

Documentation

Functional Description
Electronic governor
ECU 8
for MTU Series 1600
Genset application

E532291/01E



Power. Passion. Partnership.

Printed in Germany

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

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1 General

1.1 General requirements

1.1.1 General

In addition to the notices in this brochure, the valid, country-specific, statutory regulations on accident prevention and environmental protection are to be observed. This engine is built according to the current state of the art standards and valid regulations and rules. Nevertheless dangers to persons and property are still present if this engine is:

- • Not used properly
- • Operated, maintained and repaired by non-trained and unauthorized personnel
- • Modified or changed
- • Safety notices are not observed

1.1.2 Intended use

This engine is only to be used for the purpose stated in the contract or at the delivery. A different or additional use will be considered a “non-intended use”. The manufacturer assumes no responsibility for any damages resulting from a “non-intended use”. The user is solely responsible.

Intended use also includes observing the operating instructions and the maintenance and repairs specifications.

1.1.3 Modifications or changes

Any unauthorized modifications or changes to the engine affect safety.

MTU assumes no responsibility and accepts no warranty claims for damages resulting from unauthorized modifications or changes.

1.1.4 Spare parts

Only MTU original parts may be used when exchanging or replacing components or assemblies.

Liability and warranty claims against the engine manufacturer for damage resulting from the use of non-OEM parts will be rejected.

1.2 Safety regulations for maintenance and repair work

1.2.1 Safety regulations for commissioning

The product must be properly installed and have passed the acceptance test according to the MTU regulations before it can be commissioned.

Each time the device or system is put into commission make sure

- • That all maintenance and repair work are finished
- • That all loose parts have been removed from rotating parts
- • That no one is in the danger zone of moving parts

Right after placing the device or system into commission make sure that the controls and indicators and the monitoring, signaling and alarm systems are operating properly.

1.2.2 Safety regulations for operation

Regularly train and practice the operating procedures in case of emergencies.

The operator must be familiar with the controls and indicators.

The operator must know the effects of each operating step performed.

The operator must carry out each operating step according to the documentation.

During operation the display instruments and monitoring groups must be constantly monitored with respect to the current operating states, the operating limits and any warnings and alarms.

If a problem with the system is detected or if the system reports a problem:

- • The person(s) responsible is/are to be informed
- • The messages is to be evaluated
- • Any emergency actions are to be taken, as necessary, e.g. emergency engine stop

1.2.3 Engine operation

Always wear hearing protection when engine is running!

Make sure engine room is well ventilated!

Immediately wipe up any operating fluids that have leaked out or have been spilled; use a binding agent as necessary.

A combustion engine's exhaust is poisonous. Inhaling the exhaust is hazardous to your health. Exhaust pipes must be air tight and routed to the open air.

Do not touch or come into contact with any battery terminals, generator terminals or cables while engine is running!

Improper insulation or grounding of electrical parts can lead to serious electrical shocks causing injury.

Absolutely do not loosen or open any water, oil, brake fluid, fuel, compressed air or hydraulic lines while the engine is running!

1.2.4 Maintenance and repairs

A major factor in safety is the compliance with the maintenance and repairs specifications.

Do not perform any maintenance or repair work while the engine is running, unless it is explicitly permitted. Secure the engine from being accidentally started. If an electrical starter is installed, disconnect the battery. If a compressed air starter is installed, close the main valve of the compressed air system and release pressure in the air line. Place a sign "Do not operate" in the operating room or at the controls! Keep all nonessential persons away!

Do not rectify any problems for which you do not have the proper knowledge or the special tools required! Maintenance and repair work should only be made by authorized and qualified personnel.

Only use appropriate and calibrated tools.

Do not work on engines or components that are only being held up by lifting equipment or by a crane. Always properly support these components with suitable equipment before starting any maintenance or repair work.

Before cranking engine make sure no one is in the danger zone of the engine. After finishing work on the engine, make sure all protective devices are reinstalled and that all tools and loose parts have been removed from the engine.

Fluids exiting at high pressures can penetrate through clothing and skin and cause serious injuries. Before starting any work, release the pressure in those systems that are to be worked on!

Never rebend any fuel injection lines and do not install any lines that have been rebent. Keep fuel injection lines and connections clean. When removing or opening lines, always close off the openings using suitable caps and plugs.

Make sure to not damage the fuel lines during maintenance and repair work. When installing lines always use the correct tightening torque and make sure that all brackets and dampers are installed properly.

Makes sure that all fuel injection lines and oil pressure lines have sufficient clearance so as to avoid any contact with other components. Do not install fuel or oil lines near hot components unless the design does not allow otherwise.

Elastomers (e.g. Viton sealing rings) are safe at normal operating temperatures. If a fire occurs or if the temperature rises above 300 °C, the materials will start to melt setting off hydrogen fluoride fumes, which is an acid. If this acid comes into contact with the skin, serious burns can occur. If elastomer seals appear burnt or glassy, do not touch them with unprotected hands! Wear protective gloves!

Be cautious with hot fluids in lines, pipes and spaces ⇒ Risk of burn injuries!

Observe the cool off times of components that are heated up for installation/removal Risk of burn injuries!

Do not touch or come into contact with the hot parts of the compressor and the exhaust system ⇒ Risk of burn injuries!

Be careful when removing vent screws or screw plugs from the engine. To prevent the fluid from escaping, hold a rag over the vent screw or stop plug. The risk of injury is greater if the engine was just turn off and the fluids are still hot.

Be careful when draining hot operating fluids. ⇒ Risk of scalding!

Drain the operating fluids into a suitable container and clean up any spilled fluids using a binding agent as necessary.

Make sure the engine room is well ventilated when changing any operating fluids or working on the fuel system!

For any work above body height use safety gear and work platforms.

Make sure engine parts are placed on stable surfaces!

To avoid back injuries when lifting components, adults should only lift between 10 to 30 kg depending on age and gender, therefore:

- Get help or use a lifting aid.
- Make sure that all chains, hooks, loops, etc. are tested and approved and have sufficient payload rating and that the hooks are correctly positioned. Lifting lugs may not be loaded laterally.

When carrying out maintenance and repair work on the engine, pay special attention to cleanliness. After finishing the maintenance and repair work, make sure that any loose parts have been removed.

1.2.5 Welding

Welding is prohibited on the engine or on installed assemblies!

Never use the engine as a ground connection for welding! This will prevent the welding current from being conducted through the engine causing burns to the mounts, bearings and gears, which in turn leads to bearing seizures or damage to the components.

Do not let the welding cables lie across or near the wiring harness of the MTU system. The welding current could cause a voltage to be induced in the wiring harness which could lead to damage to the electrical system.

The ground connection of the welder must be connected within 60 cm of the spot to be welded.

If parts of the engine have to be welded (e.g. exhaust pipe), they should be removed from the engine before welding.

The connector and connections for the MTU electronics do not have to be removed for welding work, if the main power switch has been turned to "OFF" and the battery has been disconnected at both the positive and negative terminals.

1.2.6 Pressing and pulling work

Only those devices specified in the work plan and the assembly instructions are to be used for pressing and pulling work.

The maximum pressure of the pressing and pulling device must not be exceeded when pressing on parts.

The high-pressure lines for the hydraulic pressing or pulling device have been tested with 3800 bar.

Do not bend or apply pressure to the lines when they are under pressure!

Before starting any pressing work, observe the following:

- Bleed the pressing and pulling device and the pump and the lines at the designated positions for each system used (e.g. open the bleed screw, pump oil until it is free of air bubbles, close bleed screw).
- When pressing parts on, install the device with the piston inserted.
- When pulling parts off, install the device with the piston removed.

On a pressing and pulling device with a central expansion supply line, screw the spindle into the shaft end until a sealing effect is reached.

During hydraulic pressing and pulling of parts, make sure that no one is near the parts being pressed on or pulled off. When the system is under pressure, there is always the danger that the part being pressed on will suddenly "fly off".

Before the devices are used they are to be inspected and tested at regular intervals (crack tests).

1.2.7 Work on electric/electronic assemblies

Before starting any maintenance or repair work or before shutting off any parts of the electronics, get the approval of the manager responsible.

Turn off the power supply to the corresponding areas before starting any work on assemblies. If a specific measure requires a power supply, this is noted at the appropriate place in the document.

Gases produced by the battery are explosive. For this reason avoid any sparks and open flames. Do not touch or come into contact with battery acid. Wear safety glasses. Do not place any tools on the battery. Before installing any cables on the battery, check for correct polarity. Crossing the polarity on the battery can lead to injuries caused by the sudden expulsion of acid or the bursting of the battery case.

Do not damage wires and cables during removal work. Reinstall wires and cables so that they are not damaged during engine operation by coming into contact with sharp edges or hot surfaces or chafing against other parts.

Do not attach cables or wires to lines carrying fluids!

After finishing the maintenance or repair work reattach and retighten any wires or cables that have come loose!

A function check of the device or system must be made after any repairs. A check of just the repaired component is insufficient. The entire system connected must also be checked.

If cables or wires are in contact with components and there is the risk that they will chafe, they should be attached with cable clamps!

Cable ties should not be used to mount wires or cables because if they are removed during maintenance or repair work, there is a chance that they will not be reinstalled when the work is finished.

Spare parts must be properly stored before being used, i.e. especially protected against moisture. Faulty electronic parts or assemblies must be properly packaged for transport back for repairs, i.e. especially protected against moisture, shocks and wrapped in antistatic foil.

1.2.8 Working with laser devices

When working with laser equipment wear special safety glasses for laser applications!

Laser equipment can produce extremely intense, highly focused radiation by the effect of stimulated emission in the range of visible light or in the infrared or ultraviolet spectral ranges. The laser radiation can cause damage by photochemical, thermal or optomechanical effects. The main danger is of irreversible damage to eyes.

Laser equipment must be equipped with the necessary protective equipment meeting the requirements of the class and application of the laser.

Only the following laser equipment may be used for equisignal systems and survey work:

- Class 1, 2 or 3A laser equipment
- Class 3B laser equipment which only radiate in the visible wavebands (400 nm to 700 nm), have a maximum output of 5 mW and have a radiation axis or radiation surface that is set to prevent any hazards to the eyes.

1.2.9 Operation of electrical devices

When electrical devices are in operation certain parts are electrified.

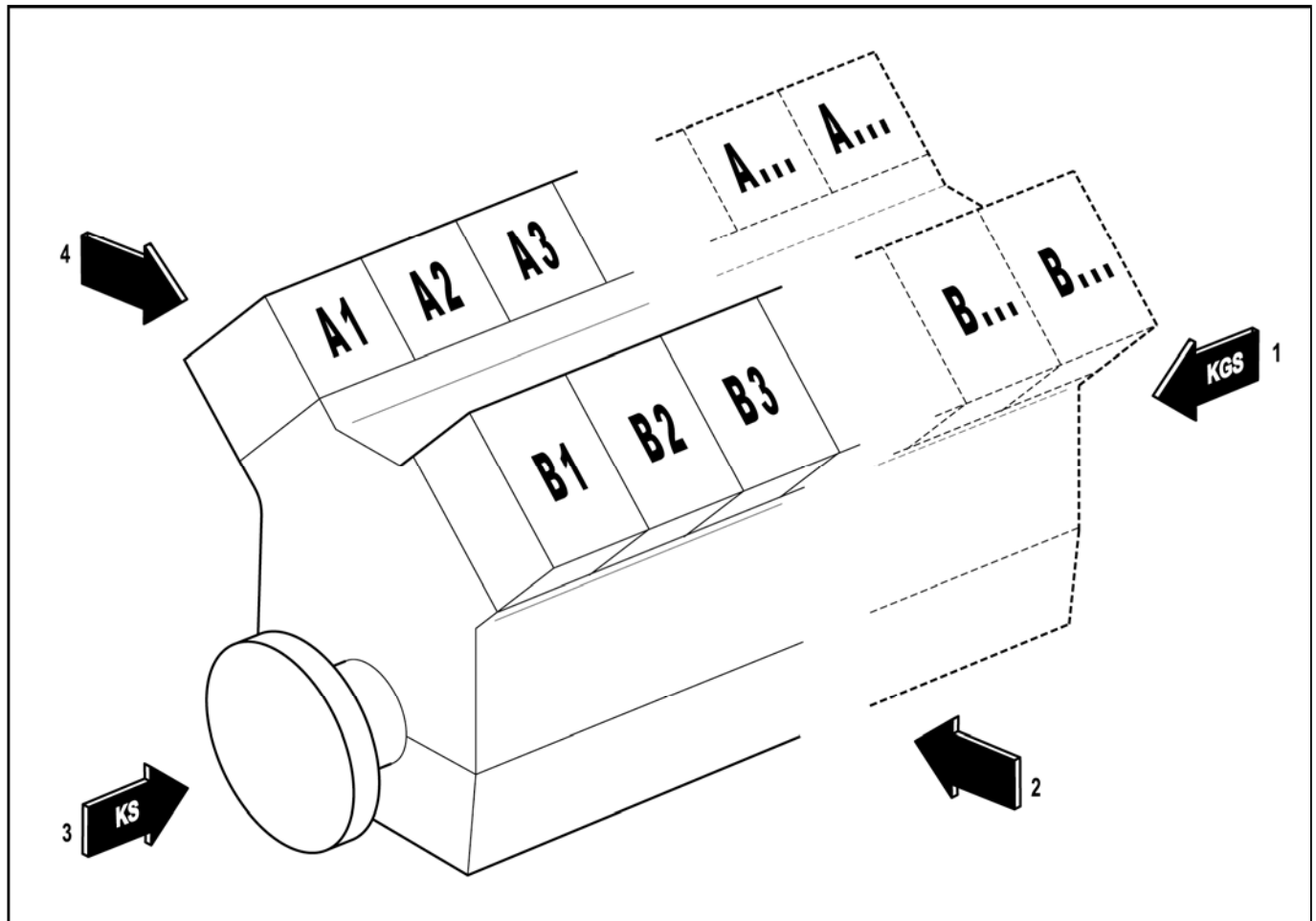
Failure to heed the warnings for these devices may result in serious injuries or damage to property.

1.3 Designation of the sides of the engine and the cylinders

The engine is always shown from the driving end (KS).

Cylinders are designated (according to DIN ISO 1204) with A for the left cylinder bank and with B for the right cylinder bank. Each cylinder bank is numbered started with no. 1 at the driving end (KS) of the engine.

Numbering of other components start with no. 1 at the driving end (KS) of the engine.



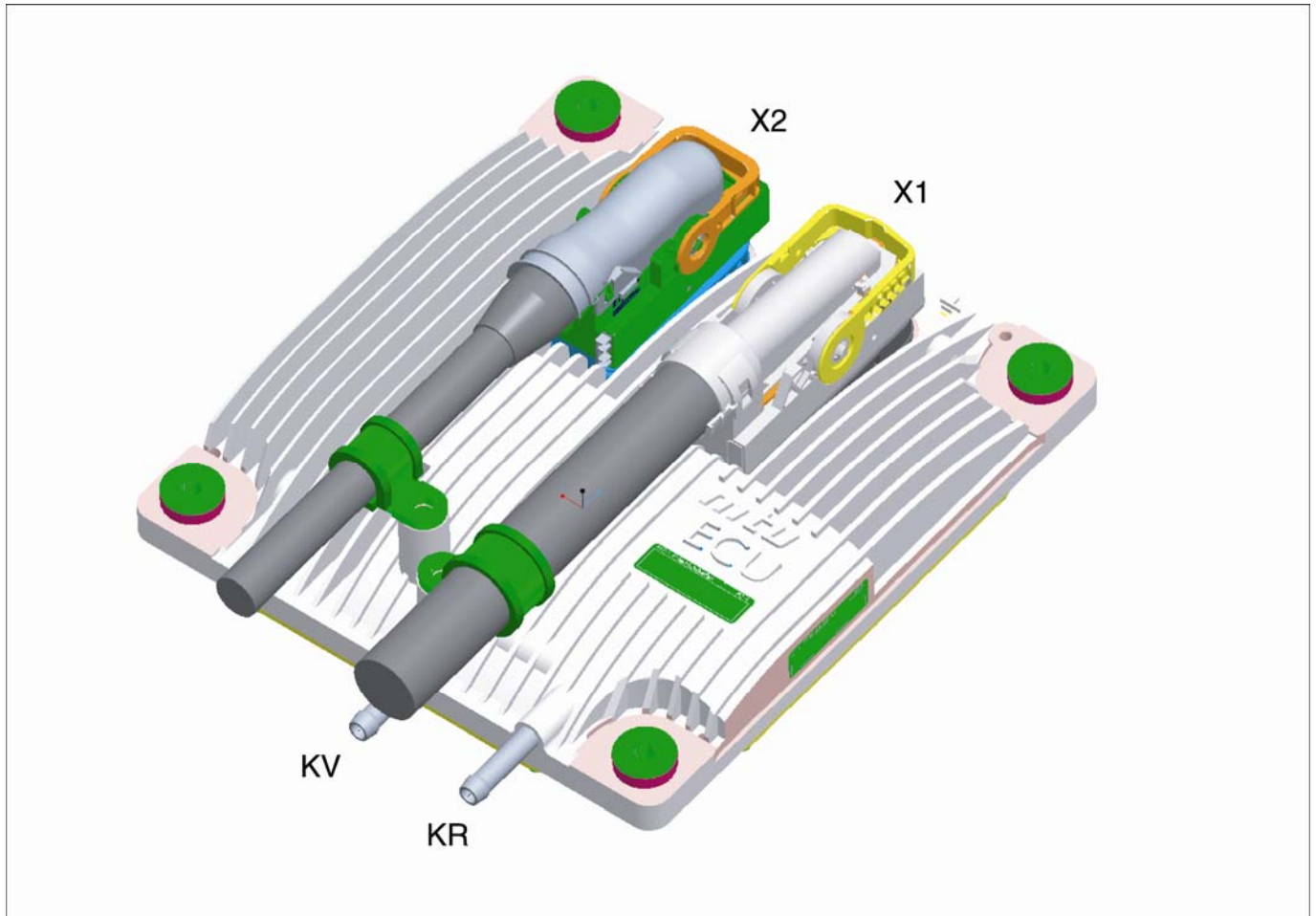
1 KGS = Free end
2 Right side of engine

3 KS = Driving end
4 Left side of engine

2 Overview

2.1 MTU Engine Control Unit ECU8

2.1.1 Overview



Connections:

X1	System wiring harness
X2	Engine wiring harness
KV	Coolant supply line
KR	Coolant return line

The ECU8 Engine Control Unit was specially developed for application in BR 1600 engines and can be used for 6R, 8V, 10V and 12V.

It is especially suitable for offroad applications like genset, C&I and railway applications.

The injector output stage is only suitable for Common Rail systems.

There are three current levels that can be set – Bootpeak/Boost/Hold current.

The housing is mounted to the engine on dampers.

The housing is designed with connections to the cooling system for applications at high ambient temperatures and heavy soiling.

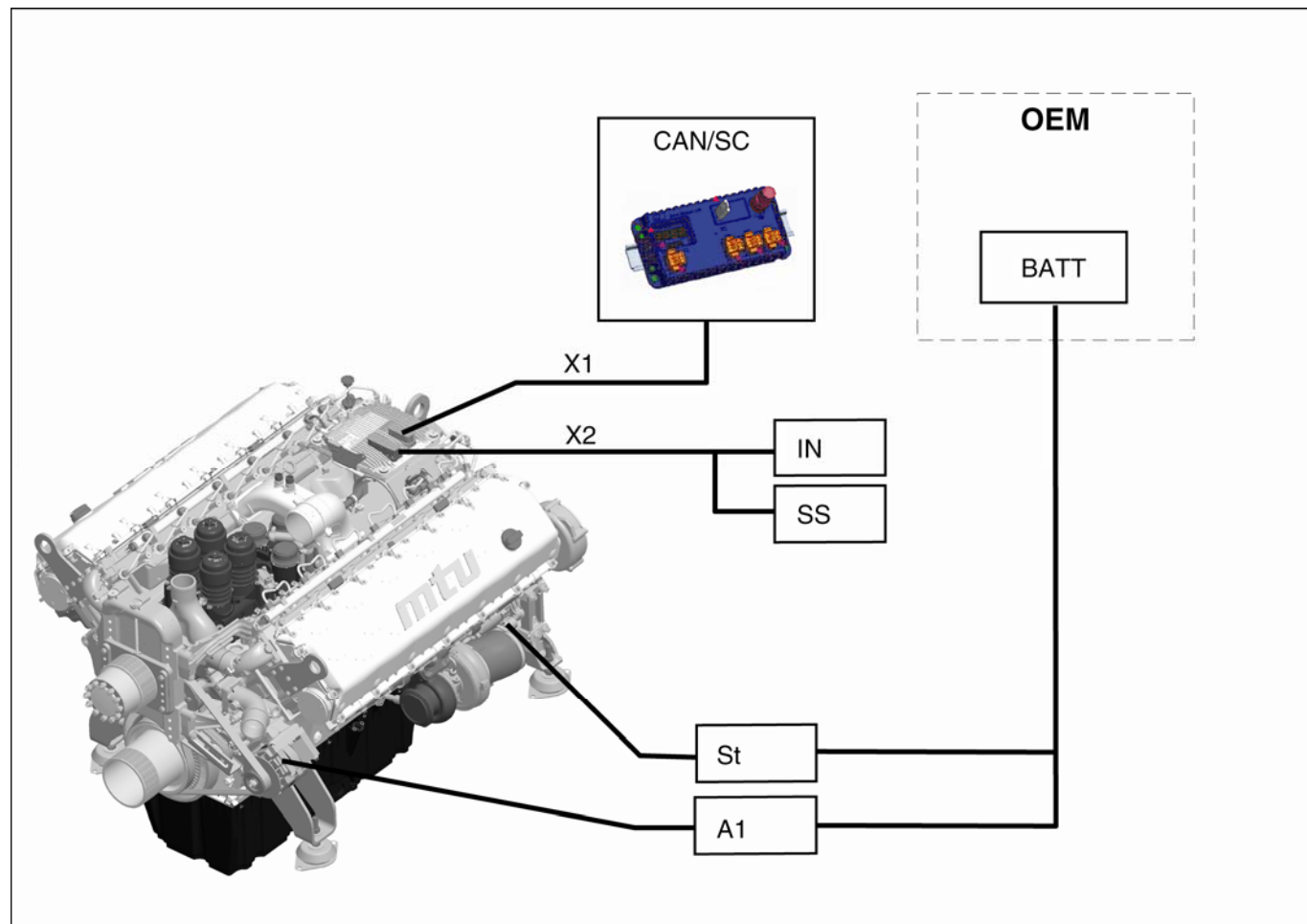
2.1.1.1 System devices

The basic equipment for genset is composed of the following devices

- ECU8
- Smart Connect

The ECU8 Engine Control Unit has been adapted for the Common Rail technology in the BR 1600 engines.

2.1.2 Design



Functions:

BATT	Battery
CAN/SC	Smart Connect device for ECU setting
X1	System wiring harness
X2	Engine wiring harness
IN	Inductors
SS	Sensors
St	Starter
A1	Battery-charging generator

2.2 Scope of delivery

2.2.1 MTU basic equipment

The following devices, assemblies and components are supplied in the basic equipment:

2.2.1.1 Engine sensors, actuators

All of the sensors and actuators necessary for the control of the Engine Control Unit are installed directly on the engine including the EIL (electrical data plate).

2.2.1.2 Engine wiring + injection wiring

Engine wiring harness for connecting all sensors to the Engine Control Unit ECU8

Connection of all injectors to the Engine Control Unit ECU8 (via Window Gasket)

2.2.1.3 ECU8 Engine Control Unit

Control, monitoring and regulation of the engine (installed on the engine)

2.2.1.4 Engine Control Unit connecting cable to system/power supply

Connecting cable from connector **X1** of ECU8, on one terminal block.

The connecting cable has one open end and can be delivered in the following lengths:

- 6 m
- 10 m
- 15 m
- 25 m

2.2.1.5 24V DC power supply

The 24V DC power supply for the Engine Control Unit is connected via the terminal block and the connecting cable **W1** and connector **X1**.

Starter, generator and other power consumers must be supplied via externally wired connections.

2.2.1.6 Smart Connect

This device makes it possible to change certain settings without using a DiaSys dialog unit. Furthermore, ECU fault codes are shown on a four-figure display.

2.2.2 OEM parts

The OEM must supply the following parts:

- Displays, e.g. indicator lamps, display instruments for:
 - Lube-oil pressure
- Controls, e.g. pushbuttons for “Start”, “Stop”, “Override”, etc.
- Cables/wires for the 24V DC power supply of the starter, generator, etc.

