Workshop Manual

Group 30

A
2(0)

D1-13, D1-20, D1-30, D2-40

Content

00-0 General

About this Workshop manual

General information

This Service Manual contains technical data, descriptions and maintenance and repair instructions for standard model Volvo Penta products. A list of these products may be found in the section ***Specifications***.

The product designation and the serial number and specification is indicated on the engine decal or type plate. This information must be included in all correspondence regarding the product.

The service manual is produced primarily for the use of Volvo Penta workshops and their qualified personnel. It is assumed that any person using the Service Manual has a fundamental knowledge of the product and is able to carry out mechanical and electrical work to trade standard.

Volvo Penta continually develops its products; we therefore reserve the right to make changes. All information in this manual is based on product data which was available up to the date on which the manual was printed. New working methods and significant changes introduced to the product after this date are communicated in the form of ***Service bulletins***.

Spare Parts

Spare parts for the electrical and fuel systems are subject to various national safety standards. Volvo Penta Original Spare Parts meet these standards. No damage of any kind caused by the use of spare parts not approved by Volvo Penta will be compensated by any warranty undertaking.

Certified engines

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

Certification means that an engine type has been inspected and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are manufactured to correspond to the certified engine.
This places special demands on service and repair work, namely:

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only spare parts approved by Volvo Penta may be used.
- Service on injection pumps, pump settings and injectors must always be carried out by an authorized Volvo Penta workshop.
- The engine must not be converted or modified, except with accessories and service kits which Volvo Penta has approved for the engine.
- No changes to the exhaust pipe and engine air inlet duct installations may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.

The general instructions in the Operator's Manual concerning operation, service and maintenance apply.

IMPORTANT!

Neglected or poorly-performed care/service and the use of spare parts not approved by Volvo Penta, will mean that AB Volvo Penta no longer guarantees that the engine conforms to the certified model.

Volvo Penta accepts no responsibility for damage or costs arising as a result of failure to follow the above mentioned standards.

03-3 Specifications, Electrical

Electrical System

Group 30: Electrical System

System voltage	12 V
Battery capacity (starter battery)	
D1-13-A/B/F, D1-20-A/B/F, D1-30-A/B/F	70 Ah
D2-40-A/B/F	88 Ah
Glowplugs	
rated voltage	11 V
current	11 A

Alternator

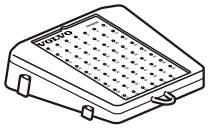
Output voltage at +20°C (68°F)	
with sense	14.2 ±0.15 V
without sense	14.2 ±0.30 V
Max. current	115 A
Power, approx.	1,630 W
Suppression capacitor	2.2 µF

Starter motor

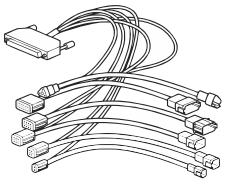
Power, approx.	
D1-13-A/B/F, D1-20-A/B/F	0.8 kW
D1-30-A/B/F	1.1 kW
D2-40-A/B/F	1.4 kW

08-2 Special Service Tools

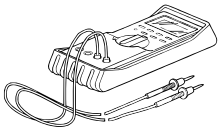
The following special tools are used when working on the engine. The tools can be ordered from AB Volvo Penta by specifying the number indicated.



9998699 Break-out box



88890016 Break-out cable



88890074 Multimeter

30-0 General

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 switching off the current at the main switch) when the MDI connector is removed or reconnected. Never switch off the current at the main switch when the engine is running. Never disconnect a battery cable when the engine is running.
Switch off the main switches or disconnect the battery cables when fast-charging the batteries.

NOTICE! It is not necessary to switch off the main switches during normal maintenance charging.

Only batteries may be used for starting. A jumpstart unit is able to supply very high voltage and damage the control unit and other electronics.
Take extreme care so that the harness terminals do not come into contact with oil, water or dirt if a connector is removed from a sensor.

Check all connectors visually

Look for 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 occasional recurrent faults can be difficult to trace and are often caused by oxidation, vibration or poorly connected cables.
Wear can also cause problems. For this reason, avoid disconnecting a connector unless necessary.
Other contact problems can be caused by damage to pins, sleeves and connectors etc.
Shake the cables and pull on the connector during test measurements to find where the cable is damaged.

Contact resistance and oxidation

The resistance in connectors, wiring and splitters must be approx 0 Ω. However, there is always a certain resistance in connectors due to oxidation.
However, if the resistance is too high problems will occur. The amount of resistance that can be tolerated before a fault occurs varies depending on circuit load.

Fault tracing of cables and connectors

Tools:
88890074 Multimeter

Open circuit

Possible fault causes can be defective or chafed cables or loose connectors.
Use the wiring diagram to check the cables that are relevant to the function. Begin with the most probable cable in the circuit.

Look for the following:

- Disconnect the relevant connector at both ends of the harness.
- Use 88890074 Multimeter to measure the resistance between the cable ends.
  Nominal value ~ 0 Ω.
- If possible, shake the cables and pull on the connectors during test measurements to determine whether the harness is damaged.
- Check the next cable system in the wiring diagram if no fault is found.

Electrical Welding

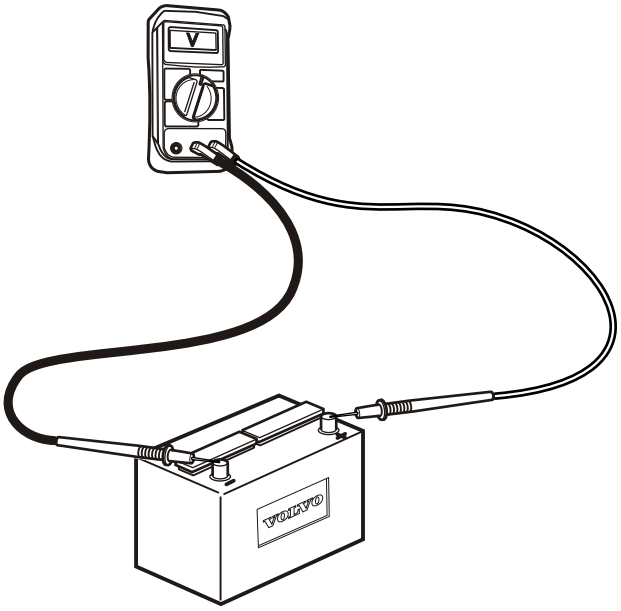
Remove the positive and negative cables from the batteries. Then disconnect all connections to the alternator, starter motor and the MDI.
Connect the welder ground clamp to the component to be welded, or as close as possible to the weld site. The clamp must never be connected to the engine or in such a way that current can pass through a bearing.

IMPORTANT!

When welding is finished the alternator cables must be reconnected before the battery cables are connected.

Starter motor

Starter motor fault tracing must be assigned to an authorized marine electrical workshop with the necessary test equipment.



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Check battery voltage

Tools:
88890074 Multimeter

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 a voltage on an open circuit of around 12.7 V (depending on ambient temperature). When open circuit voltage falls to 12.5 V, the battery is half charged.

NOTICE! * Measured at the batteries.

Voltage measurement, check

1 Check that battery voltage is at least 12.4 V while the batteries are not under load by using multimeter 9812519 to measure between the battery terminals.

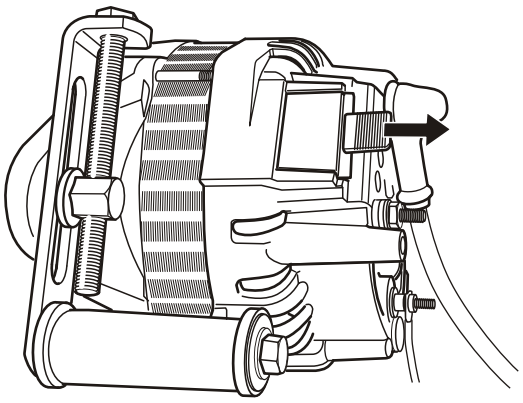
NOTICE! * Measured at the batteries.

2 Turn the main switch on.

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

Check the alternator brushes

Removal of alternator brushes



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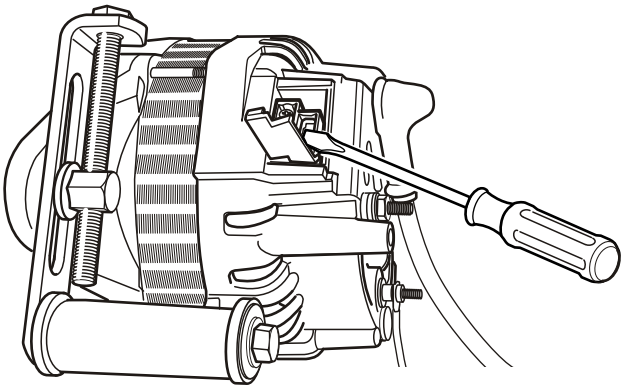
1 Pull back the black plastic cover.



