

Installation
EMS 2
Industrial Engines

I
1(1)

TAD1640GE, TAD1641GE, TAD1642GE
TAD1641VE, TAD1642VE
TWD1643GE

Installation

EMS 2

TAD1640GE, TAD1641GE TAD1642GE, TWD1643GE TAD1641VE, TAD1642VE

Contents

Safety instructions	2	TAD1641VE, 1642VE (DCU)	33
Special tools	4	General	33
General information	5	Connection	34
The EMS 2-system	5	Parameter setting	35
Component location	10	Connecting parameter tool VODIA	35
Voltage supply 24 V	12	Adjustable parameters TAD1640GE–1642GE, TWD1643GE (CIU/DCU)	36
Electrical diagram EMS2	14	Alarm limits TAD1640GE–1642GE, TWD1643GE (CIU/DCU)	37
Electrical diagram CIU	16	Engine protectors TAD1640GE–1642GE, TWD1643GE (CIU/DCU)	38
Electrical diagram DCU	17	Adjustable parameters TAD1641VE–1642VE (CIU/DCU)	39
TAD1640GE–1642GE, TWD1643GE (CIU)	18	Engine protectors TAD1641VE–1642VE (CIU/DCU)	40
General	18	Fault tracing	41
Connection	19	Diagnosis function	42
Engine control	19	Fault codes	45
Warning and indication lamps	20	Reference to Service bulletins	56
Instruments	21		
Other	23		
Synchronization/load distribution	23		
TAD1640GE–1642GE, TWD1643GE (DCU)	24		
General	24		
Connection	25		
TAD1641VE, 1642VE (CIU)	26		
General	26		
Connection	27		
Engine control	27		
Warning and indication lamps	29		
Instruments	30		
Other	32		

Safety instructions

Presentation

The Instruction Book contains the information you need in order to install and test performance of the EMS 2 system (electronic control of the injection system).

Read the instruction book carefully before you start installation. If the installation is done in a faulty manner, this can cause personal injury or damage to property and machinery.

If you do not understand or are unsure of anything in this installation manual, please contact your Volvo Penta dealer for assistance.

Installation

This installation manual is produced for professional use only.

The installation manual is intended to be used together with the relevant engine instruction book.

Volvo Penta declines all responsibility for personal injury or property damage which might occur as a result of not following the installation advice, or if the work is not done by professional personnel.

The installer is responsible for ensuring that the system operates in the manner described in the instruction book.

Work methods


These instructions are intended for qualified personnel. In these instructions, these person(s) is/are referred to as the installer(s).


Also refer to the specific engine instruction book for relevant information when necessary, and in particular for information relating to safety and engine operation.

Work must be performed by Volvo Penta workshops, boat yards or other authorized, well equipped workshop, by qualified and experienced personnel.

Important!


The following special warning symbols are displayed in this book and on the engine.

 **WARNING!** Possible danger of personal injury, damage to property or serious mechanical malfunction if the instructions are not followed.

 **IMPORTANT!** Used to draw your attention to something that can cause damage or malfunctions on a product or damage to property.


NOTE: Used to draw your attention to important information that will facilitate the work or operation in progress.







Below is a summary of the risks involved and safety precautions you should always observe or carry out when installing and calibrating the EMS 2 system.

 Before performing electric welding, the connectors on the EMS control unit must be disconnected.

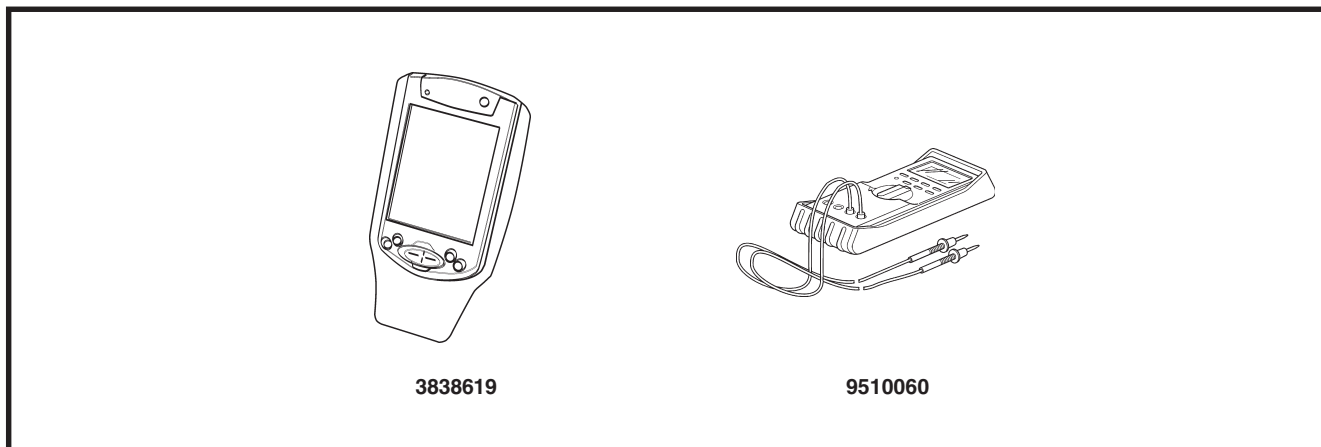
Disconnect power from the engine at the main breaker.

Disconnect the connectors from the control unit. Reconnect the connectors to the EMS 2 control unit once the welding is finished and the welding equipment has been disconnected.

 Be careful, watch out for the moving components of the engine during function testing and in operation. Approaching the engine during operation entails a risk of personal injury. Remember that loose clothes or long hair can catch on rotating components and cause severe injury.

-
-  Never do any work on an engine which just hangs from a lifting device (crane etc.).
 -  The engine must not be run in areas where explosive material or any gases are stored.
 -  Only start the engine in a well-ventilated area. If the engine is run in a confined space, make sure that the crankcase ventilation and exhaust gases can be led away from the workplace.
 -  The batter lockers must never be exposed to open flames or sparks. Never smoke close to the batteries. The batteries generate hydrogen gas when charged, which can form an explosive gas when mixed with air. This gas mixture is very flammable and highly explosive. A spark, which can be caused by incorrect battery connection, can cause a single spark which is sufficient to cause an explosion with resulting damage. Do not shift the connections when attempting to start the engine (spark risk) and do not lean over any of the batteries. Please refer to the advice in the instruction book.
 -  Always ensure that the + (positive pole) and – (negative pole) are securely connected to their appropriate terminals on the battery. If the batteries are wrongly connected, this can cause severe damage to the electrical equipment. Please refer to the wiring diagram in the engine instruction book.
-  Always use goggles when charging and handling batteries. Battery electrolyte contains sulphuric acid, which is very corrosive. If battery acid comes into contact with your skin, wash it off at once with a lot of soap and water, and then get medical help. If battery acid comes into contact with your eyes, flush your eyes at once (preferably with an eye shower) with a lot of clean water, and then get medical help at once.

Special tools

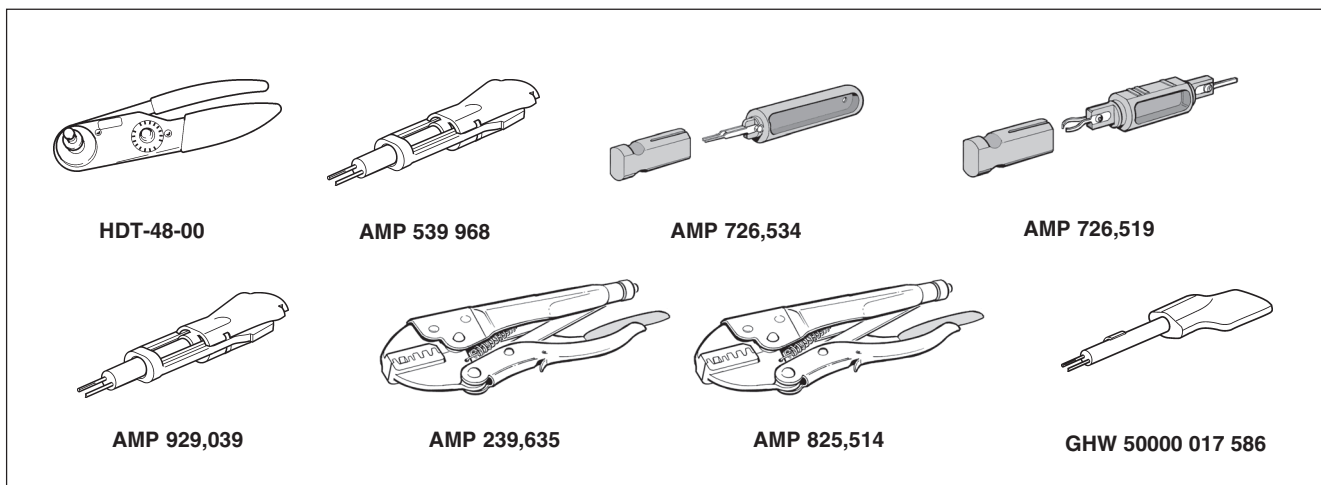


3838619 VODIA, complete with cable harness.
See VODIA Users Guide for ordering separate parts.

9510060-8 Multimeter

Other special equipment

The tools below are used for work on the engine cable harness. The tools are not offered by Volvo Penta, but can be ordered from a local **AMP** or **Deutsch** agents. If you experience problems in contacting a dealer, please contact Volvo Penta Quality Action Center for advice.



Deutsch connectors

HDT-48-00 Crimping tool

AMP contact (42-pin CIU, 62-pin EMS, 2- and 3-pin Bosch etc.)

539,968-1 Removal tool, 1.5 mm pin width

726 534-1 Removal tool, 0.06 in pin width

726 519-1 Removal tool, 2.8 mm pin width

929 039-1 Removal tool, 2.8 mm pin width

239 635-1 Crimping tool

825 514-1 Crimping tool

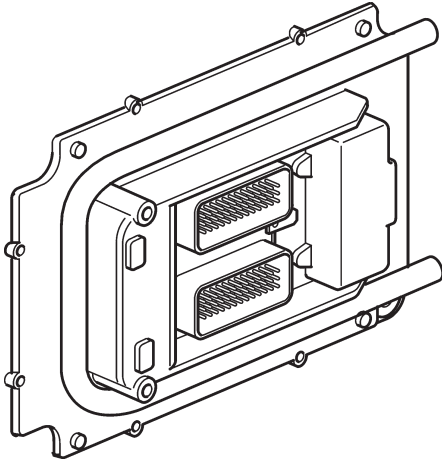
4.8 mm and 6.3 mm cable clamps. Tongues and socket terminals

825 514-1 Crimping tool

GHW contact (relay box)

50000 017 586 Removal tool, 4.8 mm pin width
pin width

General information



EMS 2

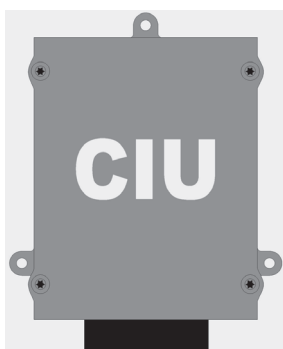
Engine management system

EMS 2 stands for “Engine Management System” and is an electronic system with CAN communications (Controller Area Network) for control of diesel engines. The system has been developed by Volvo Penta and includes fuel control and diagnosis function. The system consists of a control module, six unit injectors, a number of sensors that supply the control module with measurements, sockets for diagnosis and functional checks. The engine can be connected to a communication interface comprising a CAN-link and a serial link.

CAN (Controller Area Network)

The CAN J1939 link handles all communication between the engine control module EMS 2 and the CIU, in addition to the diagnostics that are handled by the so called J1708/J1587 link. The CAN link is much faster than the J1708/J1587 link. The CAN link has been prepared to connect to other components with SAE J1939 protocol such as instrument panels and transmissions.

If, for some reason, a fault develops on the CAN link, signals for the rpm-potentiometer and the start and stop knobs are taken over by the J1708/J1587 link. However, instrument and indicator lamps are completely turned off. If a fault occurs on both links, GE engines maintain engine speed, while VE engines go to idle. The only way to shut off the engine in this case is to use the auxiliary stop (AUX-STOP) placed on the engine’s left side.

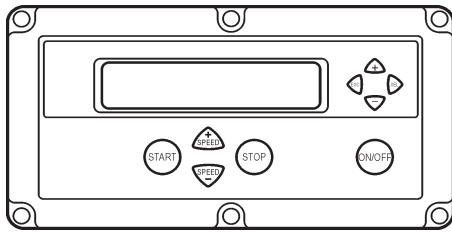


CIU (Control Interface Unit)

The CIU is a “translator” between the CAN bus and the customer’s own control panel. This unit has two serial communication links, one fast and one slow. The fast one is a CAN link that features a bus speed of 250 Kbit/s. All data regarding instruments, indicator lamps, contacts and potentiometers are controlled by this bus. The slower J1708/J1587 link handles diagnostic information for, among other things, the flashing code. The diagnosis tool VODIA also uses the J1708/J1587 link to communicate with the system.

DCU (Display Control Unit)

DCU is a digital instrument panel that communicates with the engine control unit via the CAN-link. DCU has several functions, such as:



Engine control

- Start, stop, rpm regulation, preheating, etc.

Monitoring

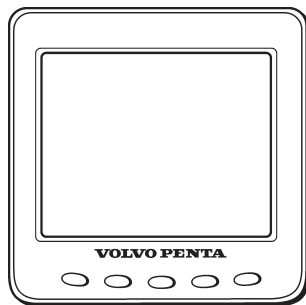
- Shows engine speed, charge pressure, charge temperature, coolant temperature, oil pressure, oil temperature, engine hours, battery voltage, instantaneous fuel consumption and fuel consumption (trip fuel).

Diagnostic

- Shows fault codes in text. Lists previous faults.

Parameter setting

- Idle speed, alarm limits for oil temperature/coolant temperature, regulation mode (speed droop/isochronous).



DU (Display Unit)

DU is an instrument for showing the engines operating values. The values are shown graphically on an LCD display. The display communicates via the CAN link and consists of a computerized unit for attachment to the control panel.

It is connected to the CAN link between the engine control unit and CIU or DCU.

Input signals

The control module receives input signals about the engines operating conditions and other things from the following components:

- coolant temperature
- charge pressure / charge temperature sensor
- crankcase pressure sensor
- position sensor, camshaft
- speed sensor, flywheel
- piston cooling pressure sensor
- coolant level sensor
- oil pressure sensor
- oil level and oil temperature sensor
- fuel pressure sensor
- water in fuel indicator
- air filter pressure
- air temperature sensor
- exhaust temperature (TWD1643GE)

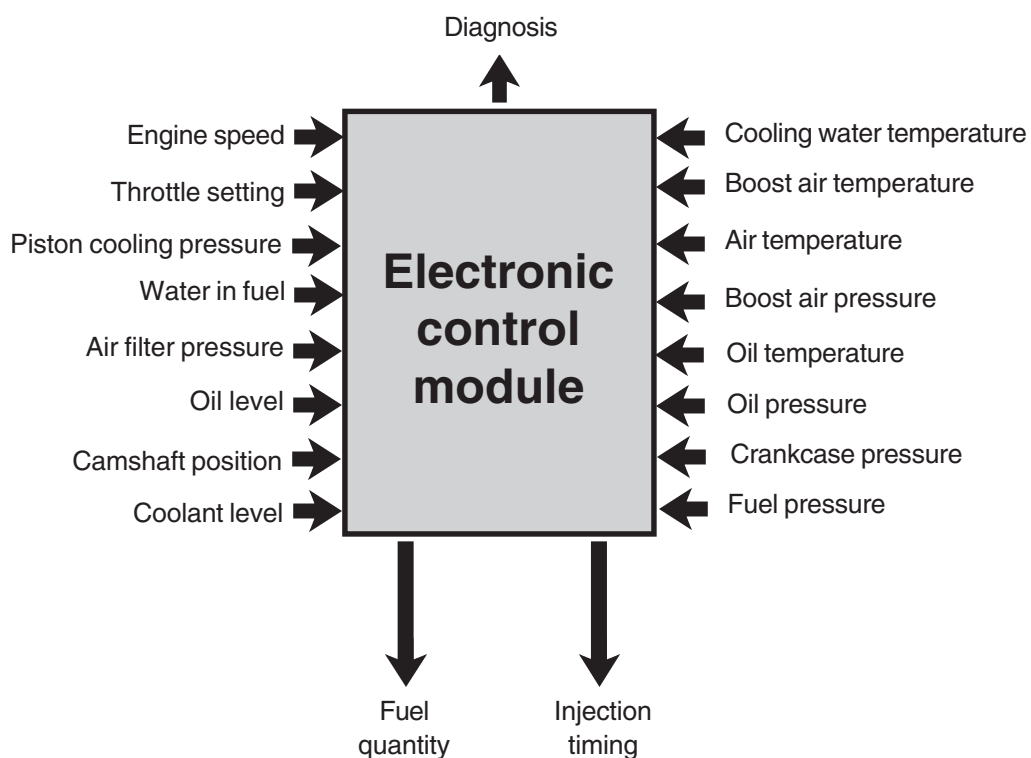
Output signals

Based on the input signals the control module controls the following components:

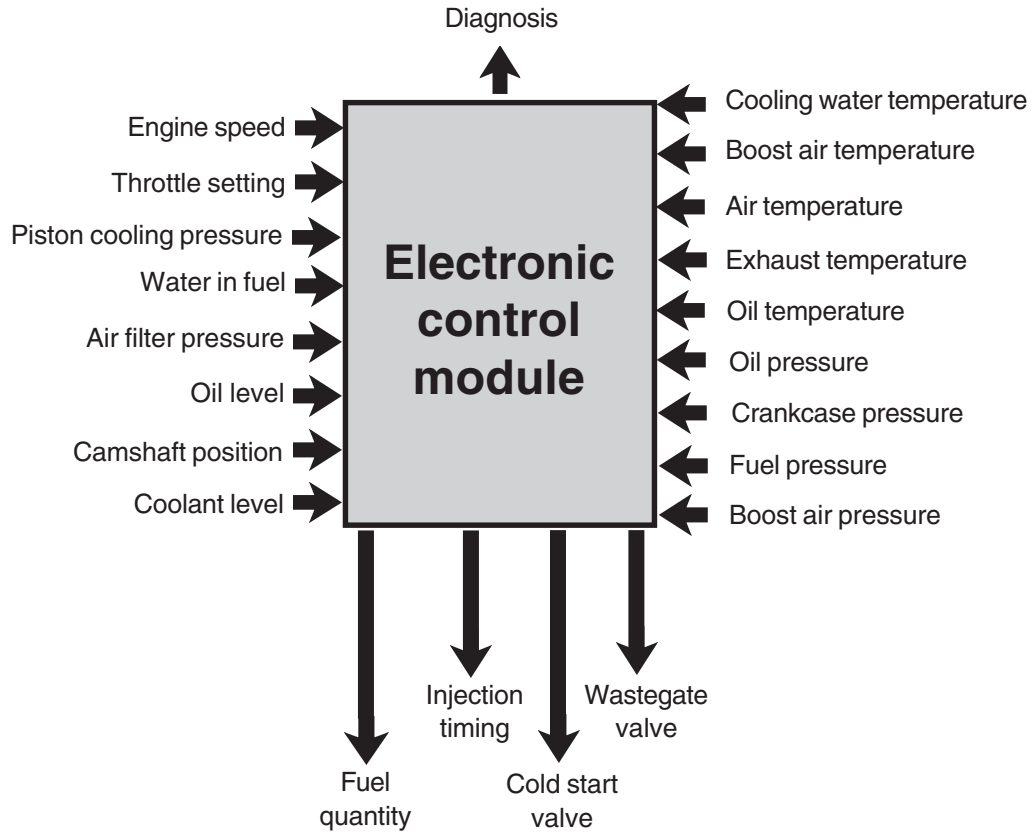
- unit injectors
- starter motor
- alternator
- main relay
- preheater relay

The information from the sensors give exact data about prevailing operating conditions and allows the processor in the control module to, among other things, calculate correct injection amount, injection timing and check the engine's condition.

