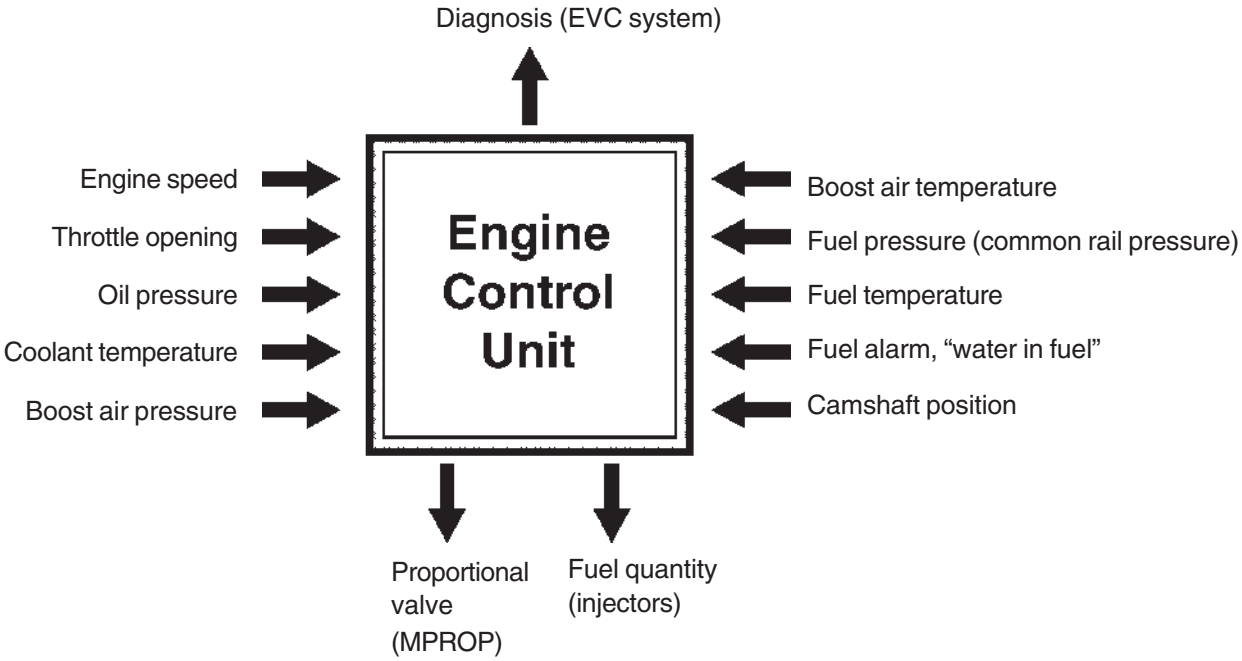
885675 Adapter cable for sensor test

Design and function

System description EDC 7

EDC* is a system for electronic diesel engine control. The system has been developed by Volvo Penta and includes fuel control and diagnostic function

* EDC = “Electronic Diesel Control”.



Engine control unit

EDC system processor is located in the controlunit, protected from water and vibration.

The processor receives continuous information about:

- Engine speed
- Throttle opening
- Oil pressure
- Boost air pressure/temperature
- Fuel pressure (common rail pressure)
- Fuel temperature
- Fuel alarm, “water in fuel”
- Camshaft position
- Coolant temperature

The information provides information about current operation conditions and allows the processor to calculate the correct fuel volume, monitor engine status etc.

Fuel control

The amount of fuel injected into the engine and the injection advance are fully electronically controlled, via fuel valves and the injectors, once the control unit has analyzed the engine’s fuel requirements.

This means that the engine always receives the correct volume of fuel in all operating conditions, which offers lower fuel consumption, minimal exhaust emissions etc.

The control unit monitors and reads the injectors to ensure that the correct volume of fuel is injected into each cylinder, and it calculates and set the injection advance. Control is mainly done with the help of the speed sensors, fuel pressure sensor and the combined sensor for boost air pressure/boost air temperature.

The control unit controls the injectors via a signal to the electromagnetically operated fuel valve in each injector, which can be opened and closed.

When the fuel valve is open, fuel is forced through the injector nozzle and into the cylinder. Injection ceases when the fuel valve is closed.

The control unit receives signals from various sensors on the engine, which allow it to decide when the fuel valve should be opened and closed.

Calculation of fuel quantity

The quantity of fuel to be injected into the cylinder is calculated by the control unit. The calculation gives the time when the fuel valve is open (fuel is injected into the cylinder when the fuel valve is open).

The parameters which govern the amount of fuel injected are:

- Demanded engine speed
- Engine protection functions
- Temperature
- Boost air pressure
- Fuel pressure

Diagnostic function

The EDC system has a built-in diagnostic function which can discover any faults in the engine and sensors.

The function of the diagnostic function is to discover and localize any function faults in the EDC system, to protect the engine and guarantee continued operation if a serious function fault should occur.

Idling adjustment (low idle)

Idling speed can be adjusted to a value between 600–650 rpm.

EVC system

The EVC system is a so-called distributed system. Distributed systems consist of many smaller electronic units (nodes) located at suitable places in the boat.

The EVC nodes are the driveline control system or PCU (Powertrain Control Unit), the control station system or SHCU (Helm station Control Unit) and the drive leg control system or SUS (Servo Unit Steering). The nodes are located close to their external components. The SHCU is located close to the helm station, the PCU in the engine room and the SUS on the drive leg.

Each node is connected to a number of external components such as sensors, controls, instruments and control levers.

Each PCU, SHCU and SUS is programmed for a specific engine. There is a decal on each PCU, SHCU and SUS, containing a serial number and CHASSIS ID number. The CHASSIS ID number must coincide with the CHASSIS ID number on the decals on the engine.

A data link (a CAN bus) links the nodes to each other. They combine to form a data network and the nodes exchange information and benefit from each others services. The principle of using a network of nodes to which all components are connected means that the amount of cable installation is radically reduced.

A distributed system allows the system architecture to be extended by adding extra equipment. New nodes can be connected to the network with minimal changes to the cables. Functionality becomes more effective since the nodes are allowed to collaborate and combine their resources, which creates a more useful and safer product.

Functions

Engine speed and gear shifting

Engine speed and gear shifting is controlled electronically. The outboard drives are always protected against excess speed. The EVC system have both dual-function electronic controls.

Engine synchronizing

Engine synchronizing gives greater comfort, good fuel economy and minimized wear, thanks to reduced vibration and reduced sound levels. The master system (port) and slave system (starboard) must be able to communicate, to make synchronization possible. For this reason, a synchronizing cable must be installed at the main helm station and all alternative helm stations.

Instruments

The instruments use a serial communication bus called “Easy Link”. Easy Link in combination with the rest of the EVC system radically reduces the need for cable installation, and simplifies installation.

Display

The EVC display is used as a complement to, or as a replacement for the instruments. The EVC display functionality is similar to the EDC display, but gives more information. The display is connected to the synchronizing bus from the SHCU.

Fuel level (optional)

EVC makes it easy to install fuel level indication. All that is needed is a fuel level sensor in the tank and a fuel gauge or display on the instrument panel. If a fuel level gauge is used, it should be connected to the instrument “Easy Link” in the SHCU. The cable harness between the PCU and the engine has a connector for the fuel level sensor. No new cable installation needs to be done.

Boat speed (optional)

The EVC can indicate boat speed if you have a GPS which is compatible with NMEA 0183, NMEA 2000 and an NMEA unit. Boat speed can be indicated on the display and in a log connected to the “Easy Link”.

Fresh water level (optional)

EVC makes it easy to install the water level indicator. All you need is a level sensor in the water tank and a level gauge or a display at the helm. If a water level gauge is used it must be connected to the instrument serial communication bus. The PCU–engine cable harness has an input for the fresh water level sender.

Rudder indicator

The rudder indicator (drive leg position indicator) is a part of the EVC system. All you need is a gauge to connect to the instrument serial communication bus.

Boat speed, echo sender and water temp (Multi sensor), (optional)

The multisensor is connected to the multilink cable. Data from the multi sensor are shown on the EVC display.

Braked Autopilot (extra optional)

An Autopilot computer can be connected to EVC system via an Autopilot-interface.

Activation

The activation of the autopilot, along with other user information, is described in the autopilot suppliers documentation.

NOTE! The system can refuse activation if the steering wheel is turned at the same time as an attempt is made to activate the autopilot.

The autopilot does not work when traveling backwards.

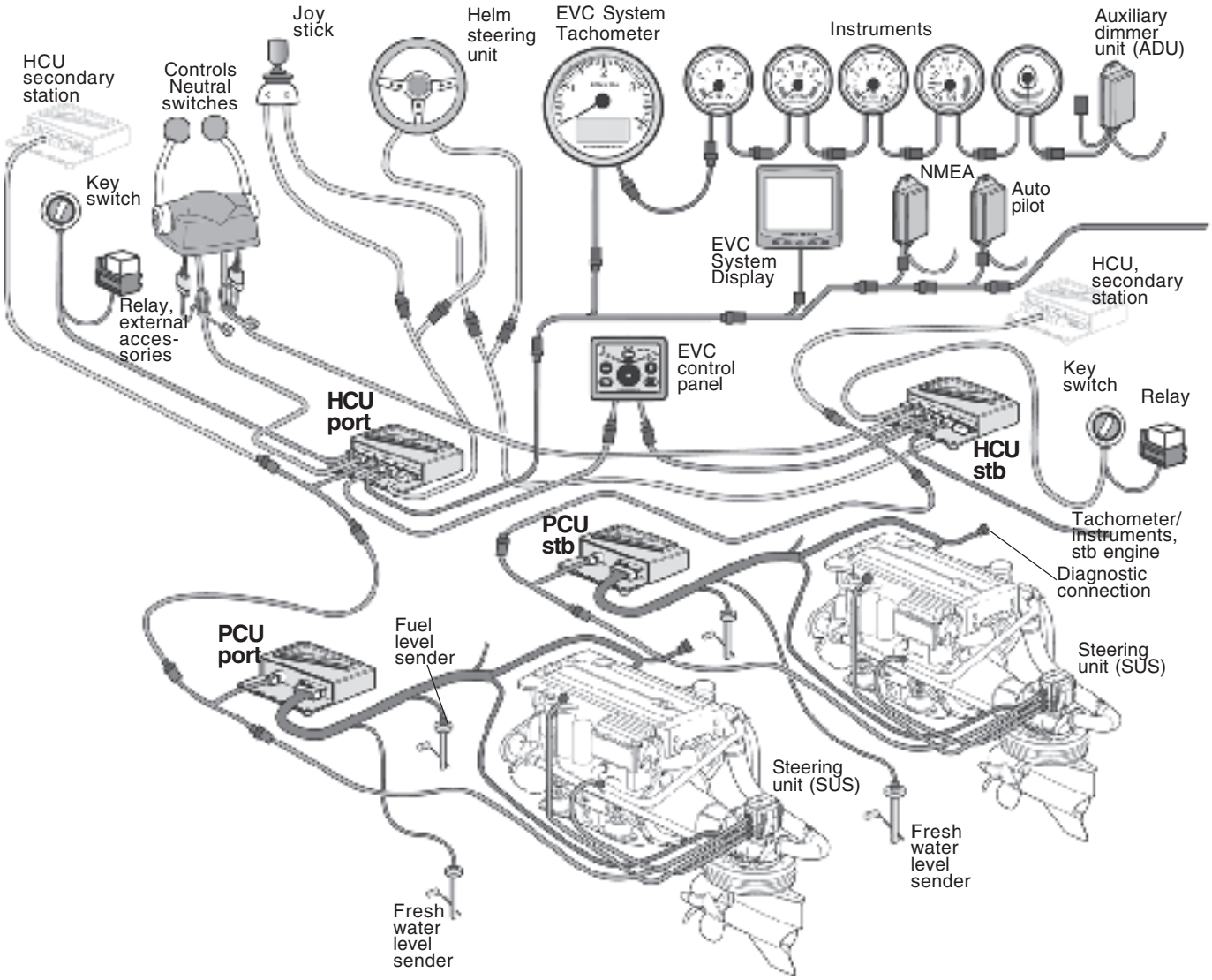
The steering wheel is braked while the autopilot is in control (AUTO position)

Disconnection

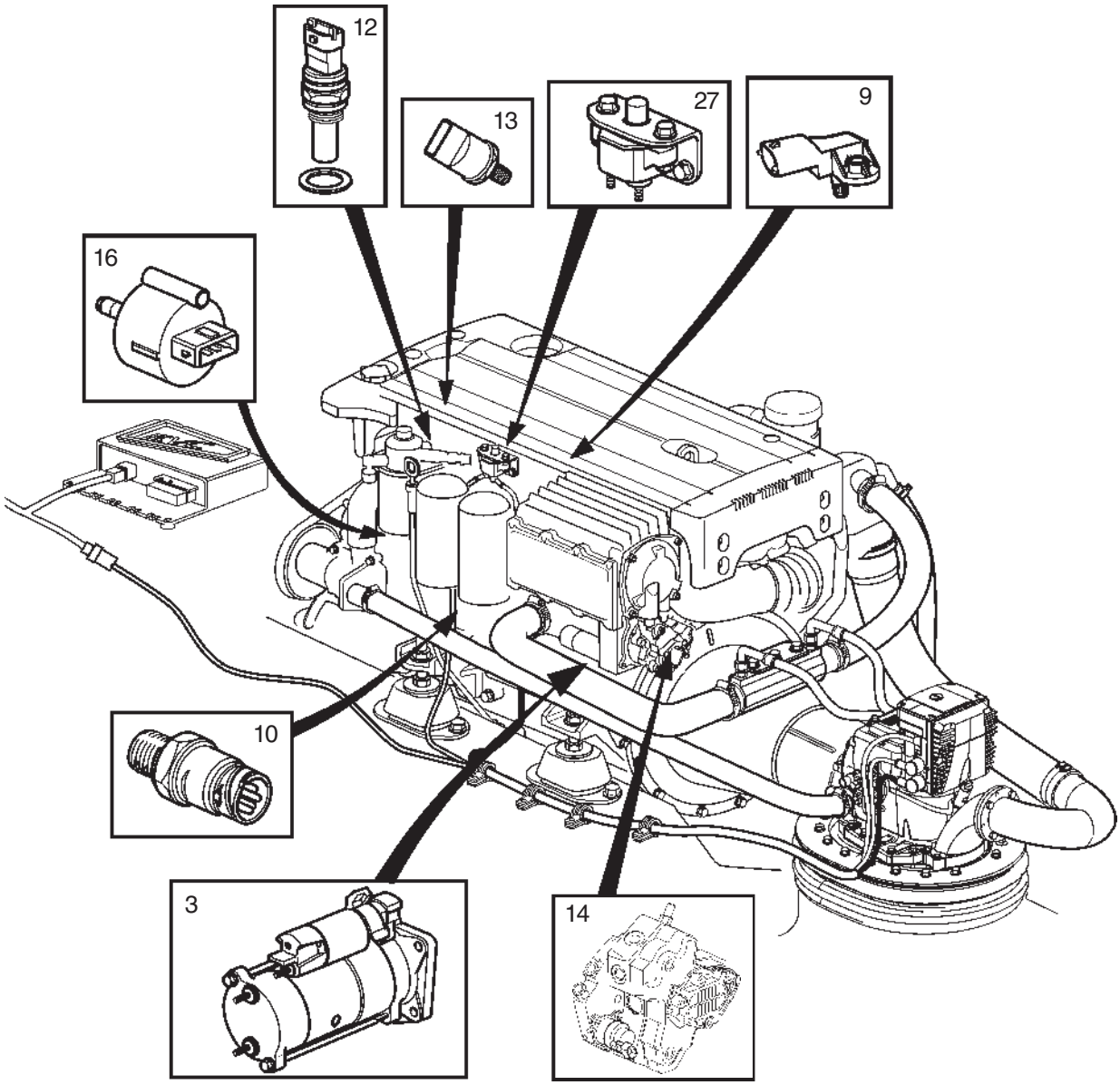
The autopilot is disconnected with steering wheel movements greater than 2°, with change of helm, or if a serious fault occurs.

NOTE! If the autopilot is activated from a passive helm, then disconnection via steering wheel movement is not possible from that helm.

Component location



NOTE! The position numbers coincide with the position numbers in the engine wiring diagram.

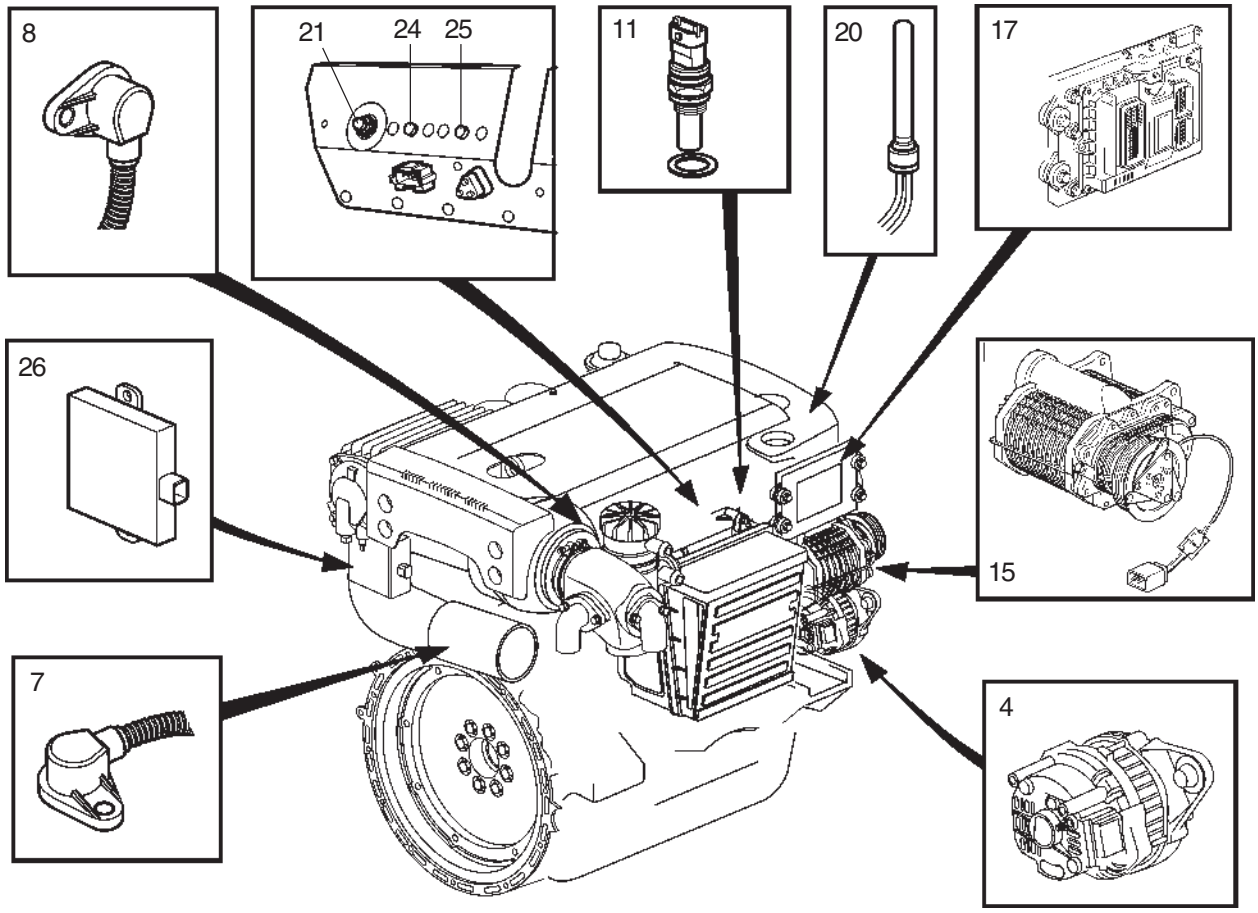


Engine components

3. Starter motor (with starter motor solenoid)
9. Sensor, air pressure/boost air temperature
10. Sensor, oil pressure* (engine)
12. Sensor, fuel temperature
13. Sensor, common rail pressure (fuel)
14. Solenoid controlled proportional valve, high pressure pump – fuel (MPROP)
16. Monitor, “water in fuel” (secondary filter)
27. Fuse, IPS (50 A)

* Pressure is measured after the oil filters.

NOTE! The position numbers coincide with the position numbers in the engine wiring diagram.



Engine components

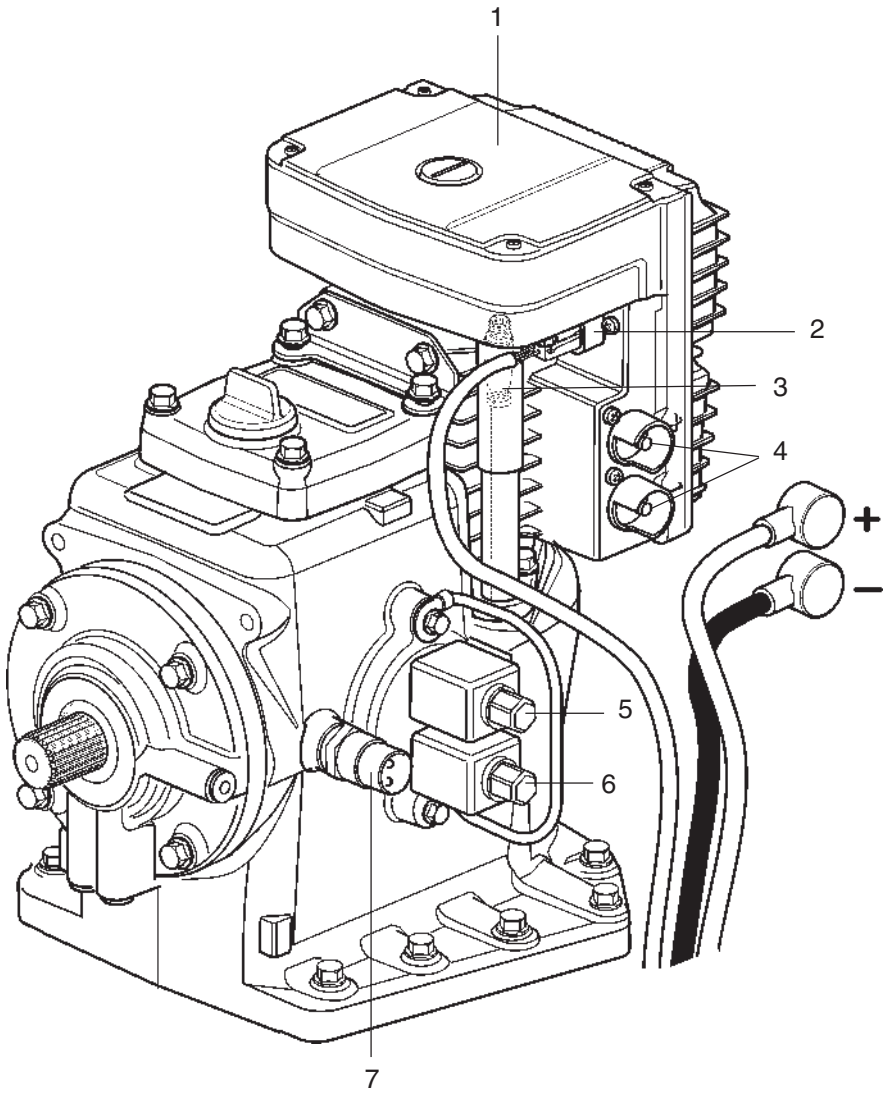
4. Alternator
7. Speed sensor – flywheel
8. Sensor, camshaft position
11. Sensor, coolant temperature
15. Supercharger (D6-370D-B)
17. Engine control unit, EDC7 (with air pressure sensor)
20. Monitor, coolant level
21. Extra stop button
24. Fuse*, engine control unit (20 A)
25. Fuse*, EVC (20 A)
26. Voltage converter (DC / DC)**

*Circuit breaker with manual re-set (only on engines with 24 V system voltage).

Note. Relative positions of the fuses (pos. 24 and 25) can vary, please refer to the wiring schedule.
Red and red/white cable to fuse for enginecontrol unit.
Red and red/black cable to fuse for EVC.

** Semi-automatic circuit breaker (only on engines with 12 V system voltage).

NOTE! The position numbers in figure do not corresponding to the engine wiring diagram.

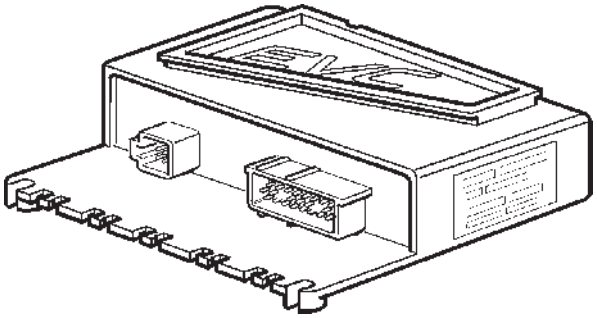


Transmission components

1. SUS
2. Connector, EVC
3. Resolver, signal cable
4. Power supply connectors, electric motor
5. Secondary solenoid, reverse gear
6. Primary solenoid, forward gear
7. Sensor, oil temperature/pressure

Component description

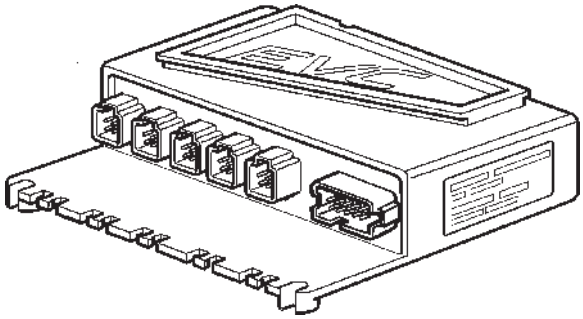
NOTE! The number / letter in brackets in the headings coincides with the position number on the component location illustrations or to the position number in the engine wiring diagram.



PCU*

The node is located in the engine room. It communicates with the engine and transmission and helm station control unit, SHCU, via the standard bus.

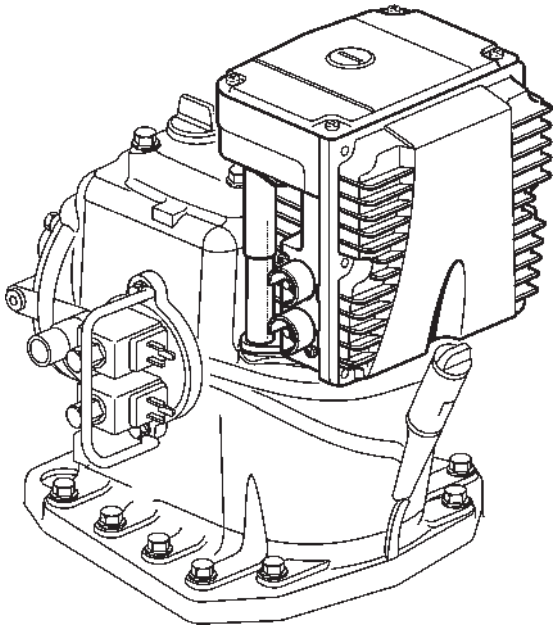
* PCU = Powertrain Control Unit.
  There is a decal containing the serial number and CHASSIS ID on the PCU. The CHASSIS ID number must coincide with the CHASSIS ID number on the decals on the engine.



SHCU*

The node is located close to the helm station and its components. Communicates with the PCU and SUS via the standard bus.

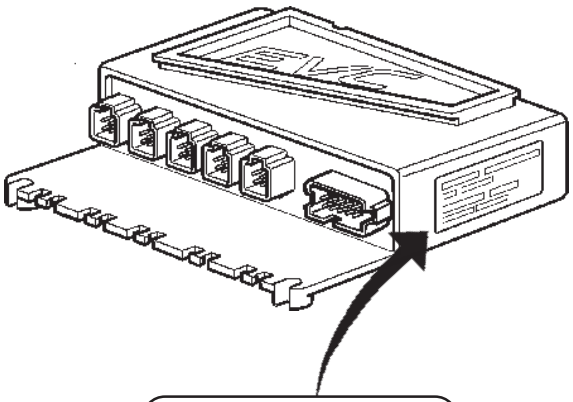
* SHCU = Steering Helm Control Unit.
  There is a decal containing the serial number and CHASSIS ID on the SHCU. The CHASSIS ID number must coincide with the CHASSIS ID number on the decals on the engine.



SUS*

The SUS consists of a control unit and an electric motor. The unit is located on the upper gear of the IPS. Communicates with the SHCU and PCU via the standard bus.

* SUS = Servo Unit Steering.
  There is a decal containing the serial number and CHASSIS ID on the SUS. The CHASSIS ID number must coincide with the CHASSIS ID number on the decals on the engine.



PCU/SHCU, engine and SUS label

Identification of the PCU and SHCU

Each PCU and SHCU (node) in the EVC system is programmed to communicate with a specific engine. Software can vary depending on engine type, equipment, parameter setting, etc. It is therefore, prior to installation, important to identify the different nodes .

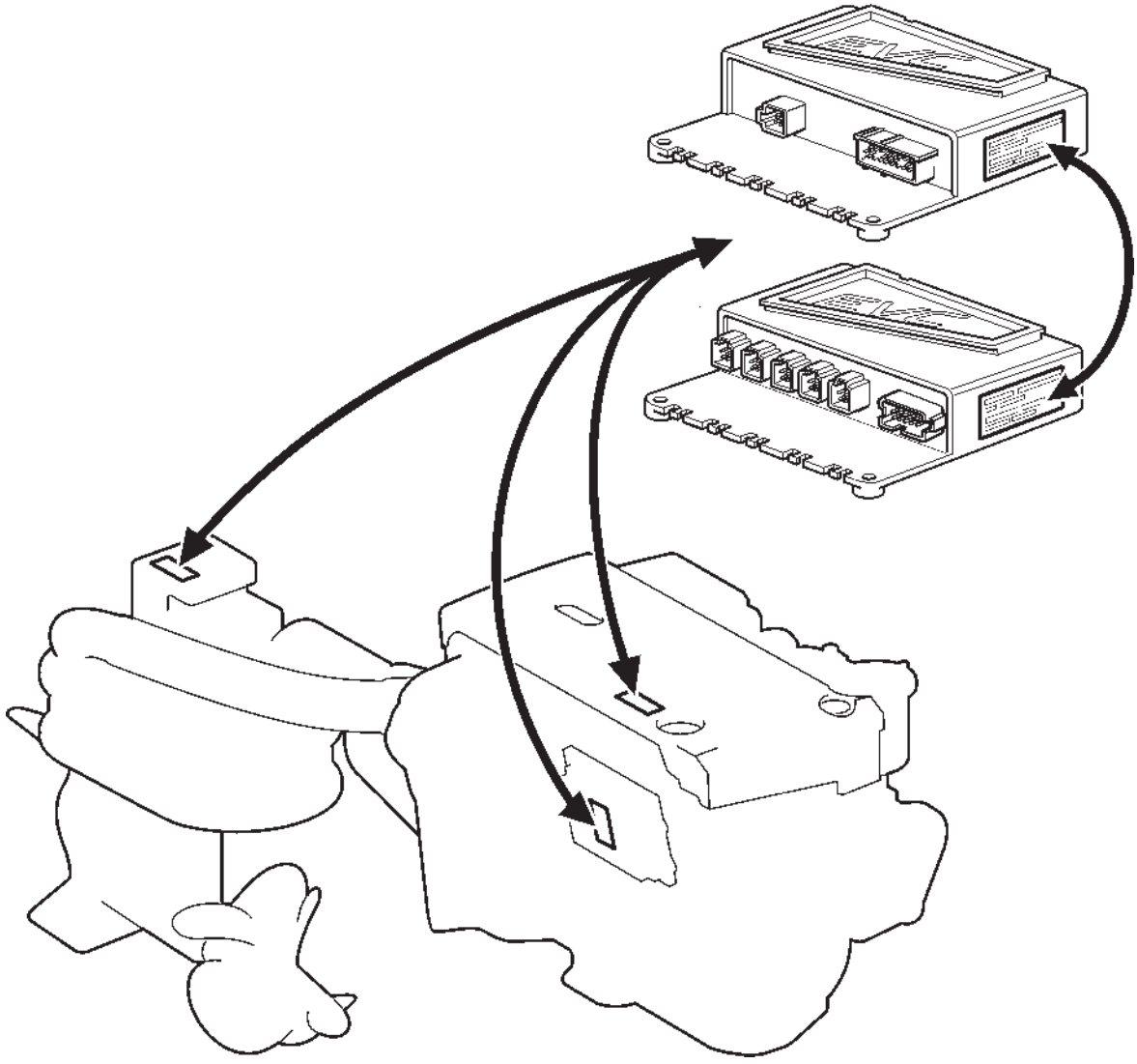
This is carried out by checking indentically designed labels, placed on the node gables, on top of the engine cover, on the engine control unit (ECU) and on the Servo Unit Steering (SUS).

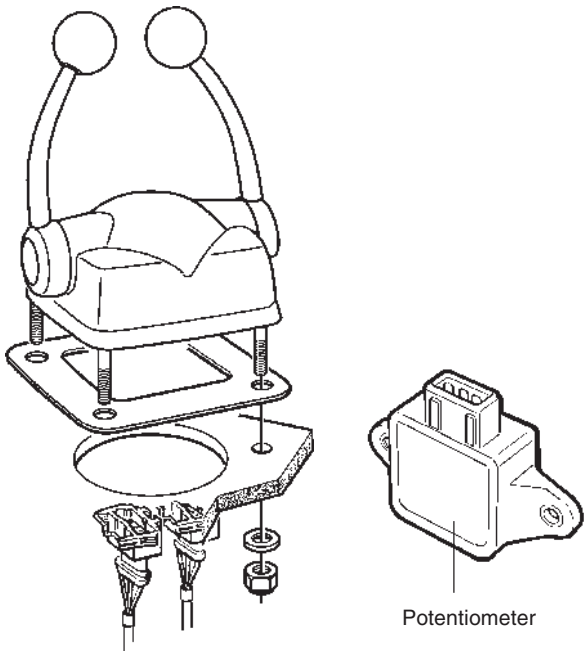
Identification is done by using the **ENGINE CHASSIS ID.** number.

⚠ **IMPORTANT!** The CHASSIS ID. number on the node labels must correspond with the chassis id. number on engine and SUS labels.

The CHASSIS ID. number on the node labels are also intended for the Volvo Penta organisation for identification of the system in the VODIA diagnostic tool.

The CHASSIS ID. can also be shown in the EVC display.





Control

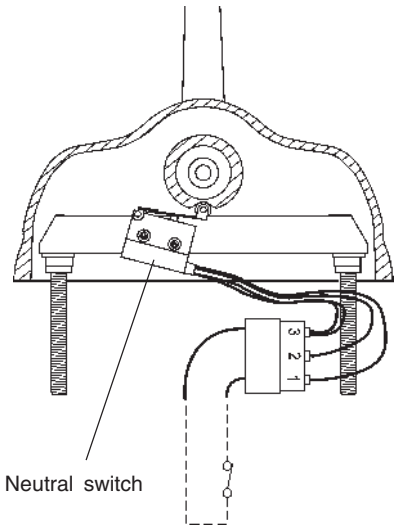
Only electronic controls can be used on the engines.

NOTE! If a control is changed, the control must be calibrated before starting (please refer to the “Calibration before starting” section).

Potentiometer

The potentiometer registers the movements of the control lever and gives the control module information about engine speed and gear shift demanded. The potentiometer is installed inside the control.

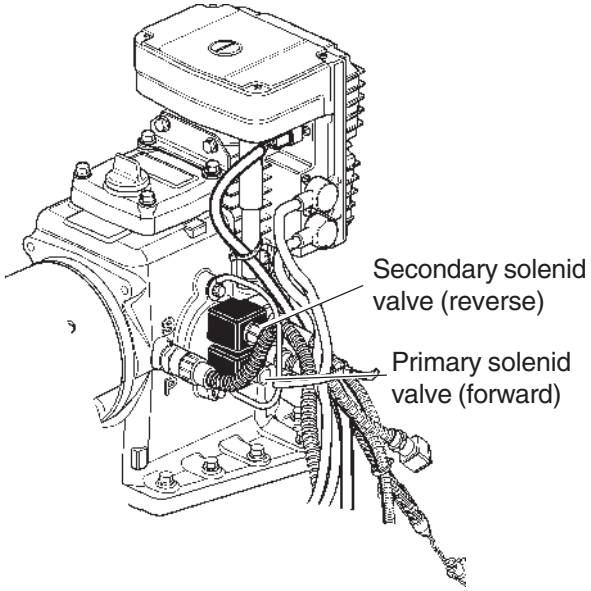
NOTE! If a potentiometer is changed, the control must be calibrated before starting (please refer to the “Calibration before starting” section).



Neutral switch

The neutral switch is a safety device that prevent the boat to began running when the control is in neutral mode.

The neutral switch is installed inside the control.



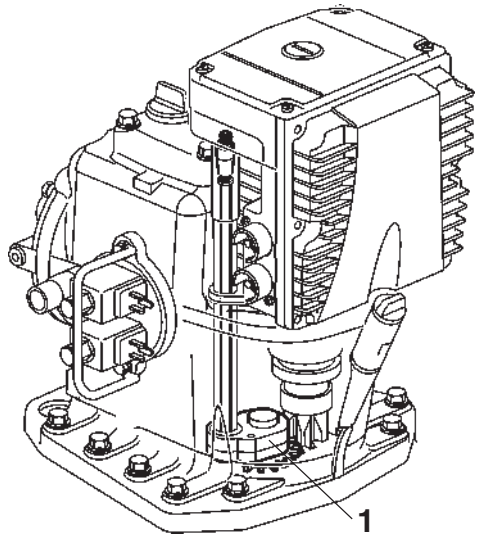
Solenoid valves, transmission

Solenoid valves (V) for gear shifting are located on the upper gear.

The valves are ordinary OFF–ON valves which allow oil to pass to the correct clutch when ON.

When sufficient oil pressure has been built up, the clutch is activated (the oil pressure is raised gradually to give a gentle engagement).

In the OFF position, the oil in the clutch is emptied and the reversing gear goes into neutral.

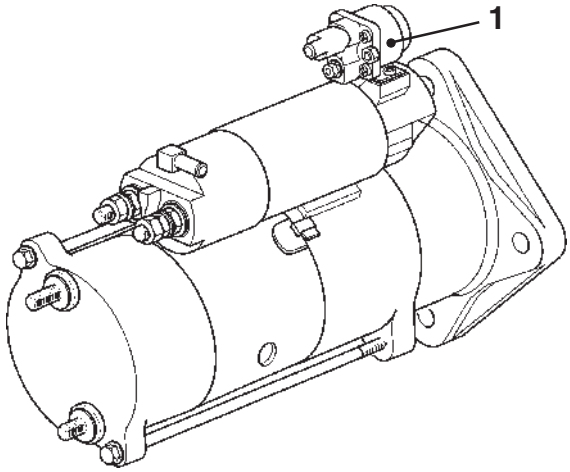


Resolver

The resolver (1) is the unit that communicates to the SUS in what position the driveleg actually is located.

The resolver unit consists of a resolver, a gear wheel and a signal cable. Inside the resolver there is no physical contact points.

The resolver is not serviceable and has to be replaced as a complete unit.

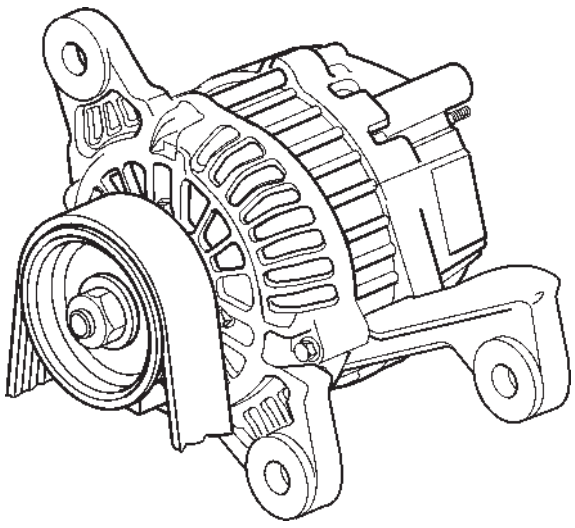


Starter motor

The starter motor is installed in the flywheel housing, on the left-hand side of the engine. The starter motor relay is “positive connected”, which means that the relay receives a positive signal (+) to activate the starter motor.

The starter motor solenoid is engaged via the starter relay, which is activated when the starter key is turned to position III.

The starter relay (1) is mounted on the starter motor solenoid.

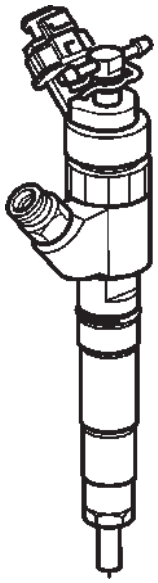


Alternator

The alternator* is belt driven and mounted on the front of the engine, on the right.

The voltage regulator in the standard alternator has a sensor system which can compensate for voltage drop in the cables to the battery.

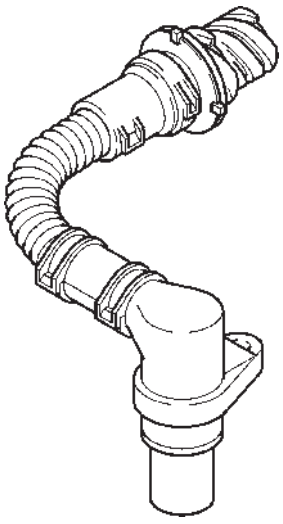
* 14 V/115 A alt. 24 V 80 A



Injectors

The injectors are installed on the cylinder head, underneath the protective cover.

The amount of fuel injected and injection duration is controlled by the control unit, via electromagnetically controlled fuel valves in the injectors. This means that the engine always receives the correct volume of fuel in all operating conditions, which offers lower fuel consumption, minimal exhaust emissions etc.



Sensor, engine speed (flywheel)

The sensor is located on top of the flywheel housing and is identical with the camshaft position sensor.

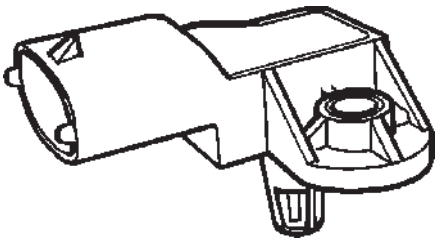
The sensor is inductive. It reads the crankshaft position and speed by means of 58 small holes drilled on the outer radius of the flywheel, plus a distance without holes.
The signal is sent to the control unit, which calculates the injection advance and the amount of fuel to be injected.

Sensor, camshaft position

The camshaft position sensor is located at the rear on the right of the cylinder head and is identical with the engine speed sensor.

The sensor is inductive, and reads off a toothed wheel on the exhaust camshaft. The toothed wheel has one tooth per cylinder plus a synchronisation tooth, i.e. 7 teeth (six of which are located inside one interval).

The impulses from the cam position sensor provide the control unit with information about the cylinder which is next in line for fuel injection.



Sensor, boost air pressure/boost air temperature

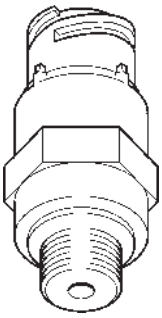
The boost air pressure and the boost air temperature are measured by a combined sensor located underneath the inlet manifold on the left of the engine.

The sensor is supplied by a 5 Volt reference voltage from the engine control module.

The boost air pressure sensor measures the absolute pressure, which is the sum of the boost air pressure and atmospheric pressure (300 kPa thus corresponds to a boost pressure of 200 kPa when atmospheric pressure is 100 kPa).

The pressure signal is a voltage signal which is proportional to absolute pressure.

The boost air temperature sensor consists of a non-linear resistor, whose resistance varies with boost air temperature. The resistance falls as the temperature rises.

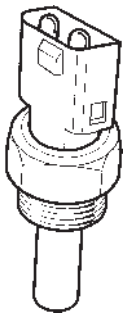


Sensor, lube oil pressure, engine

Oil pressure is measured by a sensor installed in the engine block on the left side of the engine.

The sensor measures pressure in the main oil gallery, and is supplied by a 5 Volt reference voltage from the engine control module.

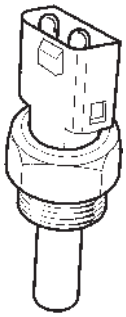
The pressure signal is a voltage signal which is proportional to the lube oil pressure.



Coolant temperature sensor

The sensor is located on the exhaust manifold, on the right hand side of the engine.

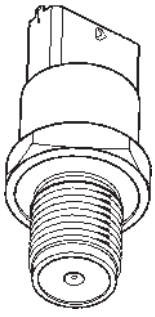
The sensor senses the engine coolant temperature and sends the information to the engine control unit. The sensor consists of a non-linear resistor, whose resistance varies with coolant temperature. The resistance falls as the coolant temperature rises.



Fuel temperature sensor

The sensor is mounted on the bracket for the secondary fuel filter on the right of the engine.

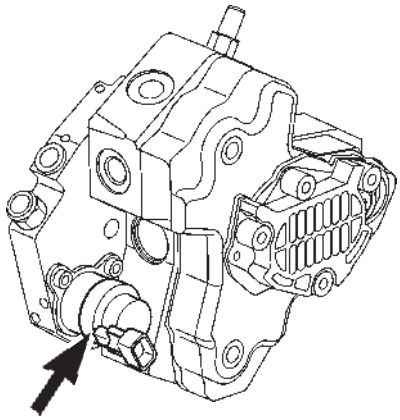
The sensor senses the fuel temperature and sends the information to the engine control unit. The sensor consists of a non-linear resistor, whose resistance varies with fuel temperature. The resistance falls as the fuel temperature rises.



Sensor, common rail pressure (fuel)

The sensor is mounted on the left of the engine, at the front of the distribution manifold (“rail”) which distributes fuel to the injectors.

The rail pressure sensor senses the fuel pressure and converts this to a voltage which is registered by the engine control unit.



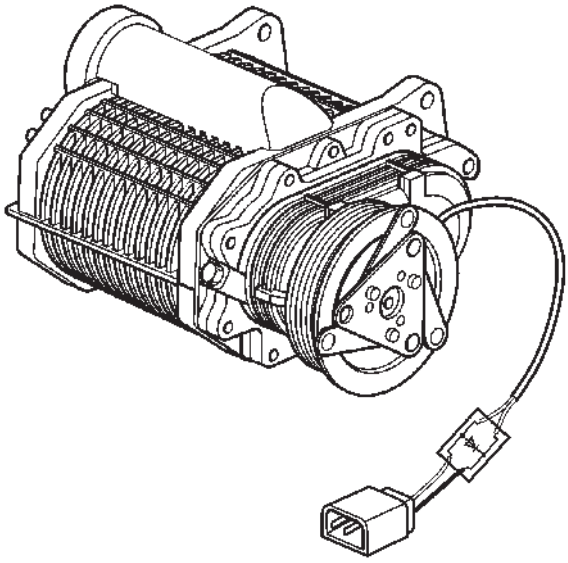
Magnetically controlled proportional valve (MPROP)

A magnetically controlled proportional valve (MPROP) controls the high pressure pump to ensure that the correct fuel pressure (rail pressure) is retained despite varying engine speed and loading.

The valve is located in the high pressure pump at the rear of the engine on the left.

The input signal to the valve is a PWM signal whose pulse width is controlled by the engine control module.

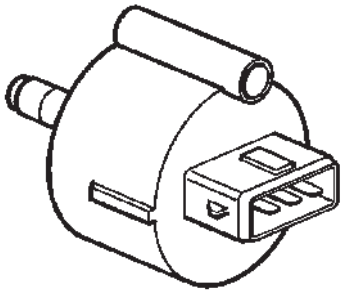
When the current through the valve is changed, this affects the fuel flow, which results in changed fuel pressure (rail pressure).



Supercharger

The mechanical supercharger is located at the right front of the engine. An electromagnetic clutch is used to engage and disengage the supercharger.

The engine control unit activates the coupling by providing the coupling solenoid with current.

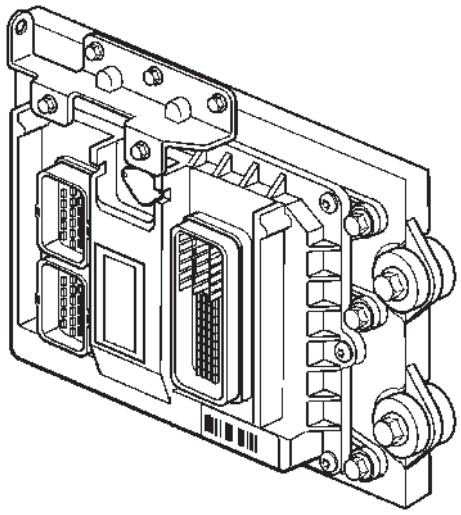


Water switch, secondary fuel filter

A monitor is located underneath the secondary fuel filter. Its task is to discover water in the fuel system.

The monitor consists of a measurement probe containing two measurement points, galvanically isolated by a layer of insulation. The measurement probe is in contact with the fuel.

When there is no water in the fuel, the resistance between the measurement points is very high. If there is any water in the fuel, the resistance falls. When the resistance falls below a limit value (which happens when water gets into the fuel), the engine control module receives an alarm signal.



Engine control unit, EDC7

Control unit (EDC7) is installed at the front on the right side of the engine. It checks and controls the injectors, to ensure that the correct volume of fuel is injected into each cylinder at the right time. It also controls the high pressure pump via the proportional valve (MPROP) to ensure that the system always has the correct fuel pressure (rail pressure).

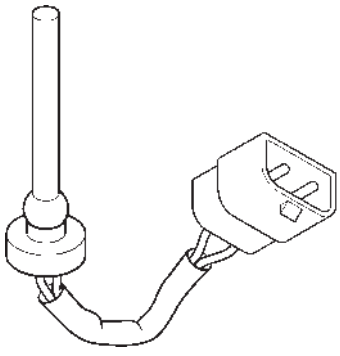
The control unit also calculates and adjusts the injection advance. Regulation is mainly done with the aid of the engine speed sensors and the combined sensor for boost air pressure/boost air temperature.

The EDC system processor is located in the control unit, unit, protected from water and vibration.

The processor receives continuous information about:

- Engine speed
- Throttle opening
- Oil pressure
- Boost air pressure/temperature
- Fuel pressure (common rail pressure)
- Fuel temperature
- Fuel alarm, “water in fuel”
- Camshaft position
- Coolant temperature

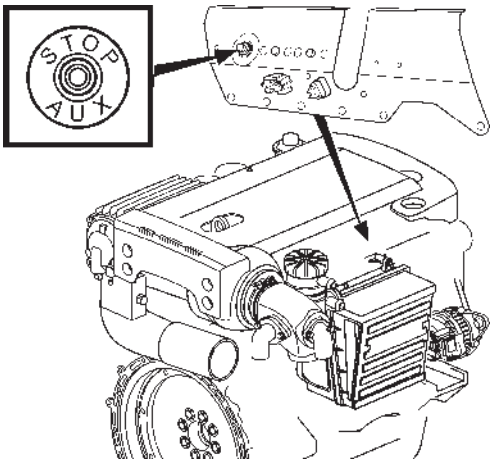
The information provides information about current operation conditions and allows the processor to calculate the correct fuel volume, monitor engine status etc.



Swich, coolant level

The monitor is installed on the right beneath the expansion tank at the front of the engine.

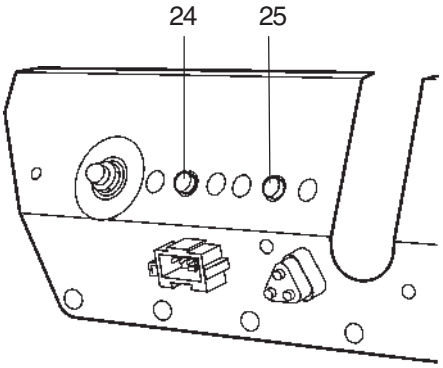
The task of the monitor is to discover whether the coolant level in the engine (expansion tank) has become too low. An alarm signal is sent when the coolant level is too low.



Extra stop button

An extra stop button is located on the right side of the engine. When the button is pressed, a pulse is sent to the engine control unit and the engine stops.

Note. If the stop button is depressed during a start attempt, this does **not** prevent the engine from starting.



Fuses (24, 25, 27)

The engines are provided with over-voltage protection, which cuts the current if the electrical system is overloaded.

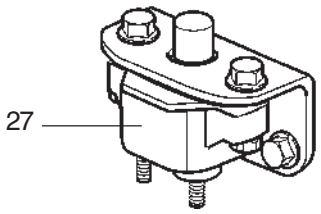
Engines with 24 V system voltage

The engine has two over-voltage protection circuit breakers (24, 25). These are re-set by pressing the button on the over-voltage protection circuit breaker.

⚠ **IMPORTANT!** Always investigate the reason for the overload.

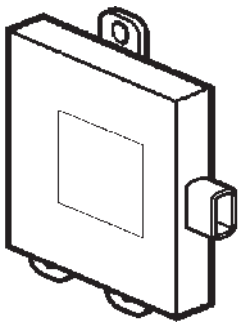
IPS with 12 V / 24 V system voltage

The IPS unit has an over-voltage protection circuit breaker (27) of 50 A, placed on the engine. This circuit breaker is re-set by pressing its button.



Engines with 12 V system voltage

The engine and IPS have a fully automatic over-voltage protector built into the voltage converter (26). If there is an intermittent fault, re-setting is done automatically.



Voltage converter DC/DC, 12 V

The engines with 12 V system voltage are equipped with a DC/DC converter, installed at the rear on the left of the engine. Its task is to stabilize the voltage supplied to the control unit during the starting sequence.

Circuit breaker

The engines have a fully automatic over-voltage protector built into the voltage converter (26). If there is an intermittent fault, re-setting is done automatically.

Repair instructions

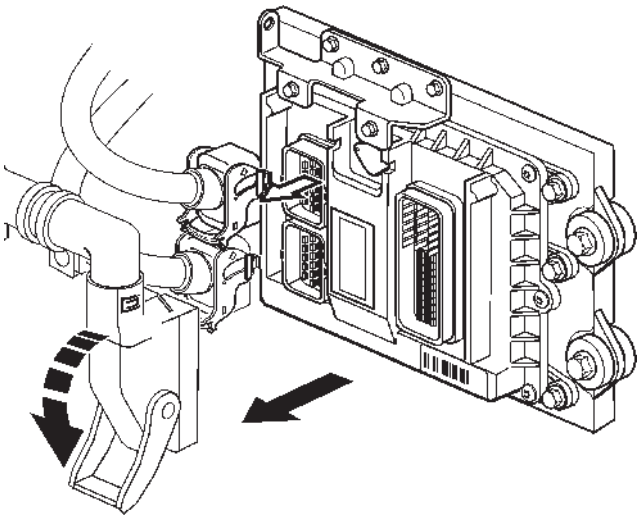
General advice on working with EVC engines

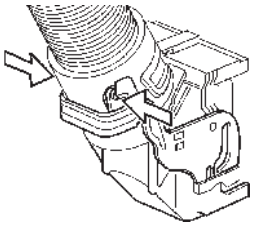
The following advice must be followed to avoid damage to the engine control unit and other electronics.