2.2.2.1 External sensors

External sensors are optionally supplied for:

- Coolant sensor

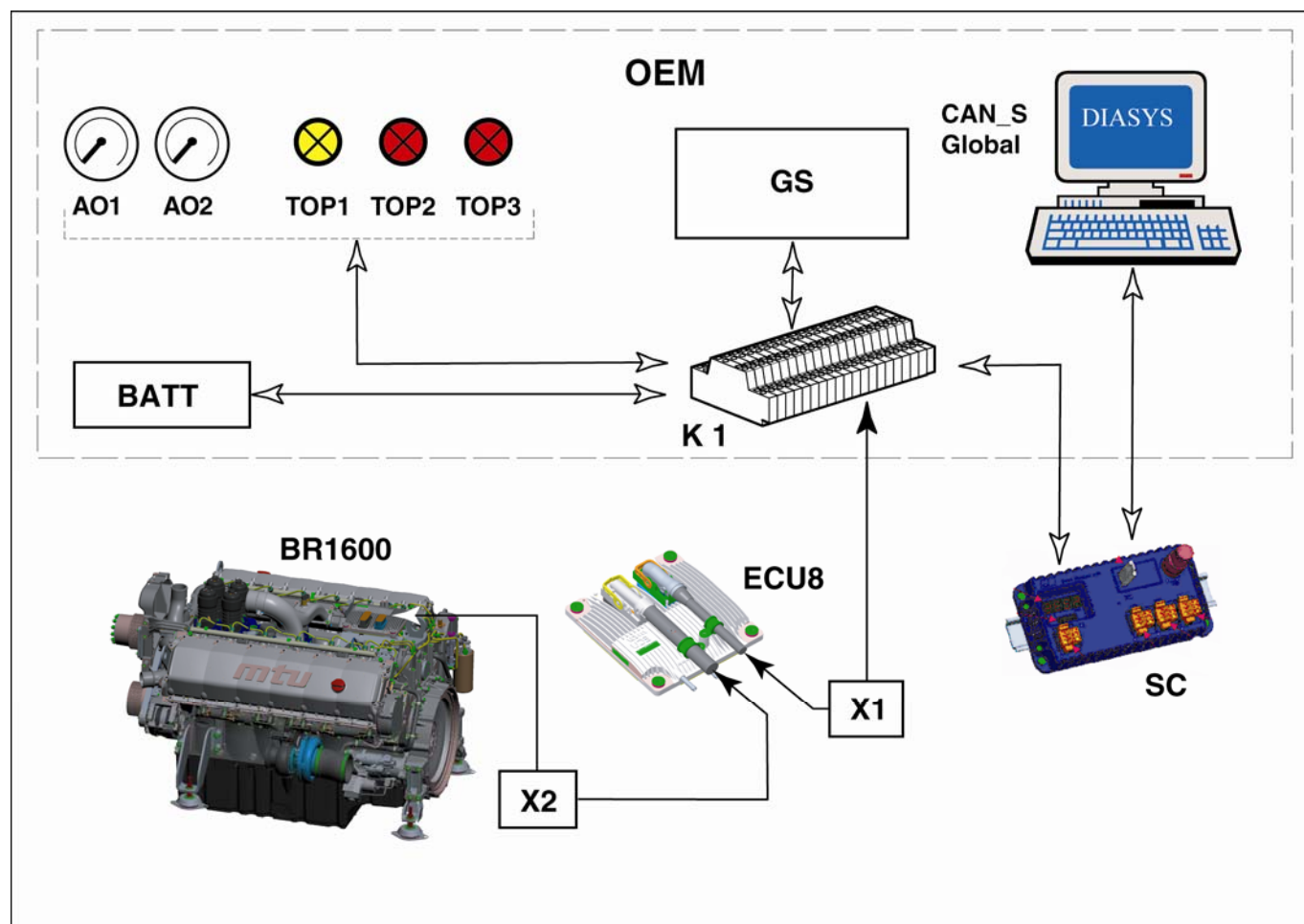
The sensor must be acquired and evaluated by the OEM.

2.2.2.2 Connecting cables/wires for external sensors

Connection of all external sensors to the system by the OEM

2.3 Customer interface/operator's devices

2.3.1 System overview/customer interface



OEM

AO1 Display instrument
 TOP1 - 3 Indicator lamps
 CAN -S Diagnostic system DiaSys
 K1 Terminal block/control box
 BATT Battery
 GS Generator control

MTU

Series 1600 engine with ECU8
 X1 System wiring harness
 ECU8 Engine Control Unit
 X2 Internal engine wiring harness
 SC Smart Connect

All of the devices/parts required by the operator to control and monitor the engine are included in the OEM scope of delivery.

2.3.1.1 Instrument outputs

There are 2 outputs for analog display instruments for displaying the engine operating values (AO1/AO2). They can be used for the following displays:

- Coolant temperature
- Lube-oil pressure

2.3.1.2 Binary inputs

The following pushbuttons can be configured:

Channel	Name	Type	PV	Description/function
DI1	ENGINE STOP	Pushbutton	2.7001.800	Pressing this pushbutton triggers the engine stop process without shutting down the Engine Control Unit.
DI2	SWITCHOVER Speed droop	Switch	2.1060.830	Two speed droop settings can be selected by switch.
DI3	SWITCHOVER 50/60Hz	Switch	2.7003.800	Two generator frequencies 50Hz and 60Hz can be selected by switch.
DI4	ALARM RESET	Pushbutton	2.8009.021	Pressing this pushbutton switches off the signaling of alarms. Pressing this pushbutton acknowledges the alarm.
DI5	SPEED UP	Pushbutton	2.1060.800	Pressing this pushbutton = Increase engine speed.
DI6	SPEED DOWN	Pushbutton	2.1060.810	Pressing this pushbutton = Decrease engine speed.
DI7	START	Pushbutton	2.1090.800	Pressing this pushbutton initiates the automatic engine start sequence.
DI8	OVERRIDE	Pushbutton	2.7002.800	Pressing this pushbutton triggers a temporary override of the safety system.

2.3.1.3 Transistor outputs

The alarm indicator lamps supply information about the operating state of the engine.

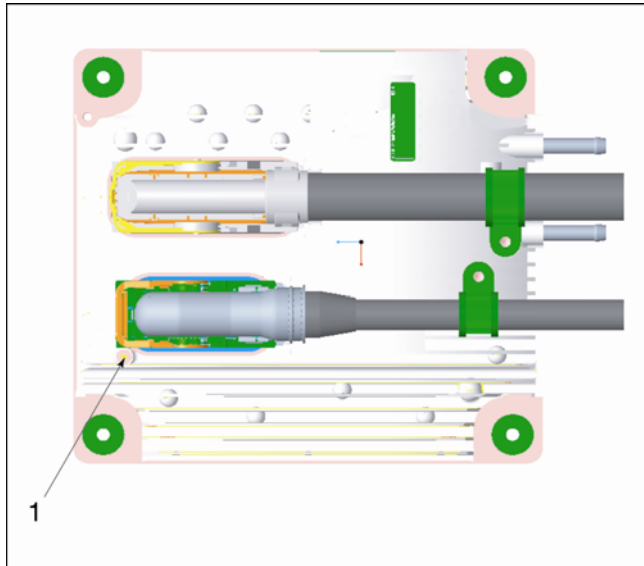
Channel	Meaning	Function
TOP1	YELLOW ALARM	Combined alarm indicator lamp lights up when a so-called "Yellow alarm" was triggered. The engine power may also be automatically reduced.
TOP2	RED ALARM	Combined alarm indicator lamp lights up when a so-called "Red alarm" was triggered. The engine power may also have been automatically reduced.
TOP3	LUBE OIL STOP	Oil pressure too low
TOP4	Starter ON	Actuation of starter

2.4 Diagnosis and tools

2.4.1 Device's own diagnosis

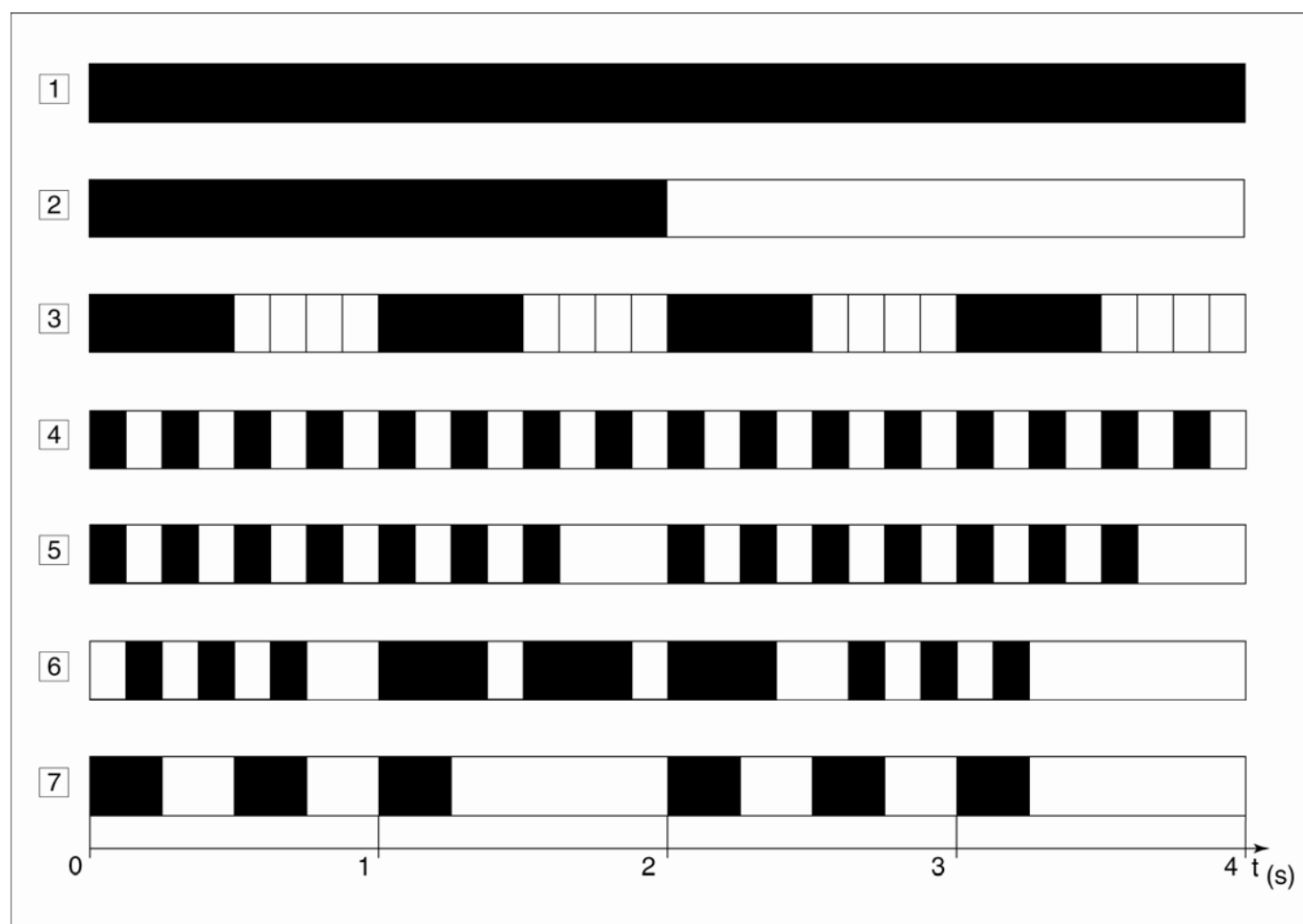
The ECU8 has a diagnosis lamp to aid the operator in detecting problems with the system.

Position of the diagnosis lamp on the ECU8 (1)



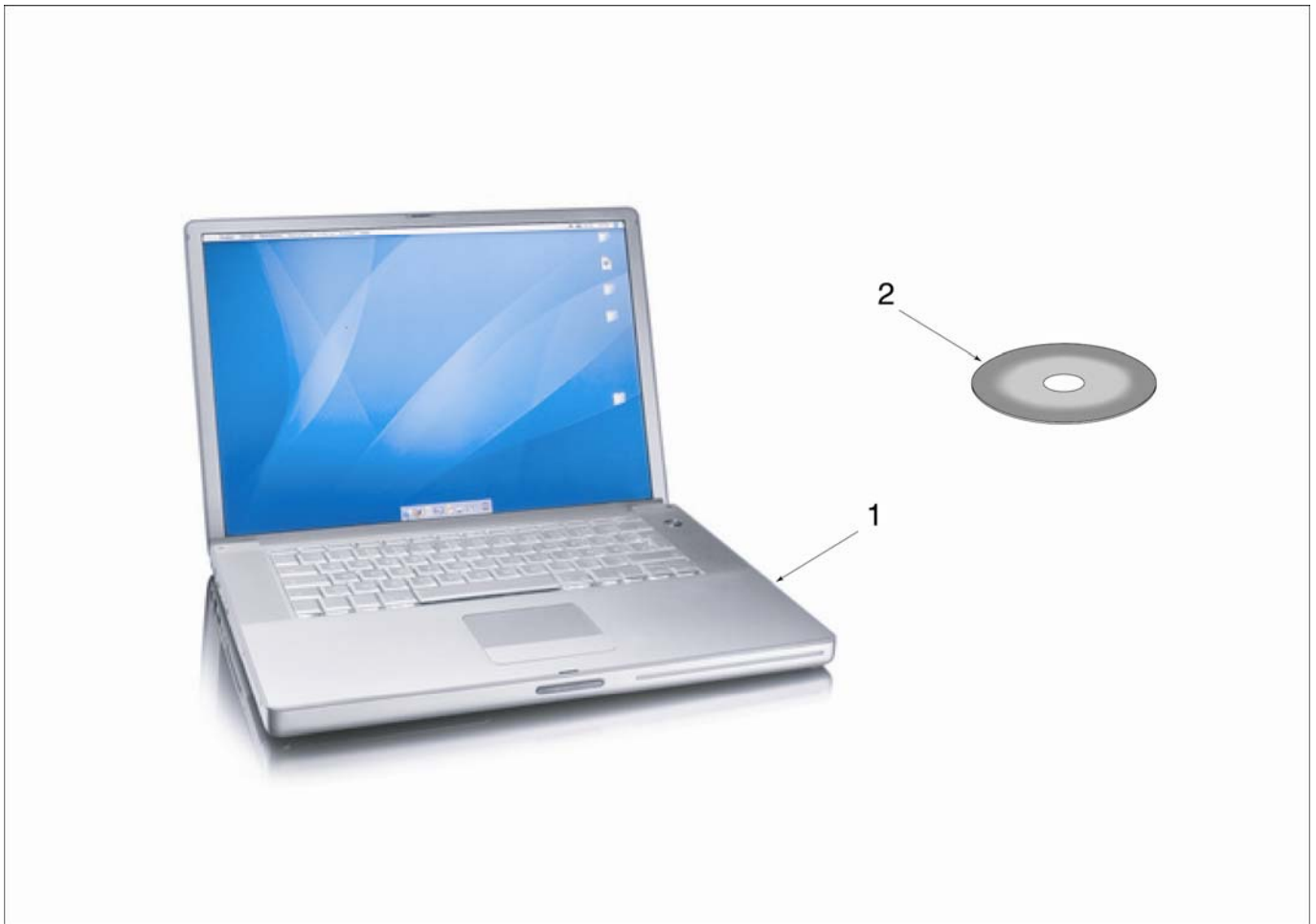
1 Diagnosis lamp

2.4.1.1 Flashing frequencies



- 1 Control unit is ready
- 2 Application loader is active
- 3 Internal fault detected by ITS (Integrated Test System)
- 4 External RAM faulty
- 5 External flash memory faulty
- 6 No firmware
- 7 Application crashed

2.4.2 DiaSys



- 1 Laptop
- 2 CD-ROM with DiaSys 2.53 software (SP1 or higher)

A more in depth diagnosis of the electronic system can be made using the DiaSys[®] dialog system, consisting of one laptop with the DiaSys[®] 2.53 SP1 or higher program, one user dongle and one CAN interface.

The main purpose of the dialog system is to change the settings in the ECU8.

2.4.3 Smart Connect

2.4.3.1 Functional description

Smart Connect provides the following functions:

- DIP switch to switch over speed demand, frequency and droop settings
- Four-figure display to indicate ECU fault codes
- Interface for DiaSys connection

Smart Connect comprises a device with connectors, a display and pre-programmed software.

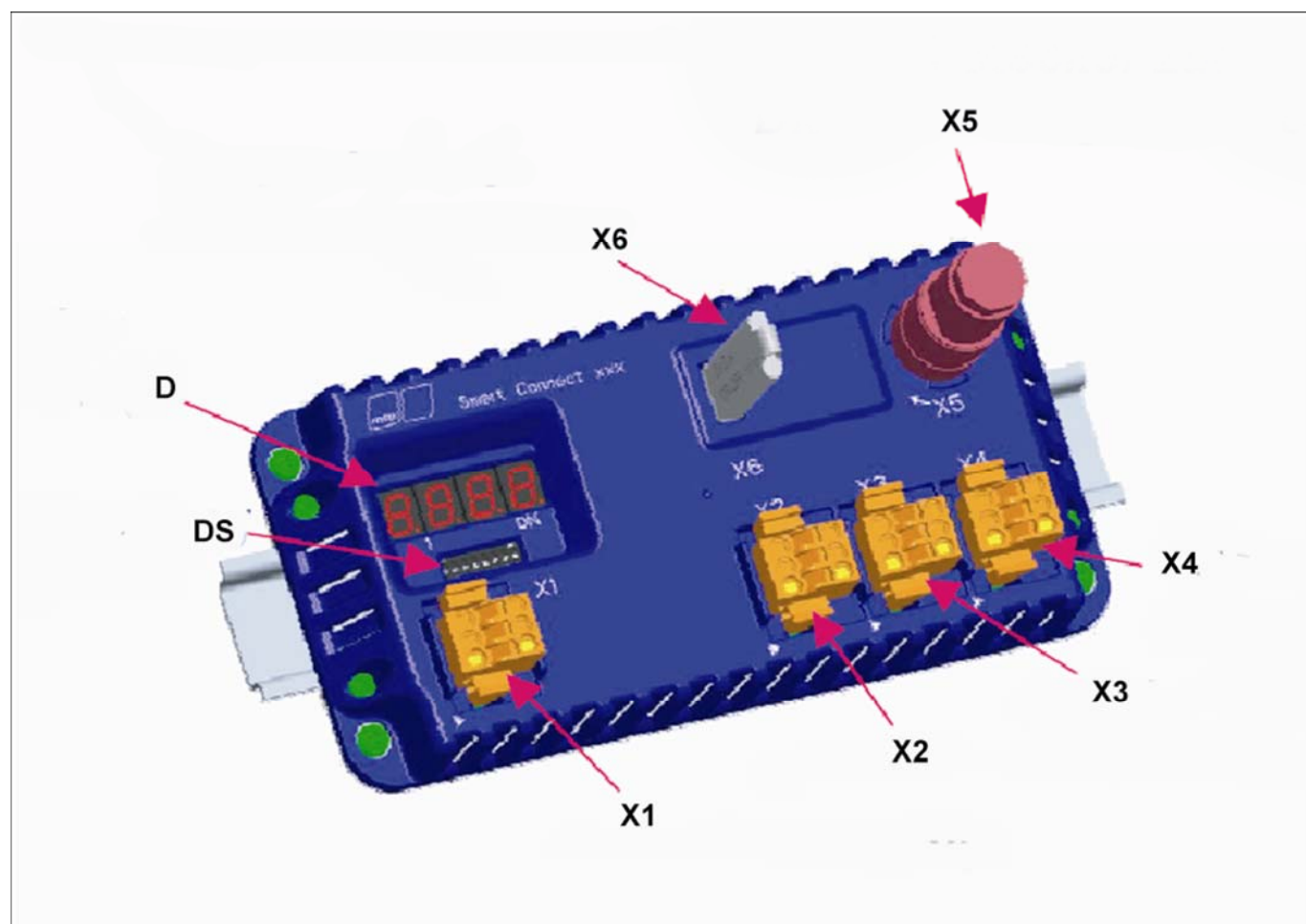
2.4.3.2 Description of Smart Connect hardware

Visualization of faults in the connected ECU transmitted on CAN1. Furthermore, it is possible to set a specific mode for a range of applications using DIP switches.

It is also possible to connect dialog systems (CAN1 and CAN2) via the additional DiaSys connector with a 24V supply for dialog PCs. Software and parameter downloading to the ECU is possible using a USB flash stick (USB -> RS485).

Note: The USB and RS485 interfaces to the ECU are not active in SC1-01.

The figure below provides an overview of the interfaces and functions of Smart Connect SC1-01. The housing is intended for DIN rail mounting.



DS	DIP switch to set plant configuration
D	Four-figure fault code display
X6	USB interface for memory sticks
X5	DiaSys connector for dialog with MTU Service
X4	CAN2 (J1939)
X3	CAN1 (MTU internal)
X2	RS485 (MTU internal)
X1	24 V supply

The DiaSys connecting cable is no longer restricted to the usual 1-2 m in length thanks to the integral CAN repeater upstream of the DiaSys interface. A significantly longer cable can be used as a result (up to 50 m).

Bus termination by means of two 120 ohm resistors at the CAN interfaces CAN1 and CAN2 can be configured, i.e. the terminators can be removed from the two connectors to allow connection of additional units featuring CAN interfaces to these connectors.

2.4.3.3 Overview of interfaces

2.4.3.3.1 Connector assignment SC1-01 (see system illustration SC <-> ECU8)

Connector X1 – Supply

Channel	Signal	Pin	Signal description	Twisting	Cross-
Housing	Ground	1	Ground connection via rail mounting		>1.5 mm ²
Power	+ 24V	2	24 V/0.3 A		>0.75 mm ²
Power	GND	3			>0.75 mm ²

Connector X2 – RS485

Channel	Signal	Pin	Signal description	Twisting	Cross-
RS485	B	1	Signal B (120 ohm connected between A and B)	a	>0.5 mm ²
RS485	A	2	Signal B (120 ohm connected between A and B)	a	>0.5 mm ²
RS485	GND	3	50 V isolated	a	>0.5 mm ²

Connector X3 – CAN1

Channel	Signal	Pin	Signal description	Twisting	Cross-
CAN1	High	1	50 V isolated (install 120 ohm in connector as necessary)	b	>0.5 mm ²
CAN1	Low	2	50 V isolated (install 120 ohm in connector as necessary)	b	>0.5 mm ²
CAN1	CAN_GND	3	50 V isolated	b	>0.5 mm ²

Connector X4 – CAN2

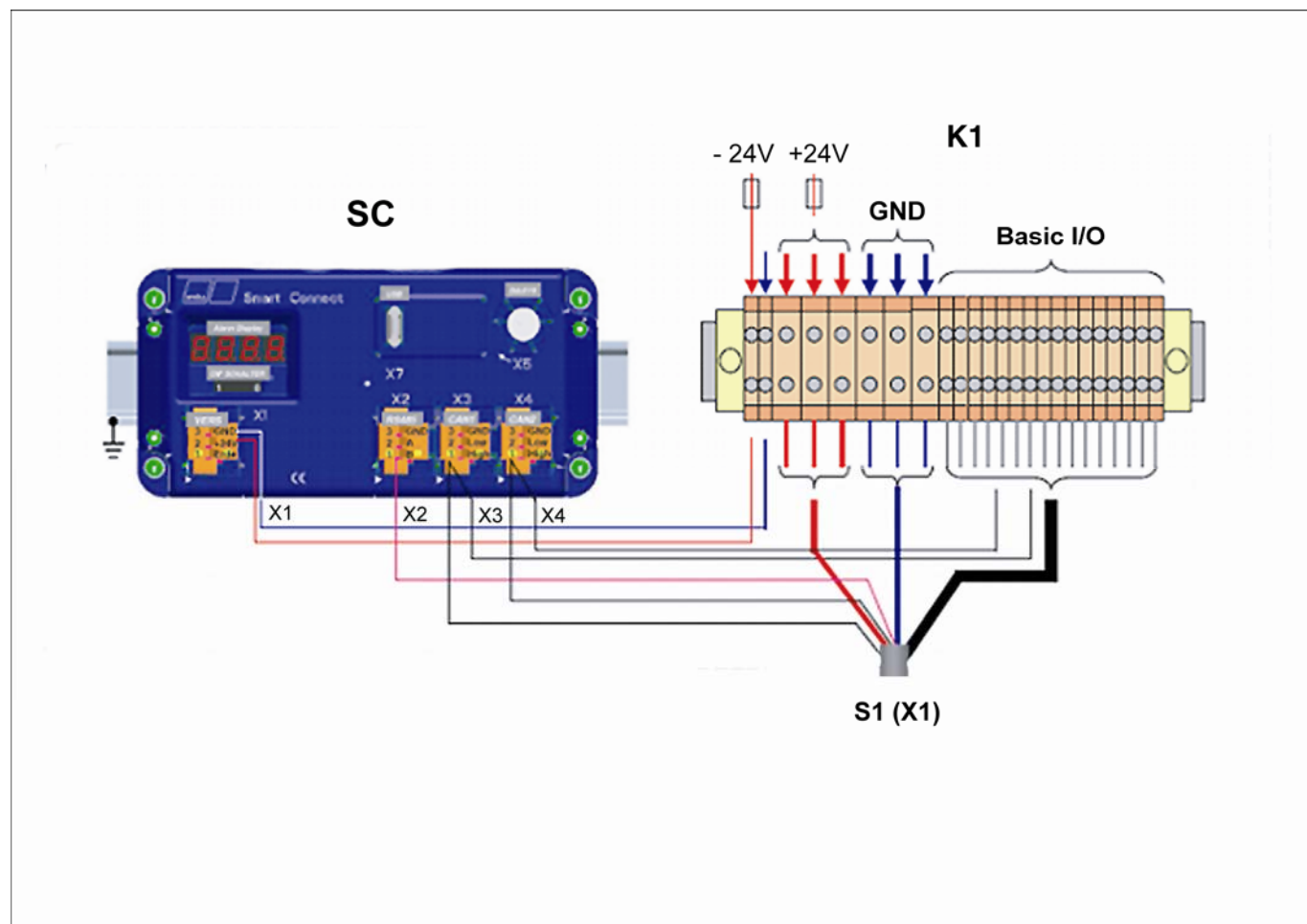
Channel	Signal	Pin	Signal description	Twisting	Cross-
CAN2	High	1	50 V isolated (install 120 ohm in connector as necessary)	c	>0.5 mm ²
CAN2	Low	2	50 V isolated (install 120 ohm in connector as necessary)	c	>0.5 mm ²
CAN2	CAN_GND	3	50 V isolated	c	>0.5 mm ²

Connector X5 – DiaSys connector

Channel	Signal	Pin	Signal description	Twisting	Cross-
		A			>0.5 mm ²
CAN2	High	B	50 V isolated(120 ohm fitted)	d	>0.5 mm ²
CAN2	Low	c	50 V isolated(120 ohm fitted)	d	>0.5 mm ²
		D			
24 V DiaSys	+24 V	E	DiaSys supply for PC <3A DC		>1.0 mm ²

		F			
CAN1	High	G	50 V isolated(120 ohm fitted)	c	>0.5 mm ²
CAN1	Low	H	50 V isolated(120 ohm fitted)	c	>0.5 mm ²
		J			
GND DiaSys	GND	K	DiaSys supply for PC <3A DC		>1.0 mm ²
CAN2	CAN_GND2	L	50 V isolated	d	>0.5 mm ²
CAN1	CAN_GND1		50 V isolated	c	>0.5 mm ²

2.4.3.3.2 System illustration SC <-> ECU8



SC Smart Connect
K1 Terminal block
S1 System cable (X1 system wiring harness)

Note: A 4 A fuse is required for Smart Connect SC 1-01.