TAD1640GE–TAD1642GE, TAD1640VE–TAD1642VE



TWD1643GE



Fuel control

The engine's fuel requirement is analyzed up to 100 times per second (depending on engine rpm). The engine's injection amount and injection timing is controlled electronically via fuel valves on the unit injectors.

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

The control module checks and controls the unit injectors so that the correct amount of fuel is injected into each cylinder. It calculates and sets the injection angle. The control is primarily performed using the speed sensors and the combined sensor for boost pressure/charge air temperature.

The control module affects the unit injectors via an electronic signal to the unit injectors' electromagnetic fuel valve, which can open and close.

When the fuel valve is open, fuel flows through the unit injector hole and out through the fuel channel. Fuel is not sprayed into the cylinder in this position.

When the fuel valve closes, pressure starts to build from the unit injector's mechanically operated pump plunger. When sufficient pressure has developed, fuel is injected into the cylinder via the unit injector's injector section.

The fuel valve is re-opened and pressure in the unit injector decreases at the same time as the fuel injection to the cylinder stops.

In order to determine when the fuel valve shall open or close, the control module has access to signals from sensors and switch contacts.

Calculating fuel quantity

The amount of fuel that is sprayed into a cylinder is calculated by the control module. The calculation determines the time that the fuel valve is closed (when the fuel valve is closed fuel is sprayed into the cylinder). The parameters controlling injected amount of fuel are:

- Requested engine speed
- Motor protector
- Temperature
- Boost air pressure

Altitude correction

The control unit is fitted with an atmospheric air pressure sensor and an altitude correction function for engines operating at high altitudes. This function limits the fuel volume in relation to ambient air pressure.

This is to prevent smoke, high exhaust temperature and to protect the turbocharger from over-speeding.

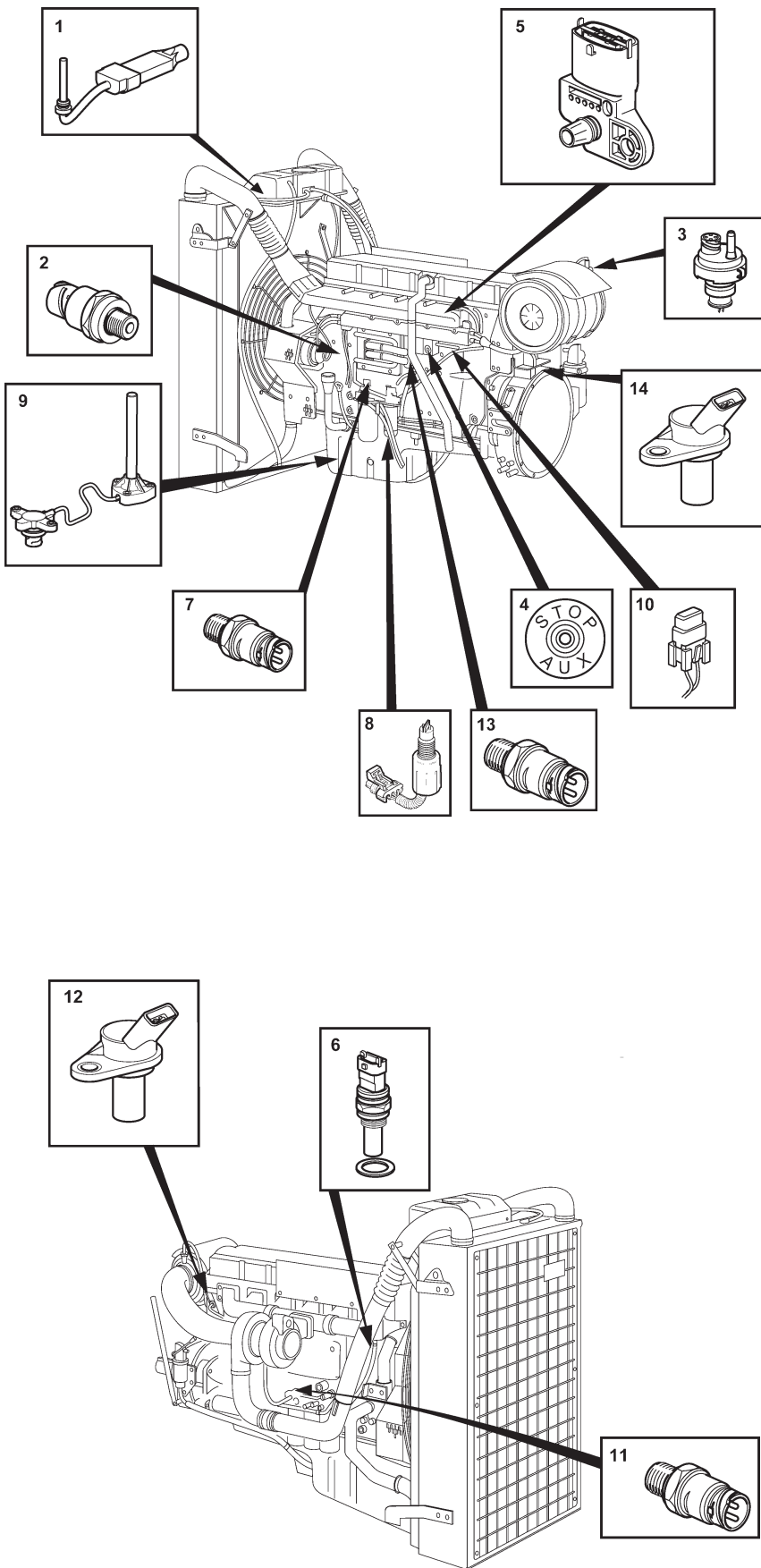
Diagnosis function

The task of the diagnosis function is to detect and locate disturbances within the EMS 2 system, to protect the engine, and to provide information about problems that have developed.

If a malfunction is discovered, this is announced by warning lamps, a flashing diagnostic lamp or in plain language on the instrument panel, depending on the equipment used. If a fault code is obtained as a flashing code or in plain language, this is used for guidance in any troubleshooting. Fault codes can also be read by Volvo's VODIA tool at authorized Volvo Penta workshops.

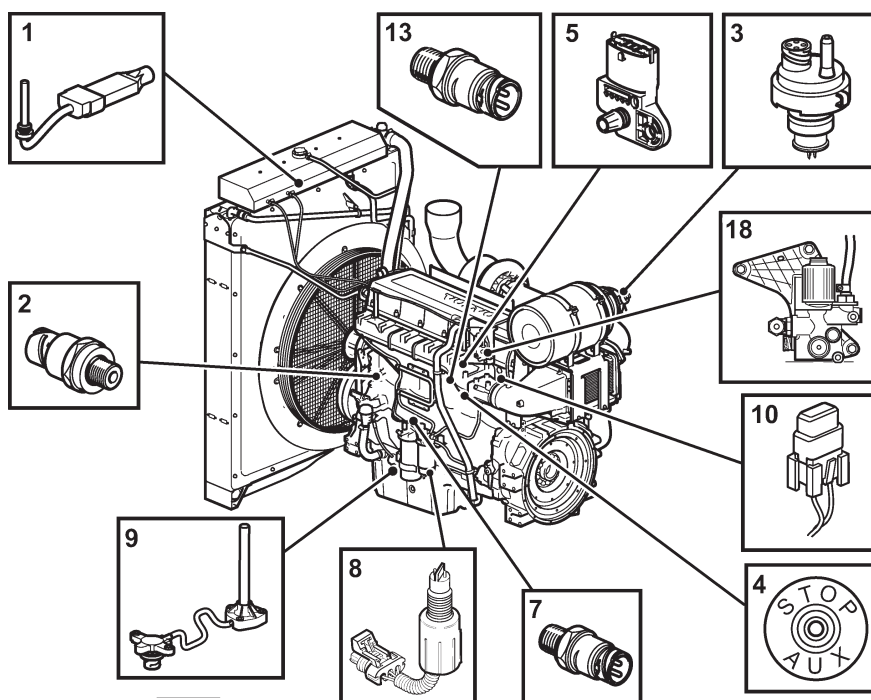
In case of serious malfunctions, the engine is shut down completely, or the control unit reduces the power output (depending on application). A fault code is set as a guide when fault tracing.

Component location, TAD1640GE–TAD1642GE, TAD1641VE–TAD1642VE

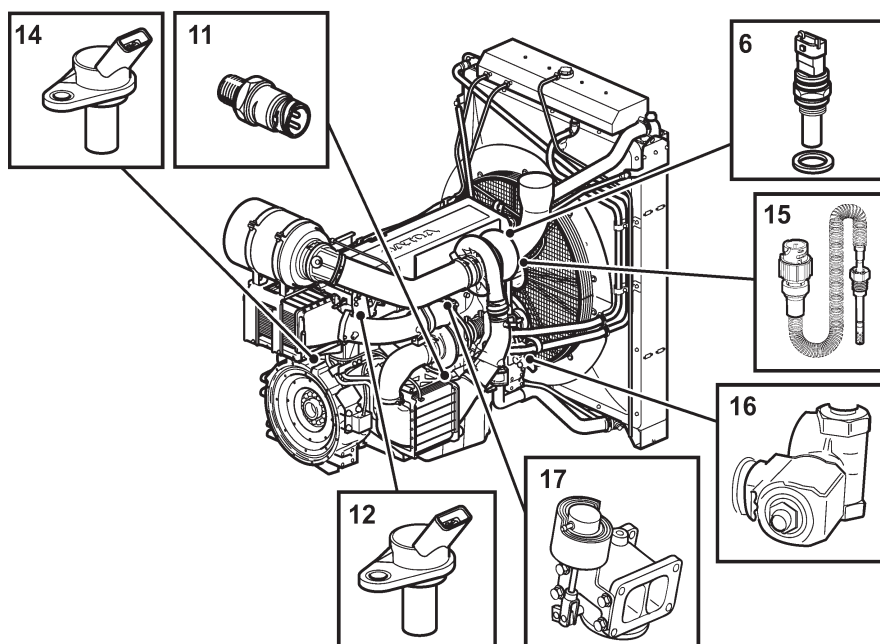


1. Coolant level sensor (in the expansion tank)
2. Crankcase pressure sensor
3. Air filter pressure sensor
4. Extra stop
5. Charge pressure / charge temperature sensor
6. Coolant temperature sensor
7. Fuel pressure sensor
8. Water in fuel sensor
9. Oil level and oil temperature sensor (installed inside the oil pan)
10. Main fuse 10 A
11. Piston cooling pressure sensor
13. Oil pressure sensor
12. Camshaft position sensor
14. Flywheel position and speed sensor

Component location, TWD1643GE



1. Coolant level sensor (in the expansion tank)
2. Crankcase pressure sensor
3. Air filter pressure sensor
4. Extra stop
5. Charge pressure / charge temperature sensor
6. Coolant temperature sensor
7. Fuel pressure sensor
8. Water in fuel sensor
9. Oil level and oil temperature sensor (installed inside the oil pan)
10. Main fuse 10 A
11. Piston cooling pressure sensor
12. Camshaft position sensor
13. Oil pressure sensor
14. Flywheel position and speed sensor
15. Exhaust temperature sensor
16. Cold start valve
17. Wastegate valve
18. Wastegate governor



Voltage supply 24 V, TAD1640GE–TAD1642GE, TAD1641VE–TAD1642VE

NOTE: All engines are equipped with a 2-pole electrical system. This means that the battery's plus and minus cables must be connected to the starter motor connections.

The **battery plus cable** shall be routed via a main switch to connection **30** on the starter motor.

The **battery minus cable** shall be connected directly to connection **31** on the starter motor.
See figure below.

Battery specification

Max. battery 2x220 Ah (series connection),
800 A CCA DIN.

Battery charge

Standard practice on all engines is that the batteries are provided with power from the alternator.

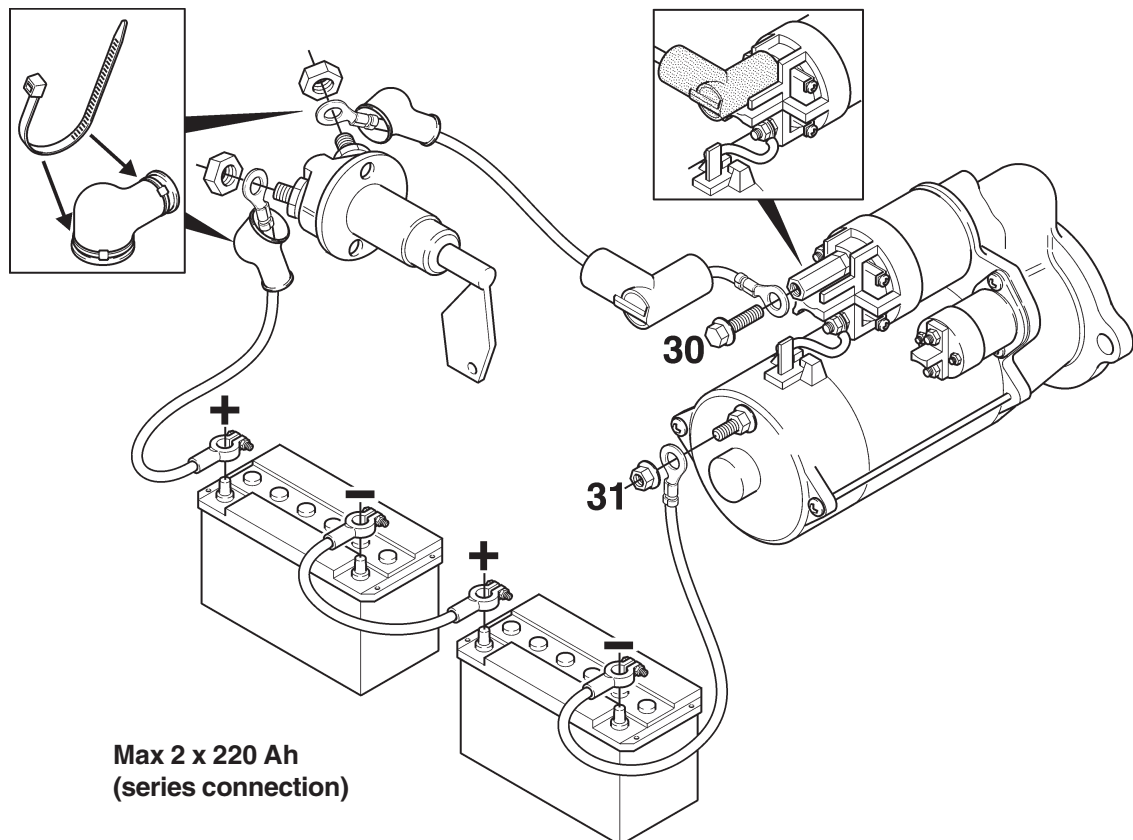
Battery cable area

The total length (L) of the plus- **and** minus cable determines the cable cross sections (A).

Note! Due to fire risk, the cable area should never be less than 70 mm² (0.1 mm²).