⚠ **IMPORTANT!** The system must be disconnected from system voltage (by cutting the current with the main switch) and the starter key(s) must be in the 0 position when the engine control module connectors are disconnected or connected.

- Never disconnect the current with the main switches when an engine is running.
- Never undo a battery cable when the engine is running.
- Turn the main switches off or disconnect the battery cables during quick charging of the batteries.

  NOTE! During normal trickle charging, it is not necessary to turn the main switches off.
- Only batteries may be used for start help. A help start device can produce a very high voltage and damage the control unit and other electronics.
- If a connector is disconnected from a sensor, be very careful to avoid allowing the contact pins to come into contact with oil, water or dirt.





Electric welding

1

NOTE! Cut the current with the main switch.

⚠ **IMPORTANT!** The system must be disconnected from system voltage and the starter key(s) must be in the 0 position when the engine control module connectors* are disconnected or connected*.

* **Note.** Check that the seal is in position before each connector is joined up.

2

Undo the three connectors from the engine control unit before any electric welding starts. Turn the locking arm down at the same time as the connector is pulled outwards*.

* **Note.** Both the smaller plastic pins must be pressed in (see arrows) to allow the two smaller connectors to be undone.

3

Disconnect all connections to the alternator.

Connect the welder earth clamp to the component to be welded, or as close as possible to the weld site. The clamp must never be connected to the engine or in such a way that current can pass through a bearing.

⚠ **IMPORTANT!** After welding is completed, the disconnected components, such as alternator cables and battery cables must be connected in the correct order.

The battery cables must always be connected last.

Fault tracing of cables and connectors

Special tools: 9812519, 9998482

Check all connectors visually

Check the following:

- Look for oxidation which can impair contact in connectors.
- Check that terminals are undamaged, that they are correctly inserted into their connectors, and that the cable is correctly terminated in the terminal.
- If possible, shake the cables and pull the connectors during measurement to discover whether the cable harness is damaged.
- Check that the cables are not damaged. Avoid clamping cables in tight bends close to the connector.

Contact problems

Intermittent contact or temporary recurring faults can be difficult to fault trace, and are frequently caused by oxidation, vibration or poorly terminated cables.

Wear can also cause faults. For this reason, avoid disconnecting a connector unless it is necessary.

Other contact problems can be caused by damage to pins, sockets and connectors etc.

Shake cables and pull connectors during measurement, to find where the cable is damaged.

Contact resistance and oxidation

Resistance in connectors, cables and junctions should be approx. 0 Ω. A certain amount of resistance will occur, however, because of oxidation in connectors.

If this resistance is too great, malfunctions occur. The amount of resistance that can be tolerated before malfunctions occur varies, depending on the load in the circuit.

Open circuit

Possible reasons for faults could be chafed or broken cables, or connectors which have come undone.

Use the wiring schedule to check the cables which are relevant to the function. Start off with the most probable cable in the circuit.

Check the following:

- Disconnect the relevant connector at each end of the cable harness.
- Use multimeter 9812519 to measure the resistance between the ends of the cable.
  Nominal value ~ 0 Ω.
- If possible, shake the cables and pull the connectors during measurement to discover whether the cable harness is damaged.
- Check the next cable system in the wiring schedule if no fault has been found.

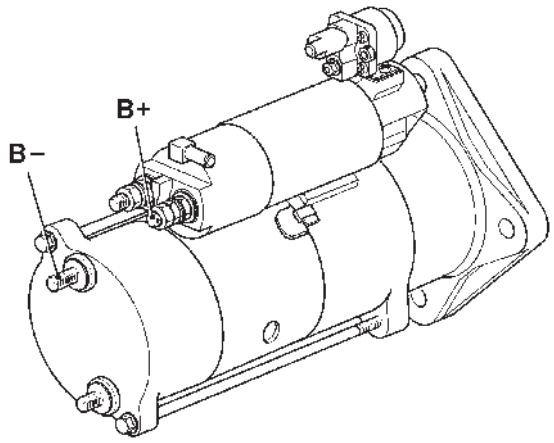
Fault tracing of the starter motor and windings

Special tools: Multimeter 981 2519

General

If battery voltage falls below 12.4 V* (12 V system voltage) alt. 24.7 V* (24 V system voltage), the starter motor will not be able to crank the engine at normal speed.

* **Note.** Measured on the batteries.



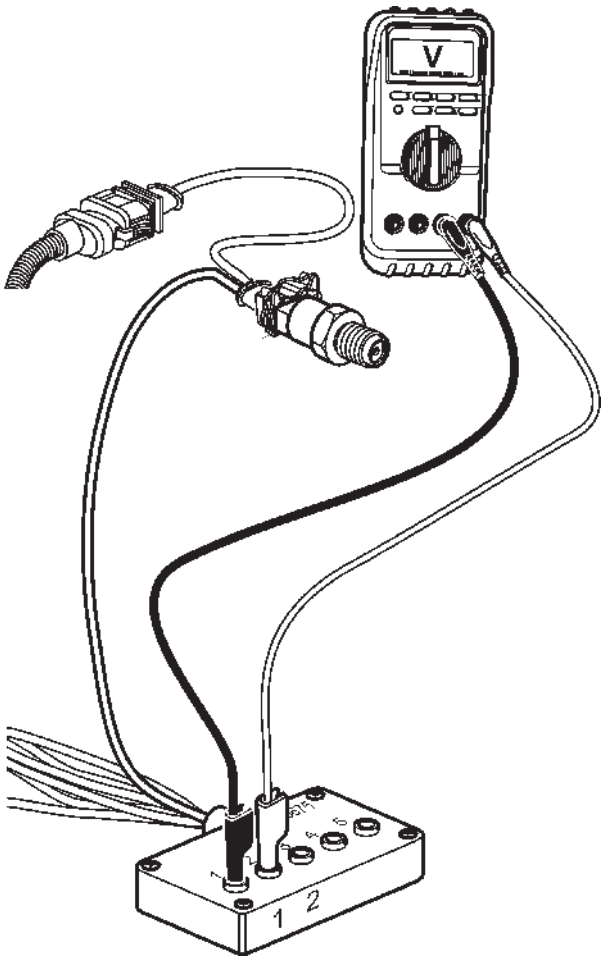
Voltage measurement, check

1
Check that the battery voltage is at least 12.4 V* (12 V system voltage) alt. 24.7 V* (24 V system voltage) when unloaded, by measuring between the battery poles with multimeter 981 2519.

* **Note.** Measured on the batteries.

2
Turn the main switch on.

3
Check that the voltage between terminals B+ and B– on the starter motor are the same as the battery voltage.



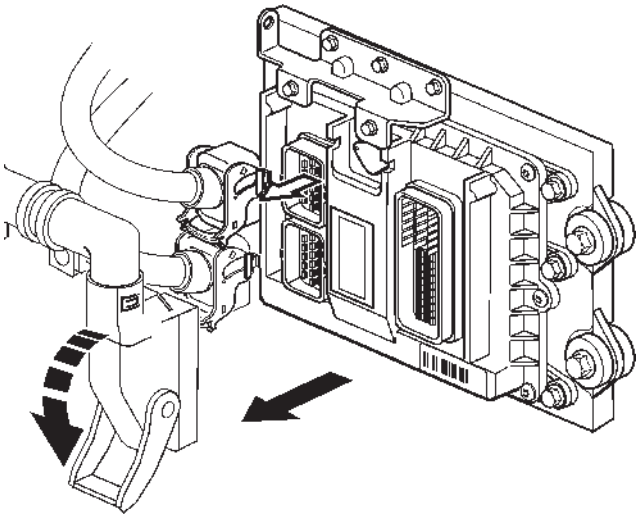
Rail pressure measurement

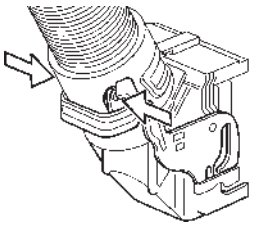
This measurement is used for measuring the rail pressure. For example if the engine doesn´t start this measurement can show the rail pressure while the engine is cranking. If it is air in the system the rail pressure could be too low for the engine control unit to activate injection.

1. **NOTE!** Starter key in position 0.
2. Undo the connector from the sensor.
3. Connect adapter cable (885675) between the sensor and the engine control unit.
4. Use multimeter (9812519) for voltage measurement. Connect the COM from the multimeter to measurement point 1. Connect V from the multimeter to measurement point 2.
5. **NOTE!** Starter key in position I. The multimeter should now show 0.5 Volt which is equal to 0Mpa (0bar).
6. When cranking the engine, read the voltage value on the multimeter and look in the table which pressure the voltage equals.

NOTE! To activate injection a rail pressure of at least 20 MPa (200 bar) is demanded for the D4/D6 engines.

Voltage	0.5	0.95	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7
MPa	0	20.3	22.5	27.0	31.5	36.0	40.5	45.0	49.5	54.0
Bar	0	203.0	225.0	270.0	315.0	360.0	405.0	450.0	495.0	540.0
Voltage	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
MPa	58.5	63.0	67.5	72.0	76.5	81.0	85.5	90.0	94.5	99.0
Bar	585.0	630.0	675.0	720.0	765.0	810.0	855.0	900.0	945.0	990.0
Voltage	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7
MPa	103.5	108.0	112.5	117.0	121.5	126.0	130.5	135.0	139.5	144.0
Bar	1035.0	1080.0	1125.0	1170.0	1215.0	1260.0	1305.0	1350.0	1395.0	1440.0
Voltage	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5		
MPa	148.5	153.0	157.5	162.0	166.5	171.0	175.5	180.0		
Bar	1485.0	1530.0	1575.0	1620.0	1665.0	1710.0	1755.0	1800.0		





Changing the engine control unit

1

NOTE! Cut the current with the main switch.

⚠ **IMPORTANT!** The system must be disconnected from system voltage and the starter key(s) must be in the 0 position when the engine control module connectors* are disconnected or connected*.

* **Note.** Check that the seal is in position before each connector is joined up.

2

Remove the three connectors from the engine control unit. Turn the locking arm down at the same time as the connector is pulled outwards*.

* **Note.** Both the smaller plastic pins must be pressed in (see arrows) to allow the two smaller connectors to be undone.

3

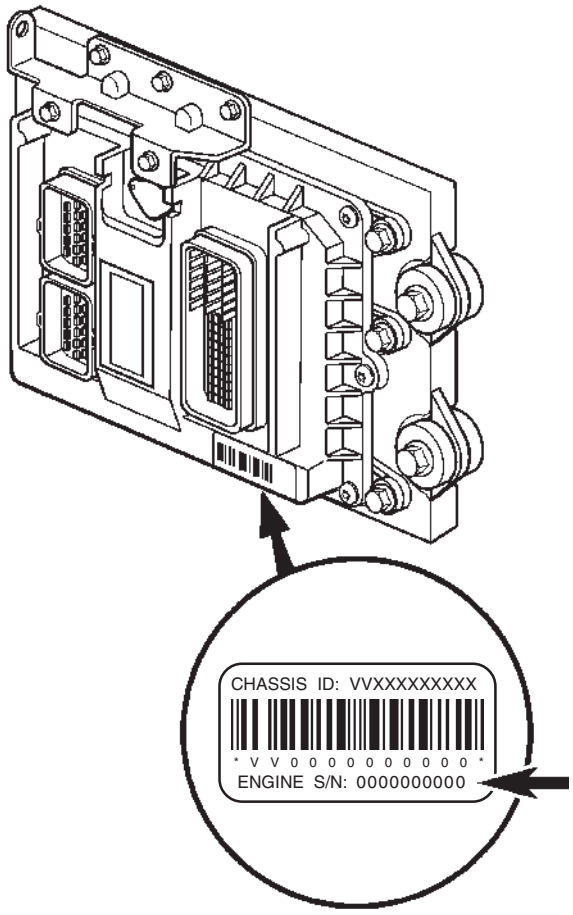
When the control unit is changed or re-programmed, fault codes MID 187, PSID 17 and MID 164, PSID 99 “Data bus network, configuration fault” will be generated.

Do an auto-configuration.

4

If the new engine control unit has recently been programmed:

Start the engine and check whether any fault codes related to the engine control unit occur.



Identifying the engine control unit

Identification is done via the CHASSIS ID number.

⚠ **IMPORTANT!** The CHASSIS ID number on the decal must coincide with the CHASSIS ID number on the protective cover above the engine, and the decals on each PCU and SHCU.

Reprogramming a control unit

⚠ **IMPORTANT!** The CHASSIS ID number must be readily available to allow the software to be downloaded.

Action:

1
Log in to **Volvo Penta Partner Network's** website:

www.vppn.com

2
Choose "VODIA" in the left-hand menu.

3
Choose "ECU programming" in the left-hand menu.

4
Follow the instructions under "Download software". Choose the control units to be re-programmed and click the "Download" button. The software for the control units is now downloaded to the PDA*.

*** Note.** PDA = "Personal Digital Assistant" (palmtop computer).

5
Take a look under "Settings", "Software information" in VODIA to check that the software has been downloaded.

6
Connect the VODIA to the engine (control unit) to be programmed.

7
Start with the engine control unit (EDC 7). Select "Engine with mounting and equipment" in the VODIA menu. Select "MID 128 Control unit, programming".

VODIA will guide you through the entire programming process.

8
The next control unit is the driveline control unit (PCU). Select "Electrical system and instruments" in the VODIA menu. Select "MID 187 Control unit, programming". VODIA will guide you through the entire programming process.

9
The next control unit to be programmed is the steering helm station control unit (SHCU). Select "Electrical system and instruments" in the VODIA menu. Select "MID 164 Control unit, programming". VODIA will guide you through the entire programming process.

NOTE! All helm station control units on the same drive line should be programmed in one sequence.

10
The next Control unit to be programmed is the Servo Unit Steering (SUS). Select "Transmission" in the Vodia menu. Select "MID 250 ECU, programming". Vodia will guide you through the entire programming process.

11
NOTE! Programming must be reported back to Volvo Penta within 28 days. Log in to **Volvo Penta Partner Network's** web site:

www.vppn.com

12
Choose "VODIA" in the left-hand menu.

13
Choose "Report software" in the left-hand menu.

14
Follow the instructions for "Report software/parameter". Click "Report software/parameter".

NOTE! An autoconfiguration shall be performed after all ECU programming.

Programming an empty control unit

When a new engine control unit is installed (EDC 7), where no software has been downloaded, the control unit must be programmed.

The new control unit must have the same part number as the old control unit. If the control units do not have the same part number, it will not be possible to program the new control unit until a “Conversion kit” has been ordered from Volvo Penta.

If the control units have the same part number, the new control unit can be programmed as usual. Please refer to “Programming a control unit”.

If the part numbers do not coincide – proceed as follows:

1
Have both part numbers available.

2
Log in to **Volvo Penta Network’s** web site:

www.vppn.com

3
Choose “VODIA” in the left-hand menu.

4
Choose “Conversion kit” in the left-hand menu. A new page, “Conversion kit / Accessory kit”, opens up.

5
Click the text “**Available conversions kits**” which is shown in bold face.

6
A new window opens. Follow the instructions given in the window.

7
Retur to the “Conversion kit / Accessory kit” page and follow the instructions to order a new “conversion kit”.

8
Volvo Penta’s database is now updated. It can take about a minute before a confirmation is sent.

9
Programing of the control unit can now start. Please refer to “Programming a control unit”.

Malfunctions

Fault code information

- **MID** (“Message Identification Description”):
  The MID consists of a number which designates the control unit that sent the fault code message. (e.g. the engine control unit).
- **PID** (“Parameter Identification Description”):
  The PID consists of a number that designates a parameter (value) to which the fault code relates (oil pressure, for example).
- **PPID** (“Proprietary PID”):
  The same as the PID, but this is a Volvo-specific parameter.
- **SID** (“Subsystem Identification Description”):
  The SID consists of a number that designates a component to which the fault code relates (tachometer, for example).
- **PSID** (“Proprietary SID”):
  The same as the SID, but this is a Volvo-specific component.
- **FMI** (“Failure Mode Identifier”):
  FMI indicates the type of fault (please refer to the FMI table below).

FMI table

SAE standard

FMI	Display text	SAE text
0	“Value too high”	Data valid, but above the normal working range
1	“Value too low”	Data valid, but below the normal working range
2	“Faulty data”	Intermittent or faulty data
3	“Electrical fault”	Voltage above normal or short circuit to higher voltage
4	“Electrical fault”	Voltage below normal or short circuit to lower voltage
5	“Electrical fault”	Current below normal or open circuit
6	“Electrical fault”	Current above normal or short circuit to battery negative
7	“Mechanical fault”	Faulty response from mechanical system
8	“Mechanical or electrical fault”	Abnormal frequency, pulse width or period
9	“Communication fault”	Abnormal updating rate
10	“Mechanical or electrical fault”	Abnormally large variations
11	“Unknown fault”	Unidentified fault
12	“Component fault”	Faulty unit or component
13	“Faulty calibration”	Calibration values outside the limits
14	“Unknown fault”	Special instructions
15	“Unknown fault”	Reserved for future use

Volvo-specific for injectors (MID 128, SID 1–6)

FMI	Help
2	Short circuit to battery voltage, injector high voltage side
3	Short circuit to battery voltage, injector low voltage side
4	Short circuit to battery negative, injector low voltage or high voltage side
9	Open circuit in injector circuit

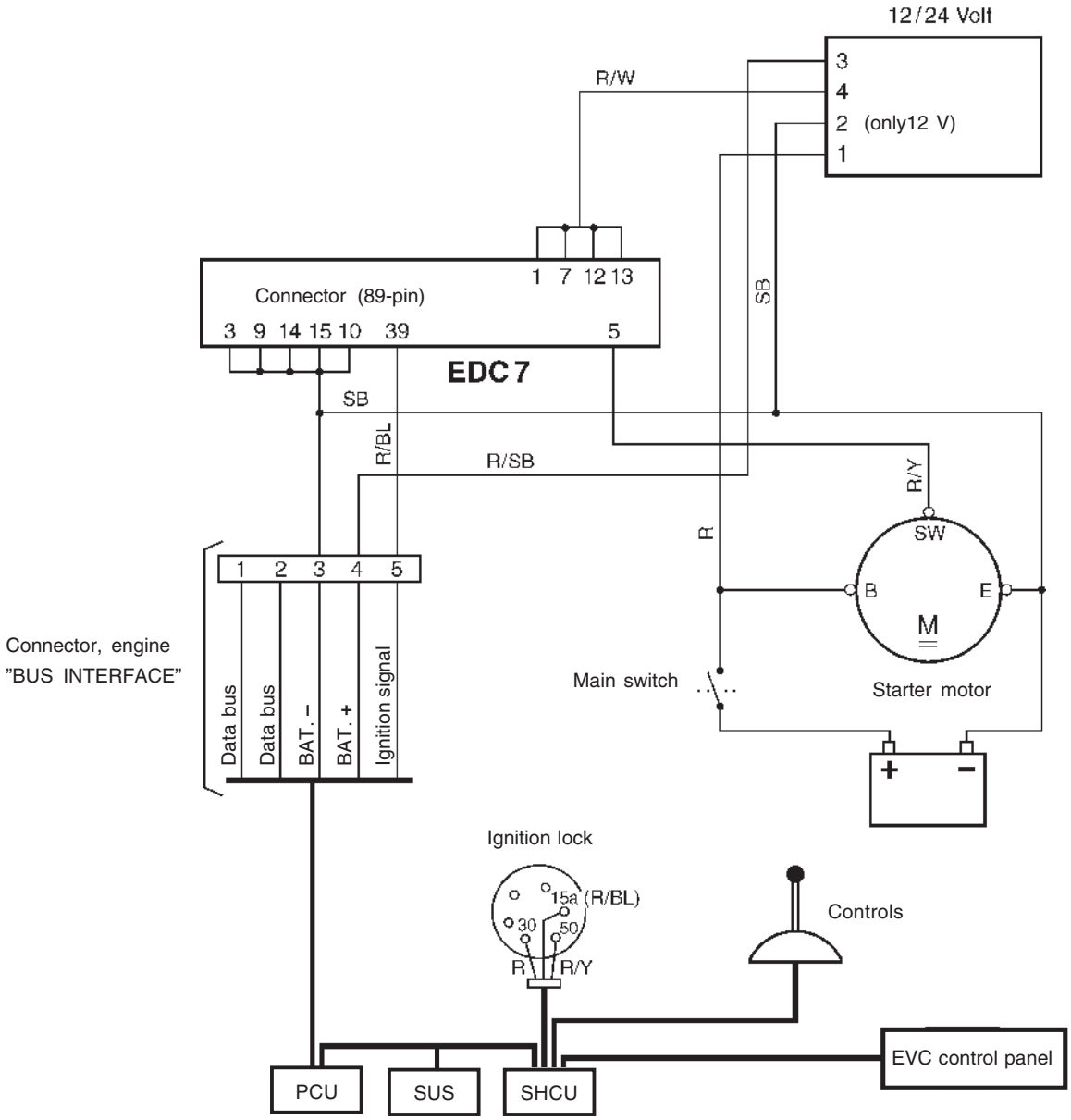
General advice

NOTE!

The following must be done before fault tracing continues, to avoid changing functional sensors:

- **If there is an active / inactive fault code.**
  Remove the connector from the sensor. Check that there is no oxidation and that the connector pins are not damaged.
  If there is a fault, please refer to the instructions in chapter “Fault tracing of cables and connectors”.
  Note. Some fault codes become inactive when the engine is stopped. Start the engine to check whether the fault code is still inactive with the engine running.
- **After an action with the connector**
  Put the connector* back. Check if the fault code becomes inactive.
  Check faults that could be related to that specific sensor.
  If the fault remains, measure the cables and sensors to check them, as instructed.
  * **NOTE!** No grease in the connector.

System introduction, EVC



Starting sequence

1
When the main switch is closed, the engine control unit (EDC7), PCU, SHCU and SUS receive system voltage (via pins 3 and 4 in the "Engine interface" connector).

2
When the starter key is turned to position "**I**" (pin 1)5a on the starter switch is connected to pin 30), the engine control unit (pin 39) receives an activation signal from the PCU (via pin 5 in the "Engine interface" connector).

When the ignition is switched, the EVC equipment such as the control panels and instruments are activated. All relays connected to the starter switch and start - /stop panels are activated to supply current which does not belong to the EVC.

3
Check that all controls are in the neutral position and that the stop button is not depressed.

4
Turn the key to position **III** (pin 50 on the starter switch is connected to pin 30). Then pin 5 on the engine control unit receives an electric voltage and the starter motor is activated.

Network

The system has two types of communication buses.

CAN

A data link (CAN bus) links the nodes to each other. CAN (“Controller Area Network”) is an industrial standard for distributed systems.

The CAN bus consists of a pair of copper conductors which are twisted 30 times per meter. The nodes-communicate via the CAN bus and they form a network together, which exchanges information and benefits from each other’s services.

The CAN bus is a serial bus and is the primary control bus.

J1587

The communication bus, J1587, is also used for accessories and for diagnostics.

This is a serial bus in accordance with standard SAE J1708.

Manual fault tracing in bus cables

Special tools: Multimeter 9812519

⚠ **IMPORTANT!** Cut the current with the main switch before the cables are disconnected.

Use multimeter 9812519 to check the bus cables. The conductors in the bus cables should not be in contact with each other.

Disconnect a bus cable at each end and measure the resistance between the pins to check this. The multimeter should show infinite resistance between each pin. If the resistance is less than infinite, there is a fault.

It can be difficult to check whether there is a cable fault in the bus cable when it is installed in the boat. For this reason, always keep checked bus extension cables in the fault-tracing equipment.

Connect the extension cable to one end of the boat’s bus cable and run it back to the other end of the bus cable, to allow each conductor to be checked individually. After this, all the pins can be checked.

If the CAN bus cables between the engine control unit (EDC7) and the PCU need to be checked, the resistance can also be checked when the cables are connected to the other end.

1
Disconnect the PCU.

2
Measure the resistance between pin 17 (yellow/white conductor and pin 7 (gray/ yellow conductor) against the engine control unit (EDC7).

Measurement points	Nominal value
17 – 7	R ≈ 120 Ω

3
Repeat the measurement in the other direction. Connect the PCU and disconnect the engine control unit.

4
Measure the resistance between pin 1 (yellow/white conductor and pin 2 (gray/ yellow conductor) towards the PCU.

Measurement points	Nominal value
1 – 2	R ≈ 120 Ω

Measuring the engine cables

Two types of measurement are done on the engine cable harness, both resistance measurement and voltage measurement.

The measurements are done to ensure that no open circuits or short circuits occur.

If there is an open circuit, the resistance is infinite, and if there is a short circuit, it is close to zero. The resistance values given in the workshop manual are approximate, and should be regarded as guidelines.

NOTE!

When resistance measurement is done, the engine should be stopped and system voltage should be cut off with the main switch.

All resistance measurement is done at +20°C (68°F) and with a cold engine.

Fault tracing the EVC system

Special tools: VODIA 3838619

Check that the system has the correct power supply.

The best way to retrieve diagnostic information from the EVC is to use the VODIA tool (3838619). The VODIA tool shows the fault codes as text, and you can retrieve information about each fault code.

When you set an SHCU in service mode, VODIA can communicate with the SHCU to read fault codes and log its parameters. Since all SHCU have the same ECU (MID) number, only one SHCU can be put into service mode at the same time. It would not otherwise be possible to identify the SHCU which issued a fault code.

Fault codes from the PCU and SHCU can be read from any helm station. In a twin installation, the codes can only be read from the network, driveline, in which the node is located.

When VODIA is connected to the port network, VODIA can only show fault codes from the port PCU, and vice versa for the starboard side.

Problems in identifying the engine control unit (MID 128)

In normal cases, VODIA identifies the engine control unit (MID 128), the PCU (MID 187) and the SUS (MID 250) automatically when the choice of engine installation is done.

The SHCU must be in service mode to allow it to be identified.

If VODIA is not able to identify the engine control unit (MID 128), this will not be visible under “Vehicleinformation”.

NOTE! If the engine control unit has not been identified, it can not be programmed.

One reason that identification can not be done could be that the PCU contains software for a different engine than the one it is connected to.

Stop

The system can not be shut down, although the starter key is turned to the “S” position, or the stop button has been pressed.

This can be caused by a short circuit in the cables between the SHCU and the key switch, or by a short circuit in the key switch.

Shut the system off with the extra stop button on the side of the engine.

Starter motor is activated at “ignition on”

If the starter motor is activated directly the key switch is turned to ignition, the key switch diode may be short-circuited. Fault trace the diode according to “Check of key switch diode”.

Checking the instruments

Special tools: Multimeter 9812519

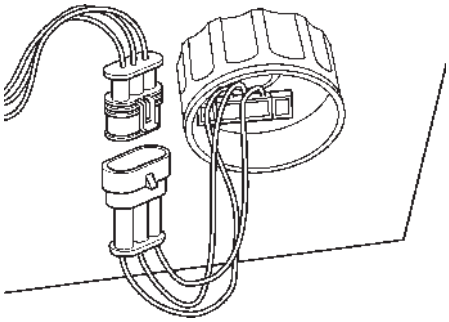
The instruments are “Easy Link” types and receive their signals from a serial bus consisting of a total of 3 conductors:

- Battery plus
- Battery minus
- Data bus

If a fault occurs in the “Easy Link” bus for the instruments, this can be discovered when the needles stop in the same positions on the instrument(s) (“frozen”). If no one of the instruments works, check with multimeter 9812519 if there is power supply voltage between red and blue conductors in the “Easy Link” harness.

Since common signals for various types of instruments pass through the same cable, it is difficult to determine whether information is missing from the serial bus, or if an individual instrument is faulty.

If you suspect an instrument fault, you can use the following procedure to determine whether the instrument is fault or not.



1
Start the engine and let it idle, with the control lever in the neutral position.

2
Disconnect the instrument which is suspected of being faulty.

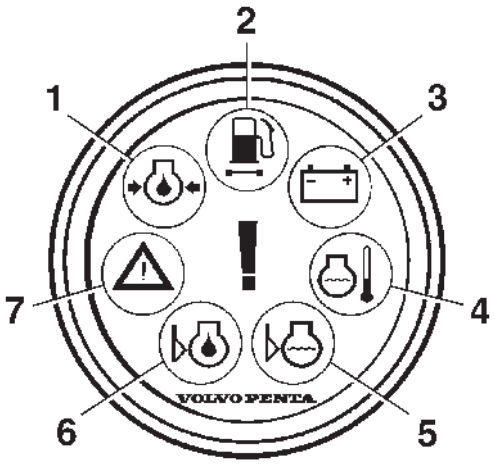
3
The fault dissappears:

- Check that there is no oxide or moisture in the relevant instrument’s connector.
- Exchange the relevant instrument with a new one and check if the fault still is dissappeared.

The fault remains:

Continue to disconnect instrument until remaining instruments starts to indicating correctly.

Re-connect the instruments again. Begin with the first disconnected instrument and continue to re-connect the other instruments until the connected instruments stops to indicating. Change the last re-connected instrument.



Alarm display

1. **Lube oil pressure:** When the oil pressure falls below a certain value at a certain engine speed, the alarm lamp is lit.

2. **Water in fuel:** When the water level in the water trap exceeds a certain level, the alarm lamp is lit.

3. **Battery voltage:** If the voltage in the starting battery falls below 12.4 Volt, the alarm lamp is lit. When the voltage exceeds 12.6 Volt, the alarm lamp goes out. The lamp is also lit when the alternator is not charging.

4. **Coolant temperature:** When the coolant temperature exceeds 98°C, the alarm lamp lights up.

5. **Coolant level:** When the coolant level falls below a certain level, the alarm lamp lights up.

6. Not used.

7. **Serious fault** (red indication).
   The lamp lights up when a serious fault occurs.

7. **Incorrect** (orange indication).
   The lamp lights up when a fault occurs.

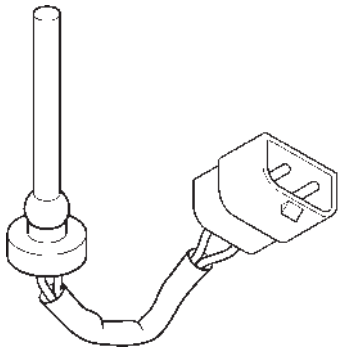
Time delay on alarm indication

Fuel temperature: Monitoring of fuel temperature is activated 5 minutes after the engine has been started. This is to prevent stationary fuel which has been warmed up from setting a fault code.

Coolant level: Low coolant level must have been detected for at least 5 minutes before the alarm is activated.

The engine control unit (EDC7) has a time delay of about 8 seconds after engine starting, before all pressures are checked.

Coolant level monitor



NOTE! No fault code is generated for low coolant level.

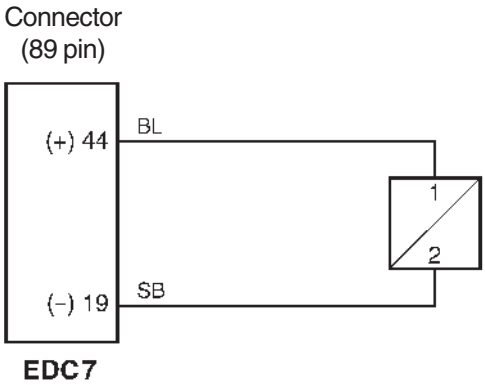
Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

Symptom

None



Circuit description

The coolant level in the engine is monitored by a level monitor.

Pin 44 on the engine control unit (EDC7) provides pin 1 on the level monitor with a voltage. Pin 2 on the level monitor is connected to battery negative via pin 19 on the engine control unit.

The level monitor has two states: On/Off.

The level monitor consists of two sections, the actual monitor and a magnetic float which is built into the expansion tank. The monitor senses the position of the magnetic float. When the coolant level falls, the float operates the monitor and a closed circuit is formed.

Fault tracing

Coolant level too low

Suitable action

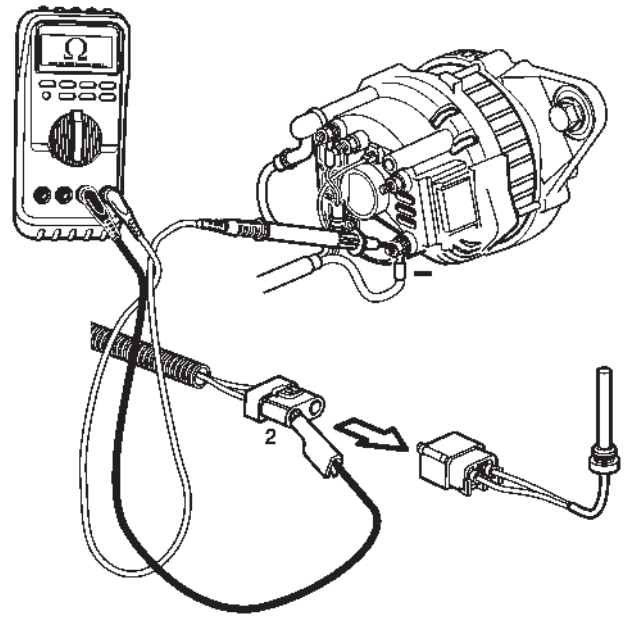
1
Check the coolant level.*

* **NOTE!** The low coolant alarm can be activated if the boat is heeled over to port, although the coolant level would appear to be correct. This is because of the position of the monitor on the right side of the expansion tank, whereas the filler opening is located on the left.

2
Check that no coolant leakage occurs.

3
Check the level sensor cables.

4
Change the level sensor.



Measurements

Special tools: 9812519

Negative cable

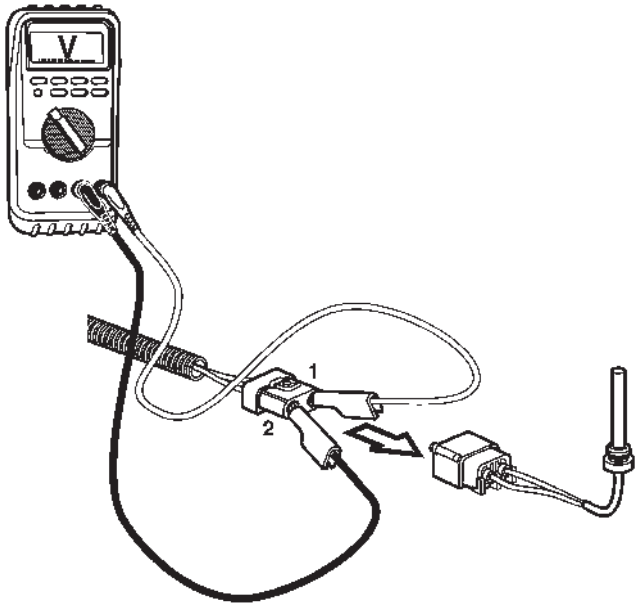
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the monitor.

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Supply cable

1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the monitor.

3
Turn the main switches on. Turn the starter key to **position I** (driving position).

4
Use multimeter 9812519 to measure the resistance against the engine control unit (EDC7).

Measurement points	Nominal value
1 – 2	U ≈ Battery voltage

Checking the coolant monitor

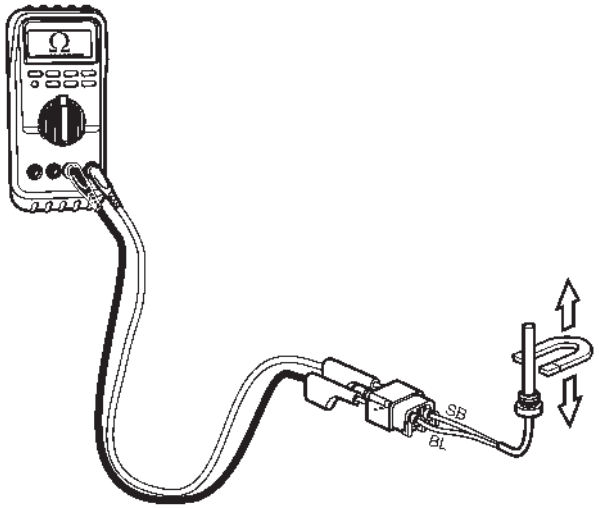
Special tools: 9812519

Note. The coolant level monitor can be removed without having to drain the coolant.

1
Undo the expansion tank and hang it up (without undoing any unions).

⚠ **WARNING!** Hot surfaces and hot coolant in the pipes and hose can cause burns (scalds).

2
Undo the connector and remove the monitor from the expansion tank.



3
Use multimeter 981 2519 to do resistance measurement against the monitor.

Measurement points	Nominal value
Blue – Black	R ≈ ∞ Ω

4
Move a magnet along the monitor and observe the resistance value. The resistance should drop to approx. 0 Ohm.

Measurement points	Nominal value
Blue – Black	R ≈ 0 Ω

Diagnostic Trouble Codes

MID 128, PID 91

Throttle control position

MID 128: Engine control unit

Fault code

FMI 9: Throttle control signal not found on data bus (CAN J1939).

FMI	Fault code explanation
9	Fault in circuit. A fault code is set if the engine control unit (EDC 7) does not receive information about the throttle from the PCU.

Fault indication

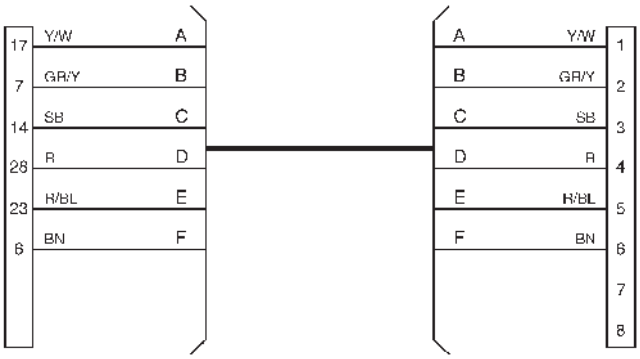
Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display.

Symptom

Engine in “limp-home” mode.

Circuit description



Connector, PCU
Connector X3

Connector
”ENGINE CONN.”

A. CAN H – data link to engine
B. CAN H – data link to engine
C. Negative power supply (–)
D. Positive power supply (+)
E. Ignition signal
F. Not used

Fault tracing

FMI 9: Testing the sensor and circuit

Conditions for fault code

Abnormal updating speed or no updating at all.

Possible reason

- Auto-configuration not done with new SHCU. Fault code occurs together with MID 128, PSID 216, FMI 4.
- CAN H signal between engine control unit (EDC7) and the PCU short circuited to battery voltage. Fault code occurs together with MID 128, SID 231, FMI 9.
- Short circuit between CAN H and the ignition signal in the cables between the engine control unit and the PCU. Fault code occurs together with MID 128, SID 231, FMI 9.
- Open circuit in both CAN L and CAN H between the SHCU and the PCU. The fault occurs when a gear is engaged.
- Faulty throttle control.
- Faulty PCU.
- Faulty SHCU.

Suitable action

1
Do an auto-configuration. Cut the system voltage with the key switch.

2
Check the CAN cables and the connections between the engine control unit (EDC7) and the PCU.

3
Check the throttle control cables and connections.

4
Try using a new throttle control.

5
Check the connections to the PCU.

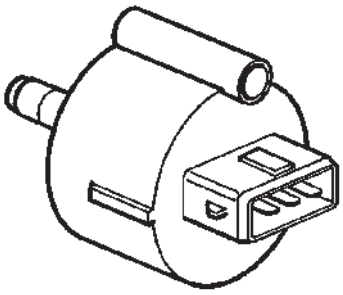
6
Check the connections to the SHCU.

7
Try using a new PCU.

8
Try using a new SHCU.

MID 128, PID 97

Water switch, fuel filter



MID 128: Engine control unit

Fault code

FMI 0: The value is valid but exceeds the normal working range.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Water in fuel
9	Faulty sensor / Faulty sensor circuit

Fault indication

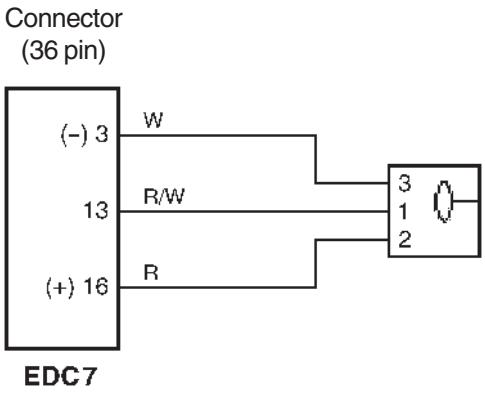
Warning is displayed in the tachometer/display.

FMI 0: Indication for “water in fuel” flashes in the alarm display.

FMI 9: An orange lamp flashes in the alarm display.

Symptom

Engine stops when there is a short circuit in the monitor power supply cables.



Circuit description

The monitor consists of a measurement probe containing two measurement points, galvanically isolated by a layer of insulation. The measurement probe is in contact with the fuel.

When there is no water in the fuel, the resistance between the measurement points is very high. If there is any water in the fuel, the resistance falls.

At a threshold resistance (water has been detected), the monitor (pin 1) will give an output signal which is proportional to the monitor supply voltage.

Pin 16 on the engine control unit (EDC7) provides pin 2 on the monitor with battery voltage. Pin 3 on the monitor is connected to battery negative via pin 3 on the engine control unit.

Fault tracing

FMI 0: Water in fuel

Possible reason

- Water in the fuel filter.
- Short circuited monitor signal cable to battery voltage or 5 Volt voltage.
- Fault in sensor.
- Intermittent contact in the power supply or negative cable to the sensor. The fault code is shown as being inactive.

Suitable action

1
Empty the water tap under the fuel filter or secondary fuel filter.

2
Empty the fuel tank sludge trap.

3
If there is an inactive fault code: Check the monitor power supply and negative cables.

4
Check the monitor.

FMI 9: Checking the monitor

Conditions for fault code

Abnormal updating rate.

Possible reason

- Open circuit in monitor signal cable (engine control unit (EDC7) sets a fault code when the ignition is turned on, not if a fault occurs during operation).
- Open circuit in monitor negative cable (engine control unit sets a fault code when the ignition is turned on, not if a fault occurs during operation).
- Open circuit in monitor power supply cable (engine control unit sets a fault code when the ignition is turned on, not if a fault occurs during operation).
- Open circuit, all cables failed (engine control unit sets a fault code when the ignition is turned on, not if a fault occurs during operation).
- Short circuited monitor signal cable to battery negative.
- Short circuited monitor power supply cable to battery negative.
- Faulty monitor.

Suitable action

1
Check the cables and the connectors between the monitor and the engine control unit (EDC7).

2
Check the monitor.

Measurements

Special tools: 9812519

Negative cable

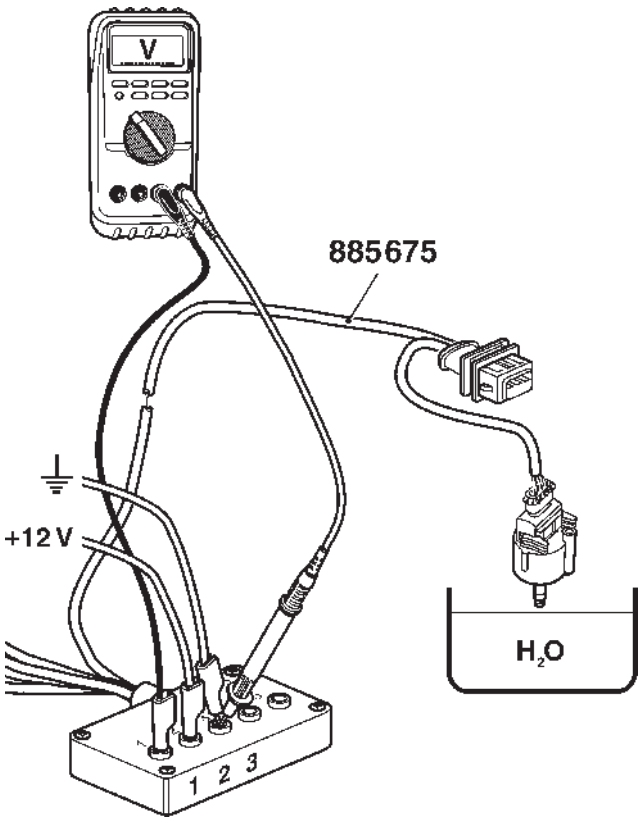
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the monitor.

3
Use multimeter 9812519 to do resistance measurement against the engine control unit (EDC7).

Measurement points	Nominal value
3 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Supply cable

1
Remove the connector from the monitor.

2
Turn the main switches on. Turn the starter key to **position I** (driving position).

3
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
2 – 3	U ≈ Battery voltage

Checking the water monitor, fuel filter

Special tools: 885675, 9812519

1
Undo the connector and remove the water sensor from the secondary fuel filter.

2
Connect the monitor to adapter cable 885675.

3
Connect a +12 V alt. +24 V power supply to measurement connection 2 on the adapter cable. Connect measurement connection 3 to the power supply battery negative terminal.

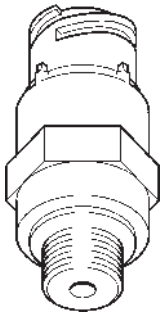
4
Use multimeter 9812519 to measure the voltage between measurement connection 1 and measurement connection 3 on the adapter cable.

5
The multimeter should indicate 0 Volt when the monitor is not in contact with water.

6
Lower the monitor into a vessel containing water. The multimeter should indicate 12 alt. 24 Volt.

MID 128, PID 100

Oil pressure sensor (engine)



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 1: The sensor value is valid but is less than the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 5: The current is less than the normal value or is open circuited.

FMI 6: The current is greater than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Too high lube oil pressure
1	Too low lube oil pressure
3, 4, 5, 6, 9	Faulty sensor / Faulty sensor circuit

Fault indication

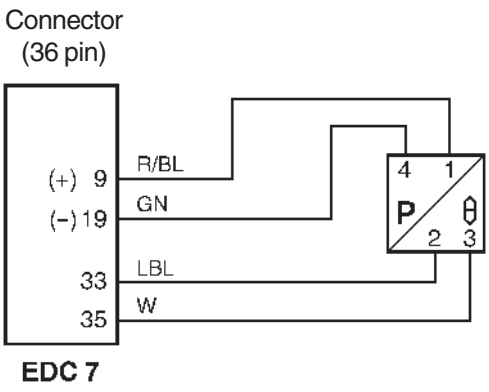
Warning is displayed in the tachometer/display.

FMI 1: Oil pressure indication in alarm display shows red. Audible warning.

FMI 0, 3, 4, 5, 6, 9: A red lamp flashes in the alarm display.

Symptom

Engine power is limited.



Circuit description

Sensor is an active sensor, i.e. the sensor must have operating voltage.

Pin 9 on the engine control unit (EDC7) provides pin 1 on the sensor with an operating voltage of +5 Volt. Pin 4 on the monitor is connected to battery negative via pin 19 on the control unit.

The output signal from the pressure sensor (pin 2 on sensor to pin 33 on the control unit) is a voltage signal which is proportional to the oil pressure (**after** the oil filters).

Fault tracing

FMI 0: Too high lube oil pressure

Conditions for fault code

Oil pressure exceeds 600 kPa (6,0 bar).

Possible reason

- Lube oil contaminated or far too thick (high viscosity).
- Fault in reduction valve or pressure relief valve.
- Fault in sensor.

Suitable action

1
Check the oil level in the engine.

2
Check that the oil filters are not blocked. Change oil filters.

3
Check that no leakage occurs.

4
Check the sensor by checking the engine oil pressure. Please, refer to “Lubrication system, Workshop manual”.

FMI 1: Too low lube oil pressure

Conditions for fault code

Oil pressure is less than 50–250 kPa (0.5–2.5 bar) at engine speeds up to 4,000 rpm.

Possible reason

- Too low lube oil level.
- Oil contaminated, viscous or too thin.
- Fault in bypass valves.
- Worn oil pump.
- Blocked oil suction pipe.
- Blocked oil filter.

Suitable action

1
Check the oil level in the engine.

2
Check that the oil filters are not blocked. Change oil filter.

3
Check that no leakage occurs. Please, refer to Workshop manual.

4
Check the sensor by checking the engine oil pressure. See “Lubrication system, Workshop manual”.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 33 on engine control unit (EDC7) exceeds 4.95 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or 5 V voltage.
- Open circuit in sensor signal cable.
- Open circuit in sensor negative cable.
- Open circuit, all cables missing.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 33 on engine control unit (EDC7) is less than 0.37 Volt.

Possible reason

- Open circuit in 5 V sensor supply cable.
- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 5: Abnormally low current or open circuit has been detected.

Conditions for fault code

Voltage on pin 10 on engine control unit (EDC7) exceeds 5.05 Volt.

Possible reason

- Short circuited sensor supply cable to battery voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 6: The current is greater than the normal value or is short circuited to battery negative

Conditions for fault code

Voltage on pin 10 on engine control unit (EDC7) is less than 4.50 Volt.

Possible reason

- Short circuited 5 V sensor supply cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9

Conditions for fault code

Abnormal updating rate.

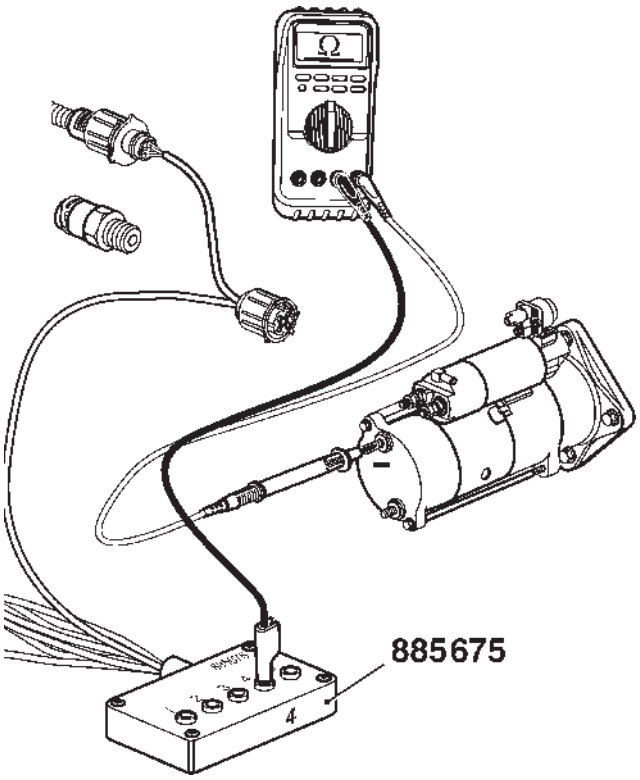
Possible reason

- Fault in sensor.
- AD conversion failed (fault in engine control unit, EDC7).

Suitable action

1
Check sensor.

2
Change engine control unit (EDC7).



Measurements

Special tools: 9812519, 885675

Negative cable

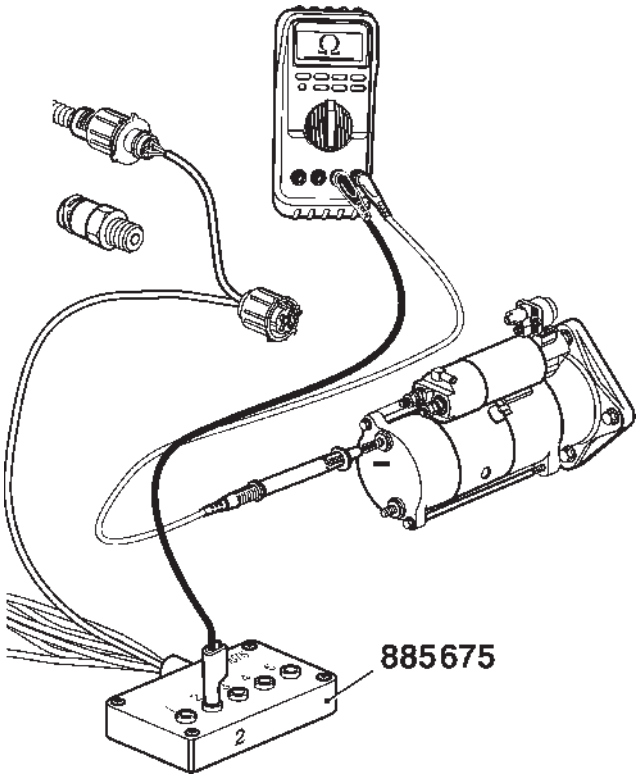
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
4 – Battery negative*	R ≈ 0 Ω

* **Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

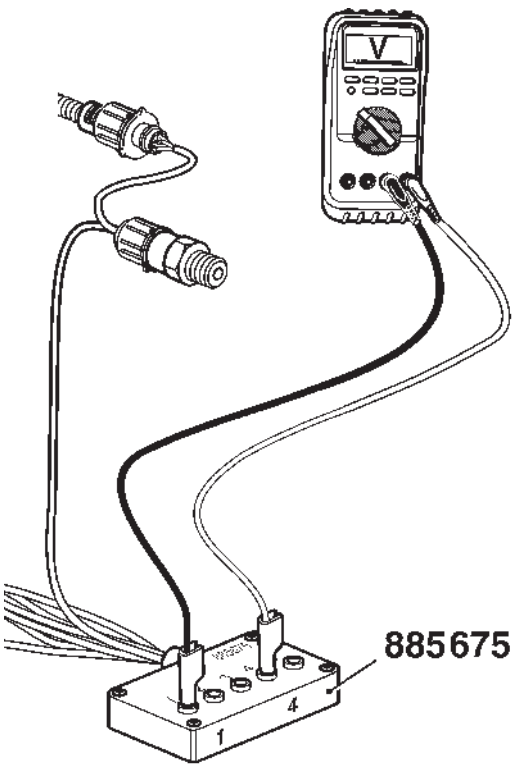
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 500–900 kΩ

* **Note.** Battery negative (–) on alternator or starter motor.



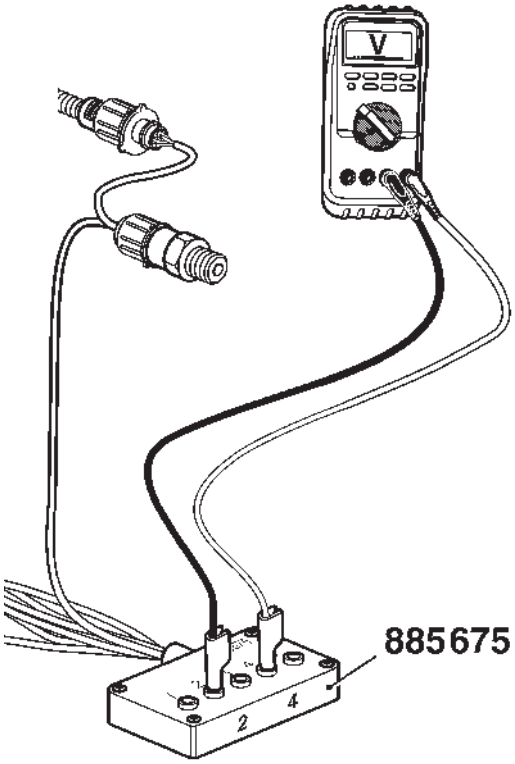
Supply cable

1
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC7).

