

# **Workshop manual**

**Group 30**

<b>A</b>
<b>2(0)</b>

**D1-13 B • D1-20 B**

**D1-30 B • D2-40 B**

**D2-55 D • D2-55 E**

**D2-75 B • D2-75 C**



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# Group 30 Electrical system

## Marine Diesel engines

D1-13 B • D1-20 B

D1-30 B • D2-40 B

D2-55 D • D2-55 E

D2-75 B • D2-75 C

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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 this safety information and the General Information and Repair Instructions in the workshop manual carefully before starting work.

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.

## 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.

To give you a overview of the risks which always need to be observed and precautions which always have to be taken, we have noted them below.

 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 get caught in rotating parts and cause serious personal injury.

 Never start the engine with the cover removed. Apart from the risk of spilling oil, there is a risk of personal injury.

 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. Foreign objects entering the intake ducts can 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 oilsoaked 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 an explosion with resulting damage. Do not move the connections when you attempt to start the engine (risk of arcing), 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 devices 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 devices may be needed to obtain the correct balance and safe handling.
-  Never do any work on an engine which just hangs from a lifting device.
-  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.
-  Remember the following when washing with a high pressure washer: Never aim the water jet at seals, rubber hoses or electrical components. Never use a high pressure washer for engine cleaning.
-  Only use the fuels recommended by Volvo Penta. Refer to the Instruction Book. 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, descriptions and repair instructions for the engines equipped with MDI.

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 must be 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 AB Volvo Penta can no longer be responsible for guaranteeing that the engine complies with the certified version.

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

# Repair instructions



**WARNING!**



**IMPORTANT!**

## NOTE!

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

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 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, 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.

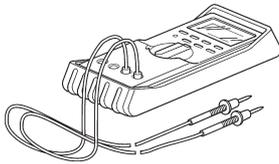
Some systems, such as the components in the fuel system, require special expertise and special testing equipment for service and maintenance. For environmental reasons etc., some components are sealed at the factory. It is only permissible to work on sealed components if you are authorized to do such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

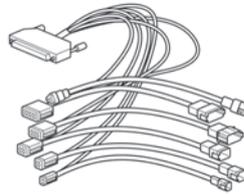
## Torque

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. If lubricants, 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.

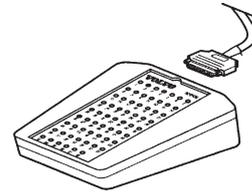
## Special tools



**9812519**



**88890016**



**9998699**

**9812519** Multimeter

**88890016** Adapter cable

**9998699** Measurebox

# The MDI system

The MDI is located on the engine and is connected to a number of nearby components, such as sensors, switches, button panel and instruments.

A data link (CAN bus) links the MDI to the tachometer/display and other optional equipment such as NMEA2000 interface, multisensor.

## Functionality

### Instrumentation

The instruments use a serial communication bus. The serial communication bus in combination with EVC reduces wiring and simplifies installation.

### EVC system tachometer

All alarms are available in the tachometer. The tachometer has a built in buzzer alarm and an output to the instrument serial bus (easy-link).

### EVC system display

The EVC system display is a complement or replacement for the EVC system tachometer and optional instruments. The display shows operation information, information messages and alarms. The user selects what operation information to display with the buttons on the display. The EVC system display can show more than one operation information at one and the same time. The display also has access to the same display mode and calibration functions as for the EVC system tachometer display.

### Fuel level

If a fuel level gauge is used it must be connected to the instrument serial communication bus (easy-link). The MDI has an input for the fuel level sender.

### NMEA support

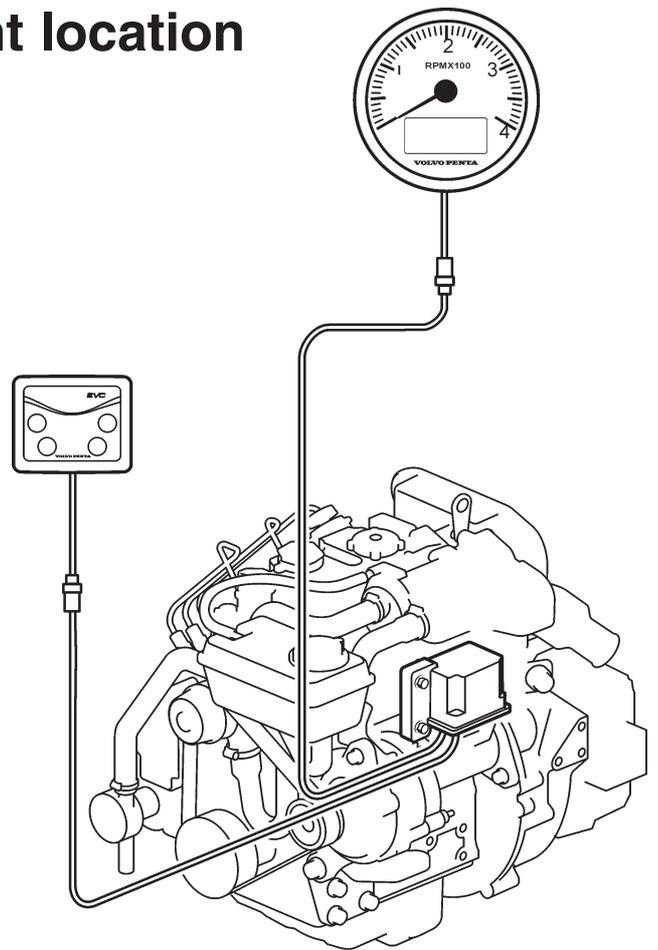
The MDI system supports NMEA 2000 by means of a hardware interface.

### Boat speed, echo sounder and water temp (Multisensor)

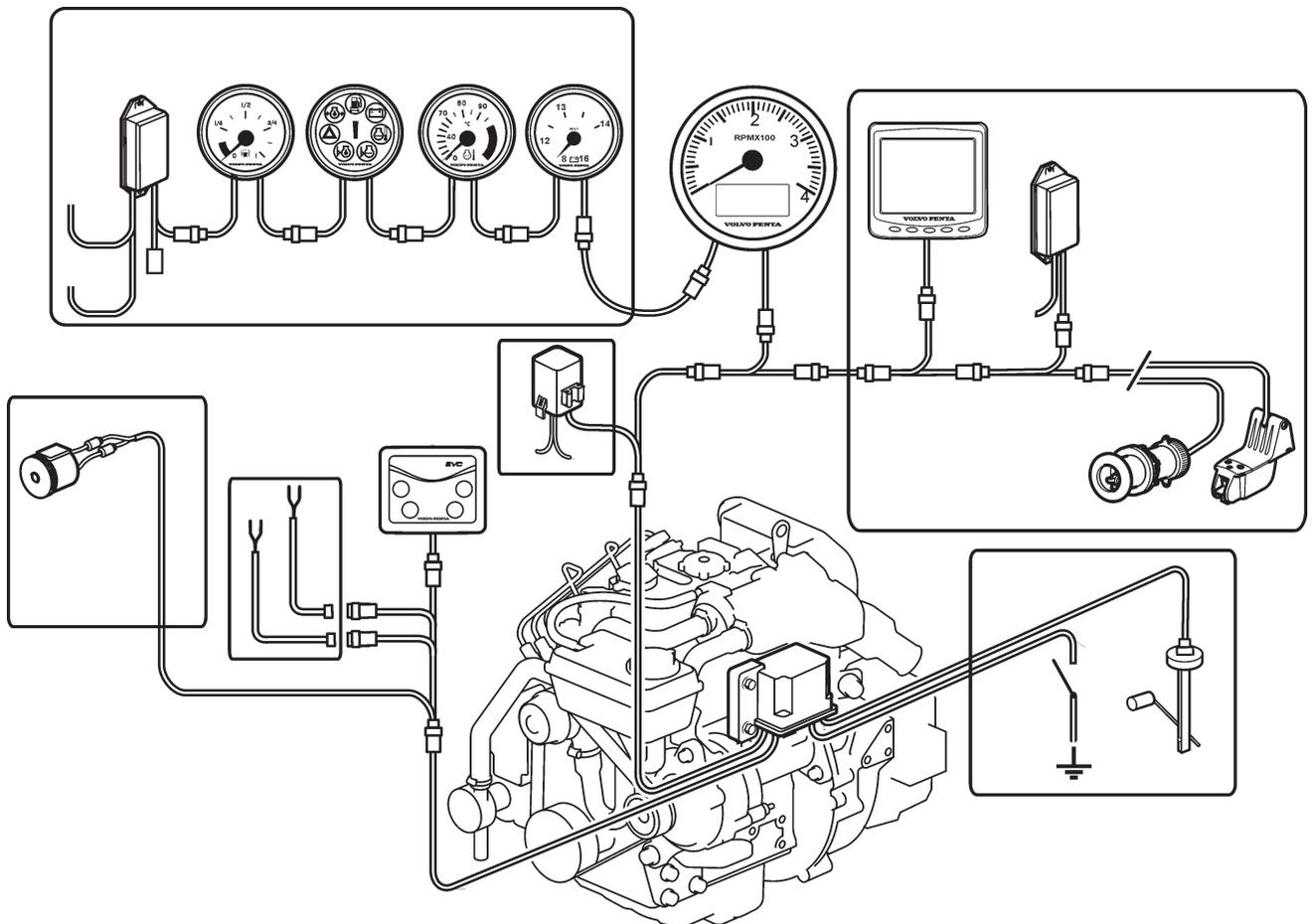
The multisensor is connected to the multilink cable. Data from the multisensor are shown in the EVC display and the speedometer instrument.