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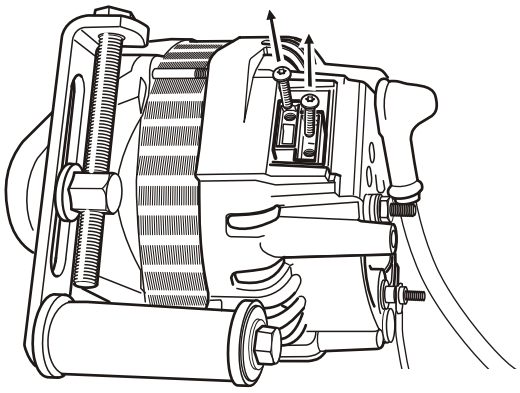
2 Use a screwdriver to loosen the plastic cover above the brush holders.



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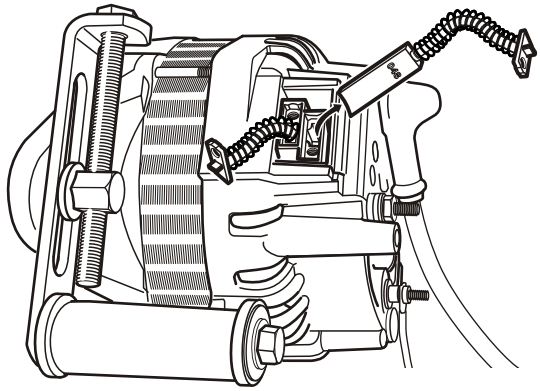
3 Unscrew the two Torx screws that retain the two brush holders.



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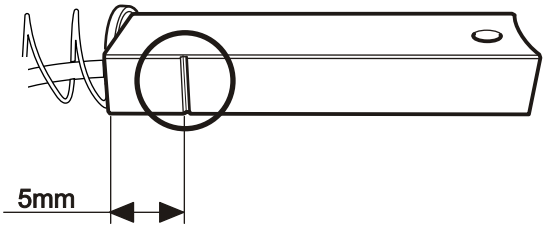
4 Pull the brushes out.



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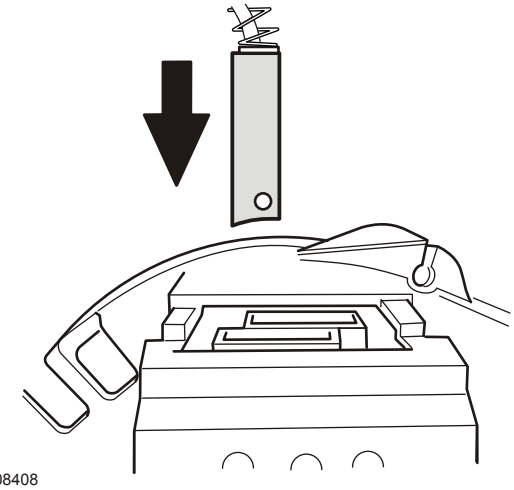
5 Measure the length of the brushes. If a brush is so worn that the 5 mm (0.2") limit has been exceeded the brush must be changed.

Installation of alternator brushes



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1 Make sure that the brushes are placed as illustrated when installing.

General alternator information

Alternator voltage must be limited to prevent battery electrolyte from evaporating. Alternator output is controlled (limited) by the voltage regulator in the alternator. The maximum current that the alternator can deliver with a controlled output depends on alternator rpm. In order for the alternator to charge efficiently a sensor line may be connected between the alternator and the battery plus terminal. A voltage drop in the cable between the alternator and the battery plus terminal is compensated in this way. When the engine is started a magnetization current is required to excite the alternator.
NOTICE! It is power consumers (including the batteries) that determine output current from the alternator.

Measurements:

1 Engine switched OFF.

2 Use 88890074 Multimeter to perform a voltage test across the batteries. The nominal voltage across a fully-charged battery is around 12.7 V (depending on ambient temperature).

3 Start the engine. Run at 1,500 rpm.

4 Use 88890074 Multimeter to perform a voltage test across the batteries. The nominal charge voltage across the battery should be around 13.8-14.6 V.

Check the charging system

Tools:
88890074 Multimeter

Charging system fault tracing

Battery (orange indication):

1 Check that all battery connections are properly installed.

2 Check the cables to the battery.

3 Check the battery electrolyte level.

4 If possible, check the specific gravity in all cells.

No charge:

1 Check the tension of the alternator drive belts.

2 Check that the alternator and battery connectors are correctly installed.

3 Check the condition of all charging system cables.

4 Check that the alternator is receiving the correct magnetization voltage.

5 Regulator fault; check with another alternator.

Charge too low:

1 Check the tension of the alternator drive belts.

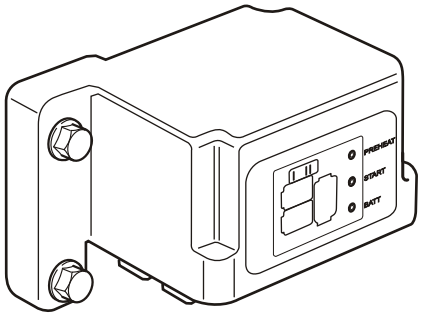
2 Check that the alternator and battery connectors are correctly installed.

3 Check the condition of all charging system cables.

4 Regulator fault; check with another alternator.

Over charge:

1 Possible regulator fault; check with another alternator.



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MDI gauge checks

Tools:
88890074 Multimeter

The gauges are of Easy-Link type and receive their signals via a serial bus. The instrument cables comprise three wires: battery positive, battery negative and a databus.
If a fault occurs in the instrument Easy Link bus, it can be detected by the gauge needles stopping in the same position on the instruments (they “freeze”). If none of the gauges function, check using 88890074 Multimeter that there is +12 V between the red (pin 1) and blue (pin 2) wires in the Easy link harness.

Since shared signals from various types of gauges pass through the same cable, it is difficult to determine whether information is lacking from the serial bus, or if an individual gauge is faulty. If an instrument fault is suspected, use the following procedure to determine whether the gauges are faulty or not.

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

2 Disconnect the gauge that is suspected of being faulty.

3 **The fault disappears**

- Check that there is no oxide or moisture in the connectors to the gauge concerned.
- Change the disconnected gauge and check if the fault is still absent when the new gauge is connected.

The fault remains

Continue to disconnect gauges until gauge displays are correct. Then attempt to connect the gauges again. Begin with the gauge that was disconnected first and continue to connect the gauges that were disconnected until the indication is no longer shown. Change the gauge connected last.

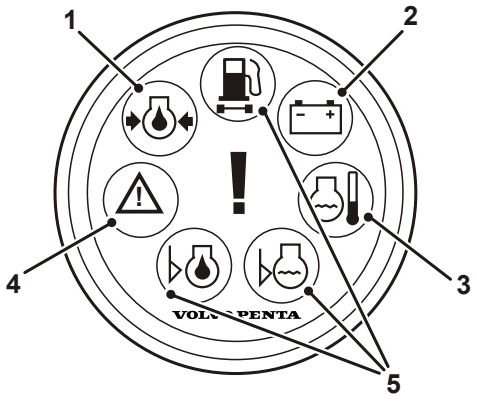
30-2 Fault Tracing

General

Fault tracing refers only to engine models with MDI.

Function fault

Symptom	Action
The alarm cannot be confirmed.	Refer to the "Fault on keypad" section.
Charging problems.	Refer to the "Battery warning" section, or to the "Check charging system" section.
Coolant alarm.	Refer to the “Warning, coolant temperature” section.
Engine does not start (due to electrical problems).	Refer to the “Warning, start / preheat” section.
Warning, fuel level.	Refer to the “Warning, fuel level” section.
Glowplug(s) not activated.	Refer to the “Warning, start / preheat” section.
No dimmer function.	Refer to the "Fault on keypad" section.
No indication of operating hours on the tachometer / display.	Refer to the “Multilink fault” section.
No indication of engine rpm on the tachometer / display.	Refer to the “Multilink fault” section.
No data from the multisensor visible in the EVC display.	Refer to the “Multilink fault” section.
Oil pressure alarm.	Refer to the ”Oil pressure warning (engine)” section.
If the button does not energize the system.	Refer to the "Fault on keypad" section.
The starter motor is not activated.	Refer to the "Warning, start / preheat" section, or to the "Check battery" section.
The stop solenoid is not activated.	Refer to the "Stop solenoid" section, or to the "Fault on keypad" section.



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Alarm display

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

2 **Battery voltage:** The alarm lamp is lit if the alternator is not charging or if it overcharges.

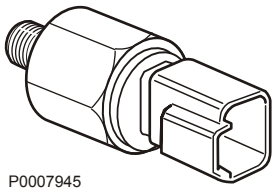
3 **Coolant temperature:** When coolant temperature exceeds the alarm limit, the alarm lamp is lit.

4 **Warning indication:** The ”System fault” lamp is lit if there is a short circuit, wiring break or AUX fault. In the case of faults that require immediate action by the helmsman, the alarm buzzer sounds continuously.