2
Turn the main switches on. Turn the starter key to **position I** (driving position).

3
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 4	U ≈ 5 V



Checking the oil pressure sensor*

* **Note.** Combined sensor, oil pressure and oil temperature (engine).

Special tools: 9812519, 885675

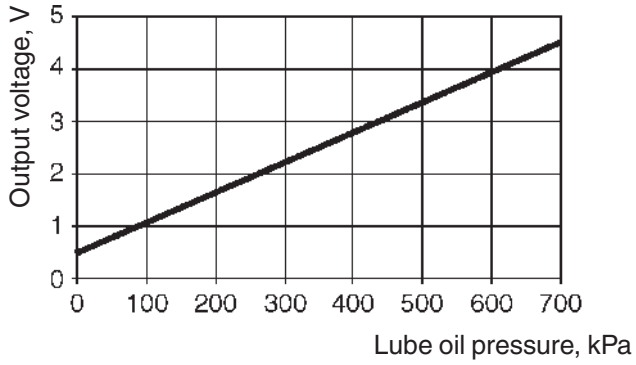
1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC7).

3
Turn the starter key to **position I** (driving position).

4
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
2 – 4	U ≈ 0,5 V*



Component specification

Working range ..... 0–700 kPa (0–7 bar)

Supply voltage ..... 5,00 ±0,25 V DC

Nominal output voltage at 25°C and power supply voltage 5.00 V DC:

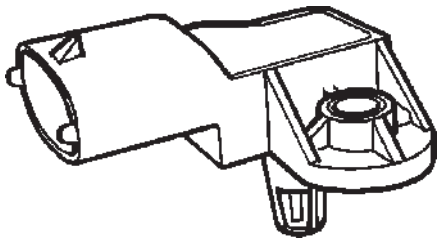
0,5 V DC at ..... 0 kPa (0 bar)*

4,5 V DC at .....700 kPa (7 bar)*

* **Note.** At normal atmospheric pressure.

MID 128, PID 105

Boost air temperature sensor



MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
3, 4, 9	Faulty sensor / Faulty sensor circuit

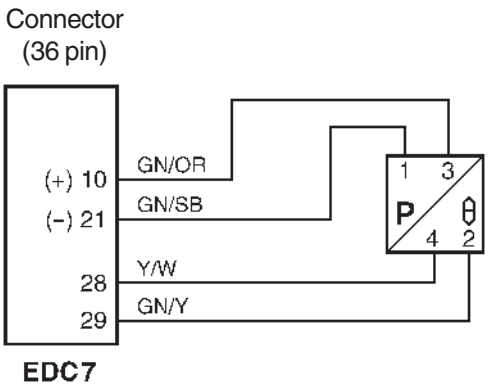
Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

Symptom

None.



Circuit description

The boost air temperature sensor consists of a thermistor. The thermistor resistor changes in a non-linear manner, depending on the boost air temperature.

When the air entering the engine is cold, the thermistor resistance is high. When the air warms up, the thermistor resistance falls.

Pin 3 on the sensor is supplied with power (+5 V) from pin 10 on engine control unit (EDC7). Pin 1 on the sensor is connected to battery negative via pin 21 on the control unit.

The voltage drop across the thermistor changes as the boost air temperature changes. The voltage drop is detected via pin 29 on the control unit.

Please refer to the table, “resistance/temperature, Checking the boost air temperature sensor”.

Fault tracing

Excesive boost air temperature*

*** Note.** Above about 60°C (140°F).

Suitable action

1
Check the intercooler.

2
Check the sea water filter.

3
Check the coolant level.

4
Check the thermostat.

5
Check seawater pump/impeller.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 29 on engine control unit (EDC7) exceeds 4.80 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or 5 V voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 29 on engine control unit (EDC7) is less than 0.30 Volt.

Possible reason

- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9: Abnormal updating rate

Conditions for fault code

Voltage on pin 29 on engine control unit (EDC7) exceeds 4.74 Volt.

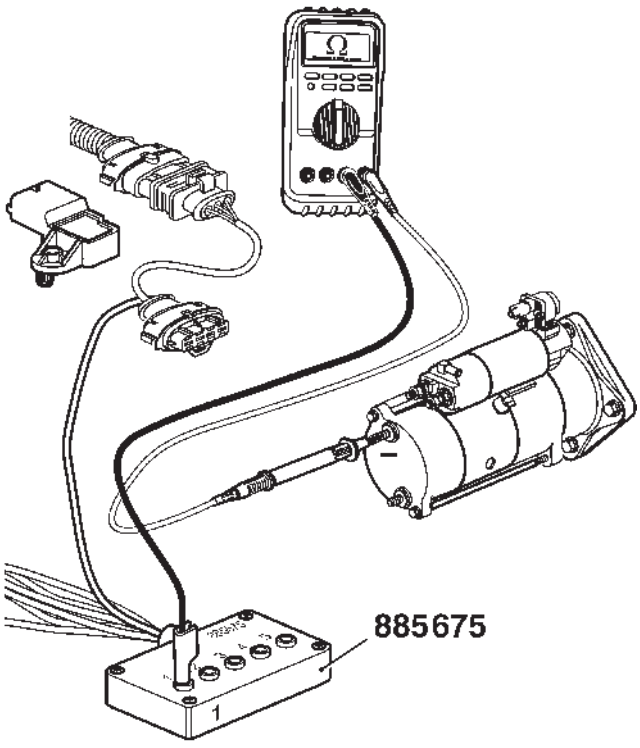
Possible reason

- Open circuit in sensor signal cable.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.



Measurements

Special tools: 9812519, 885675

Negative cable

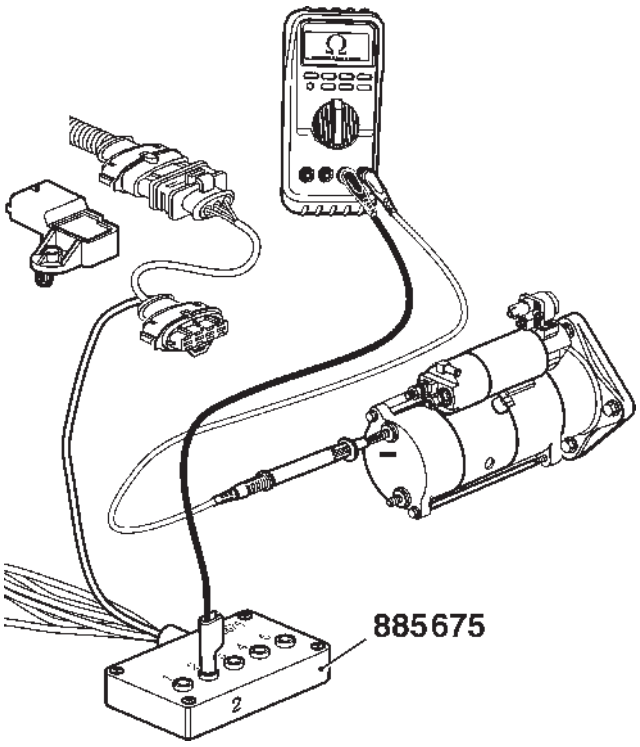
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

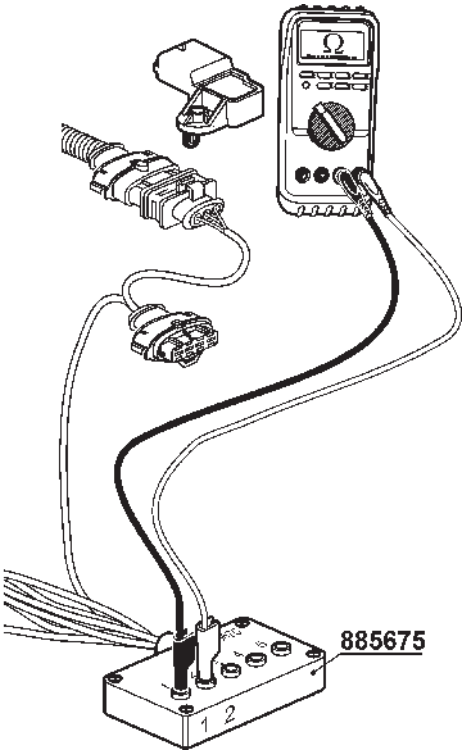
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 1,1–1.5 kΩ

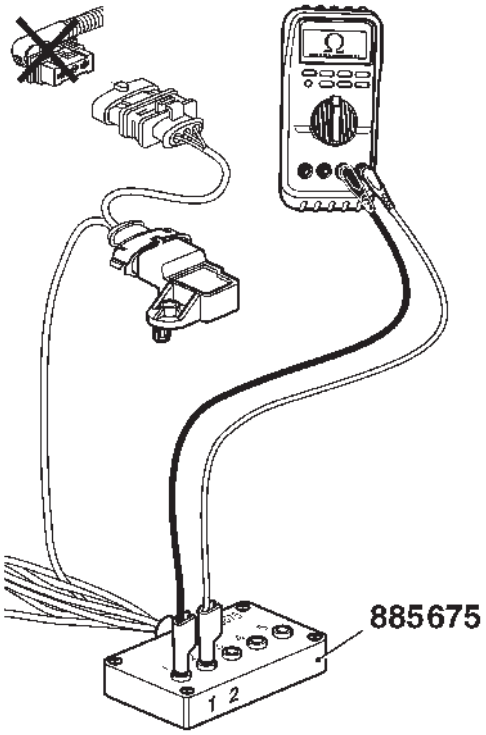
* **Note.** Battery negative (–) on alternator or starter motor.

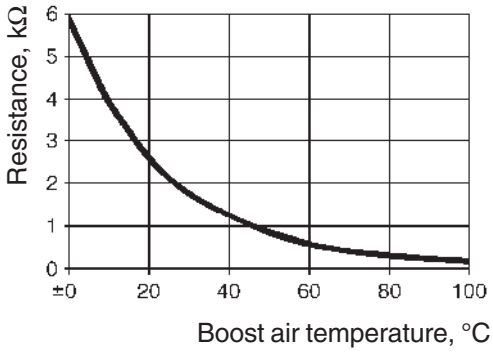


4
Turn the main switches on. Turn the starter key to **position I** (driving position).

5
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 2	U ≈ 5 V





Checking the boost air temperaturesensor*

* Combined sensor, boost pressure and boost temperature.

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to sensor*.

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

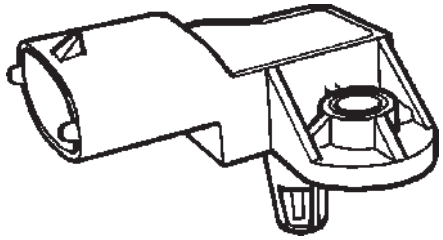
3
Use multimeter 9812519 to measure the resistance of the sensor.

Measurement points: 1 – 2
Nominal values at:

0°C (32°F) ..... R ≈ 5890 Ω ±280 Ω
20°C (68°F) ..... R ≈ 2510 Ω ±110 Ω
40°C (104°F) ..... R ≈ 1200 Ω ±46 Ω
60°C (140°F) ..... R ≈ 610 Ω ±22 Ω
80°C (176°F) ..... R ≈ 330 Ω ±11 Ω
100°C (212°F) ..... R ≈ 186 Ω ±5 Ω

MID 128, PID 106

Boost air pressure sensor



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 5: The current is less than the normal value or is open circuited.

FMI 6: The current is greater than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Too high boost air pressure
3, 4, 5, 6, 9	Faulty sensor / Faulty sensor circuit

Fault indication

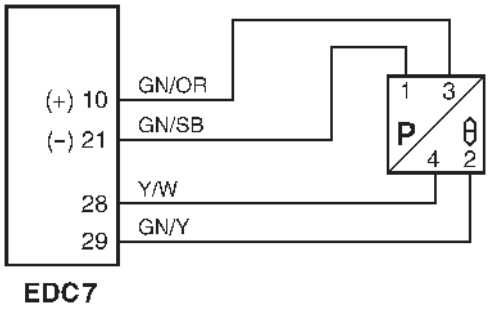
FMI 0 None.

FMI 3, 4, 5, 6, 9
Warning is displayed in the tachometer/ display.
An orange lamp flashes in the alarm display.

Symptom

None.

Connector (36 pin)



Circuit description

Sensor is an active sensor, i.e. the sensor must have operating voltage.

Operating voltage (+5 Volt) is taken from pin 10 on the enginecontrol unit (EDC7) and battery negative from pin 21.

The output signal from the pressure sensor (pin 4 on sensor to pin 28 on the control unit) is a voltage signal which is proportional to the absolute pressure.

Fault tracing

FMI 0: Too high boost air pressure

Conditions for fault code

Boost air pressure exceeds 350 kPa (3.5 bar).

Possible reason

- Wrong turbocharger / supercharger installed.
- Fault in sensor.
- The magnetic coupling does not disengage the supercharger.

Suitable action

1
Check that the correct type of turbocharger is fitted to the engine.

2
Check the sensor by checking the boost air pressure with a manometer.

3

Check that the magnetic coupling disengages the supercharger at engine speeds above:

D6-310D-B, D6-370D-B ..... app. 2200 rpm.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 28 on engine control unit (EDC7) exceeds 4.90 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or 5 V voltage.
- Open circuit in sensor signal cable.
- Open circuit in sensor battery negative cable.
- Open circuit, all cables missing.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 28 on engine control unit (EDC7) is less than 0.20 Volt.

Possible reason

- Open circuit in sensor 5 V supply cable.
- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 5: Abnormally low current or open circuit has been detected.

Conditions for fault code

Voltage on pin 10 on engine control unit (EDC7) exceeds 5.20 Volt.

Possible reason

- Short circuited sensor 5V supply cable to battery voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 6: The current is greater than the normal value or is short circuited to battery negative

Conditions for fault code

Voltage on pin 10 on engine control unit (EDC7) is less than 4.50 Volt.

Possible reason

- Short circuited sensor 5V supply cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9: Abnormal updating rate

Conditions for fault code

Abnormal updating rate.

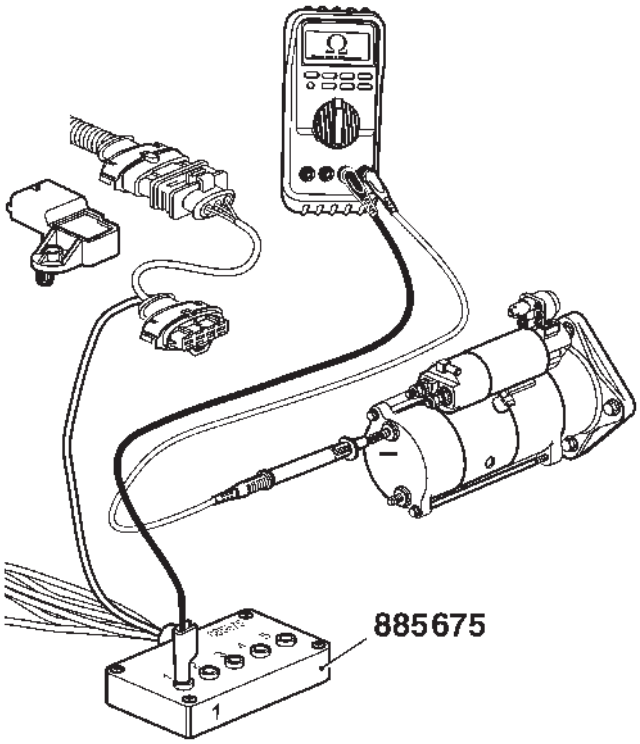
Possible reason:

- Fault in sensor.
- AD conversion failed (fault in engine control unit, EDC7).

Suitable action

1
Check sensor.

2
Change engine control unit (EDC7).



Measurements

Special tools: 9812519, 885675

Negative cable

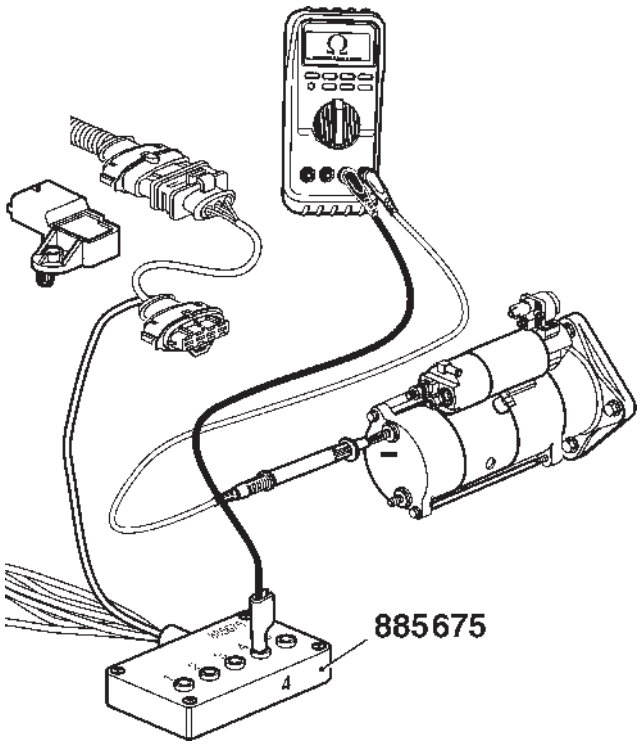
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

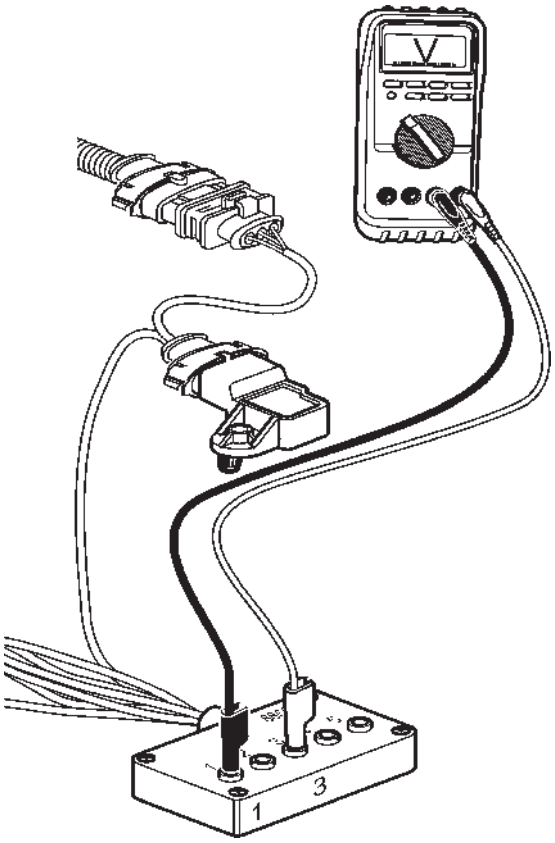
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
4 – Battery negative*	R ≈ 500–900 kΩ**

*** Note.** Battery negative (–) on alternator or starter motor.



Supply cable

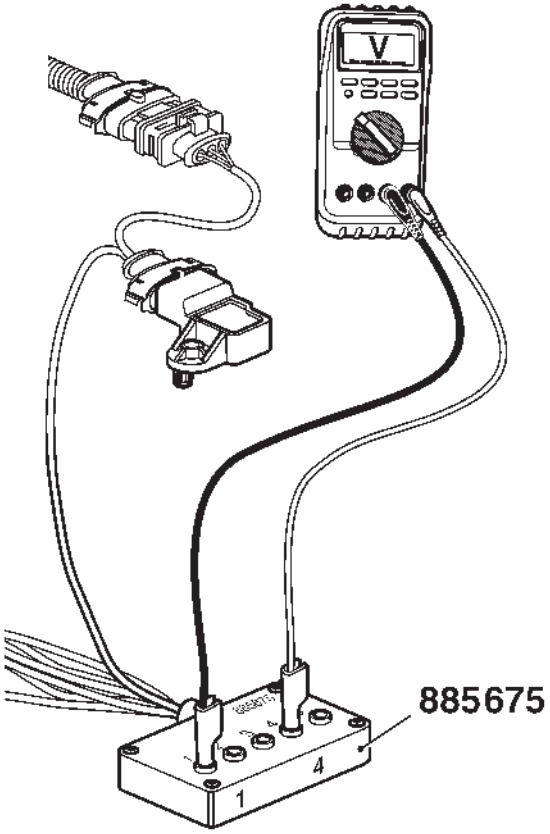
1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC7).

3
Turn the main switches on. Turn the starter key to **position I** (driving position).

4
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 3	U ≈ 5 V



Checking the boost air pressure sensor*

* Combined sensor, boost pressure and boost temperature.

Special tools: 9812519, 885675

1
NOTE! Turn the starter key to **position 0**.

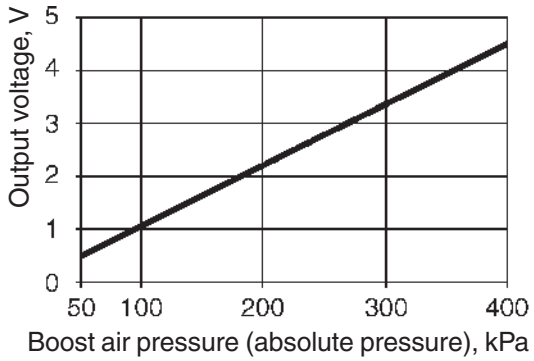
2
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC7).

3
Turn the starter key to **position I**.

4
Use multimeter 9812519 to do voltage measurement against the engine control unit.

Measurement points	Nominal value
1 – 4	U ≈ 1,1 V*

*** Note.** At normal atmospheric pressure.



Component specification

Working range .....50–400 kPa (0.5–4.0 bar)

Supply voltage ..... 5,00 ±0,25 V DC

Nominal output voltage at 25°C and supply voltage 5.00 V DC:

0,5 V DC at ..... 50 kPa (0.5 bar)

4,5 V DC at ..... 400 kPa (4 bar)

MID 128, PID 108

Atmospheric pressure sensor

MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Too high atmospheric pressure
3, 4, 9	Faulty sensor / Faulty sensor circuit

Fault indication

FMI 0: None.

FMI 3, 4, 9: Warning is displayed in the tachometer/ display.
The turbo pressure gauge shows 1 atmosphere too much.

Symptom

None.

Circuit description

The sensor is installed inside the engine control unit (EDC7).

Fault tracing

FMI 0: Too high atmospheric pressure

Possible reason

- The engine control unit (EDC7) has been exposed to extreme pressure.
- Fault in engine control unit.

Suitable action

Change engine control unit.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Internal voltage in engine control unit (EDC7) exceeds 4.80 Volt.

Possible reason

- Engine control unit has been exposed to extreme pressure.
- Fault in engine control unit.

Suitable action

Change engine control unit.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Internal voltage in engine control unit (EDC7) is less than 0.20 Volt.

Possible reason

- Engine control unit has been exposed to extreme pressure.
- Fault in engine control unit.

Suitable action

Change engine control unit.

FMI 9: Abnormal updating rate

Conditions for fault code

Internal voltage in engine control unit (EDC7) exceeds 4.60 Volt.

Possible reason

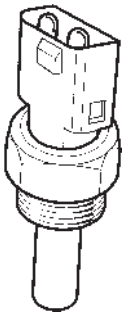
- Engine control unit has been exposed to extreme pressure.
- Fault in engine control unit.

Suitable action

Change engine control unit.

MID 128, PID 110

Coolant temperature sensor



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Excessive coolant temperature
3, 4, 9	Faulty sensor / Faulty sensor circuit

Fault indication

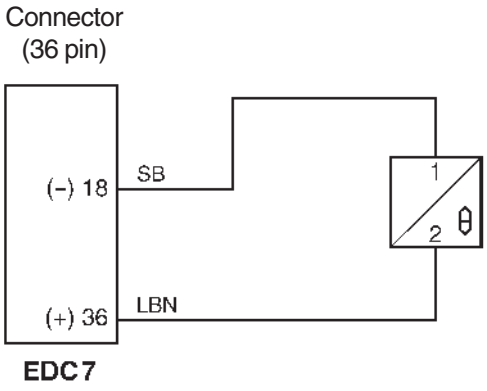
Warning is displayed in the tachometer/display.

FMI 0: High coolant temperature indication flashes red on the alarm display. Audible warning.

FMI 3, 4, 9: An orange lamp flashes in the alarm display.

Symptom

FMI 0: Engine power is cut.



Circuit description

The coolant temperature sensor consists of a thermistor which forms a closed circuit with the engine control unit (EDC7). The thermistor resistor changes in a non-linear manner, depending on the coolant temperature. The control unit (pin 36) provides the sensor (pin 1) with a reference voltage of +5 Volt. Pin 2 on the sensor is connected to battery negative via (pin 18) on the engine control unit.

When the coolant is cold, the thermistor resistance is high and the control unit senses a voltage close to the reference level. As the coolant warms up, the resistance in the thermistor falls and the voltage drop across it falls.

Please refer to the table, “resistance/temperature” in this fault code chapter.

Fault tracing

FMI 0: Excessive coolant temperature

Conditions for fault code

Coolant temperature exceeds 98 °C.

Possible reason

- Low coolant level.
- Blocked sea water filter.
- Worn impeller in seawater pump.
- Crushed/leaking/blocked hose on the suction side (sea water).
- Faulty thermostat.
- Blocked heat exchanger.
- Poor flow through the cooling system.
- Worn coolant pump.
- Incorrect pressure cap on expansion tank.
- Faulty coolant temperature sensor.

Suitable action

1
Check the coolant level.

2
Check that the sea water filter is not blocked.

3
Check the impeller in the sea water pump.

4
Check the thermostat.

5
Check that the cooling system does not leak.

6
Check the coolant temperature sensor.

7
Clean the heat exchanger in the cooling system.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 36 on control unit (EDC7) exceeds 4.80 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or 5 V voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 36 on engine control unit (EDC7) is less than 0.25 Volt.

Possible reason

- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9: Abnormal updating rate

Conditions for fault code

Voltage on pin 36 on engine control unit (EDC7) exceeds 4.74 Volt.

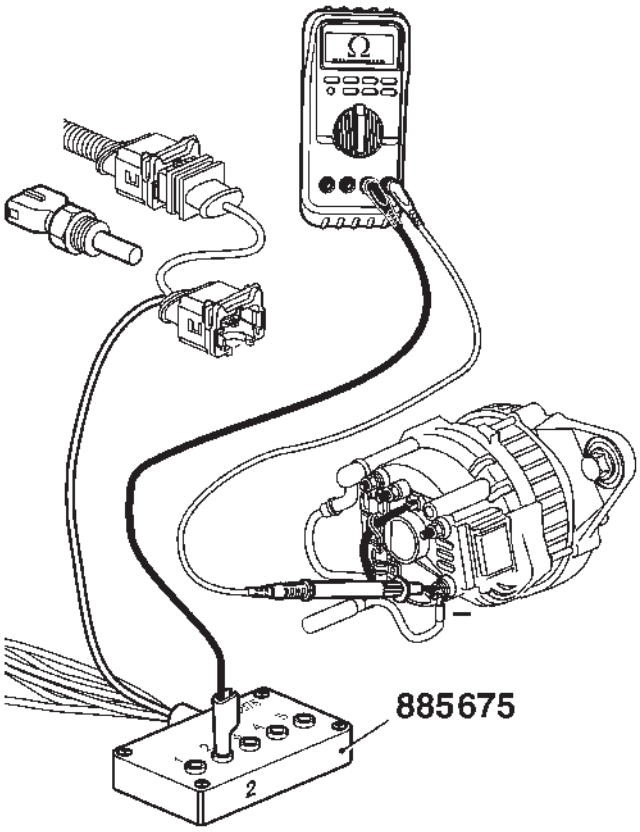
Possible reason

- Open circuit in sensor signal cable.
- Open circuit in sensor battery negative cable.
- Fault in sensor.

Suitable action

1
Check cables and the connectors between the sensor and control unit.

2
Check sensor.



Measurements

Special tools: 9812519, 885675

Negative cable

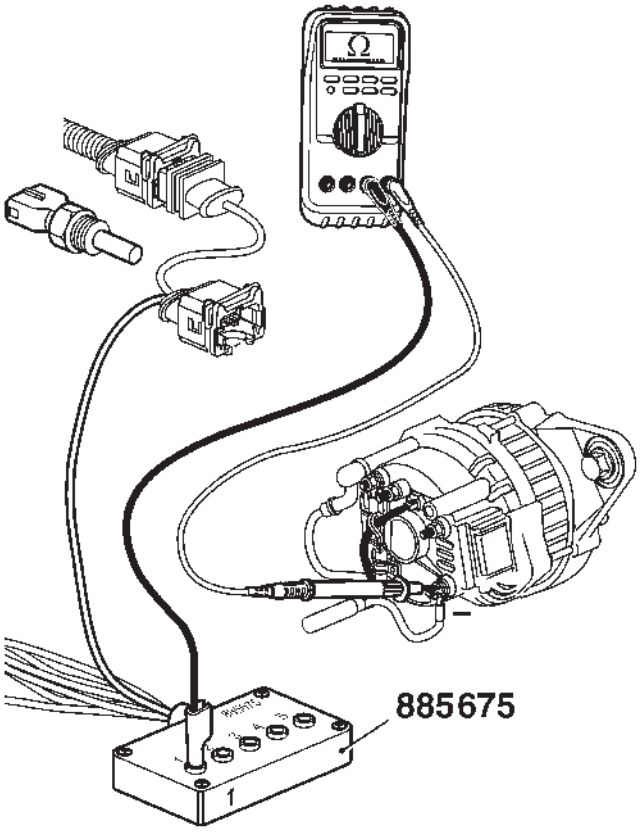
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1

NOTE! Cut the current with the main switch.

2

Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

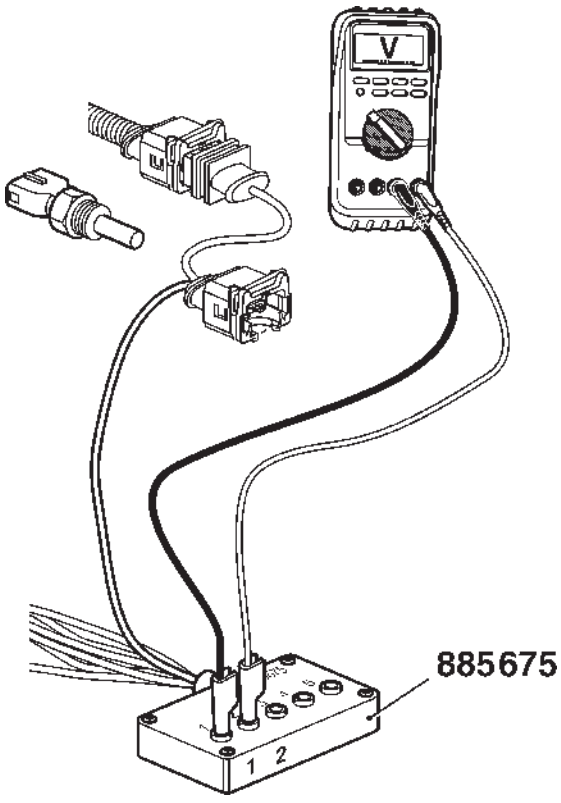
3

Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 1.1–1.5 kΩ

*** Note.** Battery negative (–) on alternator or starter motor.



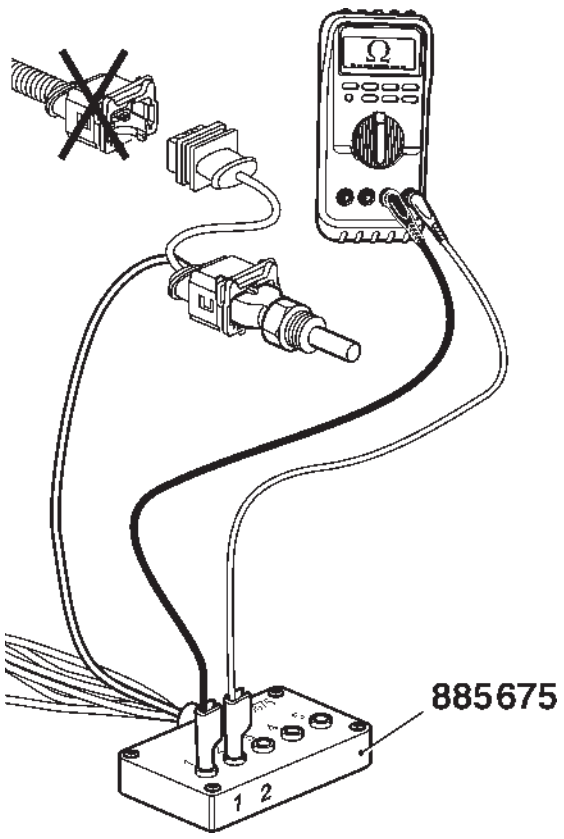
4

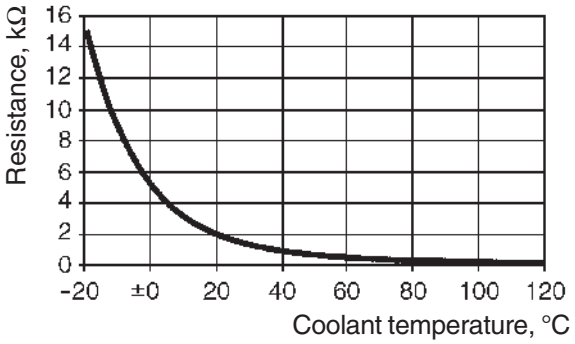
Turn the main switches on. Turn the starter key to **position I** (driving position).

5

Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 2	U ≈ 5 V





Checking the coolant temperature sensor

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to sensor*.

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

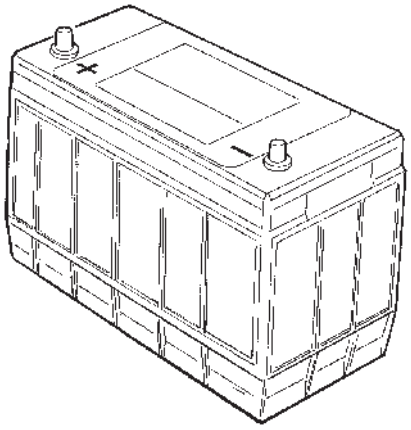
3
Use multimeter 9812519 to measure the resistance of the sensor.

Measurement points: 1 – 2
Nominal values at:

0°C (32°F)	R ≈ 4930 Ω ±440 Ω
20°C (68°F)	R ≈ 1870 Ω ±140 Ω
40°C (104°F)	R ≈ 800 Ω ±50 Ω
60°C (140°F)	R ≈ 375 Ω ±20 Ω
80°C (176°F)	R ≈ 190 Ω ±8 Ω
100°C (212°F)	R ≈ 104 Ω ±4 Ω

MID 128, PID 158

Battery voltage



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 1: The sensor value is valid but is less than the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Voltage converter fault.

FMI	Fault code explanation
0, 1, 3, 4, 9	Fault in circuit

Fault indication

Warning is displayed in the tachometer/display.

FMI 1: Battery indication (orange lamp) flashes in the alarm display.

FMI 0, 3, 4, 9: None.

Symptom

None.

Fault tracing

FMI 0: Exceeds normal working range

Conditions for fault code

Battery voltage exceeds 16.0* Volt alt. 32.0** Volt.

* Engines with 12 V system voltage
**Engines with 24 V system voltage

Possible reason

- Fault in batteries, cables or connectors.
- Faulty alternator.

Suitable action

1
Check battery cables.

2
Check alternator and drive belt.

FMI 1: Less than normal working range

Conditions for fault code

Battery voltage less than 10.0* Volt alt. 16.0 Volt**.

* Engines with 12 V system voltage
**Engines with 24 V system voltage

Possible reason

- Alternator belt.
- Flat / poor batteries.
- Fault in cables or connectors for batteries / alternator.
- Faulty alternator.
- Fault in DC/DC converter (12 V system voltage)

Suitable action

1
Check battery cables.

2
Check alternator and drive belt.

3
Check / charge the batteries.

4
Check the DC/DC converter (12 V system voltage). Measure the input and output voltages (please refer to the wiring schedule).

FMI 3: An abnormally high voltage has been detected

Conditions for fault code

Battery voltage exceeds 19.0* Volt alt. 38.0** Volt.

* Engines with 12 V system voltage
**Engines with 24 V system voltage

Possible reason

- Fault in batteries, cables or connectors.
- Faulty alternator.

Suitable action

1
Check battery cables.

2
Check alternator and drive belt.

FMI 4: An abnormally low voltage has been detected.

Conditions for fault code

Battery voltage less than 6.0* Volt alt. 12.0** Volt.

* Engines with 12 V system voltage
**Engines with 24 V system voltage

Possible reason

- Alternator belt.
- Fault in batteries, cables or connectors.
- Faulty alternator.
- Fault in DC/DC converter.

Suitable action

1
Check battery cables.

2
Check alternator and drive belt.

3
Check the DC/DC converter. Measure the input and output voltages (please refer to the wiring schedule).

FMI 9: Voltage converter fault

Conditions for fault code

Abnormal updating rate.

Possible reason

- AD conversion failed (fault in engine control unit, EDC7).
- Faulty alternator.
- Fault in engine control unit (EDC7).

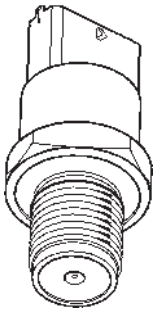
Suitable action

1
Check alternator and drive belt.

2
Change engine control unit (EDC7).

MID 128, PID 164

Fuel pressure



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 5: The current is less than the normal value or is open circuited.

FMI 6: The current is greater than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Too high fuel pressure
3, 4, 5, 6, 9	Faulty sensor / Faulty sensor circuit

Fault indication

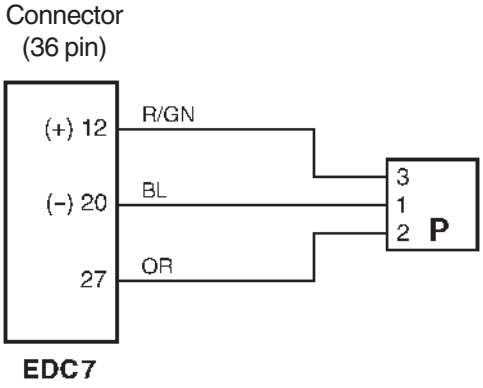
Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

FMI 0 Engine power is cut. Engine is shut off.

FMI 3, 4, 5, 6 , 9 Engine power is cut.



Circuit description

The fuel pressure sensor is an active sensor, i.e. the sensor must have operating voltage.

Pin 12 on the engine control unit (EDC7) provides pin 3 on the sensor with a voltage of +5 Volt. Pin 1 on the sensor is connected via pin 20 on the engine control unit to battery negative.

The output signal from the pressure sensor (pin 2 on sensor to pin 27 on the control unit) is a voltage signal which is proportional to the fuel pressure.

Fault tracing

FMI 0: Too high fuel pressure

Possible reason

- Low fuel level.
- Blocked fuel filter.
- Fault in fuel pump proportional valve (MPROP).
- Fault in pressure limiting valve.
- Fault in sensor.
- Faulty injectors, leakage in combustion chamber or injector does not open.
- Air in the fuel system. Leakage before the fuel pump.

Suitable action

1
Check the fuel level. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel-pressure.

2
Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

3
Check the MPROP cables and connectors.

4
Check the sensor by testing the negative pressure in the fuel pipes / fuel filter. Please refer to the Workshop manual (engine), group 23.

5
Change the pressure relief valve.

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 27 on engine control unit (EDC7) exceeds 4.99 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or
  5 V system voltage.
- Open circuit in sensor battery negative cable.
- Open circuit in signal cable.
- Open circuit, all cables missing.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 27 on engine control unit (EDC7) is less than 0.35 Volt.

Possible reason

- Open circuit in sensor 5 V supply cable.
- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 5: Abnormally low current or open circuit has been detected.

Conditions for fault code

Voltage on pin 12 on engine control unit (EDC7) exceeds 5.20 Volt.

Possible reason

- Short circuited sensor 5V supply cable to battery voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 6: The current is greater than the normal value or is short circuited to battery negative

Conditions for fault code

Voltage on pin 12 on engine control unit (EDC7) is less than 4.50 Volt.

Possible reason

- Short circuited sensor 5V supply cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9

Conditions for fault code

Abnormal updating rate.

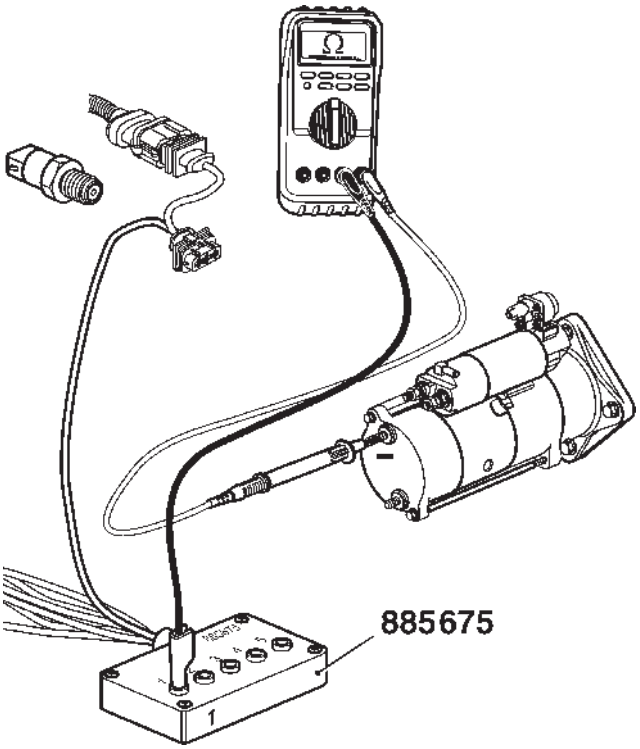
Possible reason

- Fault in sensor.
- AD conversion failed (fault in engine control unit, EDC7).

Suitable action

1
Check sensor.

2
Change engine control unit.



Measurements

Special tools: 9812519, 885675

Negative cable

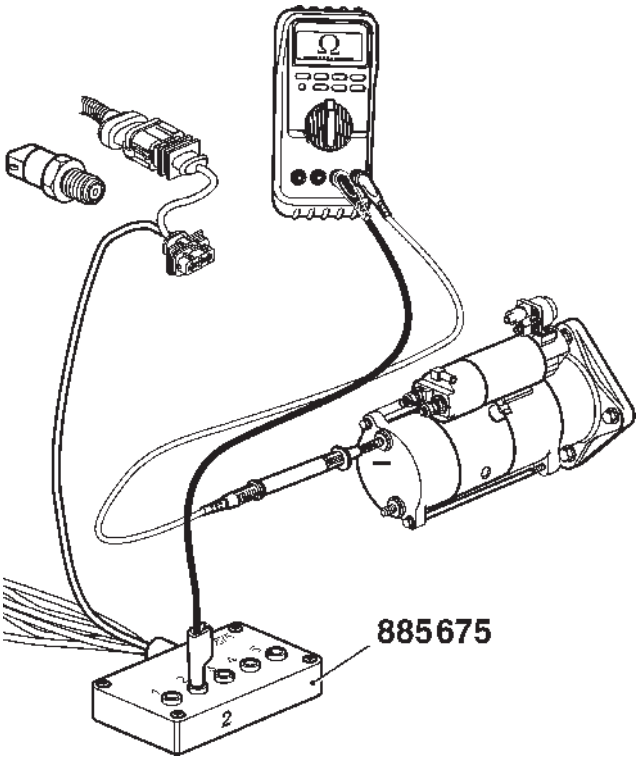
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

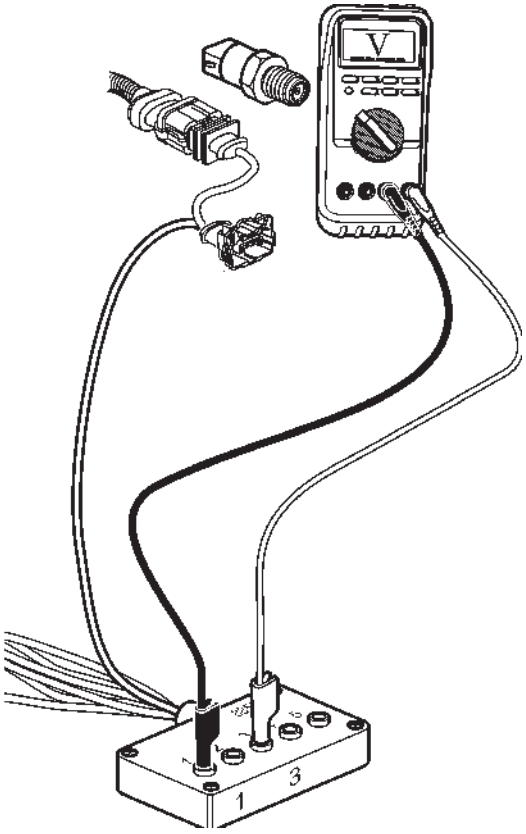
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 3,8–5.6 kΩ

*** Note.** Battery negative (–) on alternator or starter motor.



Supply cable

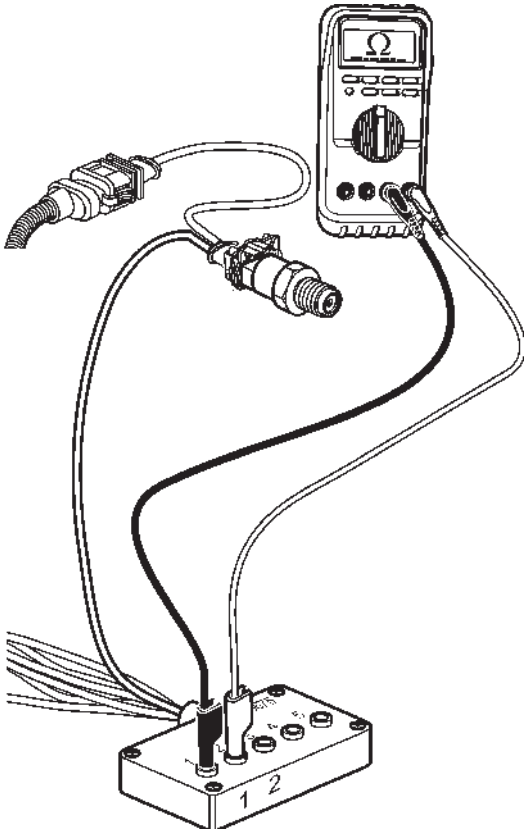
1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC7).

3
Turn the main switches on. Turn the starter key to **position I** (driving position).

4
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 3	U ≈ 5 V



Checking the fuel pressure sensor

Special tools: Multimeter 9812519

1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the sensor. Connect adapter cable 885675 between sensor and engine control unit (EDC).

3
Turn the starter key to **position I** (driving position).

4
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 2	U ≈ 0.5 V*

*** Note.** At normal atmospheric pressure.

Component specification

Working range ..... 0–180 MPa (0–1800 bar)

Supply voltage ..... 5,00 ±0,25 V DC

Nominal output voltage at 25°C and supply voltage 5.00 V DC:

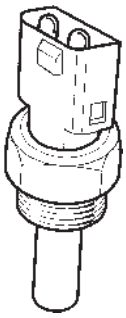
0,5 V DC at ..... 0 kPa (0 bar)*

4.5 V DC at ..... 180 MPa (1800 bar)*

*** Note.** At normal atmospheric pressure.

MID 128, PID 174

Fuel temperature sensor



MID 128: Engine control unit

Fault code

FMI 0: The sensor value is valid but exceeds the normal working range.

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
0	Excessive fuel temperature
3, 4, 9	Faulty sensor / Faulty sensor circuit

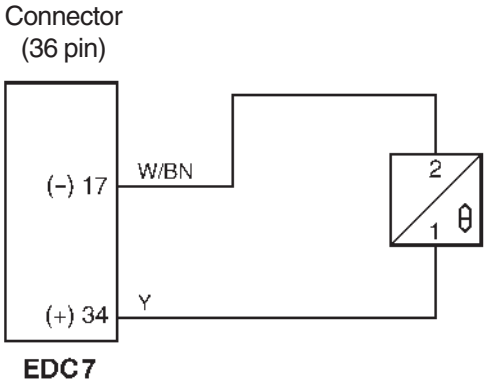
Fault indication

Warning is displayed in the tachometer/display.

Warning symbol in alarm display flashes red + audible warning.

Symptom

FMI 0: Engine power is cut.



Circuit description

The fuel temperature sensor consists of a thermistor which forms a closed circuit with the engine control unit (EDC7). The thermistor resistor changes in a non-linear manner, depending on the fuel temperature.

The control unit (pin 34) provides the sensor (pin 1) with a reference voltage of +5 Volt. Pin 2 on the sensor is connected to battery negative via (pin 17) on the engine control unit.

When the fuel is cold, the thermistor resistance is high and the control unit senses a voltage close to the reference level. As the fuel warms up, the resistance in the thermistor falls and the voltage drop across it falls.

Please refer to the table, “Resistance/Fuel temperature, Checking the fuel temperature sensor ”.

Fault tracing

FMI 0: Excessive fuel temperature

Conditions for fault code

Fuel temperature exceeds 60°C.

Possible reason

- Low fuel level in tank.
- Blocked fuel cooler.
- Excessive heat transfer to fuel tank, sensor or fuel pipe.
- Blocked sea water filter.
- Worn impeller in seawater pump.
- crushed/leaking/blocked sea water hose on suction side.
- Fault in sensor.

Suitable action

1
Check the fuel level/fill the tank up with fuel.

Note. High temperature caused by fast return flow of fuel to the tank is reduced if there is a lot of fuel in the tank.

2
Check the installation of the fuel tank and fuel pipes.

3
Check the sensor by checking the fuel temperature.

4
Change the fuel filters (primary filter and secondary filter).

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Voltage on pin 34 on engine control unit (EDC7) exceeds 4.80 Volt.

Possible reason

- Short circuited sensor signal cable to battery voltage or 5 V voltage.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Voltage on pin 34 on engine control unit (EDC7) is less than 0.25 Volt.

Possible reason

- Short circuited sensor signal cable to battery negative.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.

FMI 9: Abnormal updating rate

Conditions for fault code

Voltage on pin 34 on engine control unit (EDC7) exceeds 4.74 Volt.

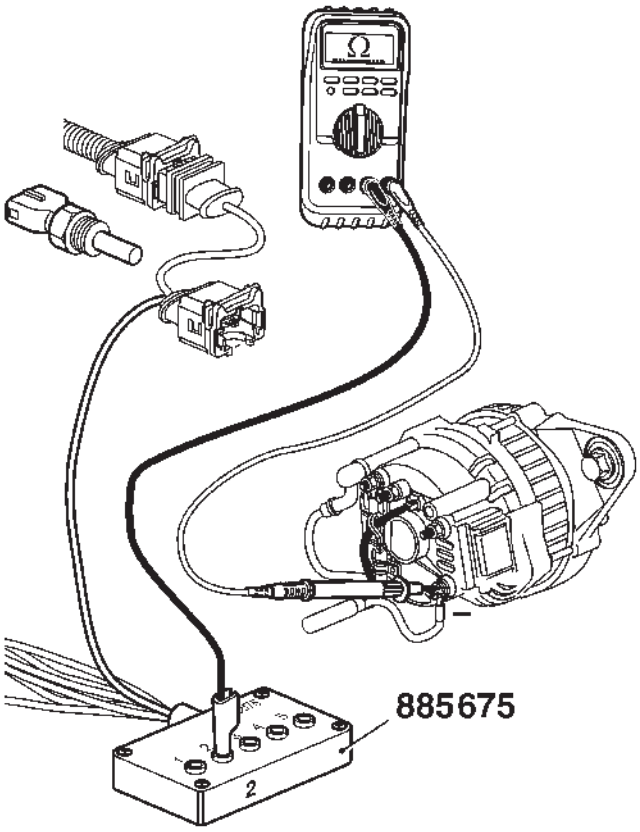
Possible reason

- Open circuit in sensor signal cable.
- Open circuit in sensor battery negativecable.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check sensor.



Measurements

Special tools: 9812519, 885675

Negative cable

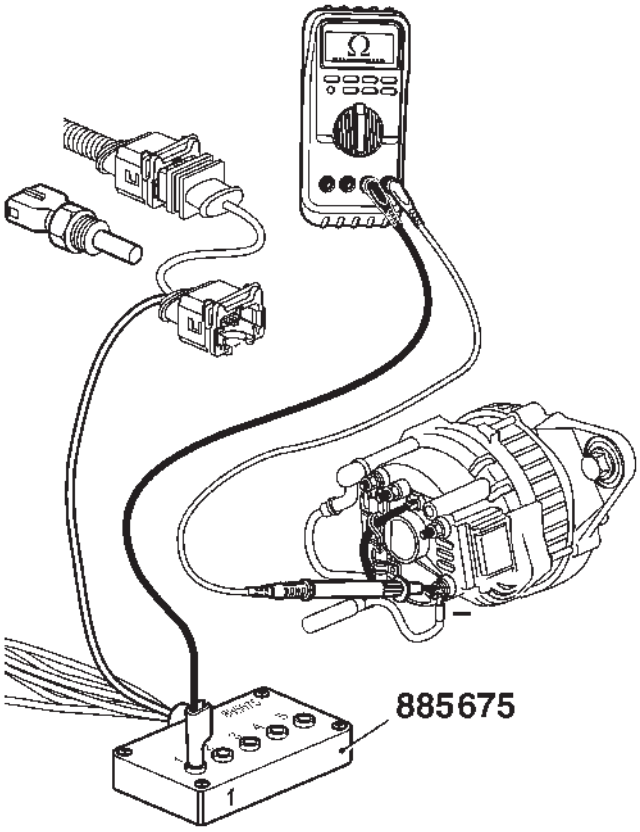
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter (9812519) to do resistance measurement against the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

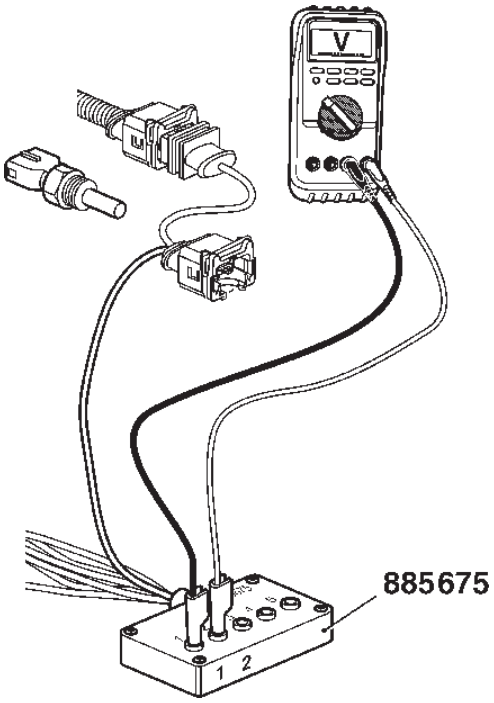
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 1,1–1.5 kΩ

*** Note.** Battery negative (–) on alternator or starter motor.



4
Turn the main switches on. Turn the starter key to **position I** (driving position).

5
Use multimeter 9812519 for voltage measurement.

Measurement points	Nominal value
1 – 2	U ≈ 5 V

Checking the fuel temperature sensor

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

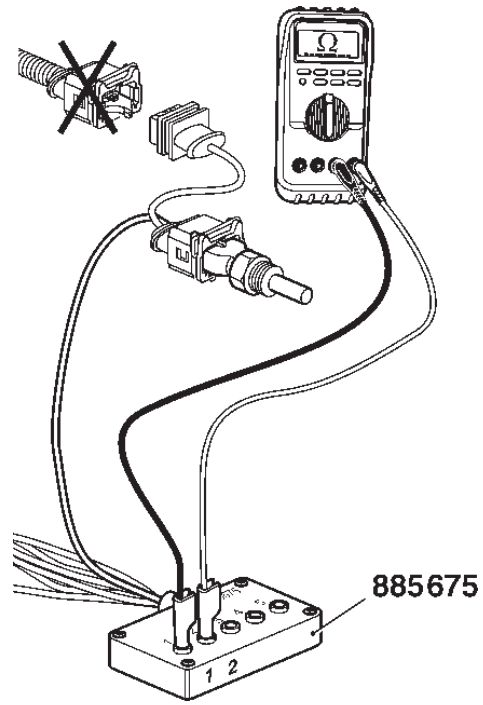
2
Remove the connector from the sensor. Connect adapter cable 885675 to sensor*.