Max. L (m) (ft)	4 13.1	5 16.4	6,5 21.3
Min A (mm ²) (in ²)	70 0.11	95 0.15	120 0.19

Battery connection TAD1640GE–TAD1642GE, TAD1640VE–TAD1642VE



Voltage supply 24 V, TWD1643GE

NOTE: All engines are equipped with a 2-pole electrical system. This means that the battery's plus and minus cables must be connected to the starter motor plus and minus terminal connections.

The **battery plus cable** shall be routed via a main switch to the plus terminal.

The **battery minus cable** shall be connected directly to the minus terminal.

See figure below.

Battery charge

Standard practice on all engines is that the batteries are provided with power from the alternator.

Battery cable area

The total length (L) of the plus- **and** minus cable determines the cable cross sections (A).

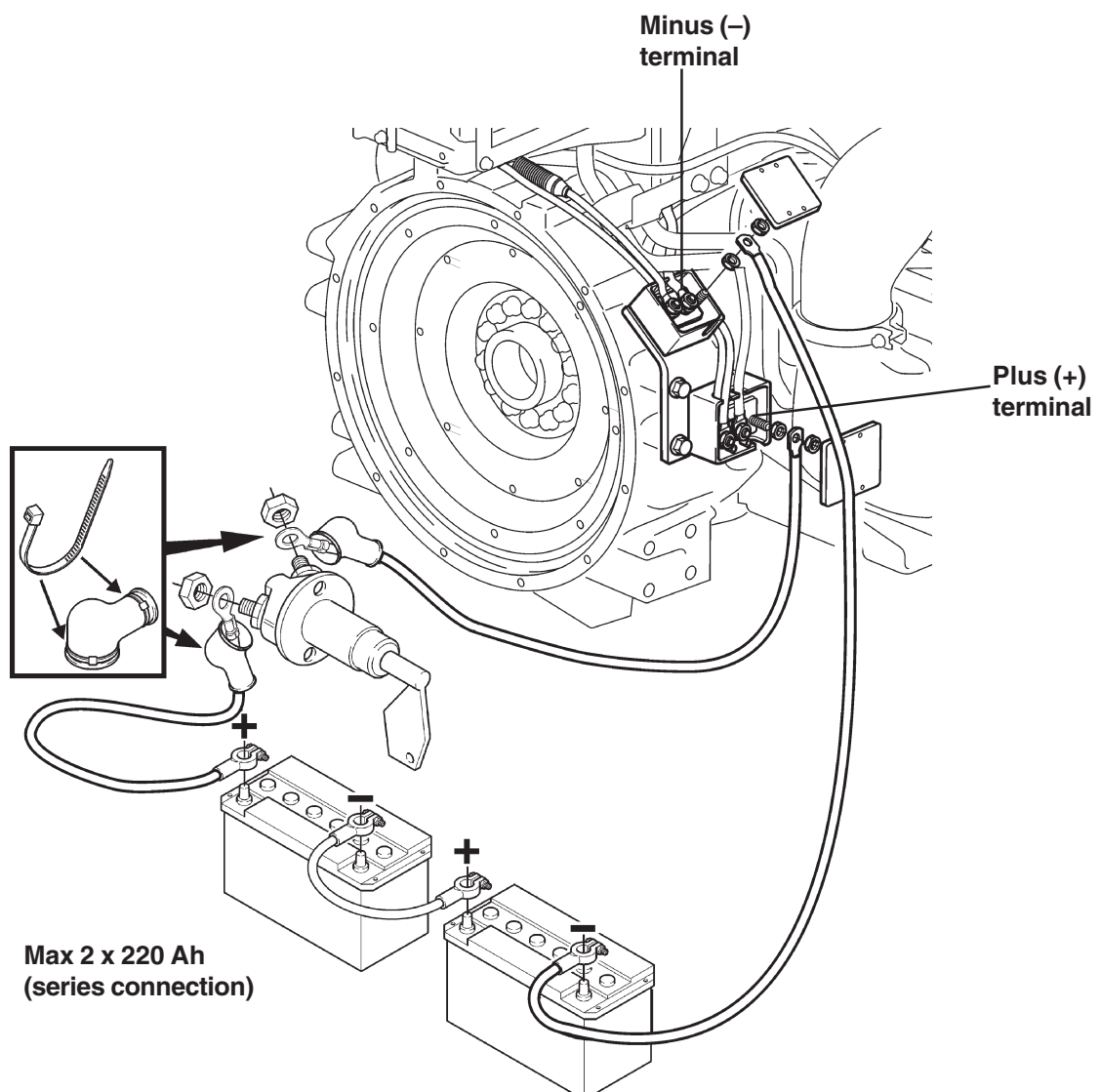
NOTE! Due to fire risk, the cable area should never be less than 70 mm² (0.1mm²).

Battery specification

Max. battery 2x220 Ah (series connection),
800 A CCA DIN.

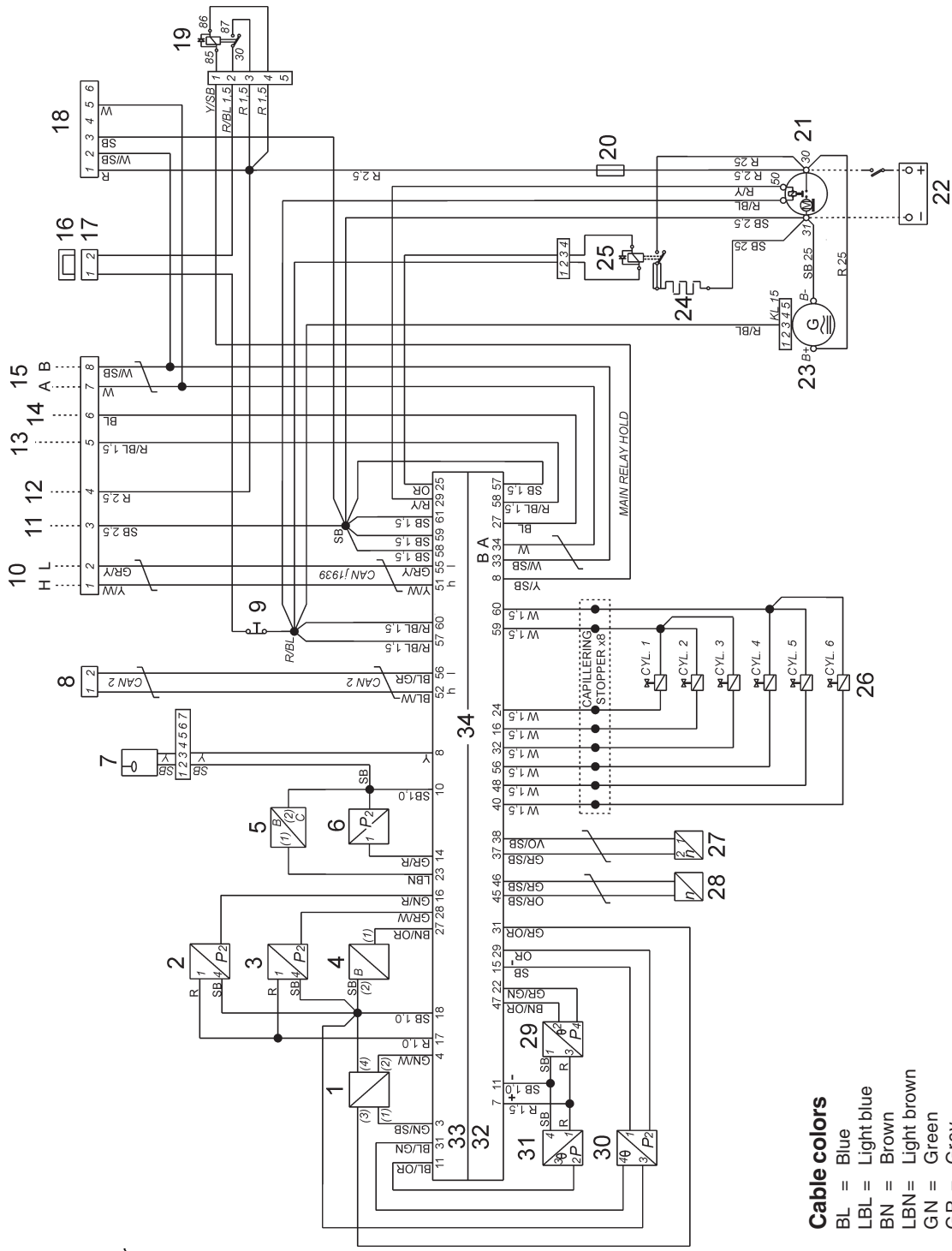
Max. L (m) (ft)	4 13.1	5 16.4	6,5 21.3
Min A (mm ²) (in ²)	70 0.11	95 0.15	120 0.19

Battery connection TWD1643GE



TAD1640GE, TAD1641GE, TAD1642GE, TAD1641VE, TAD1642VE

Electrical diagram EMS 2



1. Sensor, oil level
2. Sensor, fuel pressure
3. Sensor, crankcase pressure
4. Sensor, coolant temperature
5. Sensor, coolant level
6. Piston cooling pressure sensor
7. Sensor, water in fuel
8. Connector (not used)
9. Extra stop
10. J1939 CAN (bus)
11. Battery negative
12. Battery plus
13. Voltage after key
14. Stop button (press button)
15. J1587 (bus)
16. Jumper
17. Aux stop
18. VODIA input
19. Main relay
20. Main circuit breaker 10 A
21. Starter motor
22. Battery (24 V)
23. Alternator
24. Pre-heating
25. Relay pre-heating
26. Unit injector (Cyl. 1-6)
27. Sensor, flywheel
28. Sensor, camshaft
29. Sensor, charge air pressure / charge air temperature
30. Air filter indicator
31. Sensor, oil pressure
32. Connector A
33. Connector B
34. Control module EMS 2

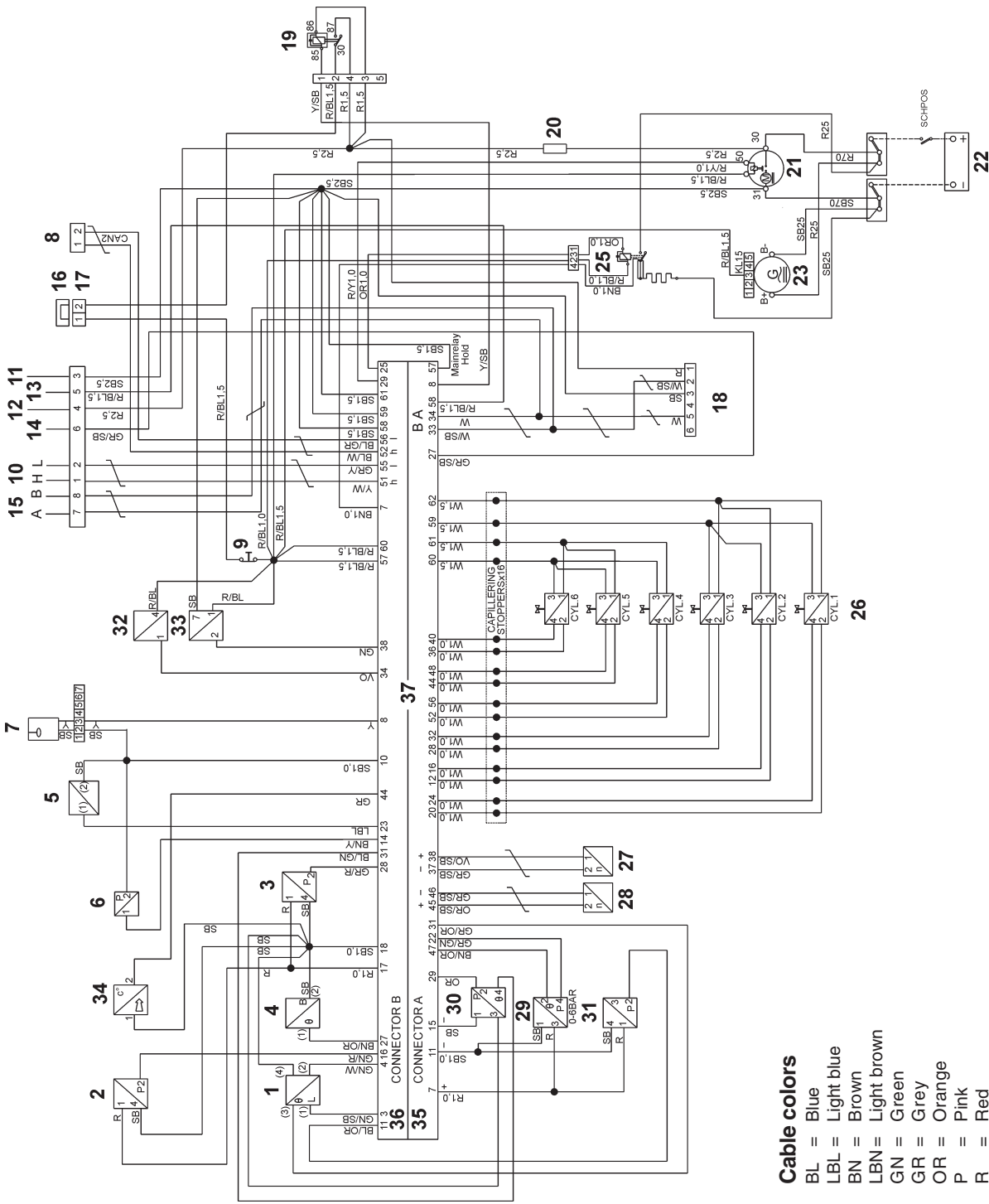
Cable colors

- BL = Blue
- LBL = Light blue
- BN = Brown
- LBN = Light brown
- GN = Green
- GR = Grey
- OR = Orange
- P = Pink
- R = Red
- SB = Black
- VO = Purple
- W = White
- Y = Yellow

Cable cross section = 0.75 mm² unless otherwise stated.

TWD1643GE

Electrical diagram EMS 2



1. Sensor, oil level
2. Sensor, fuel pressure
3. Sensor, crankcase pressure
4. Sensor, coolant temperature
5. Sensor, coolant level
6. Piston cooling pressure sensor
7. Sensor, water in fuel
8. Connector (not used)
9. Extra stop
10. J1939 CAN (bus)
11. Battery negative
12. Battery plus
13. Voltage after key
14. Stop button (press button)
15. J1587 (bus)
16. Jumper
17. Aux stop
18. VODIA input (diagnosis conn.)
19. Main relay
20. Main circuit breaker 10 A
21. Starter motor
22. Battery (24 V)
23. Alternator
24. Pre-heating
25. Relay pre-heating
26. Unit injector (Cyl. 1-6)
27. Sensor, flywheel
28. Sensor, camshaft
29. Sensor, charge air pressure / charge air temperature
30. Air filter indicator
31. Sensor, oil pressure
32. Thermostat by-pass valve
33. Wastegate valve
34. Sensor, exhaust temperature
35. Connector A
36. Connector B
37. Control module EMS 2

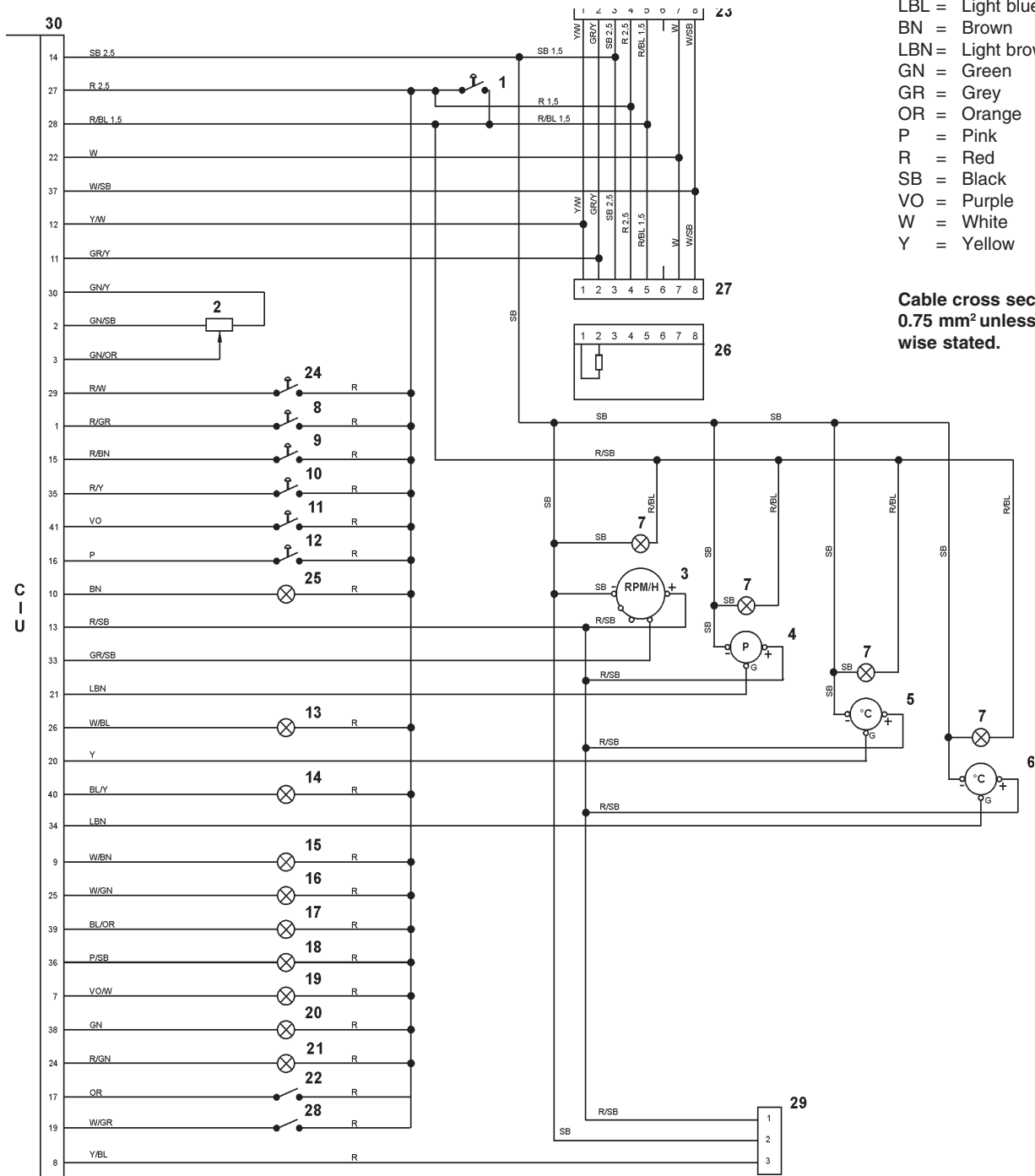
Cable cross section = 0.75 mm² unless otherwise stated.