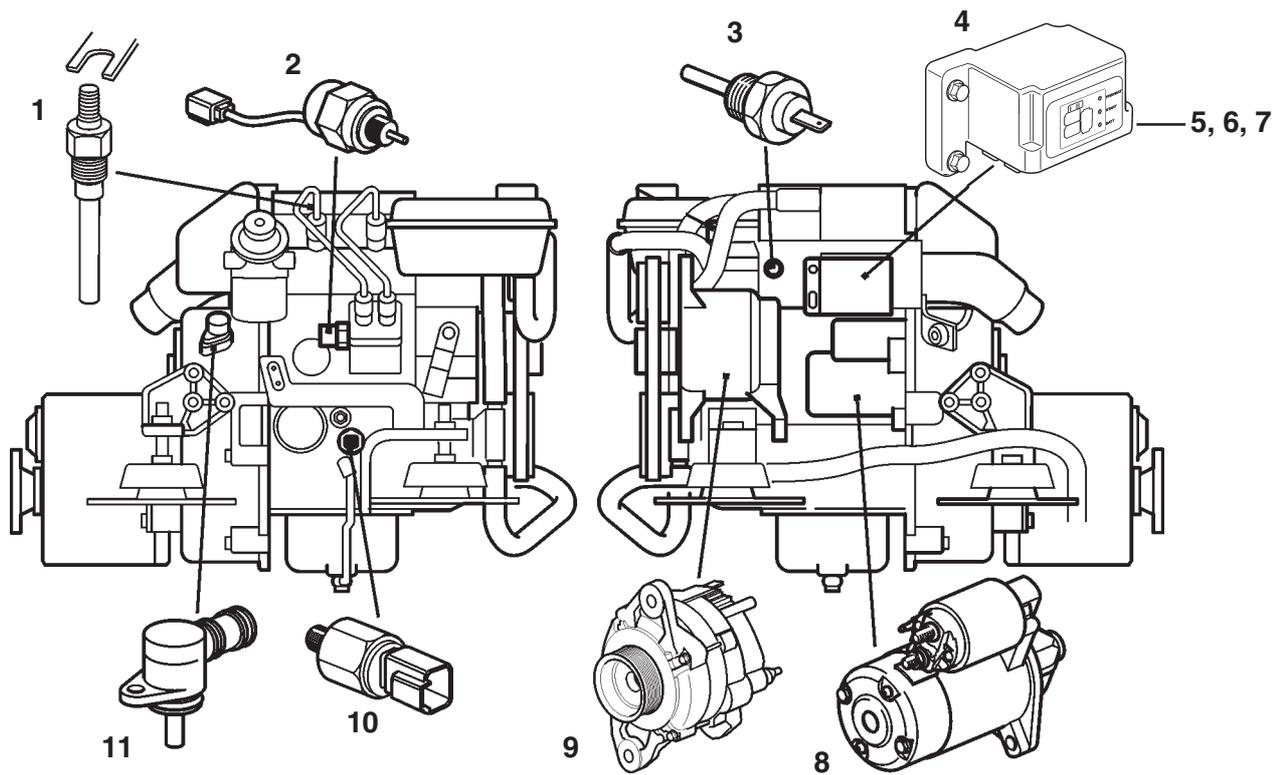
# Component location

Basic instrumentation



De luxe instrumentation

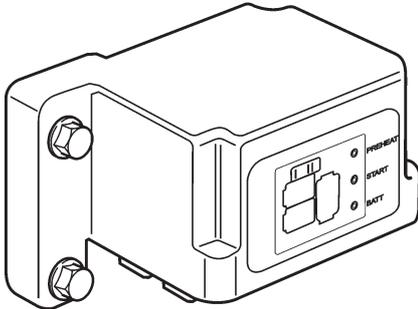




**NOTE!** The engine on these pictures is a D1-13 but the component location is the same on D1-20, D1-30, D2-40, D2-55, D2-75.

1. Glow plugs
2. Stop solenoid
3. Coolant temperature sensor
4. MDI
5. Starter relay
6. Glowplug relay
7. Charge sensing resistor
8. Starter motor
9. Alternator
10. Oil pressure switch
11. Engine speed sensor

# Component description

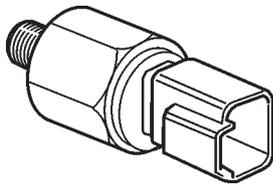


## MDI

The MDI\* is connected to sensors and switches on the engine. The MDI uses easylink instruments and/or the Volvo Penta EVC display to present information.

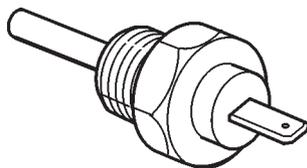
To the MDI a button panel is connected that controls the start and stop function of the engine.

\* MDI = "Mechanical diesel interface".



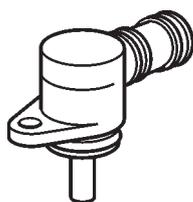
## Switch, oil pressure, engine

Oil pressure is observed by a pressure switch installed in the engine block on the right side of the engine. The switch is "normally open" in normal operation. If the oil pressure is too low, the switch closes. When the engine is not running the switch is closed.



## Sensor, coolant temperature

The sensors are located on the left side of the engine. The sensor senses the engine coolant temperature and sends the information to the MDI. The sensor consists of a non-linear resistor, whose resistance varies with coolant temperature. The resistance falls as the coolant temperature rises.



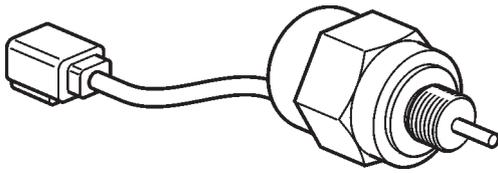
## Sensor, engine speed (flywheel)

The sensor is located on top of the flywheel housing. The sensor is inductive. It reads the crankshaft speed by means of milled slots on the outer radius of the flywheel.

The signal is sent to the MDI, which calculates the engine's revolution speed.

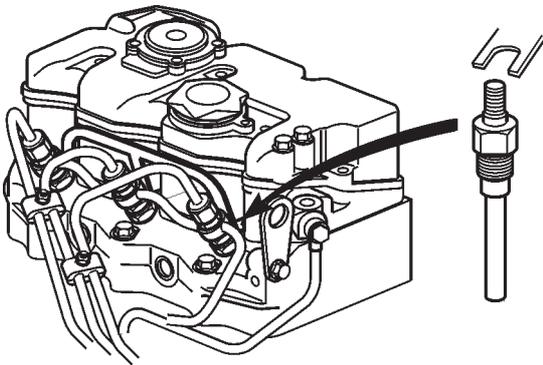
## Stop solenoid

The stop solenoid is an electromagnetic relay. When the stop button is pushed the stop solenoid is activated by the MDI. The stop solenoid shuts off the fuel supply at the injection pump.



## Glow plugs

One glowplug per cylinder is installed in the cylinder head. All glowplugs are electrically connected by a conductor rail. The glowplugs heat the air mixture during starting.



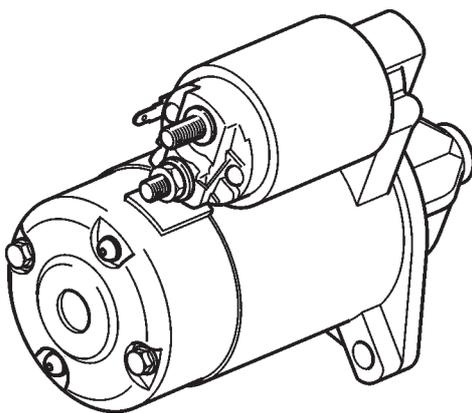
## Starter motor

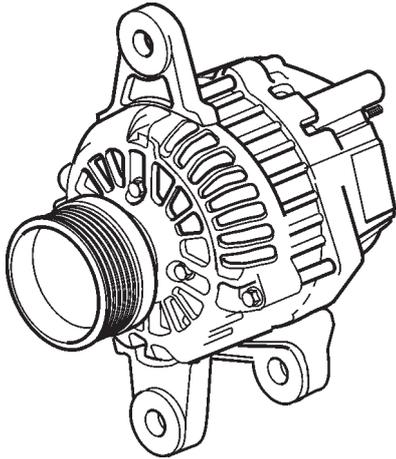
The starter motor is a DC series motor. The starter pinion is operated by a control solenoid and can be slid axially on the rotorshaft.

The starter motor has a reduction gear, which makes it possible to obtain greater torque.

The starter motor power depends on the engine it is fitted to, please refer to the table below.