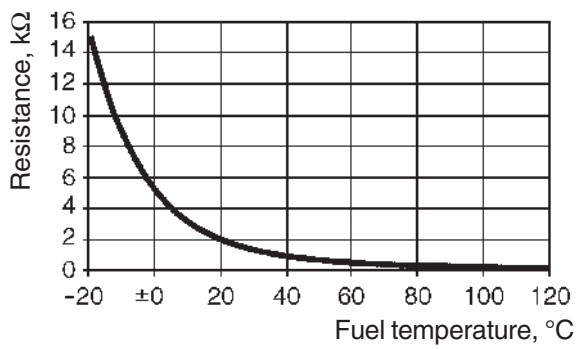
* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

3
Use multimeter 9812519 to measure the resistance of the sensor.

Measurement points: 1 – 2
Nominal value:

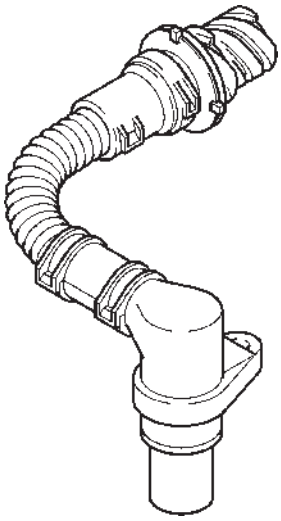
0°C (32°F) ..... R ≈ 4930 Ω ±440 Ω
20°C (68°F) ..... R ≈ 1870 Ω ±140 Ω
40°C (104°F) ..... R ≈ 800 Ω ±50 Ω
60°C (140°F) ..... R ≈ 375 Ω ±20 Ω
80°C (176°F) ..... R ≈ 190 Ω ±8 Ω
100°C (212°F) ..... R ≈ 104 Ω ±4 Ω





MID 128, PID 190

Engine speed, excess speed / calculation



MID 128: Engine control unit

Fault code

FMI 0: Calculation error.

FMI 1: Calculation error.

FMI 2: Signal value is irregular, intermittent or faulty.

FMI 4: Software error.

FMI 9: Calculation error.

FMI	Fault code explanation
0, 1, 2, 4, 9	Faulty sensor / Faulty sensor circuit / Engine speed calculation error

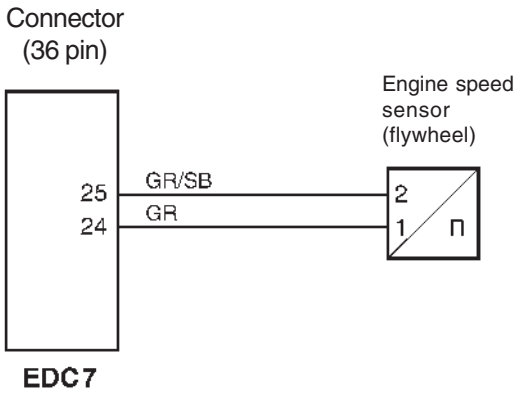
Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

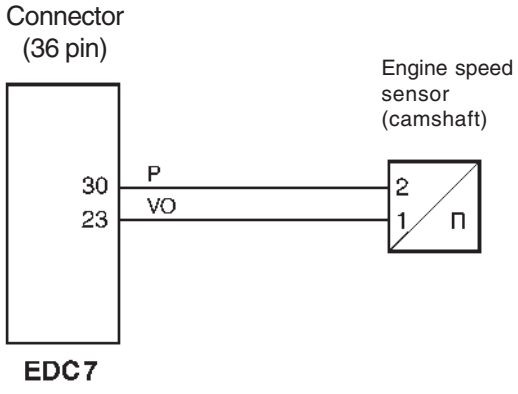
Engine power is cut.



Circuit description

The flywheel sensor is an inductive sensor.

When the flywheel rotates, pulses are generated in the sensor by holes drilled in the outer radius of the flywheel. The impulses generate a pulsating signal which the engine control unit (EDC7) uses to calculate the flywheel speed.



The camshaft sensor is an inductive sensor.

When the camshaft rotates, pulses are generated in the sensor by a toothed wheel installed on the camshaft. The impulses generate a pulsating signal in the sensor which the engine control unit (EDC7) uses to calculate the cylinder which is next in line for injection.

Fault tracing

FMI 0: Fault in signal from flywheel sensor.

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited sensor power supply cable to battery negative.
- Broken sensor power supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly installed sensor (wrong distance to flywheel).
- Electrical interference on engine speed signal.
- Damaged flywheel.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the flywheel sensor and the engine control unit (EDC7).

2
Check that the flywheel sensor is correctly installed and that no swarf has collected on the sensor.

3
Check the flywheel sensor.

FMI: 1 Faulty signal from camshaft sensor.

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited power supply cable to battery negative.
- Broken sensor supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly installed sensor (wrong distance to toothed wheel).
- Electrical interference on engine speed signal.
- Damaged toothed wheel.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the camshaft sensor and the engine control unit (EDC7).

2
Check that the camshaft sensor is correctly installed and that no swarf has collected on the sensor.

3
Check the camshaft sensor.

4
Check that the camshaft chain is correctly installed.

FMI 2

Possible reason

The camshaft sprocket index does not come to where it should be.

Suitable action

Check camshaft setting.

FMI 4: Software error

Suitable action

Check that the correct software is used.

FMI 9: Fault in signal from flywheel sensor.

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited sensor power supply cable to battery negative.
- Broken sensor supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly installed sensor (wrong distance to flywheel).
- Electrical interference on engine speed signal.
- Damaged flywheel.
- Fault in sensor.

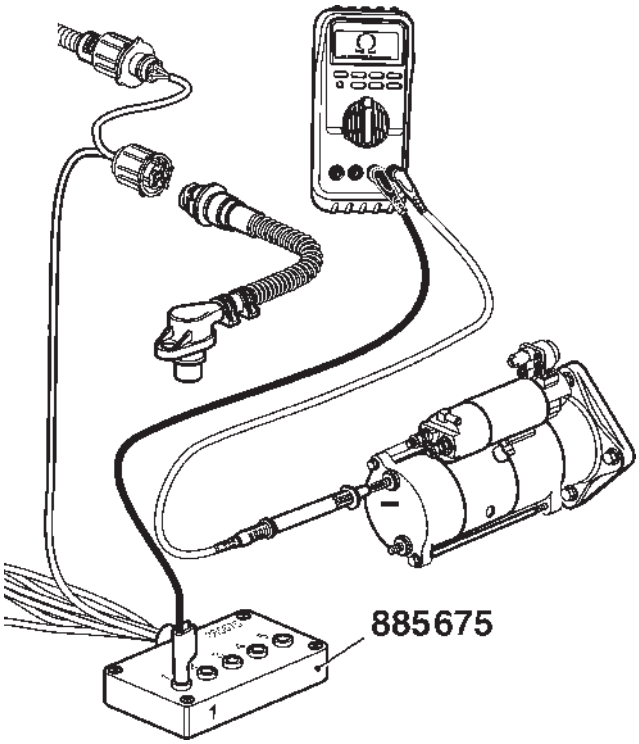
Suitable action

1
Check the cables and the connectors between the flywheel sensor and the engine control unit (EDC7).

2
Check that the flywheel sensor is correctly installed and that no swarf has collected on the sensor.

3
Check the flywheel sensor.

4
Check the flywheel for damages.



Measurements

Special tools: 9812519, 885675

Negative cable

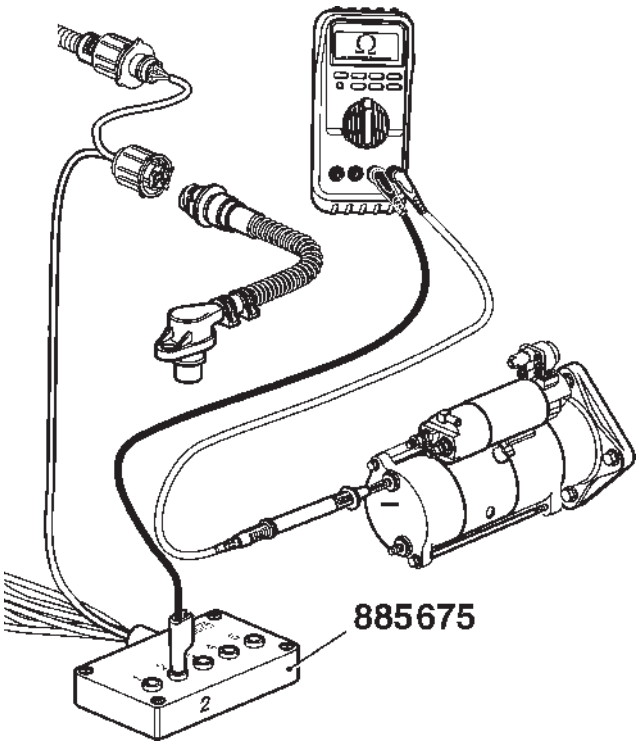
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

* **Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

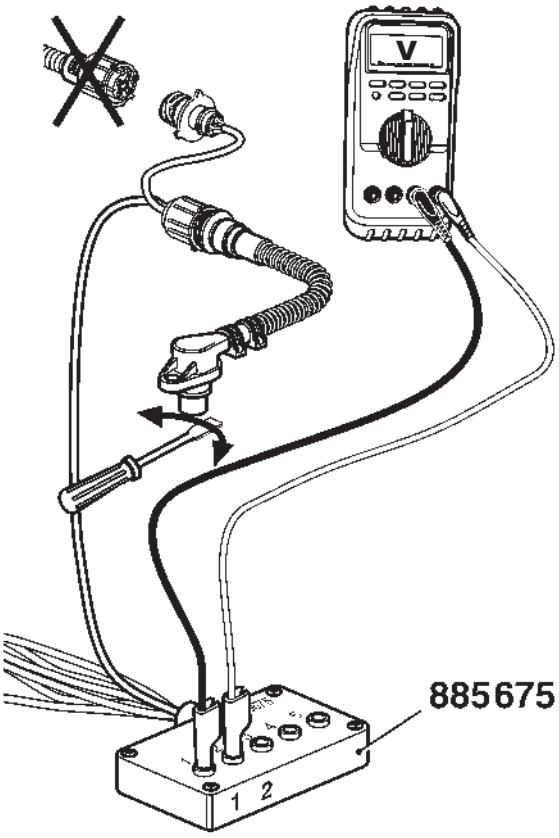
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 3,7–5.5 kΩ

* **Note.** Battery negative (–) on alternator or starter motor.



Checking the engine speed sensor

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Undo the connector from the sensor and remove the sensor from the cylinder head or the flywheel housing.

Check that the sensor does not have any external damage, or any swarf which has got stuck on it.

3
Connect adapter cable 885675 to sensor.*

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

4
Use multimeter 9812519 for resistance measurement.

Measurement points	Nominal value
1 – 2	R ≈ 0.9 kΩ*

* **Note.** ±10% at 20°C (68°F).

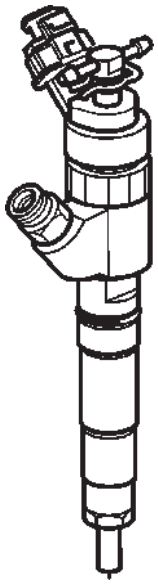
5
Use multimeter 9812519 for voltage measurement.

Move a metal object rapidly back and forwards not more than 1 mm in front of the sensor. Check that the multimeter gives a reading.

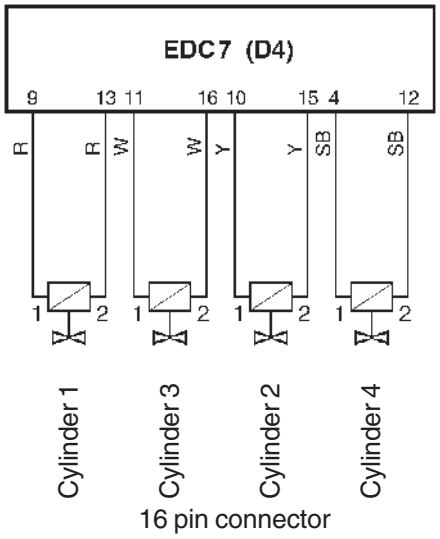
6
Install the sensor.

MID 128, SID 1/2/3/4/5/6

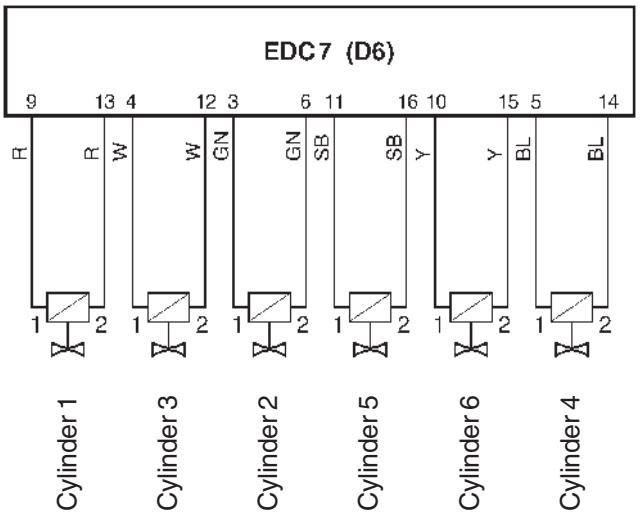
Injectors 1–6



16 pin connector



16 pin connector



MID 128: Engine control unit

Fault code

Fault code	Refers to
SID 1	Injector 1
SID 2	Injector 2
SID 3	Injector 3
SID 4	Injector 4
SID 5	Injector 5
SID 6	Injector 6

FMI 2: Current fault.

FMI 3: Short circuit to battery voltage, injector low voltage side.

FMI 4: Short circuit to battery negative, injector low voltage or high voltage side.

FMI 9: Open circuit, high voltage / low voltageside.

FMI	Fault code explanation
2, 3, 4, 9	Fault in circuit

Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

Symptom

- Engine does not run on all cylinders.
- Engine performance falls off.

Circuit description

The pulses to the injectors have a voltage of up to 80 V. The output amplifier in the engine control unit (EDC7) can give up to 20 A.

Fault tracing

NOTE! Identify the injector that the fault code applies to (please refer to previous page).

FMI 2: Checking the injector circuit

Possible reason

- Circuit closed for too long time when the solenoid is closed, which increases the volume of fuel.
- Fault in injector.

Suitable action

1
Check the cables and the connectors on the injectors.

2
Check if there is a fault in the injector, by changing to a new injector.

3
Change engine control unit (EDC7).

FMI 3: Checking the injector circuit

Conditions for fault code

Abnormally high voltage. Short circuit to higher voltage has been detected.

Possible reason

Engine D4:

- Short circuit between battery voltage and one of the injector cables on pins 12, 13 or 15, 16.
- Short circuit between the cables for one injector. Either to one of injectors 1, 2 or to one of injectors 3, 4.

Engine D6:

- Short circuit between battery voltage and one of the injector cables on pins 12, 13, 16 or 6, 14, 15.
- Short circuit between the cables for one injector. Either to one of injectors 1, 2, 3 or to one of injectors 4, 5, 4.
- Fault in injector.

Suitable action

1
Check that the cables and the connector are correctly installed on the injector.

2
Check if there is a fault in the injector, by changing to a new injector.

FMI 4: Checking the injector circuit

Conditions for fault code

Abnormally low voltage. Short circuit to battery negative has been detected.

Possible reason

- Short circuit to battery negative on one of the cables for the injector.
- **D4:** Short circuit between battery voltage and one of the injector cables on pins 4, 9 or 10, 11.
- **D6:** Short circuit between battery voltage and one of the injector cables on pins 4, 9, 11 or 3, 5, 10.
- Fault in injector.

Suitable action

1
Check that the cables and the connector are correctly installed on the injector.

2
Check if there is a fault in the injector, by changing to a new injector.

FMI 9: Open circuit

Conditions for fault code

Open circuit.

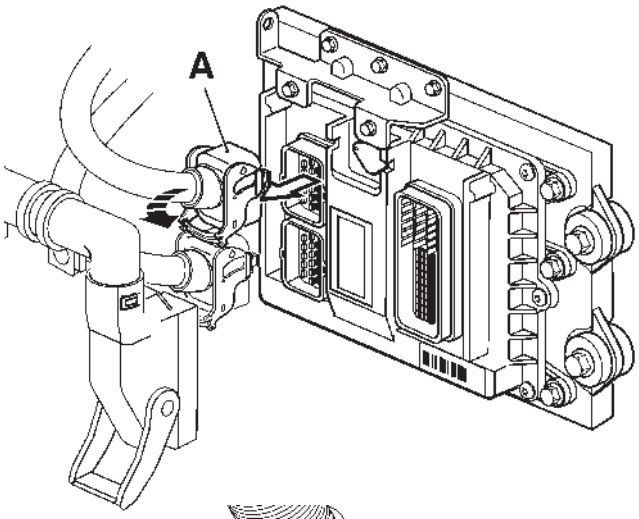
Possible reason

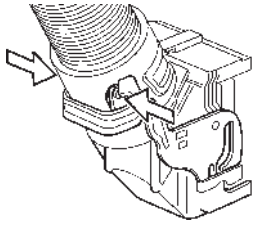
- Open circuit in one or both of the cables for the injector.
- Fault in injector.

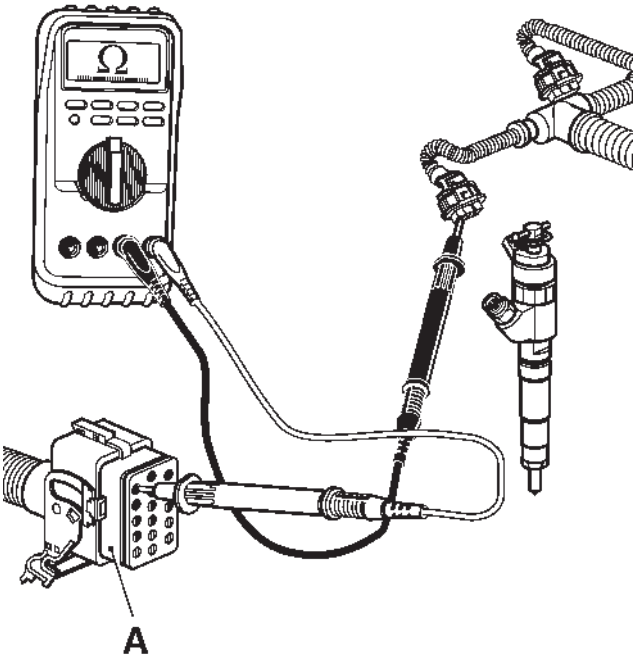
Suitable action

1
Check the cables and the connectors on the injectors.

2
Check if there is a fault in the injector, by changing to a new injector.







Checking the injector cables

Special tools: 9812519

If a break in a cable is suspected between the engine control unit (EDC 7) and one of the injectors, this is what you do:

1

NOTE! Cut the current with the main switch.

⚠ **IMPORTANT!** The system must be disconnected from system voltage and the starter key(s) must be in the 0 position when the engine control module connectors are disconnected or connected*.

* **Note.** Check that the seal is in position before each connector is joined up.

2

Undo the two smaller connectors from the engine control unit. Press both the plastic pins in (see arrows) and turn the locking arm downwards at the same time as the connector is pulled out.

3

Disconnect the connector from the injector whose cables are to be measured.

4

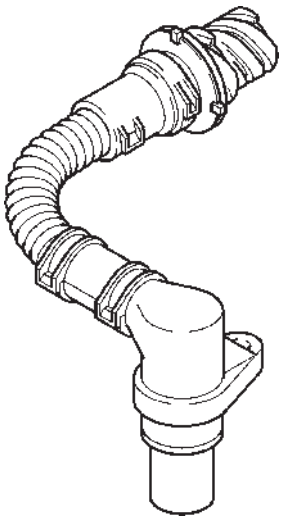
Use multimeter 9812519 to measure the resistance in the engine cable's 16-pin connector (**A**) against the injector connector.

Please refer to the circuit description on page 91 to determine the pins on each connector between which measurement should be done.

Measurement should eliminate open circuits. The resistance in the cables should be approx. 0 Ohm.

MID 128, SID 21

Camshaft position sensor (speed sensor, camshaft)



MID 128: Engine control unit

Fault code

FMI 0: Signal value is irregular, intermittent or incorrect.

FMI 2: Signal value is irregular, intermittent or incorrect.

FMI 4: Reversed polarity.

FMI	Fault code explanation
0, 2, 4	Faulty sensor / Faulty sensor circuit

Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

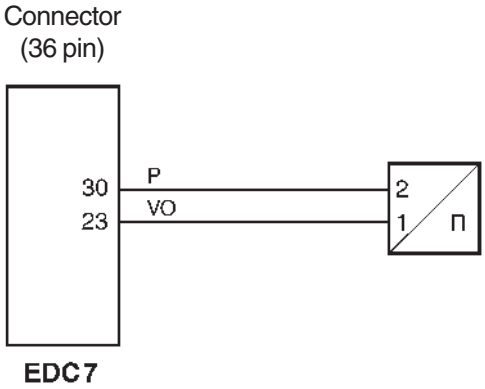
Symptom

Engine can be difficult to start.

Circuit description

The engine speed sensor is an inductive sensor.

When the camshaft rotates, pulses are generated in the sensor by a toothed wheel installed on the camshaft. The impulses generate a pulsating signal in the sensor which the engine control unit (EDC7) uses to calculate the cylinder which is next in line for injection.



Fault tracing

FMI 0

Conditions for fault code

No synchronization between camshaft and crankshaft (time based).

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited sensor power supply cable to battery negative.
- Broken sensor supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly mounted sensor (incorrect distance between sensor and toothed wheel, or loose sensor).
- Electrical interference on engine speed signal.
- Damaged toothed wheel.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check that the camshaft sensor is correctly installed and that no swarf has collected on the sensor.

3
Check sensor.

FMI 2

Conditions for fault code

No synchronization between camshaft and crankshaft (angle based).

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited power cable to battery negative.
- Broken sensor supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly mounted sensor (incorrect distance between sensor and toothed wheel, or loose sensor).
- Electrical interference on engine speed signal.
- Damaged toothed wheel.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check that the camshaft sensor is correctly installed and that no swarf has collected on the sensor.

3
Check sensor.

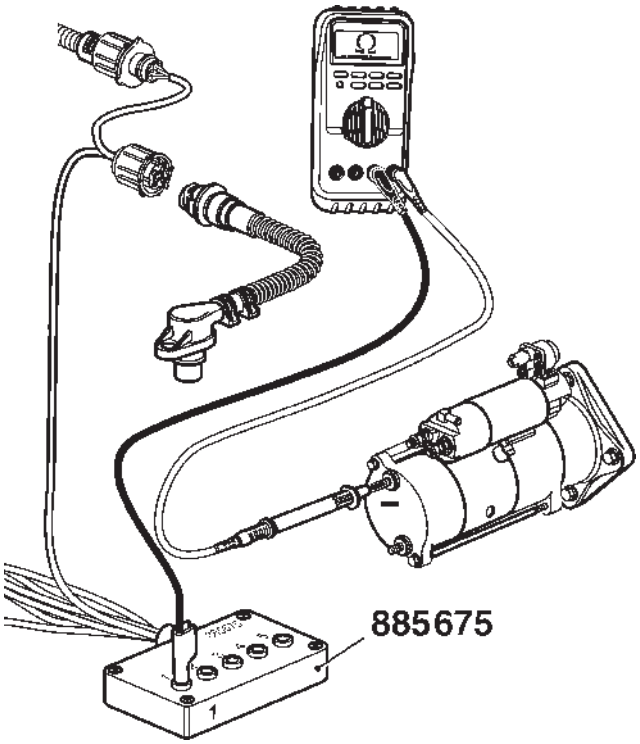
FMI 4

Possible reason

Reversed polarity in sensor.

Suitable action

Check that the sensor is connected as in the circuit description.



Measurements

Special tools: 9812519, 885675

Negative cable

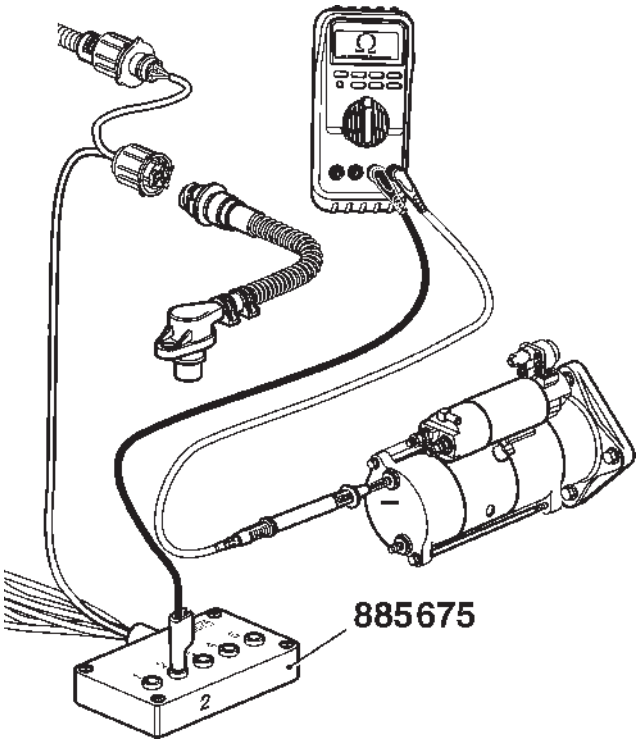
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 3,7–5.5 kΩ

*** Note.** Battery negative (–) on alternator or starter motor.

Checking the camshaft position sensor (speed sensor, camshaft)

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Undo the connector from the sensor and remove the sensor from the cylinder head.

Check that the sensor does not have any external damage, or any swarf which has got stuck on it.

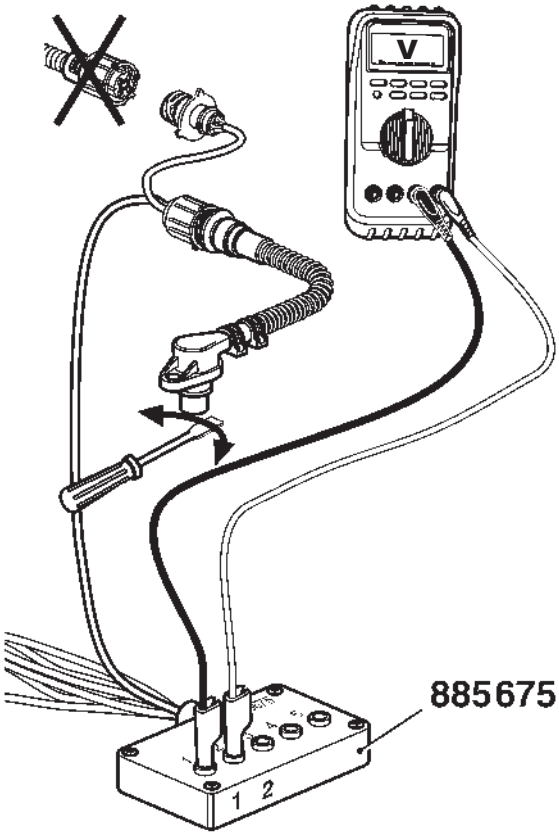
3
Connect adapter cable 885675 to sensor.*

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

4
Use multimeter 9812519 for resistance measurement.

Measurement points	Nominal value
1 – 2	R ≈ 0.9 kΩ*

* **Note.** ±10% at 20°C (68°F).



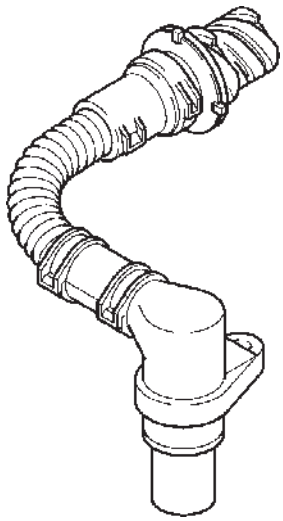
5
Use multimeter 9812519 for voltage measurement.

Move a metal object rapidly back and forwards not more than 1 mm in front of the sensor. Check that the multimeter gives a reading.

6
Install the sensor.

MID 128, SID 22

Speed sensor (flywheel)



MID 128: Engine control unit

Fault code

FMI 0: Signal value is irregular, intermittent or incorrect.

FMI 2: Signal value is irregular, intermittent or incorrect.

FMI 4: Reversed polarity.

FMI	Fault code explanation
0, 2	Faulty sensor / Faulty sensor circuit

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

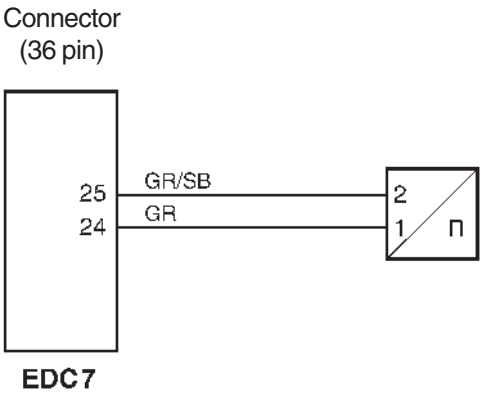
Symptom

- Engine can be difficult to start.
- Engine power is cut.

Circuit description

The engine speed sensor is an inductive sensor.

When the flywheel rotates, pulses are generated in the sensor by holes drilled in the outer radius of the flywheel. The impulses generate a pulsating signal which the engine control unit (EDC7) uses to calculate the flywheel speed.



Fault tracing

FMI 0: Signal value is irregular, intermittent or incorrect

Conditions for fault code

Too much interference.

Possible reason

Electrical interference on engine speed signal.

Suitable action

Attempt to localize the source of interference.

FMI 2: Signal value is irregular, intermittent or incorrect

Conditions for fault code

- Pulse indication where there should be a gap.
- Pulse indication did not come in time.
- Pulse indication frequency is too high.

Possible reason

- Short circuited sensor power supply cable to battery voltage.
- Short circuited sensor negative cable to battery voltage.
- Short circuited sensor power supply cable to battery negative.
- Broken sensor supply cable.
- Open circuit in sensor battery negative cable.
- Incorrectly mounted sensor (incorrect distance between sensor and flywheel, or loose sensor).
- Electrical interference on engine speed signal.
- Damaged flywheel.
- Fault in sensor.

Suitable action

1
Check the cables and the connectors between the sensor and the engine control unit (EDC7).

2
Check that the flywheel sensor is correctly installed and that no swarf has collected on the sensor.

3
Check sensor.

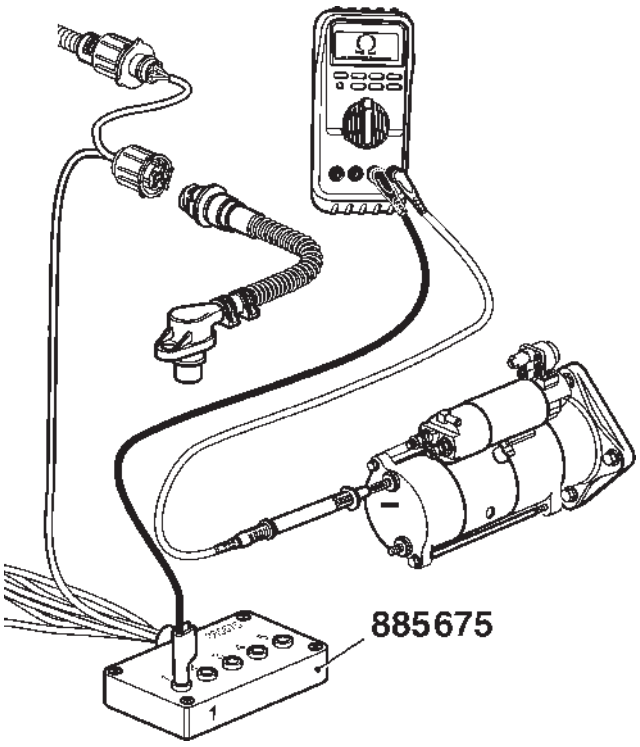
FMI 4

Possible reason

Reversed polarity in sensor.

Suitable action

Check that the sensor is connected as in the circuit description.



Measurements

Special tools: 9812519, 885675

Negative cable

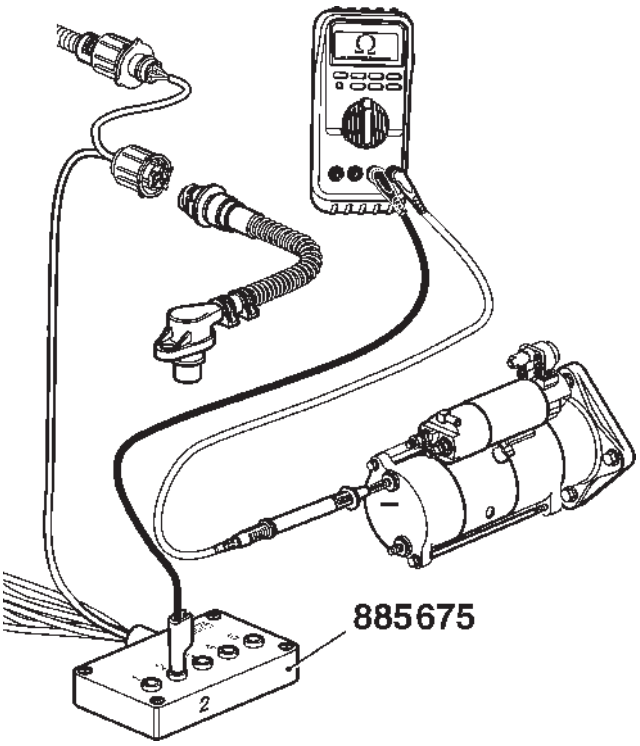
1
NOTE! Cut the current with the main switch.

2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Measurement points	Nominal value
1 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Signal cable

1
NOTE! Cut the current with the main switch.

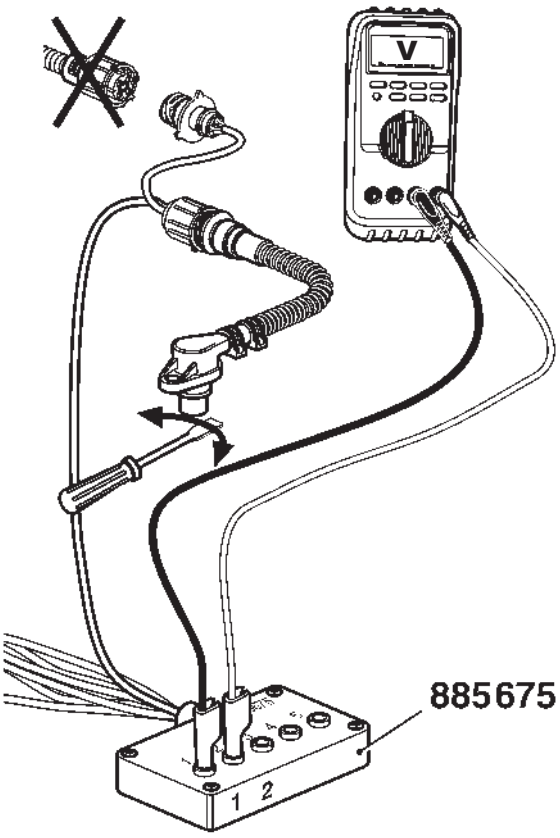
2
Remove the connector from the sensor. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
2 – Battery negative*	R ≈ 3,7–5.5 kΩ

*** Note.** Battery negative (–) on alternator or starter motor.



Checking the speed sensor, flywheel

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Undo the connector from the sensor and remove the sensor from the flywheel housing.

Check that the sensor does not have any external damage, or any swarf which has got stuck on it.

3
Connect adapter cable 885675 to sensor.*

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

4
Use multimeter 9812519 for resistance measurement.

Measurement points	Nominal value
1 – 2	R ≈ 0.9 kΩ*

* **Note.** ±10% at 20°C (68°F).

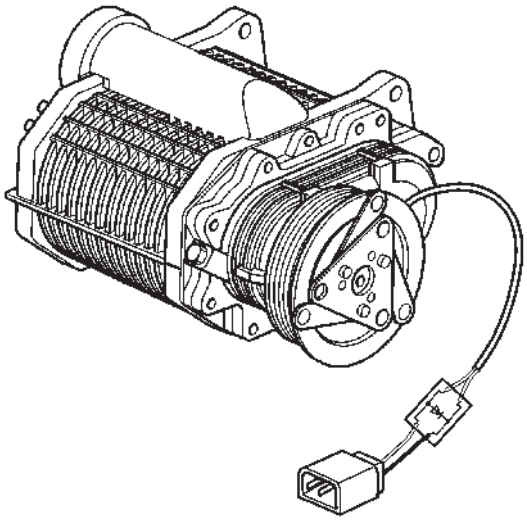
4
Use multimeter 9812519 for voltage measurement.

Move a metal object rapidly back and forwards not more than 1 mm in front of the sensor. Check that the multimeter gives a reading.

5
Install the sensor.

MID 128, SID 26

Output, compressor coupling



MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI	Fault code explanation
3, 4	Faulty component / Faulty circuit

Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

Symptom

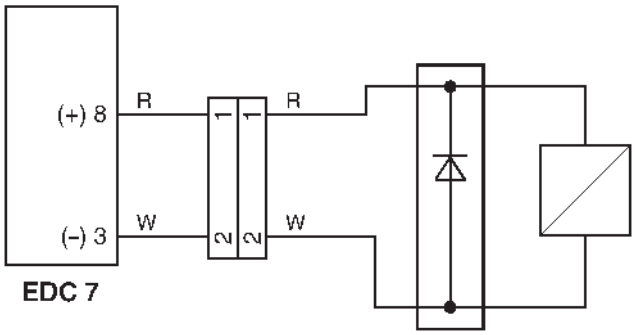
The engine gives less power, which results in less performance during acceleration and when heavily loaded.

Circuit description

An electromagnetic clutch is used to engage and disengage the mechanical supercharger.

The engine control unit (EDC7) activates the coupling by providing the coupling solenoid with voltage (+12 alt. +24 Volt) from pin 8 on the control unit. Pin 2 on the coupling is connected to battery negative via pin 3 on the engine control unit.

Connector
(36 pin)



Fault tracing

FMI 3: Checking the supercharger circuit

Conditions for fault code

Abnormally high voltage, short circuit to higher voltage or open circuit has been detected.

Possible reason

- Short circuited solenid supply cable to battery voltage.
- Short circuit in solenoid negative cable or supply cable.
- Faulty coupling.

Suitable action

- Check cables and connections to supercharger.
- Check coupling.

FMI 4: Checking the supercharger circuit

Note. This fault is only indicated when the supercharger is activated.

Conditions for fault code

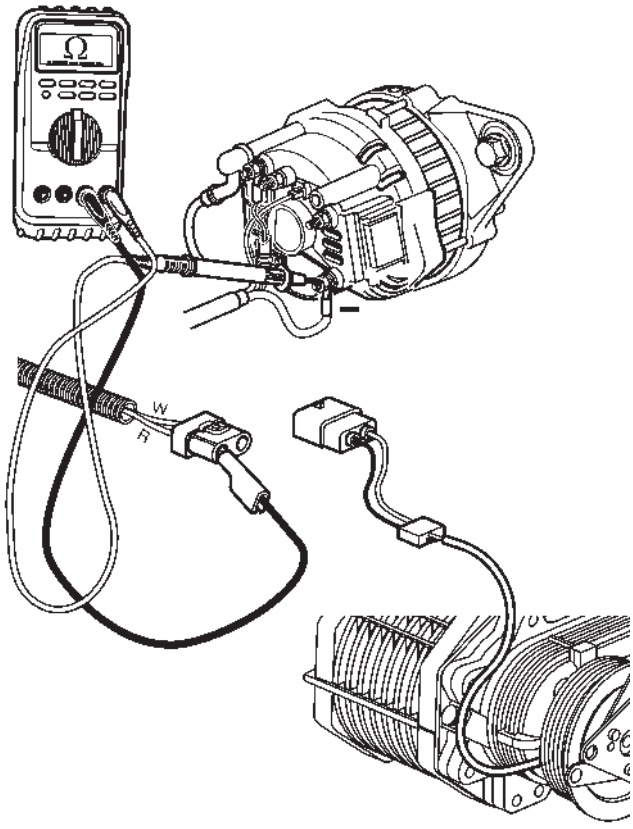
Abnormally low voltage or short circuit to battery negative has been detected.

Possible reason

- Short circuited solenoid power supply cable to battery negative.
- Faulty coupling.

Suitable action

- Check cables and connections to supercharger.
- Check coupling.



Measurements

Special tools: 9812519

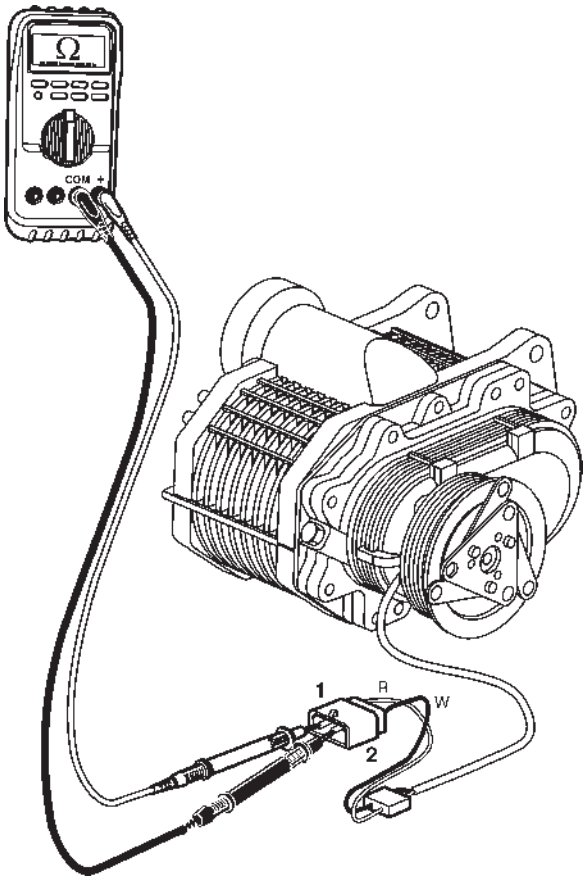
1
NOTE! Cut the current with the main switch.

2
Remove the supercharger connector.

3
Use multimeter 9812519 to do resistance measurement against the engine control unit (EDC7).

Measurement points	Nominal value
White – Battery negative*	R ≈ 0 Ω
Red – Battery negative*	R ≈ 10–20 kΩ

* **Note.** Battery negative (–) on alternator.



Checking the solenoid winding

Special tools: 9812519

1
NOTE! Cut the current with the main switch.

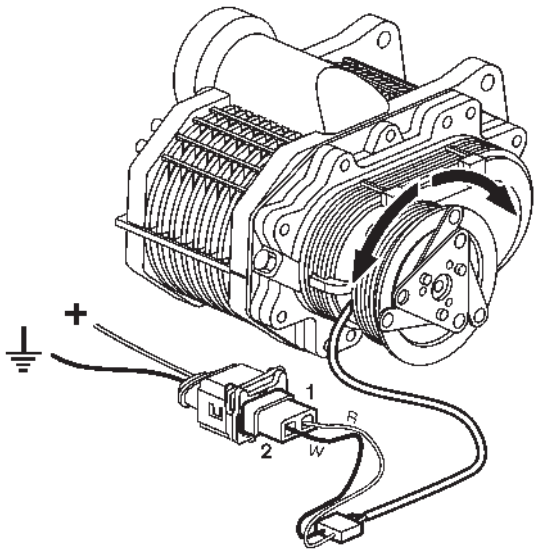
2
Remove the supercharger connector.

3
Use multimeter 9812519 to do resistance measurement against the magnetic coupling.

Connect **positive (+)** from the multimeter to pin 1 (red cable) in the connector.

Connect **"COM"** from the multimeter to pin 2 (white cable) in the connector.

Measurement points	Nominal value
White – Red	R ≈ 2–12 Ω



Checking the magnetic coupling

1
NOTE! Cut the current with the main switch.

2
Remove the supercharger connector.

3
Check that the magnetic coupling is not activated, by rotating the component in front of the pulley.

4
NOTE! Check the solenoid winding in the circuit before connecting it to system current. Stop the test if there is a short circuit in the winding or diode.Connect +12 alt. +24 Volt as follows:

Positive (+) to pin 1 (red cable) in the connector.
Negative (–) to pin 2 (white cable) in the connector.

The magnetic coupling for the supercharger should now be activated.

MID 128, SID 40

Output, starter motor

MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI	Fault code explanation
3, 4	Faulty component / Faulty circuit

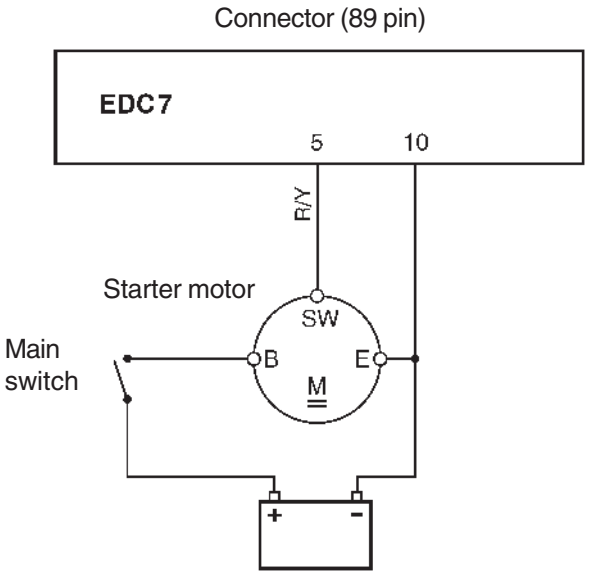
Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm display.

Symptom

The starter motor does not rotate, or turns slowly.



Circuit description

The starter motor is supplied with current from the batteries, via the main switch. The starter relay mounted on the starter motor is activated when pin 5 on the engine control unit (EDC7) receives system current when the starter switch or starter button is activated.

Fault tracing

General check for starter motor problems:

- Check the starter motor cables.
- Check that the starter relay is activated during a start attempt.

FMI 3: Checking the starter motor circuit.

Conditions for fault code

Abnormally high voltage, short circuit to higher voltage or open circuit has been detected.

Possible reason

- Broken circuit in cable between engine control unit (EDC7) and starter relay.
- Fault in starter motor.

Suitable action

1
Check the cable between the engine control unit (EDC7) and starter relay.

2
Check cables and connections to the starter motor.

3
Check the starter motor.

FMI 4: Checking the starter motor circuit.

Note. This fault is only indicated when the starter motor is activated.

Conditions for fault code

Abnormally low voltage or short circuit to battery negative has been detected.

Possible reason

Fault in starter motor.

Suitable action

1
Check cables and connections to the starter motor.

2
Check the starter motor.

Checking the solenoid winding

Special tools: 9812519

1
NOTE! Cut the current with the main switch.

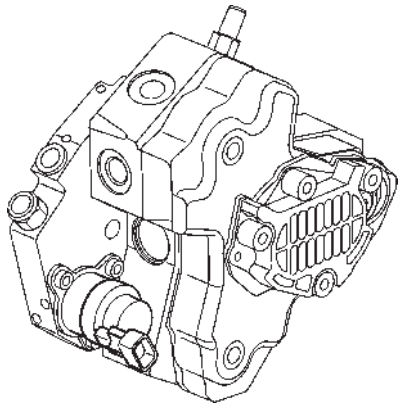
2
Remove the yellow/ red cable from the starter motor relay.

3
Use multimeter 9812519 to measure the resistance between the starter motor relay and the battery negative on the starter motor.

Nominal value: R ≈ 2–12 Ω

MID 128, SID 57

Output, fuel pump (MPROP), fault



MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 9: Abnormal updating rate.

FMI	Fault code explanation
3, 9	Faulty component / Faulty circuit

Fault indication

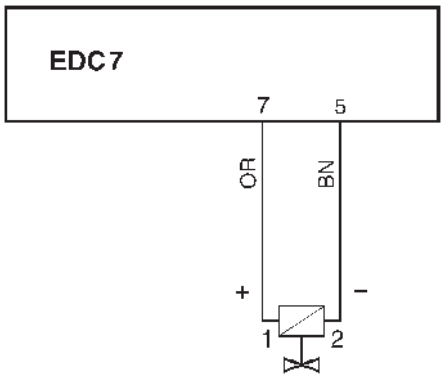
Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

- Engine is difficult to start.
- Engine power is cut.
- If the MPROP supply cable is connected to battery voltage, the MPROP valve closes and the engine stops.

Connector (36 pin)



Circuit description

A magnetically controlled proportional valve (MPROP) controls the fuel pressure (rail pressure) to ensure that the correct fuel pressure is retained despite varying engine speed and loading.

Signal from engine control unit (EDC7) is a PWM signal (pulse width modulated signal).

When the current through the valve is changed, this affects the fuel flow, which results in changed fuel pressure.

The rail pressure sensor senses the pressure and converts the pressure signal to a voltage which is registered by the engine control unit.

The more the current to the valve solenoid rises, the less is the fuelpressure (rail pressure) obtained.

Fault tracing

FMI 3: Checking the circuit

Possible reason

If the MPROP supply cable is connected to 5 Volt, the MPROP valve opens somewhat, the fuel pressure is built up and lies somewhat above the nominal value.

Suitable action

Check cables and connections to the fuel pump (MPROP valve).

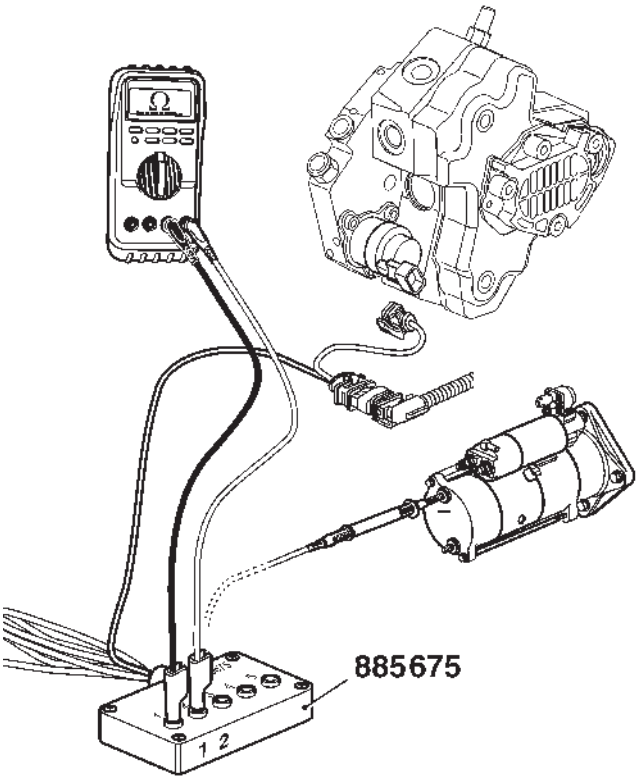
FMI 9: Checking the circuit

Possible reason

- Open circuit in MPROP battery negative cable.
- Open circuit in MPROP supply cable.
- Short circuit MPROP supply cable to battery negative.
- MPROP supply cable is short circuited to battery voltage. The MPROP valve closes and the engine stops.

Suitable action

Check cables and connections to the fuel pump (MPROP valve).



Measurements

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

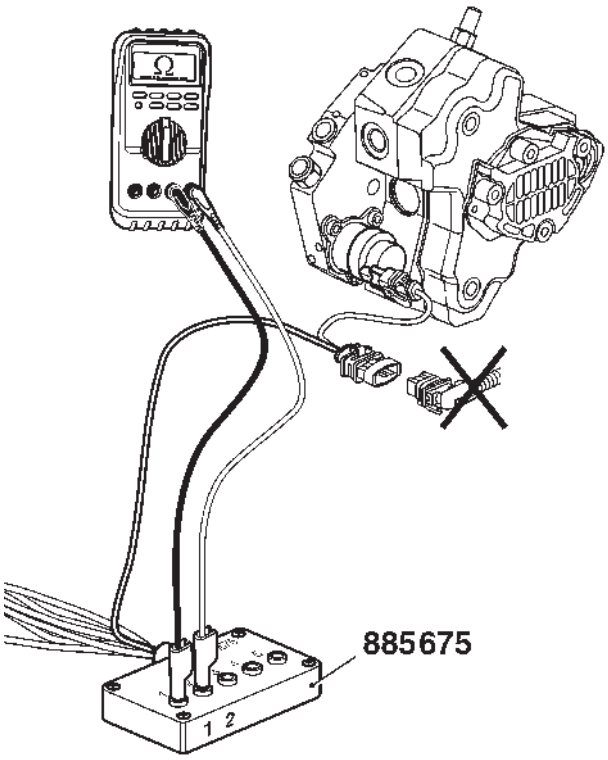
2
Remove the connector from the MPROP valve. Connect adapter cable 885675 to cable harness connector to engine control unit (EDC7).