Electrical diagram CIU

Cable colors

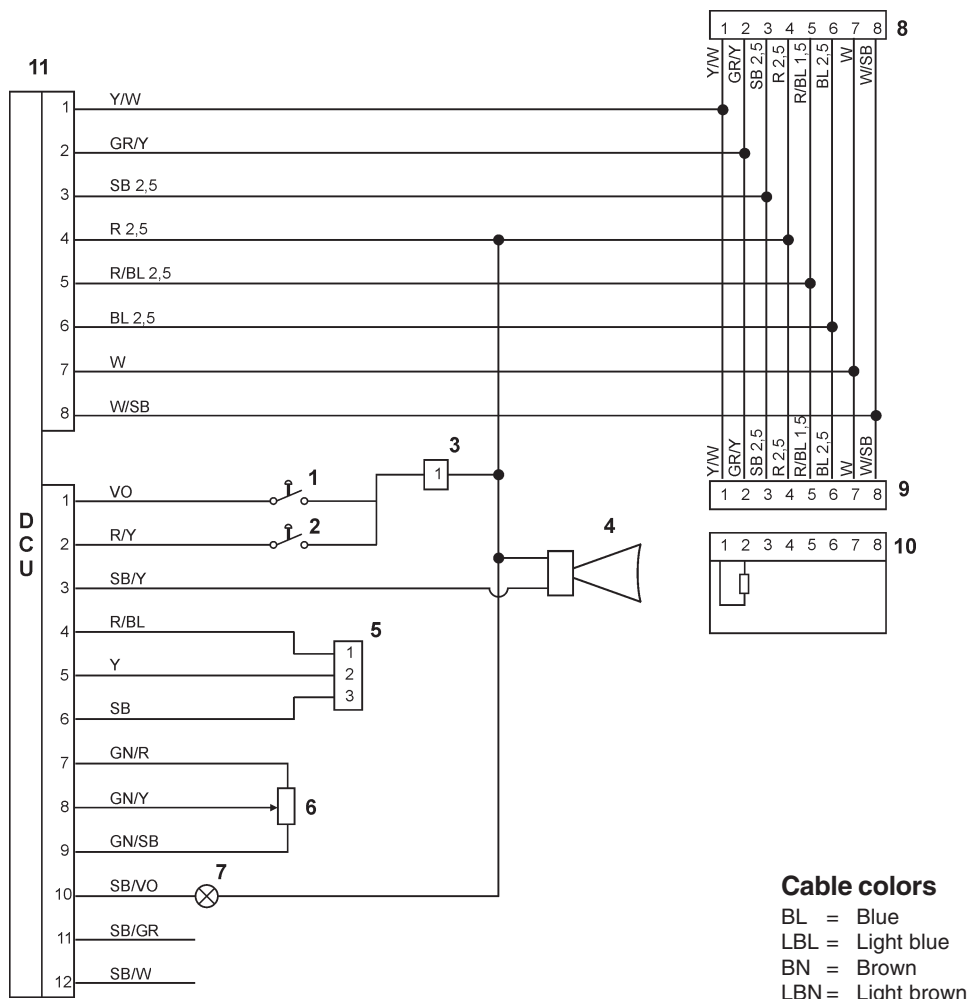
- BL = Blue
- LBL = Light blue
- BN = Brown
- LBN = Light brown
- GN = Green
- GR = Grey
- OR = Orange
- P = Pink
- R = Red
- SB = Black
- VO = Purple
- W = White
- Y = Yellow

Cable cross section = 0.75 mm² unless otherwise stated.



- | | | | |
|-----|-------------------------------------|-----|--------------------------------------|
| 1. | Key switch, operating current (15+) | 16. | Alarm, low coolant level |
| 2. | RPM-potentiometer | 17. | Fuel alarm |
| 3. | Tachometer (code 14) | 18. | Diagnostic lamp |
| 4. | Oil pressure, instrument | 19. | Overspeed indication (GE) |
| 5. | Oil temperature, instrument | 20. | Operation indicator |
| 6. | Coolant temperature, instrument | 21. | Preheating indication |
| 7. | Instrument illumination | 22. | Preheating contact |
| 8. | Idle contact, two position | 23. | 8-pin Deutsch connecting plug |
| 9. | 1500/1800 contact, two position | 24. | Governor contact |
| 10. | Start switch, spring return | 25. | Battery voltage alarm |
| 11. | Stop switch, spring return | 26. | Termination resistance 120 Ohm |
| 12. | Diagnosis contact, spring return | 27. | 8-pin Deutsch connecting socket |
| 13. | Alarm, low oil pressure | 28. | Contact, engine protector disconnect |
| 14. | Alarm, high oil temperature | 29. | Easy Link connector block |
| 15. | Alarm, high coolant temperature | 30. | Control Interface Unit (CIU) |

Electrical diagram DCU



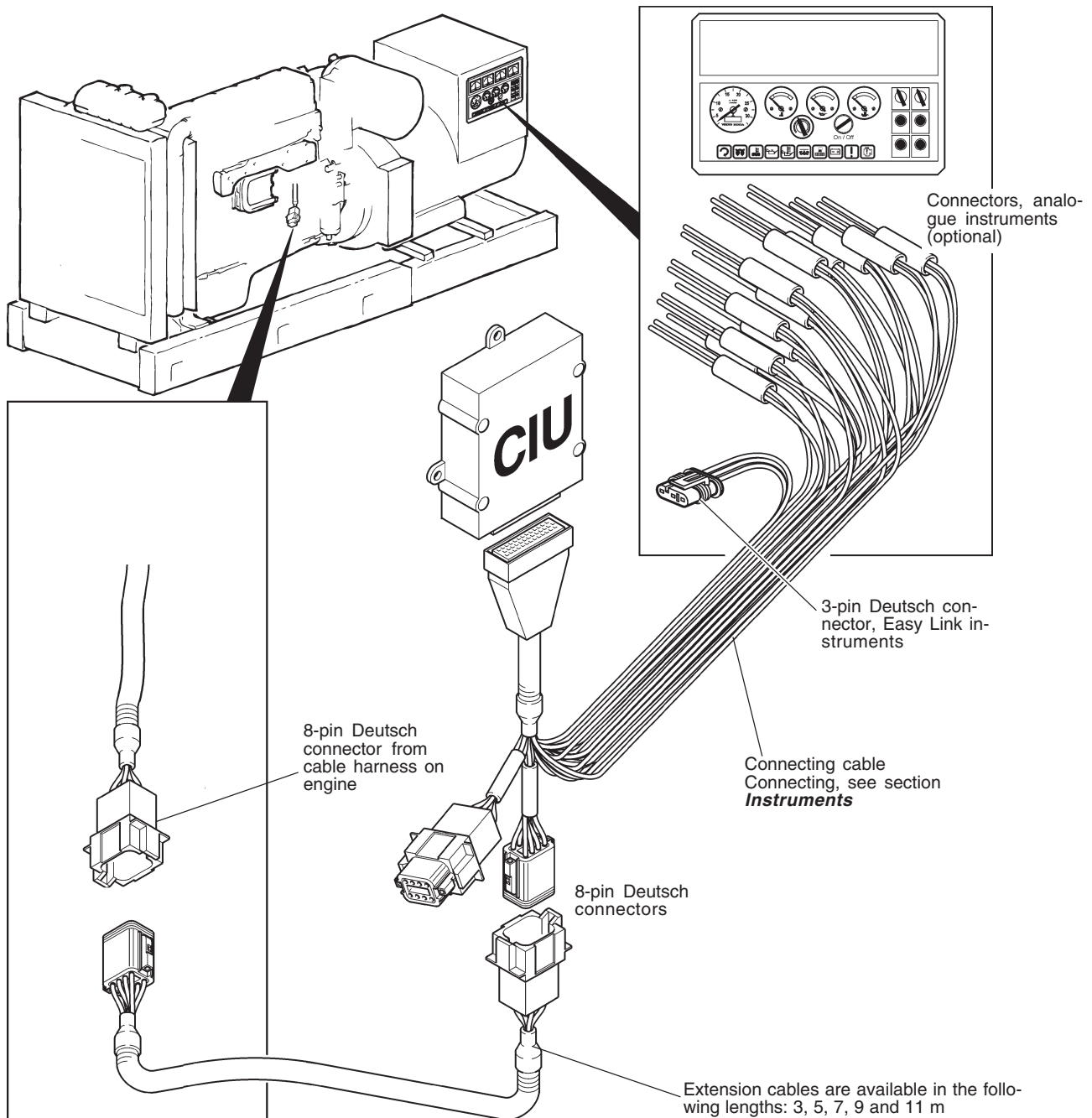
Cable colors

- BL = Blue
- LBL = Light blue
- BN = Brown
- LBN = Light brown
- GN = Green
- GR = Grey
- OR = Orange
- P = Pink
- R = Red
- SB = Black
- VO = Purple
- W = White
- Y = Yellow

Cable cross section = 0.75 mm² unless otherwise stated.

1. Stop contact
2. Start contact
3. 1-pin connector block
4. Signal horn, buzzer alarm
5. Easy Link connector block
6. RPM-potentiometer
7. Indication, engine running
8. 8-pin Deutsch connecting plug
9. 8-pin Deutsch connecting socket
10. Termination resistance 120 Ohm
11. Display Control Unit (DCU)

TAD1640GE-1642GE, TWD1643GE (CIU)



General

The installation must be well prepared and performed with great care.

Secure the connecting cable between motor and instrument panel with clamps. Remember that the strain on the coupling pieces must be relieved so that they are not subjected to any pull.

Cables must not be run too close to hot components on the engine or close to any other source of heat. Make sure that it is protected from mechanical wear,

sharp edges and water splashes. If necessary, run the cable through protective conduits.

Avoid making joints in the system as far as possible. Cables and any joints must be accessible for inspection and service.

NOTE! The connectors must be installed “dry”, they must not be packed with Vaseline etc.

Connection

Engine control

See wiring diagram.

NO = Normally open

NC = Normally closed

Ignition key (system voltage OFF/ON)

NOTE! Start current for the engine's system voltage (the control module) is 10 A. Make sure that other components in the installation are dimensioned for this current.

Start contact

Contact type, closing (NO), spring biased.

Stop contact

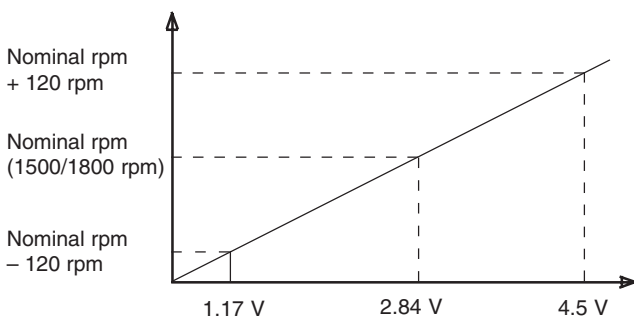
Contact type, closing (NO), spring biased.

Via parameter setting, it can become energized during operation. In that case, use contact type closed (NC).

RPM-potentiometer

Nominal rpm minus 120 rpm: 0.3–1.9 V
(preset value 1.17 V)

Nominal rpm plus 120 rpm: 1.9–4.7 V
(preset value 4.5 V)



1500 / 1800 rpm contact

This function allows a change of frequency from 50 to 60 Hz.

Contact type two position.

Idle contact

Contact type two position.

Closed contact provides idling speed (900 rpm).

Speed droop contact

The contact must be closed to obtain speed droop.

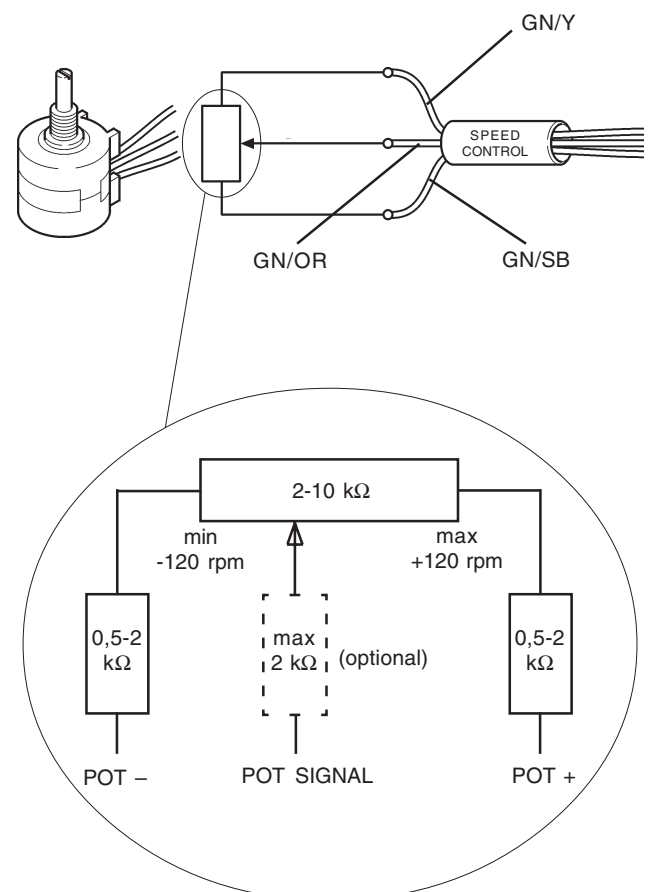
Contact type two position.

Governor contact

Contact type two position.

Preheat contact

Contact type two position.



Warning and indication lamps

The warning and indication lamps listed below are available. Specs for all lamps:

Max. load 3 W

Voltage 24 V

See ***Electrical diagram CIU***

- Alarm, low oil pressure
- Alarm, high oil temperature
- Alarm, high coolant temperature
- Alarm, low coolant level
- Alarm, fuel level
- Alarm, battery voltage
- Overspeed indication
- Operation indicator
- Diagnostic lamp
- Preheating indication

Instruments, Easy Link (optional)

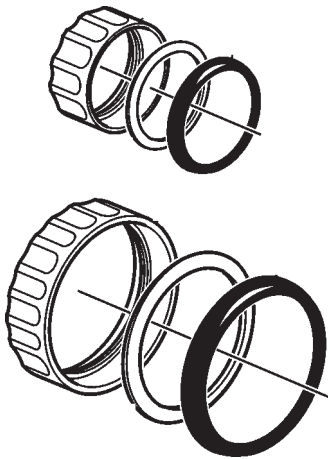
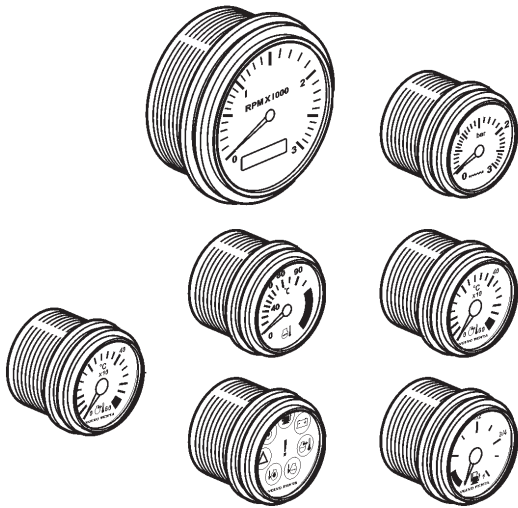
See wiring diagram

For parallel connection of up to 20 extra VDO-instruments.

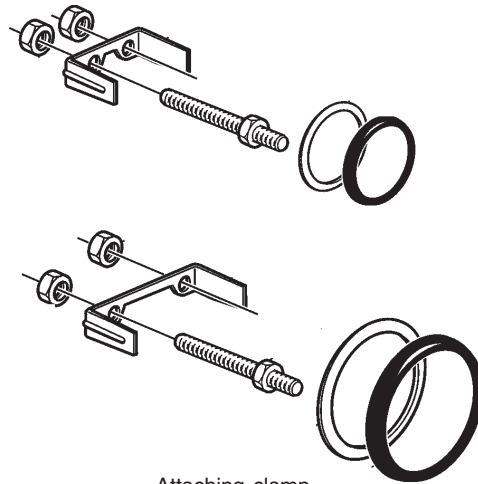
The instruments automatically find their respective parameter group in the data bus. Max length of Easy-Link wiring is 3 m (10 ft).