D1-13, D1-20	0.8 kW
D1-30	1.1 kW
D2-40	1.4 kW
D2-55, D2-27	2.0kW





## Alternator

The alternator provides alternating current (14V/115A).

The voltage regulator on the alternator is provided with a sense system.

The sense system compares the charge voltage between the alternator terminals, B+ and B-, with the voltage across the battery positive and negative terminals. The voltage regulator then compensates for any voltage drop in the cables between the alternator and the batteries, by increasing the charge voltage supplied by the alternator as necessary.

# Repair instructions

## General advice

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

**⚠ IMPORTANT!** The system must be disconnected from system voltage (by cutting the current with the main switch) when the MDI 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 floating 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.

## Fault tracing of cables and connectors

*Special tools: 9812519*

### 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 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 diagram 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.

## Electric welding

Remove the positive and negative cables from the batteries. Then disconnect all cables connected to the alternator starter motor ,MDI.

Always connect the welder earth clamp to the component to be welded, and 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.

**⚠ WARNING!** After welding is finished ,the wires to the alternator must be reconnected **before** the battery cables are reconnected.

## Starter motor

Fault tracing the starter motor should be left to an authorized electrical workshop which has the necessary test equipment.

## Checking battery voltage

*Special tools: Multimeter 981 2519*

### General

If battery voltage falls below 12.4 V\*, the starter motor will not be able to crank the engine at normal speed.

A fully charged battery has an open circuit voltage of about 12.7 V (depended of ambient temperature). When the open circuit voltage falls to 12.5 V, the battery is half charged.

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

### Voltage measurement, check

**1**

Check that the battery voltage is at least 12.4 V\* when unloaded by using multimeter 981 2519 to measure between the battery poles.

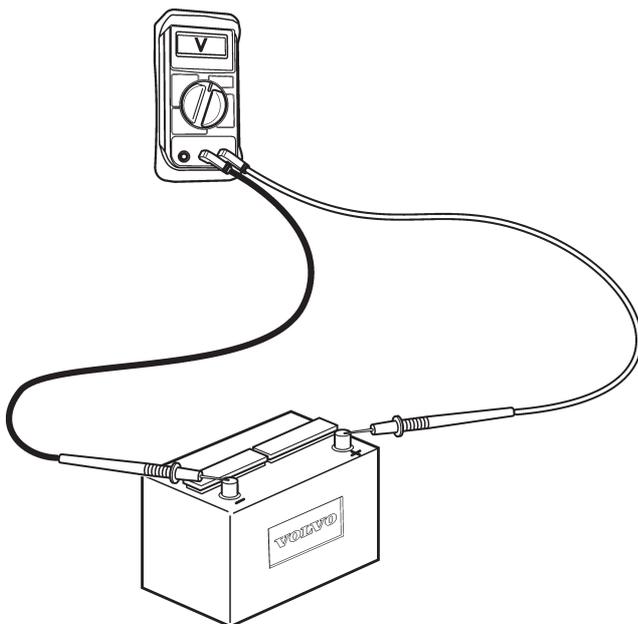
\* **Note.** Measured on the batteries.

**2**

Turn the main switch on.

**3**

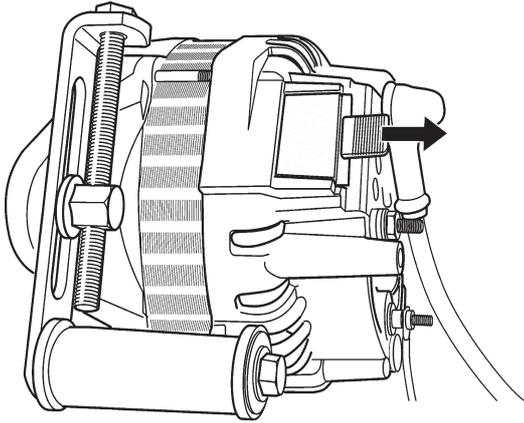
Check that the voltage between terminals B+ and B- on the starter motor are the same as the battery voltage.



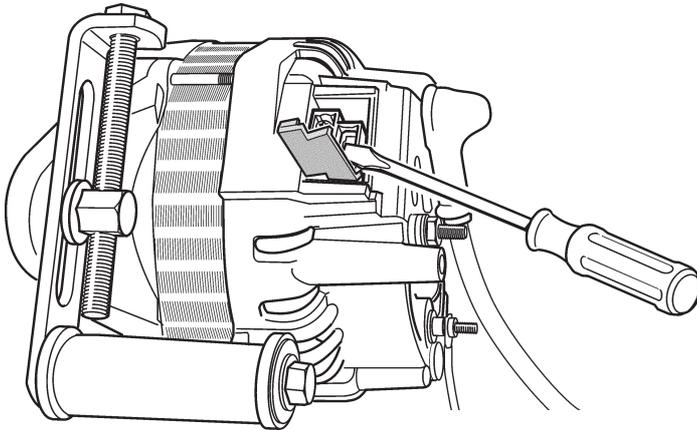
## Checking alternator brushes

### Brush dismounting

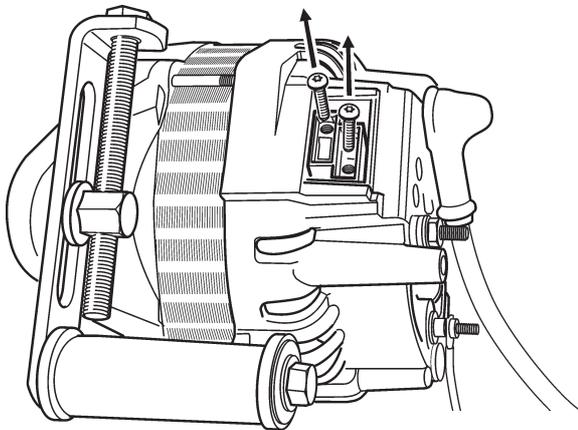
Pull out the black plastic lid.



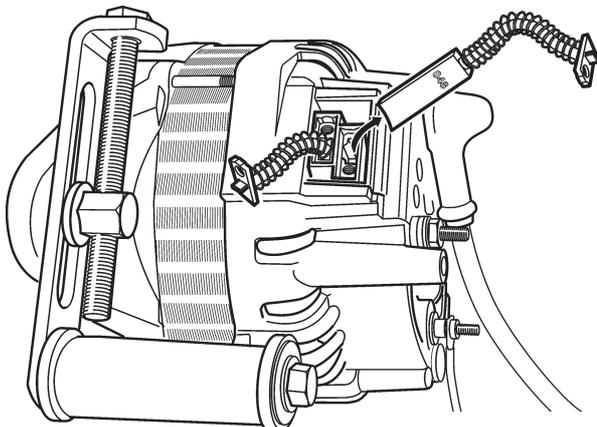
Use a screwdriver to snap of the plastic lid over the brush holders.

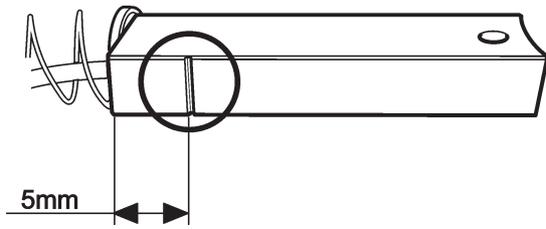


Disassemble the two torx screws that holds the two brush holders.

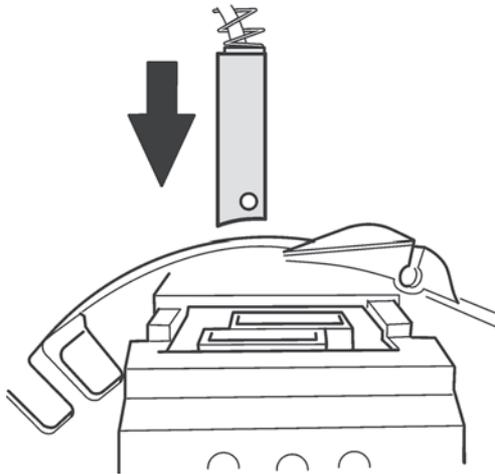


Pull out the brushes.





Measure the brush length. If the brush is worn beyond the wear limit line (5mm) it must be replaced.



### Brush mounting

When mounting the brush be sure to positioning it as shown in the picture.

## Checking the charging system

*Special tools: 9812519*

### Generally about alternators:

The voltage output from an alternator must be limited to prevent the electrolyte 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+ is 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. 12.7V (depended of ambient temperature).
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. 13.8-14.6V.

## Fault tracing 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 that the alternator recieves correct excitation voltage.
5. Regulator fault, try another alternator.

### 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. Regulator fault, try another alternator.

### when overcharge

1. Probably regulator fault, try another alternator.

## Checking the instruments

*Special tools: Multimeter 9812519*

The instruments are of the Easy-Link type and receive their signals via a serial bus. The cables connected to the instrument consist of a total of 3 conductors, battery positive, battery negative and a 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 instruments work, use multimeter 9812519 to check whether there is +12 Volt between the red (pin1) and blue (pin2) conductors in the Easy-Link cable.