3
Use multimeter 9812519 to do resistance measurement against the engine control unit.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

Measurement points	Nominal value
1 – 2	R ≈ 60–86 kΩ
1 – Battery negative*	R ≈ 60–86 kΩ
2 – Battery negative*	R ≈ 0 Ω

*** Note.** Battery negative (–) on alternator or starter motor.



Checking the solenoid in the MPROP valve

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

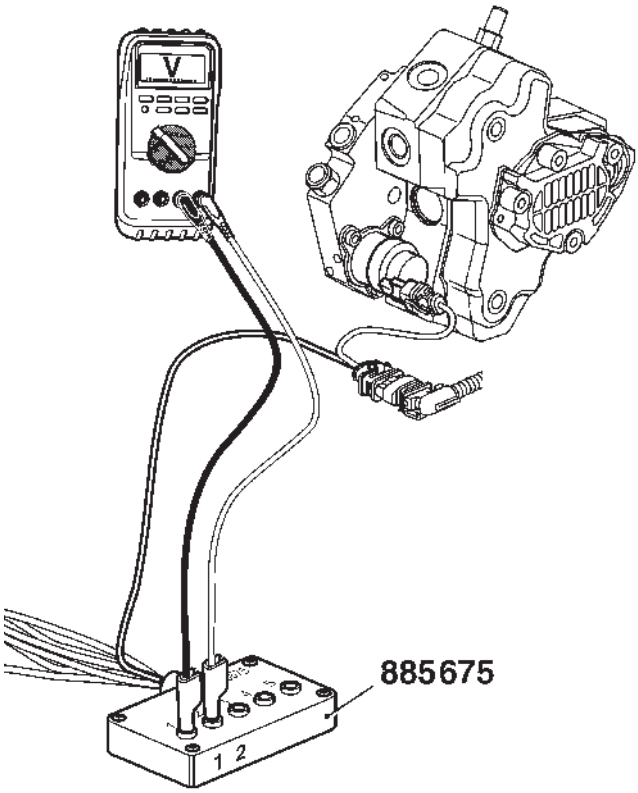
2
Remove the connector from the MPROP valve. Connect adapter cable 885675 to the valve.*

*** NOTE!** Do not **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

3
Use multimeter 9812519 to check the resistance in the MPROP valve.

Note. Measurement is done to eliminate short circuiting or breaks in the MPROP valve.

Measurement points	Nominal value
1 – 2	R ≈ 2 – 3 Ω (at 20°C/68°F)



Checking the MPROP signal

Special tools: 9812519, 885675

1
NOTE! Turn the starter key to **position 0**.

2
Remove the connector from the MPROP valve. Connect adapter cable 885675 between the MPROP valve and the cable harness connector against the engine control unit (EDC7).

3
Connect multimeter 9812519 to measure the alternating current between the connections **1** and **2**.

Note. The MPROP signal is a PWM signal. An oscilloscope is needed for correct analysis of the signal.

4
NOTE! Turn the starter key to **position I** (driving position).

5
The multimeter should show that a voltage arrives at the MPROP valve.

Note. Measurement is done to eliminate short circuiting or breaks in the cable to the engine control unit.

If there is an open or short circuit, the multimeter shows 0 Volt.

MID 128, SID 218

ECM main relay

MID 128: Engine control unit

Fault code

FMI 2, 3, 4, 9, 11: Internal components in the engine control unit (EDC7) (main relay, transistors) are defective.

FMI	Fault code explanation
2, 3, 4, 9, 11	Faulty component

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Engine power is cut.

Component description

The main relay is located inside the engine control unit (EDC7).

Fault tracing

FMI: 2, 3, 4, 11

Possible reason

Internal components in the engine control unit (EDC7) (main relay, transistors) are defective.

Suitable action

Change engine control unit (EDC7).

FMI 9

Possible reason

- Short circuit between sensor battery voltage and sensor battery negative.
- Internal components in the engine control unit (EDC7) (main relay, transistors) are defective.

Suitable action

1
Check if MID 128, SID 218 coincide with a sensor fault code which describes a short circuit. Fault trace the cables after the short circuit.

2
Change engine control unit (EDC7).

MID 128, SID 231

SAE J1939 Data link

MID 128: Engine control unit

Fault code

FMI 9: Data bus (CAN), communication not found.

FMI	Fault code explanation
9	Fault in circuit

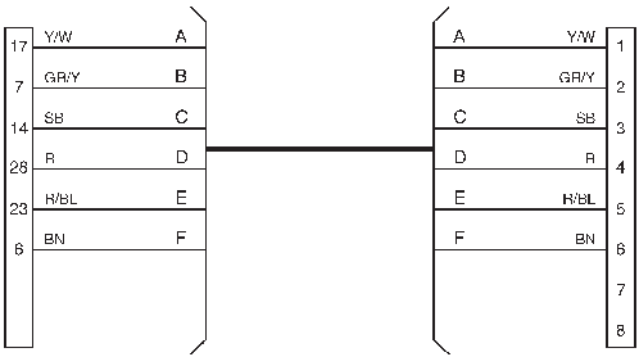
Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display.

Symptom

- Engine in “limp-home” mode.
- The engine can not be stopped with the key switch or via the start/stop panel.
- Engine can not be started.



Connector, PCU
Connector X3

Connector
”ENGINE CONN.”

Cable description

A. CAN H – data link to engine
B. CAN H – data link to engine
C. Negative power supply (–)
D. Positive power supply (+)
E. Ignition signal
F. Not used

Fault tracing

FMI 9: Checking the circuit

Conditions for fault code

Data bus (CAN), communication not found.

Possible reason

- CAN H short circuit to input voltage (pin 4 in connector, engine) between engine control unit (EDC7) and the PCU. Fault code occurs together with MID 128, PID 91, FMI 9.
- Short circuit between CAN H and ignition signal (pin 5 in connector, engine) in cables between enginecontrol unit and PCU. Fault code occurs together with MID 128, PID 91, FMI 9.

Suitable action

1
Check the data bus cables and the connections between the engine control unit (EDC7) and the PCU.

Please refer to “Manual fault tracing of bus cables” on page 34.

2
Check the PCU cables and connectors.

If the fault code coincides with MID 187, PSID 200, FMI 8, 9:

3
Check the power supply to the engine control unit (EDC7).

4
Check the cables between the engine control unit and the PCU.

MID 128, SID 251

Supply voltage

MID 128: Engine control unit

Fault code

FMI 2: Faulty voltage between power amplifiers and internal power supply.

FMI 5: Power amplifier supply voltage too high.

FMI 6: Power amplifier supply voltage too low.

FMI 9: Shut-off fault.

FMI	Fault code explanation
2, 5, 6, 9	Faulty component

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Reduced engine power.

Fault tracing

FMI 2, 5, 6, 9

Conditions for fault code

FMI 2: Faulty voltage between power amplifiers and internal power supply.

FMI 5: Power amplifier supply voltage too high.

FMI 6: Power amplifier supply voltage too low.

FMI 9: Shut-off fault.

Possible reason

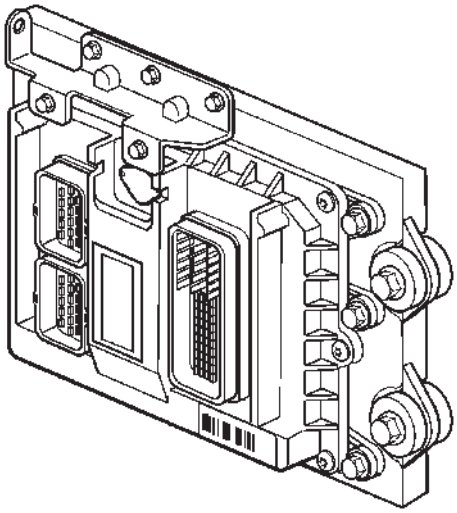
Internal components in the engine control unit (EDC7) are faulty.

Suitable action

Change engine control unit.

MID 128, SID 254

Engine control unit EDC 7



MID 128: Engine control unit

Fault code

FMI 3: Internal fault in engine control unit (overflow).

FMI	Fault code explanation
3	Internal fault in engine control unit (EDC7)

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Engine can temporarily run unevenly.

Fault tracing

FMI 3

Possible reason

Internal fault in engine control unit (overflow).

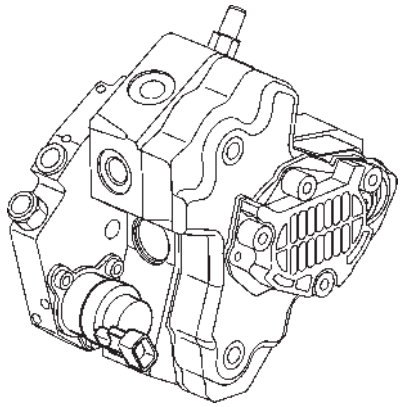
Fault code is set because the engine control unit (EDC7) receives more commands than it can execute. The control unit then shuts off for a few seconds before doing a restart.

Suitable action

Please contact Volvo Penta.

MID 128, PSID 50

Fuel pressure, monitoring (MPROP)



MID 128: Engine control unit

Fault code

FMI 0: Detected leakage, based on the quantity balance.

FMI 1: Faulty fuel pressure at idling.

FMI 2: Negative deviation in nominal/current value.

FMI 3: Too high fuel pressure (rail pressure).

FMI 5: Positive deviation in nominal/current value.

FMI 6: Leakage detected when the engine is not consuming any fuel.

FMI 9: Too low fuel pressure (rail pressure).

FMI	Fault code explanation
0, 1, 2, 3, 5, 6, 9	Alarm, monitoring of fuelpressure

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display +audible warning.

Symptom

- Engine power is cut.
- The engine is stopped if the pressure rises too high.

Circuit description

A magnetically controlled proportional valve (MPROP) controls the fuel pressure (rail pressure) to ensure that the correct fuel pressure is retained despite varying engine speed and loading.

Signal from engine control unit (EDC 7) is a PWM signal (pulse width modulated signal).

The more the current to the valve solenoid rises, the less is the fuelpressure (rail pressure) obtained. This means that if there is a cable break to the valve, the pump will give maximum fuelpressure.

Fault tracing

Note. The MPROP valve is not sold as a spare part, since the fuel pump is calibrated together with the valve during manufacture. The fuel pump is an exchange unit.

Fuel pressure monitoring detects leakage by comparing requested fuel supply (“nominal pressure value”) with “current pressure value” in the fuel pipe. If the pressure is different, a fault code is set. The fault code depends on the engine working point and pressure differences.

FMI 0: Detected leakage, based on the quality balance

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

When the difference between the nominal railpressure value and the setpoint value is higher than the allowed threshold value all within a time limit this fault is set. The variation of leakage in the injectors due to age is taken into consideration.

Possible reason

- Low fuel level.
- Air leakage.
- Fault in return flow.
- Blocked fuel filter.
- Fault in sensor.
- Injector does not open.
- Fault in relief valve.
- Wear in the pump.

Suitable action

1

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

2

Check that the hoses are not blocked, and check the return pipe.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the fuel pressure sensor.

5

Change the relief valve.

6

Check the high pressure pump according to service bulletin.

FMI 1: Faulty fuel pressure at idling

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

When the engine is running in low idle and the nominal fuel pressure is higher than a threshold value and the fuel quantity current value is lower than a threshold value all within a time limit this fault is set.

Possible reason

- Low fuel level.
- Air leakage.
- Blocked fuel filter.
- Fault in return flow.
- Fault in sensor.
- Injector does not open.
- Fault in relief valve.
- Wear in the pump.

Suitable action

1

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

2

Check that the hoses are not blocked, and check

the return pipe.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the fuel pressure sensor.

5

Change the relief valve.

6

Check the high pressure pump according to service bulletin.

FMI 2: Fuel pressure too high. Flow monitoring a negative deviation between nominal and current fuel pressure

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

When the governor output is lower than a threshold value which depends on the engine speed it indicates that the fuel flow throw the MPROP is low indicating a low fuel consumption. If the rail pressure does not decrease with respect to the set point according to a engine speed depended threshold value all within a time limit this fault is set.

Possible reason

- Low fuel level.
- Blocked fuel filter.
- Air leakage.
- The MPROP valve has stuck open. The reason can be a mechanical fault or an electrical fault, open or short circuit to battery negative in the cables for the MPROP valve.
- Fault in return flow.
- Fault in sensor.
- Injector does not open.
- Fault in relief valve.

Suitable action

1

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

2

Check that the hoses are not blocked, and check the return pipe.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the MPROP valve cables and connectors.

5

Check the fuel pressure sensor.

6

Change the relief valve.

FMI 3: Fuel pressure (rail pressure) too high.

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

If the rail pressure is higher than a threshold value all within a time limit this fault is set.

Possible reason

- Low fuel level.
- Blocked fuel filter.
- Air leakage.
- The MPROP valve has stuck open. The reason can be a mechanical fault or an electrical fault, open or short circuit to battery negative in the cables for the MPROP valve.
- Fault in return flow.
- Fault in sensor.
- Injector does not open.
- Fault in relief valve.

Suitable action

1

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

2

Check that the hoses are not blocked, and check the return pipe.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the MPROP valve cables and connectors.

5

Check the fuel pressure sensor.

6

Change the relief valve.

FMI 5: Fuel pressure too low. Flow monitoring a positive deviation between nominal and current fuel pressure

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

When the governor output is higher than a threshold value which depends on the engine speed it indicates that the fuel flow throw the MPROP is high indicating a high fuel consumption. If the rail pressure does not increase with respect to the set point according to a engine speed depended threshold value all within a time limit this fault is set.

Possible reason

- Leakage in the fuel system:
  - leakage in injectors
  - leakage in the return pipe
  - leakage in the combustion chamber.
  -leakage in relief valve.
- Fault in the fuel pressure sensor.
- The MPROP valve has stuck close. The reason can be a mechanical fault or an electrical fault,
- Wear in the pump.

Suitable action

1

Check fuel pipes for leakage (high pressure pipes, suction pipes, return pipes).

2

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the MPROP valve cables and connectors.

5

Check the fuel pressure sensor.

6

Change the relief valve.

7

Check the high pressure pump according to service bulletin.

FMI 6: Leakage detected when the engine is not consuming any fuel.

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

There are two ways of detecting this defect:

1

Rail pressure used as reference - When the engine is not consuming any fuel the expected governor output is zero but if the rail pressure is decreasing at a faster rate than expected this fault is set.

2

Governor used as a reference - When the engine is not consuming any fuel and the governor output is not zero and the output is higher than a threshold value which is a function of the rail pressure.

Possible reason

- Leakage in injectors

Suitable action

1

Check the leakage throw the injectors.

FMI 9: Fuel pressure (rail pressure) too low.

NOTE! Since this is a negative pressure system, a search must be made for air entry.

Conditions for fault code

If the rail pressure is lower than a threshold value which depends on the engine speed all within a time limit this fault is set.

Possible reason

- Leakage in the fuel system:
  - leakage in injectors
  - leakage in the return pipe
  - leakage in the combustion chamber.
  - leakage in relief valve.
- Fault in the fuel pressure sensor.
- The MPROP valve has stuck close. The reason can be a mechanical fault or an electrical fault,
- Wear in the pump.

Suitable action

1

Check fuel pipes for leakage (high pressure pipes, suction pipes, return pipes).

2

Check the fuel level, hoses and fuel filter for leakage. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

3

Change the fuel filter. If the filter is blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

4

Check the MPROP valve cables and connectors.

5

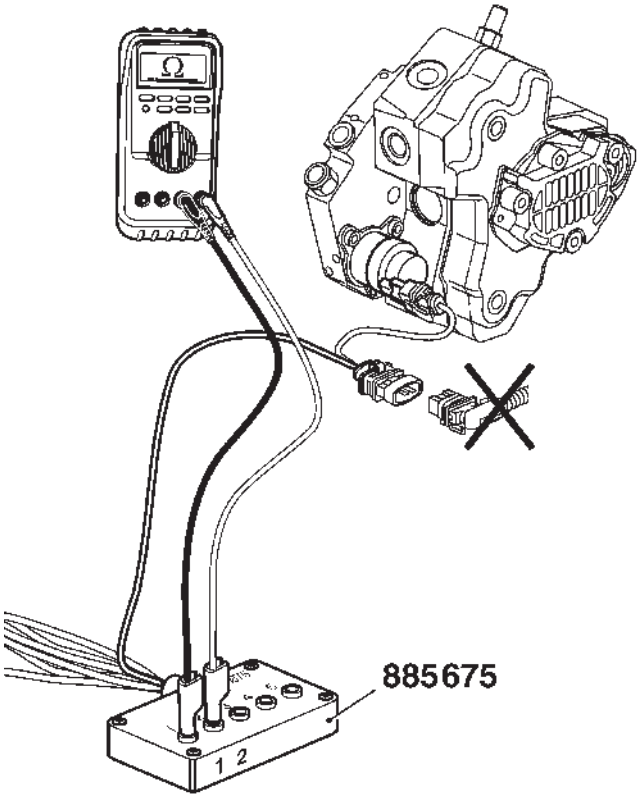
Check the fuel pressure sensor.

6

Change the relief valve.

7

Check the high pressure pump according to service bulletin.



Checking the solenoid in the MPROP valve

Special tools: 9812519, 885675

1
NOTE! Cut the current with the main switch.

2
Remove the connector from the MPROP valve. Connect adapter cable 885675 to the valve.*

* **NOTE!** Do **not** connect the other end of the adapter cable to the engine cable harness, since this can cause a measurement error.

3
Use multimeter 9812519 to check the resistance in the MPROP valve.

Note. Measurement is done to eliminate short circuiting or breaks in the MPROP valve.

Measurement points	Nominal value
1 – 2	R ≈ 2 – 3 Ω (at 20°C/68°F)

MID 128, PSID 51

Redundant Shut-off Path

MID 128: Engine control unit

Fault code

FMI 12: Faulty unit or component.

FMI	Fault code explanation
12	Faulty component

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Engine power is cut.

Fault tracing

FMI 12

Possible reason

Internal components in the engine control unit (EDC7) are defective.

Suitable action

Change engine control unit.

MID 128, PSID 53

Monitoring the pressure relief valve

MID 128: Engine control unit

Fault code

FMI 0: The pressure relief valve is open.

FMI 1: The pressure relief valve does not open on request.

FMI	Fault code explanation
0	The valve is open
1	The valve does not open on request

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display +audible warning.

Symptom

FMI 0: Engine power is cut.

FMI 1: Engine stops.

Circuit description

The task of the pressure limiting valve (safety valve) is to protect the system from excess pressure. The valve opens and reduces the fuel pressure (rail pressure) by releasing fuel to the return pipe as necessary.

The valve is a two-stage valve. Stage one opens at about 190 MPa (1900 bar / 27557 psi) and stage 2 maintains the pressure at about 60 MPa (600 bar / 8702 psi).

If the MPROP valve* has been damaged and gives full flow, for example, the pressure relief valve reduces the fuel flow to about 60 MPa (600 bar / 8702 psi).

*** Note.** MPROP valve = Magnetically controlled proportional valve.

Fault code description

The engine control unit (EDC 7) continually monitors the fuel pressure (rail pressure) via the fuel pressure sensor and controls fuel pressure via the MPROP valve.

If the rail pressure rises too high, the engine control unit attempts to reduce the pressure by increasing the current going to the MPROP valve. If a fault occurs and the engine control unit still detects excessive pressure, despite attempts to reduce the pressure, the control unit expects that the pressure relief valve should open and thus reduce the pressure.

If the pressure relief valve has not opened after a certain time (at the same time as the high fuel pressure remains), the engine control unit interprets this as a fault and shuts the engine off as a protective measure.

Fault tracing

FMI: 0, 1

Reason for fault code

Threshold value for pressure relief valve is 185–195 MPa (1850–1950 bar / 26832–28282 psi).

Possible reason

Pressure relief valve is open or does not open on request.

Suitable action

1
Check the fuel level. If air gets into the system, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

2
Check fuel pipes for leakage on both suction and high pressure side.

3
Check / change the fuel filters. If the filters are blocked, the high pressure pump can start to compensate for fuel pressure drop. The result can be oscillating fuel pressure.

Check the negative pressure in the fuelpipe. Please refer to the instruction in the Workshop manual for D4/ D6 engines, group 23.

4
Check the connections and cables for the proportional valve (MPROP valve).

5
Check the fuel pressure sensor function, please refer to “Checking the fuel pressure sensor”.

6
Fault in injectors.

7
Change the pressure relief valve.

MID 128, PSID 54

Booster voltage (high bank 1)*

MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Open circuit.

FMI	Fault code explanation
3, 4, 9	Faulty component / Faulty circuit

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Engine is difficult to start and runs roughly when it starts.

Fault tracing

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Excessive voltage.
Power amplifier for injectors 1, 2, 3.

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Supply voltage is too high to power amplifier for “bank 1” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7).

2
Change engine control unit.

*** Note:**
”High bank 1” is a power amplifier for cylinders 1, 2 and 3.
”High bank 2” is a power amplifier for cylinders 4, 5 and 6.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Too low voltage.

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Supply voltage is too low to power amplifier for “bank 1” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7)

2
Check the pin connections between injectors and injector cables.

3
Change engine control unit.

FMI 9: No signal

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Open circuit in power supply to power amplifier for “bank 1” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7).

2
Check the pin connections between injectors and injector cables.

3
Change engine control unit.

MID 128, PSID 55

Booster voltage (high bank 2)*

MID 128: Engine control unit

Fault code

FMI 3: The voltage exceeds the normal value or is short circuited to higher voltage.

FMI 4: The voltage is less than the normal value or is short circuited to battery negative.

FMI 9: Open circuit.

FMI	Fault code explanation
3, 4, 9	Faulty components

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

Symptom

Engine is difficult to start and runs roughly when it starts.

*** Note:**

”High bank 1” is a power amplifier for cylinders 1, 2 and 3.
”High bank 2” is a power amplifier for cylinders 4, 5 and 6.

Fault tracing

FMI 3: Abnormally high voltage or short circuit to higher voltage has been detected.

Conditions for fault code

Excessive voltage.
Power amplifier for injectors 4, 5, 6.

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Supply voltage is too high to power amplifier for “bank 2” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7).

2
Change engine control unit.

FMI 4: Abnormally low voltage or short circuit to battery negative has been detected.

Conditions for fault code

Too low voltage.

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Supply voltage is too low to power amplifier for “bank 2” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7).

2
Check the pin connections between injectors and injector cables.

3
Change engine control unit.

FMI 9: No signal

Possible reason

Internal components in the engine control unit (EDC7) are faulty. Open circuit in power supply to power amplifier for “bank 2” (injectors).

Suitable action

1
Check the power supply to the engine control unit (EDC7).

2
Check the pin connections between injectors and injector cables.

3
Change engine control unit.

MID 164, PPID 390

Lever 1 position relative to potentiometer supply failure

MID 164: SHCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
3, 4	The signal from lever 1 is outside normal range.

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

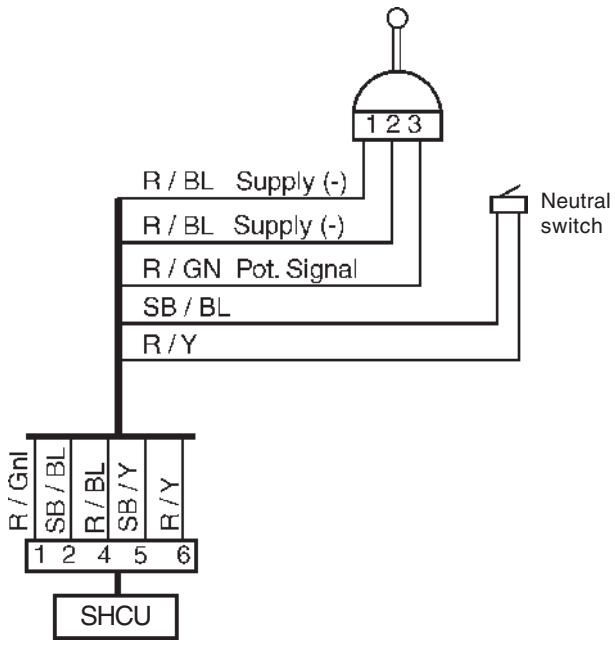
Symptom

Not possible to make this station active.

Gear to neutral. Shifting permitted after acknowledge.

Cranking disabled. Cranking permitted after acknowledge.

Cable description



Connector: X7
Colour: Blue

Fault tracing

Preconditions

Lever calibration done.

Lever calibration has activated this input.

There is no fault on the potentiometer supply.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

Open circuit in the negative wire to the lever.

Short circuit between lever potentiometer signal and lever power supply.

Fault in lever potentiometer.

Suitable action

1

Check wiring between SHCU and lever 1.

2

Check the wiring for for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short circuit or open circuit.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Possible reason

Open circuit in lever power supply.

Open circuit in potentiometer signal.

Potentiometer signal short circuit to the negative wire.

Short circuit between the lever power supply and the negative wire.

Fault in lever potentiometer.

Suitable action

1

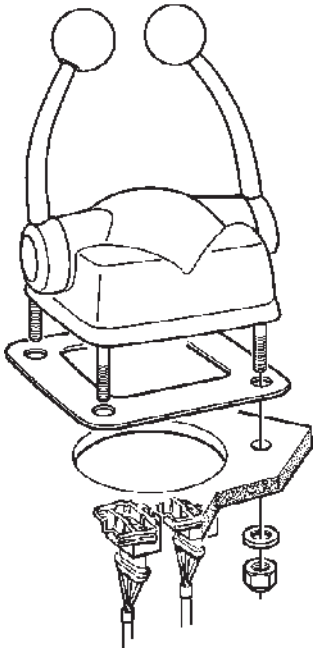
Check wiring between SHCU and lever 1.

2

Check the wiring for for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short circuit or open circuit.



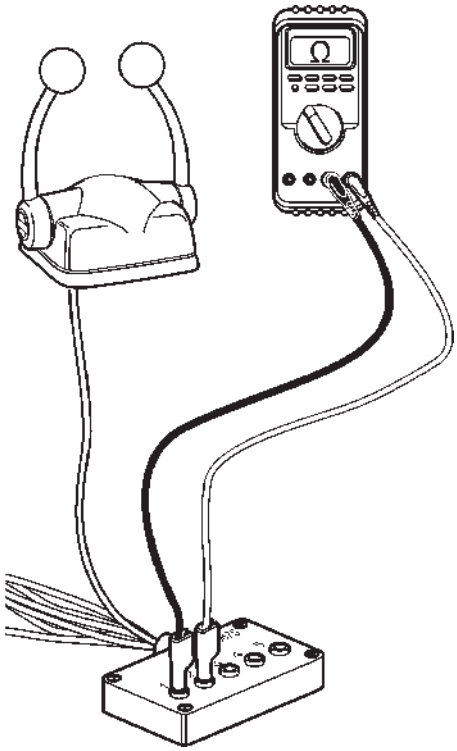
Checking the potentiometer in electronic controls

Special tools: *Multimeter 9812519*
Adapter cable 885675

1
Cut the current with the main switches. Disconnect the wires between SHCU and the control. If necessary, remove the control unit from the helm station.

2
Check that there is no oxide or dampness in the connectors.

Use Multimeter 9812519 to check if there are any open circuits in the wiring.



3
Remove the connector block from the throttle potentiometer. Connect adaptor cable 885675 to the potentiometer

4
Use Multimeter 9812519 to check the resistance of the potentiometer.

Measurement points	Nominal value
1 – 2	R ≈ 2.0 kΩ ±10%

5
Use Multimeter 9812519 to check the resistance of the potentiometer. Move the control lever between its two end positions.

Measurement points: Pins 1 - 3 and 2 - 3.
Nominal value:
The Multimeter should show a value above 0.9 kΩ at one end position and a value of less than 2.9 kΩ at the other end position.

6
Replace the potentiometer if the fault persists.

7
Erase all fault codes for SHCU by disconnecting power to the starter lock.

8
Check the engine's speed regulation/gear changing functions.

Measurement

Vodia logging the lever potentiometer supply

1

Choose log test.

2

Choose MID 164, Lever Potentiometer supply

Lever position	Nominal value
Neutral	U ≈ 3.6 V
Forward / Reverse	U ≈ 4.1 V

If the nominal value deviates there could be a problem with the potentiometer, the power supply to the potentiometer or the connection between the SHCU and the potentiometer.

Vodia logging the lever position

1

Choose log test.

2

Choose MID 164, Lever1 position relative to …

Lever position	Nominal value
Neutral	U ≈ 2.9 V
Forward idle	U ≈ 3.4 V
Forward max	U ≈ 5.0 V
Reverse idle	U ≈ 2.4 V
Reverse max	U ≈ 0.5 V

If the nominal value deviates there could be a problem with the potentiometer, the power supply to the potentiometer or the connection between the SHCU and the potentiometer.

Voltage measurement of HCU-voltage to the throttle control potentiometer

1
Remove the connector block from the throttle potentiometer. Connect adaptor cable 885675 between the throttle control cable connector and the throttle control potentiometer.

2
Use multimeter 9812519 for voltage measurement.

Shift control	Measurement points	Nominal value
Neutral	1 - 2	U ≈ 2.5 – 2.6 Volt
Neutral	1 - 3	U ≈ 1.3 – 1.5 Volt
Forwards, idle	1 - 3	U ≈ 1.1 – 1.3 Volt
Forwards, max throttle	1 - 3	U ≈ 0.3 – 0.5 Volt
Reverse, idle	1 - 3	U ≈ 1.7 – 1.8 Volt
Reverse, max reverse	1 - 3	U ≈ 2.5 – 2.8 Volt

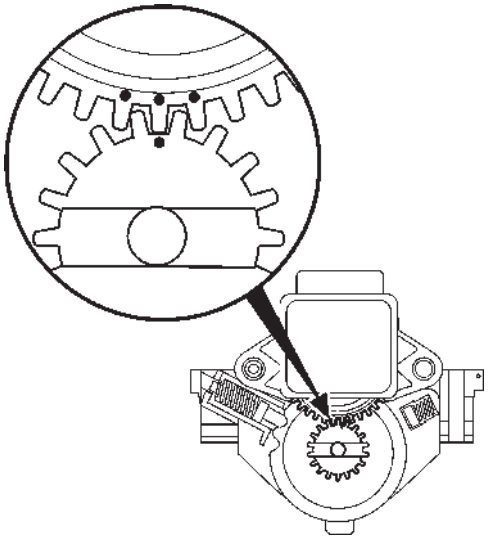
Note! Forward and reverse value could be shifted depended on installation.

Suitable measures with suspected voltage level faults.

1
Check the electronic control unit according to “check of potentiometer in electronic control unit”.

2
If the fault remains, try another HCU.

Changing the potentiometer in electronic controls



1
Cut the power with the ignition switch or main switch.

2
Remove the control from the instrument panel. Undo the connector and remove the defective potentiometer.

3
Install the new potentiometer. Check that the markings on the teeth line up before the potentiometer is screwed into place. Put a drop of thread locking fluid* on the screw that holds the control lever, and tighten the screw until the control lever has the correct friction.

* Volvo Penta part no. 1161053-2.

4
Connect the connector and screw the control down on the instrument panel.

5
Turn the main switch on.

6
Calibrate the controls.

7
Erase any fault codes by cutting the current with the starter switch.

8
Check the engine's speed regulation/gear changing functions.

MID 164, PPID 391

Lever 2 position relative to potentiometer supply failure

MID 164: SHCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
3, 4	The signal from lever 2 is outside normal range.

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

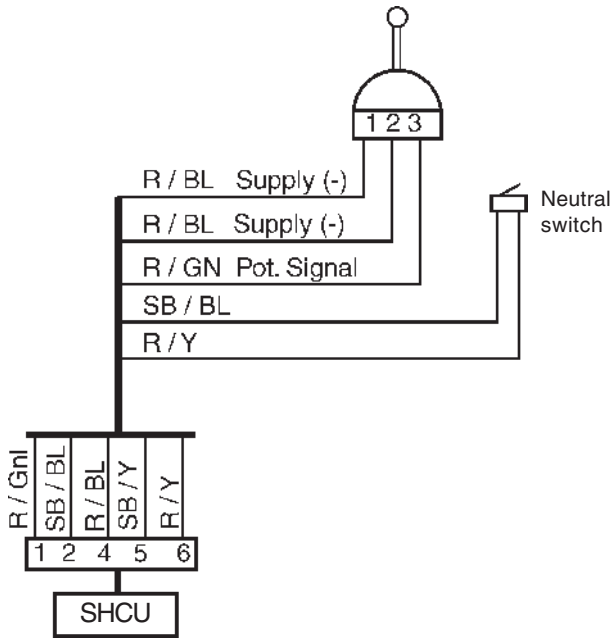
Symptom

Not possible to make this station active.

Gear to neutral. Shifting permitted after acknowledge.

Cranking disabled. Cranking permitted after acknowledge.

Cable description



Connector: X7
Colour: Blue

Fault tracing

Preconditions

Lever calibration done.

Lever calibration has activated this input.

There is no fault on the potentiometer supply.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

Open circuit in the negative wire to the lever.

Short circuit between lever potentiometer signal and lever power supply.

Fault in lever potentiometer.

Suitable action

1

Check wiring between SHCU and lever 2.

2

Check the wiring for for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short circuit or open circuit.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Possible reason

Open circuit in lever power supply 5 V.

Open circuit in potentiometer signal.

Potentiometer signal short circuit to the negative wire.

Short circuit between the lever power supply and negative wire negative.

Fault in lever potentiometer.

Suitable action

1

Check wiring between SHCU and lever 2.

2

Check the wiring for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short circuit or open circuit.

Potentiometer test

Please refer to “Test of the lever potentiometer” described under faultcode MID 164, PPID 390.

MID 164, PPID 392

Lever potentiometer supply failure

MID 164: HCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
3, 4	Fault in supply to potentiometers.

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + audible warning.

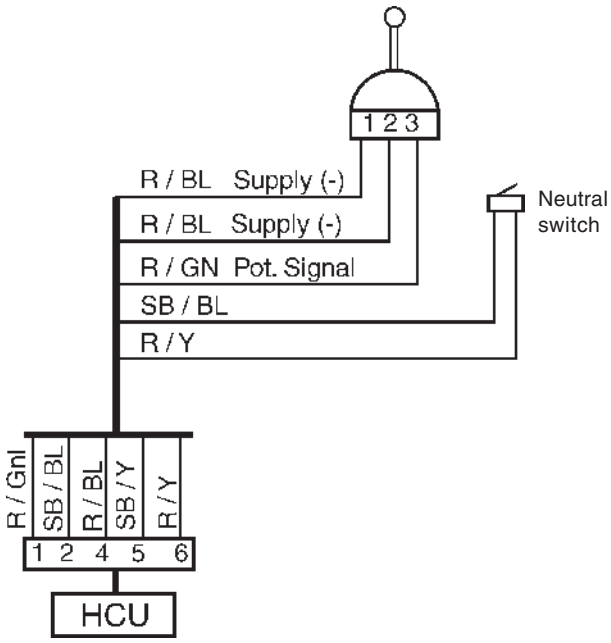
Symptom

Not possible to make this station active.

Gear to neutral. Shifting permitted after acknowledge.

Cranking disabled. Cranking permitted after acknowledge.

Cable description



Connector: X7
Colour: Blue

Fault tracing

Preconditions

Lever calibration OK.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

Open circuit in lever power supply.

Open circuit in the negative wire to the lever.

Fault in lever potentiometer.

Suitable action

1

Check wiring between SHCU and lever(s).

2

Check the wiring for for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short or open circuit.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Possible reason

Open circuit in lever power supply.

Open circuit in the negative wire to the lever.

Fault in lever potentiometer.

Short circuit between the lever power supply and the negative wire.

Suitable action

1

Check wiring between SHCU and lever(s).

2

Check the wiring for for bad contact between the lever and the SHCU.

3

Check lever potentiometer for internal short or open circuit.

Potentiometer test

Please refer to “Test of the lever potentiometer” described under faultcode MID 164, PPID 390.

MID 164, PPID 394

Key supply

MID 164: SHCU
Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

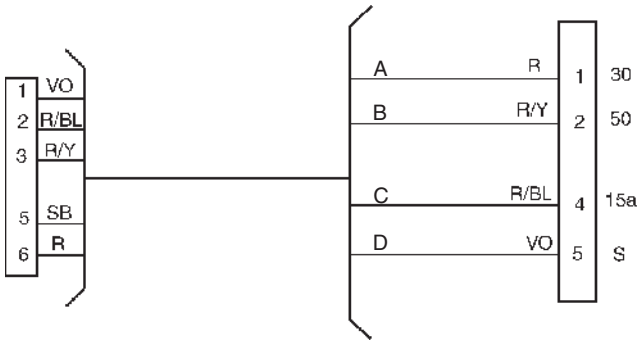
FMI	Fault code explanation
3, 4	Fault on the power supply to the key.

Fault indication

None.

Symptom

- Impossible to start engine.
- No backlight in start / stop panel, if installed.



HCU connector: X4 Key connector

Circuit description

A. Power supply

B. Starter motor

C. 15a

D. Stop

When the main switch is closed pin 1 in the key lock gets system voltage. When the key is turned to position 1 pin 4 in the key lock gets system voltage from pin 1.

To get the startermotor to run the key is turned to position 3 and pin 2 in the keylock gets system voltage from pin 1.

While the key is turned to position 3 pin 4 in the keylock still needs to have system voltage therefore a diode is placed between pin 2 and pin 4 to uphold the voltage in pin 4. The voltage at pin 4 in this case will be system voltage minus the voltage drop over the diode.

When the key is turned to position S pin 5 gets system voltage.

Fault tracing

FMI 3

Conditions for fault code

Driver indicates short to supply.

Suitable action

1
Check wiring harness to key and the key for primarily short circuits.

FMI 4

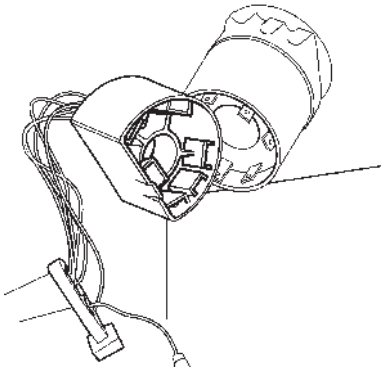
Conditions for fault code

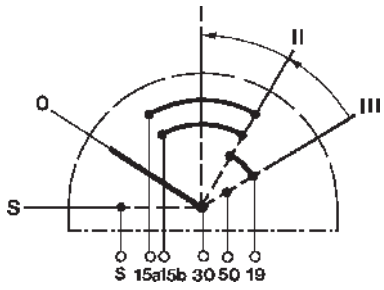
Driver indicates short to battery negative when system tries to activate supply.

Suitable action

1
Check the wiring to the key lock and the key lock for primarily short circuits.

Key test





Special tool: Multimeter 9812519

1
Cut the power with the main switches. Remove the key switch.

2
Check that all connections are clean and free from oxide, both in the cable connectors and in the starter switch.

3
Connect Multimeter 9812519 to pin 30. Turn the starter key and perform a functional check of the other connections.*

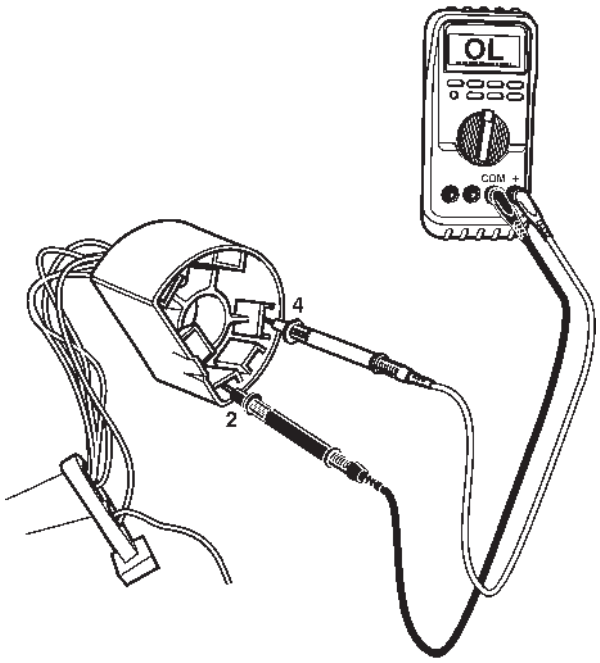
*** NOTE! Position II ("glow plug position") in the starter switch is not used.**

4
Mount the key switch and check its function.

Checking the key switch diode

Special tool: Multimeter 9812519

The diode in the key switch connector block maintains the activation signal to the engine control unit (EDC7) even while the starter is cranking. The diode should also ensure that the starter motor does not crank when just the ignition is on.



1
Cut the power with the main switches.

2
Undo the connector block on the key switch.

3
Use Multimeter 9812519 set to diode test. Connect the **COM**-outlet from the multimeter to connector pin 2 and the **PLUS**-outlet from the multimeter to pin 4. The multimeter should show **OL**, the diode blocks.

4
Swap the multimeter probes - **COM** to pin 4, **PLUS** to pin 2. The multimeter should now show around 0.5 Volts, the diode is conducting.

5
If these measurements indicate a defective diode, replace the key wiring.

MID 164, PPID 397

Main panel communication failure

MID 164: SHCU
Fault code

FMI 9: Abnormal update rate.

FMI	Fault code explanation
9	There is some fault on the EVC control panel. The EVC control panel is not responding on the AUX bus or the EVC control panel has stopped sending data.

Fault indication

Warning is displayed in the tachometer/display.

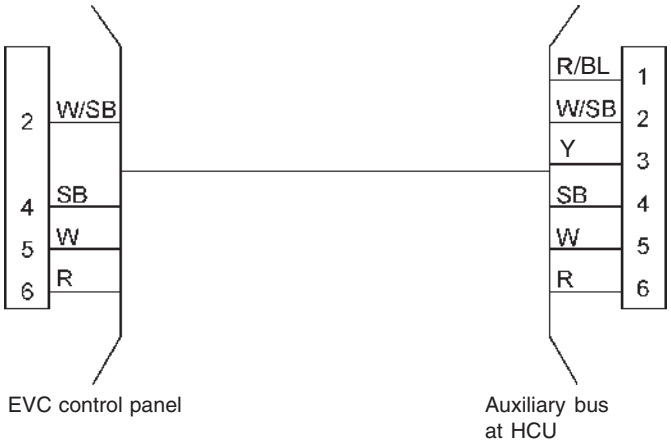
Orange lamp flashes in alarmpanel.

Symptom

- No button on the EVC control panel will function.

Circuit description

The EVC control panel gets its power supply from the SHCU. The EVC control panel communicates over the auxiliary bus with the SHCU.



Buzzer positive

J1708B

Easy link data

Battery negative

J1708A

Battery positive

Fault tracing

Preconditions

None.

FMI 9

Conditions for fault code

Communication fault with the EVC control panel.

Possible reason

- Open circuit in J1708 data bus wire from the SHCU, connector X3, pin 2 or 5 or both.
- Open circuit in the power supply on the auxiliary bus.
- Short circuit between J1708A and J1708B.
- Short circuit between J1708A, pin 5, and battery negative wire on pin 3 or pin 4.
- Short circuit between any or both of the J1708 wires to battery positive wire on pin 1 or pin 6.
- Fault in EVC control panel.

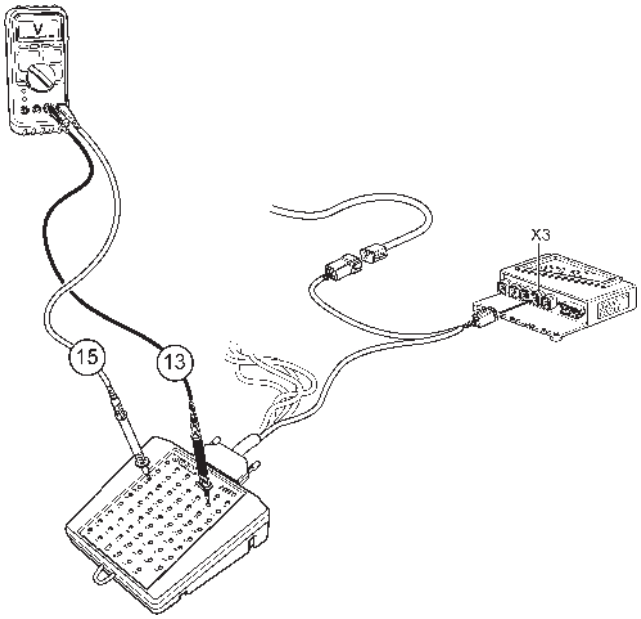
Suitable action

1
Check the power supply on the auxiliary bus.

2

Check data bus wiring between the EVC control panel and the SHCU. See “Manual fault tracing in bus cables”.

3
Change the EVC control panel.



Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Checking the power supply:

1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the SHCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

5

Turn the ignition on.

Measurement points	Nominal value
13 - 15	U ≈ Battery voltage

MID 164, PSID 139
Auto pilot fault

MID 164: SHCU

Fault code

FMI 2: Data erratic, intermittent or incorrect

FMI 9: Abnormal frequency, pulse width, or period.

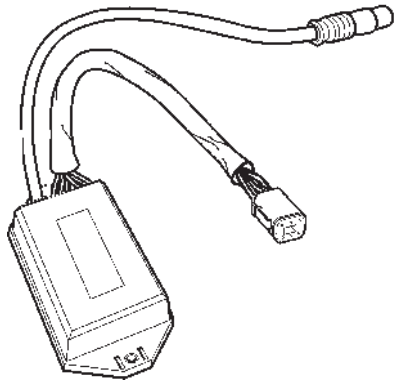
FMI	Fault code explanation
2, 9	The SHCU recieves no autopilot data through the autopilot interface, or the data is faulty.

Fault indication

None

Symptom

Can not enable/active auto pilot.



Auto pilot interface

Cable description

The auto pilot interface is installed via the multilink breakout part of the Y-split cable.

Fault tracing

Preconditions

Enabled in DST2.

FMI 2

Conditions for fault code

Too large drive angles requested, or the auto pilot has a faulty course controller.

Suitable action

1
Check wiring.

2
Check that auto pilot is enabled in DST2.

3
Check the auto pilot.

FMI 9

Conditions for fault code

Communication time out fault.

Suitable action

1
Check wiring.

2
Check that auto pilot is enabled in DST2.

3
Check the auto pilot.

4
Replace the auto pilot interface.

MID 164, SID 226

Neutral switch and lever position mismatch

MID 164: SHCU

Fault code

FMI 5: Current below normal or open circuit.

FMI 7: Mechanical system not responding properly.

FMI	Fault code explanation
5, 7	Fault in the neutral switch or that the neutral switch and the calibrated position are in mismatch.

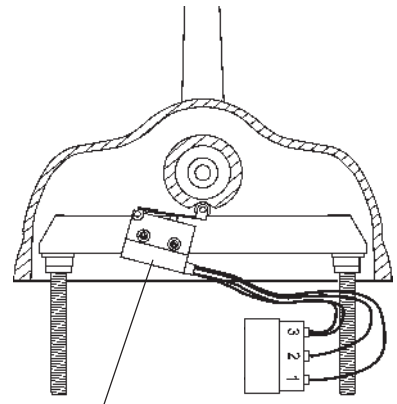
Fault indication

Warning is displayed in the tachometer/display.

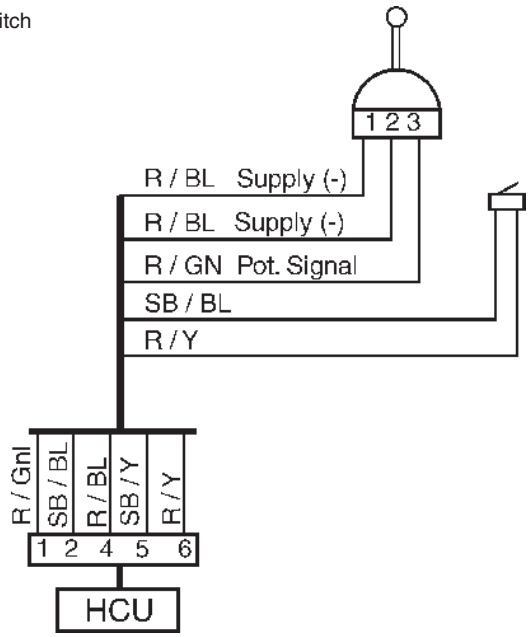
Red lamp flashes in alarmpanel + audible warning.

Symptom

- Not possible to crank the engine
- Not possible to make this station active.
- The system will command the gear to neutral.
- The engine will go to limp home speed.
- Cranking disabled. Cranking permitted after acknowledge.



Neutral switch



Cable description

Pin number 1 and number 3 on the neutral switch is closed when lever is in neutral position.

Fault tracing

FMI 5

Conditions for fault code

Neutral switch does not indicate neutral when the lever is in calibrated neutral position.

Possible reason:

- Open circuit in the neutral switch cable between the lever and the SHCU.

Suitable action

1

Check lever(s) potentiometer for internal short or open circuit or if the neutral switch does not work correctly.

2

Check the neutral switch cable between the neutral switch and the SHCU.

3

Check mechanical connection between the neutral switch and the lever arm.

FMI 7

Conditions for fault code

Neutral switch does not indicates neutral when the lever is in calibrated neutral position.

Possible reason:

- Neutral switch is activated even if the lever is not in neutral position.
- Neutral position switch not centered in control.

Suitable action

1

Check that the neutral switch works correctly.

2

Check mechanical connection between the neutral switch and the lever arm.

3

Check lever(s) potentiometer for internal short or open circuit.

Measurements

Checking the neutral switch

Special tools: 9812519

1

NOTE! Cut the current with **the main switch.**

2

Disconnect the X7 connector at the HCU. Connect the X7 connector to the adapter cable 88890016 with measurebox 9998699.

3

Use multimeter 9812519 to do resistance measurement towards the neutralswitch.

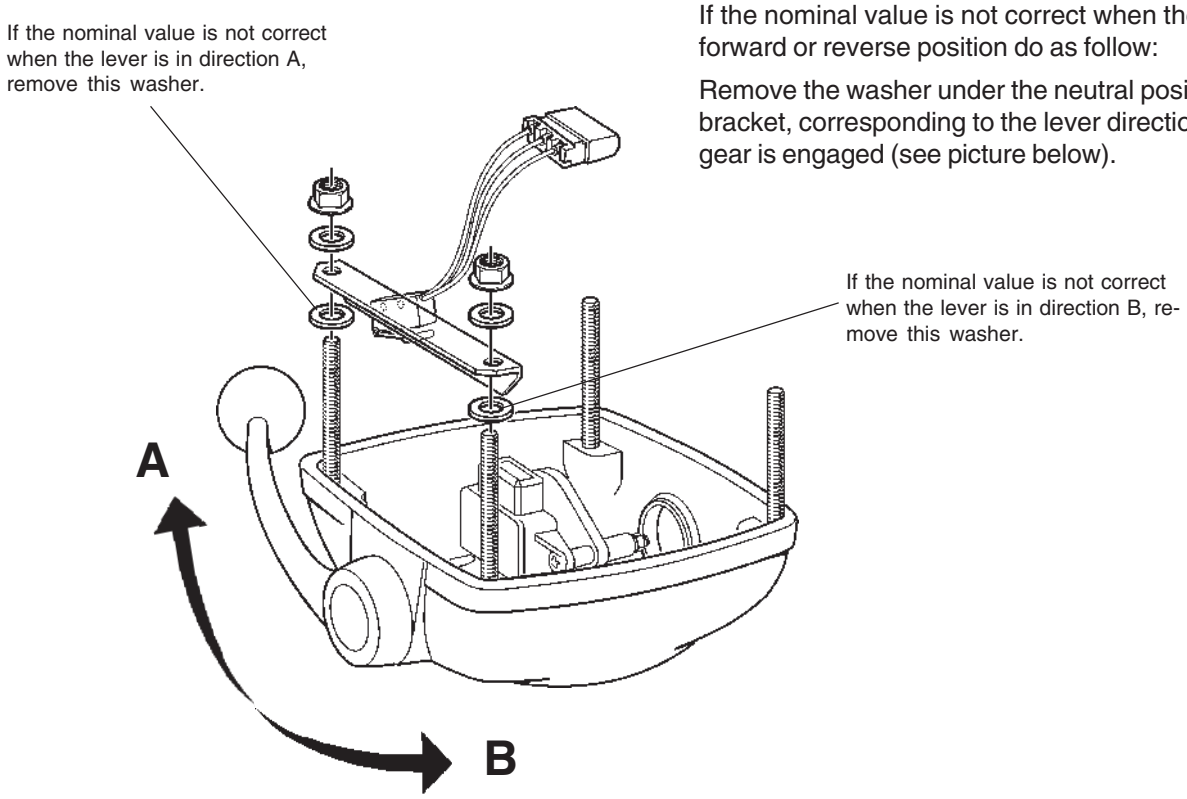
Measurement points	Nominal value
11 – 15 (Gear in neutral position)	R ≈ 0 Ω
11 – 15 (Gear in forward position)	R ≈ ∞ Ω
11 – 15 (Gear in reverse position)	R ≈ ∞ Ω

4

Switch the ignition on and take the active helm station. Go to “log test” in VODIA and select parameter “MID 187 Requested gear” and click “Play”. Use the control to shift gear and see if the parameter tracks the control.

If the nominal value is not correct when the lever is in forward or reverse position do as follow:

Remove the washer under the neutral position switch bracket, corresponding to the lever direction when a gear is engaged (see picture below).



MID 164, SID 231

Sync bus communication fault

MID 164: SHCU

Fault code

FMI 2: Data erratic, intermittent or incorrect.

FMI 9: High numbers of error frames.

FMI	Fault code explanation
2, 9	Unit has detected too many errors on the CAN communication and has shut down the interface or timeout on frame(s) from other powertrain.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel.

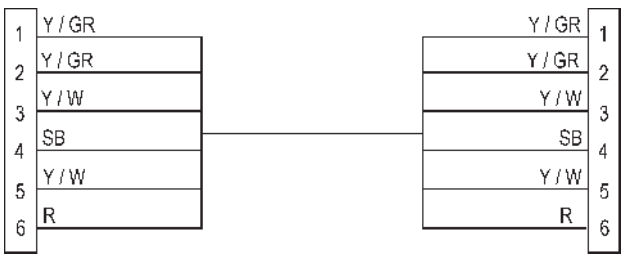
Symptom

- Loss of engine sync.
- Display information from other power train lost in single display / dual engine installations.
- No data from the Multi sensor.

Circuit description

Child lock/Station lock is supported and the sync cable between the drive lines, needs to be installed in a twin installation at all helm stations.