5 Not used.

Fault Codes

Oil pressure (engine) warning



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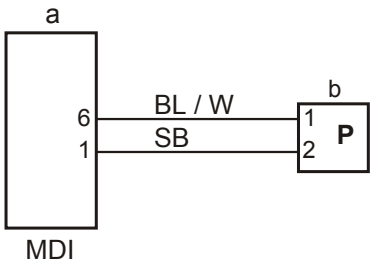


P0008410

a Engine connector

b Oil pressure switch

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 condition

The oil pressure switch closes at a oil pressure lower than 60 kPa (8.7 PSI).
The alarm is depended of the engine rpm.

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

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

Possible reason

- Oil level too low.
- 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.

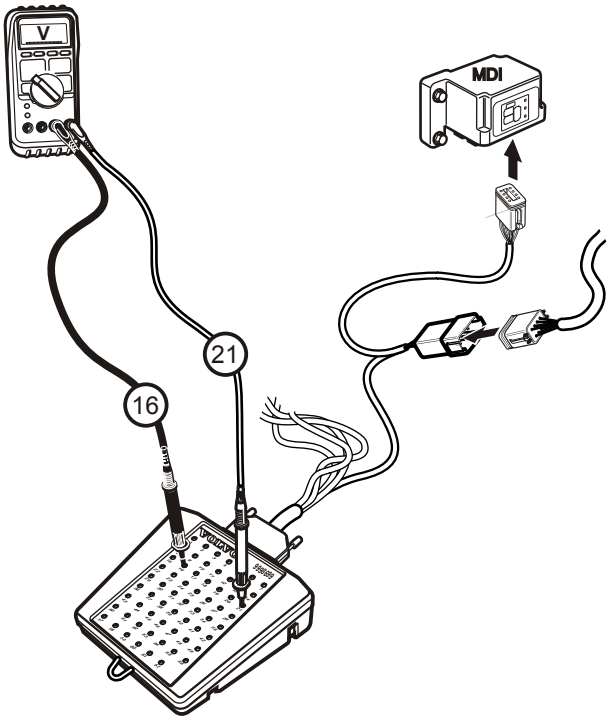
4 Check all wiring and connectors between the oil pressure switch and the MDI.

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

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable



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1 **NOTICE!** Cut the current with the main switch.

2 Connect 88890016 Break-out cable with 9998699 Break-out box between the MDI and the engine connector.

3 Use 88890074 Multimeter for voltage measurement.

4 Turn the main switch on and press the on button on the button panel.

Measurement points	Nominal value
16 (battery negative) - 21 (oil pressure switch supply)	U ≈ 0 V (switch closed)

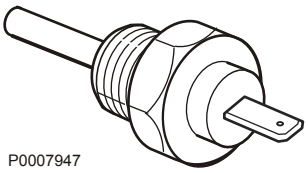
5 Disconnect the oil pressure switch connector at the oil pressure switch.

Measurement points	Nominal value
16 (battery negative) - 21 (oil pressure switch supply)	U ≈ 3,5 V

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 negative) - 21 (oil pressure switch supply)	U ≈ 3,5 V (switch open)



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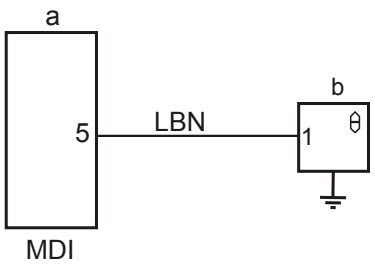


P0008412

a Engine connector

b Coolant Temperature

Coolant temperature warning

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.
- Defective 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 coolant pump.

4 Check that the seawater intake is not blocked.

5 Check the impeller in the sea water pump.

6 Change the thermostat.

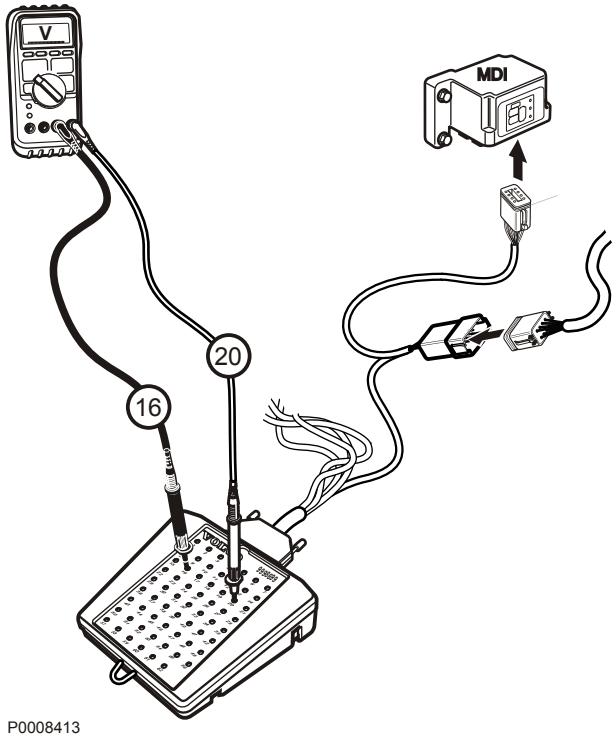
7 Check the pressure cap on the expansion tank. See “Checking the pressure valve in the filler cap” in the mechanical workshop manual for the engine.

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.



P0008413

Measurements

Check MDI output for coolant temperature sensor

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

1 **NOTICE!** Cut the current with the main switch.

2 Connect 88890016 Break-out cable with 9998699 Break-out box between MDI and the engine connector.

3 Use 88890074 Multimeter for voltage measurement.

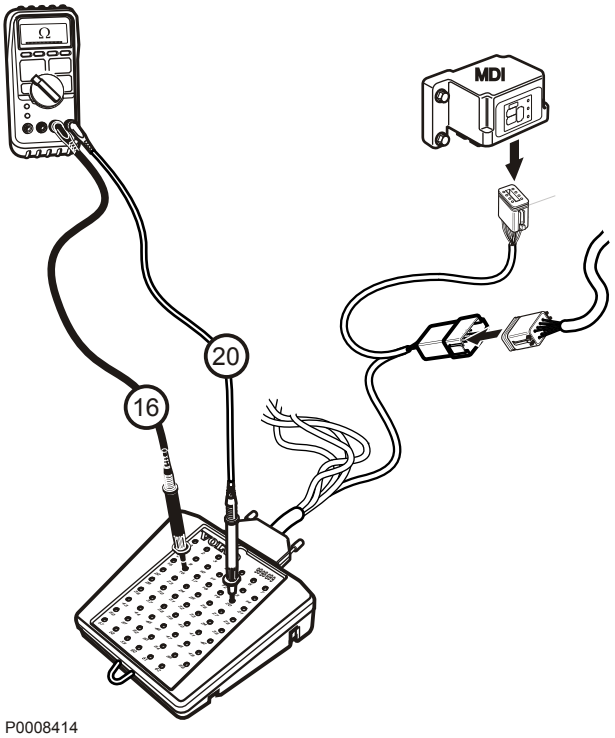
4 Disconnect the coolant temperature sensor connector at the coolant temperature sensor.

5 Turn the main switch on and press the on button on the button panel.

Measurement points	Nominal value
16 (battery negative) - 20 (coolant temperature)	U ≈ 5 V

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

Measurement points	Nominal value
16 (battery negative) - 21 (coolant temperature sensor)	U ≈ 2–3 V at +20°C (+68°F)



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Checking the coolant temperature sensor

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

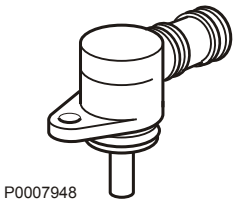
1 **NOTICE!** Cut the current with the main switch.

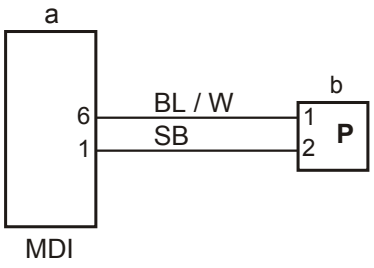
2 Connect adapter cable 88890016 Break-out cable with 9998699 Break-out box and with the engine connector. Do not connect the MDI.

3 Use 88890074 Multimeter for resistance measurement.

NOTICE! All resistance values shall be seen as guide line values.