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 faulty or not.

1

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

2

Disconnect the instrument that is suspected of being faulty.

3

The fault disappears:

-Check that there is no oxide or moisture in the relevant instrument's connector.

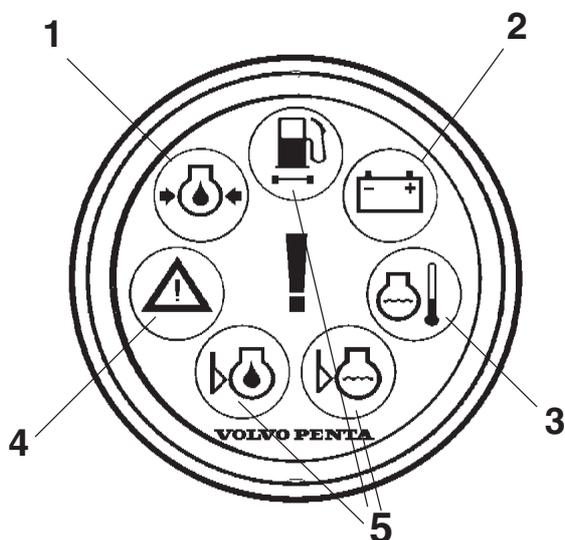
-Change the removed instrument and check that the fault still is disappeared when the instrument is re-connected.

The fault remains:

Continue to disconnect instruments until instrument display is correct. Then try to connect the instruments again. Start with the instrument that was disconnected first, and continue to connect the instruments that were removed until indication no longer functions. Change the instrument that was connected last.

# Malfunctions

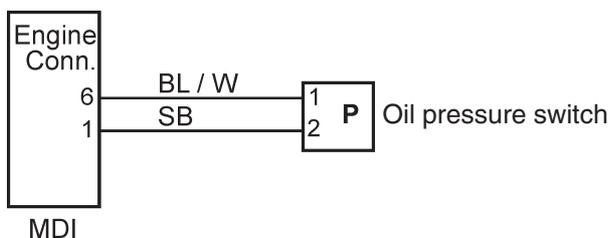
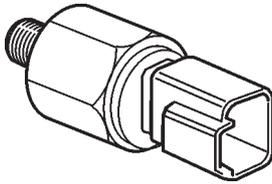
Symptom	Action
Alarm can not be acknowledged.	see section "Button panel fault".
Charging problems.	see section "Battery warning" or see section "Checking the charging system".
Coolant alarm.	see section "Coolant temperature warning".
Engine does not start. (due to electrical conditions)	see section "Start/preheat warning".
Fuel level warning.	see section "Fuel level warning".
Glowing not activated.	see section "Start/preheat warning".
No dimmer function.	see section "Button panel fault".
No engine hours in the tachometer/display.	see section "Multi link fault".
No engine revolution in the tachometer/display.	see section "Multi link fault".
No multisensor data in the EVC display.	see section "Multi link fault".
Oil pressure alarm.	see section "Oil pressure (engine) warning".
On button does not power up the system.	see section "Button panel fault".
Starter motor not activated.	see section "Start/preheat warning" or see section "Checking the battery".
Stop solenoid not activated.	see section "Stop solenoid" or see section "Button panel fault".



## Alarm display

- Lube oil pressure:** When the oil pressure falls below a certain value at a certain engine speed, the alarm lamp is lit.
- Battery voltage:** The alarm lamp lights up if the alternator does not charge or if it overcharge.
- Coolant temperature:** When the coolant temperature exceeds the alarm limit level, the alarm lamp lights up.
- Warning indication:** The "System Failure lamp" will light up at short circuit, broken wire and AUX failure. For faults requiring immediate action or attention by the operator. The buzzer will sound constantly.
- Not used.

## Oil pressure (engine) warning



### Fault indication

#### Tachometer:

The tachometer LCD screen will show a flashing oil pressure icon and the alarm buzzer sounds.

#### Alarm display:

The oil pressure indication flashes in the alarm display + audible warning.

### Circuit description

The oil pressure in the engine is monitored by a pressure switch. The output signal from the pressure switch can have two distinct positions, high/low, in the same way as a relay output. A pre-set limit value determines when the switch switches from one distinct position to the other one. The switch is closed when the oil pressure is low and when the engine is off. Pin 6 in the engine interface connector at the MDI provides the switch with a voltage signal.

### Fault tracing

#### Fault conditions

The oil pressure switch closes at a oil pressure lower than 60kPa (0.6bar).

The alarm is depended of the engine rpm.

<1000rpm: oil pressure switch closed for more than 30 seconds.

>1000rpm: oil pressure switch closed for more than 0.5 seconds.

#### Possible reason

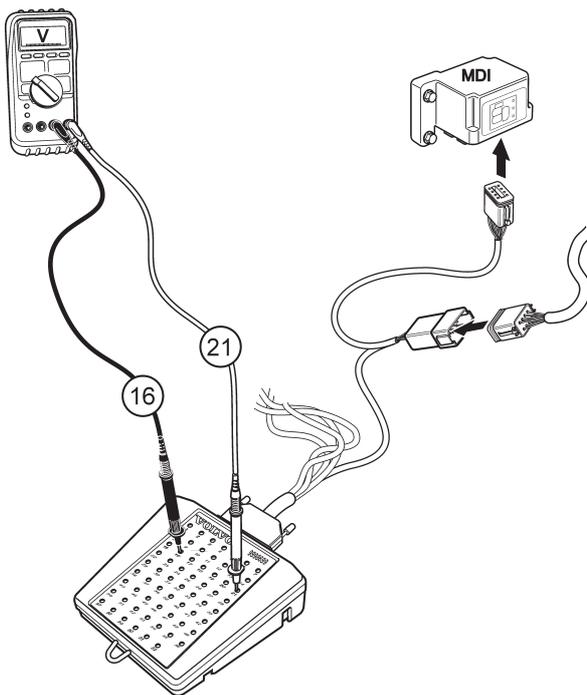
- Low oil level.
- Short circuit between oil pressure switch supply cable and battery negative.
- Faulty oil pressure switch.

**Suitable action**

1. Check the oil level in the engine and the oil quality.
2. Check that the oil filter is not blocked. Change oil filter and engine oil.
3. Check that no leakage occurs.
4. Check all wiring and connectors between the oil pressure switch and the MDI.
5. Check the switch by checking the engine oil pressure. (see "checking lubrication oil pressure" in the mechanical workshop manual for the engine)

**Measurements****Check MDI input for oil pressure switch**

*Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699*



1. **NOTE!** Cut the current with the main switch.
2. Connect adapter cable 88890016 with measurebox 9998699 between the MDI and the engine connector.
3. Use multimeter 9812519 for voltage measurement.
4. Turn the main switch on and press the on button on the button panel.

Measurement points	Nominal value
16 (battery neg.) – 21 (oil pressure switch supply)	$U \approx 0V$ (switch closed)

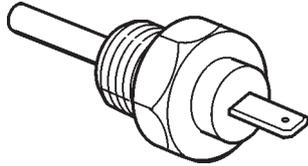
5. Disconnect the oil pressure switch connector at the oil pressure switch.

Measurement points	Nominal value
16 (battery neg.) – 21 (oil pressure switch supply)	$U \approx 3.5V$

6. Reconnect the oil pressure switch connector at the oil pressure switch.
7. Start the engine. Wait a minute before measuring.

Measurement points	Nominal value
16 (battery neg.) – 21 (oil pressure switch supply)	$U \approx 3.5V$ (switch open)

## Coolant temperature warning



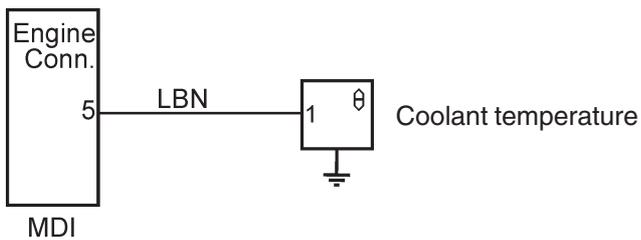
### Fault indication

#### Tachometer:

The tachometer LCD screen will show a flashing coolant temperature icon and the alarm buzzer sounds.

#### Alarm display:

The coolant temperature indication flashes in the alarm display + audible warning.



### Circuit description

The coolant temperature sensor consists of a thermistor. The property of a thermistor is that its resistance changes non-linearly with temperature in the medium it measures. Pin 5 in the engine interface connector at the MDI supplies the thermistor with a reference voltage of +5 Volt. The sensor is connected to battery negative via the engine. When the engine coolant is cold, the sensor resistance is high and the MDI senses a voltage close to the reference level. When the coolant heats up, the resistance in the thermistor falls and the voltage drop across the thermistor changes.

## Fault tracing

### Fault condition

Coolant temperature exceeds +110 °C (+230 °F) for more than 15 seconds.