The following instruments are available:

- Tachometer/operating hours
- Coolant temp
- Oil pressure
- Oil temp
- Battery voltage



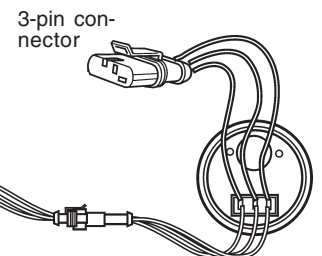
Attaching nut



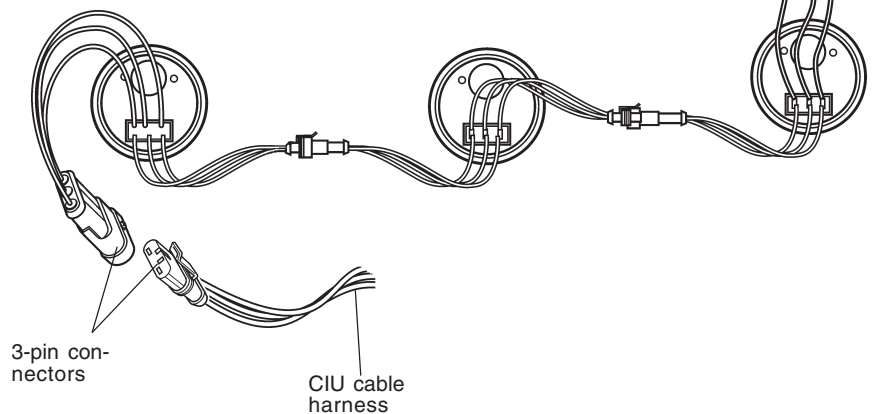
Attaching clamp



Extension cable, 3-pin
1.0 m (3 ft), 3.0 m (10 ft)



3-pin connector



3-pin connectors

CIU cable harness

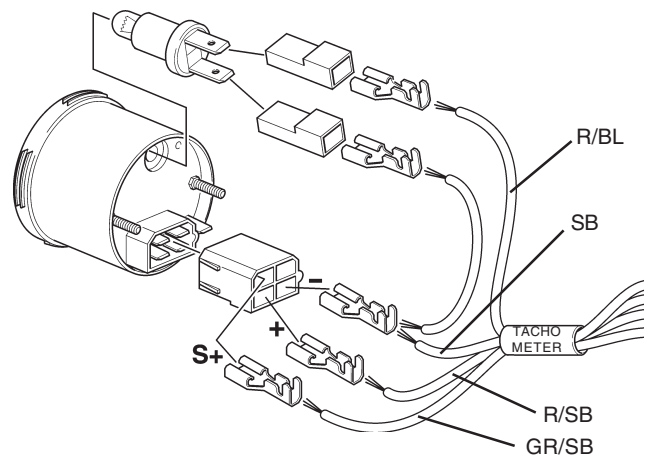
Instruments, analogue (optional)

See wiring diagram

Tachometer

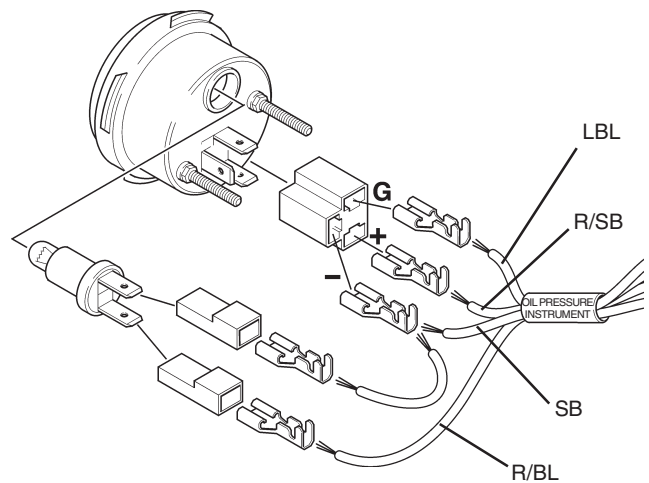
Use Volvo Penta universal tachometer, graduated 0-2600 rpm.

Set code 14. See *Installation instructions*.



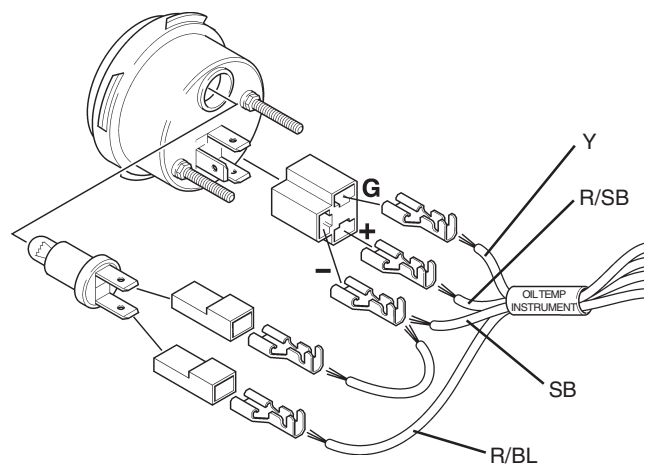
Oil pressure instrument

Use Volvo Penta oil pressure instrument, graduated 0-10 bar (0-145 psi).



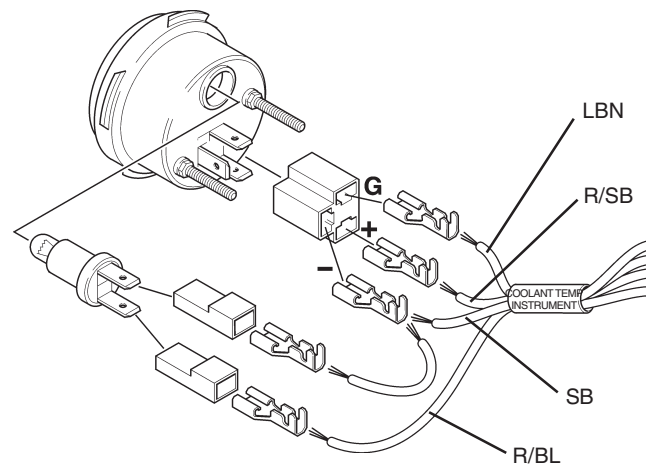
Oil temperature instrument

Use Volvo Penta oil temperature instrument, graduated 40-150°C (104-302°F).



Coolant temperature instrument

Use Volvo Penta oil temperature instrument, graduated 40–150°C (104–302°F).



Diagnostic connector

Contact type, closing (NO), spring biased.

For reading of fault codes, see chapter *Fault tracing*.

Preheating contact

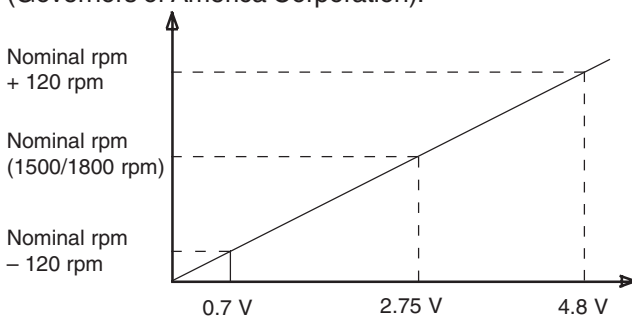
Contact type, closing (NO), spring biased.

This contact will activate the pre-heating.

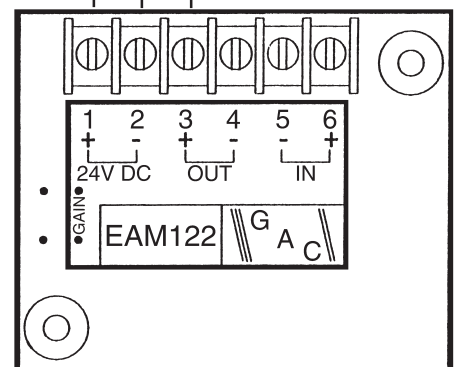
Synchronization/load distribution

The system has been adapted to GAC synchronization and load distribution system. When connecting this system, use interface module EAM122. The voltage levels must simultaneously be adjusted using the VODIA tool, as shown below, when this system is used.

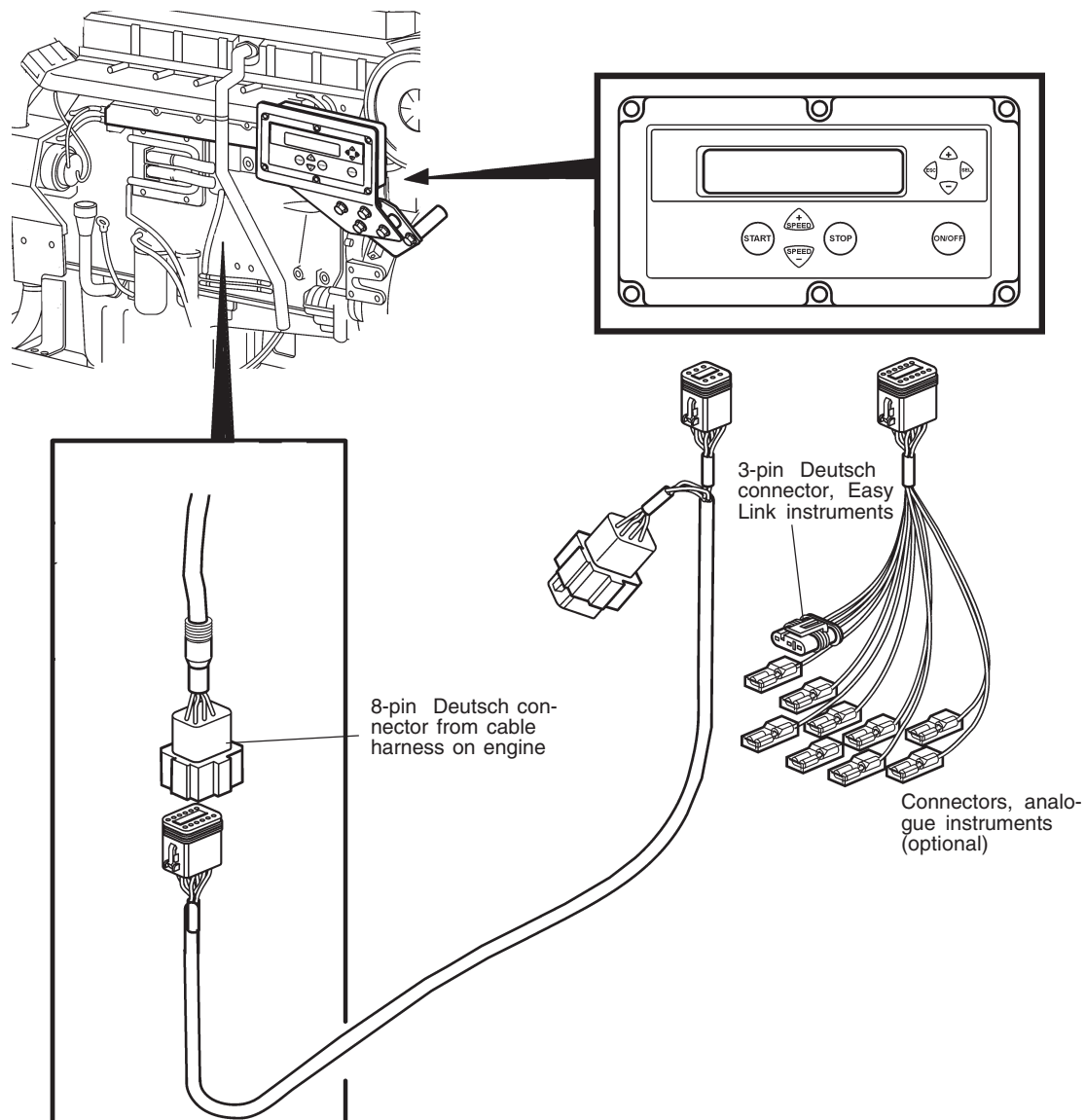
NOTE! The interface module EAM122 is not sold by Volvo Penta. Contact the local representative for GAC (Governors of America Corporation).



SPEED CONTROL (GN/OR)
SPEED CONTROL (GN/SB)
ON SWITCH (R/BL 1.5)



TAD1640GE-1642GE, TWD1643GE (DCU)



General

The installation must be and performed with great care.

Secure the connecting cable between motor and instrument panel with clamps. Take into consideration that the connectors blocks must be mechanically secured so that they are not subjected to pulling forces.

Cables must not be run too close to hot components on the engine or close to any other source of heat. Make sure that it is protected from mechanical wear,

sharp edges and water splashes. If necessary, run the cable through protective conduits.

Avoid making joints in the system as far as possible. Cables and any joints must be accessible for inspection and service

NOTE! The connectors must be installed “dry”, they must not be packed with Vaseline etc.

Connection

Display Control Unit (DCU)

The DCU is connected in via the 8-pin data bus connector, see Component location.

Start ignition contact (optional)

Contact type, closing (NO), spring biased.

Stop contact (optional)

Contact type, closing (NO), spring biased.

Easy Link (optional)

For parallel connection of up to 20 extra VDO-instruments. The instruments automatically find their respective parameter group in the data bus. Max length of Easy-Link wiring is 3 m (10 ft).

The following instruments are available:

- Tachometer/operating hours
- Coolant temp
- Oil pressure
- Oil temp
- Battery voltage

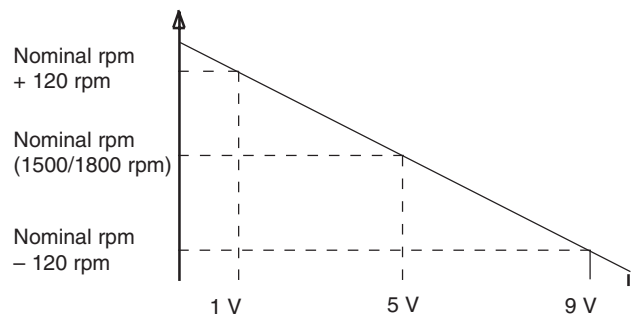
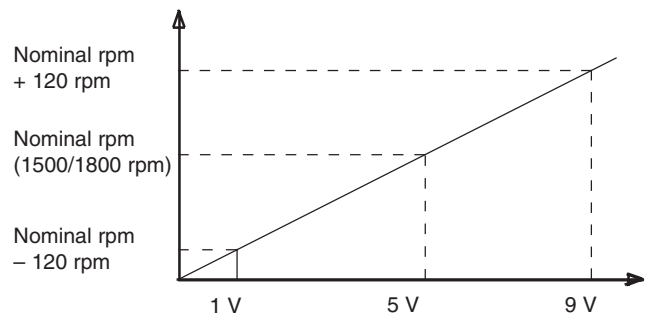
RPM potentiometer/load distribution system (optional)

In the DCU the values of: the throttle potentiometer input or the voltage input from the connection to an external load distribution system can be set.

Nominal rpm minus 120 rpm: 0 -10 V
(preset value 1 V)

Nominal rpm plus 120 rpm: 0 -10 V
(preset value 9 V)

The signal is invertible, see diagram below.



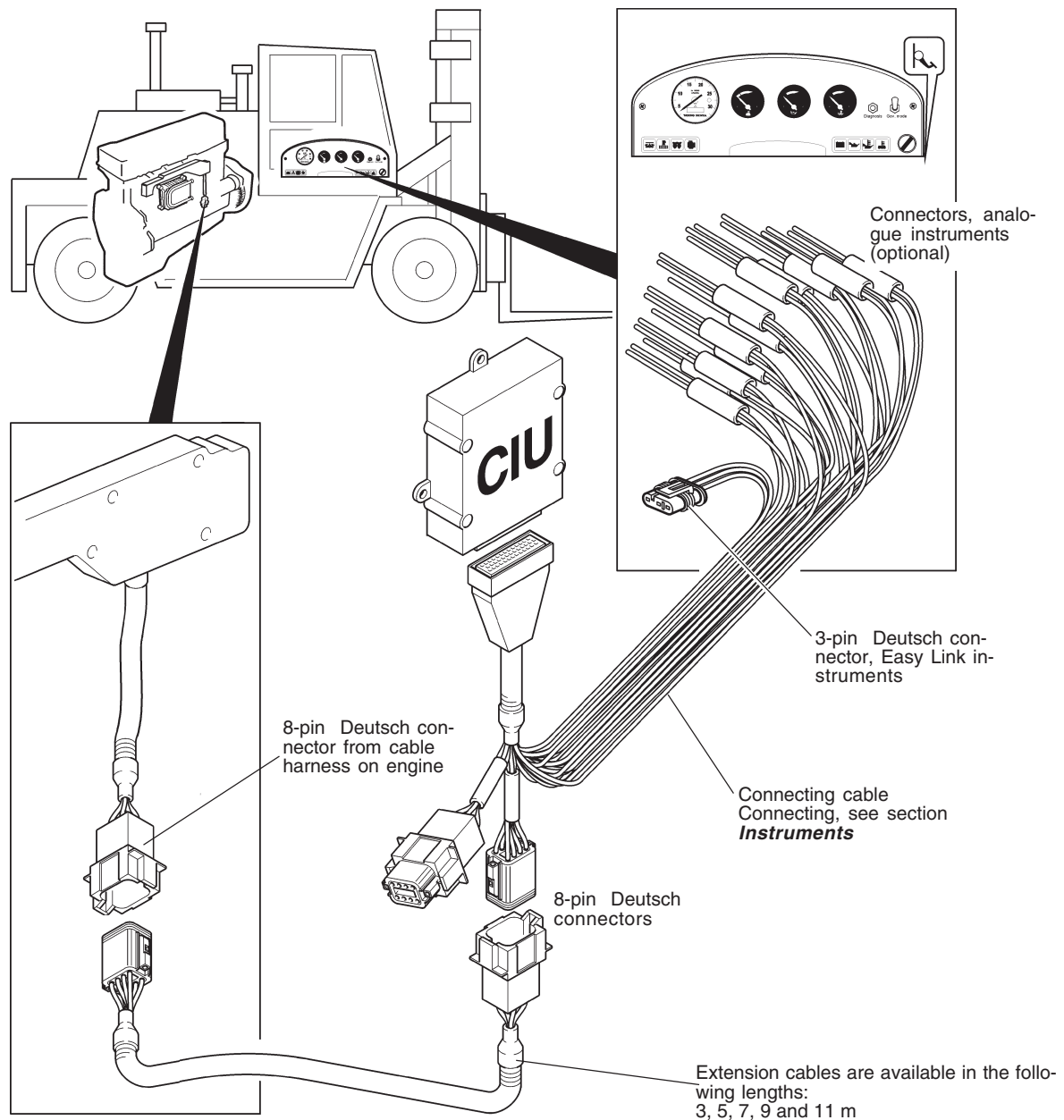
Warning and indication lamps

Indication engine running

Max. load 3 W

Voltage 24 V

TAD1641VE, 1642VE (CIU)



General

The installation must be well prepared and performed with great care.