Measurement points	Nominal value
16 - 20	R ≈ 1743 Ω at 0°C
16 - 20	R ≈ 1076 Ω at 10°C
16 - 20	R ≈ 677 Ω at 20°C
16 - 20	R ≈ 439 Ω at 30°C
16 - 20	R ≈ 291 Ω at 40°C
16 - 20	R ≈ 197 Ω at 50°C
16 - 20	R ≈ 134 Ω at 60°C
16 - 20	R ≈ 97 Ω at 70°C
16 - 20	R ≈ 70 Ω at 80°C
16 - 20	R ≈ 51 Ω at 90°C
16 - 20	R ≈ 38 Ω at 100°C
16 - 20	R ≈ 29 Ω at 110°C
16 - 20	R ≈ 22 Ω at 120°C





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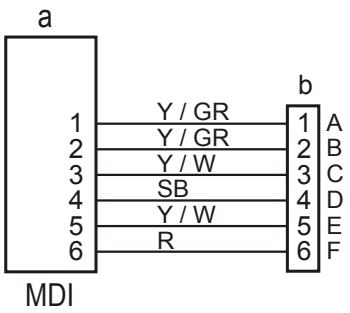
a Engine connector

b Flywheel sensor



P0008422

a Engine connector

b Connector, multilink

Multilink fault

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 recieves 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 communiction 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.

A CAN L

B CAN L

C CAN H

D Power supply negative

E CAN H

F Power supply positive

Fault tracing

Fault condition 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 condition 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”.

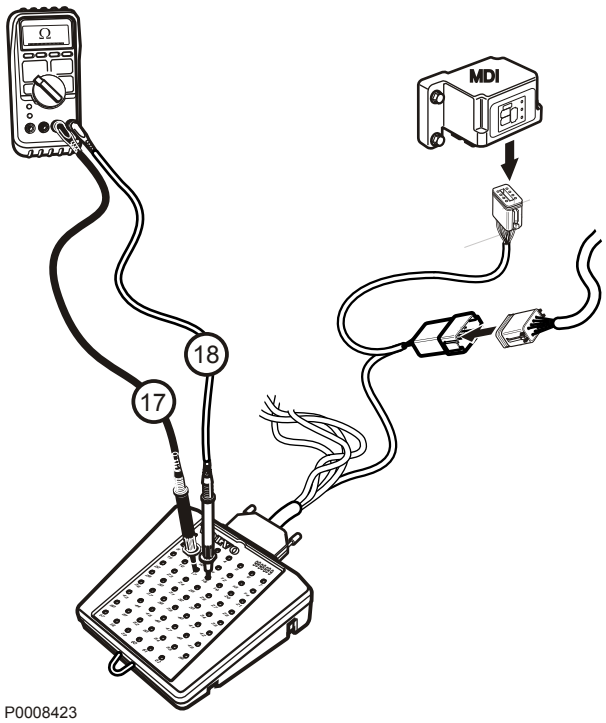
Possible reason

- 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 multlink bus and connectors between the multlink connector at the MDI and all connected optional equipment such as display, NMEA interface, multi sensor.

2 Try with another tachometer/optional equipment.



P0008423

Measurements

Check speed sensor, flywheel

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

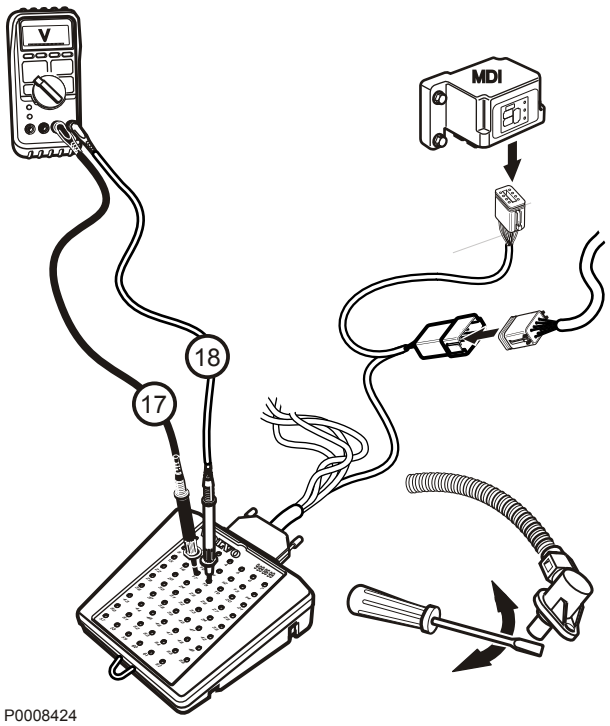
Check 1

1 **NOTICE!** Cut the current with the main switch.

2 Connect 88890016 Break-out cable with 9998699 Break-out box between MDI and engine connector. Do not connect the MDI.

3 Use 88890074 Multimeter for resistance measurement.

Measurement points	Nominal value
17 - 18	R ≈ 0,9 kΩ



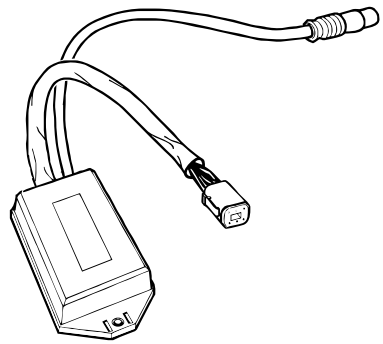
P0008424

4 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.

5 Use 88890074 Multimeter for a AC voltage measurement.

6 Move a metal object rapidly back and forwards not more than 1 mm (0.039") in front of the sensor. Check that the multimeter gives a reading.

7 Install the sensor.



P0004839

Checking 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

Enheten tar emot MULTILINK-data men har ingen NMEA-anslutning (tar inte emot NMEA velocity-data).

Flashes three strobes and than off repeatedly

The unit is receiving NMEA data but has no MULTI-LINK connection.

Manual fault tracing of bus cables

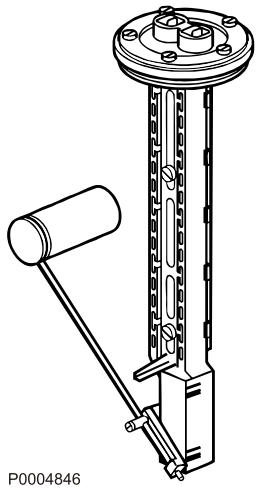
Tools:
88890074 Multimeter

NOTICE! Cut the current with the main switch.

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 88890074 Multimeter 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 pin 1 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.


P0004846

Fuel level warning

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.

Circuit 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 V.

Fault tracing

Fault condition

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

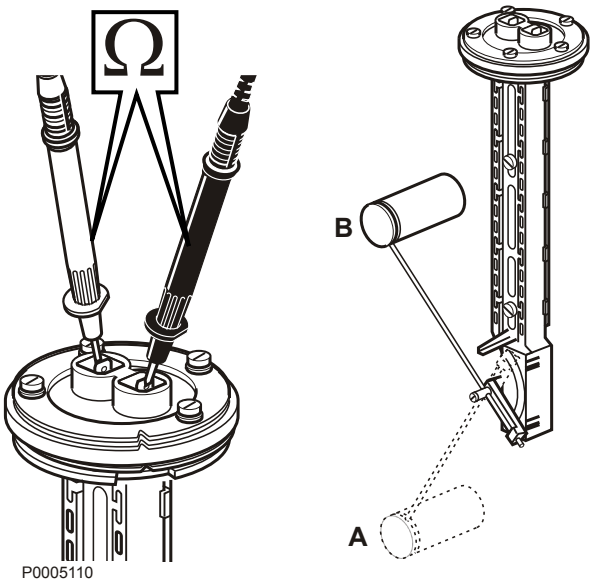
Possible reason

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

Suitable action

1 Check fuel level.

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



Measurements

Checking the fuel level sensor

Tools:
88890074 Multimeter

1 **NOTICE!** Cut the current with the main switch.

2 Remove the connector from the fuel level sensor.

3 Use 88890074 Multimeter to measure the resistance between the two terminal pins on the level sensor.

Nominal value	
Empty tank (**A**)	R ≈ 3 ±2 Ω
Full tank (**B**)	R ≈ 180 ±15 Ω

4 Turn the main switch on.Turn the ignition on

5 Use 88890074 Multimeter 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 ≈ 5 V

Button panel fault

Tachometer

None.

Alarm display

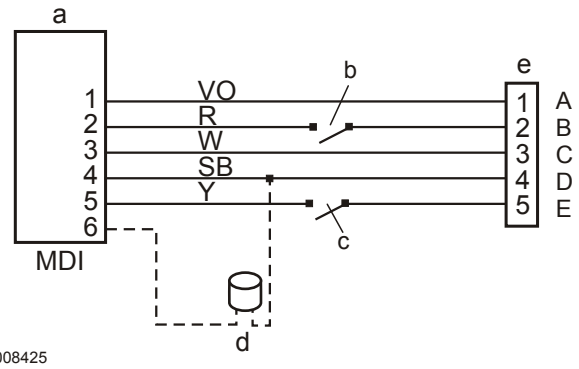
None.

Symptom

No system response when a button is pushed.