### Possible reason

- Low coolant level.
- Blocked sea water filter or sea water intake.
- Worn impeller in seawater pump.
- kinked/leaking/blocked hose on the suction side (sea water).
- Slipping or broken drive belt for circulation pump.
- Faulty thermostat.
- Incorrect pressure cap on expansion tank.
- Fault in the coolant temperature sensor cable between the MDI and the sensor.
- Faulty coolant temperature sensor.
- Blocked heat exchanger.
- Poor flow through the cooling system due to worn coolant pump/seawater pump.

### Suitable action

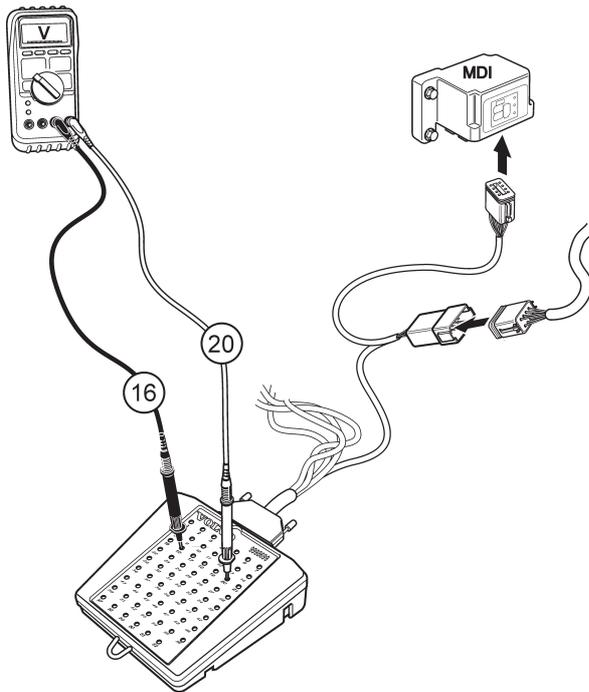
1. Check the coolant level.
2. Check that the system does not leak.
3. Check the drive belt tension for the circulation pump.
4. Check that the sea water filter is not blocked.
5. Check the impeller in the sea water pump.
6. Change the thermostat.
7. Check the pressure cap on the expansion tank. (see “checking the pressure valve in the filler cap” in the mechanical workshop manual for the engine)
8. Check the cables and the connectors between the engine connector at the MDI and the coolant temperature sensor.
9. Check the sensor.
10. Clean the heat exchanger. (see “clean the heat exchanger” in the mechanical workshop manual for the engine)
11. Change coolant pump/seawater pump.

## Measurements

### Check MDI output for coolant temperature sensor

Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699

1. **NOTE!** Cut the current with the main switch.
2. Connect adapter cable 88890016 with measurebox 9998699 between the MDI and the engine connector.
3. Use multimeter 9812519 for voltage measurement.
4. Disconnect the coolant temperature sensor connector at the coolant temperature sensor.
5. Turn the main switch on and press the on button on the button panel.



Measurement points	Nominal value
16 (battery neg.) – 20 (coolant temp. sensor)	$U \approx 5V$

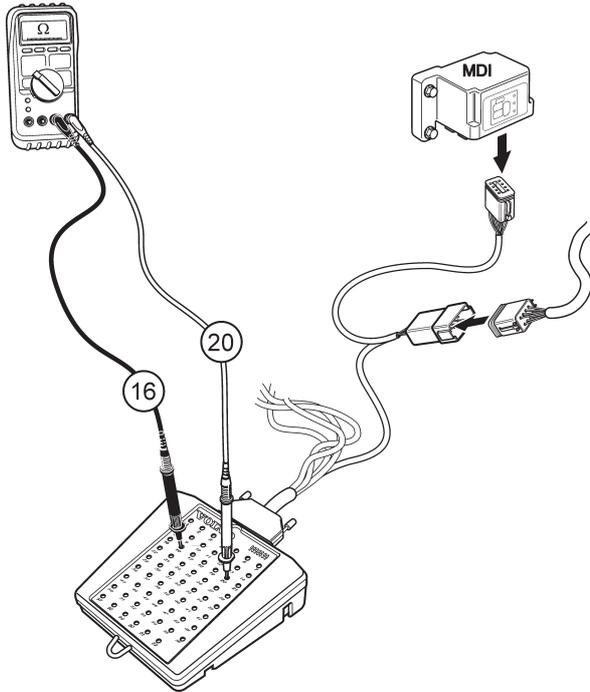
6. Reconnect the coolant temperature sensor connector at the coolant temperature sensor.

Measurement points	Nominal value
16 (battery neg.) – 20 (coolant temp. sensor)	$U \approx 2-3V$ at $+20^{\circ}C$

## Check coolant temperature sensor

Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699

1. **NOTE!** Cut the current with the main switch.
2. Connect adapter cable 88890016 and the measurebox 9998699 and with the engine connector. Do not connect the MDI.
3. Use multimeter 9812519 for resistance measurement.



**NOTE!** All resistance values shall be seen as guideline values

Measurement points	Nominal value
16 - 20	R ≈ 1743 Ω at 0°C (+32F)
16 - 20	R ≈ 1076 Ω at 10°C (+50F)
16 - 20	R ≈ 677 Ω at 20°C (+68F)
16 - 20	R ≈ 439 Ω at 30°C (+86F)
16 - 20	R ≈ 291 Ω at 40°C (+104F)
16 - 20	R ≈ 197 Ω at 50°C (+122F)
16 - 20	R ≈ 134 Ω at 60°C (+140F)
16 - 20	R ≈ 97 Ω at 70°C (+158F)
16 - 20	R ≈ 70 Ω at 80°C (+176F)
16 - 20	R ≈ 51 Ω at 90°C (+194F)
16 - 20	R ≈ 38 Ω at 100°C (+212F)
16 - 20	R ≈ 29 Ω at 110°C (+230F)
16 - 20	R ≈ 22 Ω at 120°C (+248F)

# Multilink fault

## Fault indication

### Tachometer:

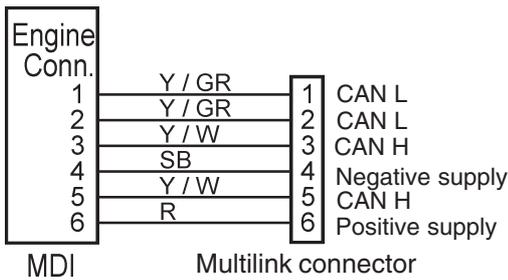
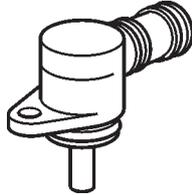
No revolution speed is shown in the tachometer/display. Engine hours might not be visible in the tachometer/display.

### Alarm display:

None.

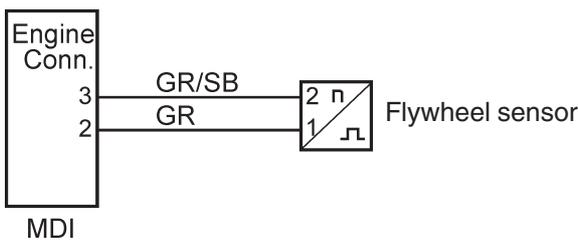
### Symptom

The button panel will function as normal.



## Circuit description

The tachometer and the display receives information from the MDI via the multilink bus. Connected to the multilink is also, if they are used, the multisensor and the NMEA interface. The multilink contains of two pairs of CAN communication wires and supply voltage. To be able to present engine revolution a flywheel sensor is used. The flywheel sensor is an inductive sensor. The MDI uses the sensor signal to calculate the flywheel speed which presents in the tachometer. The flywheel input in the MDI is at pin 2 and pin 3 in the engine interface connector.



## Fault tracing

### Fault conditions 1

The tachometer shows engine hours but not engine revolution due to that no flywheel speed signal is available.

### Possible reason

- Fault in the flywheel sensor cable between the MDI and the sensor.
- Incorrectly mounted sensor (incorrect distance to flywheel, or loose sensor).
- Electrical interference on engine speed signal.
- Faulty flywheel sensor.
- Damaged flywheel.

### Suitable action

1. Check the cables and the connectors between the engine connector at the MDI and the flywheel sensor.
2. Check that the flywheel sensor is correctly installed and that no swarf has collected on the sensor.
3. Check the function of the flywheel sensor.

### Fault conditions 2

The tachometer and/or the display shows neither engine hours nor engine revolution and easy link instruments does not work.

If fault in multilink CAN communication the display shows "Connection lost".

### Possible reason

- Open circuit in multilink bus or multilink supply.
- Short circuit in multilink bus or multilink supply.
- Faulty tachometer/optional equipment such as display, NMEA interface, multi sensor.

### Suitable action

1. Check multilink bus and connectors between the multilink connector at the MDI and all connected optional equipment such as display, NMEA interface, multi sensor.
2. Try with another tachometer/optional equipment.