Secure the connecting cable between motor and instrument panel with clamps. Take into consideration that the connectors blocks must be mechanically secured so that they are not subjected to pulling forces.

Cables must not be run too close to hot components on the engine or close to any other source of heat. Make sure that it is protected from mechanical wear, sharp edges and water splashes. If necessary, run the cable through protective conduits.

Avoid making joints in the system as far as possible. Cables and any joints must be accessible for inspection and service

NOTE! The connectors must be installed “dry”, they must not be packed with Vaseline etc.

Governor contact

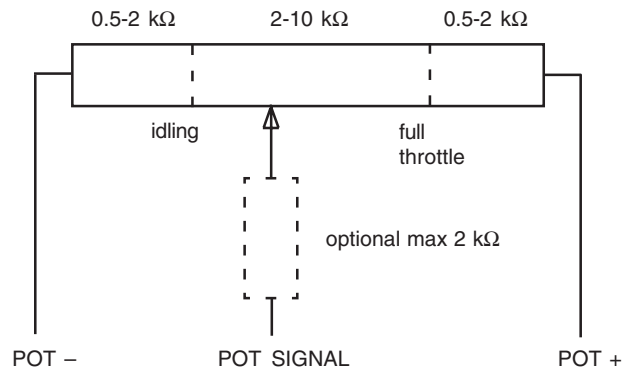
Contact type two position.

Accelerator

Idling: 0.3 1.9 V (preset value 1.17 V)

Full throttle: 1.9 4.7 V (preset value 4.5 V)

Where an accelerator with different resistance and voltage values is used, the control module must be re-calibrated using the parameter tool, see "Parameter setting".

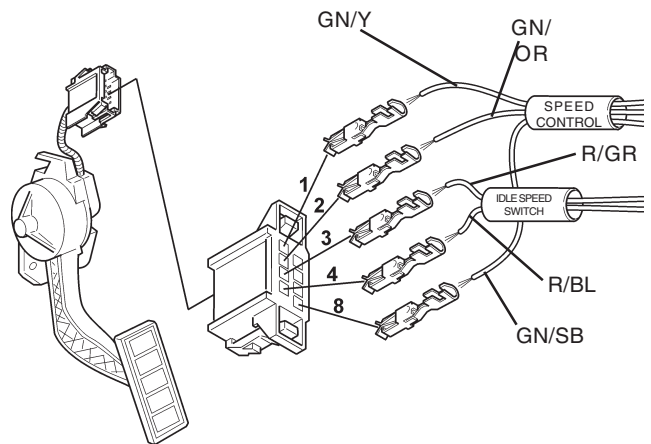


Idle contact

The accelerator features a built-in idle contact that works like a Limp home device if the accelerator potentiometer should break down.

Depressing the pedal will close the contact and the engine will gradually accelerate towards 80% of max. rpm.

Releasing the pedal will open the contact, and the engine will directly slow down to idle.



Warning and indication lamps

The warning and indication lamps listed below are available. Specs for all lamps:

Max. load 3 W

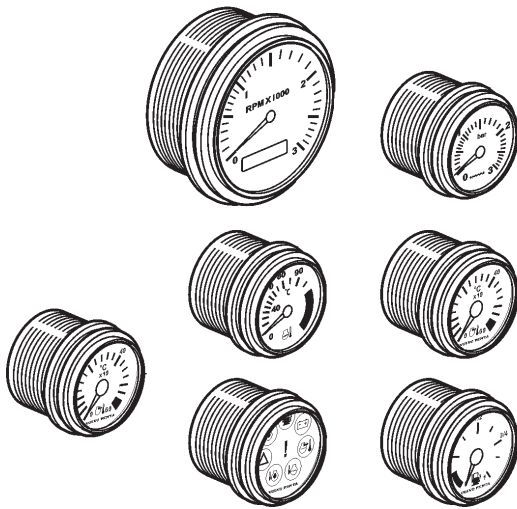
Voltage 24 V

See wiring diagram

- Alarm, low oil pressure
- Alarm, high oil temperature
- Alarm, high coolant temperature
- Alarm, low coolant level
- Alarm, fuel level
- Alarm, battery voltage
- Diagnostic lamp
- Preheating indication

Instruments, Easy Link (optional)

See wiring diagram

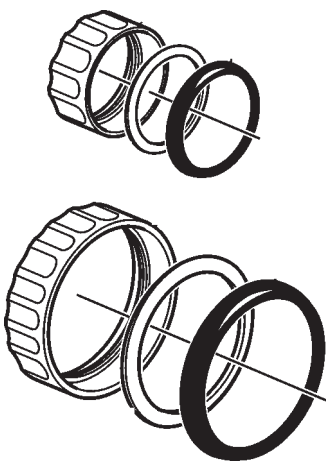


For parallel connection of up to 20 extra VDO-instruments.

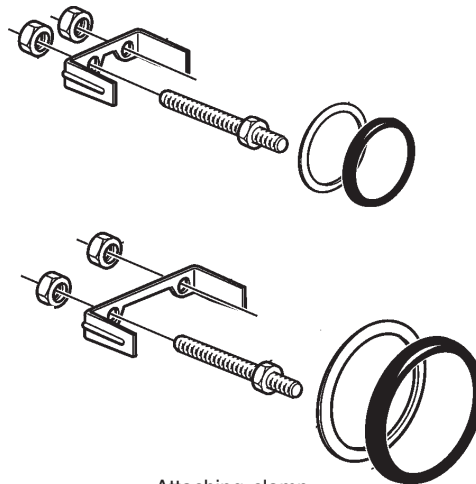
The instruments automatically find their respective parameter group in the data bus. Max length of Easy-Link wiring is 3 m (10 ft).

The following instruments are available:

- Tachometer/operating hours
- Coolant temp
- Oil pressure
- Oil temp
- Battery voltage



Attaching nut

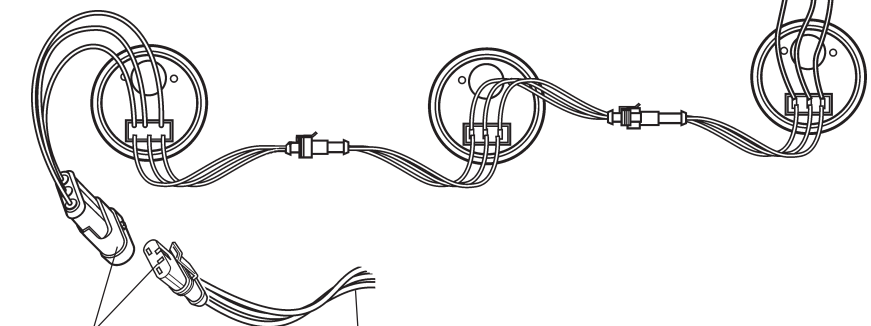


Attaching clamp



Extension cable, 3-pin
1.0 m (3 ft), 3.0 m (10 ft)

3-pin con-
nector



3-pin con-
nectors

CIU cable
harness

Instruments, analogue (optional)

See wiring diagram

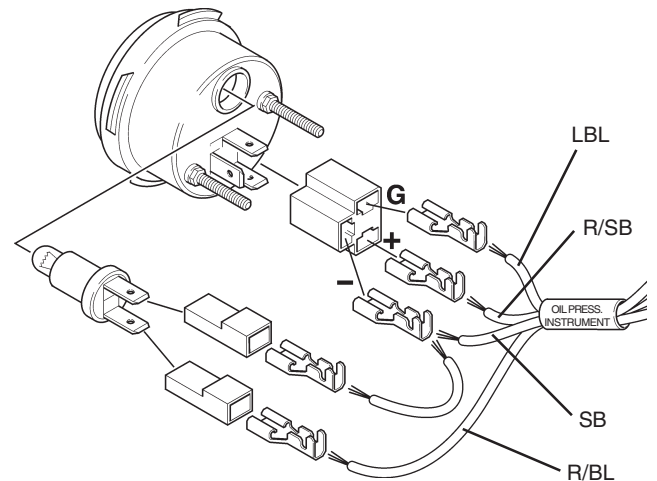
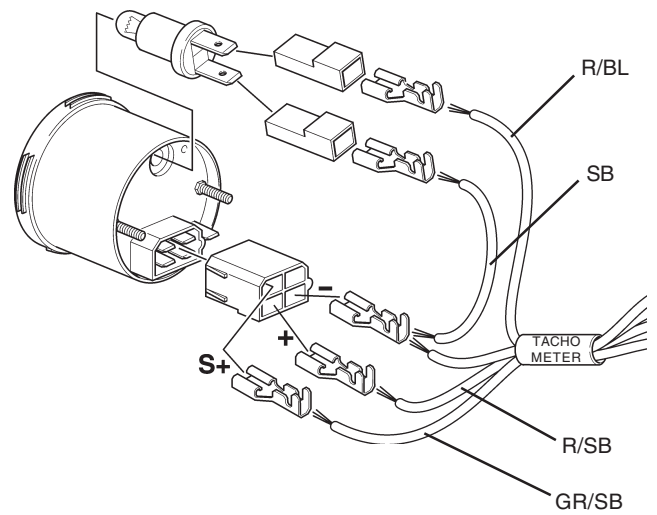
Tachometer

Use Volvo Penta universal tachometer, graduated 0–2600 rpm.

Set code 14. See *Installation instructions*.

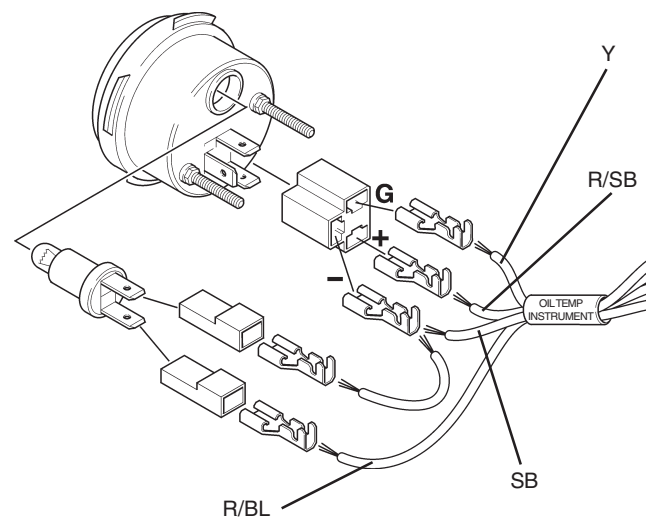
Oil pressure instrument

Use Volvo Penta oil pressure instrument, graduated 0–10 bar (0–145 psi).



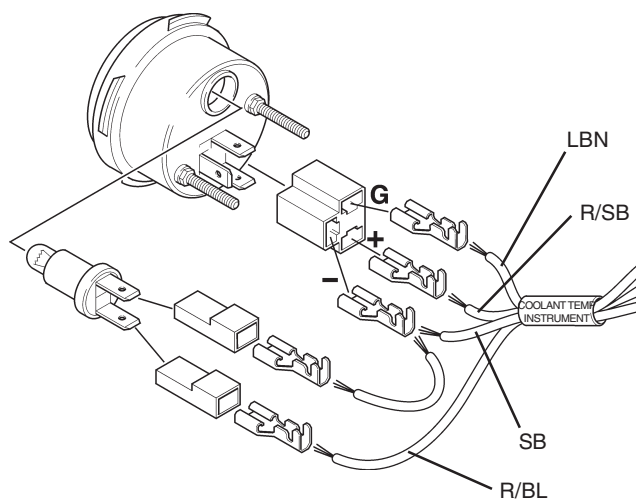
Oil temperature instrument

Use Volvo Penta oil temperature instrument, graduated 40–150°C (104–302°F).



Coolant temperature instrument

Use Volvo Penta oil temperature instrument, graduated 40–150°C (104–302°F).



Diagnostic connector

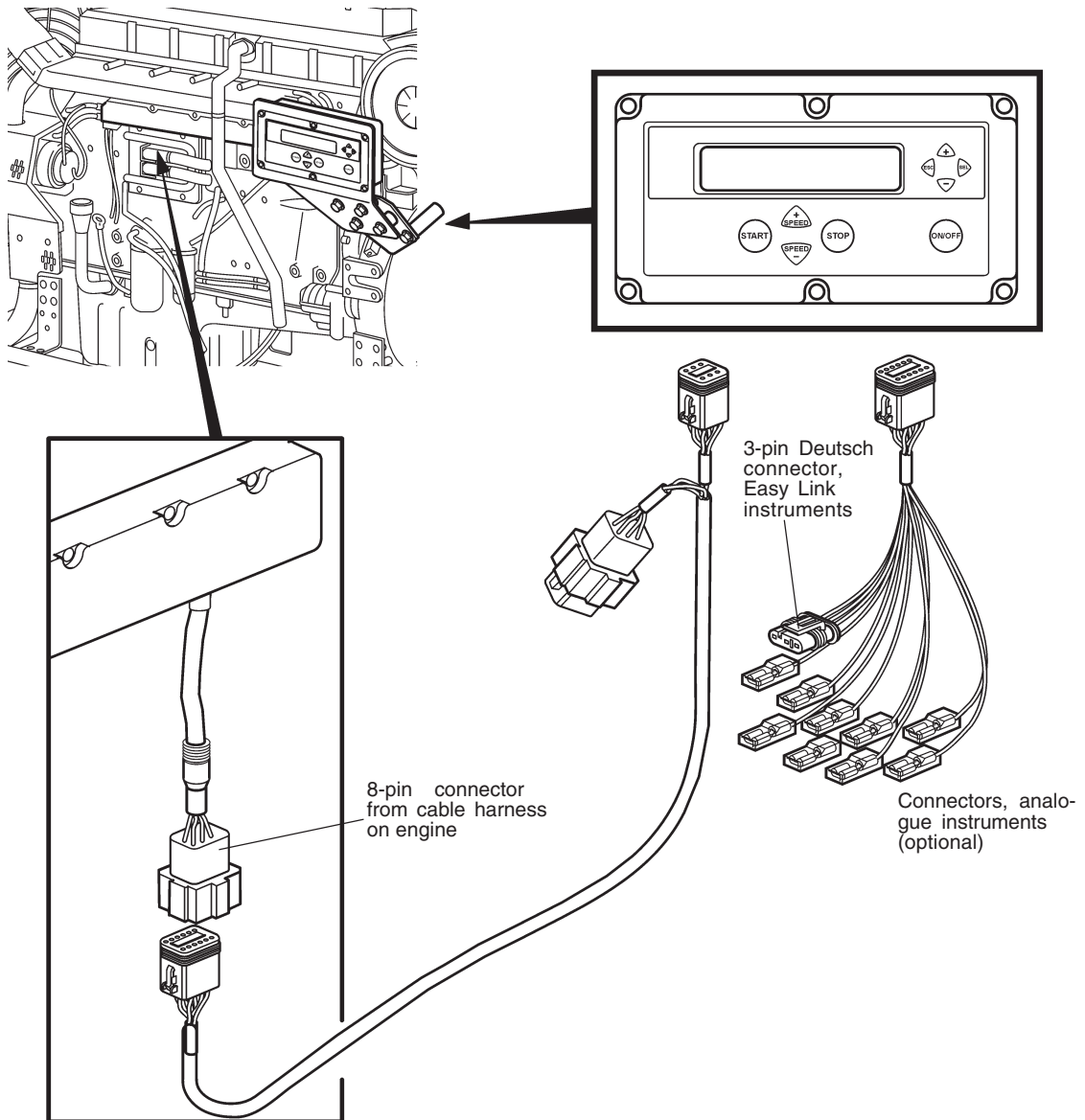
Contact type, closing (NO), spring biased.

For reading of fault codes, see chapter ***Fault tracing***.

Contact, engine protector disconnect

Contact type, closing (NO), spring biased.

TAD1641VE, 1642VE (DCU)



General

The installation must be well prepared and performed with great care.

Secure the connecting cable between motor and instrument panel with clamps. Take into consideration that the connectors blocks must be mechanically secured so that they are not subjected to pulling forces.

Cables must not be run too close to hot components on the engine or close to any other source of heat.

Make sure that it is protected from mechanical wear, sharp edges and water splashes. If necessary, run the cable through protective conduits.

Avoid making joints in the system as far as possible. Cables and any joints must be accessible for inspection and service

NOTE! The connectors must be installed "dry", they must not be packed with Vaseline etc.