Circuit 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 system can be activated. The neutral switch must be closed before the engine can be started.



a Connector, button panel

b Switch

c Neutral switch

d Buzzer

e Button panel

A Stop

B On/off

C Ack./dimmer

D Battery negative

E Start/preheat

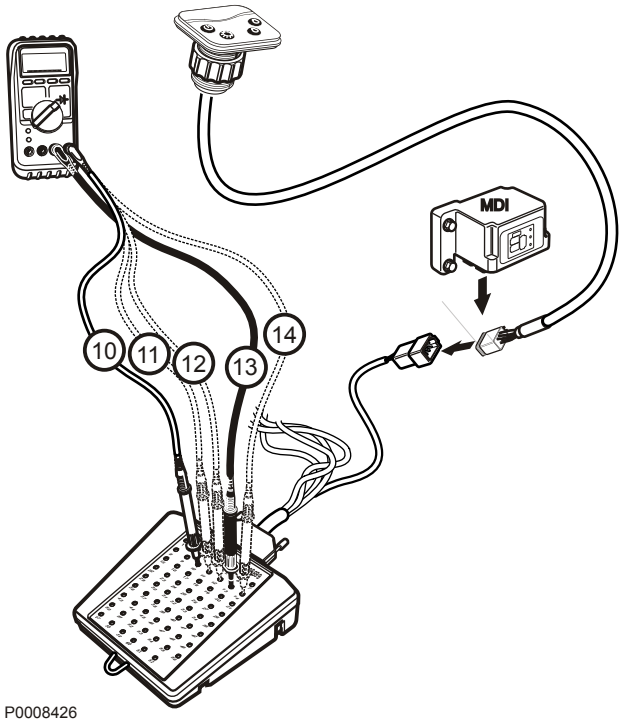
Fault tracing

Fault condition

The button panel does not function properly.

Possible reason

- The power switch is disconnected.
- The multilink 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.



P0008426

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

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

1 **NOTICE!** Cut the current with the main switch.

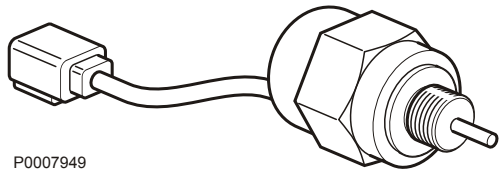
2 Connect 88890016 Break-out cable with 9998699 Break-out box towards the button panel.

3 Use 88890074 Multimeter to do a continuity (diode) test.

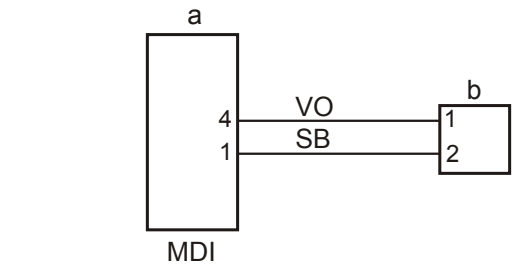
Measurement points	Nominal value
13 - 10 Battery negative - Stop	**OL*** (button not pushed)
13 - 10 Battery negative - Stop	**line** (button pushed)
13 - 11 Battery negative - On/off	**OL** (button not pushed)
13 - 11 Battery negative - On/off	**line** (button pushed)
13 - 12 Battery negative - Ack./ dimmer	**OL** (button not pushed)
13 - 12 Battery negative - Ack./ dimmer	**line** (button pushed)
13 - 14 Battery negative - Start/ preheat	**OL** (button not pushed)
13 - 14 Battery negative - Start/ preheat	**line** (button pushed)

***OL** = Open line

NOTICE! 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.



P0007949



P0008427

a Engine connector

b Stop solenoid

Stop solenoid fault

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.

Circuit 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 condition

The stop solenoid does not function properly.

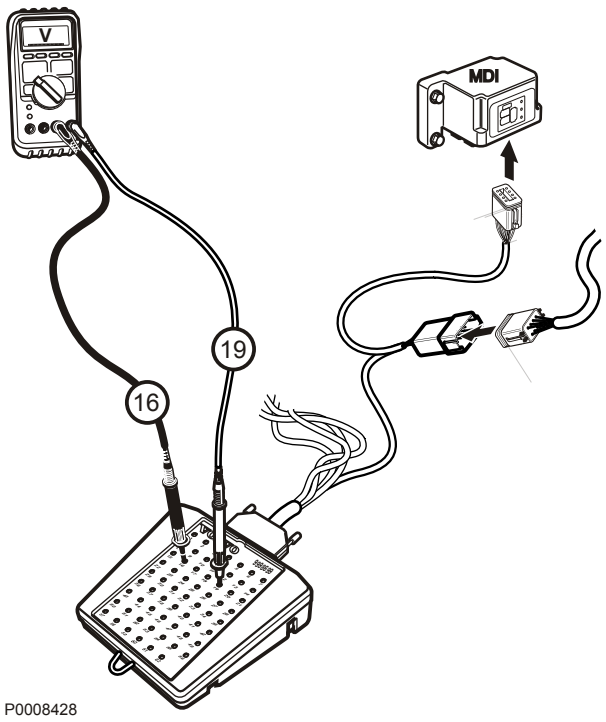
Possible reason

- 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.



P0008428

Measurements

Check MDI output for stop solenoid

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

1 **NOTICE!** Cut the current with the main switch.

2 Connect 88890016 Break-out cable with 9998699 Break-out box between MDI and the engine connector.

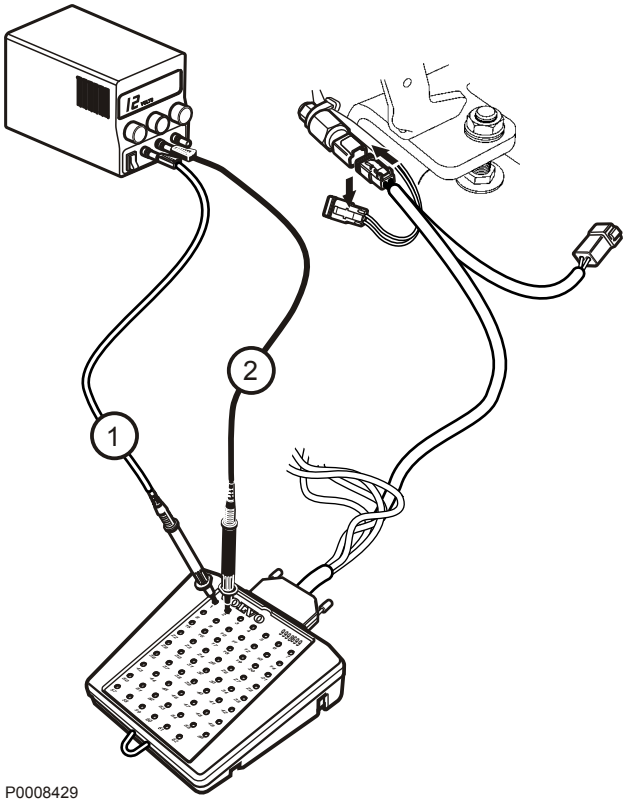
3 Use 88890074 Multimeter for voltage measurement.

4 Turn the main switch on and press the on button on the button panel.

Measurement points	Nominal value
(stop button not pushed) 19 (solenoid positive) - 16 (battery negative)	U ≈ 0 V (solenoid not activated)
(stop button pushed) 19 (solenoid positive) - 16 (battery negative)	U ≈ 0,9 x battery voltage (solenoid activated)

5 Disconnect the solenoid connector at the stop solenoid.

Measurement points	Nominal value
(solenoid disconnected) 19 (solenoid positive) - 16 (battery negative)	U ≈ Battery voltage



P0008429

Check stop solenoid

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

1 **NOTICE!** Cut the current with the main switch.

2 Disconnect the solenoid connector at the stop solenoid.

3 Connect 88890016 Break-out cable with 9998699 Break-out box to the stop solenoid.

4 Connect a power supply of +12 V, 6 A 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

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.

Circuit 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 condition 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 (122 °F) 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. Repress 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 condition 2

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

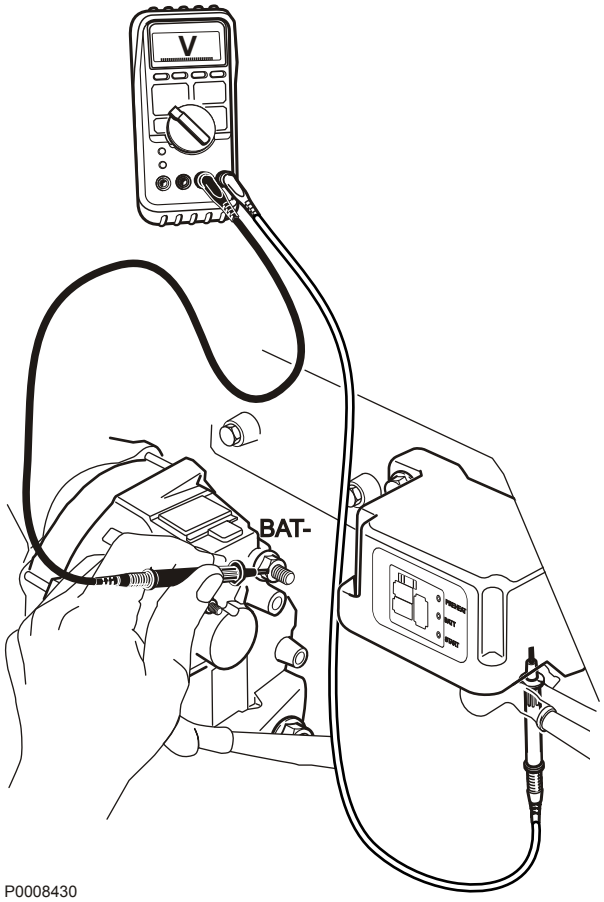
Possible reason

- The coolant temperature is above 50 °C (122 °F) 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.