2.4.3.4 Settings

2.4.3.4.1 Overview of functions available for selection with DIP switches

The Smart Connect unit is equipped with 6 DIP switches to facilitate configuration for ECU8 (eight switches are provided in total, however the last two switches 7 and 8 are only used internally by Smart Connect).

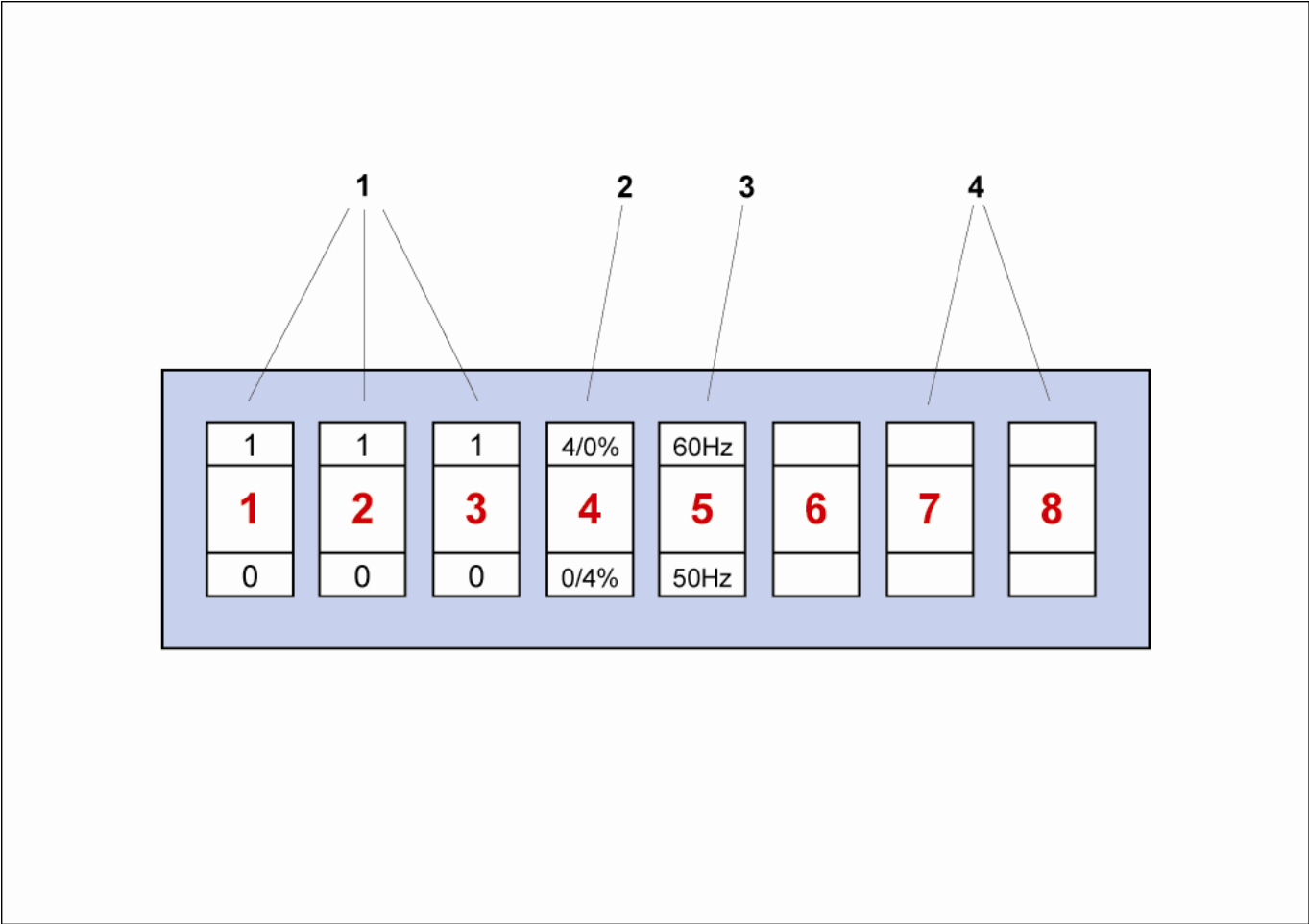
The Smart Connect switch settings are transmitted by a message via CAN1 to the ECU cyclically at one second intervals.

Changes made to the switch settings do not take effect until the ECU has been restarted.

The configuration which can be set using the switches is preset and cannot be modified. The figures below illustrate the assignment of the switches.

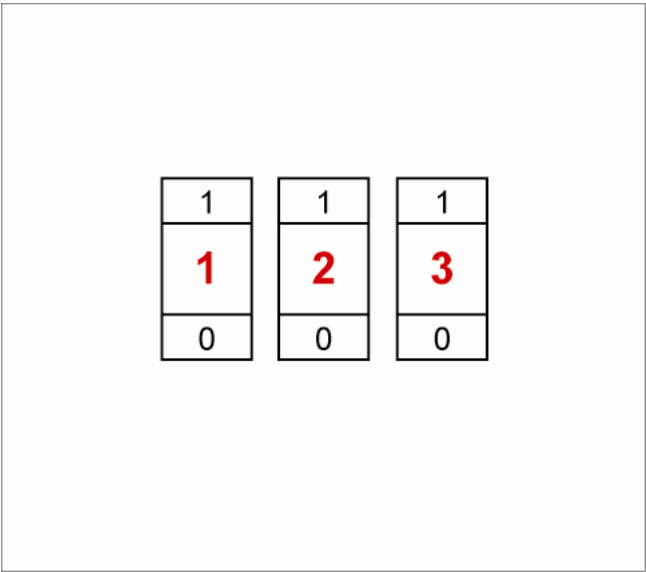
Note: All switches are set to "0" on delivery. The switches must be set (customized) for the specific application concerned during commissioning.

The figure below illustrates the assignment of the 8 DIP switches.



- 1 Speed demand
- 2 Speed droop
- 3 Frequency
- 4 Internal

2.4.3.4.1.1 Speed demand is set as follows:



DIP switches for speed demand

The speed demand is set with the three DIP switches ($2^3 = 8$ variants), see table below.

Variant	Code	Definition	Function
1	000 = 0	ECU default	ECU default settings of the 4 internal speed demand switches.
2	001 = 1	ECU direct up/down	Speed demand (up/down) controlled by binary inputs directly at the ECU. Settings can be made via DiaSys at the ECU.
3	010 = 2	ECU analog relative	The analog speed demand is controlled by analog inputs directly at the ECU. Settings can be made via DiaSys at the ECU. 0 Volt = -100rpm 5 Volt = +100rpm
4	011 = 3	ECU analog relative	The analog speed demand is controlled by analog inputs directly at the ECU. Settings can be made via DiaSys at the ECU. 0 Volt = -100rpm 10 Volt = +100rpm
5	100 = 4	ECU analog relative	The analog speed demand is controlled by analog inputs directly at the ECU. Settings can be made via DiaSys at the ECU. 4 mA = -100rpm 20 mA = +100rpm
6	101 = 5	CAN analog	The speed demand value (unit: rpm) is transferred to the ECU via CAN bus.
7	110 = 6	CAN up/down	The speed demand value (up/down) is transferred to the ECU via CAN bus.
8	111 = 7	External speed demand source	The speed demand source can be transmitted from an external controller.

2.4.3.4.2 Alarm display function overview

The display on the Smart Connect unit indicates the three-figure ECU fault codes in operation. The ECU fault numbers scroll by as banner text. Scrolling means that all faults which are active in the ECU are displayed consecutively at intervals of one second. A one-second break during which “----” appears on the Smart Connect display follows after each active fault has been displayed once. This indicates that all faults have already been displayed once and that the fault codes will be displayed again from the beginning.

“----” is displayed constantly if no ECU fault numbers are pending display.

The ECU determines which faults are to be displayed at the Smart Connect unit via CAN1.

Fault code “F000” appears on the display if the Smart Connect unit fails to detect an ECU8 on CAN1 (e.g. because the cable is not connected).

The following two fault codes are assigned to the Smart Connect:

- Fault code 696 (USB faulty)
- Fault code 697 (RS485 faulty)

The Smart Connect displays fault code F050 instead of 696 and F051 instead of 697 for a USB fault which occurs at the Smart Connect unit when an ECU8 is not connected at CAN1.

The table below lists all alarms:

Alarm code on SC display when no ECU8 is detected on the CAN1 bus	Alarms on SC display when ECU8 is connected to the CAN1	Description
F000		This alarm always appears on the Smart Connect display when no ECU8 is detected on the CAN1 bus.
F050	696	AL Smart Connect USB Error. This alarm appears in case of a fault at the USB interface of the Smart Connect unit. This alarm is transmitted to the ECU8 provided that one is connected to the CAN1 bus. 696 then appears on the display. F050 is displayed instead if ECU8 is not there.
F051	697	AL Smart Connect RS485 Error. This alarm appears in case of a fault at the RS485 interface of the Smart Connect unit. This alarm is transmitted to the ECU8 provided that one is connected to the CAN1 bus. 697 then appears on the display. F051 is displayed instead if ECU8 is not there.
	0001 – 0999	Three-figure fault code from ECU8 depending on the faults pending in ECU8.

2.4.4 Engine Identification Label EIL

The **Engine Ident Label EIL** is an electronic data plate. It is permanently affixed to engine and the engine cannot be operated without it..

The EIL is connected to the ECU via the engine wiring harness by means of a two-pole connector. The cabling between EIL and ECU must be routed properly to ensure trouble-free operation. Trouble-free operation is jeopardized if the connection is disrupted.

Check the cabling if the **“616 AL EIL Error”** is displayed.

Also inspect the EIL for visible signs of damage or manipulation.



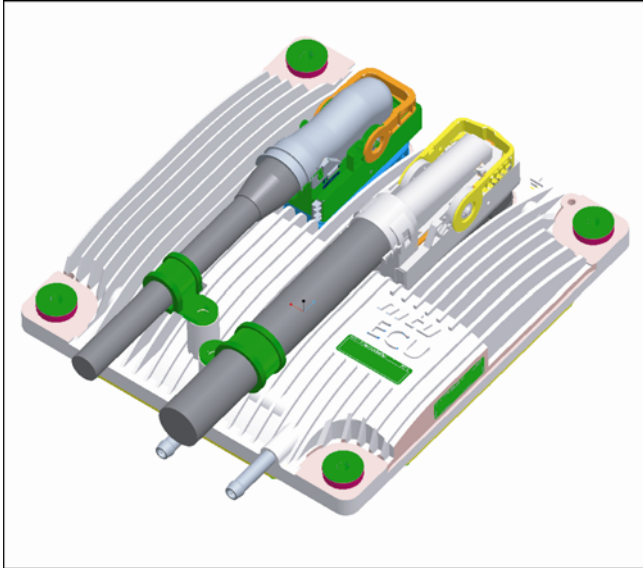
The EIL ensures that only the data record which was specifically compiled for a certain engine is used with the engine concerned. The engine is shut down after 15 minutes should it have become necessary to use the ECU of another engine on the engine concerned. Yellow alarm **“615 AL EIL Protection”** and red alarm **“454 SS Power Reduction Active”** are set during this time. This makes it possible to pinpoint or localize a fault by replacing with an ECU from another engine.

A new ECU with a valid data record for the engine concerned must be ordered and subsequently installed in case of a fault in the ECU.

Note: Any manipulation of the EIL will render your warranty null and void. Normal engine operation is also no longer possible in such cases.

3 Use and design

3.1 Functions



Central open- and closed loop control unit for the engine

- Implementation of the specifications of the monitoring, control and remote control systems as signals sent to the engine control
- Control of the injection system
- Control of other actuators on the engine
- Recording of sensors and evaluation of the operating states of the engine
- Monitoring of the limits and triggering an engine stop if states/limits become impermissible.
- Sending fault messages to the monitoring and control systems
- Downloading of settings for engine and system.
- Self-monitoring ITS
- Diagnosis with dialog unit (laptop)

3.2 Function of the ignition (IGI)/emergency stop (ESI)

3.2.1 Ignition input (IGI TI.15)

The IGI input can be used for two functions:

1. ECU on/off, if device has power supply (TI. 30).
2. Emergency stop function with “no-load current principle”

If this function is not used the input is switched to 24V (UBatt).

The user can turn the device ON/OFF with the IGI input as follows

- Input level = low to high - “wake”
The ECU is activated and the microcontroller is booted and goes through its “start up” and maintains the power supply in “hold”.
- Input level = low to high - “power down”
Shut off of the IOS (injector output stage) for all cylinders. This state is saved and can only be restored by the software. Saves all data and alarms “Data - Storage”. Shut off of internal power supplies.

3.2.2 Emergency stop input (ESI)

An emergency stop of the engine by completely shutting off the power supply to the Engine Control Unit is NOT PERMITTED!!

The ESI input is activated with a normally-open contact to UBatt (24V).

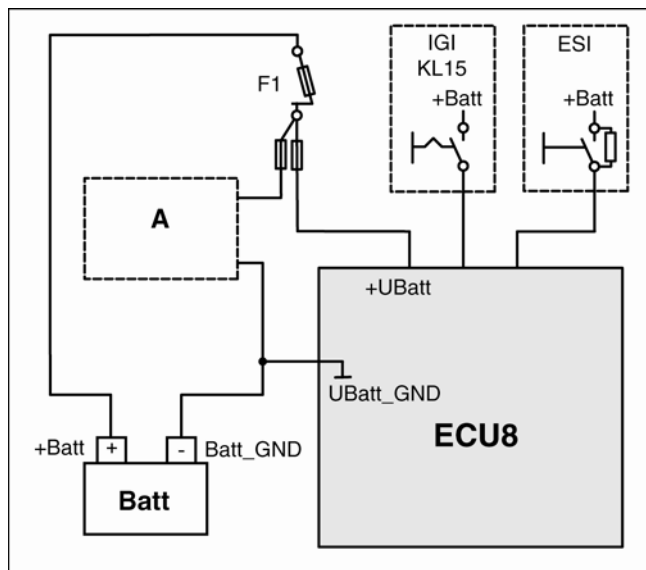
If this function is not used, the input remains unswitched.

The ESI input shuts off the IOS (injector output stage) directly by the hardware.

An immediate stop of the engine is therefore possible. Engine data and alarms are saved in an external flash memory.

- Input level = low ->
The ECU detects the input state as a discontinuity if a parallel resistance of $33\text{kohm} \pm 10\%$ is connected. The parameters of this function can set in the SW.
- Input level = high ->
Shut off of the IOS (injector output stage) for all cylinders. This state is saved and can only be restored by the software. “Open-circuit current principle”

Connection diagram and main functions of the IGI/ESI



ECU8	Engine Control Unit	F1	Main fuse
A	Additional devices	IGI	Ignition on
BATT	Battery	ESI	Emergency stop

3.3 Installation on engine

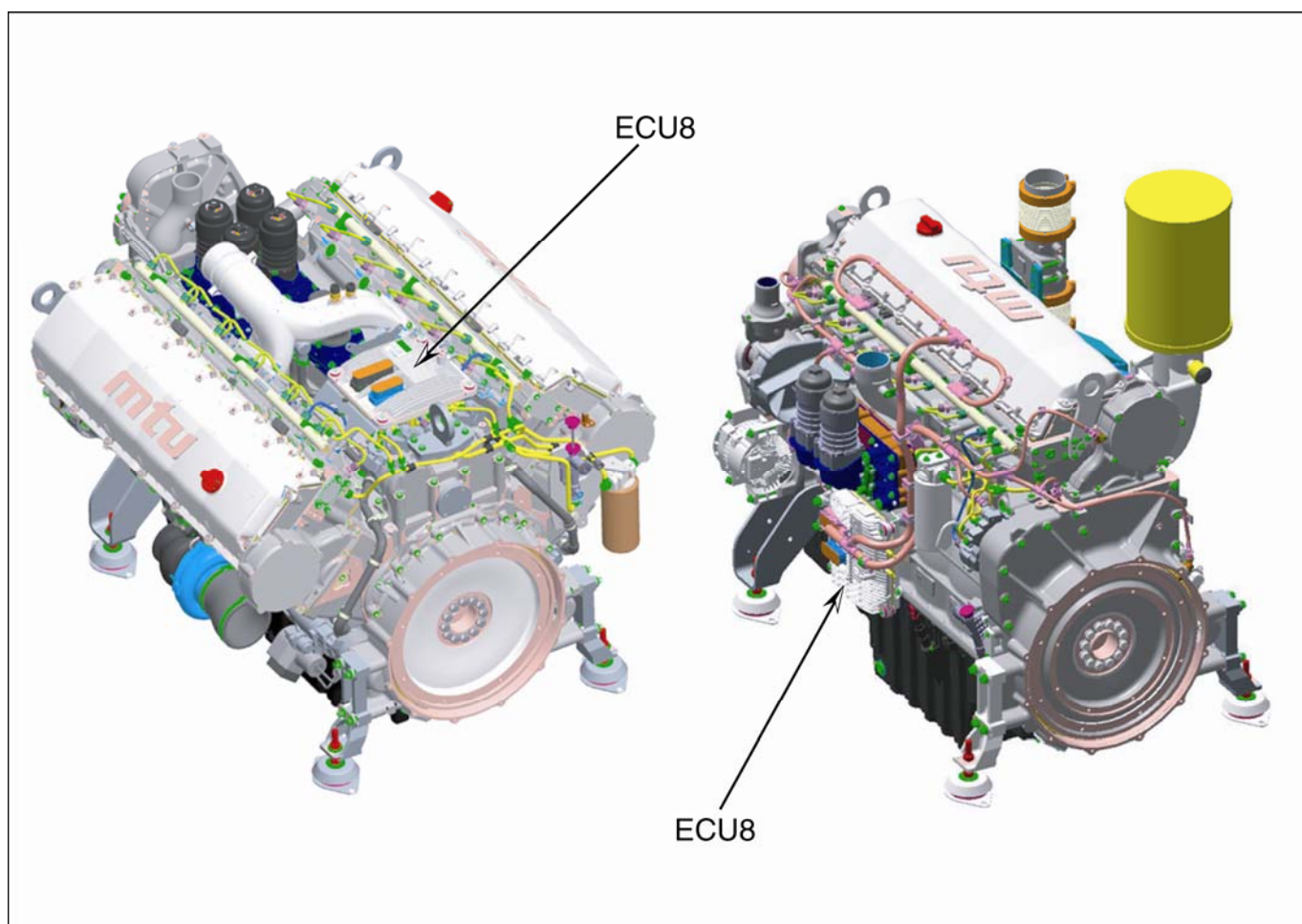
3.3.1 Specifications

The ECU8 (ADEC) Engine Control Unit is constructed with respect to the mechanical and thermal loads so that it can be directly mounted onto the engine (see specifications).

Ambient temperature -40°C to $+80^{\circ}\text{C}$

Housing temperature range for extreme conditions with coolant flow (70°C coolant temp.) -40°C to $+120^{\circ}\text{C}$

3.3.2 Mechanical design/installation location



On 8V, 10V and 12 V engines the ECU8 control unit is mounted at the top of the engine in an easily accessible location facing in the direction of the driving end (KS). On 6R engines the ECU8 control unit is installed on the left side of the engine at the bottom left.

The control unit cannot, however, be mounted away from the engine.

3.4 Technical data of ECU8

Term	Unit	Value
Housing material		AlSi10Mg
Dimensions (length x width x height)	mm	298 x 272 x 93
Draw-out clearance	mm	74
Weight (without cable connections)	kg	4.5
Installation position		Any
Operating voltage	VDC	16.8V to 24V to 32V (operation, injection without reduction in power) 14.4V to 16.8V (emergency operation, injection with reduction in power)
Power consumption	A	0.2 to 18 (typical) 33 max. at 24V (engine running) 10 mA with IGI off (ignition off) 0.2 A with IGI on (ignition on, engine off)
Heat output	W	45
Grounding		Must be made using a grounding strip
EMC protection		DIN ISO 7637-2 : 2002 (C&I International (SAEJ1113-13:2000)) DIN ISO 7637-3 : 1995 (C&I International) DIN ISO11452-2 : 2000 (SAEJ1113-21 : 1998), (CE Classification) EN 55011 : 2000 Curve A (CE Classification (industrial)) EN 55011 : 2000 Curve A (CE Classification (industrial) CISPR 11) EN 55025 : 2003 (Car, Marine (CISPR 11), SAEJ1113-41:2000) EN 50121-3-2 : 2001 (Rail Curve A + 10dB) EN 50155 (Rail) EN 55025 : 2003 (C&I International (CISPR 25)) EN 61000-4-2 : 2001 (IEC 61000-4-2), (Marine classified/Rail) EN 61000-4-4 : 2004 (IEC 61000-4-4), (Rail) EN 61000-4 : 2006 (IEC 61000-4-4), (Rail) EN 61000-4-5 : 2004 (IEC 61000-4-5), (Marine classified) EN 61000-4-6 : 2001 (IEC 61000-4-6), (Marine classified) EN 61000-4-17 : 2000 (Marine classified) EN 61000-6-2 (CE industrial) EN 13390 : 2000 (ISO13766), (C&I International) IEC 60533 : 1990 (Marine classified (CISPR 16)) IEC 60533 : 1999 (Marine classified (CISPR 16)) ISO 10605 : 2001 (C&I International (SAEJ1113-13:2000))
Dielectric strength		10 mΩ (IEC 60092-504) $U_{\text{test}} \geq 50 \text{ VDC}$ (ECU8 removed for test) 500 VDC as per EN 50155

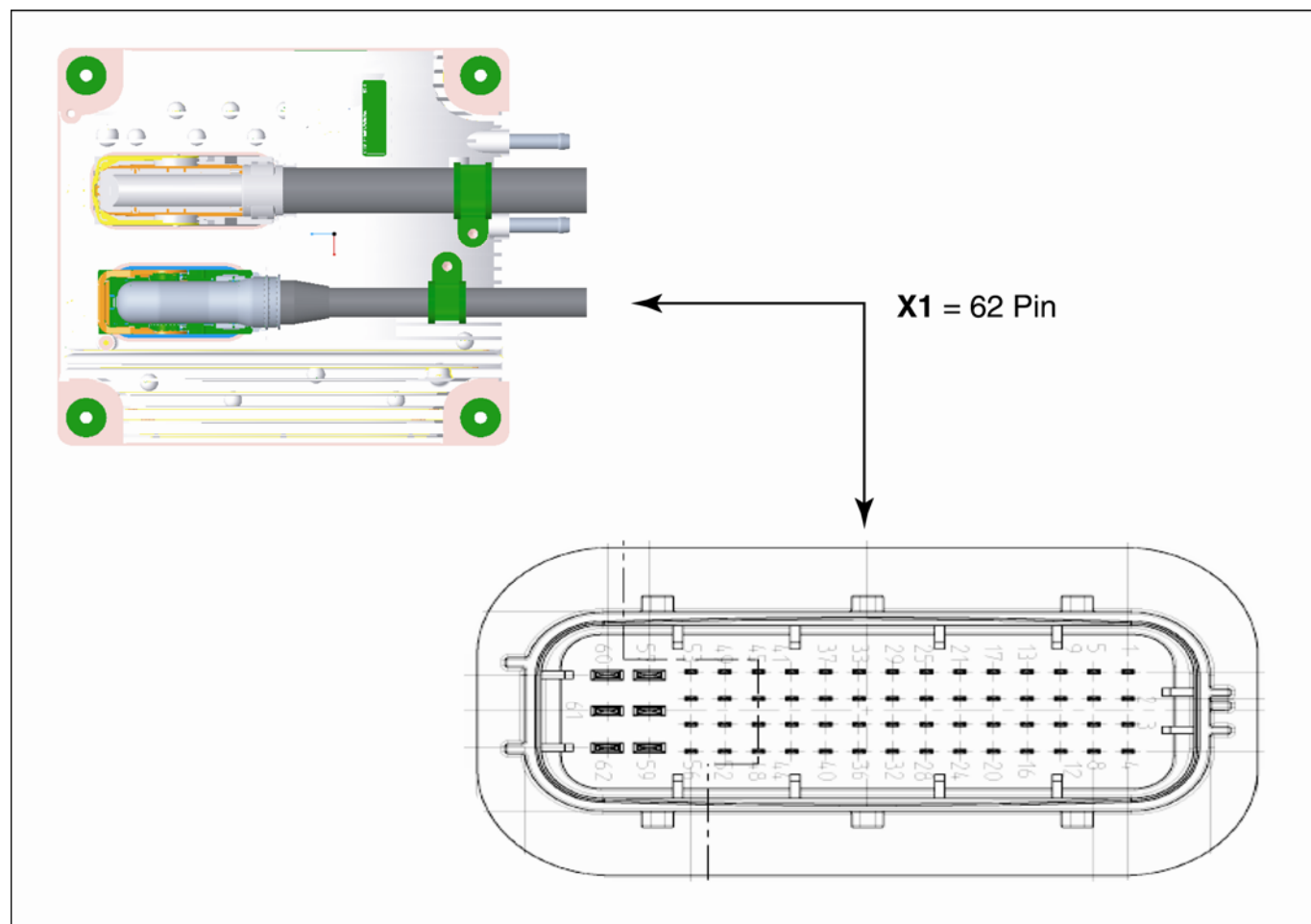
Term	Unit	Value
ESD protection		EN 61000-4-2 : 2001 (IEC 61000-4-2) EN 50121-3-2, EN50155 Rail IEC 60533 Civil Marine EN 61000-6-2 CE Industrial ISO 10605 : 2001 (C&I international)
Ambient temperature in operation	°C	- 40 to + 80 (up to 95°C max 60 minutes, with an air circulation of at least >2m/min)
Storage temperature	°C	- 40 ... + 85
Housing temperature	°C	+ 105 max (cooled down to 75°C after 60 min)
Relative air humidity	%	0 to 95%, condensing
Degree of protection		Connected IP69K (IEC 60529, DIN 40050) Open (not connected) IP20 with connector caps IP54
Shock resistance		ICE 600-2-32 drop test ICE 68-2-27 (30g/11ms)
Vibro stability ECU housing noise		ICE 60068-2-6 (requirements for the x/y/z axis 5Hz to 2000Hz) 4.7 grms at 5Hz to 20Hz 4.7 grms at 20Hz to 150 Hz 4.7 grms at 150Hz to 300 Hz 4.7 grms at 300Hz to 1000 Hz 4.7 grms at 1000Hz to 2000 Hz
Resistance to chemicals		EN 60271-1-3-5 (MTU requirements: EU standards, diesel, bio diesel, oil, coolant)
MTBF	h	20,000 (at 75°C ambient temperature)

3.5 Connectors

3.5.1 Connector X1/connector to ECU8

3.5.1.1 Connector assignment

Pin assignment X1 (system cable) 62 pin (6 x MCP2.8; 54 x MCP1.5)



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This connector is the interface to the system.