Connection

Display Control Unit (DCU)

The DCU is connected in via the 8-pin data bus connector, see chapter **Component location**.

Start contact (optional)

Contact type, closing (NO), spring biased.

Stop contact (optional)

Contact type, closing (NO), spring biased.

Easy Link (optional)

For parallel connection of up to 20 extra VDO-instruments. The instruments automatically find their respective parameter group in the data bus. Max length of Easy-Link wiring is 3m.

The following instruments are available:

- Tachometer/operating hours
- Coolant temp
- Oil pressure
- Oil temp
- Turbo pressure
- Battery voltage
- Alarm instrument

Warning and indication lamps (optional)

Indication engine running

Max. load 3 W

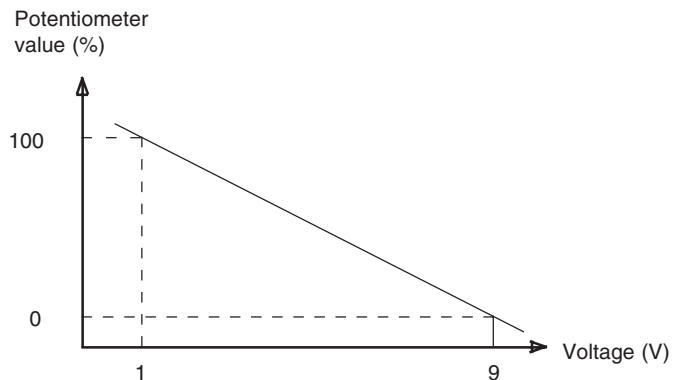
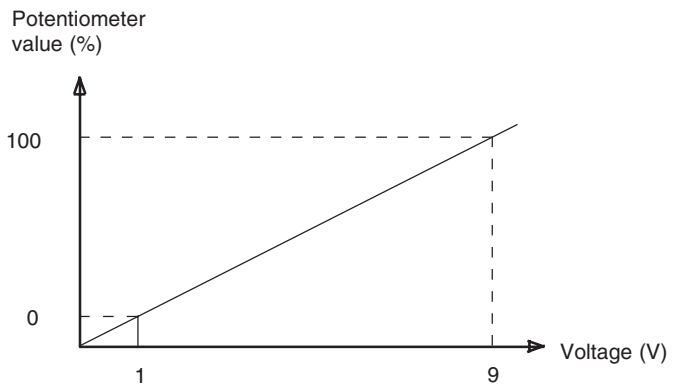
Voltage 24 V

RPM-potentiometer (optional)

Max. potentiometer value: 0 -10 V (preset value 9 V)

Min. potentiometer value: 0 -10 V (preset value 1 V)

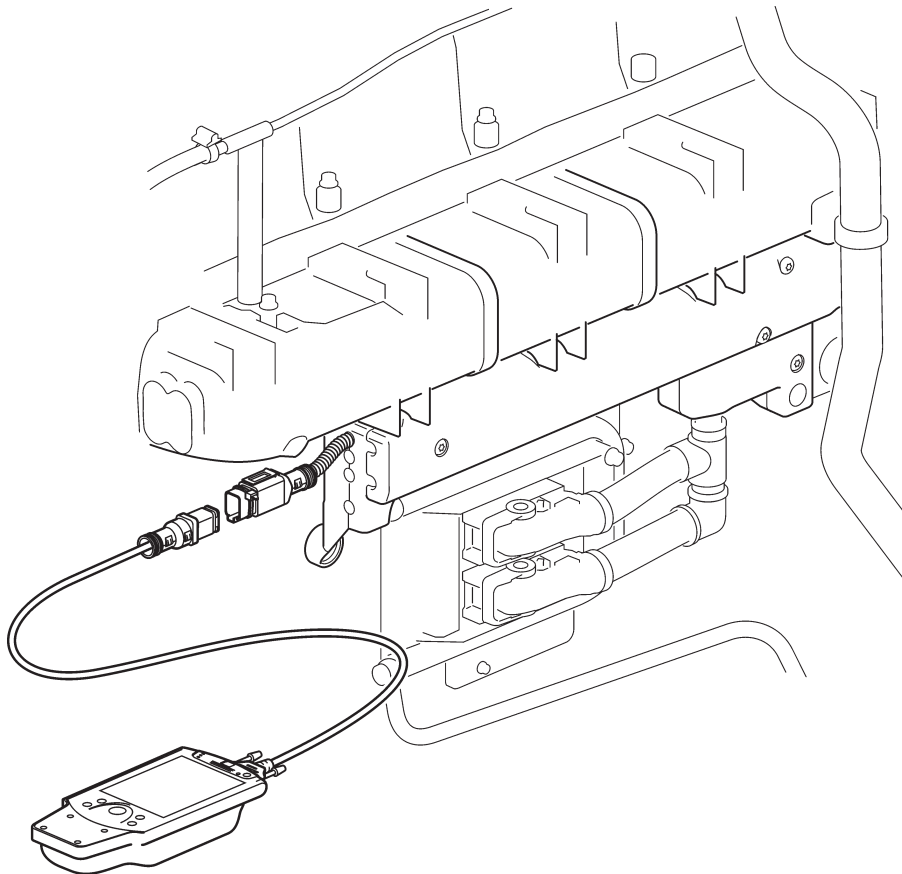
The signal is invertible, see diagram below.



Parameter setting

Connecting special tool VODIA

TAD1640–1642GE, TAD1641–1642VE,
TWD1643GE



Operation

Using the VODIA-tool, part no. **3838619** you can read and adjust the parameters listed on the following pages.

The VODIA tool is connected to the diagnostic outlet, 6-pin connector, from the cable cover on the left side of the engine.

For instructions see **VODIA User's Guide**.

Adjustable parameters TAD1640GE-1642GE, TWD1643GE (CIU/DCU)

NOTE! Certain parameters require special authorization.

Functions

Primary control mode

Selects which governor is used when the governor switch is used.

Alternative position "Isochronous" or "Speed droop"
Preset position "Isochronous"

PTO govenot gradient used

The gradient is defined either by % droop if parameter *Governor droop* is not equal to zero or Nm/rpm if parameter *Governor gradient* is equal to zero.

Govenor droop

Selects how much speed droop is to be used when speed droop is activated (percent).

Min. value 0 %
Preset value 4 %
Max. value 8 %

Stop function (CIU)

The stop input on the CIU-unit receives voltage during "Run" or "Stop"

Preset position "Stop".

Lamp test

This parameter selects whether lamp test shall be performed when the system is started.

Alternative positions "Off" or "On"
Preset position "On".

Idle engine speed

Setting idle speed.

Min. value 600 rpm
Preset value 900 rpm
Max. value 1200 rpm

Rated engine speed inverted value

Selects which governor is used when the governor switch is used.

Alternative rpm 1500 rpm or 1800 rpm
Preset rpm Depending on which spec. that has been ordered

Maximumt engine speed (CIU)

Voltage at the potentiometer input on the CIU-unit that corresponds to nominal rpm (1500/1800 rpm) plus (+)120 rpm.

Min. value 1.90 V
Preset value 4.50 V
Max. value 4.70 V

Preheat on ignition

Selects if preheating and after heating are to be activated directly when ignition is turned on.

The length of preheating/afterheating is dependant on coolant temperature.

If the parameter is in the "Off" position, then preheating/afterheating must be activated manually via the ignition switch or the preheating button.

Alternative positions "Off" or "On"
Preset position "Off"

Alarm limits TAD1640GE-1642GE, TWD1643GE

Alarm limit for oil temperature

At this temperature, a warning lamp is lit.

Min. value	120 °C (248 °F)
Preset value	125 °C (257 °F)
Max. value	130 °C (266 °F)

Alarm limit for coolant temperature

At this temperature, a warning lamp is lit.

Min. value	95 °C (203 °F)
Preset value	98 °C (208 °F)
Max. value	103 °C (217 °F)

Overspeed limit

Percentage above normal rpm at which the overspeed warning will be activated.

Min. value	0 %
Preset value	20 %
Max. value	20 %

Engine protectors TAD1640GE-1642GE, TWD1643GE

Oil temperature

Selects whether engine protector should be activated, with regard to high oil temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Coolant temperature

Selects whether engine protector should be activated, with regard to high coolant temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Coolant level

Selects whether engine protector should be activated, with regard to low coolant level.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Overspeed shut down

Selects whether engine protector should be activated, with regard to overspeed.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Boost temperature

Selects whether engine protector should be activated, with regard to high charge air temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Boost air pressure

Selects whether engine protector should be activated, with regard to high charge air pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Oil pressure

Selects whether engine protector should be activated, with regard to low oil pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Piston cooling pressure

Selects whether engine protector should be activated, with regard to low piston cooling pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Crankcase pressure

Selects whether engine protector should be activated, with regard to high crankcase pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

TWD1643GE only: Exhaust temperature

Selects whether engine protector should be activated, with regard to high charge air pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Adjustable parameters TAD1641VE-1642VE (CIU/DCU)

NOTE! Certain parameters require special authorization.

Functions

Governor mode inverted

Set if the droop shall be active.

Alternative positions	“No droop” or “Variable droop”
Preset position	“Fix droop”

Governor mode

Set when droop is active.

Alternative positions	“Yes” or “No”
Preset position	“No”

Primary control mode

Selects which governor is used when the governor switch is used.

Alternative position	“Isochronous” or “Speed droop”
Preset position	“Isochronous”

Governor gradient

Selects how much speed droop to use (gradient)

Min. value	10 Nm/rpm
Preset value	25 Nm/rpm
Max. value	128 Nm/rpm

Stop function

Preset position “Stop”

Stop function CIU

The stop input on the CIU-unit receives voltage during “Run” or “Stop”.

Preset position “Stop”

Lamp test

This parameter selects whether lamp test shall be performed when the system is started.

Alternative positions	“Off” or “On”
Preset position	“On”.

Idle engine speed

Setting idle speed.

Min. value	550 rpm
Preset value	600 rpm
Max. value	800 rpm

Idle voltage CIU

Voltage of throttle regulation input to the CIU unit that corresponds to idle.

Min. value	0.30 V
Preset value	1.17 V
Max. value	1.90 V

Max. rpm voltage CIU

Voltage of throttle regulation input to the CIU unit that corresponds to full throttle.

Min. value	1.90 V
Preset value	4.50 V
Max. value	4.70 V

Preheating on ignition

Selects whether pre-heating should be activated directly when ignition is turned on. If the On parameter is in the Off position, then preheating/afterheating must be activated manually via the ignition switch or the preheating button.

Alternative positions	“Off” or “On”
Preset position	“Off”

Alarm limits

Alarm limit for oil temperature

At this temperature, a warning lamp is lit.

Min. value	120 °C (248 °F)
Preset value	125 °C (257 °F)
Max. value	130 °C (266 °F)

Alarm limit for coolant temperature

At this temperature, a warning lamp is lit.

Min. value	95 °C (203 °F)
Preset value	98 °C (208 °F)
Max. value	103 °C (217 °F)

Engine protectors TAD1641VE-1642VE

Oil temperature

Selects whether engine protector should be activated, with regard to high oil temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Coolant temperature

Selects whether engine protector should be activated, with regard to high coolant temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Coolant level

Selects whether engine protector should be activated, with regard to low coolant level.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Boost air temperature

Selects whether engine protector should be activated, with regard to high charge air temperature.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Boost air pressure

Selects whether engine protector should be activated, with regard to high charge air pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Oil pressure

Selects whether engine protector should be activated, with regard to low oil pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Piston cooling pressure

Selects whether engine protector should be activated, with regard to low piston cooling pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Crankcase pressure

Selects whether engine protector should be activated, with regard to high crankcase pressure.

A fault code is indicated and the engine is shut down.

Alternative positions "Yes" or "No"

Preset position "No"

Fault tracing

A number of symptoms and possible causes of engine malfunctions are described in the table below. Always contact your Volvo Penta dealer if any problems occur which you cannot solve by yourself.

⚠ WARNING! Read the safety instructions for handling and service in the chapter "Safety precautions" before starting work.

Symptoms and possible causes

☼ The diagnostic button indicator blinks	Please refer to chapter Diagnostic information
Engine cannot be stopped	2, 5
Starter motor does not rotate	1, 2, 3, 4, 5, 6, 7, 24
Starter motor rotates slowly	1, 2
Starter motor rotates normally but engine does not start	8, 9, 10, 11,
Engine starts but stops again	8, 9, 10, 11, 13
Engine does not reach correct operating speed at full throttle	9, 10, 11, 12, 13, 21, 25, 26
Engine runs roughly	10, 11
High fuel consumption	12, 13, 15, 25
Black exhaust smoke	12, 13
Blue or white exhaust smoke	15, 22
Lubrication oil pressure too low	16
Coolant temperature too high	17, 18, 19, 20
Coolant temperature too low	20
No, or poor charge	2, 23
Exhaust temperature too high (only TWD1643GE)	13, 17, 18, 19, 21, 25, 27, 28, 29, 30

- | | | |
|---|--|--|
| 1. Discharged batteries | 11. Water/contamination in fuel | 20. Defective thermostat |
| 2. Poor contact/open circuit in electrical wiring | 12. Faulty unit injector | 21. Blocked charge air cooler |
| 3. Main switch turned off | 13. Insufficient air supply to the engine: | 22. Too high oil level |
| 4. Main fuse faulty | – clogged air filter | 23. Alternator drive belt slips |
| 5. Faulty ignition lock | – air leakage between the turbo and the engine's intake pipe | 24. Water entry into engine |
| 6. Faulty main relay | – dirty compressor part in the turbocharger | 25. High back pressure in the exhaust system |
| 7. Faulty starter motor/solenoid | – faulty turbocharger | 26. Break in "Pot+" cable to throttle |
| 8. No fuel: | – poor engine room ventilation | 27. High temperature, charge air cooler |
| – fuel cocks closed | 14. Coolant temperature too high | 28. Blocked radiator |
| – fuel tank empty/wrong tank connected | 15. Coolant temperature too low | 29. No pressure in cooling system |
| 9. Blocked fuel fine-filter/pre-filter (because of contamination, or stratification in the fuel at low temperature) | 16. Oil level too low | 30. Check waste gate function |
| 10. Air in the fuel system | 17. Coolant level too low | |
| | 18. Air in the coolant system | |
| | 19. Faulty circulation pump | |

Diagnosis function

The diagnosis function monitors and checks that the EMS 2 system functions normally.

The diagnosis function has the following tasks:

- To detect and localize malfunctions
- To inform that a malfunction has been detected
- Give advice in fault tracing

Message regarding disturbance

If the diagnosis function detects a malfunction in the EMS 2 system, this is informed by means of fault codes in the instrumentation. Depending on which equipment is in use, this can be done in different ways (fault codes can also be read via VODIA):

From the DCU - (Display Control Unit):

- the text “!! ENGINE WARNING !!” is shown in the display. **NOTE!** the language in which the DCU presents the information is selectable.

From CIU - Control Interface Unit:

- the diagnostic lamp starts to flash

Simultaneously, the fault will be stored in the control module memory. As soon as the fault has been corrected and the ignition has been turned off and on, the fault code will no longer be active.

- The DCU - fault code is shown as passive
- CIU - diagnostic lamp goes out

Both corrected (passive) and uncorrected (active) faults are stored in the control unit.

To read off fault codes, see chapter Operation.

All fault codes are found in the fault code list, with information about the reason, reaction and measures to be taken, see chapter on “Fault codes.”

NOTE! The flashing codes noted only apply when a Volvo Penta CIU is used.

Effect on engine

The engine is affected in different ways, depending on the seriousness of the fault detected by the diagnosis function.

A fault message in the form of a fault code is always generated when the diagnosis function discovers a fault.

The engine is affected by different degrees (see below) depending on the seriousness of the fault:

- The engine is not affected
- Engine goes to idle speed (VE engines)
- Engine torque is limited to different levels (VE engine)
- Engine is shut off

Operation

When a malfunction has occurred and the diagnostic system has generated one or more fault codes, these can be read off either via:

- Plain text on the instrument panel (DCU - Display Control Unit).
- Diagnostic lamp on the instrument panel (CIU - Control Interface Unit).
- VODIA tool. For instructions, see "VODIA User's Guide."

If the system indicates that a fault code has been set:

1. Reduce engine speed to idle/shut down engine.
2. For DCU: Read off fault code shown via instrument panel, see Reading fault codes via Display Control Unit (DCU).

or

For CIU: press in diagnostic button and read off fault code via flashes of diagnostic lamp, see Reading fault codes via diagnostic lamp on instrument panel (CIU).

3. Look up the fault code in the fault code list and take the necessary measures.

Reading fault codes via Display Control Unit (DCU)

When a fault code is set is shown as the text "!! ENGINE WARNING !!" alternating with "Press SEL for information."

NOTE! the language in which the DCU presents the information is selectable.

The fault list is selected by pressing the SEL-button. The fault list shows:

- Operating hours
- Fault
- Cause
- Active/inactive

To leave the fault list, press ESC.

To enter the fault list when a fault code is not set, press the SEL-button and select menu alternative Diagnostics.

Reading fault codes via the diagnostic lamp on the instrument panel (CIU)

If the diagnosis button is depressed and then released, a fault code will flash.

The fault code consists of two groups of flashes, separated by a pause of two seconds. A fault code is obtained by counting the number of flashes in each group.

Example: ✨ ✨ pause ✨ ✨ ✨ ✨ = Fault code 2.4

The fault code is stored and can be read as long as the malfunction remains. You can find information about cause, reaction and actions in the fault code list.