The sync cable consists of power supply on pin 4 and 6, and two pairs of CAN-buses. One bus uses pin 1 and 3, the other one uses pair 2 and 5.



Sync cable

CAN H
CAN H
CAN L
Battery negative
CAN L
Battery positive

Fault tracing

Preconditions

Node is SHCU.

FMI 2

Conditions for fault code

Bus error from the communication circuit.

Possible reason

Open circuit in multilink cable between helms.

Suitable action

1
Check that other segment is powered up by activating one of the helms connected to that segment.

2
Check multilink wiring between helms. See “Manual fault tracing in bus cables”.

FMI 9

Conditions for fault code

Too many error frames

Suitable action

1

Check that other segment is powered up by activate one of the helms connected to that segment.

2

Check multilink wiring between helms. See “Manual fault tracing in bus cables”.

MID 164, SID 250
SAE J1708 / J1587 data link

MID 164: SHCU
Fault code

FMI 12: Bad intelligent device or component.

FMI	Fault code explanation
12	The communication over the J1708 interface to instruments is monitored. Fault is set if helm can not recieve out data on the bus.

Fault indication

Warning is displayed in the tachometer/display.

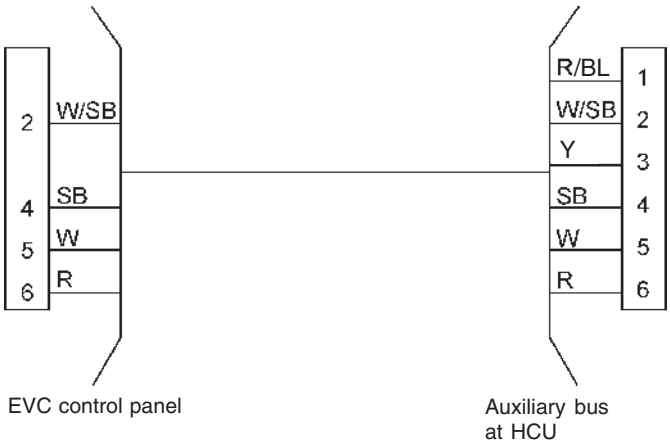
Orange lamp flashes in the alarmpanel

Symptom

- Instruments connected to J1587 do not work.

Circuit description

The EVC control panel gets its power supply from the SHCU. The EVC control panel communicates over the auxiliary bus with the SHCU.



Buzzer positive

J1708B

Easy link data

Battery negative

J1708A

Battery positive

Fault tracing

Preconditions

- Power to instrument bus is OK.
- Node is SHCU.

FMI 12

Conditions for fault code

There is no echo on the J1708 bus.

Possible reason:

- Short circuit between J1708A, pin 5, and battery negative pin 3 or pin 4 in wire harness between the EVC control panel and the SHCU.
- Short circuit between any or both of the J1708 wires to battery positive on pin 1 or pin 6.
- Fault in third part instrument(s).

Suitable action

1

Disconnect all third part instruments.

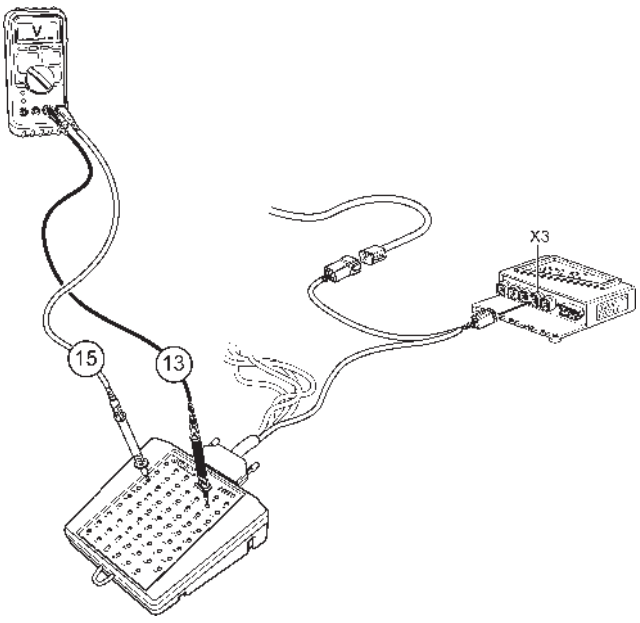
2

Check data/instrument bus wiring between the EVC control panel (and the power trim panel if installed) and the SHCU.

Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Checking the power supply:



1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the EVC and the SHCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on. Turn the ignition on.

Measurement points	Nominal value
13 - 15	U ≈ Battery voltage

MID 164, PSID 64

Joystick fault

MID 164: SHCU

FMI 9: Data missing or incorrect.

FMI 12: Faulty device or component.

FMI	Fault code explanation
9	SHCU unit has detected too may errors on the CAN communication and has shut down the interface or timeout on frame/frames from the joystick unit. SHCU unit has not detected any communication from the joystick unit.
12	SHCU unit has detected that the joysticks x, y, z value are out of range or faulty.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Docking mode can not be activated. No steering pin functionality

Fault tracing

Preconditions

FMI 9: Docking must be activated in DST2.

FMI 9

Conditions for fault code

The HCU unit has not detected any communication from the joystick unit.

Suitable action

1

Check wiring between joystick and SHCU unit.

FMI 12

Conditions for fault code

One of the signals x, y, z are above maximum value or below minimum value (position)/calibrated operational range.

Suitable action

1

Redo joystick calibration.

2

Change joystick unit.

MID 164, PSID 65
Joystick on-button

MID 164: SHCU

FMI 4: Voltage below normal or shorted to low.

FMI	Fault code explanation
4	SHCU unit has detected that the docking activation button is faulty.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Docking mode can not be activated. No steering pin functionality

Fault tracing

FMI 4

Conditions for fault code

The button has been pressed for more than 2 minutes.

Suitable action

1

Change joystick unit.

MID 164, PSID 66

Joystick hi-button

MID 164: SHCU

FMI 4: Voltage below normal or shorted to low.

FMI	Fault code explanation
4	HCU unit has detected that the work speed button is faulty.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Work speed mode can not be changed, is controlled by the Hi button.

Fault tracing

FMI 4

Fault condition

The button has been pressed for more than 2 minutes.

Suitable action

1

Change joystick unit.

MID 164, PSID 67

Joystick sync fault

MID 164: SHCU

FMI 9: Data missing or incorrect.

FMI	Fault code explanation
9	Joystick angles x, y and z between the two drive lines deviates.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

No docking function.

Fault tracing

FMI 9

Conditions for fault code

Valid sync data (joystick position x, y, z) from other drive train deviates with more than 5%.

Suitable action

1

Change joystick unit.

MID 164, PSID 95

Lever detection

MID 164: SHCU

Fault code

FMI 7: Mechanical system not responding properly

FMI 12: Bad intelligent device or component.

FMI	Fault code explanation
7, 12	Helm can not determine type or numbers of control levers. Fault is set when Lever calibration is initiated.

Fault indication

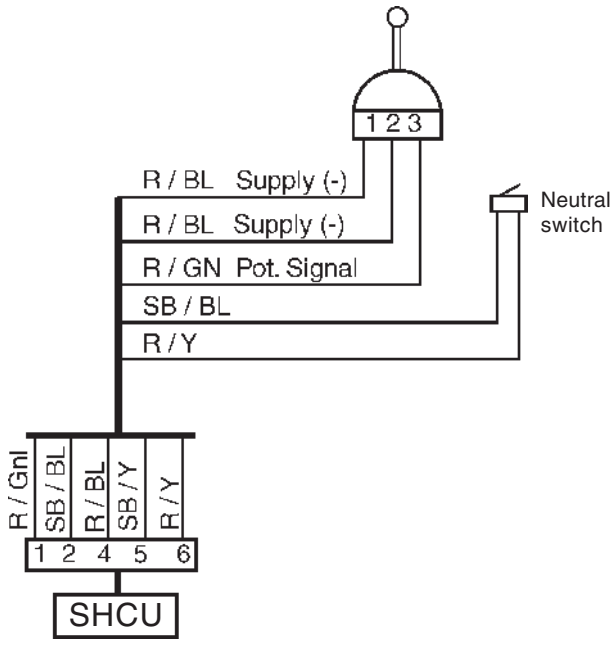
Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel

Symptom

- SHCU exits lever calibration mode and indicates an error.
- Not possible to calibrate levers.

Circuit description



Connector: X7
Colour: Blue

Fault tracing

Preconditions

Units is in lever calibration mode.

FMI 7

Conditions for fault code

No neutral switch detected when entering calibration mode.

Possible reason

- Lever is of wrong type.
- Connection problem between lever and SHCU.
- Lever is not in neutral position.
- Activated neutral switch.

Suitable action

1

Check that the lever is of correct type.

2

Check the connection between the lever and the SHCU

3

Check that the lever is straight up when entering calibration mode.

4

Check if the neutral switch is activated.

FMI 12

Conditions for fault code

Faulty lever connected or fault resistance value is checked when entering calibration mode.

Possible reason

- Lever is of wrong type.
- Connection problem between lever and SHCU.
- Lever is not in neutral position.

Suitable action

1

Check that the lever is of the correct type.

2

Check connection between levers and SHCU.

3

Check that the lever is straight up when entering calibration mode.

4

Check that the lever potentiometer is of the correct type (see "Checking the potentiometer in electronic controls" under MID 164, PPID 390).

MID 164, PSID 96

Calibrated lever travel too small

MID 164: SHCU

Fault code

FMI 13: Out of calibration

FMI	Fault code explanation
13	The travel between calibrated points is too small.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- SHCU exits lever calibration mode and indicates an error.
- Not possible to calibrate levers.

Fault tracing

Preconditions

Units is in lever calibration mode.

FMI 13

Conditions for fault code

Lever calibration fault.

Possible reason

Too small reading between calibration points on any lever.

Suitable action

1
Check that there is enough room to move the lever.

2
Turn ignition off, then re-enter the calibration mode.

3
Follow the steps in the installation manual carefully.

4
Check that the potentiometer value changes when moving the lever.

MID 164, PSID 97

Lever calibration procedure

MID 164: SHCU

Fault code

FMI 13: Out of calibration

FMI	Fault code explanation
13	There has been some kind of error when the levers are calibrated, e.g neutral button pressed at the wrong time.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

SHCU exits lever calibration mode and indicates an error.

Fault tracing

Preconditions

Units is in lever calibration mode.

FMI 13

Conditions for fault code

Lever calibration fault.

Possible reason

- No communication with PCU during calibration.
- Neutral button pressed at the wrong moment during calibration.

Suitable action

1
Check that there is enough room to move the lever.

2
Turn ignition off, then re-enter the calibration mode.

3
Follow the lever calibration steps in the installation manual carefully.

MID 164, PSID 98
Lever(s) not calibrated

MID 164: SHCU
Fault code

FMI 13: Out of calibration.

FMI	Fault code explanation
13	The SHCU lever setup is not calibrated and can not run PCU control data without performing calibration.

Fault indication

Warning is displayed in the tachometer/display.

Orange lampa blinkar i larmdisplayen.

Symptom

Impossible to select active station.

Fault tracing

Preconditions

- Power ON.
- The SHCU is in lever calibration mode.

FMI 13

Conditions for fault code

Lever calibration fault.

Possible reason

No calibrated lever setup has been detected on power up.

Suitable action

1
Check that there is a lever installed.

2
Perform an auto configuration and the lever calibration.

3
Check data bus wiring between the SHCU and the PCU.

MID 164, PSID 103

Neutral button

MID 164: SHCU

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
4	Fault on neutral button, either short to ground or supply in the SHCU, wire or panel or the button is mechanical stuck.

Fault indication

None. Fault only visible in Vodia.

Symptom

- No indication if gear is in neutral or not.
- Lamp can either be constantly on or constantly off independent of gearbox status.

Circuit description

The EVC control panel gets its power supply from the SHCU. The EVC control panel communicates over the auxiliary bus with the SHCU.



Buzzer positive

J1708B

Easy link data

Battery negative

J1708A

Battery positive

Fault tracing

Preconditions

Positive supply to panel is OK.

FMI 4

Conditions for fault code

Low reading on more then two minutes

Possible reason

- Defective EVC control panel.

Suitable action

1

Change the EVC control panel.

MID 164, PSID 104

Lighting button (multifunction button)

MID 164: SHCU

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
4	Fault on lighting button (multifunction button) either short to battery negative or supply in SHCU, wire or panel or the button is mechanical stuck.

Fault indication

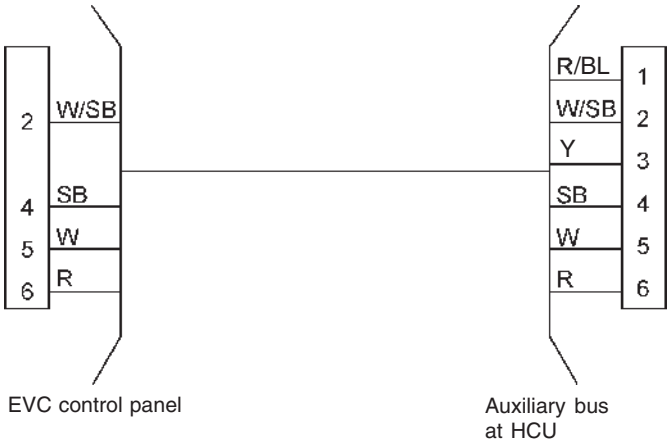
None. Fault only visible in Vodia.

Symptom

- Not possible to change backlight on instrument and panels.
- Not possible to enter monitoring mode on this station.

Circuit description

The EVC control panel gets its power supply from the SHCU. The EVC control panel communicates over the auxiliary bus with the SHCU.



Fault tracing

Preconditions

Positive supply to panel is OK.

FMI 4

Conditions for fault code

Low reading on more then two minutes

Possible reason

- Defective main panel.

Suitable action

1

Change the EVC control panel.

MID 164, PSID 105

Active station button

MID 164: HCU

Fault code

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
4	Fault on active station button, either short to battery negative or supply in SHCU, wire or panel or the button is mechanical stuck.

Fault indication

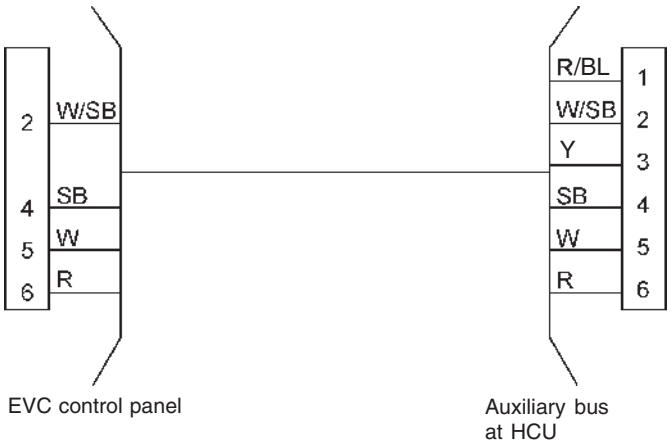
None. Fault only visible in Vodia.

Symptom

- Active station lamp may either be on or off independent of the status for this helm station.
- Not possible to request active station if station was passive before the error.

Circuit description

The EVC control panel gets its power supply from the SHCU. The EVC control panel communicates over the auxiliary bus with the SHCU.



Fault tracing

Preconditions

Positive supply to panel is OK.

FMI 4

Conditions for fault code

Low reading on more then two minutes.

Possible reason

- Defective EVC control panel.

Suitable action

1
Change the EVC control panel.

MID 164, PSID 106

Start

MID 164: SHCU
Fault code

FMI 3: Voltage above normal or shorted high.

FMI	Fault code explanation
3	The start signal is high for more than 1 minute.

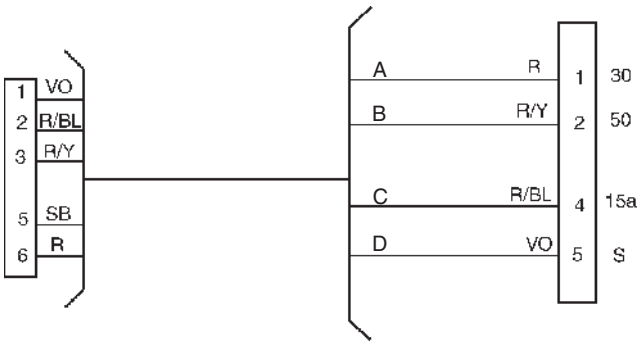
Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

Engine starts cranking without the key or start button is activated.



HCU connector: X4

Key connector
Colour: Grey

Circuit description

A. Power supply

B. Starter motor

C. 15a

D. Stop

When the main switch is closed pin 1 in the key lock gets system voltage. When the key is turned to position 1 pin 4 in the key lock gets system voltage from pin 1.

To get the startermotor to run the key is turned to position 3 and pin 2 in the keylock gets system voltage from pin 1.

While the key is turned to position 3 pin 4 in the keylock still needs to have system voltage therefore a diode is placed between pin 2 and pin 4 to uphold the voltage in pin 4. The voltage at pin 4 in this case will be system voltage minus the voltage drop over the diode.

When the key is turned to position S pin 5 gets system voltage.

Fault tracing

Preconditions

None.

FMI 3

Conditions for fault cod

Start activated for more than 1 minute.

Suitable action

1
Check the wiring to the key lock and the key lock for primarily short circuits.

Vodia logging Key panel status 

1

Choose log test.

2

Choose MID 164, Key panel status

3

Starter key in position I.

Parameter	Nominal value
Crank input status	off

If the starter key is turned to position III the “Crank input status” should change status.

Parameter	Nominal value
Crank input status	on

Key test

Please refer to, “Key test” described under faultcode MID 164, PPID 394.

MID 164, PSID 107

Stop

MID 164: SHCU
Fault code

FMI 3: Voltage above normal or shorted high.

FMI	Fault code explanation
3	The stop signal is high for more than 1 minute.

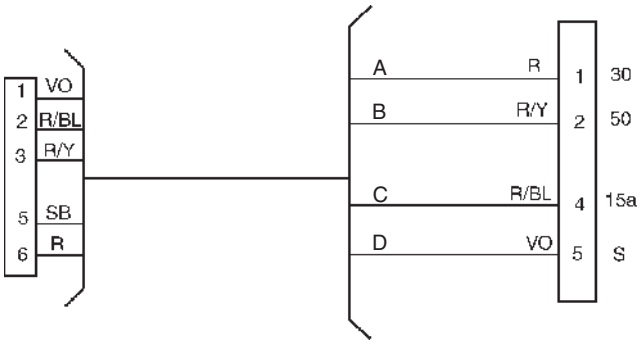
Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Impossible to start engine the first minute from ignition on.
- Possible to start engine after that if the error has been acknowledged with the diagnostic button.
- If the engine is started it is impossible to stop it from the helm.
  NOTE! Shut down the engine by pressing down the AUX-stop-button.



HCU connector: X4

Key connector
Colour: Grey

Circuit description

A. Power supply

B. Starter motor

C. 15a

D. Stop

When the main switch is closed pin 1 in the key lock gets system voltage. When the key is turned to position 1 pin 4 in the key lock gets system voltage from pin 1.

To get the startermotor to run the key is turned to position 3 and pin 2 in the keylock gets system voltage from pin 1.

While the key is turned to position 3 pin 4 in the keylock still needs to have system voltage therefore a diode is placed between pin 2 and pin 4 to uphold the voltage in pin 4. The voltage at pin 4 in this case will be system voltage minus the voltage drop over the diode. When the key is turned to position S pin 5 gets system voltage.

Fault tracing

Preconditions

None.

FMI 3

Conditions for fault code

Stop activated for more than 1 minute (if stop shorted high it takes up to 60 sec for all instruments to come alive. No fault indication is shown).

Suitable action

1

Check the wiring to the key lock and the key lock for primarily short circuits.

Vodia logging Key panel status 

1

Choose log test.

2

Choose MID 164, Key panel status

3

Starter key in position I.

Parameter	Nominal value
Stop input status	off

If the starter key is turned to position S the “Stop input status” should change status.

Parameter	Nominal value
Stop input status	on

Key test

Please refer to, “Key test” described under faultcode MID 164, PPID 394.

MID 164, PSID 133

Steering wheel data link

MID 164: SHCU

Fault code

FMI 2: Data erratic, intermittent or incorrect.

FMI 5: Open circuit.

FMI 9: Abnormal update rate.

FMI	Fault code explanation
2, 5, 9	SHCU unit has detected too may errors on the CAN communication and has shut down the interface or timeout on frame/frames from the Steering wheel unit. SHCU unit has not detected any communication from the Steering wheel unit.

Fault indication

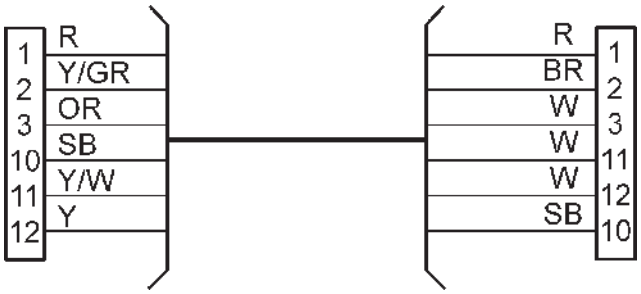
Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel

Symptom

- No steering response and drive train to safe mode
- Only error information, the drive train operates on the other side steering wheel signals

Circuit description



SHCU connector
X8 Brown

Steering wheel

Power supply, 12V / 24V

CAN H

Power supply, 0V

Back up power supply, 0 V

CAN L

Back up power supply, 12V / 24V

Fault tracing

FMI 2

Conditions for fault code

Too many error frames or time out.

Suitable action

1
Check connectors and wires between steering wheel and SHCU unit for bad contact. See “Manual fault tracing in bus cables”.

FMI 5

Conditions for fault code

One wire mode communication.

Suitable action

1
Check connectors and wires between steering wheel and SHCU unit for bad contact. See “Manual fault tracing in bus cables”.

FMI 9

Conditions for fault code

The SHCU unit has not detected any communication from the steering wheel unit.

Possible reason

- Open circuit in wiring between steering wheel and SHCU.
- Short circuit between wires.

Suitable action

1
Check connectors and wires between steering wheel and SHCU unit for bad contact. See “Manual fault tracing in bus cables”.

2
Try with another SHCU.

3
Try with another steering wheel unit.

MID 164, PSID 134
Steering wheel module

MID 164: SHCU

Fault code

FMI 12:Faulty device or component.

FMI	Fault code explanation
12	Fault in one of the two encoders channels in the steering wheel unit.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel.

Symptom

None.

Fault tracing

FMI 12

Conditions for fault code

Steering wheel unit send encoder fault.

Suitable action

1
Change steering wheel unit.

MID 164, PSID 135
Steering wheel brake

MID 164: SHCU

Fault code

FMI 12:Faulty device or component.

FMI	Fault code explanation
12	Internal fault of the friction brake.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel.

Symptom

Brake does not work, or works only with reduced torque.

Fault tracing

FMI 12

Conditions for fault code

Brake fault message from Steering wheel unit (hardware fault in the brake or temperature fault in the steering wheel).

Suitable action

1
Change steering wheel unit.

MID 164, PSID 136
Steering wheel controller

MID 164: SHCU

Fault code

FMI 12:Faulty device or component.

FMI	Fault code explanation
12	Internal fault in the micro controller.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel.

Symptom

Variable.

Fault tracing

FMI 12

Conditions for fault code

Steering wheel unit sends program failure message to SHCU.

Suitable action

1
Change steering wheel unit.

MID 164, PSID 137

Rudder angle

MID 164: SHCU

Fault code

FMI 9: Abnormal update rate.

FMI 12:Faulty device or component.

FMI	Fault code explanation
9, 12	SHCU detects an error integrity fault in rudder angle value from SUS.

Fault indication

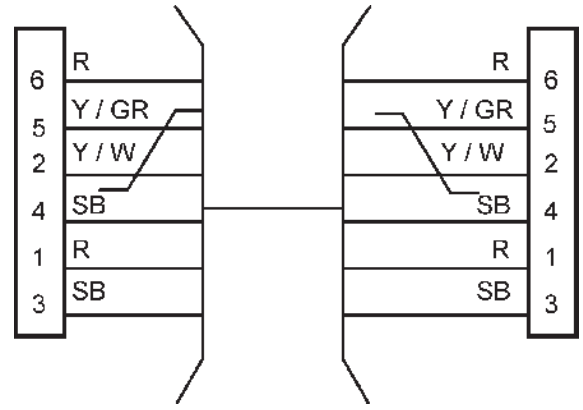
Warning is displayed in the tachometer/display.

A red lamp flashes in the alarmpanel + Audible warning.

Symptom

- Not possible to steer on one or both sides.
- Drive train in failsafe mode.

Circuit description



SHCU connector or
SUS connector

PCU connector
Conn. X2
Colour: Green

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

FMI 9, 12

Conditions for fault code

Integrity fault in current rudder angle frame from SUS unit.

Possible reason

- Open circuit in both CAN L and CAN H between SUS and PCU.
- Software problem in SUS.

Suitable action

1

Check connectors and wires between SUS and PCU for bad contact. See “Manual fault tracing in bus cables”.

2

Reprogram the SUS.

3

Check resolver connector.

MID 164, PSID 138

Steering position divergence

MID 164: SHCU

Fault code

FMI 10: Abnormaly large variations.

FMI	Fault code explanation
10	Requested rudder angle between the two drive lines deviates.

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarmpanel + audible warning.

Symptom

No steering function (both SUS units locked). Boat in lowspeed mode.

Fault tracing

FMI 10

Conditions for fault code

If valid sync data from other sides drive train and it deviates with steering wheel position more than (± 5 degrees).

Suitable action

1
Change steering wheel unit.

MID 164, PSID 140
Incompatible sync bus version

MID 164: SHCU

FMI 12: Faulty device or component

FMI	Fault code explanation
12	Incompatible sync bus communication protocol in one SHCU.

Fault indication

Warning is displayed in the tachometer/display.

An orange lamp flashes in the alarm panel.

Symptom

- Engine sync does not work.

Fault tracing

FMI 12

Conditions for fault code

The SHCU that set the faultcode has the wrong software regarding the sync bus communication.

Suitable action

1

Download new SHCU software from Partner network and reprogram the SHCU that set the faultcode.

MID 164, PSID 218

Data bus passive / active helm communication failure

MID 164: SHCU

Fault code

FMI 8: Abnormal frequency, pulse width, or period.

FMI 9: Abnormal update rate.

FMI	Fault code explanation
8, 9	**Passive helm:** Communication between this SHCU and PCU has been lost. Each SHCU detecting this fault will set the error. **Active helm:** This SHCU has lost communication with PCU while it was in active state.

Fault indication

Warning is displayed in the tachometer/display.

Passive helm:
An orange lamp flashes in alarmpanel.

Active helm:
A red lamp flashes in alarmpanel + Audible warning.

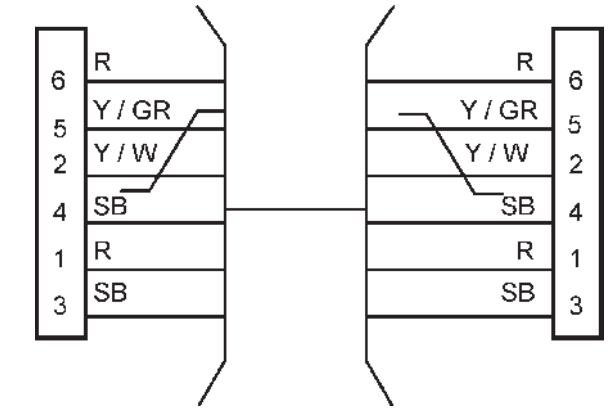
Symptom

Passive helm:

- Sync lost if failure occurs on master SHCU.
- Monitoring not possible on this SHCU.

Active helm:

- Engine goes to limp home mode.
- Gear disengaged.
- Impossible to start engine from key / start-stop panel connected to this SHCU.



Connector SHCU

Connector PCU
Connector X2
Colour Green

Circuit description

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

Passive helm:

- This SHCU has been configured on the network.

Active helm:

- Network configured.
- Helm is active.

FMI 8, 9

Conditions for fault code

SHCU receives no frames from PCU for 5 seconds.

Possible reason

Open circuit in both CAN wires to SHCU.

Suitable action

1
Check connectors and wires between SHCU(s) and PCU for bad contact. See “Manual fault tracing in bus cables”.

MID 164, PSID 226

SHCU communication failure with other helm

MID 164: SHCU
Fault code

FMI 9: Abnormal updating rate.

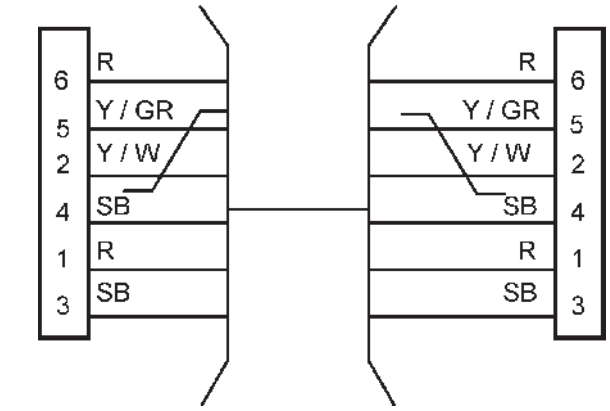
FMI	Fault code explanation
9	SHCU has lost communication with a helm that previously has been configured on the network.

Fault indication

The fault code is only visible in Vodia.

Symptom

Impossible to make request active station from one or more helm stations.



Connector SHCU

Connector PCU
Connector X2
Colour:Green

Circuit description

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

Network configured.

FMI 9

Conditions for fault code

Frames from a specific, passive, SHCU is missing for more than 5 seconds.

Possible reason

- Open circuit in both CAN L and CAN H wires into the PCU from a SHCU.
- Fault in the power supply to the SHCU.

Suitable action

1

Check data bus wiring between PCU and SHCU. Check connectors and wires for bad contact. See “Manual fault tracing in bus cables”.

2

Check the power supply to the SHCU.

MID 187/164, PSID 231
Incompatible Chassi ID

MID 187: PCU
MID 164: SHCU

FMI 2: Data Erratic.

FMI	Fault code explanation
2	SHCU: SHCU unit checks the VIN number (Vehicle Indication number=chassie number) between all ECU that are connected to the EVC bus. PCU: The PCU checks if the VIN number is correct between the PCU and the engine ECU.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Not possible to engage any gear.
- Not possible to calibrate units before the chassie number is correct.

Fault tracing

Preconditions

The network need to be programmed.

The system needs to be auto configured

FMI 2

Conditions for fault code

SHCU: SHCU checks that the chassie number is incorrect between the HCU and PCU.

PCU: PCU checks that the chassie number is incorrect between the PCU and engine ECU.

Suitable action

1

Check article and chassie numbers on all EVC nodes to determine which one is wrong.

2

Reprogram that unit.

MID 187, PID 96

Fuel level

MID 187: PCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
3, 4	There is a fuel level sensor connected to the system.

Fault indication

The fault code is only visible in Vodia.

Symptom

Invalid reading of the fuel level on display or gauge.



Connector: X3
Colour: Light red

Fuel level sensor connector

Circuit description

Battery negative

Fuel level signal

Fault tracing

Preconditions

None.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

- Open circuit in the fuel level wiring.

Suitable action

1
Check wiring from fuel level sensor to the connection to the EVC system.

2
Check fuel sensor.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Suitable action

1
Check wiring from fuel level sensor to the connection to the EVC system.

2
Check fuel sensor.

Measurement

Special tools: multimeter 9812519

Checking the fuel level signal

1

NOTE! Turn the starter key to position 0.

2

Disconnect the fuel level sensor

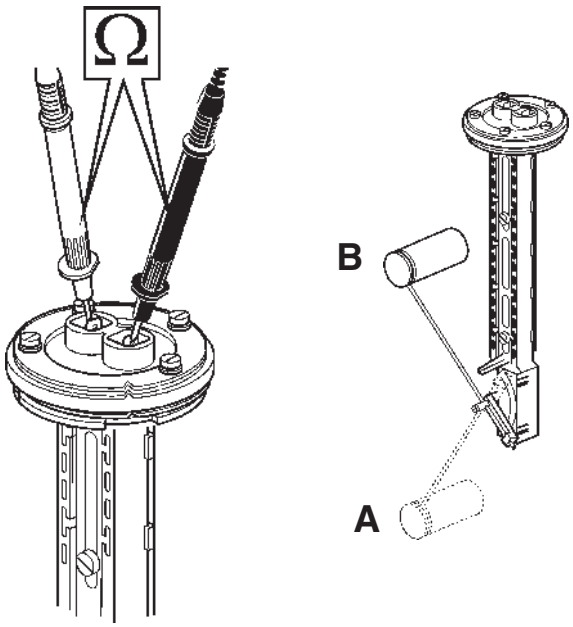
3

Use multimeter 9812519 for voltage measurement

4

NOTE! Turn the starter key to position 1.

Measurement points	Nominal value
1 – 2	U ≈ 0.9 x battery voltage



Checking the fuel level sensor (part no. 873772)

Special tools: Multimeter 9812519

1

NOTE! Turn the starter key to **position 0**.

2

Remove the connector from the sensor.

3

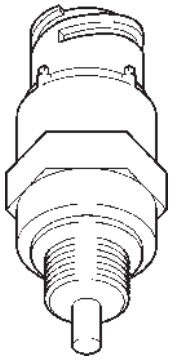
Use multimeter 9812519 to measure the resistance between the two terminal pins on the level sensor.

Nominal values:

Empty tank (A)	R ≈ 3 ±2 Ω
Full tank (B)	R ≈ 180 ±15 Ω

MID 187, PID 127

Transmission oil pressure sensor



MID 187: PCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
3, 4	Fault on the gearbox pressure sensor.

Fault indication

FMI 3, 4 None.

Symtom

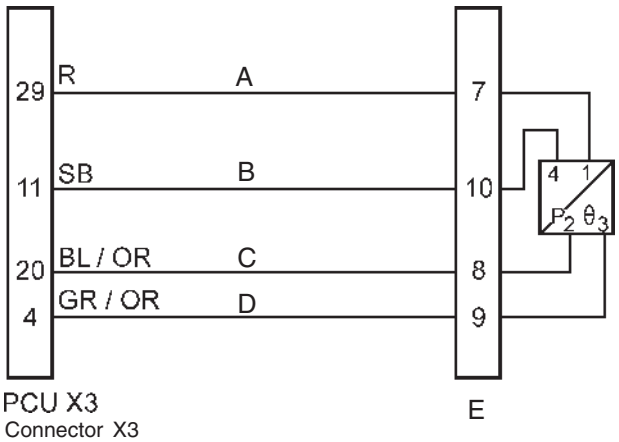
- Instruments for gearbox pressure shows wrong value.
- FMI 3, 4: None.

Circuit description

The reverse gear oil temperature and the reverse gear oil pressure sensor is a combined sensor. The sensor is an active sensor, i.e. the sensor must receive operating voltage.

Pin 29 on the PCU provides pin 1 on the sensor, via the gearbox connector,with an operating voltage of +5 Volt. Pin 4 on the sensor is connected to battery negative via pin 11 on the PCU, via the gearbox connector.

The output signal from the reverse gear oil pressure sensor pin 2 on the sensor to pin 20 on the PCU, is a voltage signal that is proportional to the reverse gear oil pressure.



A. Gear sensor supply plus (+)
B. Gear sensor supply minus (–)
C. Gear pressure input
D. Gear temperature input
E. Gearbox connector

Fault tracing

Preconditions

Autoconfiguration has detected a transmission temperature and pressure sensor.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

- Open circuit in oil pressure signal cable.
- Open circuit in the oil pressure 5V supply cable.
- Short circuit between oil pressure signal cable and the sensor 5V supply cable.
- Faulty sensor.

Suitable action

1

Check if there is a short circuit or open circuit in the cables between the PCU and the reverse gear oil pressure sensor.

2

Disconnect and reconnect X3 connector at the PCU.

3

Check reverse gear oil pressure sensor.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Possible reason

- Short circuit between the oil pressure signal cable and battery negative.
- Faulty sensor.

Suitable action

1

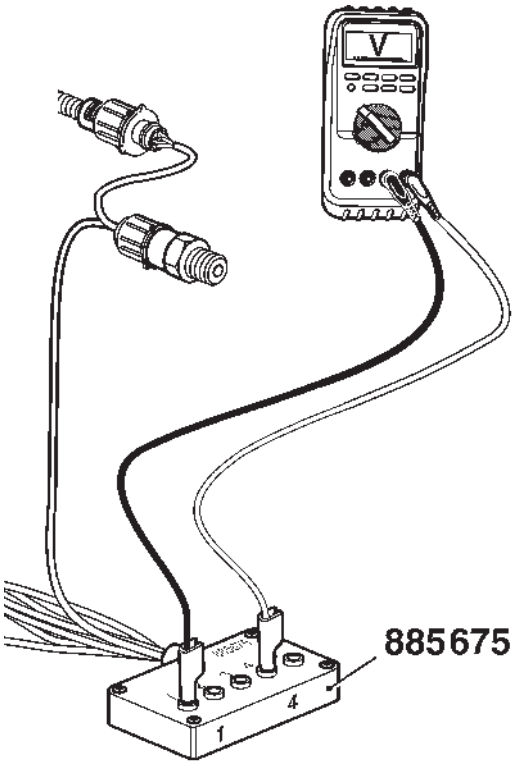
Check if there is a short circuit or open circuit in the cables between the PCU and the reverse gear oil pressure sensor.

2

Disconnect and reconnect X3 connector at the PCU.

3

Check reverse gear oil pressure sensor.



Measurements

Supply cable:

Special tools: Adapter cable 885675, multimeter 9812519.

1

NOTE! Turn ignition off.

2

Remove the connector from the sensor. Connect adapter cable 885675 between the sensor and engine control unit.

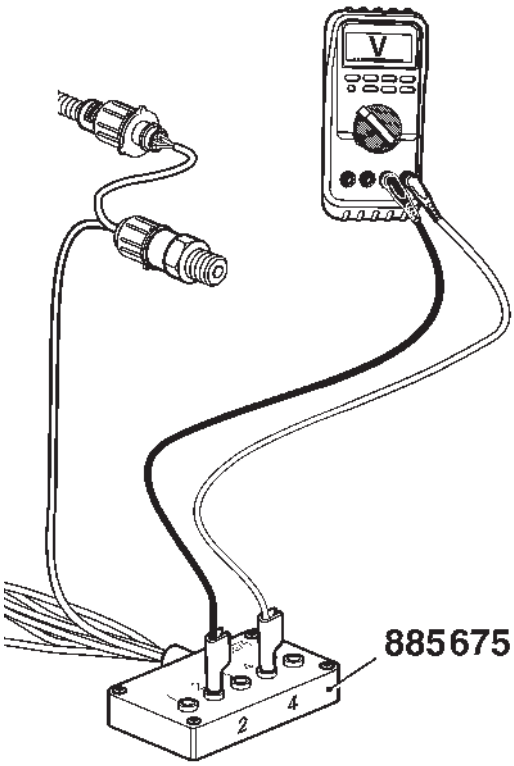
3

Use multimeter 9812519 for voltage measurement

4

Turn ignition on.

Measurement points	Nominal value
1 - 4	U ≈ 5 V



Checking the sensor

Special tools: Adapter cable 885675, multimeter 9812519.

1

NOTE! Ignition off.

2

Disconnect wireharness to sensor.

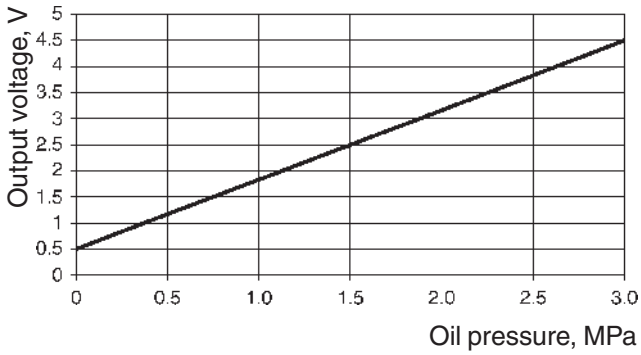
3

Connect adapter cable 885675 between sensor and the PCU.

4

Use multimeter 9812519 for measuring voltage.

Measuring points	Set point
2 - 4	U ≈ 0,5 V



Specification

Operating range ..... 0–3 MPa (0–30 bar)

Supply voltage ..... 5,00 ±0,25 V DC

Nominal output voltage at 25 °C and supply voltage 5,00 VDC:

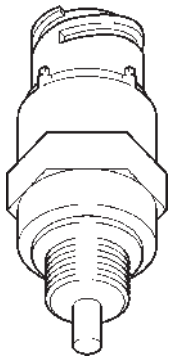
0,5 V DC at ..... 0 kPa (0 bar)*

4,5 V DC at ..... 3 MPa (30 bar)*

* **Note.** At normal atmospheric pressure.

MID 187, PID 177

Transmission oil temperature sensor



MID 187: PCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

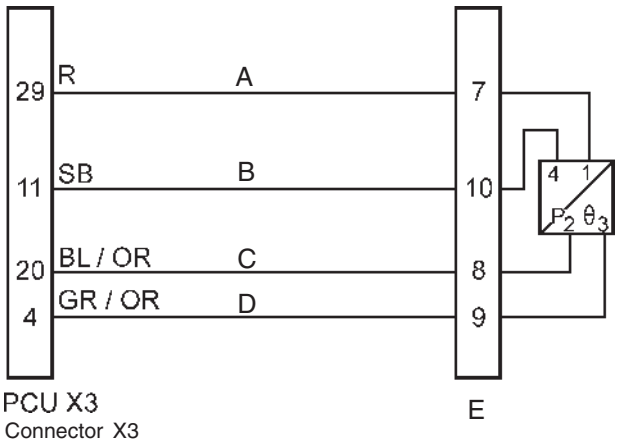
FMI	Fault code explanation
3, 4	Fault on the gearbox pressure sensor.

Fault indication

FMI 3, 4 None.

Symtom

- Instruments for gearbox temperature shows wrong value.



A. Gear sensor supply plus (+)
B. Gear sensor supply minus (–)
C. Gear pressure input
D. Gear temperature input
E. Gearbox connector

Circuit description

The oil temperature sensor consists of a thermistor which forms a closed circuit with an internal resistor in the PCU. The thermistor resistor changes in a non-linear manner, depending on the oil temperature.

The PCU provides the circuit with a reference voltage of +5 Volt from pin 29 on the PCU. The PCU measures the voltage drop over the thermistor via pin 11 and pin 4 on the PCU. Pin 4 on the sensor is connected to battery negative via pin 11 on the PCU.

When the oil is cold, the thermistor resistance is high and the PCU senses a high voltage drop. As the oil warms up, the resistance in the thermistor falls and the voltage drop across it falls.

Fault tracing

Preconditions

Autoconfiguration has detected a transmission temperature and pressure sensor.

FMI 3

Conditions for fault code

Voltage above normal or shorted high.

Possible reason

- Open circuit in the oil temperature signal.
- Short circuit between oil temperature signal cable and the sensor 5V supply cable.
- Open circuit in the sensor 5V supply cable.
- Faulty sensor.

Suitable action

1

Check if there is a short circuit or open circuit in the cables between the PCU and the reverse gear oil pressure/temperature sensor.

2

Disconnect and reconnect X3 connector at the PCU.

3

Check connectors.

4

Check reverse gear oil temperature sensor.

FMI 4

Conditions for fault code

Voltage below normal or shorted low.

Possible reason

- Faulty sensor.
- Short circuit between the oil temperature signal cable and battery negative.

Suitable action

1

Check if there is a short circuit or open circuit in the cables between the PCU and the reverse gear oil pressure/temperature sensor.

2

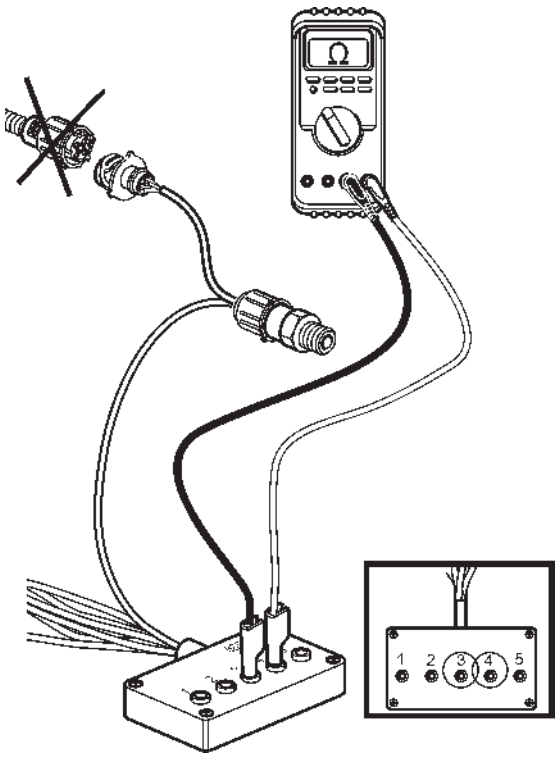
Disconnect and reconnect X3 connector at the PCU.

3

Check connectors.

4

Check reverse gear oil temperature sensor.



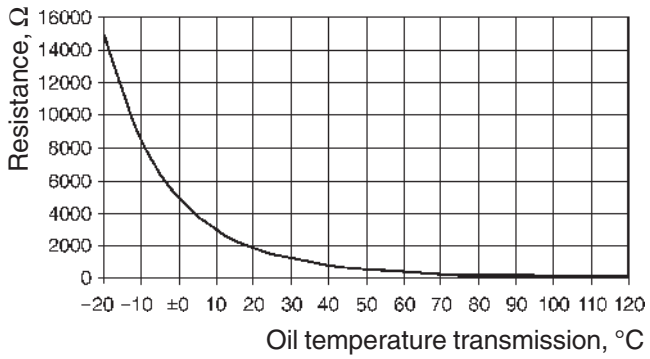
Checking the sensor

Special tools: 885675, 9812519

1
NOTE! Ignition off.

2
Connect adaptorcable (885675) to sensor. Do **not** connect the other end of the adaptor cable.

3
Use multimeter (9812519) for measuring resistance.



Set point at (measurepoints 3– 4):

100°C	R ≈ 104 Ω
80°C	R ≈ 191 Ω
60°C	R ≈ 376 Ω
40°C	R ≈ 798 Ω
20°C	R ≈ 1868 Ω
10°C	R ≈ 2987 Ω
0°C	R ≈ 4930 Ω

MID 187, PPID 400

Transmission sensor supply

MID 187: PCU

Fault code

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

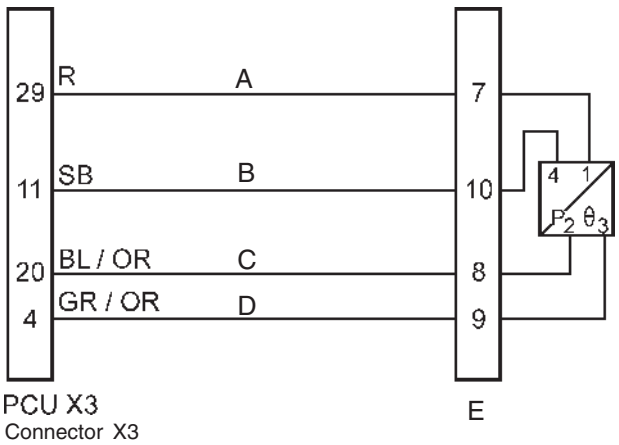
FMI	Fault code explanation
3, 4	Error in the supply line to the temperature sensors in the gearbox / transmission.

Fault indication

None.

Symtom

Instruments for gearbox temperature and gearbox pressure will not have correct values.



A. Gear sensor supply plus (+)
B. Gear sensor supply minus (–)
C. Gear pressure input
D. Gear temperature input
E. Gearbox connector

Circuit description

Sensor is an active sensor, i.e. the sensor must have operating voltage.

Pin 29 on the PCU provides pin 1 on the sensor with an operating voltage of +5 Volt. Pin 4 on the monitor is connected to battery negative via pin 11 on the PCU.

The output signal from the pressure sensor (pin 2 on sensor to pin 20 on the PCU) is a voltage signal which is proportional to the oil pressure. The output signal is linear within the sensors working range.

Fault tracing

Preconditions

Network configured.

FMI 3

Conditions for fault code

- Driver for sensor supply reports an error.
- Measured sensor voltage is out of range.

Suitable action

1

Disconnect and reconnect X3 connector at the PCU.

2

Check the supply voltage to the gearbox sensor.

3

Check wiring harness and connectors to gearbox for short circuits or open circuits.

4

Check the sensor.

FMI 4

Conditions for fault code

- Driver for sensor supply reports an error.
- Measured sensor voltage out of range.

Possible reason

Short circuit in supply to sensor.

Suitable action

1

Disconnect and reconnect X3 connector at the PCU.

2

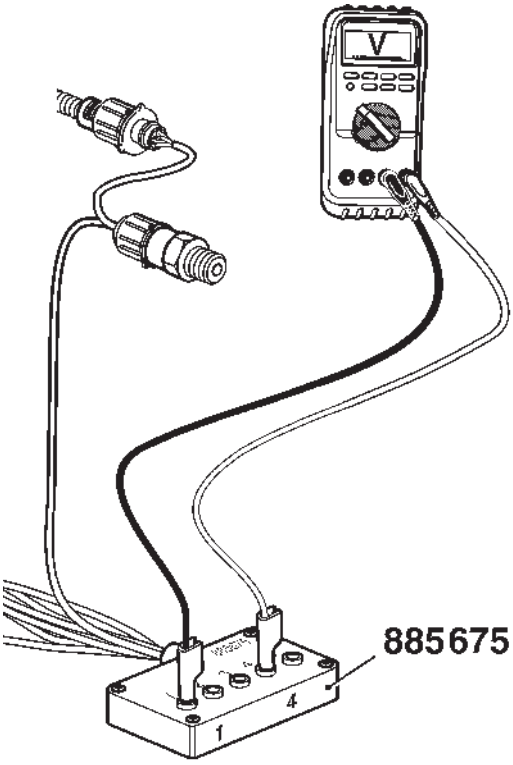
Check the supply voltage to the gearbox sensor.

3

Check wiring harness and connectors to gearbox for short circuits or open circuits.

4

Check the sensor.



Measurements

Supply cable

Special tools: Adapter cable 885675, multimeter 9812519.

1

NOTE! Turn ignition off.

2

Remove the connector from the sensor. Connect adapter cable 885675 between the sensor and engine control unit.

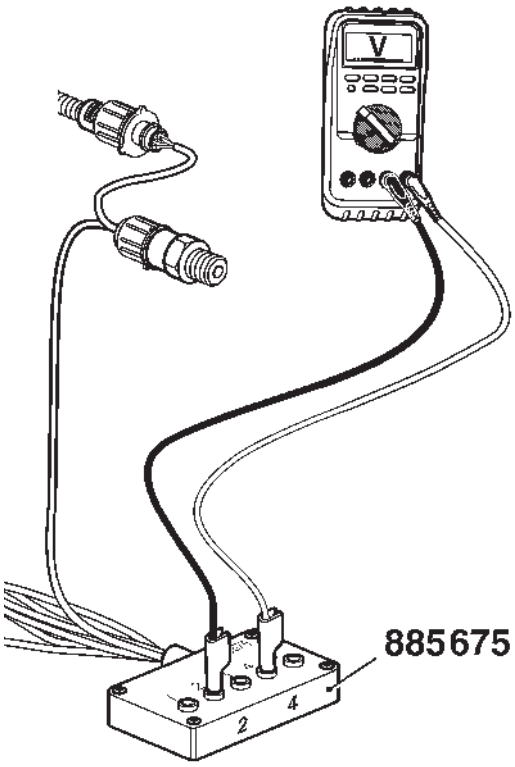
3

Use multimeter 9812519 for voltage measurement

4

NOTE! Turn ignition on.

Measurement points	Nominal value
1 - 4	U ≈ 5 V



Checking the oil pressure sensor

1

NOTE! Turn ignition off.

2

Disconnect the connector from the sensor

3

Connect adapter cable 885675 between the sensor and the engine control unit.

4

Use multimeter 9812519 for voltage measurement

5

Turn ignition on.

Measurement points	Nominal value
2 - 4	U ≈ 0,5 V*

***Note!** At normal atmospheric pressure

Specification

Operating range ..... 0–3 MPa (0–30 bar)

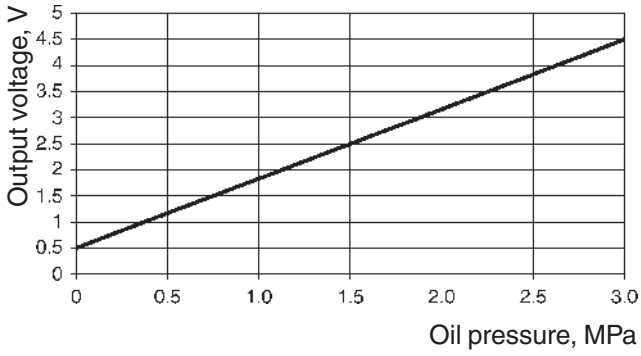
Supply voltage ..... 5,00 ±0,25 V DC

Nominal output voltage at 25 °C and supply voltage 5,00 VDC:

0,5 V DC at ..... 0 kPa (0 bar)*

4,5 V DC at ..... 3 MPa (30 bar)*

* **Note.** At normal atmospheric pressure.



MID 187, SID 231

J1939 Communication warning/fault

MID 187: PCU

Fault code

FMI 2: Data erratic.

FMI 9: High numbers of error frames.

FMI 12: Bad intelligent device or component.

FMI	Fault code explanation
2	Unit has detected too many errors on the CAN communication and has shut down the interface or timeout on frame / frames from engine.
9	This error is set if there are any timing problems on the bus indicated by a high error rate on the bus.
12	Fault has occurred during power up or power down the engine ECU does not respond or does not respond in a correct way.

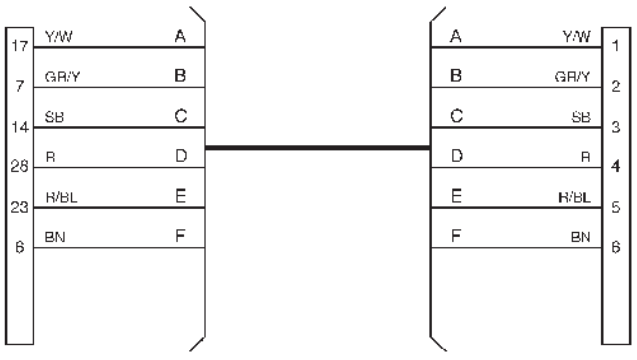
Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- Probable loss of easy link instruments, but not the tachometer.