The connector assignment of connector X1 is described in the following table. The short specification gives the most important properties of each channel.

Designation	Pin	Signal type	Brief specification
CAN1_P	1	CAN1_P_H	50V isolated
CAN1_P	2	CAN1_P_L	
CAN1_P	5	CAN1_P_GND	
CAN2_P	3	CAN2_P_H	50V isolated
CAN2_P	4	CAN2_P_L	
CAN2_P	8	CAN2_P_GND	
DI1	10	DI1_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI1	9	DI1_L	50V isolated

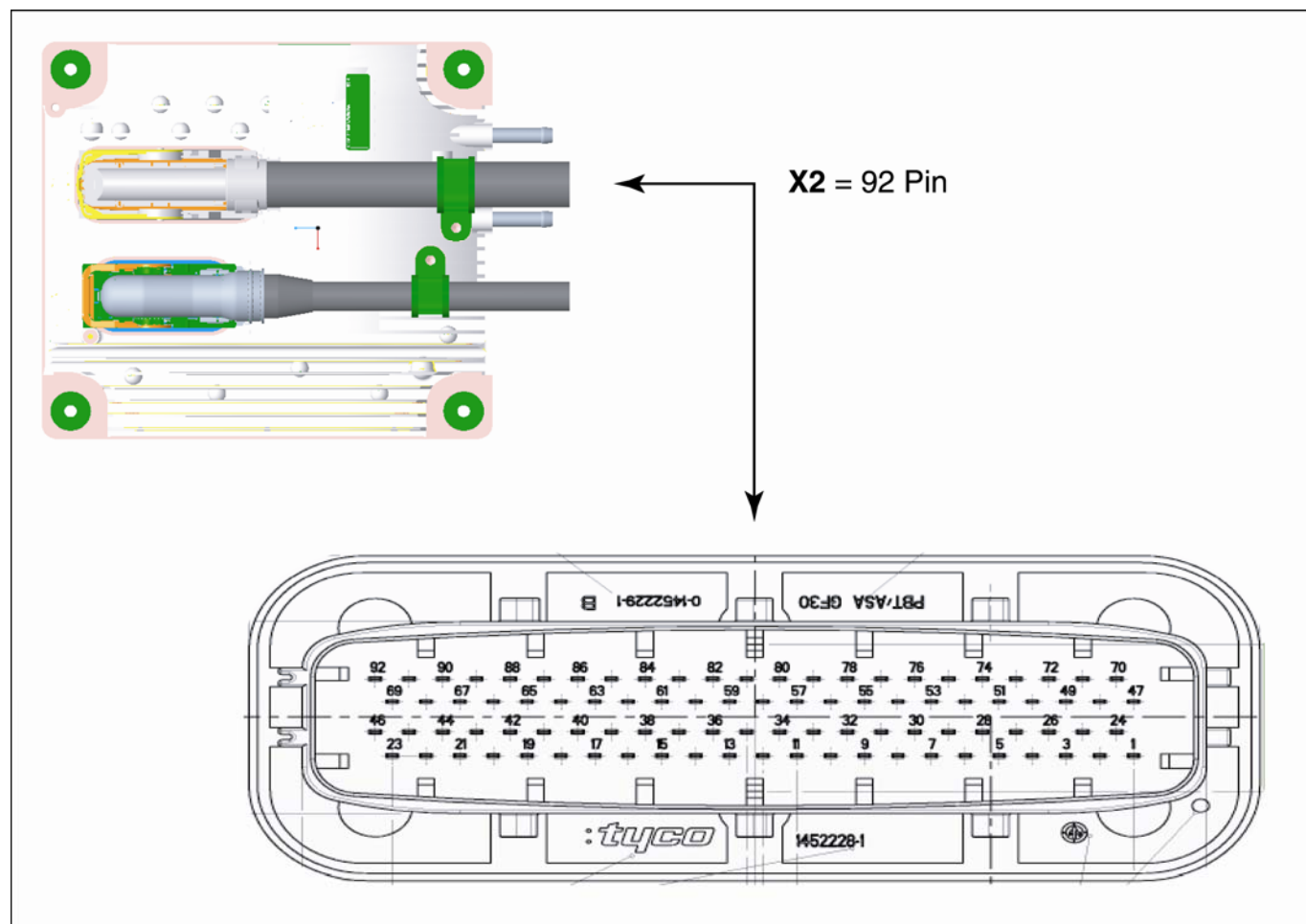
Designation	Pin	Signal type	Brief specification
I2	14	DI2_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI2	13	DI2_L	50V isolated
DI3	18	DI3_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI3	17	DI3_L	50V isolated
DI4	22	DI4_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI4	21	DI4_L	50V isolated
DI5	26	DI5_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI5	25	DI5_L	50V isolated
DI6	30	DI6_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI6	29	DI6_L	
DI7	34	DI7_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI7	33	DI7_L	50V isolated
DI8	38	DI8_H	<4V(<1.1mA) = low/>8V (>1.5mA) = high
DI8	37	DI8_L	50V isolated
AI1_2	41	AI_2_5V	5V/24° ± 50V isolated to other potential
AI1	48	AI1_U	0...10V (not isolated to AI2)
AI1	45	AI1_I	0 to 23.7mA (not isolated to AI2)
AI2	50	AI2_U	0...10V (not isolated to AI1)
AI2	49	AI2_UI	0 to 23.7mA (not isolated to AI1)
AI1_2	42	AI1_2_GND	AI_GND ± 50V isolated to other potential
AO1	40	AO1_OUT	0 to 10V/8mA
AO2	44	AO2_OUT	0 to 10V/8mA
AOI_2_FIP	35	AOI_2_FIP_GND	GND
FIP	24	FIP_IN	0 to 5V or frequency input <xV low / >yV high I=?
TOP1	12	TOP1_OUT	24V/TOP1+...+TOP4 = 3A; max 1.5A source/sink
TOP2	11	TOP2_OUT	24V/TOP1+...+TOP4 = 3A; max 1.5A source/sink
TOP1_2	15	TOP1_2_GND	LGND (3A)
TOP3	20	TOP3_OUT	24V/TOP1+...+TOP4 = 3A; max 1.5A source/sink
TOP4	19	TOP4_OUT	24V/TOP1+...+TOP4 = 3A; max 1.5A source/sink
TOP3_4	16	TOP3_4_GND	LGND (3A)
FO	48	FO_OUT	24V/1.5 A sink to LGND/< 500Hz
	28	NC	NC
	28	NC	NC
	28	NC	NC
IGI	32	IGI_24V	24 V/10 mA (bridge to IGI_IN to disable IGI function)
IGI	31	IGI_IN	<4V (2mA) = low / >8V (4mA) = high
ESI	36	ESI_IN	<4V (2mA) = low / >8V (4mA) = high

Designation	Pin	Signal type	Brief specification
ITS_OFF	39	ITS_OFF	Connect this pin to FGND-> ITS disabled
ITS_OFF	43	FGND	
	6	NC	NC
	7	NC	NC
	47	NC	NC
	51	NC	NC
	52	NC	NC
	53	NC	NC
	54	NC	NC
	55	NC	NC
	56	NC	NC
POWER	59	+24V	24V/30A
POWER	58	+24V	24V/30A
POWER	62	+24V	24V/30A
POWER	57	+24V	GND/30A
POWER	61	+24V	GND/30A
POWER	60	+24V	GND/30A

3.5.2 Connector X2/engine wiring harness

3.5.2.1 Connector assignment

Pin assignment X2 (engine wiring harness) 92 pins (92 x MCP1.5)



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Engine sensors are connected to this connector.

The connector assignment for connector X2 is shown in the following table. The short specification gives the most important properties of each channel.

Designation	Pin	Signal type	Brief specification
ASI1	78	ASI1_H	
ASI1	56	ASI1_L	< 120mV = low/< 0mV = high
ASI2	77	ASI2_H	
ASI2	55	ASI2_L	< 120mV = low/< 0mV = high
CAN3_E	24	CAN3_E_GND	
CAN3_E	1	CAN3_E_H	50V isolated
CAN3_E	2	CAN3_E_L	
FI2	53	FI2_H	<-482mV = low/> 586mV = high
FI2	75	FI2_L	

Designation	Pin	Signal type	Brief specification
FI1	54	FI1_H	<-482mV = low/> 586mV = high
FI1	76	FI1_L	
IO11	46	IO11_H	42V/10A
IO11	23	IO11_L	Bank 1
IO12	45	IO12_H	42V/10A
IO12	22	IO12_L	Bank 1
IO21	44	IO21_H	42V/10A
IO21	21	IO21_L	Bank 2
IO22	43	IO22_H	42V/10A
IO22	20	IO22_L	Bank 2
IO31	42	IO31_H	42V/10A
IO31	19	IO31_L	Bank 3
IO32	41	IO32_H	42V/10A
IO32	18	IO32_L	Bank 3
IO41	40	IO41_H	42V/10A
IO41	17	IO41_L	Bank 4
IO42	39	IO42_H	42V/10A
IO42	16	IO42_L	Bank 4
IO51	38	IO51_H	42V/10A
IO51	15	IO51_L	Bank 5
IO52	37	IO52_H	42V/10A
IO52	14	IO52_L	Bank 5
IO61	36	IO61_H	42V/10A
IO61	13	IO61_L	Bank 6
IO62	35	IO62_H	42V/10A
IO62	12	IO62_L	Bank 6
LSI1	31	LSI1_13V_5V_T8	Supply 13V/5V for LSI1 max. 12 mA/channel tracker 8
LSI1	10	LSI1_IN	0...5V / internal 47k5 pull down PI / pull up 3k32 LSI
LSI2	32	LSI1_13V_5V_T9	Supply 13V/5V for LSI1 max 12mA/channel tracker 9
LSI2	33	LSI2_IN	0 to 5V/internal 47k5 pull down PI/pull up 3k32 LSI (Data IN/OUT EI_module)
NSI1	11	NSI1_24V	24V/0.5°/Rmin 16k for OL detection
NSI1	34	NSI1_IN	0 to 5V/internal 47k5 pull down PI/pull up LSI
NSI1	30	NSI1_GND	GND
PHI1	73	PHI1_5V_T1	5V/12mA/tracker T1
PHI1	52	PHI1_GND	GND
PHI1	74	PHI1_IN	0 to 5V/internal 47k5 pull down

Designation	Pin	Signal type	Brief specification
PHI2	71	PHI2_5V_T2	5V/12mA/tracker T2
PHI2	51	PHI2_GND	GND
PHI2	72	PHI2_IN	0 to 5V/internal 47k5 pull down
PI1	49	PI1_5V_T3	5V/12mA/tracker T3
PI1	50	PI1_GND	GND
PI1	70	PI1_IN	0 to 5V/internal 47k5 pull down
PI2	25	PI2_5V_T4	5V/12mA/tracker T4
PI2	26	PI2_GND	GND
PI2	3	PI2_IN	0 to 5V/internal 47k5 pull down
PI3	4	PI3_5V_T5	5V/12mA/tracker T5
PI3	27	PI3_GND	GND
PI3	5	PI3_IN	0 to 5V/internal 47k5 pull down
PI4	6	PI4_5V_T6	5V/12mA/tracker T6
PI4	28	PI4_GND	GND
PI4	7	PI4_IN	0 to 5V/internal 47k5 pull down
PI5	8	PI5_5V_T3	5V/12mA/tracker T7 for PI5 to 7 (48mA)
PI5	29	PI5_GND	GND
PI5	9	PI5_IN	0 to 5V/internal 47k5 pull down
PI6	47	PI6_IN	0 to 5V/internal 47k5 pull down
PI7	48	PI7_IN	0 to 5V/internal 47k5 pull down
PWM_CM1	91	PWM_CN1_GND	LGND (50mohm)
PWM_CM1	92	PWM_CN1_OUT	24V/3A with current measurement (CM)
PWM_CM2	68	PWM_CN2_GND	LGND (50mohm)
PWM_CM2	69	PWM_CN2_OUT	24V/3A/< 500Hz
PWM_CM3	67	PWM_CN3_GND	LGND (50mohm)
PWM_CM3	90	PWM_CN3_OUT	24V/3A/< 500Hz
PWM1	65	PWM1_GND	LGND
PWM1	88	PWM1_OUT	24V/3A/< 500Hz
PWM2	66	PWM2_GND	LGND
PWM2	89	PWM2_OUT	24V/3A/< 500Hz
TI1	64	TI1_GND	GND
TI1	87	TI1_IN	0 to 5V/internal 1k91 pull up to TI_BUF
TI2	63	TI2_GND	GND
TI2	86	TI2_IN	0 to 5V/internal 1k91 pull up to TI_BUF
DFI2	62	DFI2_IN	Internal 47k5 pull down/pull up 1.82k + diode -> 5V
TI3	85	TI3_IN	0 to 5V/internal 1k91 pull up to TI_BUF
DFI1	61	DFI1_IN	Internal 47k5 pull down/pull up 1.82k + diode -> 5V

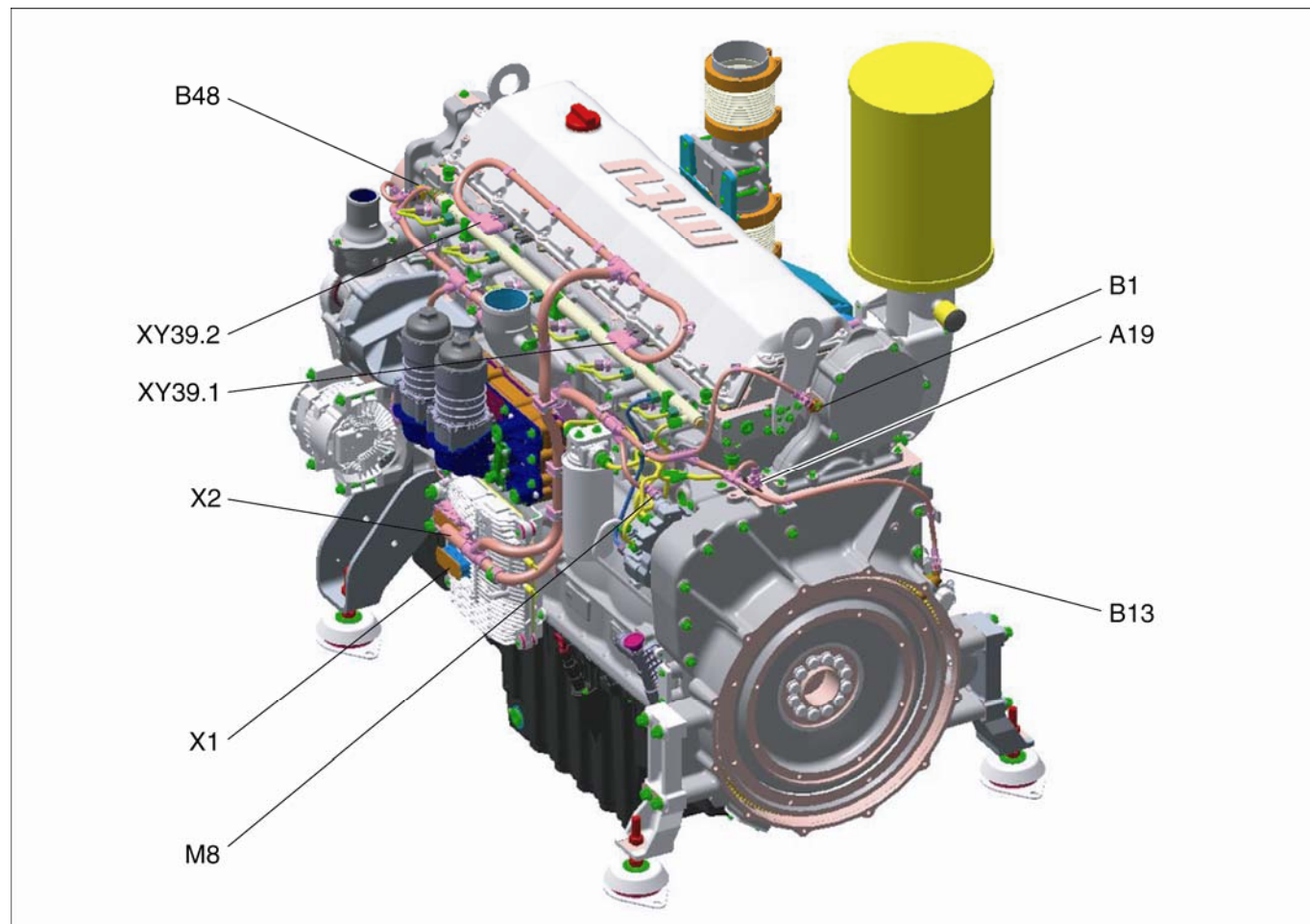
Designation	Pin	Signal type	Brief specification
TI4	84	TI4_IN	0 to 5V/internal 1k91 pull up to TI_BUF
DFI1_2	60	DFI1_2_12v	Supply for DFI1/2 (12V/200mA)
TI5	83	TI5_IN	0 to 5V/internal 1k91 pull up to TI_BUF
TI6	82	TI6_IN	0 to 5V/internal 1k91 pull up to TI_BUF
TI7	81	TI7_IN	0 to 5V/internal 1k91 pull up to TI_BUF
TI8	59	TI8_IN	0 to 5V/internal 1k91 pull up to TI_BUF
PWM_CM4	58	PWM_CM4_GND	LGND (50mohm)
PWM_CM4	80	PWM_CM4_OUT	24V/3A/< 500Hz
TO1	57	TO1_GND	LGND
TO1	79	TO1_OUT	24V/1.5A

4 Sensors

4.1 Installation location of the sensors

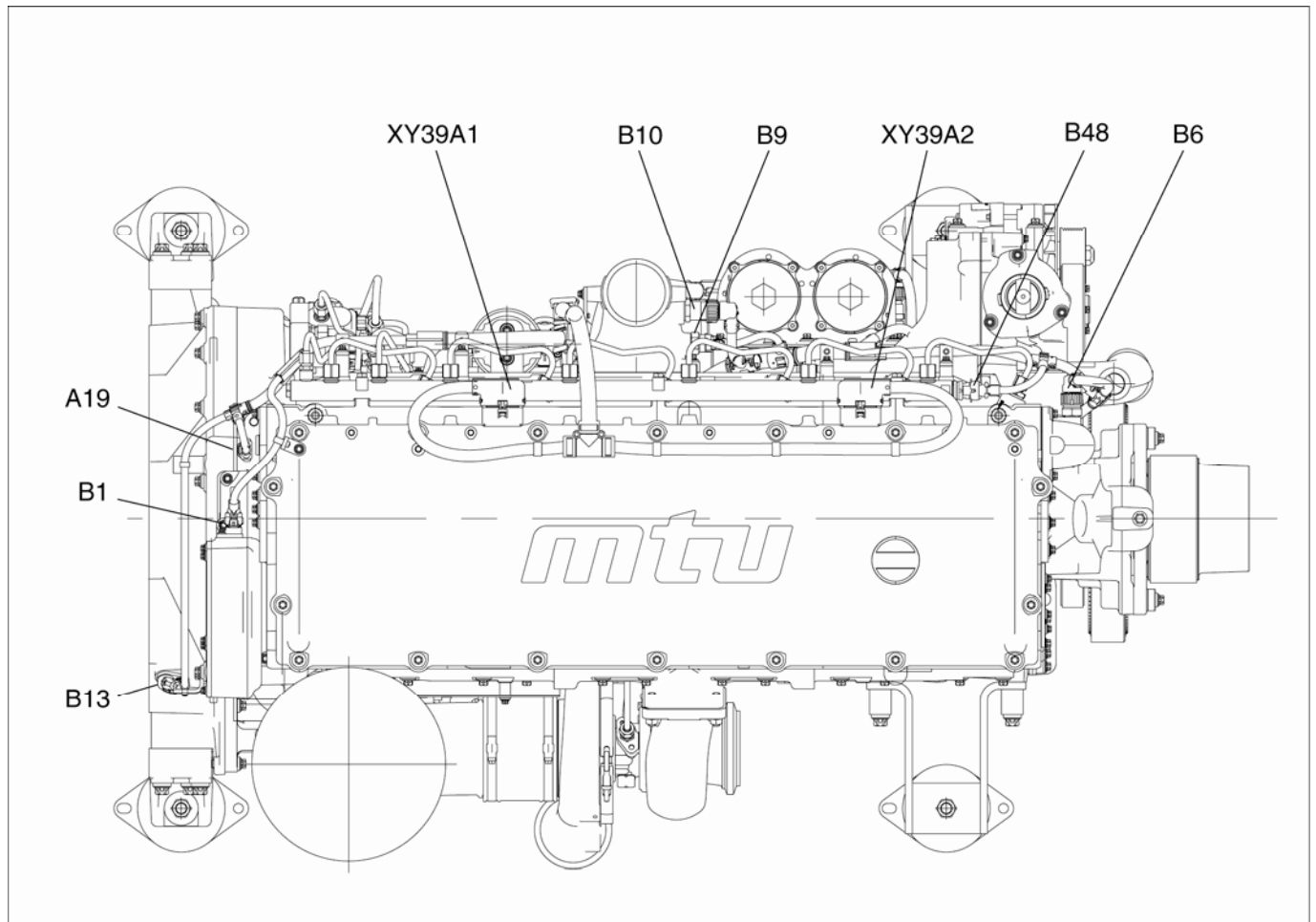
4.1.1 Sensors on Series 1600-6R engines

4.1.1.1 Series 1600-6R overview



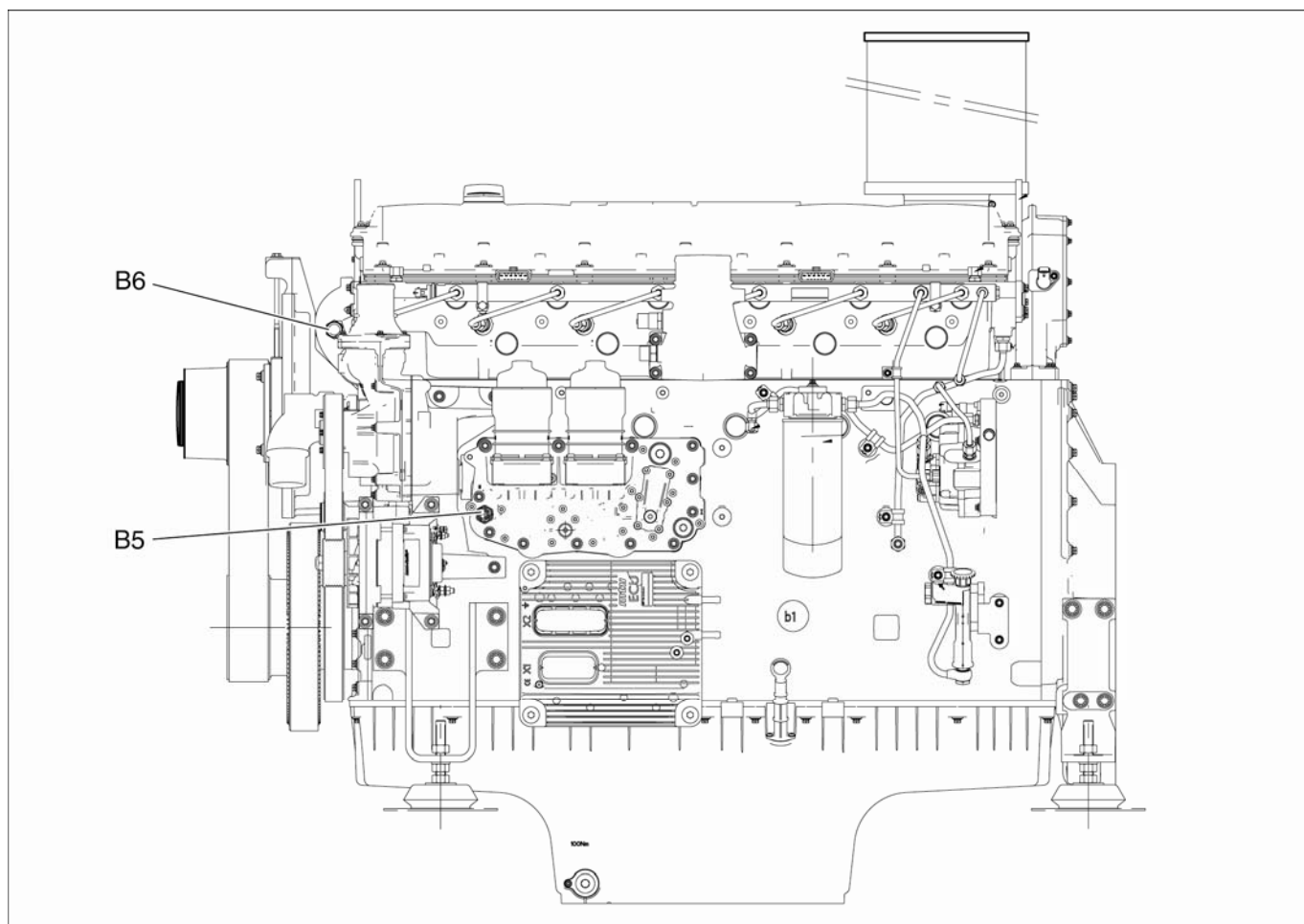
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
M8	Fuel pump HPP
X1	Smart Connect connection/system wiring harness
X2	ECU connector engine wiring harness
XY39.1	Injector connection 1
XY39.2	Injector connection 2
B48	Fuel pressure