P0008430

Measurements

Check MDI output for starter solenoid

Tools:
88890074 Multimeter

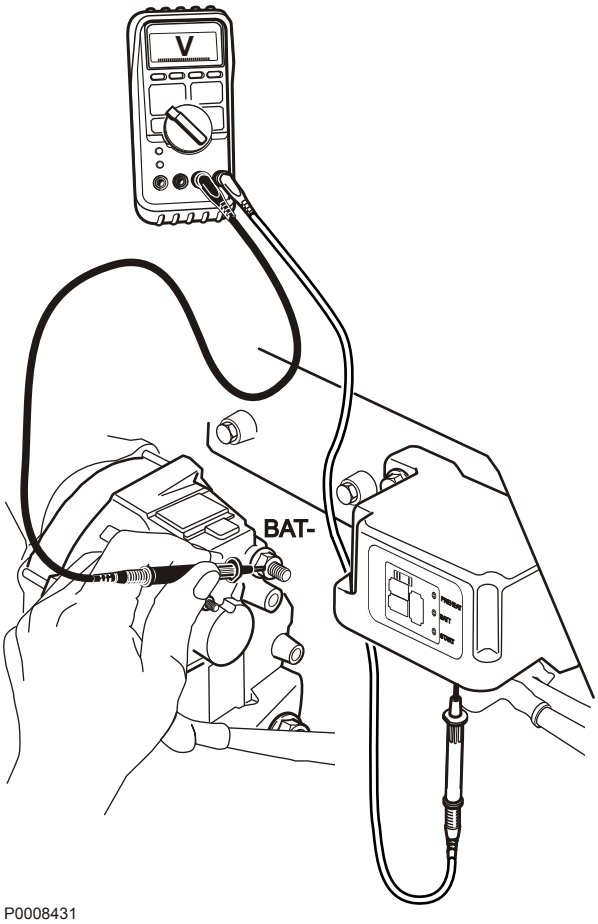
1 **NOTICE!** Cut the current with the main switch.

2 Loosen the rubber protection hood over the starter output at the MDI to be able to do a measurement.

3 Use 88890074 Multimeter 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. Repress the start/preheat button within 10 seconds to activate the starter motor.

Measurement points	Nominal value
(start/crank button not activated) MDI starter relay output - battery negative	U ≈ 0 V
(start/crank button activated) MDI starter relay output - battery negative	U ≈ Battery voltage



P0008431

Check MDI output for preheat function

Tools:
88890074 Multimeter

1 **NOTICE!** Cut the current with the main switch.

2 Loosen the rubber protection hood over the preheat output at the MDI to be able to do a measurement.

3 Use 88890074 Multimeter 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 (122 °F) the prehating is not activated.

Measurement points	Nominal value
(start/preheat button not activated) MDI preheat output - battery negative	U ≈ 0 V
(start/preheat button activated) MDI preheat output - battery negative	U ≈ 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

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 15 V 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 13 V 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 alternator brushes.
- Faulty alternator regulator.

Suitable action

1 Check the alternator belt tension.

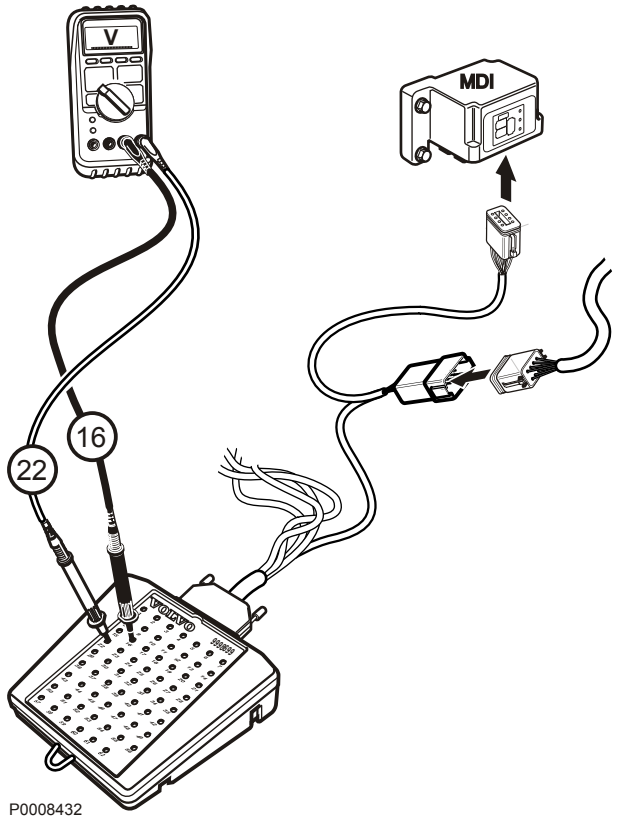
2 Check that all connectors at the alternator and at the battery are correctly assembled.

3 Check the conditions of all cables in the charging system.

4 Check that the alternator recieves 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 altenator excitation voltage

Tools:
88890074 Multimeter
9998699 Break-out box
88890016 Break-out cable

1 **NOTICE!** Cut the current with the main switch.

2 Disconnect the excitation cable on D+ on the alternator.

3 Connect 88890016 Break-out cable with 9998699 Break-out box between the MDI and the engine connector.

4 Use 88890074 Multimeter for voltage measurement.

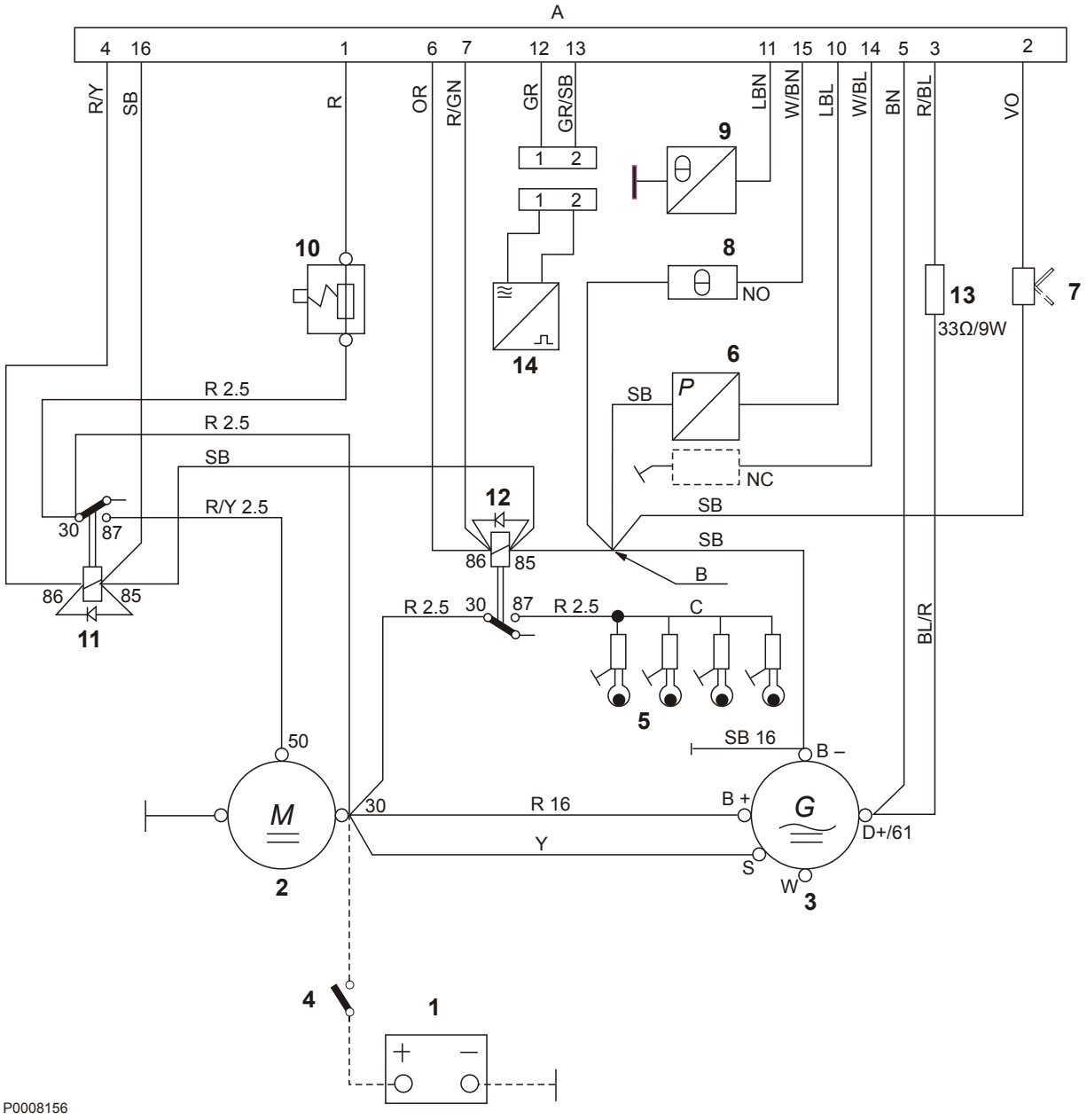
5 Turn the main switch on.