## Measurements

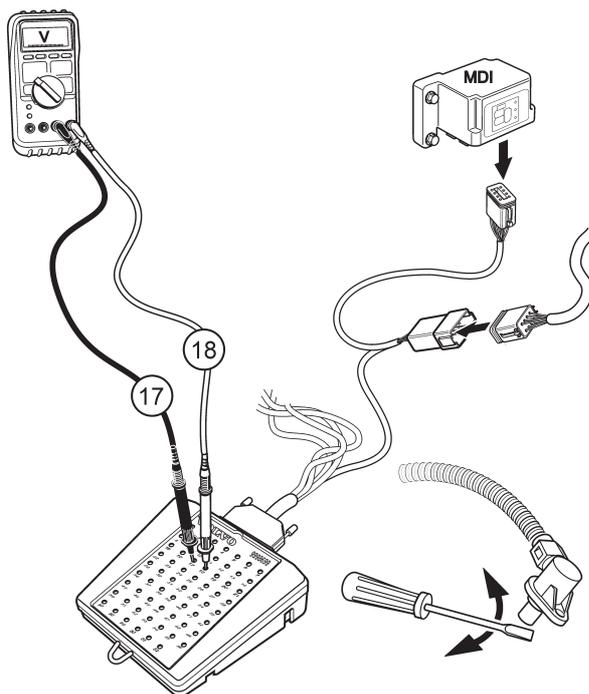
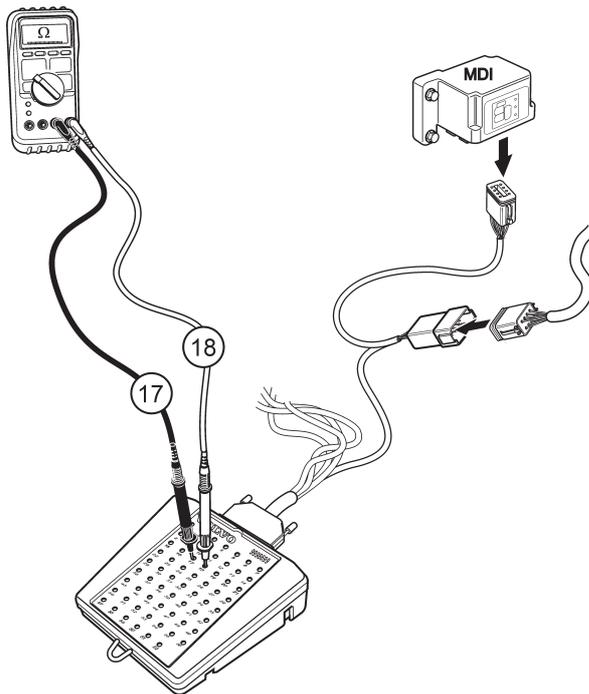
### Check speed sensor, flywheel

Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699

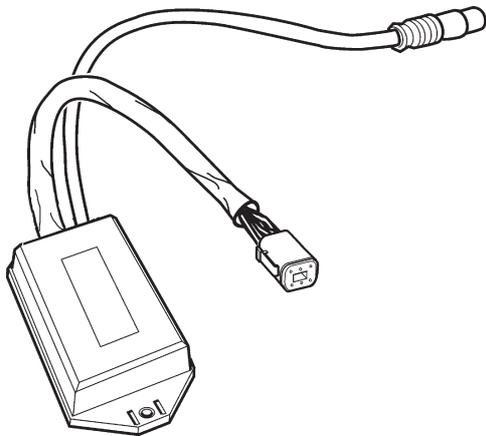
#### Check 1

- NOTE!** Cut the current with the main switch.
- Connect adapter cable 88890016 and the measurebox 9998699 with the engine connector. Do not connect the MDI.
- Use multimeter 9812519 to measure resistance.

Measurement points	Nominal value
17 - 18	$R \approx 0.9 \text{ k}\Omega$



- Remove the sensor from the flywheel casing. Check that the sensor has no external damage and that no metal chips are stuck on the sensor.
- Use multimeter 9812519 for a AC 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.
- Install the sensor.



NMEA 2000

## Check NMEA 2000 Gateway LED

There are two light emitting diodes on the interface. One is lit when the NMEA bus has power supply. The other has different lighting options.

### Constant lit

The unit is powered up but receives no communication from any side.

### Flashes on-off repeatedly

The unit is receiving and transmitting valid NMEA and MULTILINK data. Function is correct.

### Flashes two strobes and than off repeatedly

The unit is receiving MULTILINK data but has no NMEA connection (doesn't receive velocity).

### Flashes three strobes and than off repeatedly

The unit is receiving NMEA data but has no MULTILINK connection.

## Manual fault tracing of bus cables

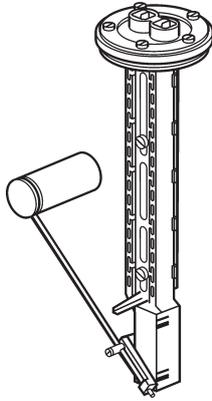
*Special tools: Multimeter 9812519*

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

It can be difficult to check whether there is a cable fault in the bus cable when it is installed in the engine. 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.

1. Use multimeter 9812519 to check the bus cables. The uninsulated parts of the conductors in the bus cables should not be in contact. Disconnect the bus cable at both ends and measure the resistance between all pins to check for short circuit between conductors. The multimeter should show infinite resistance between each pin. If the resistance is less than infinite, there is a fault.
2. Do a resistance check through each of the conductors in the cable to detect if there is any open circuit. Connect one probe to pin1 in one connector and connect the other probe to pin1 in the connector in the other end of the cable (this does not apply to the Y-split which has a different pin configuration). The resistance should be approximately 0 ohm. Continue through all pins in the connector.

## Fuel level warning



### Fault indication

#### Tachometer:

The tachometer LCD screen will show a flashing warning icon + buzzer sound.

#### Alarm display:

The fuel level indication flashes in the alarm display + buzzer sound.

### Cable description

A fuel level sensor can be connected to the MDI , 3-180 ohm. The MDI supplies the fuel level sensor with a reference voltage of +5 Volt.

### Fault tracing

#### Fault conditions

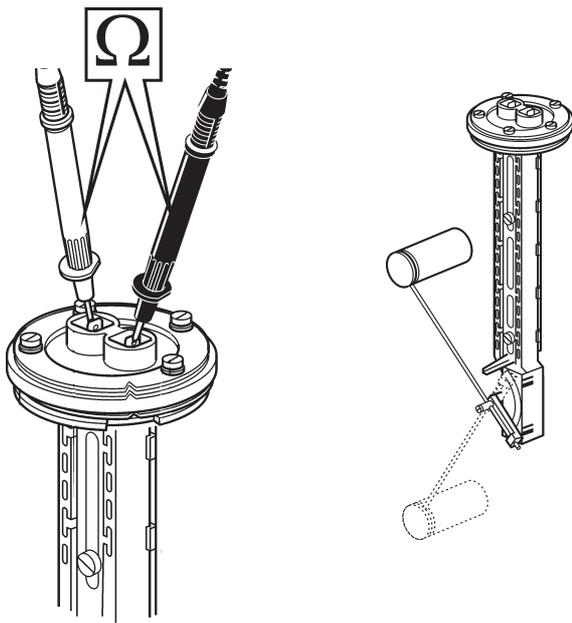
The fuel level is 20% or less for more than 60 seconds.

#### Possible reason

- The fuel level is too low.
- Fault in the fuel level sensor wiring.

#### Suitable action

1. Check the fuel level.
2. Check all wiring and connectors between the fuel level sensor and the MDI.



## Measurements

### Check fuel level sensor

*Special tools: Multimeter 9812519*

**1**

**NOTE!** Turn the main switch off.

**2**

Remove the connector from the fuel level sensor.

**3**

Use multimeter 9812519 to measure the resistance between the two terminal pins on the level sensor.

#### Nominal values

Empty tank (A) .....  $R \approx 3 \pm 2 \Omega$

Full tank (B) .....  $R \approx 180 \pm 15 \Omega$

**4**

Turn the main switch on and turn the ignition on.

**5**

Use multimeter 9812519 to measure the voltage between the two fuel level conductors from the MDI. The fuel level sensor shall not be connected.

Measurement points	Nominal value
MDI fuel level output	$U \approx 5 \text{ V}$

# Button panel fault

## Fault indication

**Tachometer:**

None.

**Alarm display:**

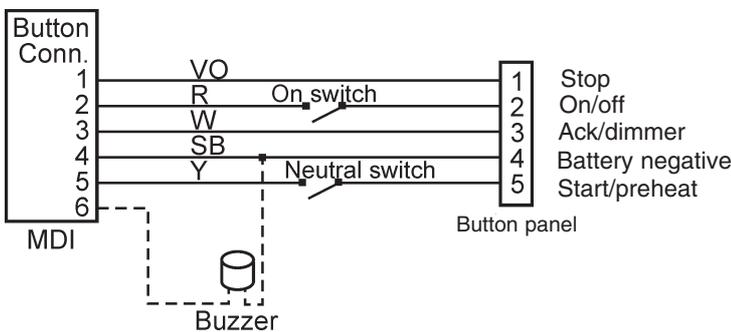
None.

**Symptom:**

No system respons when a button is pushed.

## Cable description

The button panel contains of four buttons: stop button, on/off button, acknowledge/dimmer button, start/preheat button. The buttons functions like switches and closes to battery negative when activated. The power switch must be closed before the sytem can be activated. The neutral switch must be closed before the engine can be started.