4.1.1.2 Series 1600-6R top



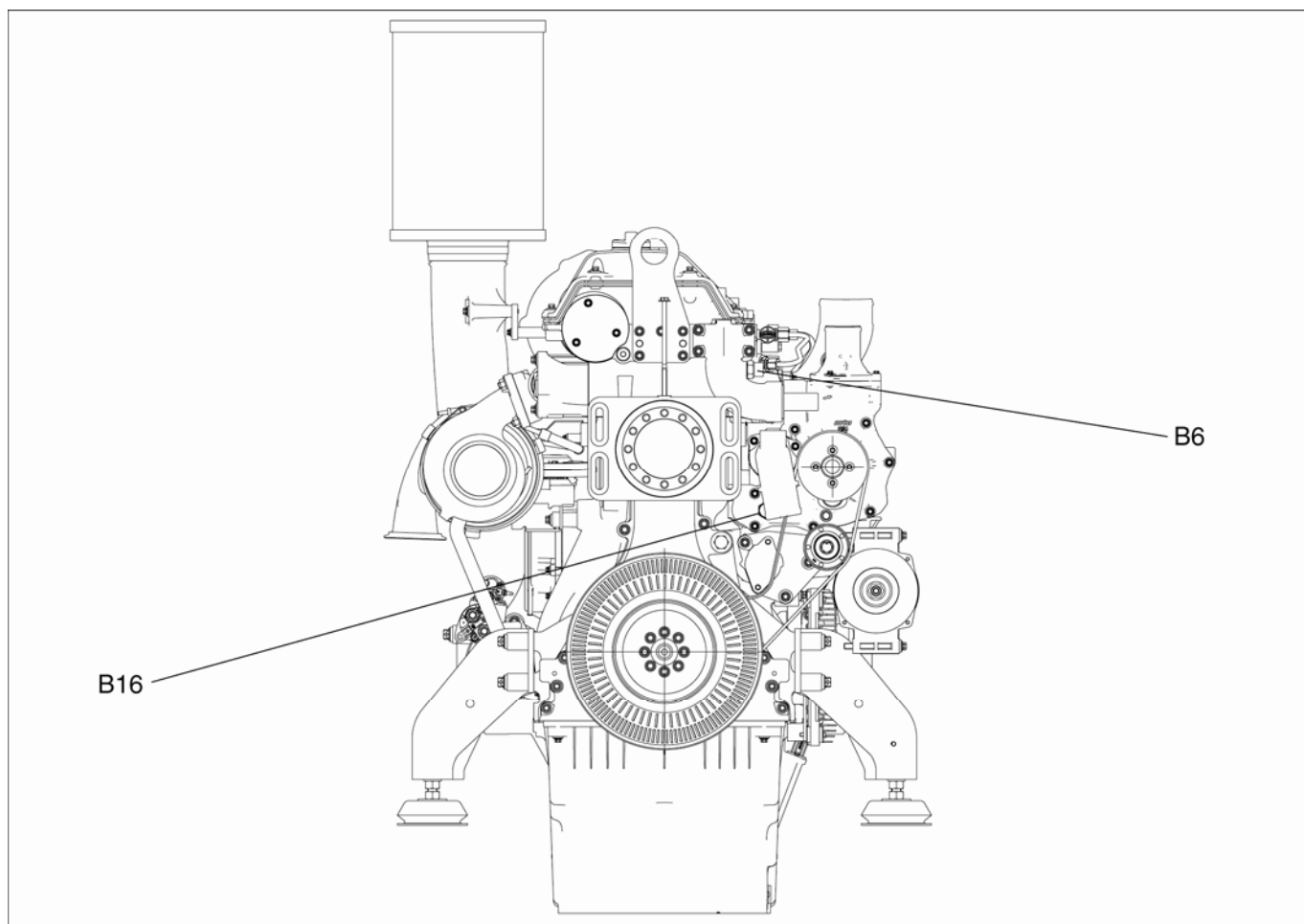
XY39.1	Injector connection 1
B10	Charge-air pressure
B9	Charge-air temperature
XY39.2	Injector connection 2
B48	Fuel pressure
B6	Coolant temperature
B13	Crankshaft speed
B1	Camshaft speed
A19	Engine Identity Label EIL

4.1.1.3 Series 1600-6R left side



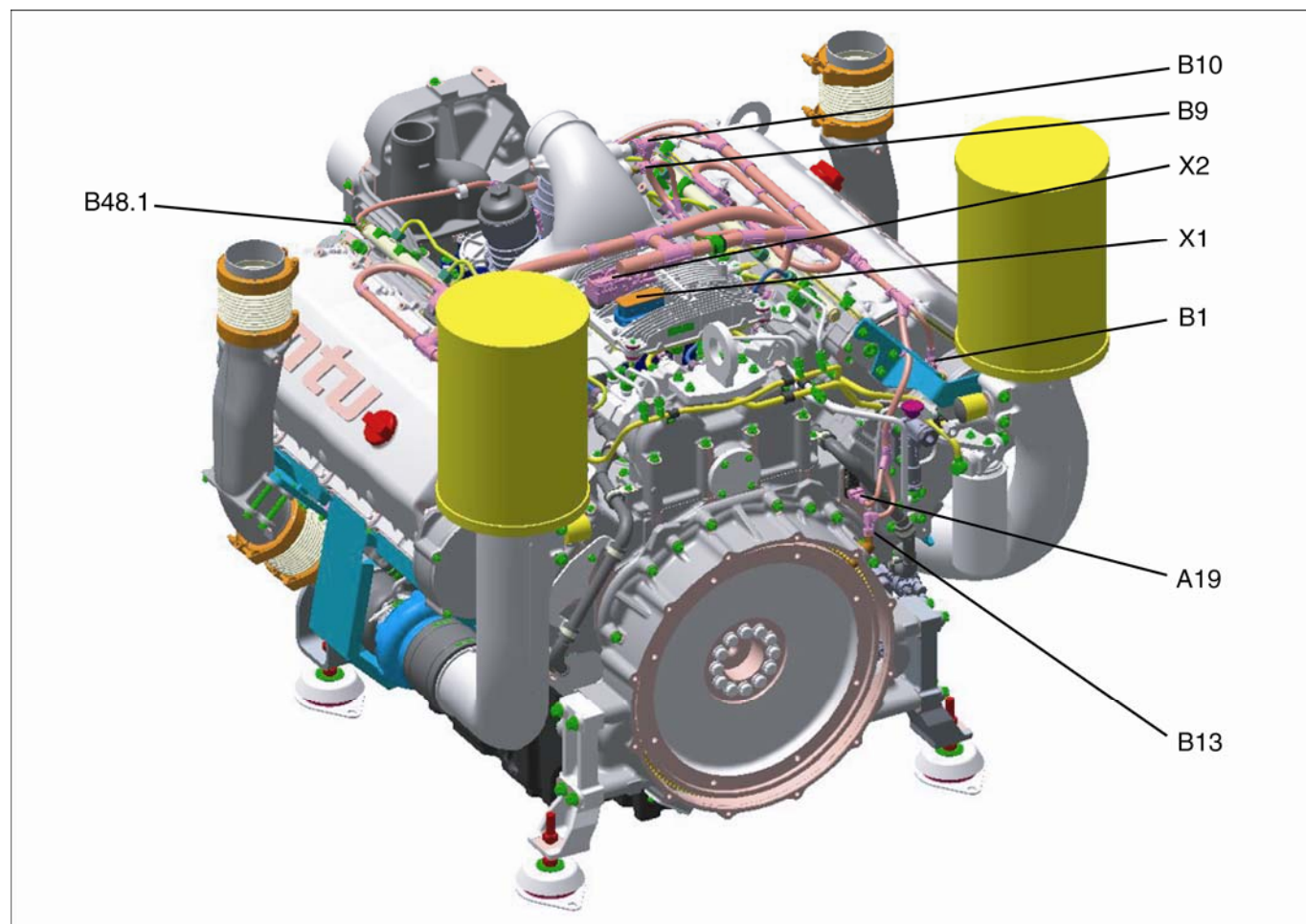
B5 Lube oil pressure
B6 Coolant temperature

4.1.1.4 Series 1600-6R free end



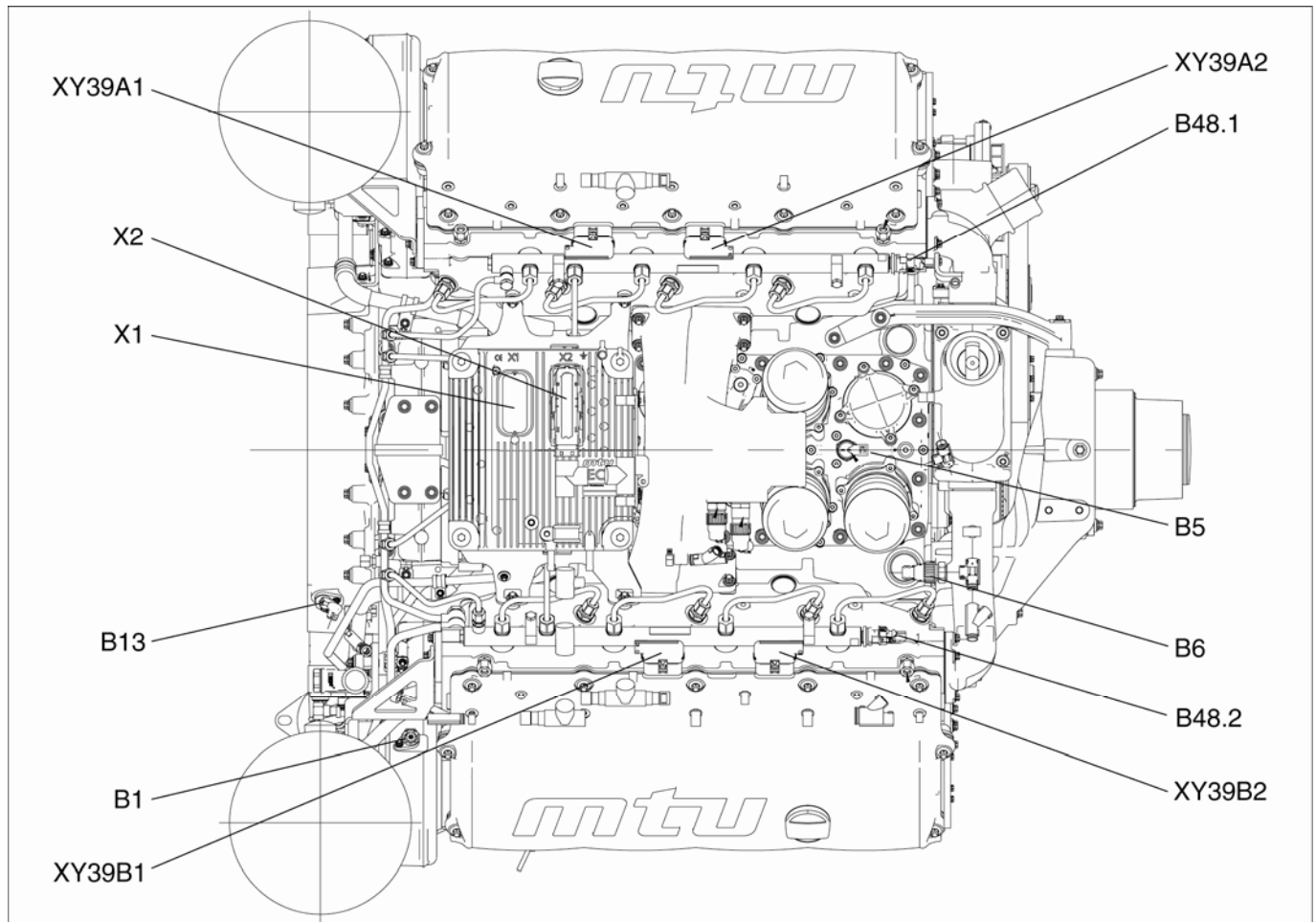
B6 Coolant temperature
B16 Coolant pressure

4.1.1.5 Series 1600-8V overview



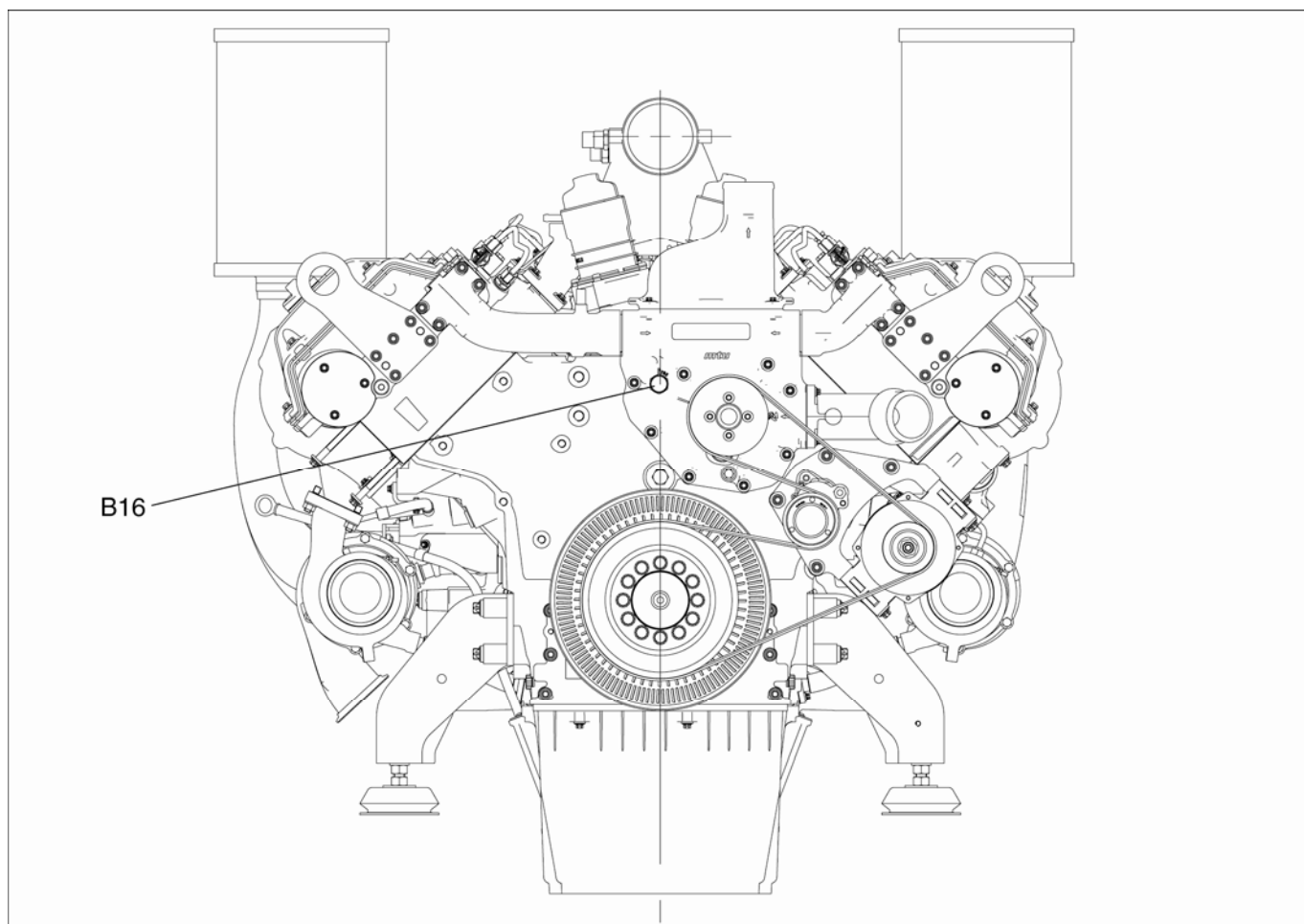
B10	Charge-air pressure
B9	Charge-air temperature
X2	ECU connector engine wiring harness
X1	Smart Connect connection/system wiring harness
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
B48.1	Fuel pressure rail A

4.1.1.6 Series 1600-8V top



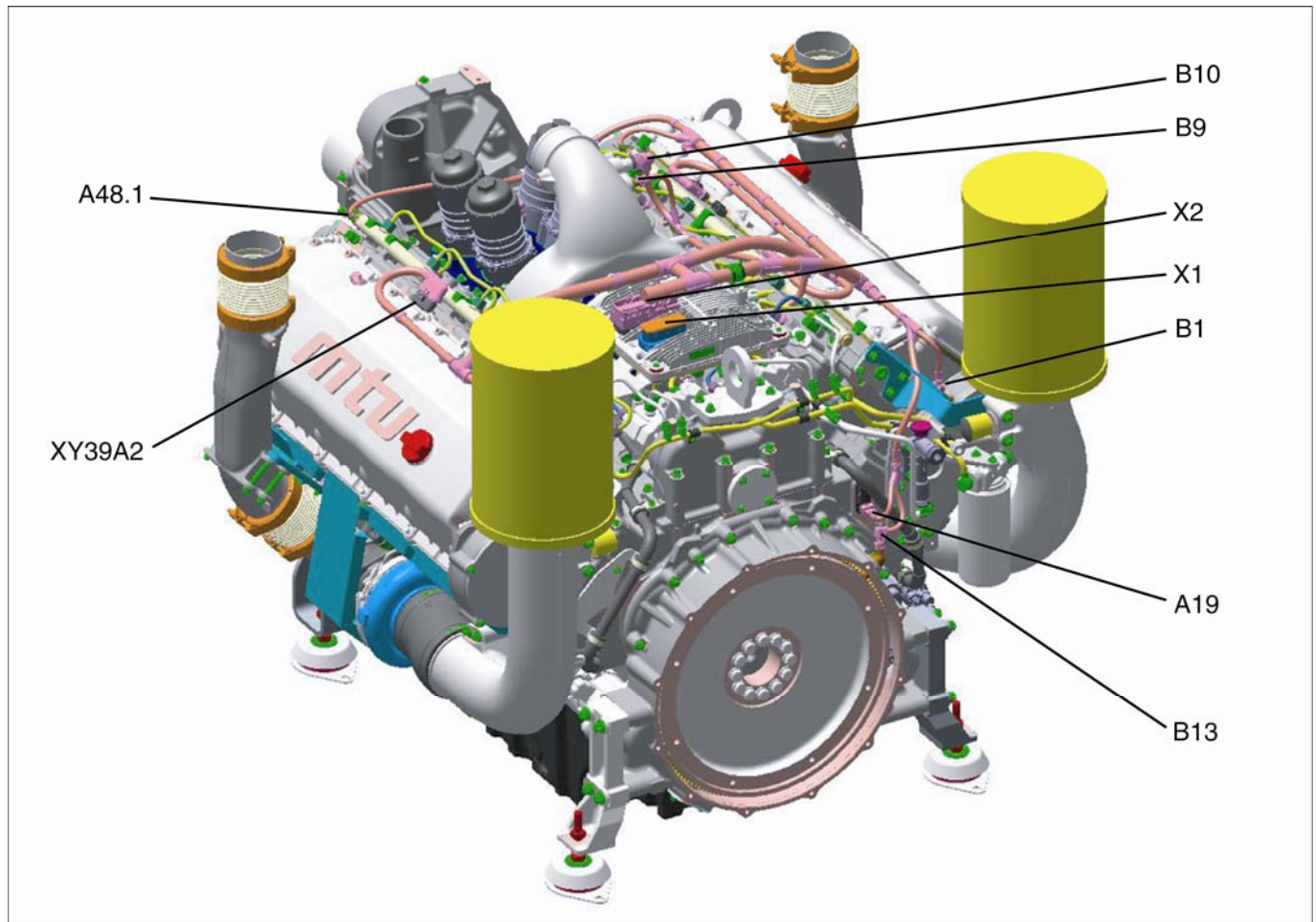
XY39A2	Injector connection A side 2
B48.1	Fuel pressure rail A
B5	Lube oil pressure
B6	Coolant temperature
B48.2	Fuel pressure rail B
XY39B2	Injector connection B side 2
XY39B1	Injector connection B side 1
B1	Camshaft speed
B13	Crankshaft speed
X1	Smart Connect connection/system wiring harness
X2	ECU connector engine wiring harness
XY39A1	Injector connection A side 1

4.1.1.7 Series 1600-8V free end



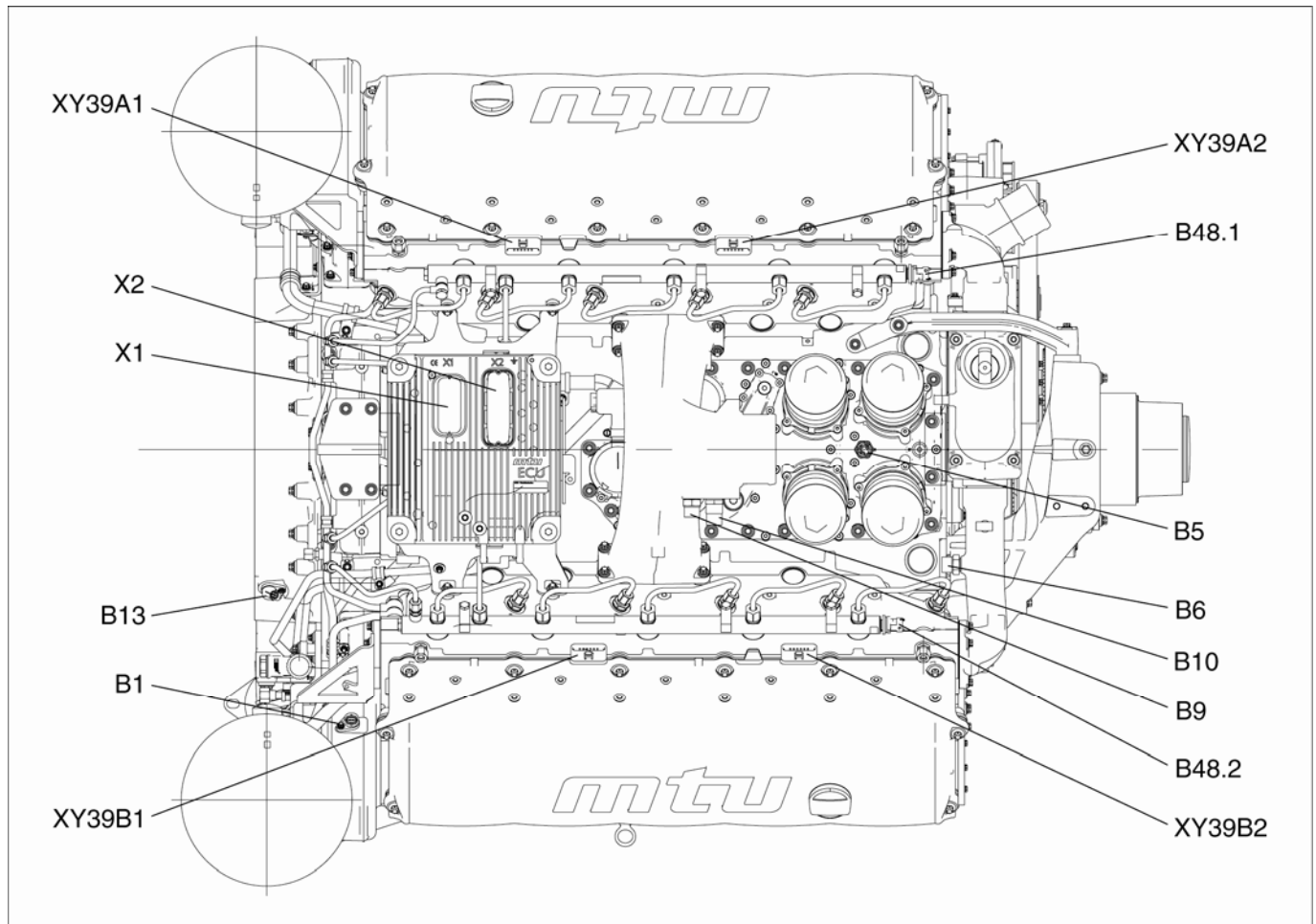
B16 Coolant pressure

4.1.1.8 Series 1600-10V overview



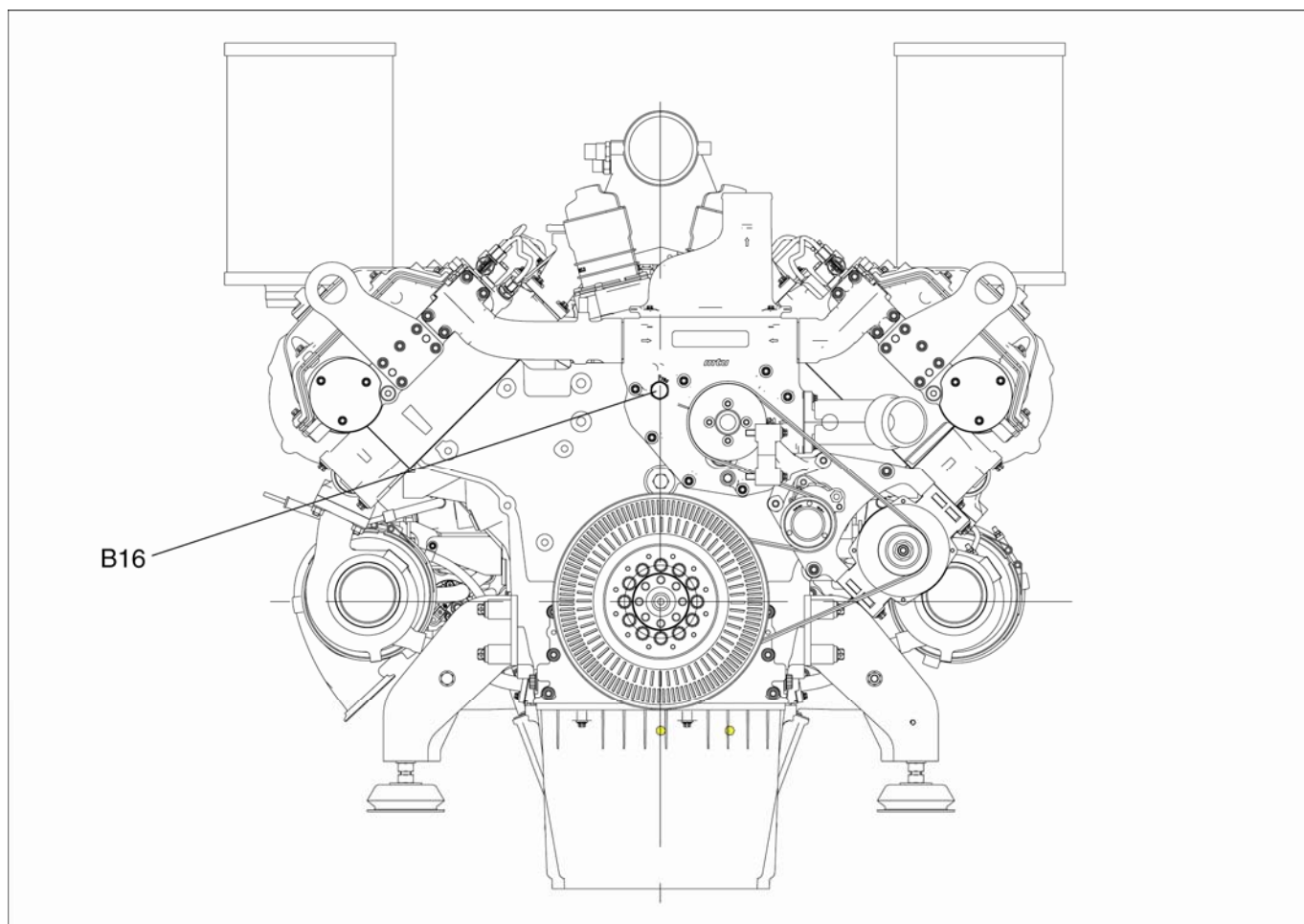
B10	Charge-air pressure
B9	Charge-air temperature
X2	ECU connector engine wiring harness
X1	Smart Connect connection/system wiring harness
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
XY39A2	Injector connection A side 2
B48.1	Fuel pressure rail A