Measurement points	Nominal value
16 - 22	U ≈ Battery voltage

37-0 Wiring Diagrams

Engine

D1-13 A, D1-20 A, D1-30 A, D2-40 A



1 Battery (orange indication)
2 Starter motor
3 Alternator
4 Main switch
5 Glowplugs
6 Oil pressure monitor
7 Stop solenoid
8 Coolant temperature monitor
9 Coolant temperature sensor
10 Circuit breaker, 16 A
11 Start Relay
12 Glowplug relay
13 Charge sensing resistor, 33 Ohm/9W
14 Engine rpm sensor

A 16-pin connection
B Joint
C Connection plate

Cable colors

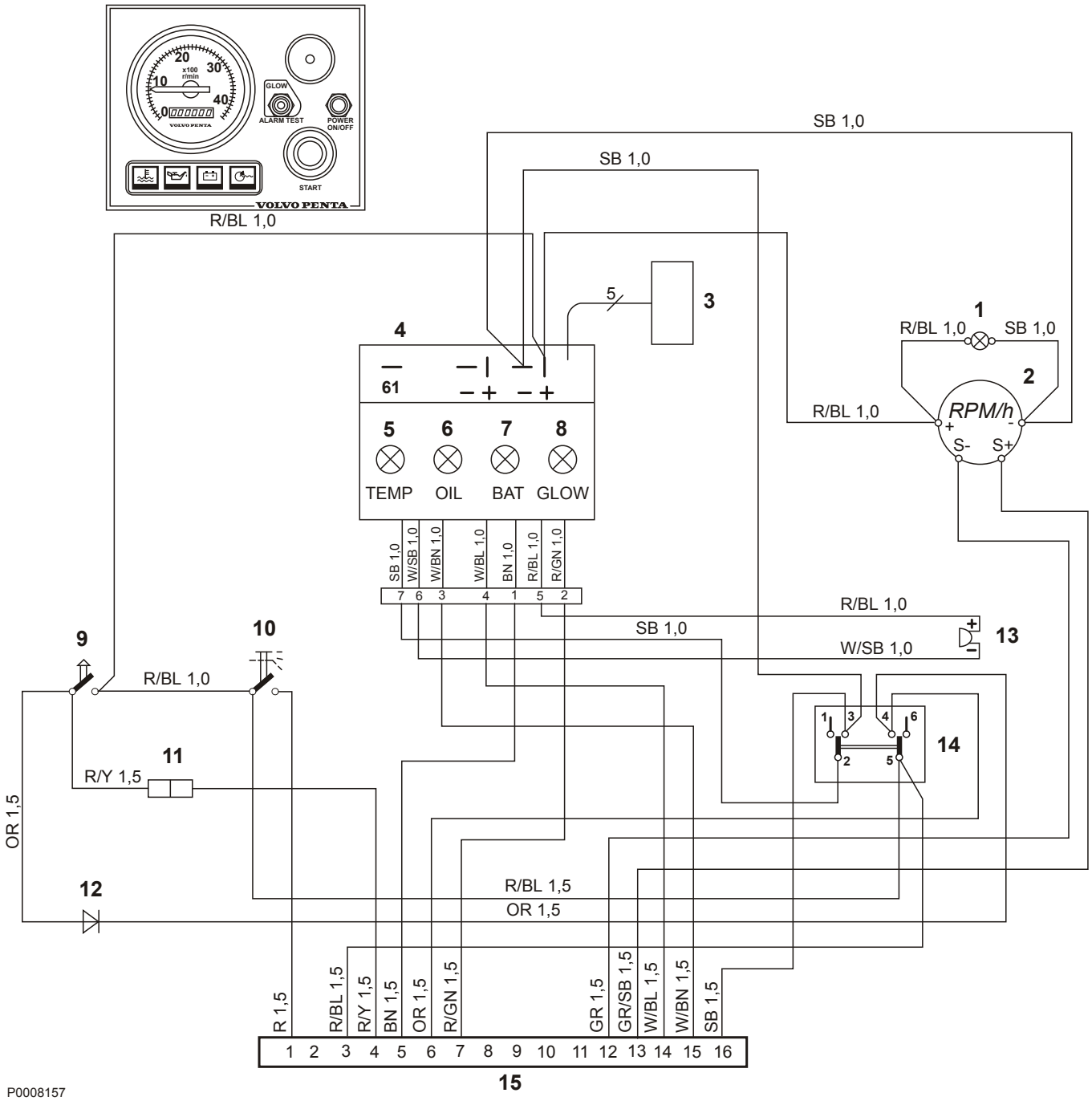
BL = Blue
LBL = Light blue
BN = Brown
LBN = Light brown
GN = Green
GR = Gray
OR = Orange
R = Red
SB = Black
W = White
Y = Yellow

Cable cross section in mm^2 is indicated after the color code in the wiring diagram.
Cable areas not specified = 1.5 mm^2.
Cables shown with broken lines are not supplied by Volvo Penta.

Instrument Panel, alternative “A” *

*** (without key switch)**

D1-13 A, D1-20 A, D1-30 A, D2-40 A



1 Instrument lighting

2 Tachometer with built-in operating hours counter (extra equip.). Or blanking plug

3 Connector for connecting extra warning display (optional equipment)

4 Electronic unit (alarm)

5 Warning lamp, coolant temperature

6 Warning lamp, oil pressure

7 Charge warning lamp

8 Indication lamp, glow plugs

9 Start button

10 Press switch. Instrument panel On/Off

11 Connector for connecting neutral position switch (extra equip.)

12 Semiconductor diode

13 Alarm

14 Toggle switch. Glow – Alarm test / Acknowledge

15 16-pin connection

Cable colors

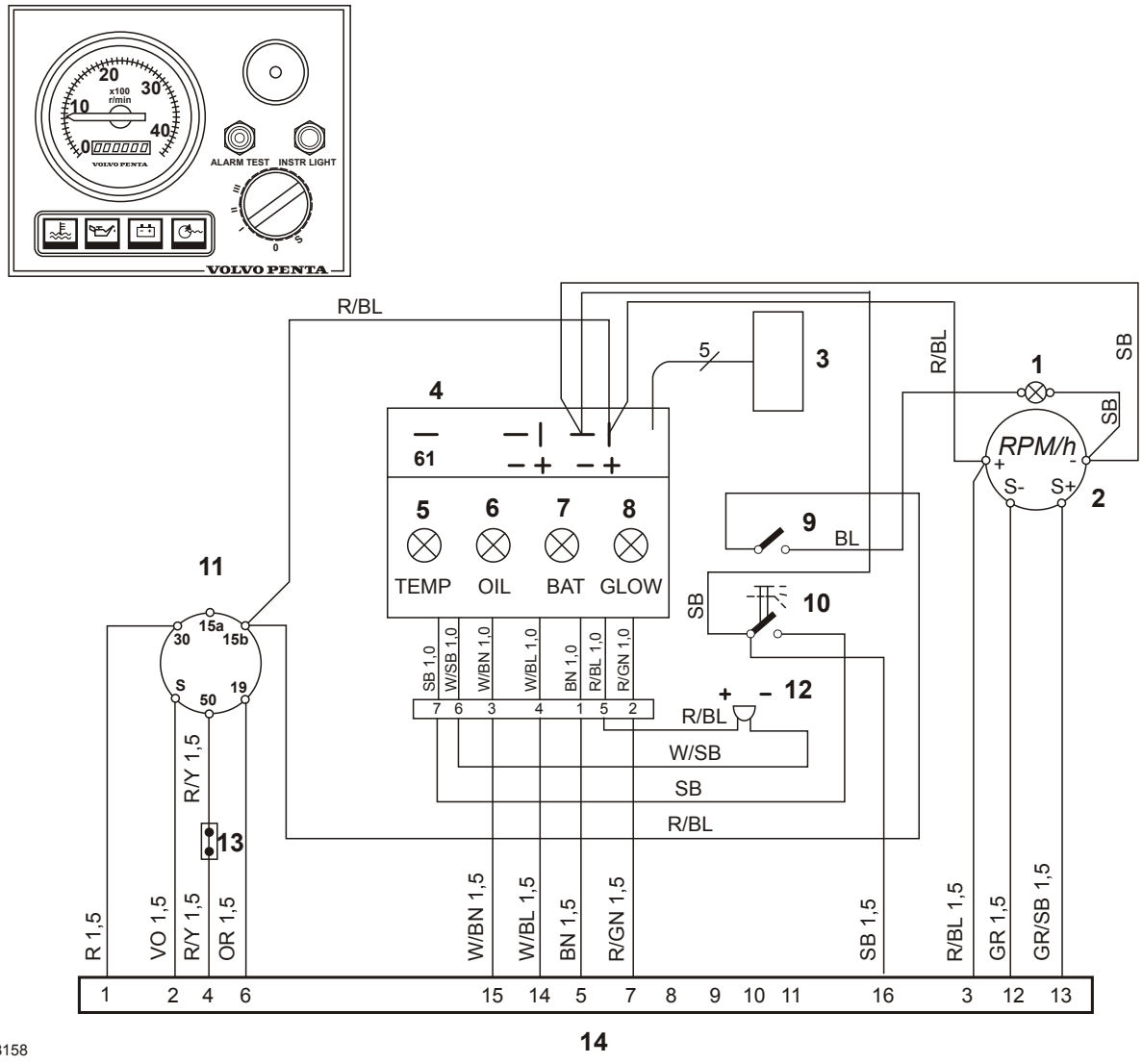
BL = Blue	PU = Purple
BN = Brown	R = Red
GN = Green	SB = Black
GR = Gray	W = White
OR = Orange	Y = Yellow