Read as follows:

1. Press the diagnostic button.
2. Release the diagnostic button and make a note of the fault that is flashed out.
3. Repeat items 1-2. A new fault code is flashed out if more are stored. Repeat until the first fault code is repeated.

NOTE! When the first fault code returns, all fault codes have been read.

Erasing fault codes (CIU)

The diagnosis function fault code memory is set to zero when the voltage to the engine is disconnected.

NOTE! Voltage must be fully disconnected.

When voltage is turned on again, the diagnosis function will check if there are any disturbances in the EMS 2 system. If this is the case, new fault codes will be set.

This means that:

1. Fault codes for malfunctions that have been rectified or disappeared are set as inactive (the inactive fault code can then be erased with the VODIA tool).
2. Fault codes from malfunctions that have not been corrected must be acknowledged and read off every time the voltage is reconnected.

If the diagnosis button is depressed after the faults have been corrected, and stored fault codes have been deleted, code 1.1 ("No fault") will flash, see chapter on **Fault codes**.

Fault codes

⚠ WARNING! Read through the safety advice for care and maintenance work in the "Safety information" chapter before you start work.

NOTE! Reading the fault codes below, such as **Code 2.1, PID 97** means that **2.1** is the flashing code indicated by the diagnostic lamp. **PID 97** is read with the VODIA diagnostic tool. With the use of DCU or DU the fault message will be shown as text in the display.

NOTE! Please refer to *Electrical diagram CIU and DCU* for references to the sleeves in the electrical connectors on the engine control unit.

Code 1.1 No faults

There are no active faults.

Code 2.1, PID / SPN 97. Water in fuel

Cause:

- Water in fuel.

Reaction:

- None.

Remedy:

- Empty the primary fuel filter.

Code 2.2, PID / SPN 111. Coolant level

Cause:

- Low coolant level.

Reaction:

- Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool).
- Engine stopped.

Remedy:

- Check the coolant level.
- Check coolant level monitor function.

Code 2.3, PID / SPN 111. Coolant level sensor

Cause:

- Short circuit to positive (+).
- Fault in sensor.

Reaction:

- None.

Remedy:

- Check that the coolant level sensor cable is not damaged.
- Check coolant level sensor function.

Code 2.4. SID22 / SPN 637 Flywheel speed sensor

Cause:

- No signal.
- Abnormal frequency.
- "Intermittent" signal from the sensor.
- Fault in sensor.

Reaction:

- Engine is very difficult to start and runs roughly when it starts.

Remedy:

- Check that the sensor connector is correctly installed.
- Check that the engine speed sensor cable is not damaged.
- Check that the engine speed sensor is correctly installed in the flywheelhousing.
- Check engine speed sensor function.

Code 2.5. SID21 / SPN 636 Camshaft drive speed sensor

Cause:

- No signal.
- Abnormal frequency.
- Fault in sensor.

Reaction:

- Engine takes longer to start than normal. Engine runs normally when running.

Remedy:

- Check that the engine speed sensor connector is correctly installed.
- Check that the engine speed sensor cable is not damaged.
- Check that the engine speed sensor is correctly installed in the upper timing gear cover.
- Check engine speed sensor function.

Code 2.6, PID / SPN 190. Engine speed

Cause:

- Engine speed too high.

Reaction:

- None.

Remedy:

- After the engine has stopped, look for the reason for the high speed.

**Code 2.8, PPID 132 / SPN 608
Speed potentiometer connected to CIU**

Cause:

- Shorted to plus (+) or minus (-).
- Fault in sensor.

Reaction:

- Engine goes to idle.
- If you release the accelerator first, and the press it down again, the engine can be forced to run using the idle contact.

Remedy:

- Check that the potentiometer has been connected correctly.
- Check that the cable harness to the potentiometer has not been damaged.
- Check the potentiometer function.

**Code 2.9. PID / SPN 97
Indicator for water in fuel**

Cause:

- Short circuit
- Open circuit.
- Fault in indicator.

Reaction:

- None.

Remedy:

- Check the indicator cables for breaks and short circuits.
- Check indicator function. Change indicator as necessary

Code 3.1, PID / SPN 100. Oil pressure sensor

Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Remedy:

- Check that the oil pressure sensor cable is not damaged.
- Check that the oil pressure sensor is correctly connected.

**Code 3.2. PID / SPN 105
Boost temperature sensor**

Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Remedy:

- Check that the boost temperature sensor connector is correctly installed.
- Check that the boost temperature sensor cable is not damaged.
- Check that the boost temperature sensor is correctly installed.
- Check boost temperature sensor function.

**Code 3.3. PID / SPN 110
Coolant temperature sensor**

Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- Preheating is also activated when the engine is hot.

Remedy:

- Check that the coolant temperature sensor connector is correctly installed.
- Check that the coolant temperature sensor cable is not damaged.
- Check that the coolant temperature sensor is correctly installed.
- Check coolant temperature sensor function.

Code 3.4. PID / SPN 106/102. Boost pressure sensor
Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- Engine smokes more than normally during acceleration/load increase.

Remedy:

- Check that the boost pressure sensor connector is correctly installed.
- Check that the boost pressure sensor cable is not damaged.
- Check that the boost pressure sensor is correctly installed.
- Check boost pressure sensor function.

Code 3.5, PID / SPN 106/102. Boost pressure
Cause:

- Boost pressure too high

Reaction:

- Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool).

Remedy:

- Check turbocharger compressor function.
- Check boost pressure sensor function.
- Check fuel volume/injector.

Code 3.6, PID / SPN 94. Fuel pressure sensor
Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Remedy:

- Check that the fuel pressure sensor connector is correctly installed.
- Check that the fuel pressure sensor cable is not damaged.
- Check that the fuel pressure sensor is correctly installed.
- Check fuel pressure sensor function.

Code 3.7, PID / SPN 175. Oil temperature sensor
Cause:

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None.

Remedy:

- Check that the cable harness to the oil temperature sensor has not been damaged.
- Check that the oil temperature sensor has been connected correctly.

Code 3.8, PID / SPN 94. Fuel pressure
Cause:

- Low supply pressure.

Reaction:

- None.

Remedy:

- Check if it is possible to build up pressure with the hand pump.
- Check the fuel filter.
- Check the fuel pre-filter.

Code 3.9, PID / SPN 158. Battery voltage, EMS
Cause:

- Faulty alternator.
- Faulty battery, battery cables.

Reaction:

- None.

Remedy:

- Check the supply voltage from the control unit.

Code 4.2 PPID 7. Coolant temperature alarm lamp, Connected to Stand-Alone Interface

Reason:

- Short circuit to negative (-).
- Short circuit to positive (+).
- Open circuit.

Reaction:

- Alarm lamp gives constant light.
- Alarm lamp does not work. If there is an open circuit on start-up, the diagnosis is de-activated.

Action:

- Check that the alarm lamp cable is not damaged.
- Check that the alarm lamp is intact and correctly installed.

Code 4.8, PPID 6/ SPN 520195. Stop input EMS

Cause:

- Short circuit to negative (-).
- Open circuit.

Reaction:

- Engine can only be stopped with the auxiliary stop.

Remedy:

- Check that the starter switch connections are not damaged.

Code 5.2, PPID 4 / SPN 520194. Starter input CIU

Cause:

- Shorted to minus (-).
- Activated for too long.

Reaction:

- The engine cannot be started.
- The engine starts immediately when ignition is turned on.

Remedy:

- Check that connections to the ignition key have not been damaged.
- Check that the cable harness to the ignition key has not been damaged.

Code 5.3, PPID 6/ SPN 970. Stop input CIU

Cause:

- Short circuit to negative (-).
- Open circuit.
- Activated for too long time.

Reaction:

- Engine can only be stopped with the auxiliary stop (AUX STOP) on engine.
- Engine stops. A fault code is displayed for 40 seconds and the engine can not be started during this time. When a fault code is active, the engine can be started but not stopped.

Remedy:

- Check that the starter switch connections are not damaged.
- Check that the ignition switch cable is not damaged.

Code 5.4, PID 45/ SPN 626. Preheating relay

Cause:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- Preheating can not be activated.
- Preheating is constantly connected.

Remedy:

- Check that the relay input cable is not damaged.
- Check relay function.

Code 5.5, PID / SPN 107, Air filter pressure

Reason:

- Too large pressure drop across filter.

Reaction:

- Less good response from engine.

Action:

- Check the air filter.

Code 5.6, PID/SPN 107. Air filter sensor**Cause:**

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None

Remedy:

- Check that the air filter sensor contact is correctly installed.
- Check that the cable harness to air filter sensor has not been damaged.
- Check the air filter sensor functionality.

Code 5.7. PID / SPN 98, Oil level**Cause:**

- Oil level is too low.

Reaction:

- Warning indication.

Remedy:

- Check the oil level.

Code 5.8, PID / SPN 175. Oil temperature**Cause:**

- Oil temperature is too high

Reaction:

- Warning indication.
- The engine control module limits engine output (unless protection has been turned off with the diagnosis tool VODIA).

Remedy:

- Check the oil level.
- Check the oil temperature.
- Check the oil temperature sensor function.

Code 5.9, PID / SPN 98. Oil level sensor**Cause:**

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None.

Remedy:

- Check that the cable harness to the oil level sensor has not been damaged.
- Check the oil level sensor function.

Code 6.1, PID / SPN 110. Coolant temperature**Cause:**

- Coolant temperature is too high.

Reaction:

- Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool).

Remedy:

- Check the coolant level.
- Check the intercooler (cleanliness).
- Check if there is air in the cooling system.
- Check the pressure cap on the expansion tank.
- Check coolant temperature sensor function.
- Check thermostat function.

Code 6.2, PID / SPN 105. Boost temperature**Cause:**

- Boost temperature is too high.

Reaction:

- Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool).

Remedy:

- Check the coolant level.
- Check the intercooler (cleanliness).
- Check boost temperature sensor function.
- Check the function of the thermostat.

Code 6.4. PPID 231 / SPN 639. Data link (CAN). CIU**Cause:**

- Faulty data link (CAN), CIU.

Reaction:

- Instruments and warning lamps stop working.

Remedy:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU and the engine management unit are not damaged.

**Code 6.5. PPID 231 / SPN 639. 2017 / PSID 201
Data link (CAN), EMS 2**

Cause:

- Internal fault in control module.

Reaction:

- Engine not operating: engine can not be started.
Engine operating: engine idles and can only be stopped with the auxiliary stop (AUX-stop).

Remedy:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU and the engine management unit are not damaged.
- Check that sleeves 11 and 12 in the connector on the CIU are not damaged.

Code 6.6, PID / SPN 100, Oil pressure

Cause:

- Oil pressure is too low.

Reaction:

- Engine control module reduces engine power (unless the protection has been shut off with the VO-DIA diagnostic tool).

Remedy:

- Check oil level.
- Check that the air filters are not blocked.
- Check system pressure valves and safety valves in the oil system.
- Check oil pressure sensor function.

**Code 6.7, PPID 8 / SPN 520192,
Piston cooling pressure**

Cause:

- Piston cooling pressure is too low.

Reaction:

- Engine stopped. The fault code is de-activated at engine speeds below 1000 rpm.

Remedy:

- Check that the oil pressure in the engine exceeds 175 kPa (25.4 psi).

**Code 6.8, PPID 8 / SPN 520192,
Piston cooling pressure sensor**

Cause:

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None.

Remedy:

- Check that the piston cooling pressure sensor contact is correctly installed.
- Check that the cable harness to the piston cooling pressure sensor has not been damaged.
- Check the piston cooling pressure sensor functionality.

Code 6.9, PID / SPN 158, Battery voltage, CIU

Cause:

- Short circuit to negative (-).
- Faulty alternator.
- Faulty battery, battery cables.

Reaction:

- Problems in engine starting.

Remedy:

- Check the supply voltage from the control unit.
- Check the battery.
- Check the alternator.
- Check the 8-pin contact.

**Code 7.1. SID 1 / SPN 651
Injector, cylinder #1**

Cause:

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #1.

**Code 7.2. SID 2 / SPN 652
Injector, cylinder #2****Cause:**

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #2.

**Code 7.3. SID 3 / SPN 653
Injector, cylinder #3****Cause:**

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #3.

**Code 7.4. SID 4 / SPN 654
Injector, cylinder #4****Cause:**

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #4.

**Code 7.5. SID 5 / SPN 655
Injector, cylinder #5****Cause:**

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #5.

**Code 7.6. SID 6 / SPN 656
Injector, cylinder #6**

Cause:

- Electrical fault.
- Faulty compression or injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.

Remedy:

- Check that the injector cables are not damaged.
- Check that the injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #6.

**Code 7.7, PID / SPN 153
Crankcase ventilation pressure**

Cause:

- Crankcase ventilation pressure too high.

Reaction:

- The engine is shut down (if the protection has not been shut off by the parameter tool).

Remedy:

- Check whether the crankcase ventilation is blocked.
- Check whether cylinder liner, piston or piston rings are worn or damaged.

**Code 7.8. PID / SPN 153
Crankcase ventilation pressure sensor**

Cause:

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None.

Remedy:

- Check that the crankcase ventilation pressure sensor contact is correctly installed.
- Check that the cable harness to the crankcase ventilation pressure sensor has not been damaged.
- Check crankcase ventilation pressure sensor function.

**Code 7.9, PID / SPN 172
Air temperature sensor, inlet**

Cause:

- Shorted to plus (+) or minus (-).
- Break.

Reaction:

- None.

Remedy:

- Check that the air temperature sensor contact is correctly installed.
- Check that the cable harness to the air temperature sensor has not been damaged.
- Check the air temperature sensor functionality.

Code 8.3, PID / SPN 164. Injection pressure

Cause:

- Fault in fuel supply.
- Fault in fuelpump.
- Fault in cable harness.
- Fault in sensor.

Reaktion:

- Warning indication.
- Engine control module reduces engine power.

Remedy:

- Check the cable harness.
- Check the sensor.
- Check the filter.
- Check the fuelpumps.

Code 8.4 PPID 55 / SPN 1136 ECU temperature

Reason:

- Control unit too hot, incorrect assembly.
- Electrical fault, damaged sensor.

Reaction:

- None

Action:

- Check the control unit installation. Recommended ambient temperature is 50 °C.

Code 8.6, SID 70 / SPN 729. Preheating sensor**Cause:**

- Fault in cable harness.
- Fault in preheating relay.

Reaktion:

- Preheating can not be activated.

Remedy:

- Check the cable harness.
- Check the preheating relay.

**Code 9.2. SID 250 / SPN 608
Faulty data link (J1587)****Cause:**

- Faulty data link.

Reaction:

- None.

Remedy:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU/DCU and the engine management unit are not damaged.

**Code 9.3. 232/211 / SPN 620/1079/1080
Power supply to sensor****Cause:**

- Shortcut.
- Fault in sensor.

Reaction:

- Faulty values in oil pressure and boost pressure sensors.
- Fault code for oil pressure- and boost pressure sensor.
- Low engine output.
- The instrument shows zero oil pressure and boost pressure.

Remedy:

- Check that the cable harness to oil pressure and boost pressure sensor has not been damaged.
- Check oil pressure and boost pressure sensors.

**Code 9.8, SID 253 / SPN 630
Data set memory EEPROM, CIU****Cause:**

- Internal fault in control module
- Programming faulty.

Reaction:

- Engine does not start.

Remedy:

- Re-program the control module. If the fault remains, change the control module.

**Code 9.8. SID 254 / SPN 629
Fault in control unit, CIU****Cause:**

- Faulty EEPROM, CIU.
- Faulty flash memory, CIU.
- Fault in control module, CIU

Reaction:

- CIU returns to factory setting.
- Engine goes to idle.
- Engine can not be started.

Remedy:

- Re- program the unit
- Change CIU unit.

Code 9.9, SID 240 / SPN 639. Memory fault**Cause:**

- Memory fault in engine management system.

Reaction:

- Engine might not start.

Remedy:

- Re-program the unit.

**Code 9.9, SID 253 / SPN 630
Data set memory EEPROM, EMS****Cause:**

- Internal fault in control module
- Programming faulty.

Reaction:

- Engine does not start.

Remedy:

- Re-program the control module. If the fault remains, change the control module.

Code 9.9. SID 254 / SPN 629
Control module EMS

Cause:

- Internal fault in control module.

Reaction:

- Engine misfires.
- Engine does not start.

Remedy:

- Change engine control unit.

PID 173 / SPN 1184
Exhaust temperature

Reason:

- Short circuit to positive (+) or negative (-).
- Open circuit

Reaction:

- Warning lamp lights up
- Engine control unit limits engine power

Action:

- Check that the exhaust temperature sensor connector is properly mounted.
- Check that the wiring to exhaust temperature sensor is not damaged.
- Check that the exhaust temperature sensor is correctly mounted.
- Check the exhaust temperature sensor function.

SID 32 / SPN 1188
Wastegate

Reason:

- Short circuit to positive (+) or negative (-).
- Open circuit
- Wastegate damaged mechanically

Reaction:

- Warning lamp lights up
- Engine control unit limits engine power

Action:

- Check that the waste gate connector is properly mounted.
- Check that the wiring to the waste is not damaged.
- Check that the waste gate is correctly mounted.
- Check the waste gate.

Notes

A series of horizontal dotted lines for writing notes.

Report form

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.

From:

.....
.....
.....

Refers to publication:

Publication no: Date of issue:

Suggestion/Motivation:

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

Date:

Name:

AB Volvo Penta
Teknisk Information
Avd. 42200
SE-405 08 Göteborg
Sweden