4.1.1.9 Series 1600-10V top



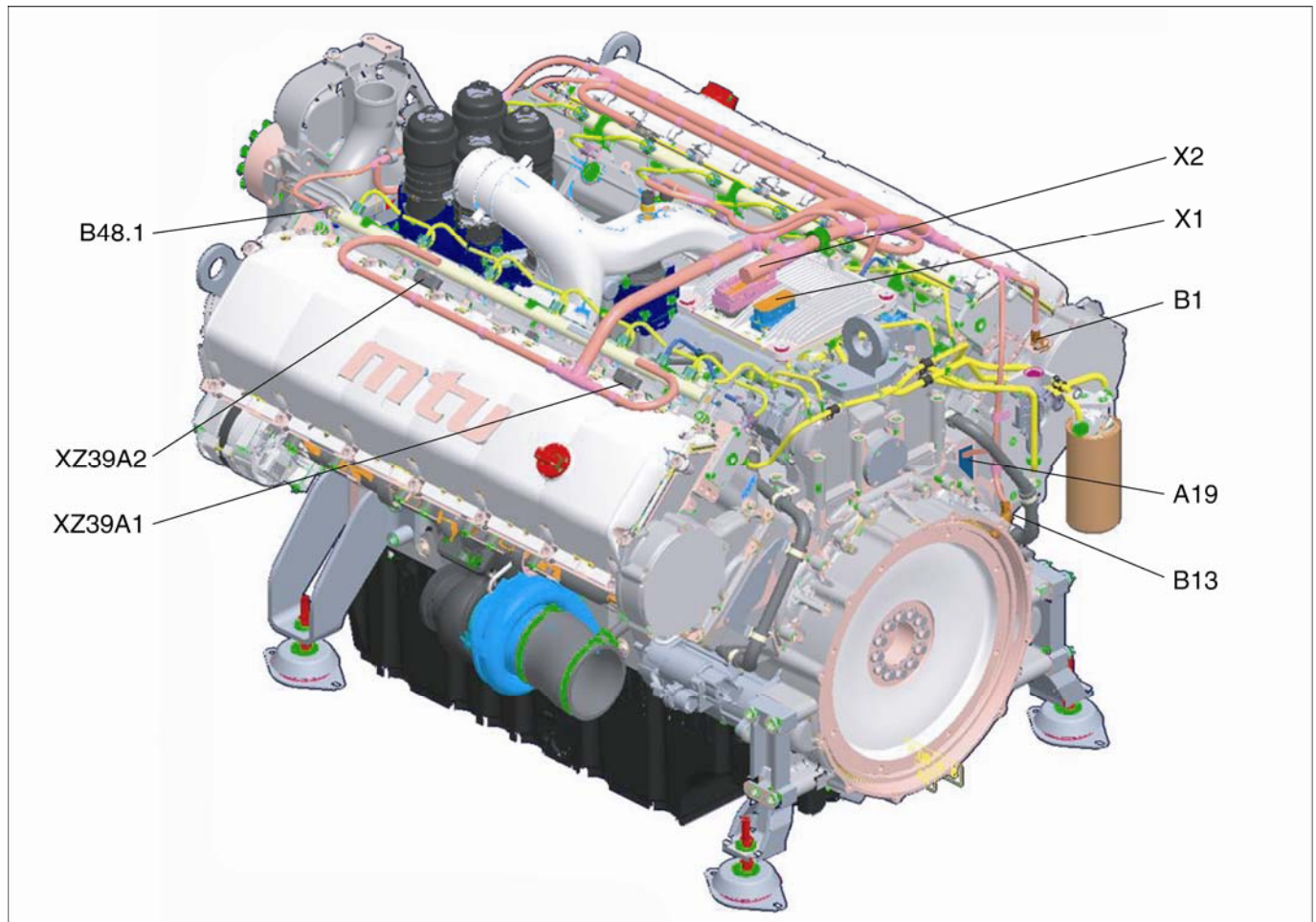
XY39A2	Injector connection A side 2
B48.1	Fuel pressure rail A
B5	Lube oil pressure
B6	Coolant temperature
B10	Charge-air pressure
B9	Charge-air temperature
B48.2	Fuel pressure rail B
XY39B2	Injector connection B side 2
XY39B1	Injector connection B side 1
B1	Camshaft speed
B13	Crankshaft speed
X1	Smart Connect connection/system wiring harness
X2	ECU connector engine wiring harness
XY39A1	Injector connection A side 1

4.1.1.10 Series 1600-10V free end



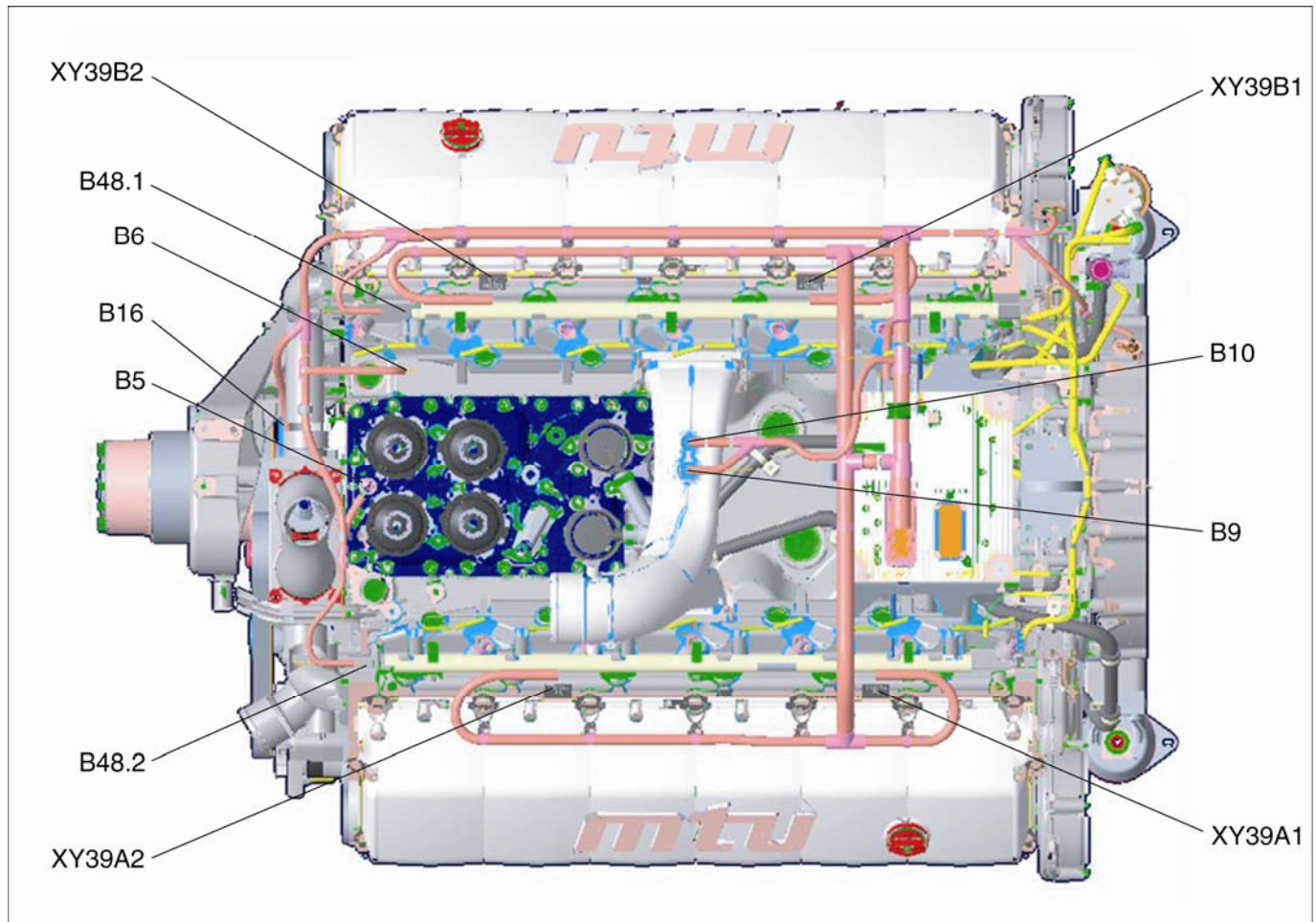
B16 Coolant pressure

4.1.1.11 Series 1600-12V overview



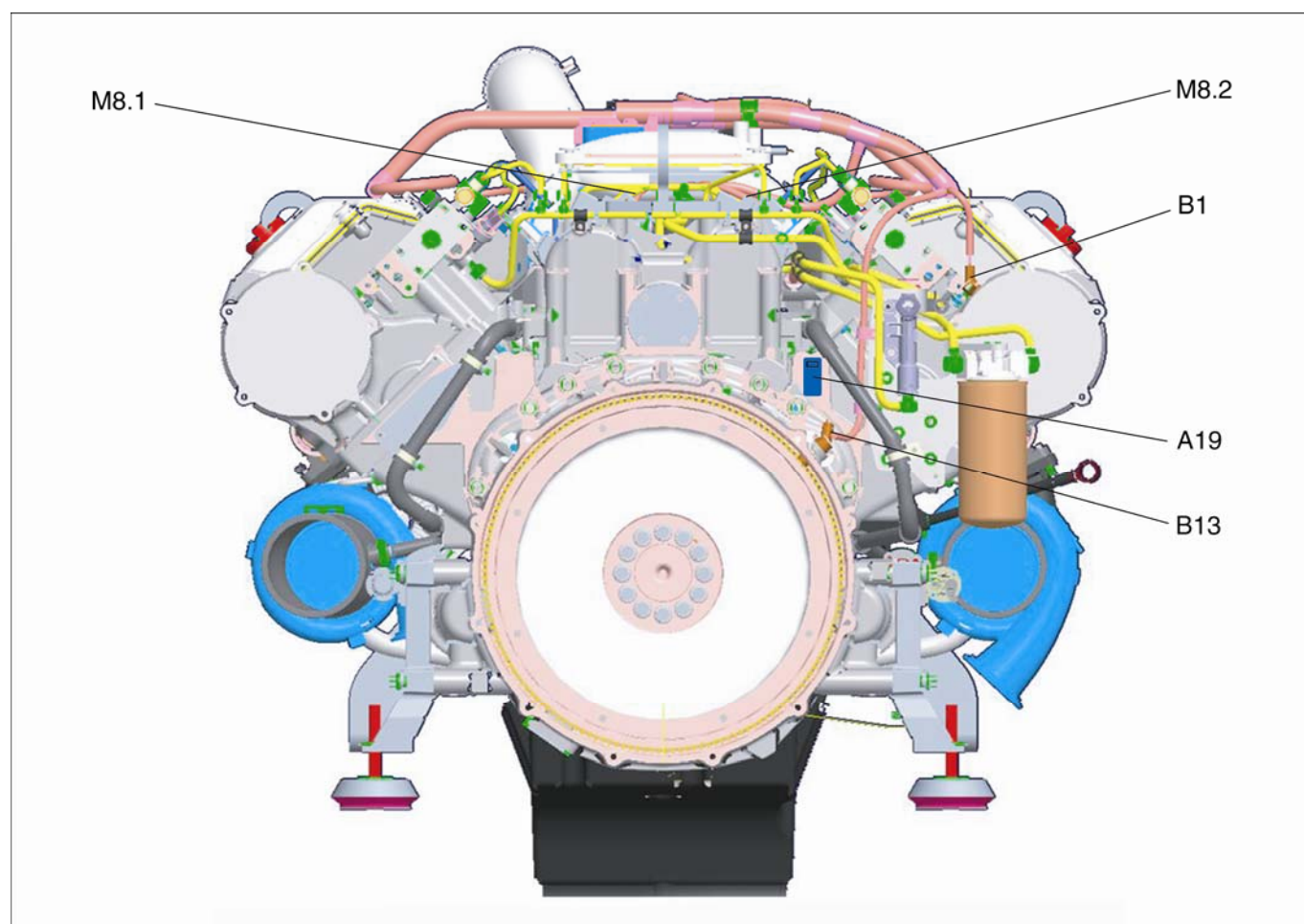
X2	ECU connector engine wiring harness
X1	Smart Connect connection/system wiring harness
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
XY39A1	Injector connection A side 1
XY39A2	Injector connection A side 2
B48.1	Fuel pressure A side

4.1.1.12 Series 1600-12V top



XY39B1	Injector connection B side 1
B10	Charge-air pressure
B9	Charge-air temperature
XY39A1	Injector connection A side 1
XY39A2	Injector connection A side 2
B48.2	Fuel pressure rail B
B5	Lube oil pressure
B16	Coolant pressure
B6	Coolant temperature
B48.1	Fuel pressure rail A
XY39B2	Injector connection B side 2

4.1.1.13 Series 1600-12V PTO end, driving end



M8.2	Fuel pump HPP B
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
M8.1	Fuel pump HPP A

4.2 Sensors used

4.2.1 Sensor types

Various sensors are used to record the engine's operating values:

- Pressure sensors
- Temperature sensors
- Speed sensors

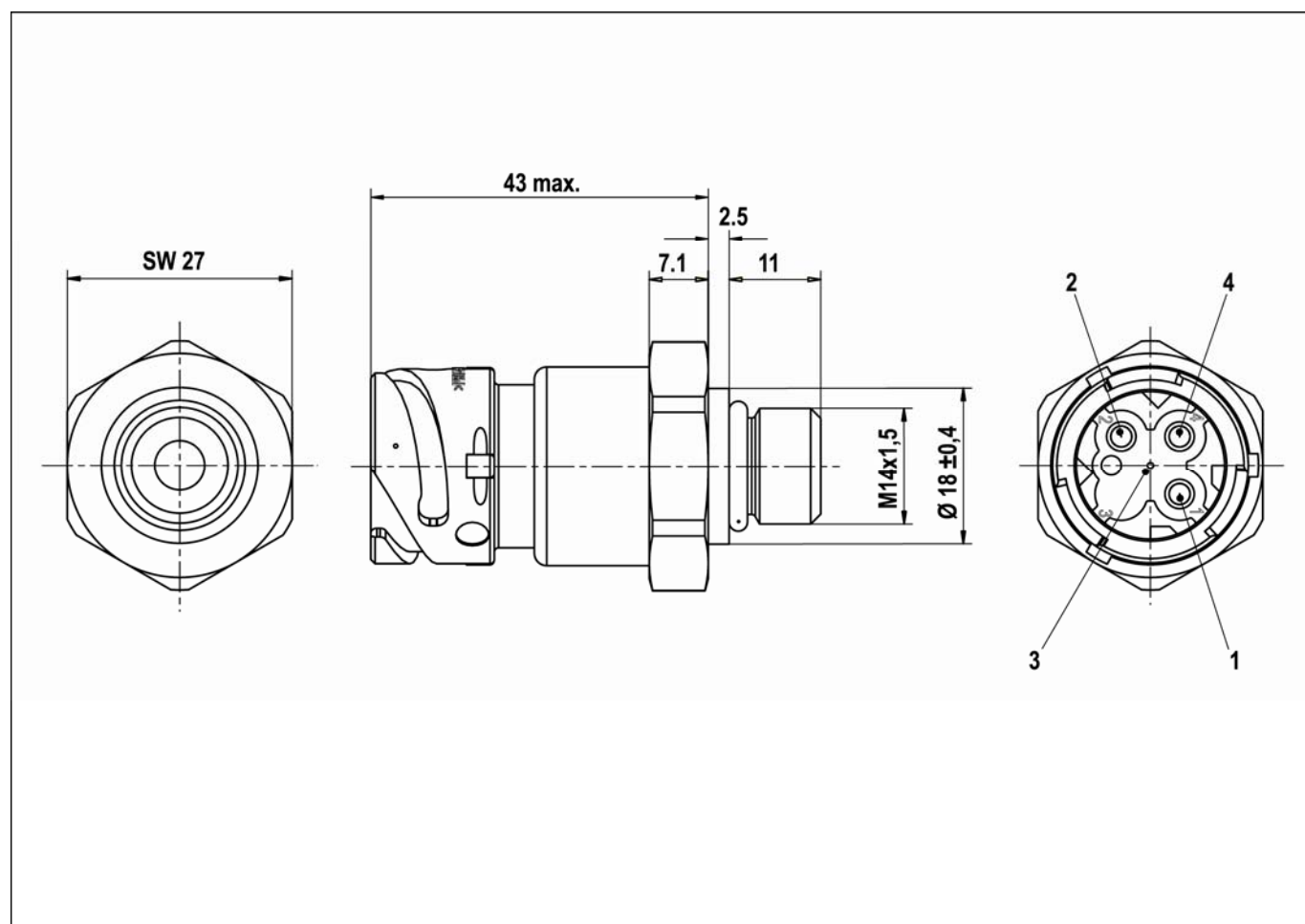
The following information is given in the subchapters for each sensor

- Equipment identifier of the sensor (e.g. B5)
- Mechanical design
- Use (measurand)
- Block diagram
- Connector with pin assignment

4.2.1.1 Pressure sensors

B5, B16 sensors (0 to 10 bar)

Mechanical design



Connections:

- 1 Supply voltage
- 2 Output voltage

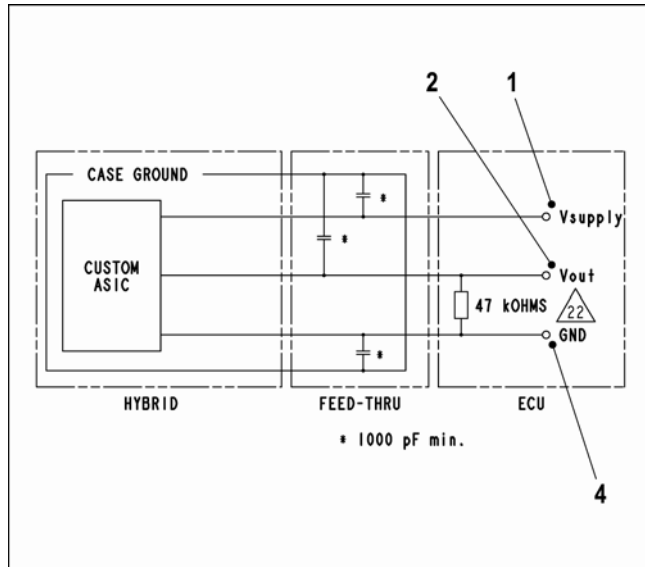
- 3 Ventilation
- 4 Ground

4.2.1.2 Use

The sensor is used for:

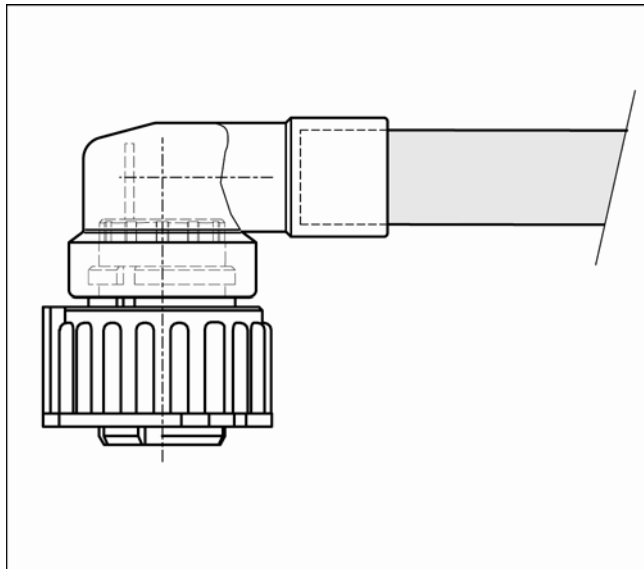
- B5 Lube-oil pressure
- B16 Coolant pressure

Block diagram



- 1 Supply voltage
- 2 Output voltage
- 4 Ground

Connectors

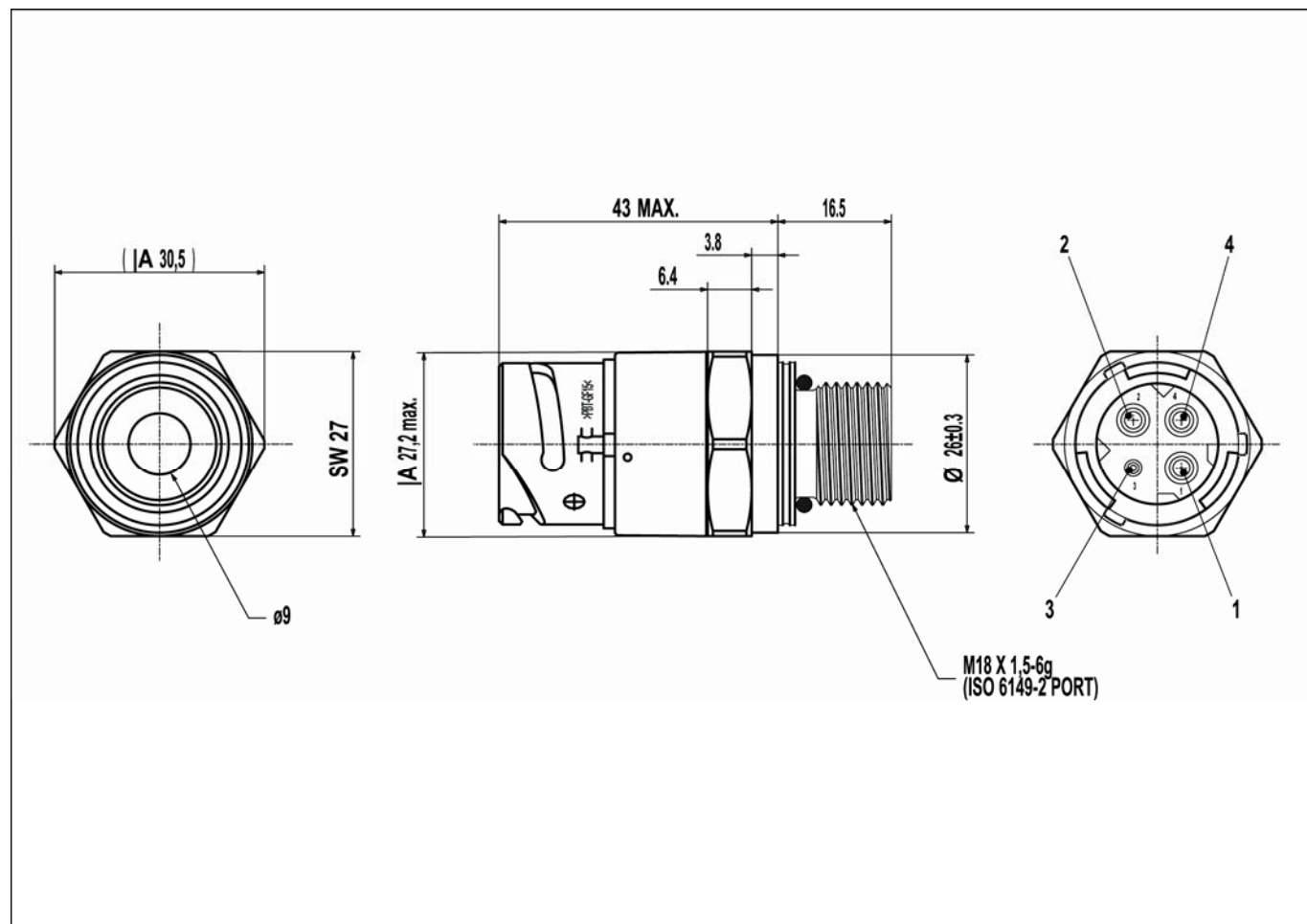


B5/B16 connector

Connector pin assignment

Pin no.:	Signal:
1	Supply voltage +U _b : 5 VDC
2	Output voltage +U _o : 0.5 ... 4.5 VDC for 0 ... 10 bar
3	Ventilation
4	Ground/GND (not connected to housing)