Connector, PCU

Connector X3
Connector

Circuit description

A. CAN H
B. CAN L
C. Battery negative
D. Battery positive
E. Ignition output
F. Not used

The cable between the PCU and the engine connector contains of communication wires, battery voltage wires and an ignition output wire.

The PCU and the engine communicates via CAN messages. The PCU gets its supply voltage by the battery voltage wires in the engine connector.

The ignition output wire delivers a wakeup signal, battery voltage, to the engine ECU when the start key is put to position 1.

Fault tracing

Preconditions

None.

FMI 2

Conditions for fault code

Bus off/ Bus warning error reported from can controller, electrical disturbance on the CAN communication link.

Possible reason

- AUX button has been activated or is stucked.
- Low battery voltage.
- Open circuit in CAN H.
- Open circuit in CAN L.
- CAN H and CAN L shorted together, short to ground, short to supply or short to ignition output.
- Open circuit in ignition output wire.
- Software problem in the engine.

Suitable action

1
Check that AUX button is not activated or stucked.

2

Check battery voltage.

3

Disconnect and inspect X3 connector at the PCU, reconnect.

4

Check wire harness and connectors between engine and PCU for damages.

5

Reprogram engine ECU.

6
Re-program the PCU.

FMI 9

Conditions for fault code

Time out error

Possible reason

- AUX button has been activated or is stucked.
- Low battery voltage.
- Open circuit in CAN H.
- Open circuit in CAN L.
- CAN H and CAN L shorted together, short to ground, short to supply or short to ignition output.
- Open circuit in ignition output wire.
- Software problem in the engine.

Suitable action

1
Check that AUX button is not activated or stucked.

2

Check battery voltage.

3

Disconnect and inspect X3 connector at the PCU, reconnect.

4

Check wire harness and connectors between engine and PCU for damages.

5

Reprogram engine ECU.

6
Re-program the PCU.

FMI 12

Conditions for fault code

Fault has occurred during power up or power down the EMS does not respond or does not respond in a correct way.

Suitable action

1
Check that AUX button is not activated or stucked.

2

Check battery voltage.

3

Disconnect and inspect X3 connector at the PCU, reconnect.

4

Check wire harness and connectors between engine and PCU for damages.

5

Reprogram engine ECU.

6
Re-program the PCU.

MID 187 / MID 164 / MID 250, SID 240

Program memory fault

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 2: Data erratic, intermittent or incorrect

FMI	Fault code explanation
2	No software loaded or there is something wrong with the software causing a unit to remain in boot mode.

Fault indication

None.

Symptom

Can not become active.

Fault tracing

Preconditions

- None.
- PCU has been replaced.

FMI 2

Conditions for fault code

Software problem.

Possible reason

- No program loaded.
- PCU has been replaced.
- Checksum error in FLASH.

Suitable action

1
Re-program node that set the faultcode.

MID 187 / MID 164 / MID 250, SID 253

Calibration Memory Failure

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 2: Data erratic, intermittent or incorrect.

FMI 9: Abnormal updating rate.

FMI 12: Bad intelligent device or component.

FMI 13: No Program/Calibration code in device.

FMI	Fault code explanation
2, 12	Checksum fault in dataset(s). The calibration point are not correct vs. eachother.
9	Node not configured or error in configuration data
13	Unvalid calibrations data.

Fault indication

Warning is displayed in the tachometer/display.

SHCU, FMI 2, 9: Orange lamp flashes.

SHCU, FMI 12: Red lamp flashes in alarmpanel + Audible warning.

SUS, FMI 13: Red lamp flashes in alarmpanel + Audible warning.

Symptom

- Impossible to verify proper configuration.
- SUS unit will not be active.

Fault tracing

FMI 2

Conditions for fault code

Checksum error in Data set 1 or Data set 2. SHCU and PCU unit will use default calibration data.

Suitable action

1
Total reset by switching of the main switches.

2
Perform an autoconfiguration.

3
Check that the correct external components are connected.

4
Reprogram fault setting unit.

5
Redo SUS calibration.

6
Try another unit.

FMI 9

Conditions for fault code

SHCU: No settings data has been received from the PCU.

Possible reason

- Open circuit in CAN communication between the PCU and the SHCU.

Suitable action

1

Total reset by switching of the main switches.

2

Perform an autokonfiguration.

3

Check CAN wires between nodes for open circuit.

4

Check CAN bus wires and connectors for bad contact

5

Check that the correct external components are connected.

6

Reprogram fault setting unit.

7

Redo SUS calibration.

8

Try another unit.

FMI 12

Conditions for fault code

No configuration data in EEPROM or stored configuration does not comply with current configuration. Checksum fault in dataset 0.

Suitable action

1
Total reset by switching off the main switches.

2
Perform an autoconfiguration.

3
Check that the correct external components are connected.

4
Reprogram fault setting unit.

5
Redo SUS calibration.

6
Try another unit.

FMI 13

Conditions for fault code

- No data in null position in DST2 or end position is not stored/calibrated in DST2.
- Unvalid calibrations data: (value out of range or calibration point Starboard,Port and Straight forward not correct)

Suitable action

1
Total reset by switching off the main switches.

2
Perform an autoconfiguration.

3
Check that the correct external components are connected.

4
Reprogram fault setting unit.

5
Redo SUS calibration.

6
Try another unit.

MID 187 / MID 164 / MID 250, SID 254

Internal CPU faults

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 2: Data erratic, intermittent or incorrect

FMI 11: Unidentifiable error

FMI 12:Bad intelligent device or component.

FMI	Fault code explanation
2, 11, 12	A node has shut down due to too many internal resets or a fault on the unit meaning it should be replaced. Internal fault in SUS.

Fault indication

Warning is displayed in the tachometer/display.

FMI 2, 11 Red lamp flashes in alarmpanel + Audible warning.

FMI 12 None

Symptom

Can not become active station.

Fault tracing

FMI 2, 11, 12

Conditions for fault code

Bad intelligent device or component.

Possible reason

- Internal flash memory fault.

Suitable action

1

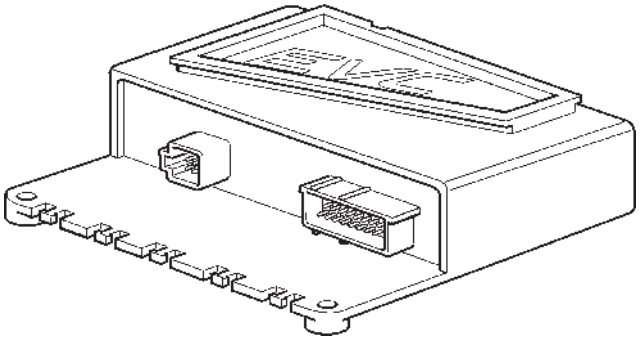
Re-program node that set the faultcode.

2

Change unit that set the faultcode.

MID 187, PSID 10

Incompatible engine type



PCU

MID 187: PCU

Fault code

FMI 12: Bad intelligent device or component

FMI	Fault code explanation
12	The engine type is not compatiblewith this PCU hardware.

Fault indication

Warning is displayed in the tachometer/display.

Symptom

Not possible to start and control engine.

Fault tracing

Preconditions

- The network has been auto configured.
- All units need to be power up and in normal operational modes(SHCU, PCU, SUS and engine ECU).

FMI 12

Conditions for fault code

- PCU receives wrong engine type information.
- The PCU compare its own software with the engine type information sent from the engine ECU.

Suitable action

1
Perform an autoconfiguration.

2
Reprogram PCU.

3
Replace PCU if PCU is of an earlier generation.

MID 187, PSID 18

Data bus power output

MID 187: PCU

Fault code

FMI 12:Bad intelligent device or component.

FMI	Fault code explanation
12	There is a problem with the power supplied to the data bus by this node. Normally the PCU.

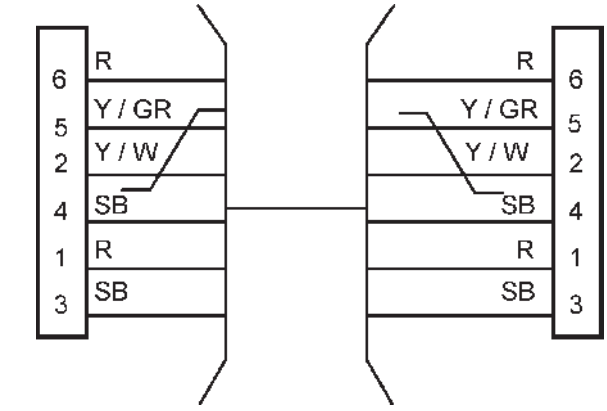
Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel.

Symptom

None.



Connector SHCU

Connector PCU
Connector X2
Colour Green

Circuit description

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

None.

FMI 12

Conditions for fault code

Power supply problem to data bus.

Possible reason

- PCU detects an overload or open load condition on power supply 12/24 Volt.
- PCU detects a voltage above battery negative on power supply 0 Volt.

Suitable action

1

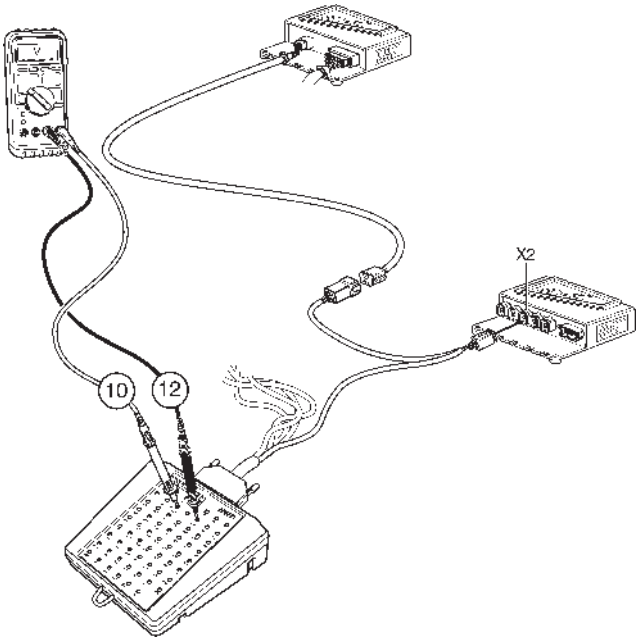
Check the power supply voltage between pin 1 and pin 3 in the X2 connector.

2

Check data bus wiring for short circuit or open circuit. Check connectors and wires for bad contact. See “Manual fault tracing in bus cables”.

3

Check that the main power supply 0 Volt, pin 3, is correct.



Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Checking the power supply:

1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the SHCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

5

Turn the ignition on. Turn the ignition on.

Measurement points	Nominal value
10 - 12	U ≈ Battery voltage

MID 187, PSID 20

Primary solenoid (high side switch)

MID 187: PCU

Fault code

FMI 4: Voltage below normal or shorted low.

FMI 5: Current below normal or open circuit.

FMI 6: Current above normal or short circuit to battery negative.

FMI	Fault code explanation
4, 5, 6	Error on the primary solenoid high side driver. This output is normally driven high when forward gear is engaged.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

- Not possible to engage any gear.
- Cranking disabled. Cranking permitted after acknowledge.

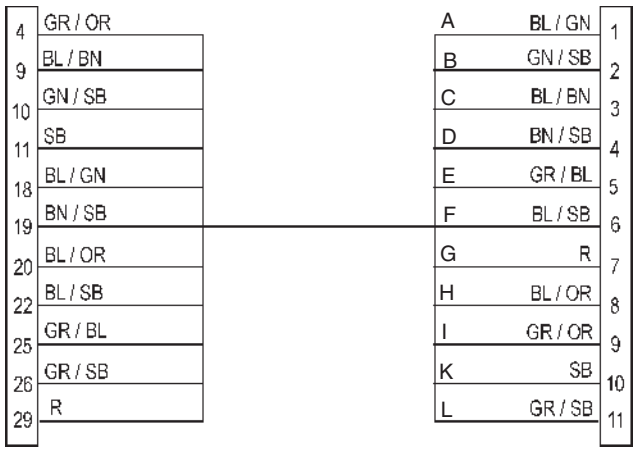
Circuit description

When the gear is in neutral position the voltage output from the PCU is approx. 0.1-0.2 V on both the solenoid connections. If the solenoid is missing or broken the potential on the solenoid connections are not equal and the PCU detects it and sets a faultcode.

When a gear is engaged the high side cable to the solenoid changes potential to approx. battery voltage.

PCU
Connector X3
Colour: Light red

Gearbox connector



A. Primary solenoid 5A ”High side”

B. Primary solenoid 5A ”Low side”

C. Secondary solenoid 5A ”High side”

D. Secondary solenoid 5A ”Low side”

E. Not used

F. Not used

G. Not used

H. Not used

I. Not used

K. Level/RPM negative

L. Not used

Fault tracing

Preconditions

Network configured: EVC configuration file has activated Reverse gear.

FMI 4

Conditions for fault code

Highside switch indicates status error.

Possible reason

- Wire harness to solenoid are shortcircuited to eachother.
- Faulty solenoid.

Suitable action

1
Check wiring to primary solenoid.

2
Check if the solnoid coil is proper, please refer to ”Transmission solenoid test” further in this chapter.

3
Check the PCU output to the transmission solenoids and the wiring between them, please refer to ” PCU output and transmission wiring test” further in this chapter.

FMI 5

Conditions for fault code

Current is below normal.

Possible reason

- Open circuit in one or both wires between PCU and gearbox.
- Faulty solenoid.

Suitable action

1
Check the solenoid valves. With the engine stopped: Switch connectors between the primary and secondary solenoid valves and check if the fault code remains or shifts to PSID 22. If the fault code shifts PSID 22 it is probably fault in the primary solenoid valve. If not, check the cable for the reversing gear solenoids.

2
Undo and check connector X3 (pink) at the PCU. Put the connector back.

FMI 6

Conditions for fault code

Current is higher than normal.

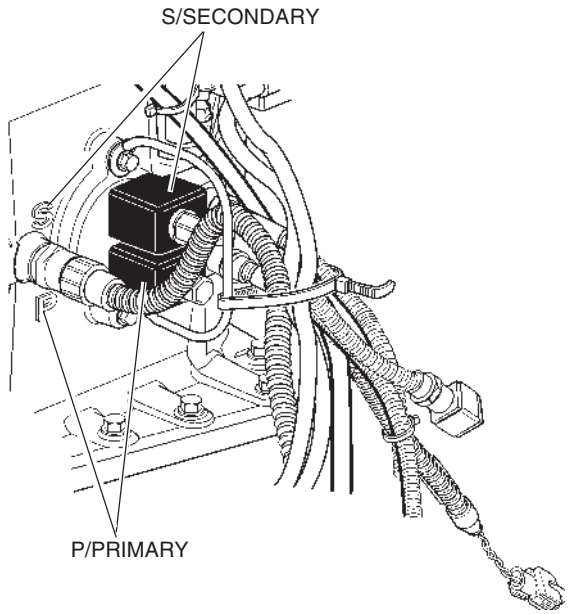
Suitable action

1
Check the solenoid valves. With the engine stopped: Switch connectors between the primary and secondary solenoid valves and check if the fault code remains or shifts to PSID 22. If the fault code shifts PSID 22 it is probably fault in the primary solenoid valve. If not, check the cable for the reversing gear solenoids.

2
Undo and check connector X3 (pink) at the PCU. Put the connector back.

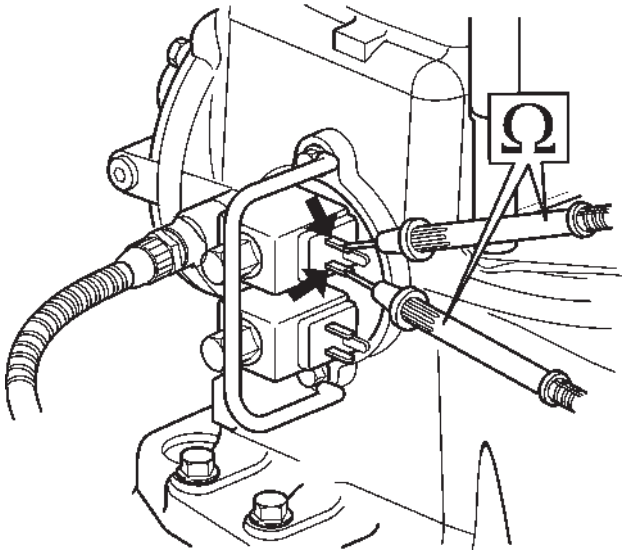
Transmission solenoid test

Special tools 9812519, 9998534



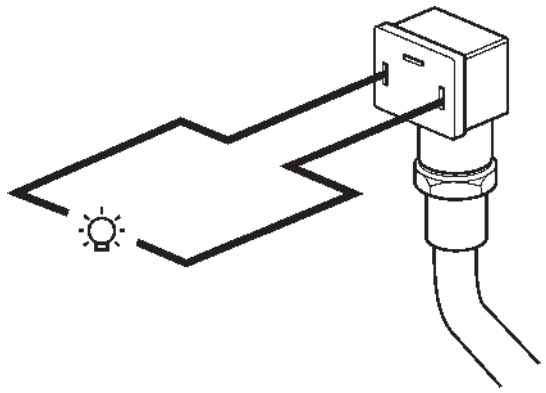
1
NOTE! Turn starter key to **position 0.**

2
Remove the connector from the solenoid valve.



3
Use multimeter 9812519 to measure the resistance of the solenoid valve (coil).

Nominal value**:** R ≈ 6–10 Ω* (at +20°C)



PCU output and transmission wiring test

Special tools 9812519, 9998534

1
Check that the EVC-system is supplying the correct signal to the solenoid valve by connecting a lamp (12V/10W) to the connector.

2
Turn the main switches on. Turn the starter key to position 1 (driving position).

3
Activate the control position by pressing the activation button (at least 1 second).

4
Engage the reversing gear (“Forwards” or “Reverse”).

NOTE! Engine stopped.

The lamp should light up when a gear is engaged.

Does the lamp light?

YES: No fault from the PCU unit to the reversing gear. Try to move the connector between the primary and secondary solenoid valve, and see if the fault also moves. If the fault code changes, the fault is probably in the solenoid valve.

NO: Go to point 5.

5
If the lamp does not light, fault trace between the PCU and the reverser.

-Turn off power at the main switches.

-Undo the connector block on the PCU and the connector block on the reverser.

-Check the resistance of the wiring between the PCU and the reverser. See wiring description for the correct values.

-The resistance should be close to 0 ohm.

Is the resistance close to 0 ohm?

YES: Go to point 6.

NO: Change the cable between the PCU and the reverser and re-perform the check from point 1.

6
If the resistance measurements show that the cable is OK, then the fault is probably in the PCU-output. Change the PCU and re-perform the check from point 1.

MID 187, PSID 22

Secondary solenoid (high side switch)

MID 187: PCU

Fault code

FMI 4: Voltage below normal or shorted low.

FMI 5: Current below normal or open circuit.

FMI 6: Current above normal or battery negative circuit.

FMI	Fault code explanation
4, 5, 6	Error on the secondary solenoid high side driver. This output is normally driven high when reverse gear is engaged.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

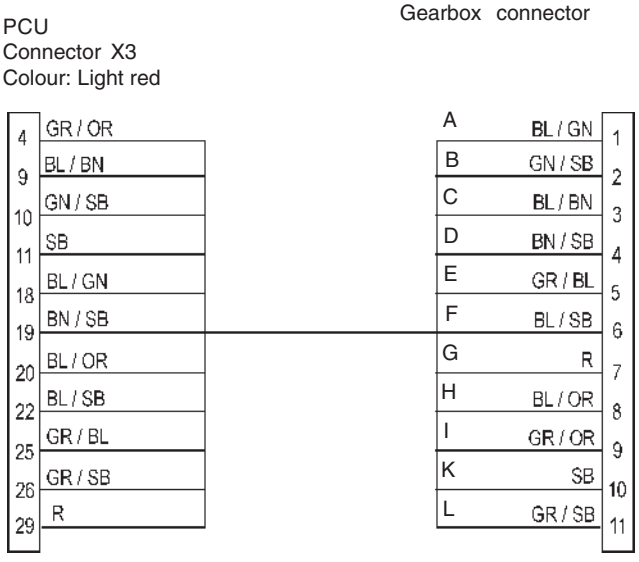
Symptom

- Not possible to engage any gear.
- Cranking disabled. Cranking permitted after acknowledge.

Circuit description

When the gear is in neutral position the voltage output from the PCU is approx. 0.1-0.2 V on both the solenoid connections. If the solenoid is missing or broken the potential on the solenoid connections are not equal and the PCU detects it and sets a faultcode.

When a gear is engaged the high side cable to the solenoid changes potential to approx. battery voltage.



A. Primary solenoid 5A "High side"

B. Primary solenoid 5A "Low side"

C. Secondary solenoid 5A "High side"

D. Secondary solenoid 5A "Low side"

E. Not used

F. Not used

G. Not used

H. Not used

I. Not used

K. Level/RPM negative

L. Not used

Fault tracing

Preconditions

Network configured: EVC configuration file has activated Reverse gear.

FMI 4

Conditions for fault code

Highside switch indicates status error.

Possible reason

- Wire harness to solenoid are shortcircuited to eachother.
- Faulty solenoid.

Suitable action

1
Check wiring to transmission solenoids.

2
Check if the solnoid coil is proper, please refer to ”Transmission solenoid test” further in this chapter.

3
Check the PCU output to the transmission solenoids and the wiring between them, please refer to ”PCU output and transmission wiring test” further in this chapter.

FMI 5

Conditions for fault code

The current is lower than normal.

Possible reason

- Open circuit in the cable between PCU and gearbox.
- Faulty solenoid.

Suitable action

1
Check the solenoid valves. With the engine stopped: Switch connectors between the primary and secondary solenoid valves and check if the fault code remains or shifts to PSID 20. If the fault code shifts PSID 20 it is probably fault in the primary solenoid valve. If not, check the cable for the reversing gear solenoids.

2
Undo and check connector X3 (pink) at the PCU. Put the connector back.

FMI 6

Conditions for fault code

The current is higher than normal.

Suitable action

1
Check the solenoid valves. With the engine stopped: Switch connectors between the primary and secondary solenoid valves and check if the fault code remains or shifts to PSID 20. If the fault code shifts PSID 20 it is probably fault in the primary solenoid valve. If not, check the cable for the reversing gear solenoids.

2
Undo and check connector X3 (pink) at the PCU. Put the connector back.

Transmission solenoid test

Please refer to ”Transmission solenoid test”, under fault code MID 187, PSID 20.

MID 187, PSID 32

Data bus communication with active helm failure

MID 187: PCU

Fault code

FMI 9: Abnormal update rate.

FMI	Fault code explanation
9	PCU has lost communication with an active SHCU.

Fault indication

Warning is displayed in the tachometer/display.

A red lamp flashes in the alarm display + Audible warning.

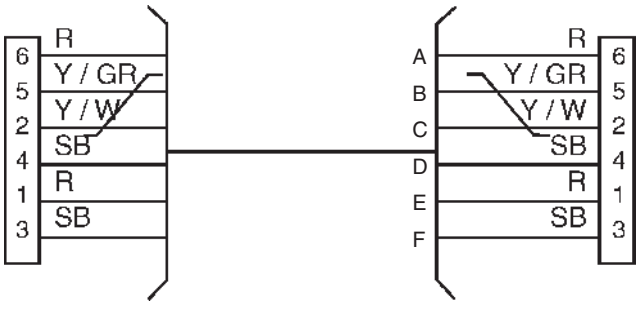
Symptom

Engine goes to limp home mode.

Gear disengaged.

Impossible to start engine from key / start-stop panel connected to a SHCU.

Steering function is disabled on fault side.



HCU connector

PCU connector X2
Colour: green

Cable description

A. Not used

B. CAN H

C. CAN L

D. Not used

E. Power supply 12/24 Volt

F. Power supply negative

Fault tracing

Preconditions

Network configured.

No other helm has entered active state.

FMI 9

Conditions for fault code

No communication with any active SHCU.

Possible reason

Open circuit in the power supply between the PCU and the SHCU.

Short circuit in the power supply between the PCU and the SHCU.

Open circuit in both CAN L and CAN H wires into the PCU from a SHCU.

Suitable action

1

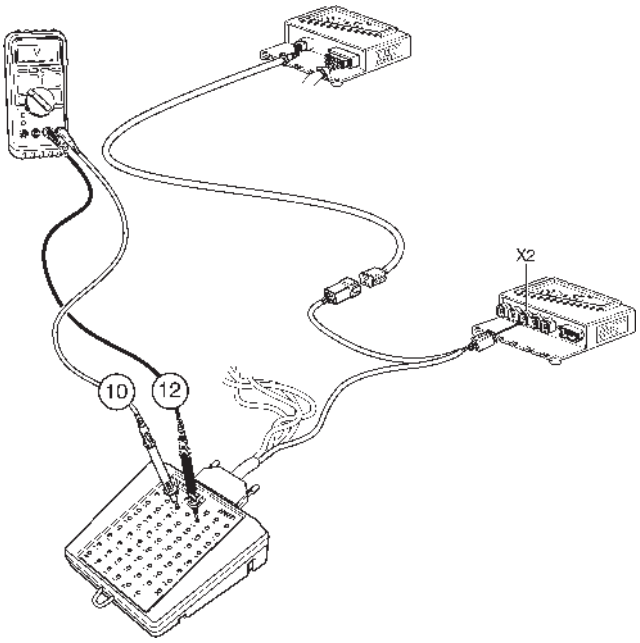
Check the power supply voltage between pin 1 and pin 3 in the X2 connector.

2

Check bus wiring between PCU and SHCU. See “Manual fault tracing in bus cables”

3

Check the actuators input wires.



Measurement

Checking the power supply

1

Note! Cut the current with **the main switch**.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the SHCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

5

Turn the ignition on.

Measurement points in the measurebox	Nominal value
10 - 12	U ≈ battery voltage

MID 187, PSID 200

No data on engine bus

MID 187: PCU

FMI 8: Abnormal frequency.

FMI 9: Abnormal update rate.

FMI 12: Bad device or component.

FMI	Fault code explanation
8, 9, 12	Unit has not detected any communication on J1939 or KWP2000 CAN interface from Engine. No communication with the engine is possible.

Fault indication

Warning is displayed in the tachometer/display.

FMI 9: Red lamp flashes in alarmpanel + Audible warning.

FMI 8: Orange lamp flashes in alarmpanel.

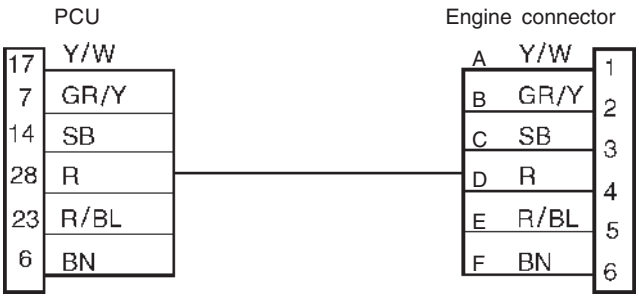
FMI 12: None.

Symptom

- System in limphome state.
- EVC can not detect engine running or read diagnostic data or control the engine.
- FMI 9: Gear in neutral and engine at limp home rpm. Shifting permitted after acknowledge. Cranking disabled.

Cable description

The cable between the PCU and the engine connector contains of communication wires, battery voltage wires and an ignition output wire. The PCU and the engine communicates via CAN messages. The PCU gets its supply voltage by the battery voltage wires in the engine connector. The ignition output wire delivers a wakeup signal, battery voltage, to the engine ECU when the start key is put to position 1.



A. CAN H

B. CAN L

C. Battery negative

D. Battery positive

E. Ignition output

F. Not used

Fault tracing

Preconditions

Engine is power on(Engine ECU is up and running)

FMI 8, 9, 12

Conditions for fault code

No communication with the engine.

Possible reason

- AUX stop button depressed or stucked or Open circuit in wires to button.
- Engine stop relay (Fire shutdown system) has been activated (if installed).
- Open circuit in both CAN L and CAN H between engine and PCU.
- Open circuit in CAN L between engine and PCU.
- Open circuit in CAN H between engine and PCU.
- Open circuit ignition output wire.
- CAN H and CAN L between engine and PCU shorted together, short to battery negative or short to supply.
- Software problem in the engine.

Suitable action

1

Check that AUX button is not activated or stucked.

2

Check what triggered the engine stop relay (Fire shutdown system) to be activated.

3

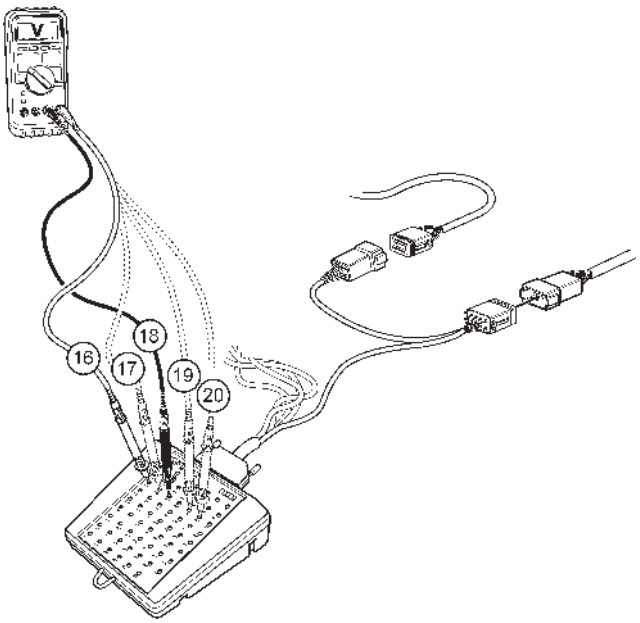
Disconnect and inspect X3 connector at the PCU, reconnect.

4

Check wire harness between engine and PCU for damages.

5

Reprogram engine ECU.



Measurements

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

1

NOTE! Cut the current with the main switch.

2

Disconnect the engine connector connect adapter cable 88890016 with measurebox 9998699 between the PCU and the engine.

3

Use multimeter 9812519 for voltage measurement.

4

Turn on the main switch and turn the starterkey to position I.

Measurement points	Nominal value
18 – 19 (battery negative – battery positive)	U ≈ battery voltage
18 – 20 (battery negative – ignition output)	U ≈ battery voltage
18 – 16 (battery negative – CAN H)	U ≈ 2.3 – 2.7 volt (fluctuating voltage)
18 – 17 (battery negative – CAN L)	U ≈ 2.0 – 2.4 volt (fluctuating voltage)

NOTE! Even if the measured value equals the nominal value the data bus cable could be faulty due to shortcircuit between a data bus cable and another cable in the harness.

MID 187, PSID 226

SHCU communication failure with other helm

MID 187: PCU

Fault code

FMI 9: Abnormal update rate.

FMI	Fault code explanation
9	PCU has lost communication with a helm that previously has been configured on the network.

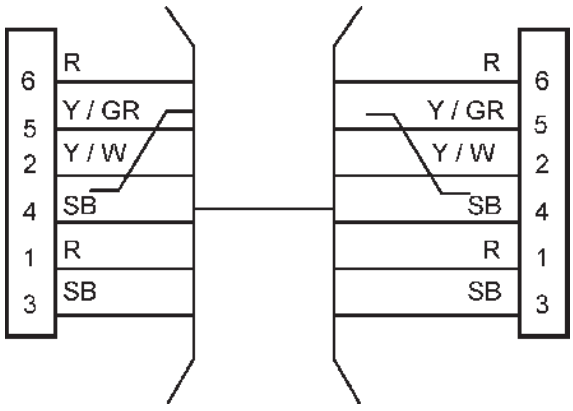
Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel.

Symptom

Impossible to make request active station from one or more helm stations.



HCU connector or
SUS connector

PCU connector
Conn. X2
Colour: Green

Circuit description

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

Network configured.

FMI 9

Conditions for fault code

Frames from a specific, passive, SHCU is missing for more than 5 seconds.

Possible reason

- Open circuit in the power supply between the PCU and the SHCU.
- Short circuit in the power supply between the PCU and the SHCU.
- Open circuit in both CAN L and CAN H wires into the PCU from a SHCU.

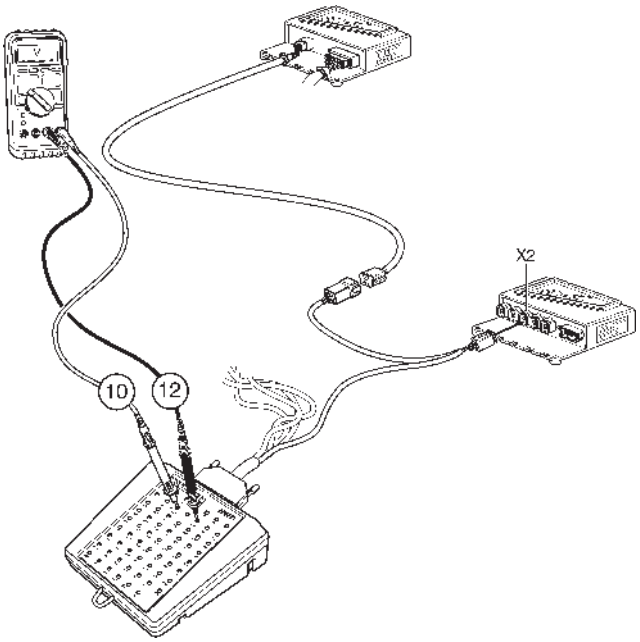
Suitable action

1

Check the power supply voltage between pin 1 and pin 3 in the X2 connector.

2

Check data bus wiring between PCU and SHCU. Check connectors and wires for bad contact. See “Manual fault tracing in bus cables”



Measurement

Checking the power supply

1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the HCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

5

Turn the ignition on.

Measurement points in the measurebox	Nominal value
10 - 12	U ≈ Battery voltage

MID 187 / MID 164 / MID 250, PSID 232

Data bus communication warning

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 2: Data Erratic

FMI 5: The voltage is less than the normal value or there is an open circuit.

FMI	Fault code explanation
2, 5	Error code indicates that thecommunication is disturbed for some reason. Fault can be between SHCU and PCU.

Fault indication

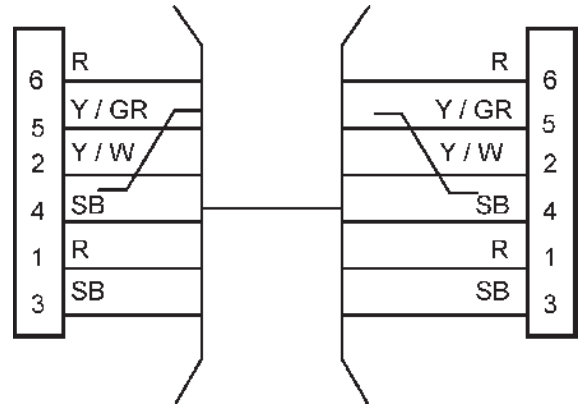
Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel

Symptom

None

Circuit description



HCU connector or
SUS connector

PCU connector
Conn. X2
Colour: Green

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

None, fault is set wether the unit is configured or not.

FMI 2

Conditions for fault code

Bus warning. The communication circuit has recvied to many error frames.

Possible reason

Open circuit in both CAN L and CAN H wires.

Open circuit in the power supply between the PCU and the HCU.

Short circuit in the power supply between the PCU and the HCU.

Bad connection in data bus wiring or in the bus power supply.

The bus cables are too long. They must not be more than 40 meter (131 ft) long.

External interference.

Suitable action

1

Check CAN wires between nodes for open circuit. See “Manual fault tracing in bus cables”

2

Check CAN bus connectors for bad connection.

3

Check the power supply voltage between pin 1 and pin 3 in the X2 connector.

FMI 5

Conditions for fault code

Data bus is working in fault mode, one wire communication mode

Possible reason

Open circuit in one of the CAN signals.

One of the CAN communication wires short circuited to battery negative or to supply voltage.

Short circuit between CAN L and CAN H.

Bad connection in data bus wiring or in the bus power supply.

Suitable action

1

Check CAN wires between nodes for short circuit or open circuit. See “Manual fault tracing in bus cables”

2

Check CAN bus connectors for bad connection.

3

Check the power supply voltage between pin 1 and pin 3 in the X2
connector.

Suitable action

1

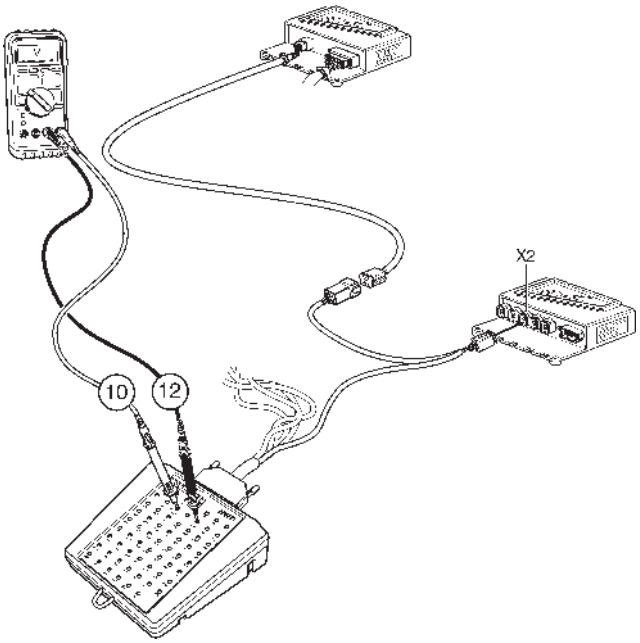
Check CAN wires between nodes for short circuit or open circuit.

2

Check CAN bus wires and connectors for bad contact See “Manual fault tracing in bus cables”

3

Check the power supply voltage between pin 1 and pin 3 in the X2 connector.



Measurement

Checking the power supply:

1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the HCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

5

Turn the ignition on.

Measurement points	Nominal value
10 - 12	U ≈ Battery voltage

MID 187, PSID 17 / MID 164, PSID 99 / MID 250, PSID 1

Data bus network configuration fault

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 12:Bad intelligent device or component.

FMI	Fault code explanation
12	This fault can appear both during auto configuration and in normal running mode. If the fault occurs during the auto configuration the network has invalid configuration. In normal running mode this fault can occur if there is some change to the configurated network, that has been stored in all units.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarm panel.

Symptoms

- System warnings will occur.
- Some functions can not be activated.
- Can cause communication related errors in other nodes.

Fault tracing

Preconditions

The system has been configured.

FMI 12

Conditions for fault code

During Auto Configuration:

- More than one unit with the same signature or ID > 8.
- Time out from a unit during auto configuration.
- There is more than 4 HCU or more than 1 PCU or SUS present in the network.

Normal operation:

- A unit that is unknown for the engine ECU is communicating on the network, i.e. the unknown node has a signature or an illegal node address.

Possible reason

Node receives a CAN message of unknown format.

Suitable action

1

Perform an autoconfiguration.

2

Check that the installed nodes are of the correct type according to the configuration.

Remove any nodes that have not been certified.

MID 187 / MID 164 / MID 250, PPID 393

Data bus power input

MID 164: SHCU
MID 187: PCU
MID 250: SUS

Fault code

FMI 4: Voltage below normal or shorted to low. Too low voltage detected under running conditions.

FMI 11: Failure mode not identifiable. Other error except low voltage such as high battery negative voltage or overloaded bus.

FMI	Fault code explanation
4, 11	There is a problem with the power supplied by the data bus. Will only be set in units that are supplied from the data bus, in most installations this will be the SHCU.

Fault indication

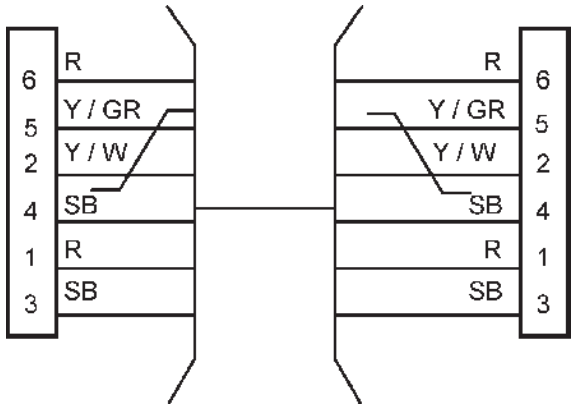
Warning is displayed in the tachometer/display.

Orange lamp flashes in the alarmpanel

Symptom

None

Circuit description



HCU connector or
SUS connector

PCU connector
Conn. X2
Colour Green

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

This segment has previously been configured.

FMI 4, 11

Conditions for fault code

Bus off. The communication circuit has recvied to many error frames.

Possible reason

- Open circuit in bus power supply.
- Too low voltage detected under running conditions.
- Failure mode not identifiable.
- Other error except low voltage such as high battery negative voltage or overloaded bus.

Suitable action

1

Check that the main power supply 12/24 Volt, pin 1, is correct.

2

Check that the main power supply 0 Volt, pin 3, is correct.

3

Check the data bus on this network segment. Check connectors and wires for bad contact. See “Manual fault tracing in bus cables”

Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Vodia logging EVC bus status

1

Choose log test.

2

Put the SHCU in service mode.

3

Choose MID 164, EVC Bus power input

4

Starter key in position I.

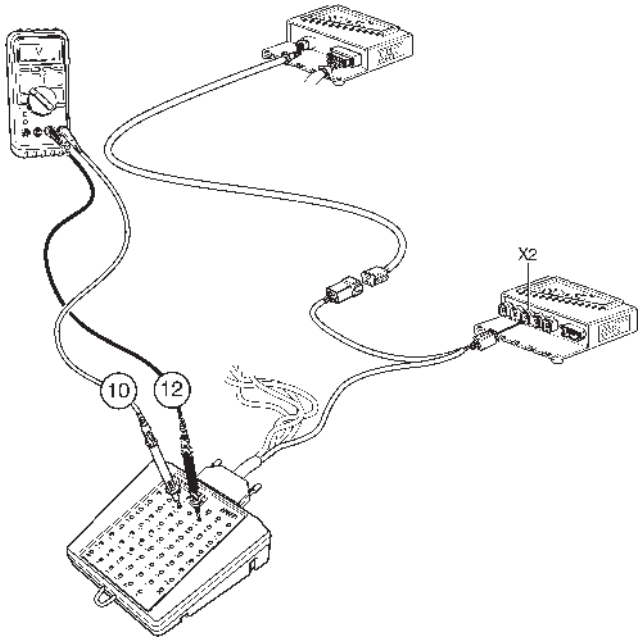
Parameter	Nominal value
EVC bus power input	U ≈ Battery voltage

Even if the nominal value seems to be correct there could be an error in the EVC power input.

Checking the power supply

1

Note! Cut the current with the main switch.



2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the SHCU.

3

Use multimeter 9812519 for voltage measurement. Be sure to measure the output voltage both at the PCU and at the SHCU.

4

Turn the main switch on. Turn the ignition on.

Measurement points	Nominal value
10 - 12	U ≈ Battery voltage

MID 250, PID 168

Battery input

MID 250: SUS

Fault code

FMI 4: Voltage below normal or shorted low.

FMI 11: Failure mode not identifiable.

FMI	Fault code explanation
4, 11	There is a problem with the power supplied directly from the engine to SUS unit.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

- If power to the PCU is missing and there is power on the Back up power supply from battery or SUS, not all actuators will work.
- If power to the SUS is missing the steering will not work.
- Fail safe mode.

Fault tracing

FMI 4

Conditions for fault code

Too low voltage detected.

Suitable action

1

Check power cable connection between SUS and engine.

2

Check fuses at engine.

3

Check main switches.

4

Check battery connection.

5

Measure battery voltage.

6

Measure the voltage on B+ and B- on the SUS.

FMI 11

Conditions for fault code

Other error, except low voltage, such as too high battery negative voltage or too high voltage.

Suitable action

1

Check power cable connection between SUS and engine.

2

Check fuses at engine.

3

Check main switches.

4

Check battery connection.

5

Measure battery voltage.

6

Measure the voltage on B+ and B- on the SUS.

MID 250, PPID 55

ECU temperature

MID 250: SUS

Fault code

FMI 12: Faulty device or component.

FMI	Fault code explanation
12	The SUS unit has two different temperature sensors, one for the ECU hardware and one for the servo motor. SUS supervice that the two sensors have almost the same value.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarm panel.

Symptom

- Not possible to become active or the steering stops working.

Fault tracing

FMI 12

Conditions for fault code

Faulty sensor, one of the two temperature sensors are faulty.

Possible reason

- Defect temperature sensor.

Suitable action

1

Change the SUS unit.

MID 164 / MID 250, PPID 424
Steering wheel position

MID 250: SUS

Fault code

FMI 2: Data erratic, intermittent or incorrect.

FMI 12: Faulty component or device

FMI	Fault code explanation
2, 12	Faulty or incorrect steering control data from the SHCU.

Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

- System will not become active.
- System will enter fail safe mode.

Fault tracing

FMI 2

Conditions for fault code

Steering angle out of range, the set point value is out side ± 35 degrees.

Suitable action

1

Check the system for other fault that can be the main problem.

2

Check that the active helm has a correct steering wheel.

3

Change steering wheel unit.

FMI 12

Conditions for fault code

Set point of steering angle is not available or faulty, or the message has been gone for more than 200 frames.

Suitable action

1

Check the system for other fault that can be the main problem.

2

Check that the active helm has a correct steering wheel.

4

Change steering wheel unit.

MID 250, PPID 426

Rudder angle

MID 250: SUS

Fault code

FMI 2: Data erratic, intermittent, or incorrect.

FMI 5: Current below normal or open circuit.

FMI 6: Abnormally high current or short circuit to battery negative.

FMI 7: Mechanical system not responding properly.

FMI	Fault code explanation
2, 5, 6, 7	Electrical faults on the resolver in the SUS unit or that the absolute position can not be determined. Or the supervisor has detected an error according its supervisor algorithms.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

- Not possible to steer.
- Drive train in failsafe mode.

Fault tracing

FMI 2

Conditions for fault code

Drive angle is outside calibrated max and min position.

Suitable action

1

Check wires between resolver and SUS.

2

Recalibrate IPS system.

FMI 5

Conditions for fault code

Controller indicates resolver signal open circuit.

Possible reason

Open circuit in wires between resolver and SUS.

Suitable action

1

Check wires between resolver and SUS.

FMI 6

Conditions for fault code

Controller indicates resolver signal short circuit.

Suitable action

1

Check wires between resolver and SUS.

FMI 7

Conditions for fault code

Error between requested position and current drive position. Resolver difference error.

Suitable action

1

Check wires between resolver and SUS.

2

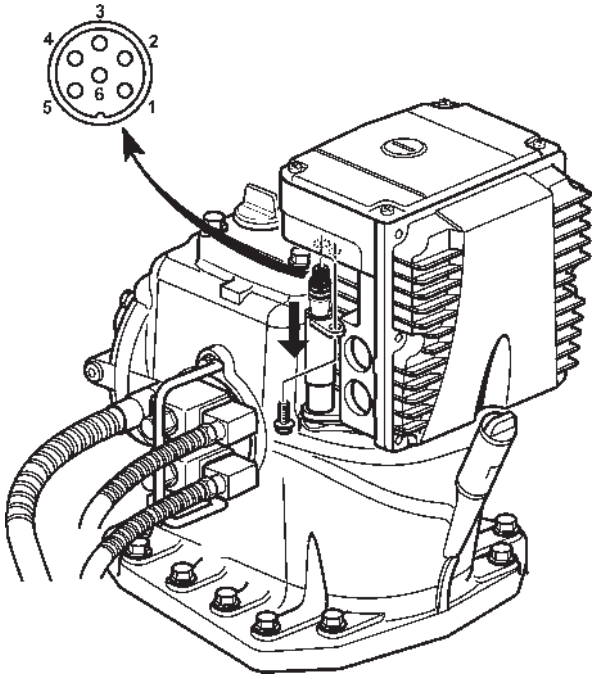
Check that the drive train or SUS has not got stuck.

3

Check if the drive train has correct position in the hull insert.

4

Return SUS unit to Volvo Penta.



Measurements

- **NOTE!** Main switch **off**.
- Disconnect resolver wireharness.
- Use multimeter 9812519 for measuring resistance.

Measuring points	Set point
1 – 2	R ≈ 100 Ω
3 – 4	R ≈ 100 Ω
5 – 6	R ≈ 37 Ω

NOTE! Measurement is done to eliminate short circuiting or breaks in the cable

MID 250, PPID 427

Servo motor temperature

MID 250: SUS

Fault code

FMI 0: Data valid but above normal operational range.

FMI 1: Data valid but below normal operational range.

FMI	Fault code explanation
0, 1	The temperature in the servo is outside its limits.

Fault indication

Warning is displayed in the tachometer/display.

FMI 0: Orange lamp flashes in alarmpanel.

FMI 1: Red lamp flashes in alarmpanel + Audible warning.

Symptom

- The steering does respond correctly.
- No response from the steering.

Fault tracing

FMI 0

Conditions for fault code

Driver indicates over temperature in the motor, need to work with limit load of current.

Possible reason

- The SUS has run too hot.
- Defect temperature sensor.

Suitable action

1

Examine the SUS unit with your hand. If it is hot, shut off the system and let it cool off. After it has cooled off, switch on the system and see if the problem still occurs. If the fault code appears when the SUS is cold the problem is with the temperature sensor, if so return unit to Volvo Penta.

It is still possible to run the system in emergency drive mode.

FMI 1

Conditions for fault code

The temperature is too low (below -20°C) in the SUS unit, and it is dangerous to start up the unit.

Possible reason

- The engine room is too cold.
- Defect temperature sensor.

Suitable action

1

Heat up the engine room and the SUS unit.

2

If the errorcode appears when the SUS is in normal climate the problem is with the temperature sensor, if so return unit to Volvo Penta.

It is still possible to run the system in emergency drive.

MID 250, PSID 2

Data bus power output

MID 250: SUS

Fault code

FMI 4: Voltage below normal or shorted low.

FMI	Fault code explanation
4	There is a problem with the power supplied to the data bus by this node. Usually the SUS.

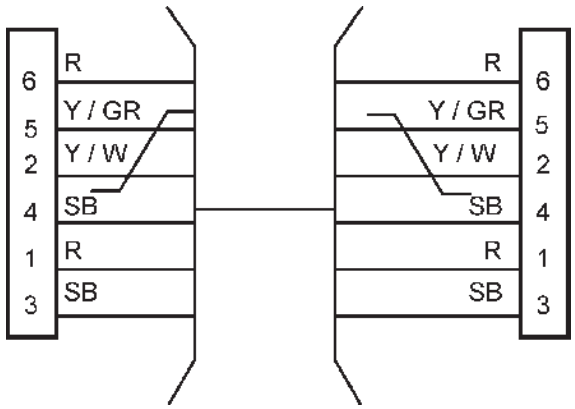
Fault indication

Warning is displayed in the tachometer/display.

Orange lamp flashes in alarmpanel.

Symptom

None.



HCU connector or
SUS connector

PCU connector
Conn. X2
Colour Green

Circuit description

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

Network configured.

FMI 4

Conditions for fault code

Power supply problem to data bus.

Possible reason

- The power supply between nodes is short circuited.

Suitable action

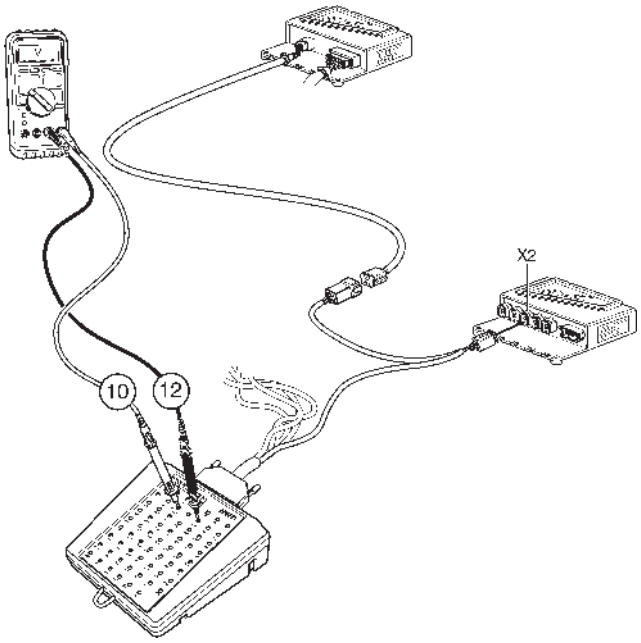
1

Check data bus wiring for short circuit or open circuit. See “Manual fault tracing in bus cables”.

Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Checking the power supply:



1.

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the HCU.

3

Use multimeter 9812519 for voltage measurement.

4

Turn the main switch on.

Measurement points	Nominal value
10 - 12	U ≈ Battery voltage

MID 250, PSID 3

Servo motor

MID 250: SUS

Fault code

FMI 0: Data valid but above normal operational range.

FMI 1: Data valid but below operational range

FMI 3: Voltage above normal or shorted high.

FMI 4: Voltage below normal or shorted low.

FMI 5: Current below normal or open circuit.

FMI 6: Current above normal or short circuit to battery negative.

FMI 7: Mechanical system not responding properly.

FMI 10: Abnormally large variations.

FMI 12: Faulty device or component.

FMI	Fault code explanation
0, 1, 3, 4, 5, 6, 7, 10, 12	Error on the drive's electronics and the servo motor inside the SUS.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

The steering does not work.

Fault tracing

FMI 0

Conditions for fault code

Motor voltage high.

Possible reason

- Error in electrical system.
- Bad battery.
- Bad battery connection.
- Bad power cable connection to SUS.

Suitable action

1

Check if other errorcodes exists that implies error in electrical system.

2

Check battery connection.

3

Measure battery voltage.

4

Check power cable connection between SUS and engine.

5

Measure the voltage on B+ and B– on the SUS.

FMI 1

Conditions for fault code

Motor voltage low.

Possible reason

- Error in electrical system.
- Bad battery.
- Bad battery connection.
- Bad power cable connection to SUS.

Suitable action

1

Check if other errorcodes exists that implies error in electrical system.

2

Check battery connection.

3

Measure battery voltage.

4

Check SUS power cable connection.

5

Measure the voltage on B+ and B– on the SUS.

FMI 3

Conditions for fault code

Motor voltage DC MAX.

Possible reason

- Error in electrical system.
- Bad battery.
- Bad battery connection.
- Bad power cable connection to SUS.

Suitable action

1

Check if other errorcodes exists that implies error in electrical system.

2

Check battery connection.

3

Measure battery voltage.

4

Check SUS power cable connection.

5

Measure the voltage on B+ and B– on the SUS.

6

Return SUS unit to Volvo Penta.

FMI 4

Conditions for fault code

SUS self test Voltage DC low.

Possible reason

- Error in electrical system.
- Bad battery.
- Bad battery connection.
- Bad power cable connection to SUS.

Suitable action

1

Check if other errorcodes exists that implies error in electrical system.