## Fault tracing

**Fault conditions**

The button panel does not function properly.

**Possible reason**

- The power switch is disconnected.
- The multi link connector and the button panel connector at the MDI have been switched.
- Open circuit in the wiring between the button panel and the MDI.
- Short circuit in the wiring between the button panel and the MDI.
- Defective button panel.

**Suitable action**

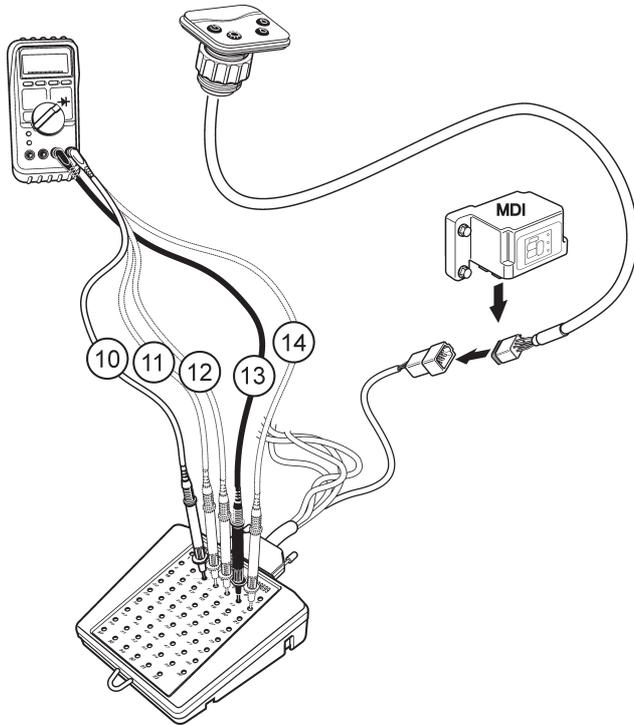
1. Check that the power switch is connected.
2. Check all wiring and connectors between the button panel and the MDI.
3. Check the button panel.

## Measurements

### Check button panel

Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699

- NOTE!** Cut the current with the main switch.
- Connect adapter cable 88890016 with measure-box 9998699 towards the button panel.
- Use multimeter 9812519 to do a continuity(diode) test.



Measurement points	Nominal value
13 - 10 Battery neg. - Stop	<b>OL*</b> (button <b>not</b> pushed)
13 - 10 Battery neg. - Stop	<b>leads</b> (button pushed)
13 - 11 Battery neg. - On/off	<b>OL</b> (button <b>not</b> pushed)
13 - 11 Battery neg. - On/off	<b>leads</b> (button pushed)
13 - 12 Battery neg. - Ack/dim	<b>OL</b> (button <b>not</b> pushed)
13 - 12 Battery neg. - Ack/dim	<b>leads</b> (button pushed)
13 - 14 Battery neg. - Start/Preh.	<b>OL</b> (button <b>not</b> pushed)
13 - 14 Battery neg. - Start/Preh.	<b>leads</b> (button pushed)

\*OL=Open line

**NOTE!** When testing a button be sure to also push the other buttons to look for short circuits between buttons. There shall be no electrical connection between buttons.

## Stop solenoid fault

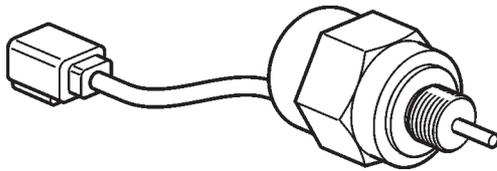
### Fault indication

#### Tachometer:

The tachometer LCD screen will show a flashing warning icon and the alarm buzzer sound.

#### Alarm display:

The warning indication flashes in the alarm display + audible warning.

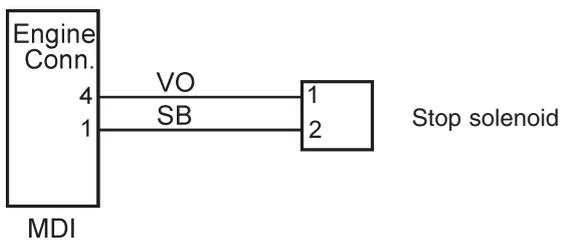


### Symptom

The engine can not be shut down by pressing the stop button.

### Cable description

The stop solenoid is an electromagnetic relay. When the stop button is pushed the stop solenoid is activated by the MDI output pin 4. The stop solenoid shuts off the fuel supply at the injection pump.



### Fault tracing

#### Fault conditions

The stop solenoid does not function properly.

#### Possible reason

- Open circuit in the wiring between the stop solenoid and the MDI.
- Short circuit in the wiring between the stop solenoid and the MDI.
- Faulty stop solenoid.

#### Suitable action

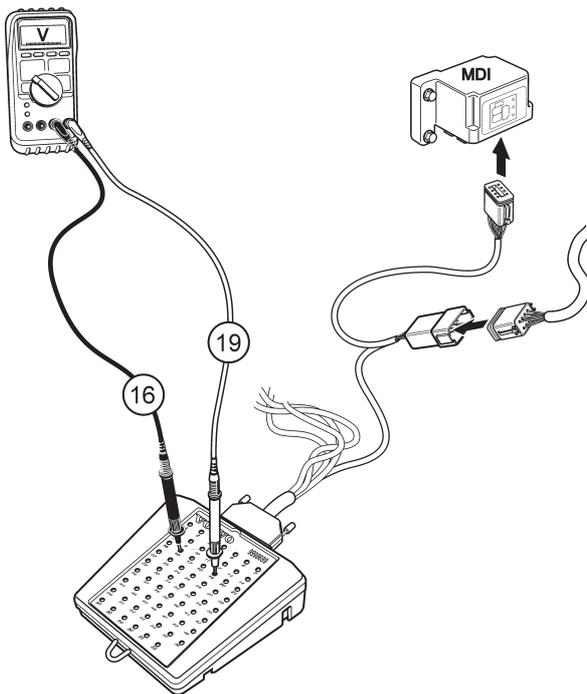
1. Check all wiring and connectors between the stop solenoid and the MDI.
2. Check the stop solenoid.

## Measurements

### Check MDI output for stop solenoid

Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699

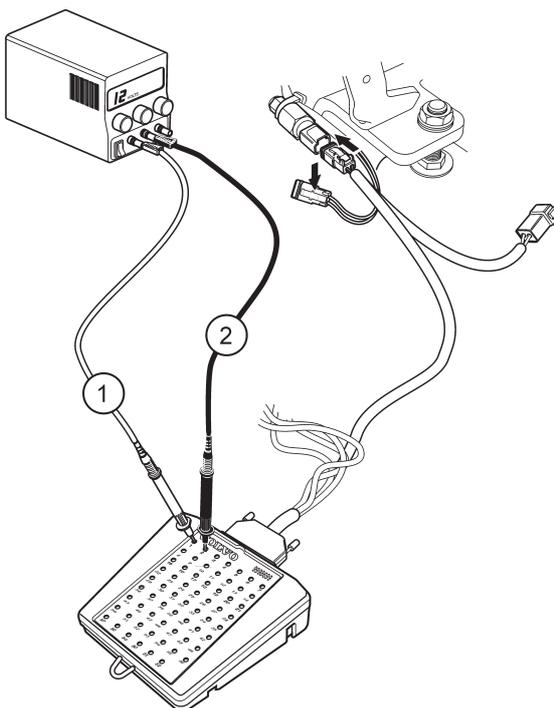
- NOTE!** Cut the current with the main switch.
- Connect adapter cable 88890016 with measurebox 9998699 between the MDI and the engine connector.
- Use multimeter 9812519 for voltage measurement.
- Turn the main switch on and press the on button on the button panel.



Measurement points	Nominal value
(stop button <b>not</b> pushed) 19 (solenoid pos.) – 16 (battery neg.)	$U \approx 0V$ (solenoid not activated)
(stop button pushed) 19 (solenoid pos.) – 16 (battery neg.)	$U \approx 0.9 \times \text{battery voltage}$ (solenoid activated)

- Disconnect the solenoid connector at the stop solenoid.

Measurement points	Nominal value
(solenoid disconnected) 19 (solenoid pos.) – 16 (battery neg.)	$U \approx \text{battery voltage}$



### Check stop solenoid

Special tools: Adapter cable 88890016,  
Measurebox 9998699

- NOTE!** Cut the current with the main switch.
- Disconnect the solenoid connector at the stop solenoid.
- Connect adapter cable 88890016 with measurebox 9998699 to the stop solenoid.
- Connect a power supply of +12 Volt, 6 Ampere to the stop solenoid. Connect the power supply positive to the measurebox outlet 1 and connect the power supply negative to the measurebox outlet 2. One should notice a click in the solenoid when the solenoid activates.

## Start / preheat warning

### Fault indication

**Tachometer:**

The tachometer LCD screen will show a flashing warning icon and the alarm buzzer sound.

**Alarm display:**

The warning indication flashes in the alarm display + audible warning.

**Symptom**

The engine will not start/crank when pressing the start button.