Sensor B10 (0 to 4.5 Bar)
Mechanical design



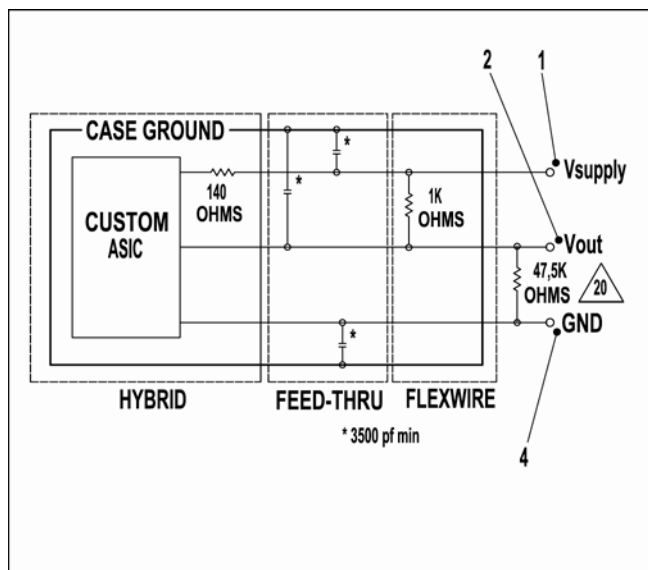
- 1 Supply voltage
- 2 Output voltage
- 3 Dummy
- 4 Ground

Use

The sensor is used for:

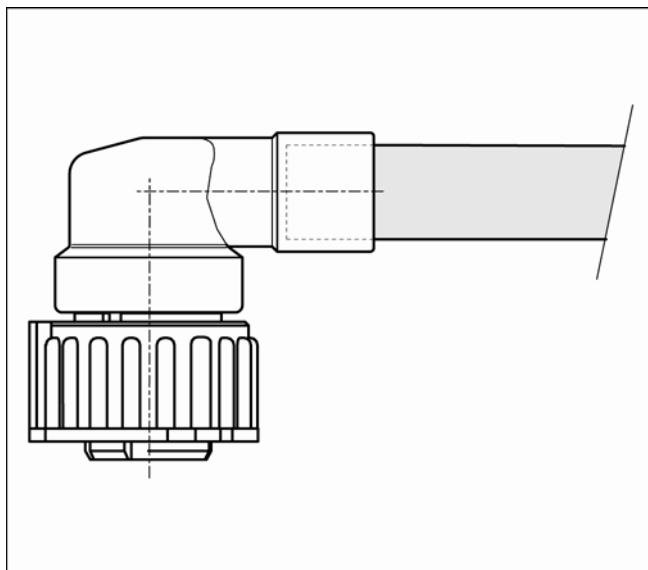
B10 Charge-air pressure

Block diagram



- 1 Supply voltage
- 2 Output voltage
- 4 Ground

Connectors

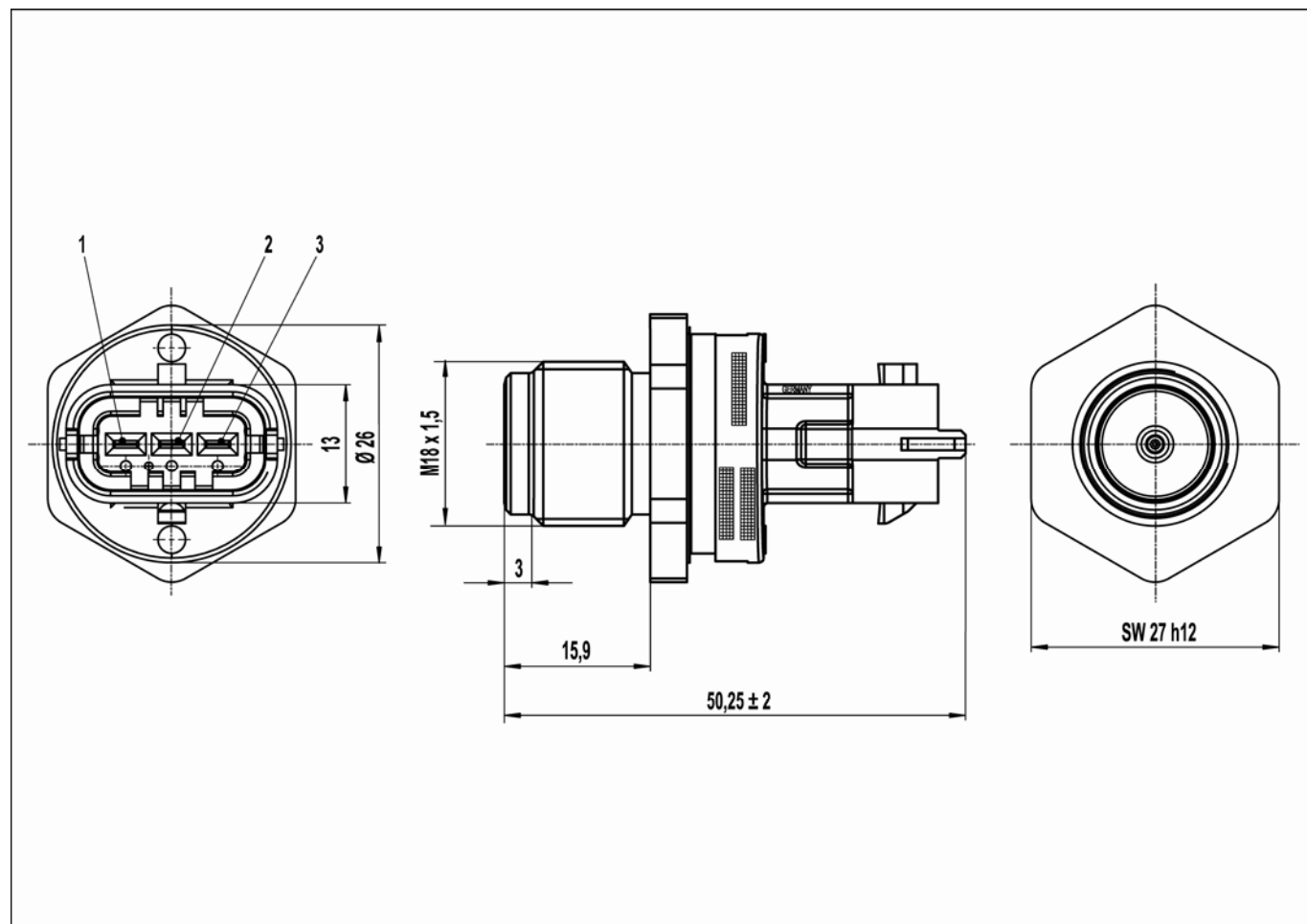


B10 Connectors

Connector pin assignment

- Pin no.: Signal:
- 1 Supply voltage $+U_b$: 5 VDC
 - 2 Output voltage $+U_o$: 0.5 ... 4.5 VDC for 0 ... 4.5 bar
 - 3 Dummy
 - 4 Ground/GND (not connected to housing)

Sensor B48.1, B48.2 (0 to 2000 bar)
Mechanical design



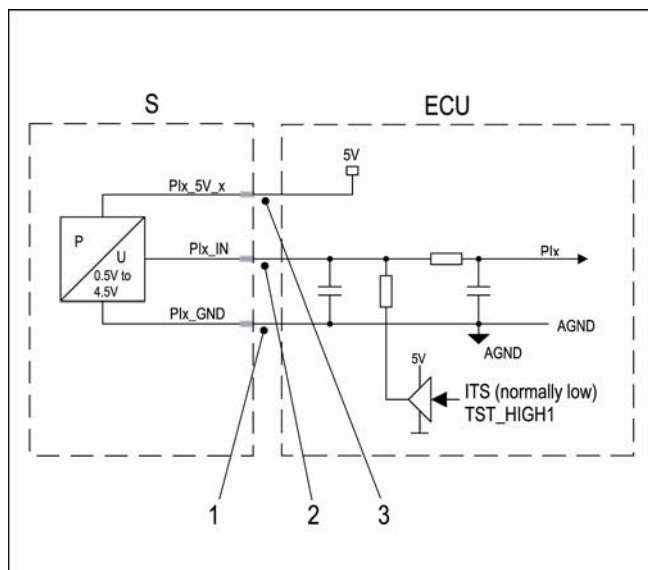
- 1 GND/Ground
- 2 Output
- 3 Supply voltage

Use

The sensor is used for:

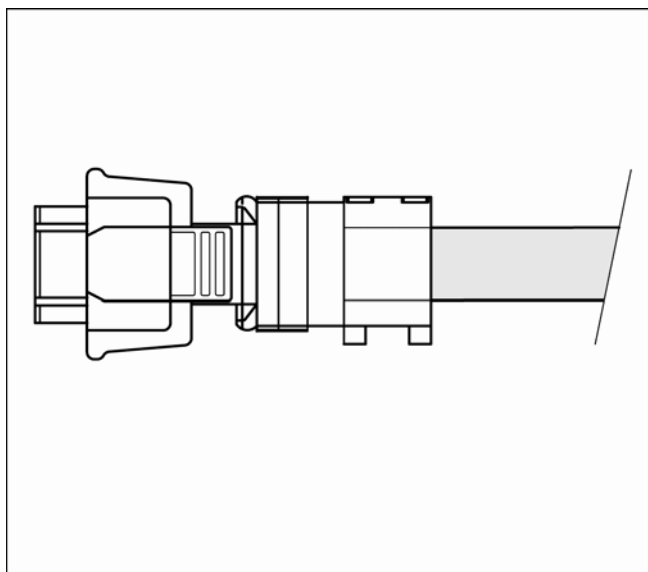
- B48.1 High-pressure fuel
- B48.2 High-pressure fuel

Block diagram



- S Pressure sensor
- ECU Engine Control Unit
- 1 Ground
- 2 Output voltage
- 3 Supply voltage

Connectors



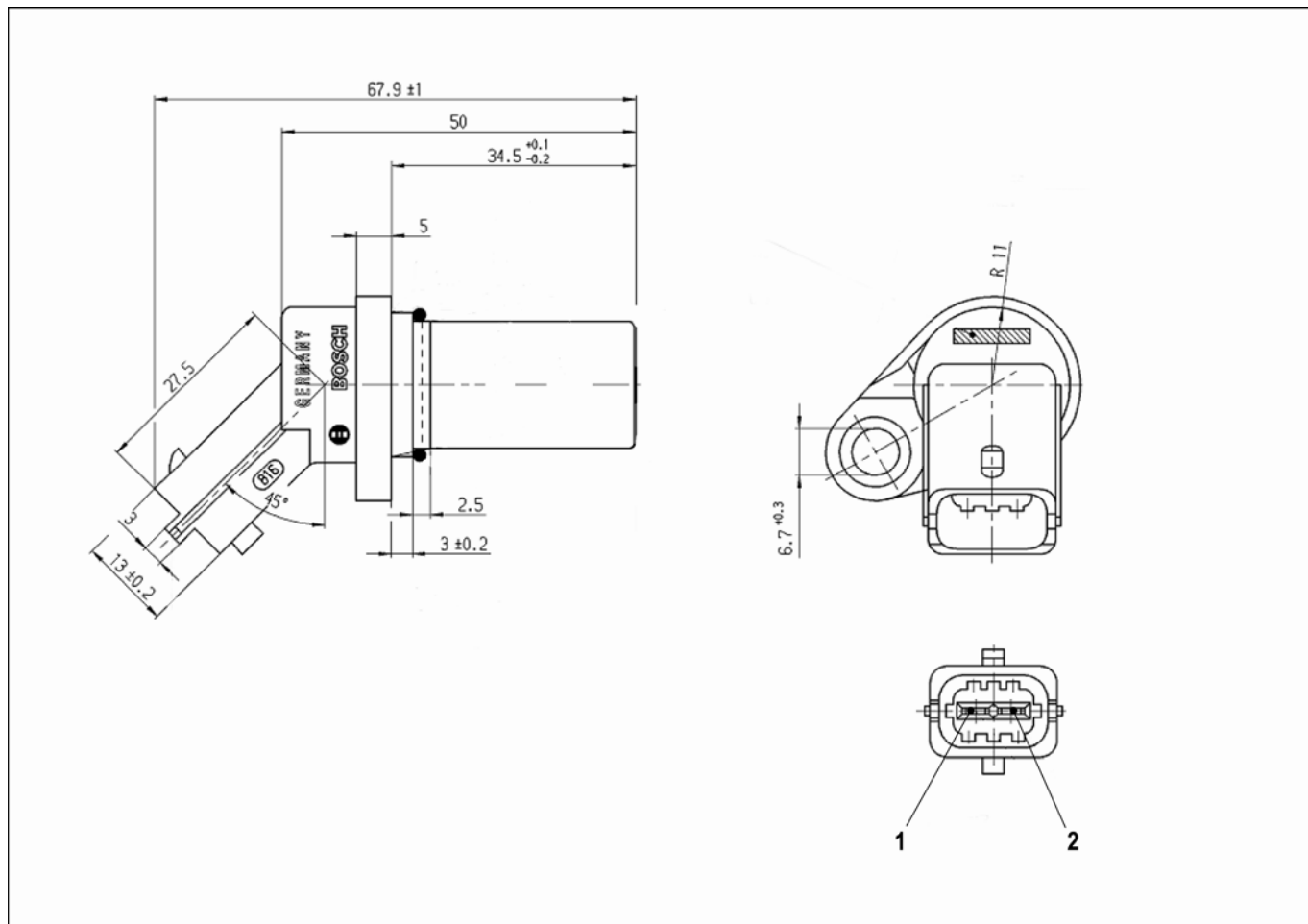
Connector pin assignment

- | Pin no.: | Signal: |
|----------|--|
| 1 | Ground/GND (not connected to housing) |
| 2 | Output voltage $+U_o$: 0.5 ... 4.5 VDC for 0 ... 2000 bar |
| 3 | Supply voltage $+U_b$: 5 VDC |
| 4 | Housing (ground) |

4.2.2 Speed sensors

B1, B13 sensors (ASI angle input)

Mechanical design



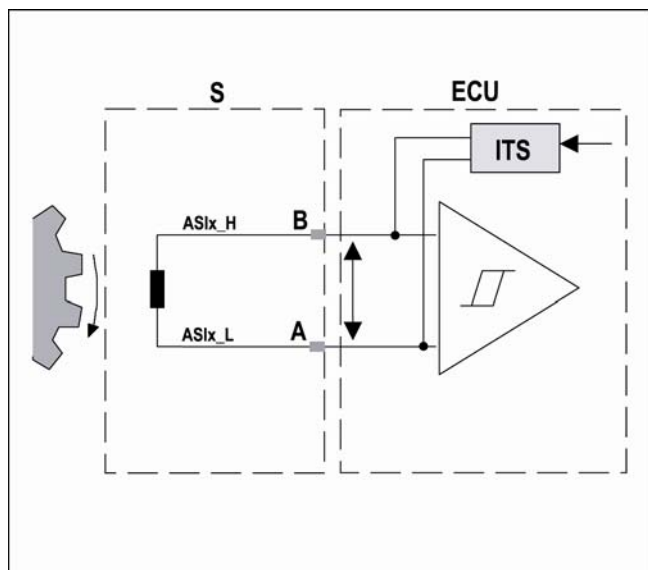
- 1 Connection B
- 2 Connection A

4.2.2.1 Use

The sensor is used for:

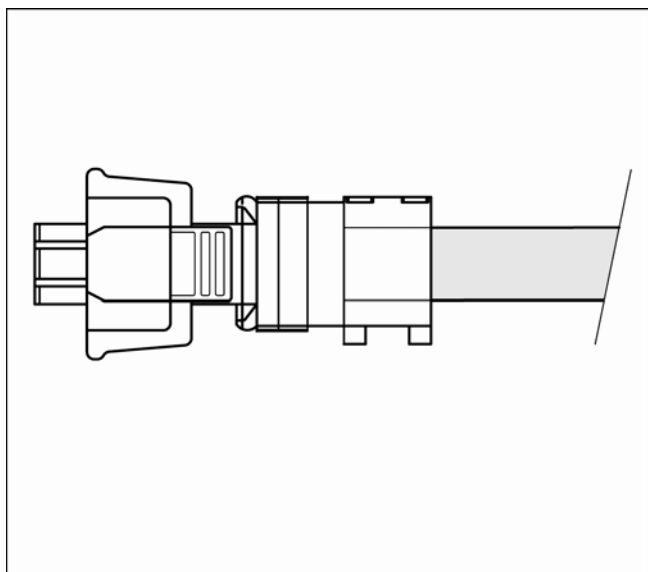
- B1 Camshaft speed
- B13 Crankshaft speed

Block diagram



S Sensor
 ECU Engine Control Unit
 ITS Fault detection OFF-LINE
 A Analog signal
 B Analog signal

Connectors

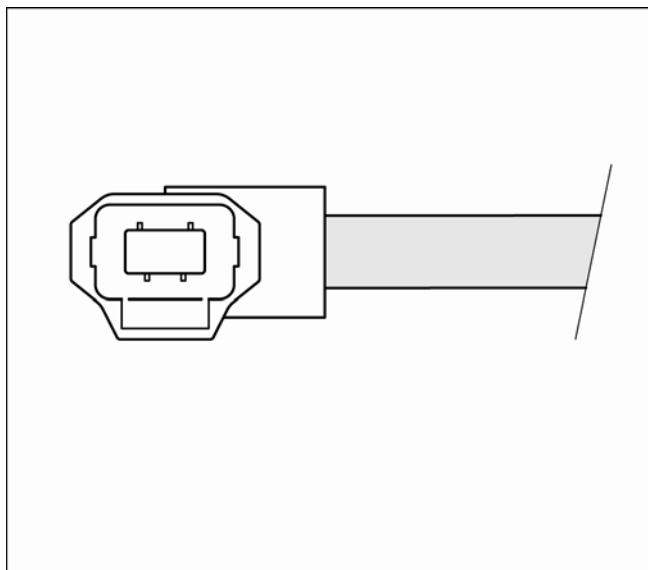


B1 Camshaft speed

Connector pin assignment

Pin no.: Signal:
 1 Black (analog signal)
 2 Red (analog signal)

Connectors



B13 Crankshaft speed

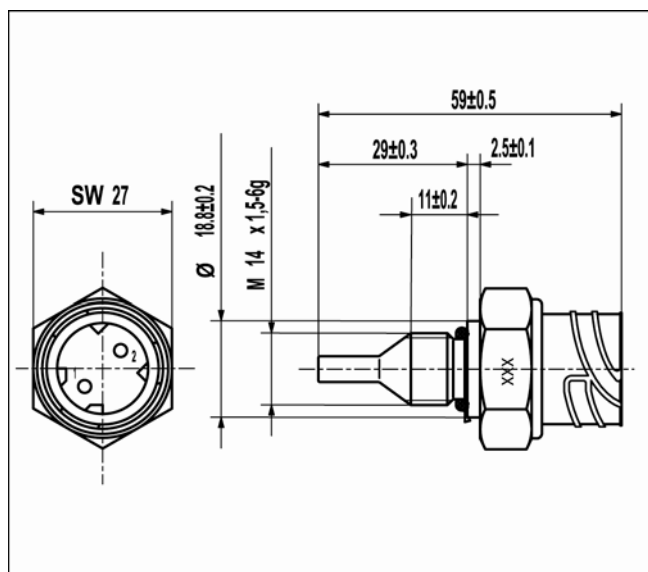
Connector pin assignment

Pin no.:	Signal:
1	Black (analog signal)
2	Red (analog signal)

4.2.3 Temperature sensors

B6, B9 sensors

Mechanical design

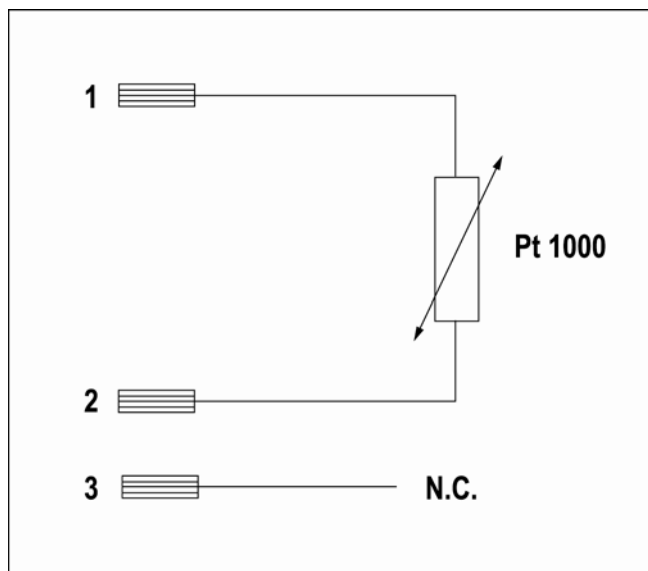


Use

The sensor is used for:

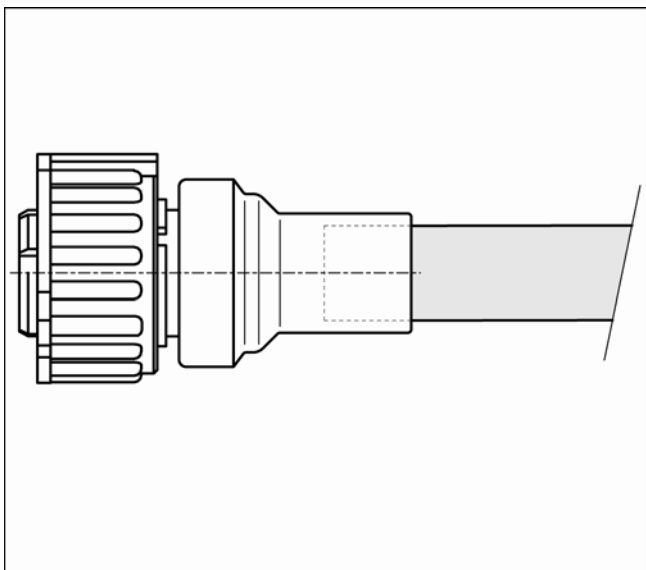
- B6 Coolant temperature
- B9 Charge-air temperature

Block diagram

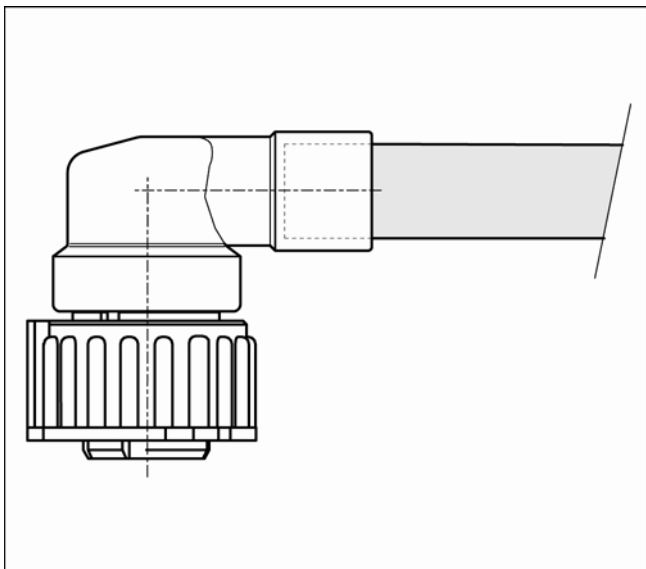


- 1 Input
- 2 GND/Ground

Connectors



B6 Coolant temperature



B9 Charge-air temperature

Connector pin assignment

Pin no.:	Signal:
1	Pt 1000: 0° C: 1000 Ω to 100° C: 1385 Ω
2	GND/Ground

5 Wiring

5.1 Power supply

5.1.1 Power supply

5.1.1.1 General

The configuration of the power supply, including the start pushbutton, is the responsibility of the OEM.

For this reason this chapter will give recommendations for a simple wiring of the power distribution.