Cable cross section in mm^2 is indicated after the color code in the wiring diagram.

Instrument Panel, alternative “B” *

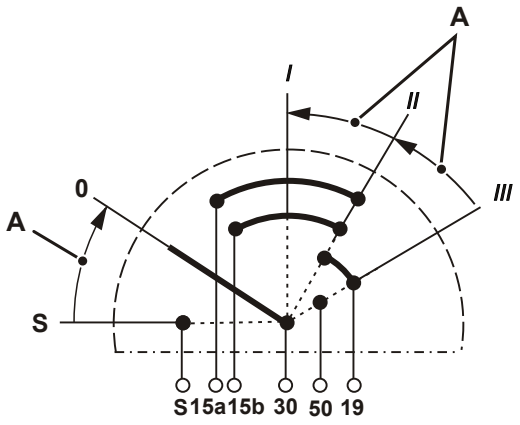
*** (with key switch)**

D1-13 A, D1-20 A, D1-30 A, D2-40 A



P0008158

1 Instrument lighting
2 Tachometer with built-in operating hours counter (extra equip.). Or blanking plug
3 Connector for connecting extra warning display (optional equipment)
4 Electronic unit (alarm)
5 Warning lamp, coolant temperature
6 Warning lamp, oil pressure
7 Charge warning lamp
8 Indication lamp, glow plugs
9 Switch, instrument lighting
10 Switch - Alarm test / Acknowledgment
11 Key switch
12 Alarm
13 Connector for connecting neutral position switch (extra equip.)
14 16-pin connection



P0008159

A Spring return

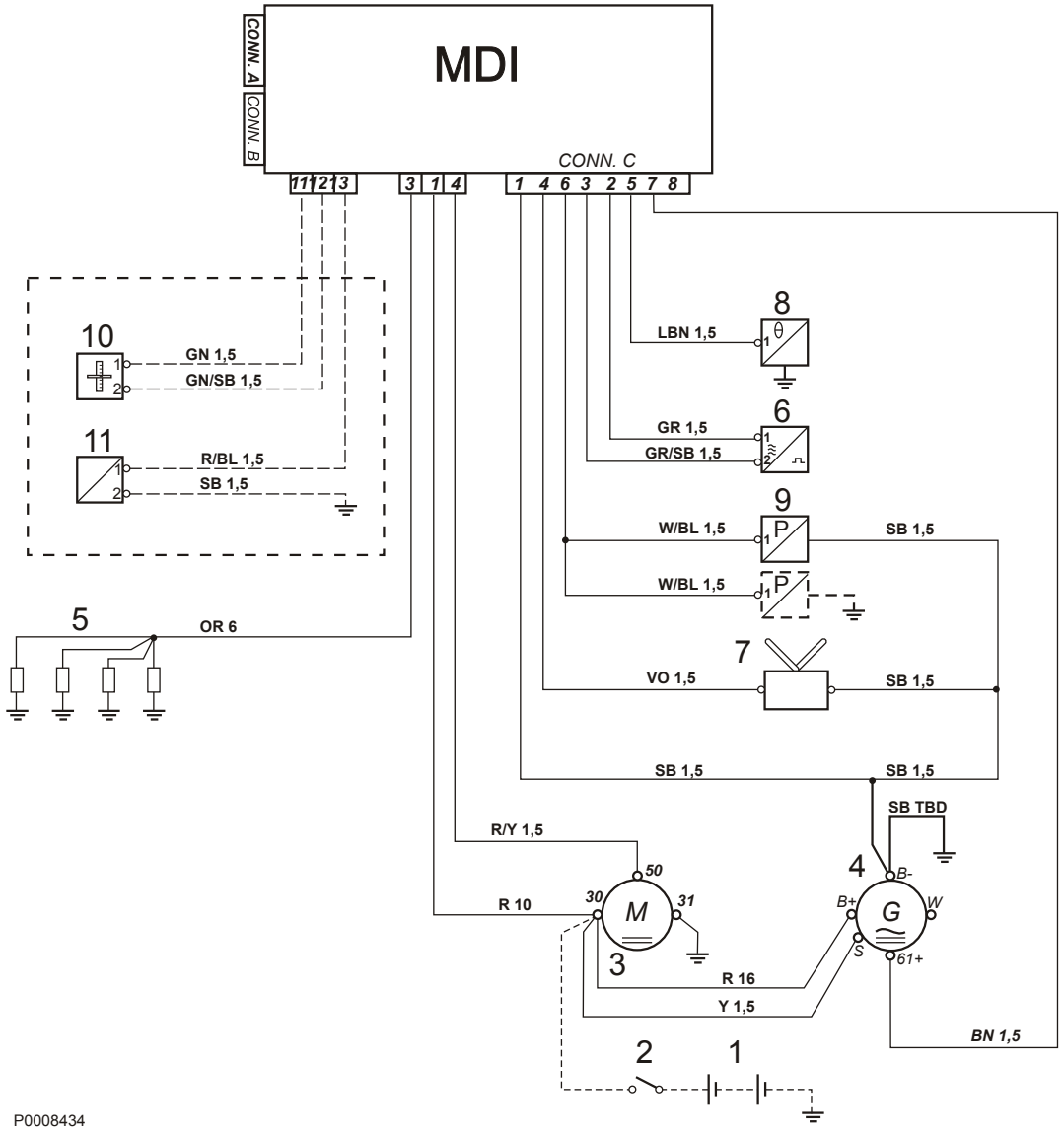
Cable colors

BL = Blue	R = Red
BN = Brown	SB = Black
GN = Green	VO = Violet
GR = Gray	W = White
OR = Orange	Y = Yellow

Cable cross section in mm^2 is indicated after the color code in the wiring diagram.

MDI

D1-13 B/F, D1-20 B/F, D1-30 B/F, D2-40 B/F



1 Battery (orange indication)
2 Main switch
3 Starter motor
4 Alternator
5 Glowplugs
6 Flywheel sensor
7 Stop solenoid valve
8 Coolant temperature sensor
9 Oil pressure monitor
10 Fuel level sensor
11 Input for accessory monitor

Cable colors

BL = Blue	R = Red
BN = Brown	SB = Black
GN = Green	VO = Violet
GR = Gray	W = White
OR = Orange	Y = Yellow

Cable cross section in mm^2 is indicated after the color code in the wiring diagram.

Keypad

1 Stop
2 On, off
3 Ackn. / dimmer
4 Battery negative
5 Start / preheat
6 Buzzer

Multilink

1 CAN L
2 CAN L
3 CAN H
4 Multilink negative supply
5 CAN H
6 Multilink voltage supply

Engine harness

1 Battery negative
2 Flywheel sensor +
3 Flywheel sensor –
4 Stop solenoid valve
5 Coolant temperature sensor
6 Oil pressure monitor
7 Magnetization
8 Not used

Alphabetical index

References to Service Bulletins

Group No.	Date	Refers to

Report form

Do you have any comments or other viewpoints concerning this manual? Make a copy of this page, and write down your comments and send them to us. The address is at the bottom of the page. We would prefer you to write in Swedish or English.

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Concerns publication: .....

Publication No.: ..... Date of issue: .....

Proposal/Motivation: .....

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AB Volvo Penta
Service Communication
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Sweden

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