### Cable description

Inside the MDI there are two not replaceable relays. One relay is used to activate the preheat function. The other relay is used to activate the starter solenoid at the starter motor.

The preheat function will be activated when the start/preheat button is pushed if the coolant temperature is below 50°C. The MDI preheat output will change its potential from 0 volt to nearly battery voltage across the glowing plugs when the preheat function is activated.

When the start/preheat button is activated the MDI start relay output will change its potential from 0 volt to battery voltage to activate the starter solenoid at the starter motor .

## Fault tracing

### Preconditions:

If preheating is activated the preheat symbol will be visible in the tachometer and/or the display.

### Fault conditions 1

The engine does not crank when the start/preheat button is pushed.

### Possible reason

- The neutral switch is not activated (switch open).
- The coolant temperature is below 50°C and therefore preheating is activated.
- Open circuit between the MDI start output and the starter solenoid at the starter motor.
- Faulty starter solenoid at the starter motor.
- Faulty starter relay inside the MDI unit. (not replaceable)

### Suitable action

1. Check that the neutral switch is activated (switch closed).
2. Preheating is activated due to too cold coolant temperature. Reheat the start/preheat button within 10 seconds to activate the starter motor.
3. Check wiring and the connections between the MDI start output and the starter solenoid at the starter motor.
4. Check the starter solenoid at the starter motor.
5. Try with another MDI unit.

### Fault conditions 2

The preheat symbol is not visible in the tachometer and/or the display.

### Possible reason

- The coolant temperature is above 50°C and therefore preheating is not activated.
- Open circuit between the MDI preheating output and the glowing plugs.
- Faulty preheat relay inside the MDI unit. (not replaceable)

### Suitable action

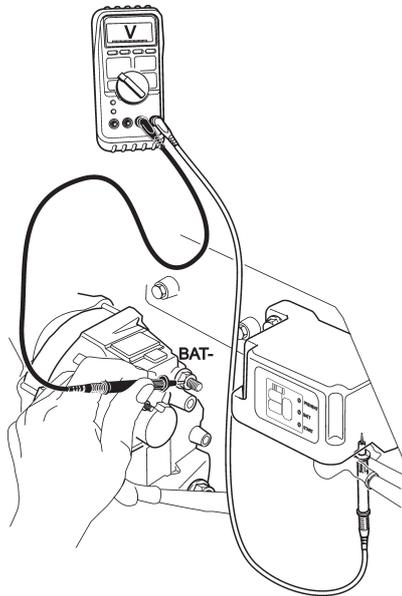
1. Check the wiring and connections between the MDI and the glowing plugs via the conductor rail.
2. Try with another MDI unit.

## Measurements

### Check MDI output for starter solenoid

*Special tools: Multimeter 9812519*

1. **NOTE!** Cut the current with the main switch.
2. Loosen the rubber protection hood over the starter output at the MDI to be able to do a measurement.
3. Use multimeter 9812519 for voltage measurement.
4. Turn the main switch on and press the on button on the button panel. The preheating could be activated due to too cold coolant temperature. Re-press the start/preheat button within 10 seconds to activate the starter motor.

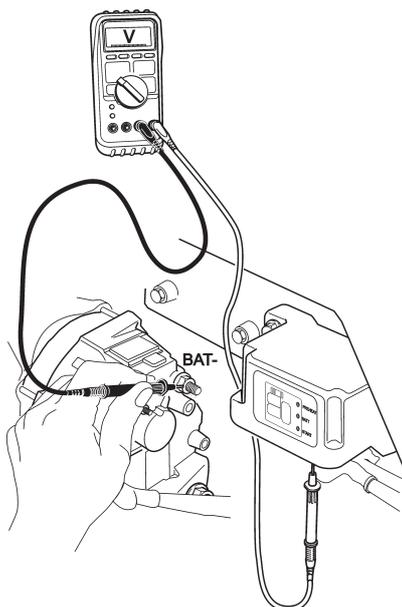


Measurement points	Nominal value
(start/crank button <b>not</b> activated) MDI starter relay output – Battery negative	$U \approx 0$ volt
(start/crank button activated) MDI starter relay output – Battery negative	$U \approx$ battery voltage

### Check MDI output for preheat function

*Special tools: Multimeter 9812519*

1. **NOTE!** Cut the current with the main switch.
2. Loosen the rubber protection hood over the pre-heat output at the MDI to be able to do a measurement.
3. Use multimeter 9812519 for voltage measurement.
4. Turn the main switch on and press the on button on the button panel. If the coolant temperature is above 50°C the preheating is not activated.



Measurement points	Nominal value
(start/preheat button <b>not</b> activated) MDI preheat output – Battery negative	$U \approx 0$ volt
(start/preheat button activated) MDI preheat output – Battery negative	$U \approx$ battery voltage

5. Also do the above measurement at the glowing plugs to verify that there is no open circuit to the glowing plugs.

## Battery warning

### Fault indication

**Tachometer:**

The tachometer LCD screen will show a flashing battery icon and the alarm buzzer sound.

**Alarm display:**

The battery indication flashes in the alarm display + audible warning.

### Fault tracing

**Fault condition 1**

The voltage input at the MDI is 15V or higher for more than 30 seconds.

**Possible reason**

- Faulty alternator regulator.

**Suitable action**

1. Try another alternator.

**Fault condition 2**

The voltage input at the MDI is 13V or less for more than 10 seconds (engine running).

**Possible reason**

- Too slack alternator belt tension.
- Faulty assembled connectors.
- Poor condition of the cables in the charging system.
- Faulty excitation voltage/current to the alternator. The alternator does not charge.
- Damaged or worn brushes.
- Faulty regulator.

**Suitable action**

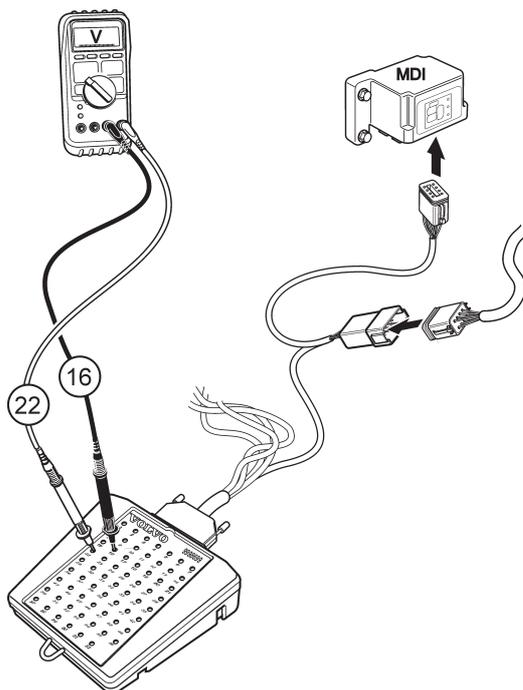
1. Check the alternator belt tension.
2. Check that all connectors at the alternator and at the battery is correct assembled.
3. Check the conditions of all cables in the charging system.
4. Check that the alternator receives correct excitation voltage/current.
5. Check the brushes length and condition.
6. Try another alternator.

**Measurements**

When the engine is started an excitation voltage/current is needed to "wake up" the alternator.

**Check alternator excitation voltage**

*Special tools: Multimeter 9812519,  
Adapter cable 88890016, Measurebox 9998699*



1. **NOTE!** Cut the current with the main switch.
2. Disconnect the excitation cable on D+ on the alternator.
3. Connect adapter cable 88890016 with measurebox 9998699 between the MDI and the engine connector.
4. Use multimeter 9812519 for voltage measurement.
5. Turn main switch on.

Measurement points	Nominal value
16 - 22	U ≈ Battery voltage



# Pin configuration, MDI

## Button panel

1	Stop
2	On / Off
3	Ack / Dim
4	Battery negative
5	Start / Preheat
6	Buzzer

## Multi link

1	CAN L
2	CAN L
3	CAN H
4	Multilink negative supply
5	CAN H
6	Multi link power supply

## Engine harness

1	Battery negative
2	Flywheel sensor +
3	Flywheel sensor -
4	Stop solenoid
5	Coolant temperature sensor
6	Oil pressure switch
7	Excitation
8	Not used

# Technical data

## Electrical system

System voltage .....	12 V
Battery capacity (starter battery)	
D1-13-B, D1-20-B, D1-30-B .....	70 Ah
D2-40-B, D2-55-B, D2-75-B .....	88 Ah

## Alternator

Voltage output at +20 °C (+68°F)	
with sense .....	14.2 ± 0.15 V
without sense .....	14.2 ± 0.3 V
Max. current .....	115 A
Power approx. ....	1630W
Suppressor capacitor .....	2.2µF

## Starter motor

Starter motor, power approx.	
D1-13-B, D1-20-B .....	0.8 kW
D1-30-B .....	1.1 kW
D2-40-B .....	1.4 kW
D2-55-B, D2-75-B .....	2.0 kW

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Do you have any comments or complaints about this manual? Please take a copy of this page, write your comments on it and send it to us. The address is at the bottom. We would appreciate it if you were to write in English or Swedish.

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