2

Check battery connection.

3

Measure battery voltage.

4

Check SUS power cable connection.

5

Measure the voltage on B+ and B– on the SUS.

6

Return SUS unit to Volvo Penta.

FMI 5

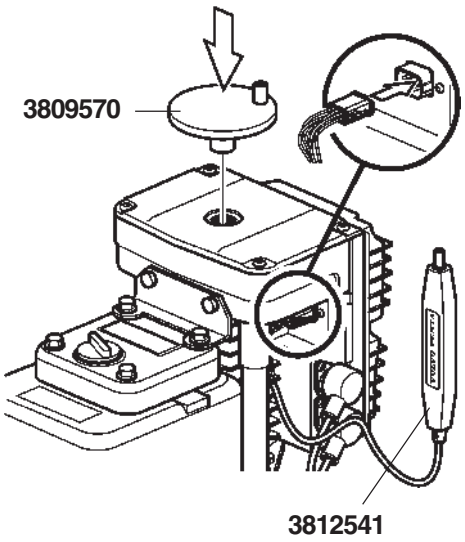
Conditions for fault code

Servo motor open circuit.

Suitable action

1

Return SUS unit to Volvo Penta.



FMI 6

Conditions for fault code

The current through the servo motor is above normal.

Possible reason

- Faulty IPS calibration.
- The servo motor is mechanically locked.

Suitable action

1

Redo IPS calibration

2

NOTE! Engine off. Main switch on.

Check that the drive train has not got stuck. Use the cranking tool 3809570 and the brake release switch 3812541 to crank the IPS unit.

If the IPS unit is hard to turn:

Disassemble the SUS unit from the IPS unit and use the cranking tool to crank the SUS unit.

NOTE! SUS unit must have power supply.

If the unit is hard to crank, return the SUS unit to Volvo Penta.

If the IPS unit is easy to turn:

There is a mechanical fault in the drive train.

FMI 7

Conditions for fault code

- The SUS controller detects an error between requested position and current position.
- Difference in angle estimates from resolver.
- The SUS has detected a high speed error on the servo motor.

Suitable action

1

Check wires between resolver and SUS.

FMI 10

Conditions for fault code

Regular Position Motor deviation.

Suitable action

1

If error constantly appears at low speed, check SUS and gear.

2

If error temporarily appears at high speed, let SUS cool off.

FMI 12

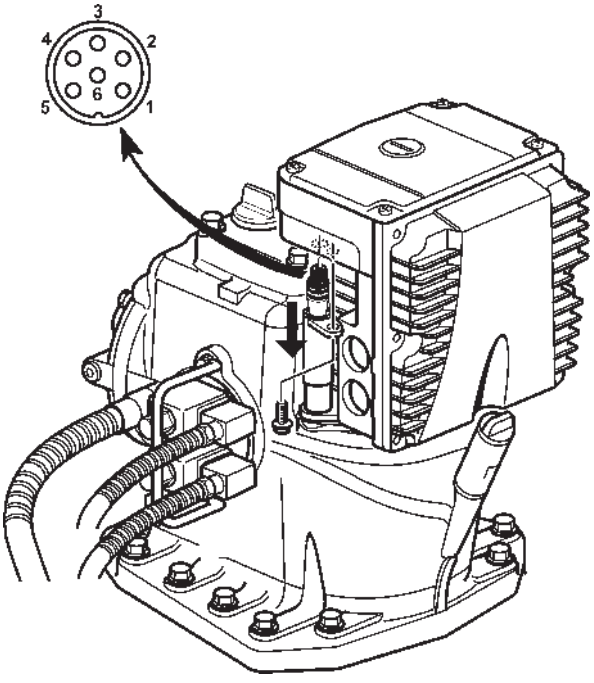
Conditions for fault code

Servo Motor self test fault.

Suitable action

1

Return SUS unit to Volvo Penta.



Measurements

- **NOTE!** Main switch off.
- Disconnect resolver wire harness.
- Use multimeter (9812519) for measuring resistance.

Measuring points	Set point
1 – 2	R ≈ 100 Ω
3 – 4	R ≈ 100 Ω
5 – 6	R ≈ 37 Ω

NOTE! Measurement is done to eliminate short circuiting or breaks in the cable.

MID 250, PSID 4

Electro mechanical rudder brake

MID 250: SUS

Fault code

FMI 5: Current below normal or open circuit.

FMI 6: Current above normal or battery negative circuit.

FMI 7: Mechanical system not responding properly.

FMI 14: Special instructions.

FMI	Fault code explanation
5, 6, 7, 14	The SUS unit has internal diagnostics for the mechanical brake. This fault describes different typs of fault.

Fault indication

Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

Not possible to become active or the steering stops working, goes to safe mode.

Fault tracing

FMI 5

Conditions for fault code

Open circuit in the control signals to mechanical brake.

Possible reason

Brake circuit burned off.

Suitable action

1

Check that the mechanical brake has not jammed. Try to turn the drive by hand with the emergency steering wheel.

2

Return SUS to Volvo Penta.

FMI 6

Conditions for fault code

The mechanical brake is short circuit.

Possible reason

Short circuit or defekt brake circuit.

Suitable action

1

Check that the mechanical brake has not jammed. Try to turn the drive by hand with the emergency steering wheel.

2

Return SUS to Volvo Penta.

FMI 7

Conditions for fault code

The brake is not responding during self test.

Suitable action

1

Check that the mechanical brake has not jammed. Try to turn the drive by hand with the emergency steering wheel.

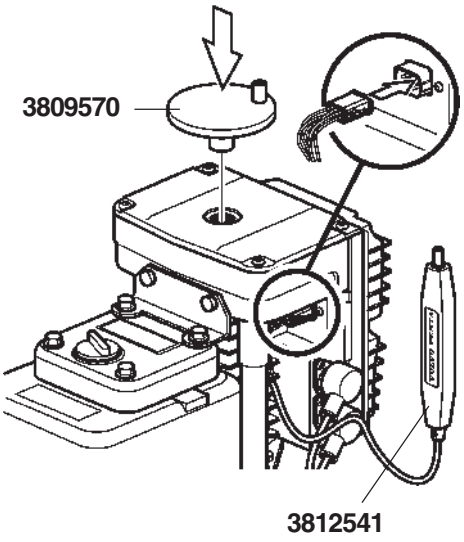
2

Return SUS to Volvo Penta.

FMI 14

Conditions for fault code

If drive response is incorrect during self-test operation, drive electronics will set self-test time out.



Suitable action

1

NOTE! Engine off. Main switch on.

Check that the drive train has not got stuck. Use the cranking tool 3809570 and the brake release switch 3812541 to crank the IPS unit.

If the IPS unit is hard to turn:

Disassemble the SUS unit from the IPS unit and use the cranking tool to crank the SUS unit.

NOTE! SUS unit must have power supply.

If the unit is hard to crank, return the SUS unit to Volvo Penta.

If the IPS unit is easy to turn:

There is a mechanical fault in the drive train.

MID 187, PSID 32 / MID 250, PSID 6

Data bus communication with active helm failure

MID 250: SUS

Fault code

FMI 9: Abnormal update rate.

FMI 10: Abnormally large variations.

FMI	Fault code explanation
9	SUS has lost communication with an active SHCU.
10	Detects integrity failure in communication message from active SHCU.

Fault indication

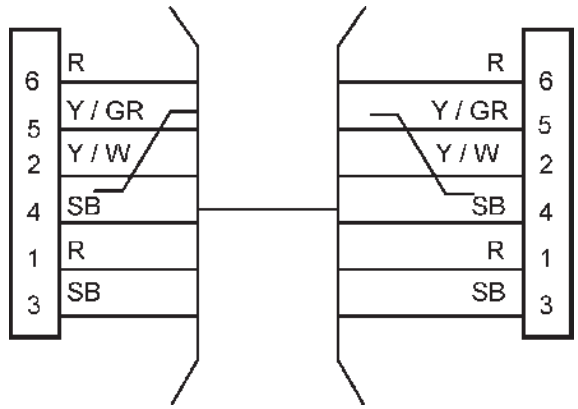
Warning is displayed in the tachometer/display.

Red lamp flashes in alarmpanel + Audible warning.

Symptom

- Engine goes to limp home mode.
- Gear disengaged.
- Impossible to start engine from key / start-stop panel connected to a SHCU.
- Steering function is disabled.

Circuit description



SHCU connector or
SUS connector

PCU connector
Conn. X2
Colour: Green

Back up power supply, 12 V / 24 V

CAN H

CAN L

Back up power supply, 0 V

Power supply, 12 V / 24 V

Power supply, 0 V

Fault tracing

Preconditions

- Network configured.
- No other helm has entered active state.

FMI 9, 10

Conditions for fault code

No communication with active SHCU.

Possible reason

- Open circuit in the power supply between the PCU and the SHCU.
- Short circuit in the power supply between the PCU and the SHCU.
- Open circuit in both CAN L and CAN H wires into the PCU from a SHCU.

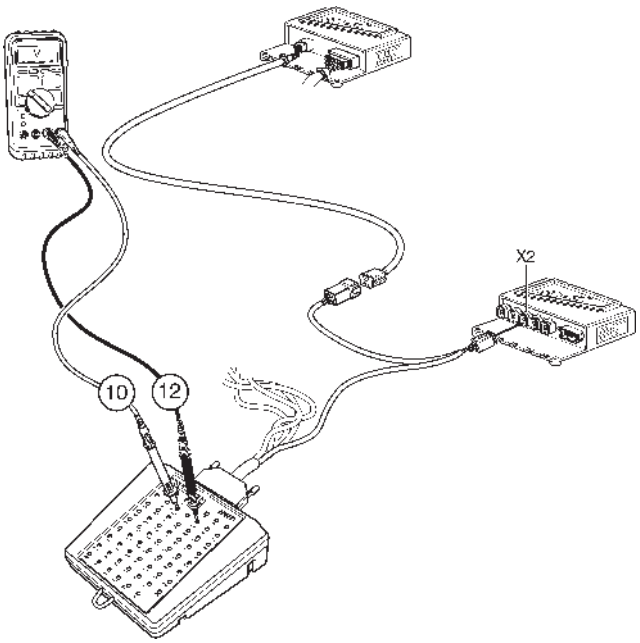
Suitable action

1

Check the power supply voltage between pin 1 and pin 3 in the X2 connector. See “Manual fault tracing in bus cables”

2

Check bus wiring and connesctors between PCU and SHCU.



Measurement

Special tools: Adapter cable 88890016, measurebox 9998699, multimeter 9812519.

Checking the power supply:

1

Note! Cut the current with the main switch.

2

Connect adapter cable 88890016 with measurebox 9998699 between the PCU and the HCU.

3

Use multimeter 9812519 for voltage measurement.

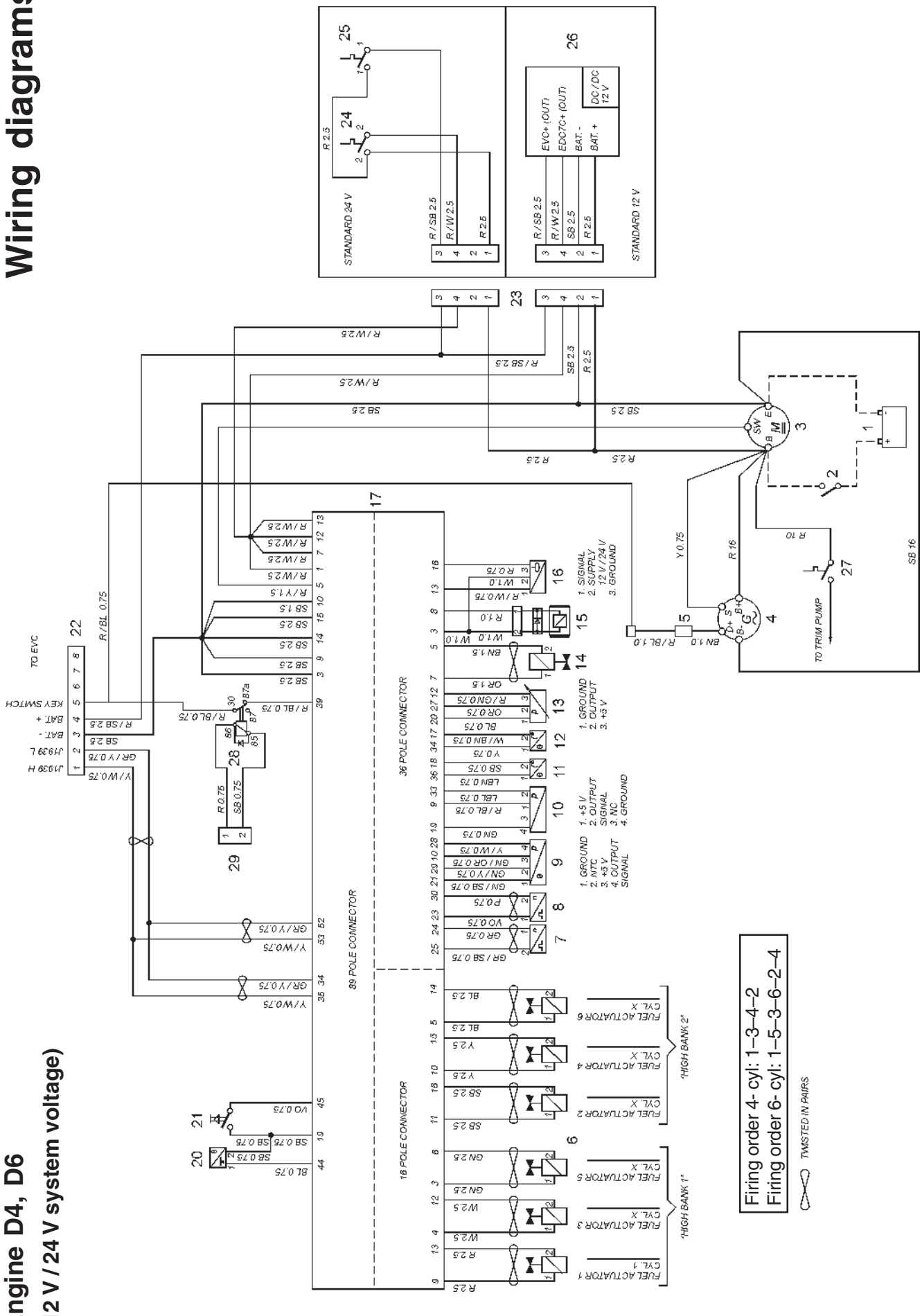
4

Turn the main switch on.

Measurement points	Nominal value
10 - 12	U ≈ Battery voltage

Wiring diagrams

Engine D4, D6
(12 V / 24 V system voltage)



D4, D6 engine

(12 V or 24 V system voltage)

1. Starting batteries
2. Main switch
3. Starter motor
4. Alternator
5. Resistor (33 Ohm)
6. Injector (cylinder 1 – 4 and 1 – 6)
7. Speed sensor, flywheel
8. Position sensor, camshaft
9. Sensor, boost air pressure / temperature
10. Sensor, lube oil pressure
11. Sensor, coolant temperature
12. Sensor, coolant temperature
13. Rail pressure sensor
14. Proportional valve (MPROP), fuel pump
15. Compressor (D6-370D-B)
16. Monitor, “water in fuel”
17. Engine control unit, EDC 7
20. Monitor, coolant level
21. Extra stop button
22. Connector, engine interface
23. Connector, DC /DC (12 V) or fuses (24 V)
24. Circuit breaker, engine control unit (20 A)
25. Circuit breaker, EVC (20 A) 24 V
26. Voltage converter (DC / DC) 12 V
27. Circuit breaker, SUS (50 A)
28. Engine stop relay (optional)
29. Connector, auto. fire extinguishers (optional)

Broken cables (lines) are not connected by Volvo Penta.

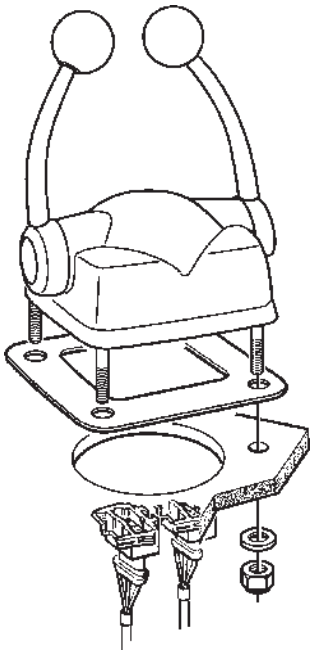
Cable areas in mm² are specified after the color code in the wiring schedule.

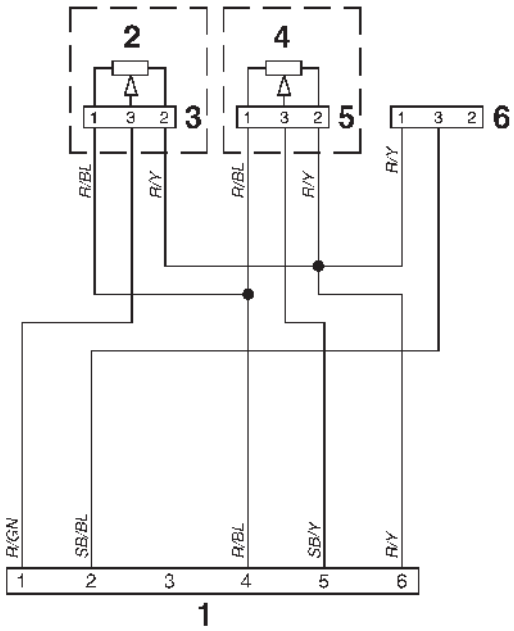
Cable colors

BL	=	Blue	P	=	Pink
BN	=	Brown	R	=	Red
GN	=	Green	SB	=	Black
GR	=	Gray	VO	=	Violet
OR	=	Orange	W	=	White
LBL	=	Light blue	Y	=	Yellow
LBN	=	Light brown			

Controls

Twin lever control with control adapter and cables for SHCU





Cable colors

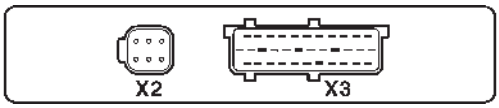
BL = Blue
GN = Green
R = Red
SB = Black
Y = Yellow

Position schedule

1. 6-pin moisture-proof connector (socket) (“CONN. X7” – blue)
2. Potentiometer
3. Connector, (”THROTTLE POT.”)
4. Potentiometer*
5. Connector, (“GEAR POT.”)*
6. Connector, (“NEUTRAL SWITCH”)

* **NOTE!** Not used

Pin configuration, PCU



X2 (Green) Data link – EVC bus cable

X3 (Pink) Engine and transmission

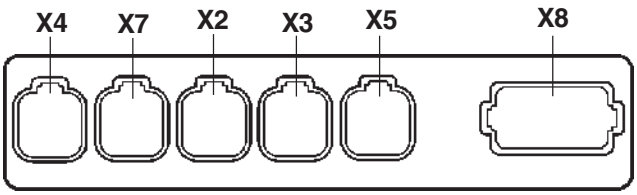
X2

1.	System voltage 12 / 24 V
2.	CAN L
3.	System voltage, 0 V
4.	Back-up, power supply, 0 V
5.	CAN H
6.	Back-up, power supply, 12 / 24 V

X3

1.	Not used
2.	Not used
3.	Not used
4.	Gearbox temp
5.	J1708B – Diagnostic bus
6.	Not used
7.	CAN L – Data link to engine
8.	Input signal, fuel level sensor
9.	Gearshift control, secondary (“high-side switch”)
10.	Gearshift control, primary (“low side switch”)
11.	Battery negative (–), fuel level sensor
12.	Not used
13.	Not used
14.	Negative (-) voltage, Engine and diagnostic connector
15.	J1708A – Diagnostic bus
16.	Not used
17.	CAN H – Data link to engine
18.	Gearshift control, primary (“high side switch”)
19.	Gearshift control, secondary (“low side switch”)
20.	Gearbox pressure
21.	Not used
22.	Lowspeed solenoid
23.	Ignition signal, key switch
24.	Not used
25.	Lowspeed solenoid
26.	Gearbox revolution pick up
27.	Not used
28.	Power supply, Engine and diagnostic connector
29.	Power supply, Gearbox connector

Pin configuration, SHCU



X2 (Green) Data link – EVC bus cable.
X3 (Pink) Auxiliary bus – Instruments, EVC panel.
X4 (Gray) Key switch or start-/stop panel.
X5 (Yellow) Multi-link – EVC display, NMEA interface, engine synchronization.
X7 (Blue) Controls.
X8 (Brown) Steering – Steering signals from steering wheel and joystick units to the SHCU.

X2

1.	System voltage 12 / 24 V
2.	CAN L
3.	System voltage, 0 V
4.	System voltage, 0 V (backup)
5.	CAN H
6.	System voltage 12 / 24 V (backup)

X5

1.	CAN H
2.	CAN H
3.	CAN L
4.	Output voltage negative (–)
5.	CAN L
6.	Output voltage (+)

X3

1.	Buzzer output
2.	J1708B to EVC panel and auxiliary equipment
3.	Easy link data output
4.	Output voltage negative (–)
5.	J1708A to EVC panel and auxiliary equipment
6.	Output voltage (+), max 1 A

X7

1.	Throttle control potentiometer, input signal
2.	Neutral position switch, input signal
3.	Not used
4.	Potentiometer output voltage negative (–)
5.	Gear shift potentiometer, input signal
6.	Potentiometer, output voltage positive (+)

X4

1.	Input signal, stop
2.	Input signal, ignition
3.	Input signal, start
4.	Not used
5.	Output voltage negative (–) to start-/stop panel
6.	Output voltage positive (+)

X8

1.	Power supply 12 / 24 V
2.	CAN H
3.	Power supply 0 V
4.	Not used
5.	Not used
6.	Not used
7.	Not used
8.	Not used
9.	Not used
10.	Back up Power supply 0 V
11.	CAN L
12.	Back up Power supply 12 / 24 V

Calibration and settings

General

Auto configuration, lever calibration and initializing of the EVC display must be done after installation is completed.

Auto configuration means that the system detects and defines all the components included in the system and creates a data file.

NOTE! Auto configuration shall always be done when there are any changes in the EVC system, e. g. the system is extended or rebuilt.

NOTE! In a twin installation when using EVC System Display, the display must be configured as a "twin" before auto configuration is performed.

Through the calibration routine the control lever positions and the idle rpm are defined for the EVC system. If a control lever has been replaced, the new one must be calibrated.

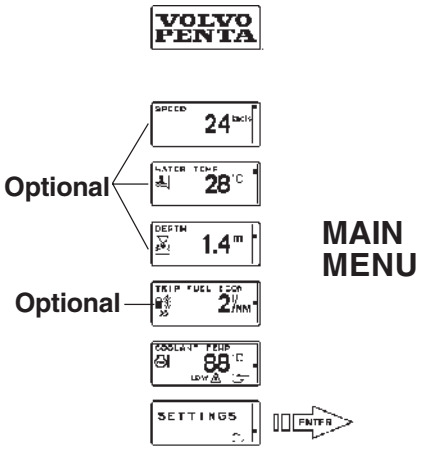
NOTE! If auto configuration and control calibration is not done, the engine cannot be started.

⚠ **IMPORTANT!** For all setting procedures: Activate helm station by pushing the ACTIVE STATION BUTTON on the EVC panel.

⚠ **IMPORTANT!** Always press the different buttons firmly and at least for one second each time.

Menu system

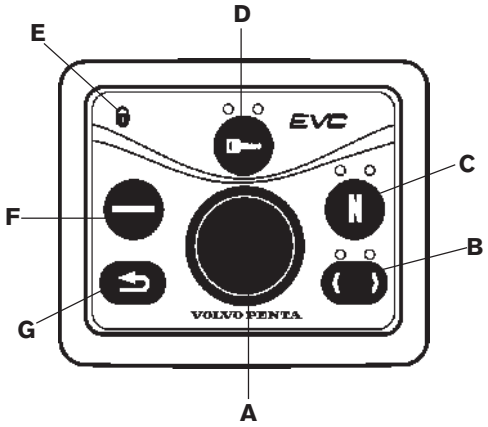
At power-up Volvo Penta logotype will be shown in



display. After a few seconds MAIN MENU will appear.

Navigate MAIN MENU by turning NAVIGATION WHEEL clockwise or counter clockwise. Views with pointing hand-symbol indicates SUB MENU. Push NAVIGATION WHEEL.

(Twin engine is shown)



A. **NAVIGATION WHEEL**
Select: Turn navigation wheel to select sub menu or select setting.
Enter: Push navigation wheel to reach selected submenu.
Confirm: Push navigation wheel to confirm setting

B. **TACHOMETER DISPLAY SELECTION**
(twin installations, port/stb.)
Indication LEDs red/green

C. **NEUTRAL BUTTON**
Confirming
Volvo Penta Lowspeed
Warming up
Indication LED
- Constant light: Neutral
- No light: FWD/REV
- Flashing: Calibration mode or disconnected

D. **ACTIVE STATION BUTTON**
Indication LEDs red

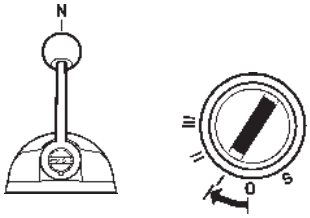
E. **STATION LOCK INDICATION**

F. **MULTIFUNCTION BUTTON**
- Dimmer
- Auto configuration
- Montoring helm

G. **BACK BUTTON**
- Menu structure

Calibration mode

Preparations



– Turn main switch(s) on.
– Turn starter key(s) to position **I**.
– Control lever(s) in neutral position.

Enter calibration mode

Procedure is the same for single/twin installations and for main/secondary helm respectively.



1. Push and hold NAVIGATION WHEEL and BACK BUTTON until a signal from buzzer is heard and calibration mode pop-up screen is shown in tachometer display.

   Release buttons.

NOTE! When entering Calibration Mode in an EVC^{EC}-C system with a never before used tacho, the text “Calibration Mode” will not appear in the Tacho display.

NOTE! The first digit varies depending on system configuration.
1.0 indicates a single lever control.
2.0 indicates separate throttle/gear or additional trolling levers.

2. Calibration mode is indicated with Neutral LED/ LEDs flashing and pop-up screen in tachometer display.

NOTE! The system exits from calibration mode after 45 seconds if no actions occur.

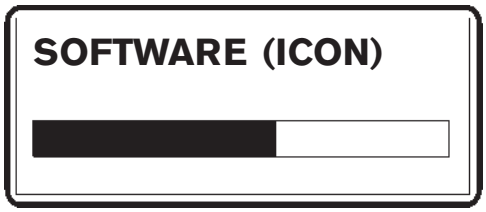
Auto configuration

Auto configuration is the EVC system self-identification. Auto configuration should be performed when the system is started for the first time or after software updates.

NOTE! A twin installation requires one auto configuration to each engine. **Start with port engine**.

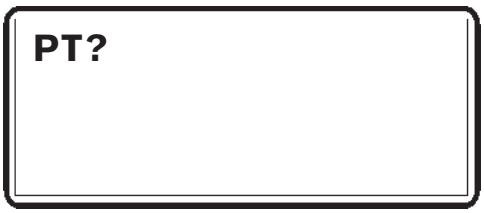
NOTE! In a twin installation when using EVC System Display, the display must be configured as a "twin" before auto configuration is performed.

1. Turn starter key to position I (ignition on).
   Twin installation: Start with port engine.
2. Enter calibration mode.
3. Push and hold BACK BUTTON and MULTI FUNCTION BUTTON until all LED:s are lit and a signal from buzzer is heard. Release buttons.



4. Self identification and software download starts. The procedure may take **several minutes** depending on software download to the tachometer display/or EVC system display.

   NOTE! The EVC system starts to download software to all tachometers followed by the EVC system displays. When downloading to the EVC system display no information will be presented in the display window and all LEDs are off.



Wait until PT? appears and follow intructions in step 5–7 or 8–15.

Tachometer configuration

Perform step 5–7 for single installation alt. step 8–15 for twin installation.

Single installation (step 5–7)

5. The tachometer display will read "**PT?**". Confirm by pushing NAVIGATION WHEEL.
6. Wait until "**PTIS**" disappers from tachometer display and MAIN MENU appears.

NOTE! Additional helm station(s)

Repeat step 5 and 6 for each additional helm station.

7. Auto configuration is finished.

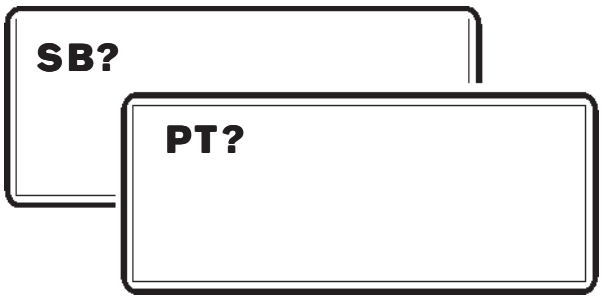
Twin installation (step 8–15)

8. One of the tachometer displays will read "**PT?**" (port engine).
   If this tachometer is connected to port engine: Confirm by pushing NAVIGATION WHEEL.

   If not: Use BACK BUTTON to move "**PT?**" to the corresponding tachometer display. Confirm by pushing NAVIGATION WHEEL.

   "**PTIS**" is shown in display.
9. The other tachometer display will read "**SB?**" (starboard engine) Confirm by pushing NAVIGATION WHEEL.

   "**SBIS**" is shown in display.



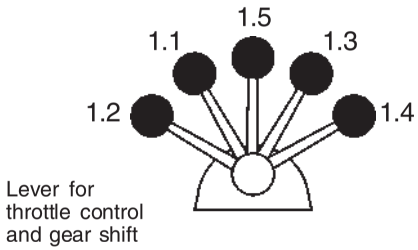
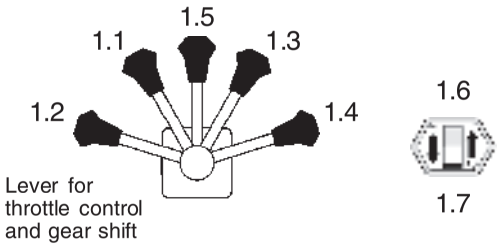
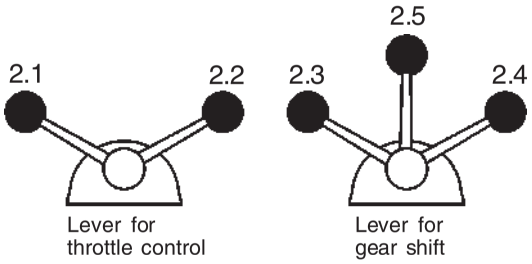
10. Wait until "**PTIS**"/"**SBIS**" disappers from tachometer display and MAIN MENU appears.

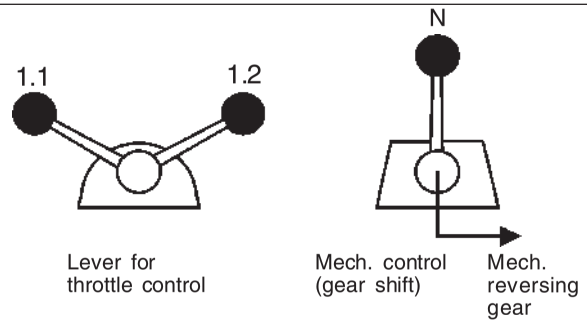
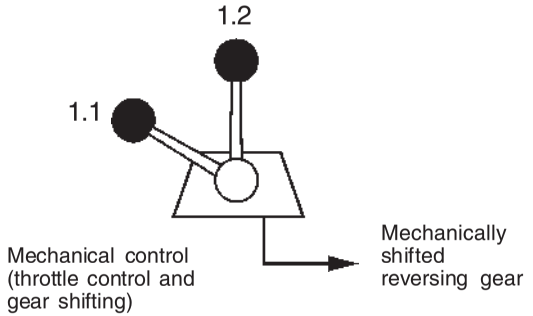
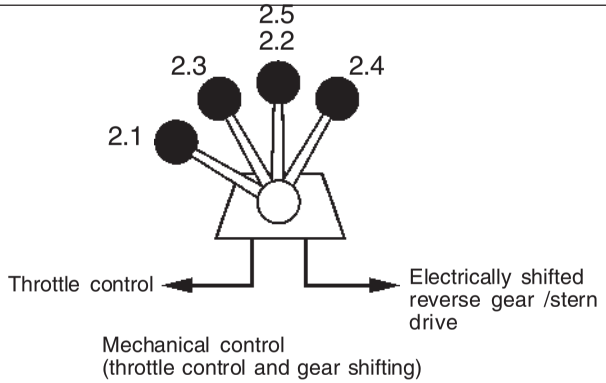
NOTE! Additional helm station(s)

Repeat step 8–10 for each additional helm station.

11. Auto configuration for port engine is finished. Turn starter key to position 0 (ignition off).
12. Repeat step 1–4 for starboard engine.
13. Auto configuration for starboard engine is finished and MAIN MENU appears.

Combinations of control levers for EVC. Summary, calibration

Controls	Notes	Number of levers and calibration positions shown in the tachometer display	Calibration order	
Single lever control. Top mounted or side mounted	Combined throttle control and gear shift. Connectors marked THROTTLE POT and NEUTRAL SWITCH to the control alt. to an adapter. Connectors marked GEAR POT are not used.	1.0 – 1.5		1.1 FORWARDS – idle 1.2 FORWARDS – full throttle 1.3 REVERSE – idle 1.4 REVERSE – full throttle 1.5 NEUTRAL – idle
Single lever control with PowerTrim buttons. Side mounted	Combined throttle control and gear shift. Connectors marked THROTTLE POT. and NEUTRAL SWITCH to the control.	1.0 – 1.7		1.1 FORWARDS – idle 1.2 FORWARDS – full throttle 1.3 REVERSE – idle 1.4 REVERSE – full throttle 1.5 NEUTRAL – idle 1.6 UP 1.7 DOWN
Two lever control.	Throttle control and gear shift on separate levers. Connectors marked THROTTLE POT. to lever for throttle control. Connector marked GEAR POT. and NEUTRAL SWICH to lever for gear shift.	2.0 – 2.5		2.1 Full throttle 2.2 Idling Lever for throttle control 2.3 FORWARDS 2.4 REVERSE Lever for gear shift 2.5 NEUTRAL

Controls	Notes	Number of levers and calibration positions shown in the tachometer display		
Two lever control. One neutral position switch	Mechanical reverse gear. Only throttle control. Connector marked NEUTRAL SWITCH connected to the neutral position switch to prevent the engine from being started with a gear engaged. Connector marked THROTTLE POT. to lever for throttle control. Connector marked GEAR POT. is not used.	1.0 – 1.2		1.1 Full throttle 1.2 Idling Neutral position switch: Closed = Neutral position Open = Gear engaged **Note.** The neutral position switch must be closed during calibration.
Mechanical single lever control for both throttle control and gear shift, incl. neutral position switch.	Throttle control and gear shift in one lever. Mechanically shifted reverse gear or stern drive. Connector marked NEUTRAL SWITCH connected to the neutral position switch to prevent the engine from being started with a gear engaged. Connector marked THROTTLE POT. connected to an adapter. Connector marked GEAR POT. is not used.	1.0 – 1.2		1.1 FORWARDS – full throttle 1.2 NEUTRAL – idle Neutral position switch: Closed = Neutral position Open = Gear engaged **Note.** The neutral position switch must be closed during calibration.
Mechanical single lever control for both throttle control and gear shift. Two control cables and two control adapters.	Throttle control and gear shift in one lever. Electrically shifted reverse gear or stern drive. Connector marked NEUTRAL SWITCH connected to an adapter to prevent the engine from being started with a gear engaged. Connector marked THROTTLE POT. connected to an adapter.	2.0 – 2.5		2.1 FORWARDS – full throttle 2.2 NEUTRAL – idle 2.3 FORWARDS – idle 2.4 REVERSE – idle 2.5 NEUTRAL – idle Neutral position switch: Closed = Neutral position Open = Gear engaged **Note.** The neutral position switch must be closed during calibration.

Lever calibration

Electronic lever control – top and side mounted

Single and twin installations

NOTE! The following description applies to Volvo Penta's electronic controls.

NOTE! If the controls for two engines are calibrated,

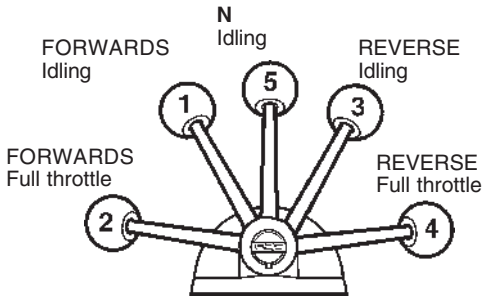


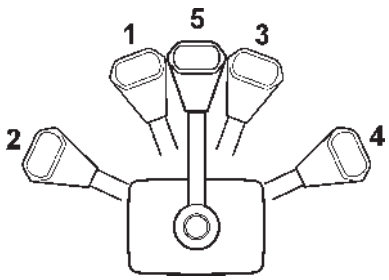
both levers should be calibrated at the same time, to give the same lever travel/positions for both engines.

1. Enter calibration mode
   1.0 is shown on the tachometer display.

   NOTE! 1.0 indicates a single lever control.

2. Move the lever to the forward idling (1).







   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.1 is shown on the tachometer display.

3. Move the lever to the position for full throttle forward (2).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.2 is shown on the tachometer display.

4. Move the lever to the reverse idle position (3).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.3 is shown on the tachometer display.

5. Move the lever to the reverse full throttle position (4).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.4 is shown on the tachometer display.

6. Move the control lever to neutral position (5).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.5 is shown on the tachometer display.

7. Push NEUTRAL BUTTON to exit lever calibration. The green LED(s) by the neutral button will show steady light. Push BACK BUTTON to return to MAIN MENU.

Mecanical two lever control

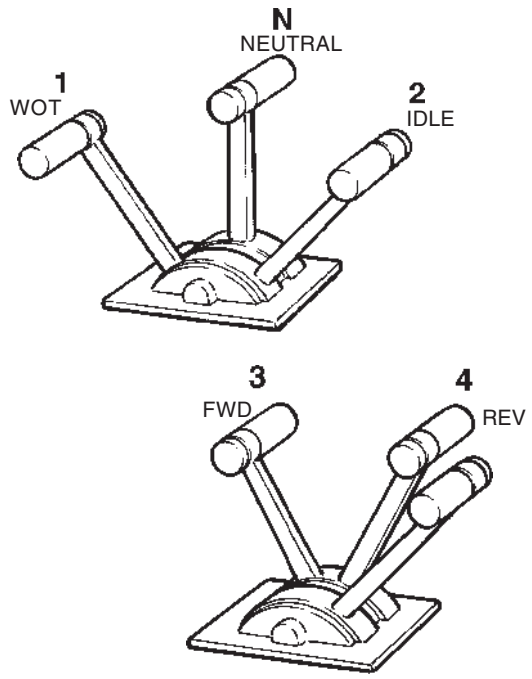
Single and twin installations. Electrical throttle and electrically shifted reverse gear

NOTE! If the controls for two engines are calibrated, both levers should be calibrated at the same time, to give the same lever travel/positions for both engines.



1. Enter calibration mode
   2.0 is shown on the tachometer display.

   NOTE! 1.0 indicates a twin lever control.



2. Move the throttle lever to the position for full throttle forwards WOT (1).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   2.1 is shown on the tachometer display.

3. Move the throttle lever to the idling position IDLE (2).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   2.2 is shown on the tachometer display.

4. Move the shift lever to the forward position FWD (3).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   2.3 is shown on the tachometer display.

5. Move the shift lever to the reverse position REV (4).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   2.4 is shown on the tachometer display.

6. Move the control lever to neutral position N (5).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   2.5 is shown on the tachometer display.

7. Push NEUTRAL BUTTON to exit lever calibration. The green LED(s) by the neutral button will show steady light. Push BACK BUTTON to return to MAIN MENU.

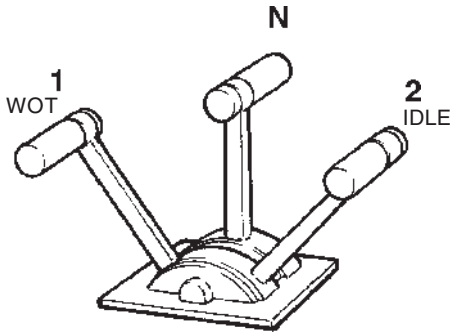
Single and twin installations. Electrical throttle and mechanically shifted reverse gear

NOTE! If the controls for two engines are calibrated, both levers should be calibrated at the same time, to give the same lever travel/positions for both engines.

Preparations:

Gear shift lever in neutral N position.(Neutral switch is closed.)

1. Enter calibration mode
   1.0 is shown on the tachometer display.





NOTE! 2.0 indicates a twin lever control.

2. Move the throttle lever to the position for full throttle forwards WOT (1).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.1 is shown on the tachometer display.

3. Move the throttle lever to the idling position IDLE (2).

   Release the lever and confirm the position by pushing NEUTRAL BUTTON.
   1.2 is shown on the tachometer display.

4. Push NEUTRAL BUTTON to exit lever calibration. The green LED(s) by the neutral button will show steady light. Push BACK BUTTON to return to MAIN MENU.

Idling speed calibration (If needed)

NOTE! When calibrating idling speed the Full Throttle Forwards position on the lever corresponds to maximum idling speed.

NOTE! D4 and D6 engines only:
Idling speed adjusting can only be done when the engine temperature is more than 40°C (104°F). When temperature is below 40°C (104°F) only Warming Up mode is activated.

1. Activate helm station by pushing the ACTIVE STATION BUTTON on the EVC panel.
2. Enter calibration mode.
3. Start the engine.

   Pop-up in display indicates:



   IDLE SPEED SET RPM

4. Adjust the idling speed with the control lever. Idling speed can be adjusted to a value between:

D4 engines	700–750 rpm
D6 engines	600–650 rpm

   Confirm rpm by pushing the NEUTRAL BUTTON.

5. Move lever to neutral position and stop the engine.

Settings, general

NOTE! For all setting procedures:

Activate helm station by pushing the ACTIVE STATION BUTTON on the EVC panel.

Checking the charging system

Special tools: 9812519

Generally about alternators:

The voltage output from an alternator must be limited to prevent the elecrolyte in the battery to evaporate. The alternator output is regulated (limited) by the voltage regulator in the alternator. The maximum current that the alternator can deliver at regulated voltage output depends on the alternator revolution. To make the alternator charging more efficient a sense cable between the alternator and the battery+ can be added to compensate if there is a voltage drop in the cable between the alternator and the battery+.

When the engine is started an excitation current is needed to “wake up” the alternator.

NOTE! It is the consumers (batteries included) which decides the output current from the alternator.

Measurements

1. Engine off.
2. Use multimeter 9812519 to do a voltage measurement over the battery. The nominal voltage over a full loaded battery is approx. 12.6V or 25.2V.
3. Engine on. Run at 1500 rpm.
4. Use multimeter 9812519 to do a voltage measurement over the battery. The nominal charging voltage over the battery should be approx. 13.6-14.4V or 27.8-28.6V (if the sense cable is connected).

Fault tracing the charging system

Battery

1. Check that all connectors at the battery is correct assembled.
2. Check the conditions of the cables to the battery.
3. Check the water level in the battery.
4. Check, if possible, the specific gravity of all cells.

when no charge

1. Check the alternator belt tension.
2. Check that all connectors at the alternator and at the battery is correct assembled.
3. Check the conditions of all cables in the charging system.
4. Check the brushes length and condition.
5. Change, if possible, the regulator.

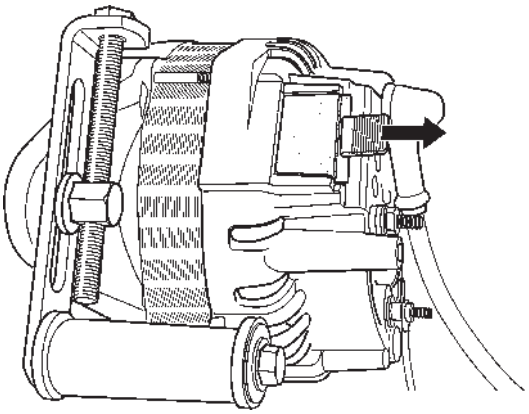
when undercharge

1. Check the alternator belt tension.
2. Check that all connectors at the alternator and at the battery is correct assembled.
3. Check the conditions of all cables in the charging system.
4. Check the brushes length and condition.
5. Change, if possible, the regulator.

when overcharge

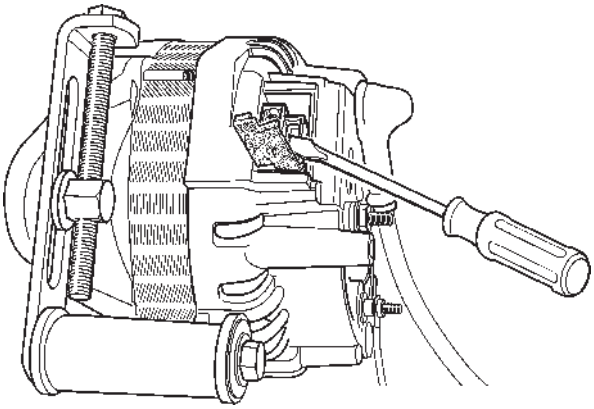
1. Change, if possible, the regulator.

Brush change

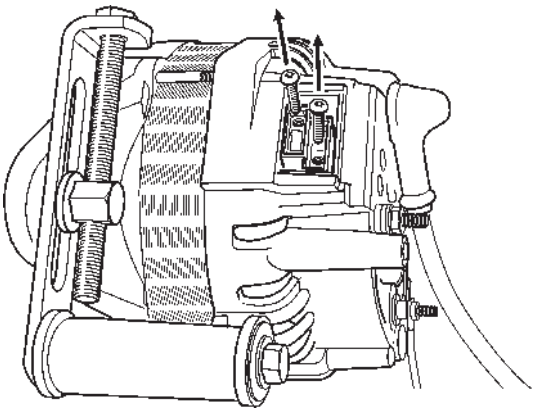


Valid for alternator 3587218, 3840182.

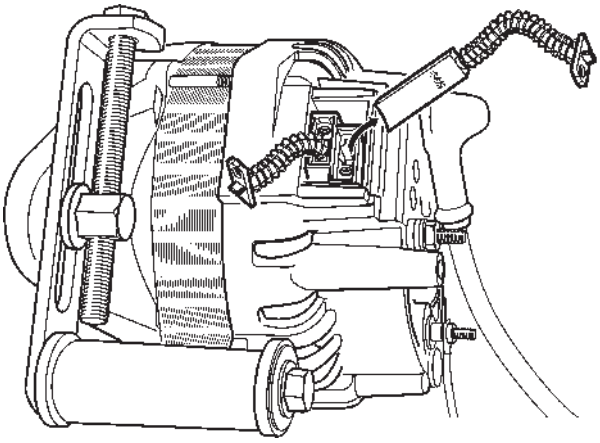
Pull out the black plastic lid.



Use a screwdriver to snap of the plastic lid over the brush holders.



Disassemble the two torx screws that holds the two brush holders.



Pull out the brushes

Technical data

Switch, water in fuel

Voltage ..... 12/24 V
Connector 3-pin
Contact type ..... Closing at detection with water

Sensor, fuel pressure

Voltage ..... 5 V
Connector 3-pin
Working pressure range: ..... 0–180 MPa (0-1800 bar)
Pressure signal ..... 0,5–4,5 V
Type ..... Linear
Max tightening torque ..... 70 Nm (51.6 lbf-ft)

Sensor, fuel temperature

Voltage ..... 5 V
Connector 2-pin
Working temperature range: ..... –40°C to +150°C
Type ..... NTC
Max tightening torque ..... 30 Nm (22 lbf-ft)

Camshaft sensor/flywheel sensor

Connector 2-pin
Working temperature range: ..... –40°C to +130°C
Type ..... Inductive sensor
Max tightening torque ..... 8 ±2 Nm (6±1.5 lbf-ft)

Sensor, oil pressure (engine)

Voltage ..... 5 V
Connector 3-pin
Working pressure range: ..... 0–700 kPa (0-7 bar)
Pressure signal ..... 0,5–4,5 V
Working temperature range: ..... –40°C to +140°C
Type ..... Linear

Combined sensor, oil pressure/oil temperature (transmission)

Voltage ..... 5 V
Connector 4-pin
Working pressure range: ..... 0–3 MPa (0-30 bar)
Pressure signal ..... 0,5–4,5 V
Working temperature range: ..... –40°C to +140°C
Type ..... Linear/NTC

Combination sensor, boost air pressure/boost air temperature

Voltage ..... 5 V
Connector 4-pin
Working pressure range:: ..... 50–400 kPa (0,5-4 bar)
Pressure signal ..... 0,5–4,5 V
Working temperature range: ..... –40°C to +130°C
Type ..... Linear/NTC

Sensor, coolant temperature

Voltage ..... 5 V
Connector 2-pin
Working temperature range: ..... –40°C to +150°C
Type ..... NTC
Max tightening torque ..... 30 Nm (22 lbf-ft)

Switch, coolant level

Connector 2-pin
Contact type ..... Closing with low coolant level

Alternator

Voltage ..... 14V/24 V
Connector 2-pin
Capacity ..... 115A at 14V / 80 A at 24V

Starter motor

Voltage ..... 14V/24 V
Connector 2-pin
Capacity ..... 3.6 kW at 12V / 5.0 kW at 24V

References to Service Bulletins

Group	No.	Date	Refers to

Index

MID 128 (Engine control unit EDC):

	PID	PPID	SID	PSID	FMI	Please refer to page:
Throttle control position	91				9	44
Water monitor, fuel filter	97				0, 9	46
Oil pressure sensor*, engine	100				0, 1, 3, 4, 5, 6, 9	49
Boost air temperature sensor*	105				3, 4, 9	56
Boost air pressure sensor*	106				0, 3, 4, 5 6, 9	61
Atmospheric pressure sensor	108				0, 3, 4, 9	67
Coolant temperature sensor	110				0, 3, 4, 9	69
Battery voltage	158				0, 1, 3, 4, 9	74
Fuel pressure	164				0, 3, 4, 5, 6, 9	77
Fuel temperature sensor	174				0, 3, 4, 9	83
Engine speed, overspeed / calculation	190				0, 1, 2, 4, 9	88
Injectors 1–6			1–6		2, 3, 4, 9	93
Camshaft position sensor (speed sensor, camshaft)			21		0, 2, 4	96
Speed sensor, flywheel			22		0, 2, 4	100
Output, compressor coupling			26		3, 4	104
Output, starter motor			40		3, 4	107
Output, fuel pump (MPROP), fault			57		3, 9	110
ECM main relay			218		2, 3, 4, 9, 11	114
SAE J1939 Data link			231		9	116
Supply voltage			251		2, 5, 6, 9	118
Engine control unit EDC7			254		3	119
Fuel pressure, monitoring (MPROP)				50	0, 1, 2, 3, 5, 6, 9	120
Redundant Shut-off Path				51	12	127
Monitoring the pressure relief valve				53	0, 1	128
Booster voltage (High bank 1)				54	3, 4, 9	130
Booster voltage (High bank 2)				55	3, 4, 9	132

* Combined sensor, boost pressure and boost temperature

MID 164 (SHCU):

	PID	PPID	SID	PSID	FMI	Please refer to page:
Lever 1 position relative to pot supply failure		390			3, 4	134
Lever 2 position relative to pot supply failure		391			3, 4	140
Lever potentiometer supply failure		392			3, 4	142
Data bus power input		393			4, 11	239
Key supply		394			3, 4	144
Main panel communication lost		397			9	147
Steering wheel position		424			2 ,12	245
Auto pilot fault				139	2, 9	150
Neutral switch and lever position mismatch			226		5, 7	152
Sync bus communication fault			231		2, 9	155
Program memory fault			240		12	210
SAE J1708 / J1587 data link			250		12	157
Calibration Memory Failure			253		2, 9, 12, 13	211
Internal CPU faults			254		2, 11, 12	214
Joystick fault				64	9, 12	159
Joystick on-button				65	4	161
Joystick hi-button				66	4	162
Joystick sync-fault				67	9	163
Lever detection				95	7, 12	164
Calibrated lever travel too small				96	13	166
Lever calibration procedure				97	13	167
Lever(s) not calibrated				98	13	168
Data bus network configuration fault				99	12	237
Neutral button				103	4	169
Lighting button (multifunction button)				104	4	171
Active station button				105	4	173
Start				106	3	159
Stop				107	3	177
Steering wheel data link				133	2, 5, 9	179
Steering wheel module				134	12	181
Steering wheel brake				135	12	182
Steering wheel controller				136	12	183
Rudder angle				137	9, 12	184
Steering position divergence				138	10	185
Incompatible sync version				140	12	187
Data bus passive / active helm communication failure				218	8, 9	188
SHCU communication failure with other helm				226	9	190
Incompatible chassi ID				231	2	192
Data bus communication warning				232	2, 5	234

MID 187 (PCU):

	PID	PPID	SID	PSID	FMI	Please refer to page:
Fuel level sensor	96				3, 4	192
Transmission oil pressure sensor*	127				3, 4	196
Transmission oil temperature sensor*	177				3, 4	200
Data bus power input		393			4, 11	239
Transmission sensor supply		400			3, 4	203
J1939 Communication warning / fault			231		2, 9, 12	206
Program memory fault			240		2	210
Calibration Memory Failure			253		2, 9, 12, 13	211
Internal CPU faults			254		2, 11, 12	214
Incompatible engine type				10	12	215
Data bus network configuration fault				17	12	237
Data bus power output				18	12	216
Primary solenoid (“high side switch”)				20	4, 5, 6	219
Secondary solenoid (“high side switch”)				22	4, 5, 6	223
Data bus communication with active helm failure				32	9, 10	225
No data on engine bus				200	8, 9, 12	228
Data bus communication with passive helm failure				226	9	231
Incompatible chassi ID				231	2	192
Data bus communication warning				232	2, 5	234

* Combined sensor, oil pressure and oil temperature

MID 250 (SUS):

	PID	PPID	SID	PSID	FMI	Please refer to page:
Battery input	168				4, 11	242
ECU temperature		55			12	249
Data bus power input		393			4, 11	239
Steering wheel position		424			2, 12	245
Rudder angle		426			2, 5, 6, 7	247
Servo motor temperature		427			0, 1	250
Program memory fault			240		2	210
Calibration Memory Failure			253		2, 9, 12, 13	211
Internal CPU faults			254		2, 11, 12	214
Data bus network configuration fault				1	12	237
Data bus power output				2	4	252
Servo motor				3	0, 1, 3, 4, 5, 6, 7, 10, 12	254
Electro mechanical rudder brake				4	5, 6, 7, 14	259
Data bus communication with active helm failure				6	9, 10	262
Data bus communication warning				232	2, 5	234

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