The following basic points must be observed for the power supply:

- Use a 2-pin master switch
- Secure all devices individually with circuit breakers
- Trip either a manual emergency stop, or through IGI, or ESI (see chap. 7.1)

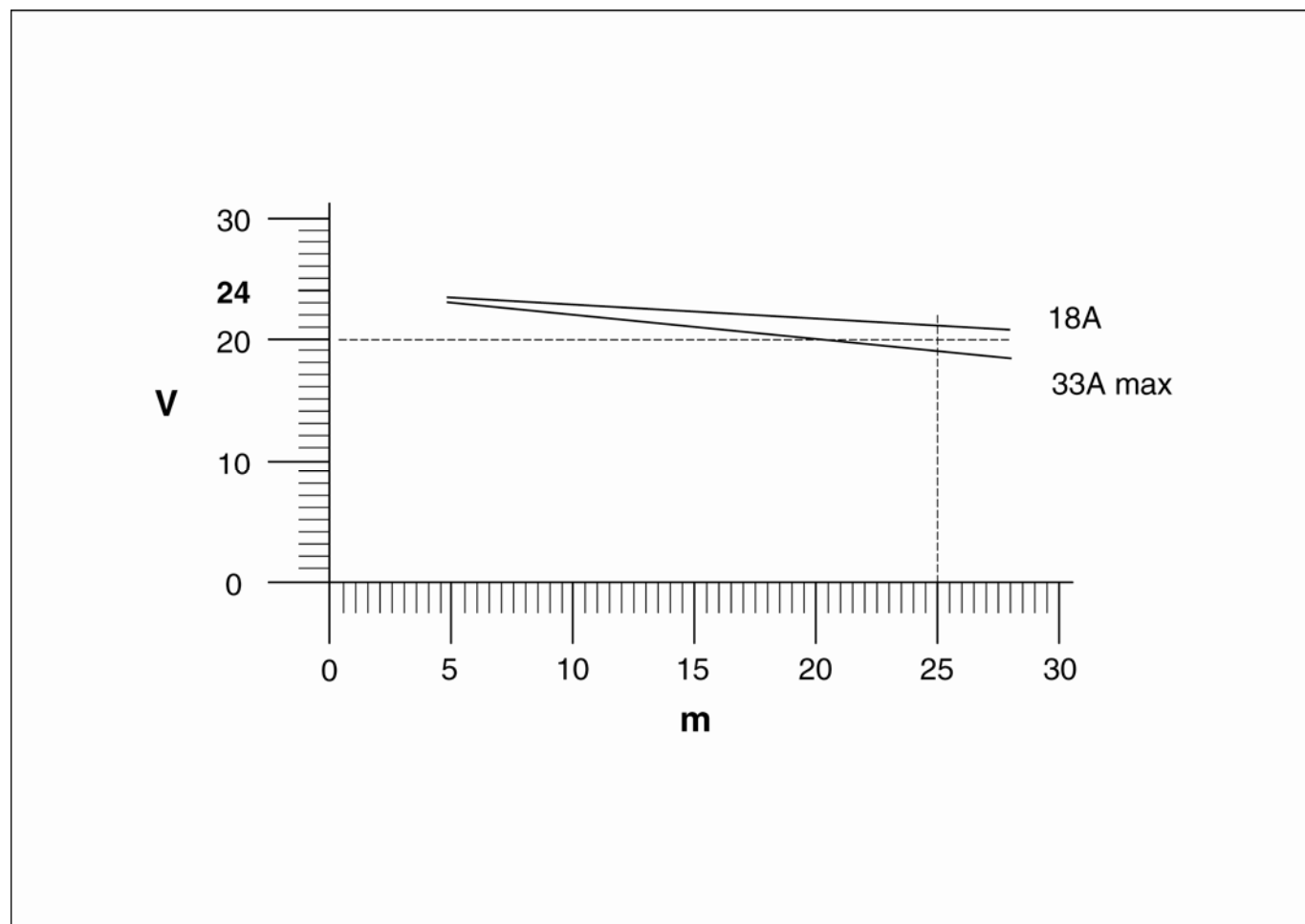
All requirements mentioned above are taken into account by the following recommendations. Basically all wire connections and their distribution must be made with terminal blocks.

The cable length from the battery to the ECU8 including the terminal box may not exceed a max. 25 m.

6 pins in the connector (X1) are to be used for the power supply (6x2.5mm²). The voltage drop between the battery and the ECU8 for 24V+ and GND lines depends on the load. Make sure that the ECU8 has a permanent voltage supply of at least 20V+ to the power supply pins. The average ECU8 current depends on the number of cylinders of the engine, the speed and the power consumers connected.

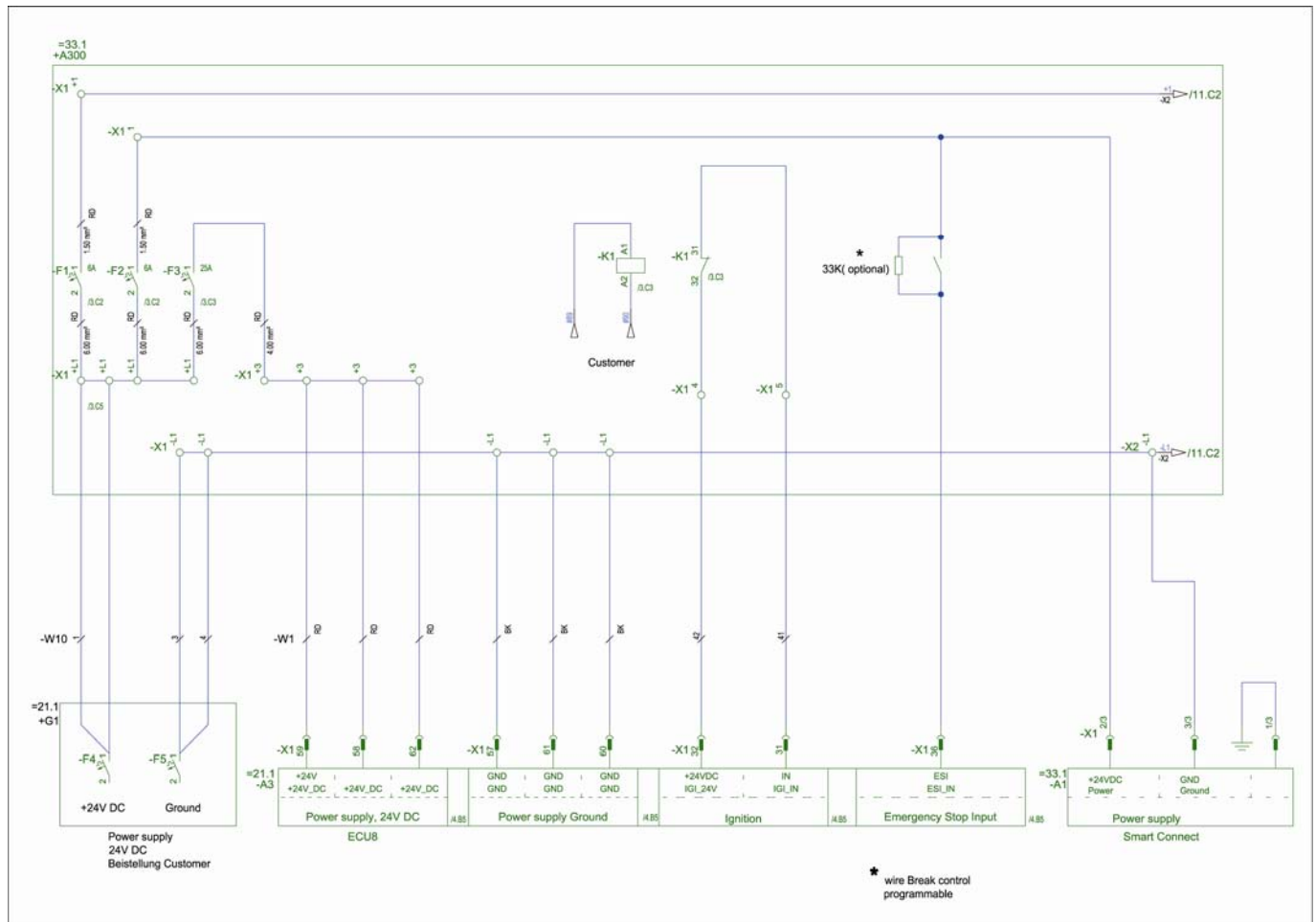
Note: If a terminal box is also integrated, then the corresponding voltage drop is also to be taken into account.

Example: Voltage drop for different cable lengths (taking into account ECU and fuses):



Power consumption of ECU8 = max. 33 A

5.1.1.2 Example for power supply setup (recommendation)



Power Supply Smart Connect Power supply Fault display of ECU8 ECU8 F1-3 Engine Control Unit Circuit breaker -X1 Ground Connector X1 at Engine Control Unit ECU8 GND/Ground

5.1.1.3 Circuit breakers

Circuit breakers are used in the following areas:

- F1 6A Supply voltage
- F2 6A Smart Connect/Emergency Stop Input supply voltage
- F3 25A ECU8 Engine Control Unit supply voltage

5.1.1.4 Emergency stop

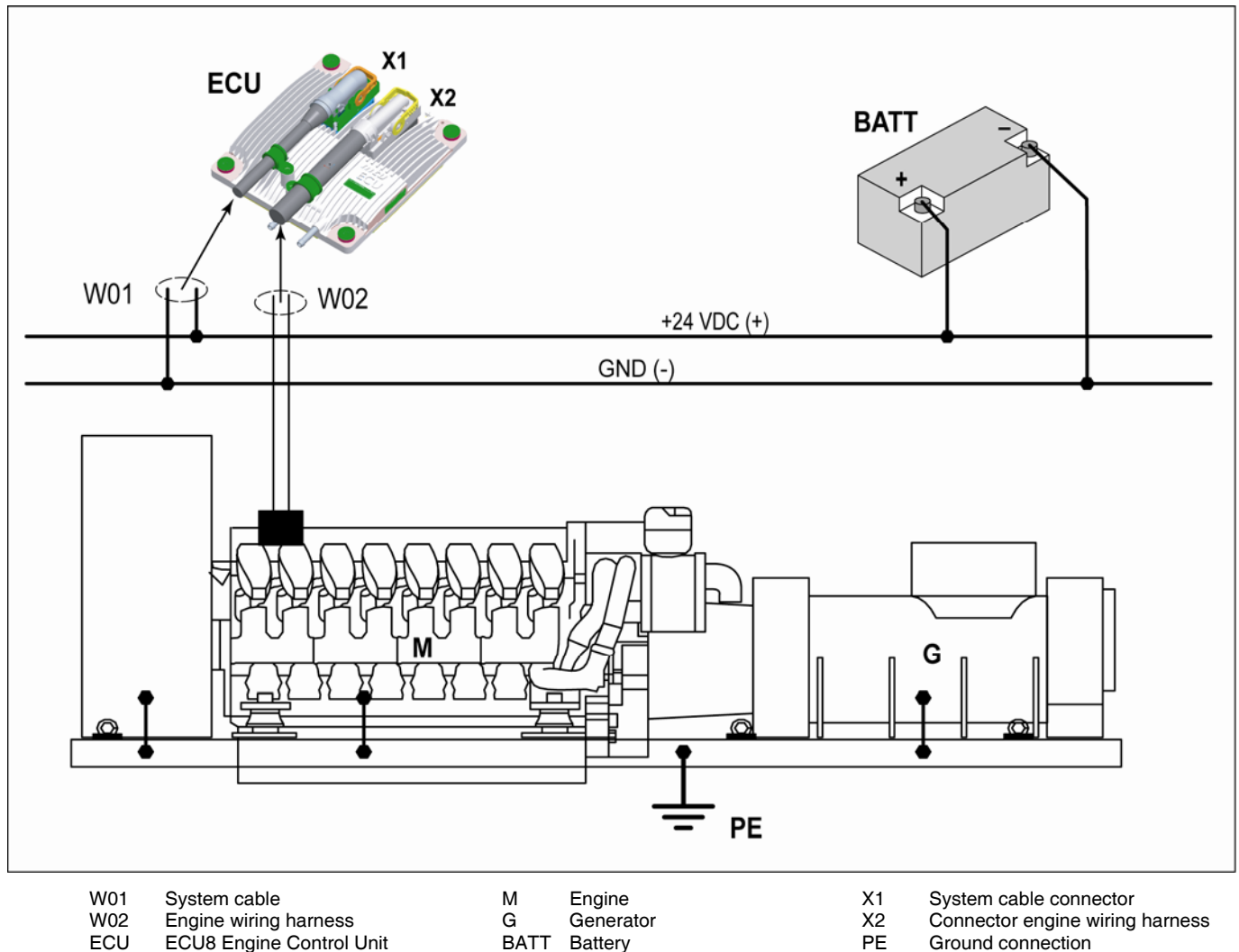
Performing an emergency stop by turning off the power supply to the Engine Control Unit is NOT PERMITTED.

Note: If, however, the engine is stopped in this manner, this process will be stored in the memory (counter). The next time the Engine Control Unit is turned on, alarm no. 549 "AL Power Interruption Detected" will be generated and saved in the fault memory.

5.1.2 Grounding concept

The grounding concept should envisage complete isolation of generator ground and power supply ground.

5.1.2.1 Grounding concept



The following ground connections are to be made:

- W01 cable/system connection: The shield of the cable to the system connection is connected via the connector X1 with the housing of the Engine Control Unit (factory). On the open side it must be connected to the housing in which the terminal block and the customer's controls are installed (switchgear cabinet) (to be checked by the OEM).
- W02 cable/engine wiring harness: The shielding is connected to the Engine Control Unit via the engine wiring harness connector (ex-works).
- The engine must be grounded using a ground strap (PE). See "Grounding engines and systems" for the details about the design, cross section, etc.

5.1.3 CAN bus

5.1.3.1 General

To maximize signal-to-noise ratio and hence maximum operational reliability, the wiring of the CAN bus must be carefully made according to the specification.

Note: A failure of the CAN bus will always lead to serious limitations or to the total failure of the engine. Therefore, the setup of the CAN bus is of central importance for the reliability of the whole system!

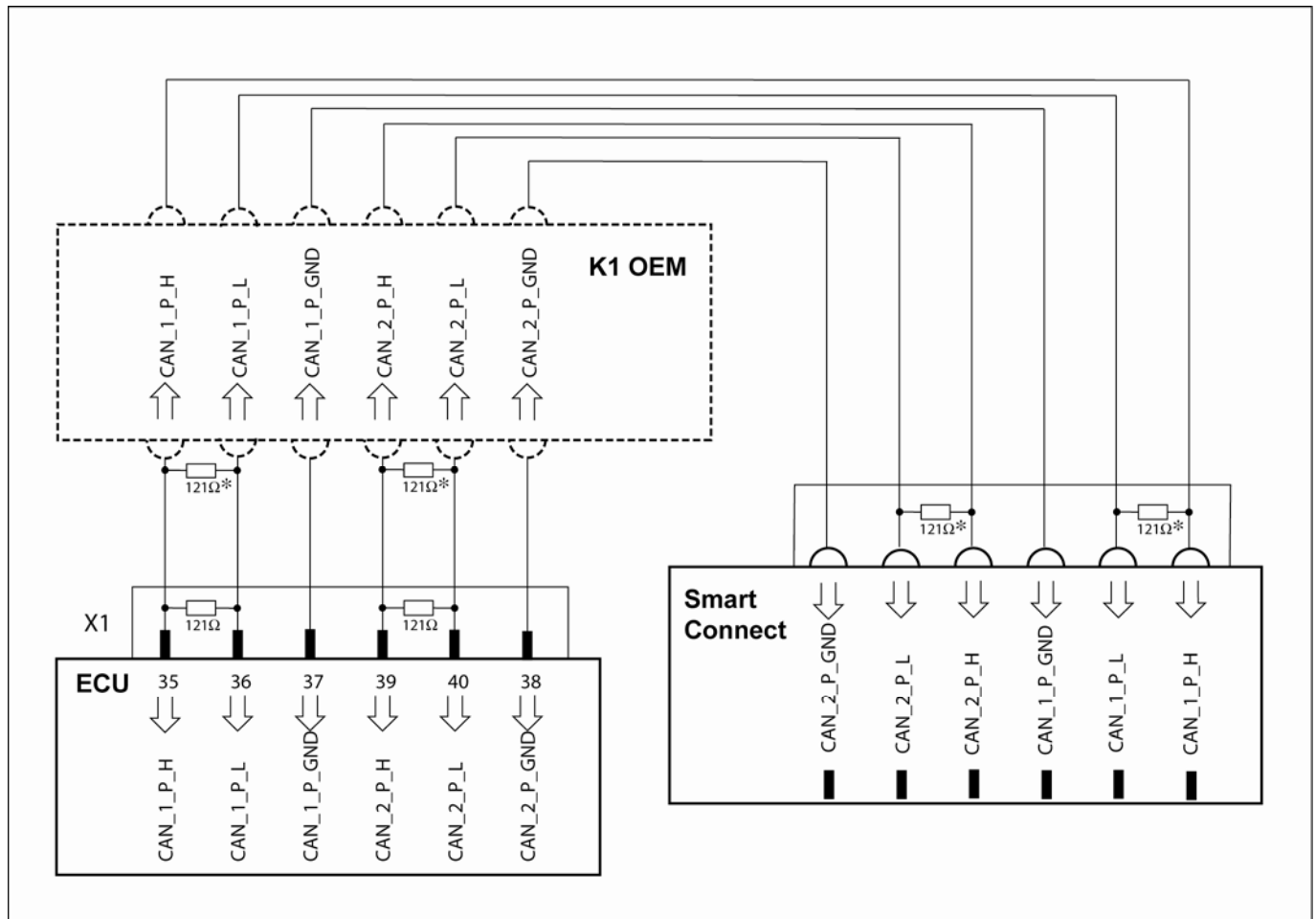
5.1.3.2 Wiring requirements

The cable used must at least possess the following electrical characteristics:

- Impedance Z : $120\ \Omega (\pm 10\%)$
- Specific resistance r_b : Max. $50\ \Omega/\text{m}$ at 20°C
- Specific signal delay t_p : $5\ \text{ns}/\text{m}$
- Specific capacitance between the leads c_b : max. $75\ \text{pF}/\text{m}$
- Specific capacitance of lead to ground c_s : max. $110\ \text{pF}/\text{m}$

5.1.3.3 Block diagram

This diagram shows an example of the schematic setup of the CAN bus.



* Resistors may only be installed at the ends of the busses.
Either at the terminal blocks or at the Smart Connect.

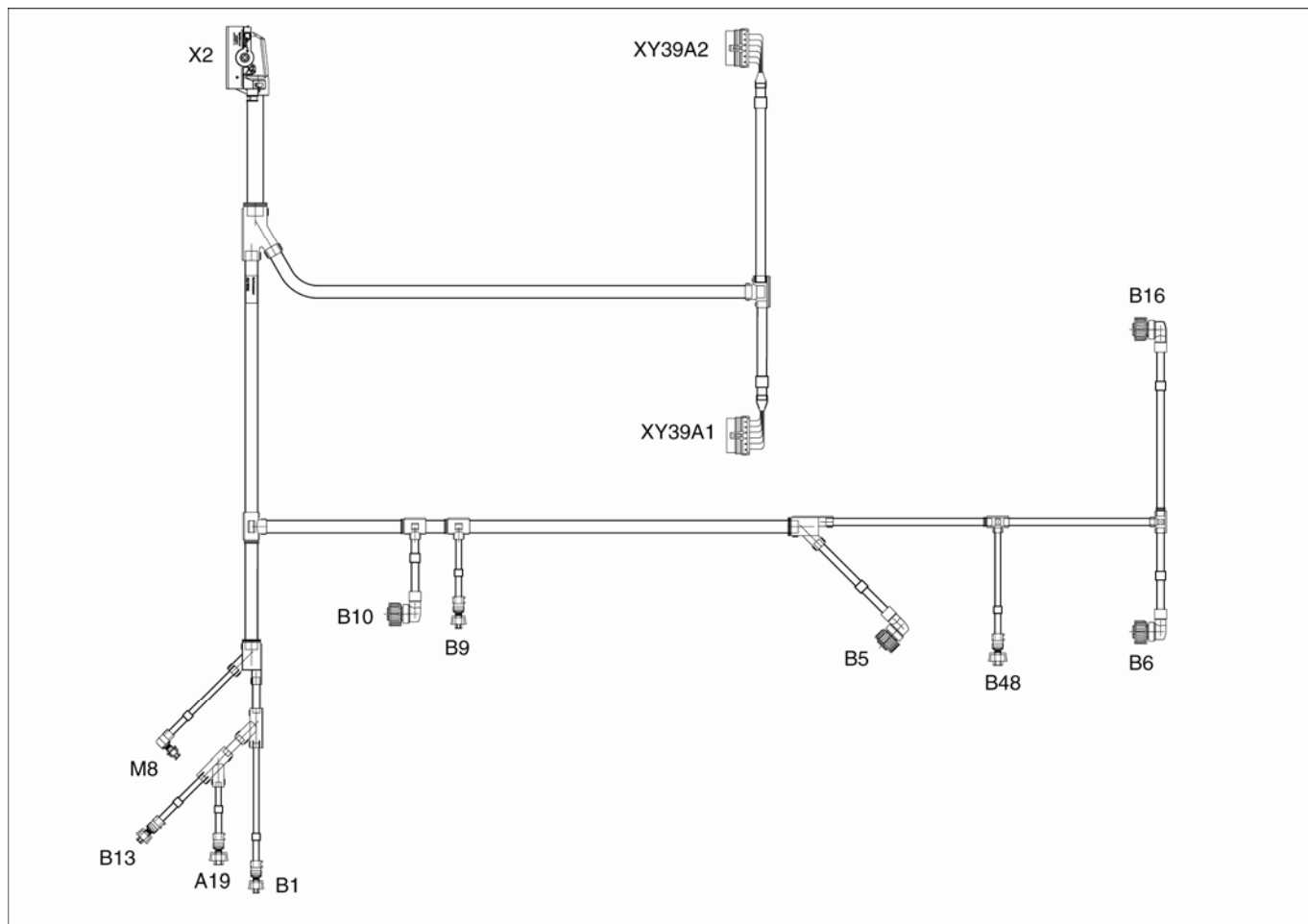
Please observe the following when connecting the CAN bus:

- Termination resistor: One terminating resistor ($120\ \Omega$) is to be installed at each end of the CAN busses.
- The shielding of the bus cables (switchgear cabinet) is to be connected to the housing/cable gland of the switchgear cabinet.
The (twisted) bus cable in the switchgear cabinet does not have to be grounded.
- CAN_GND connections: These connections must NOT be connected to the shielding, the operating voltage ground, or the vehicle ground!

5.2 Engine wiring harnesses

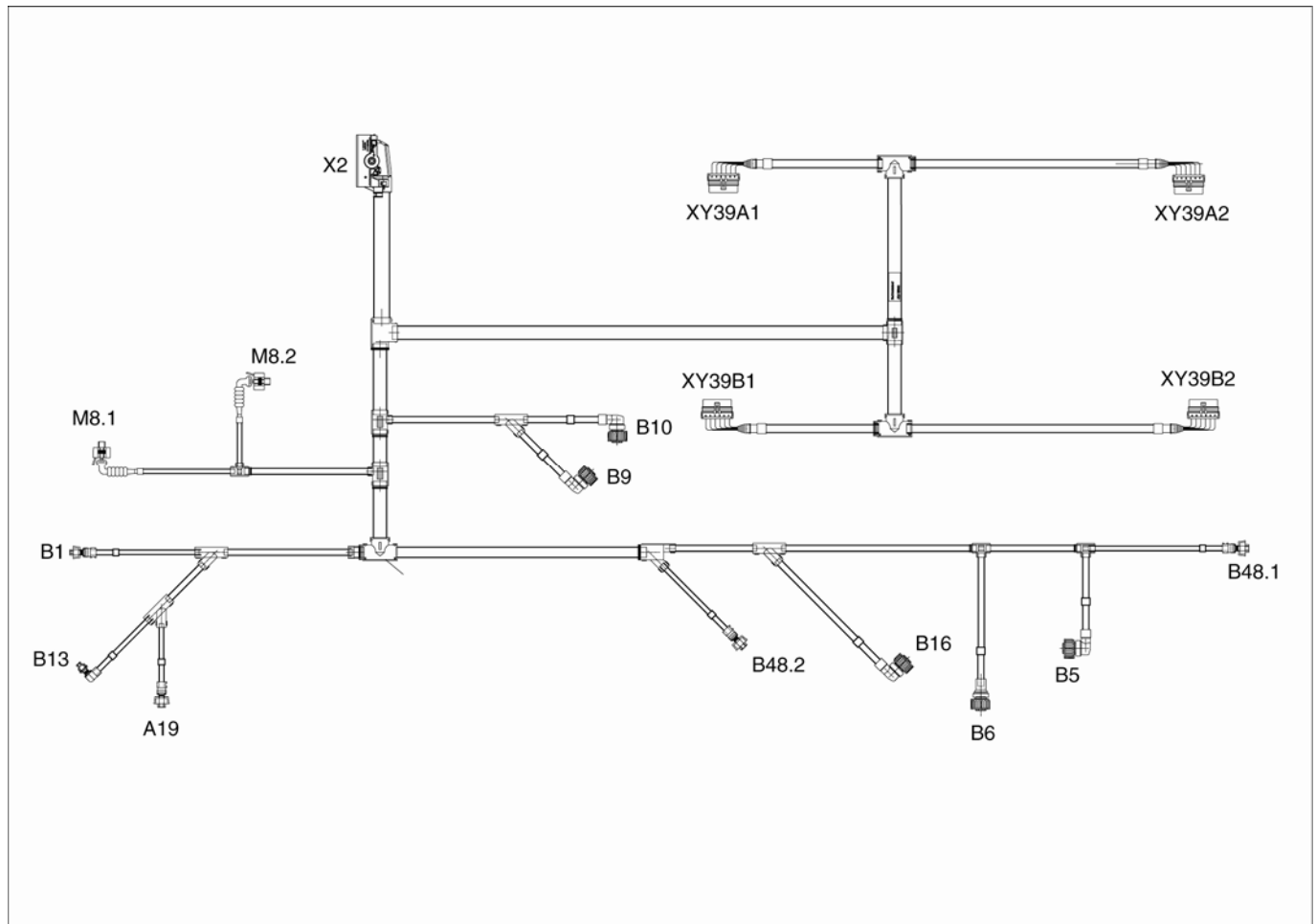
5.2.1 Sensor wiring harness

5.2.1.1 Series 1600 6R (six-cylinder in-line engine)



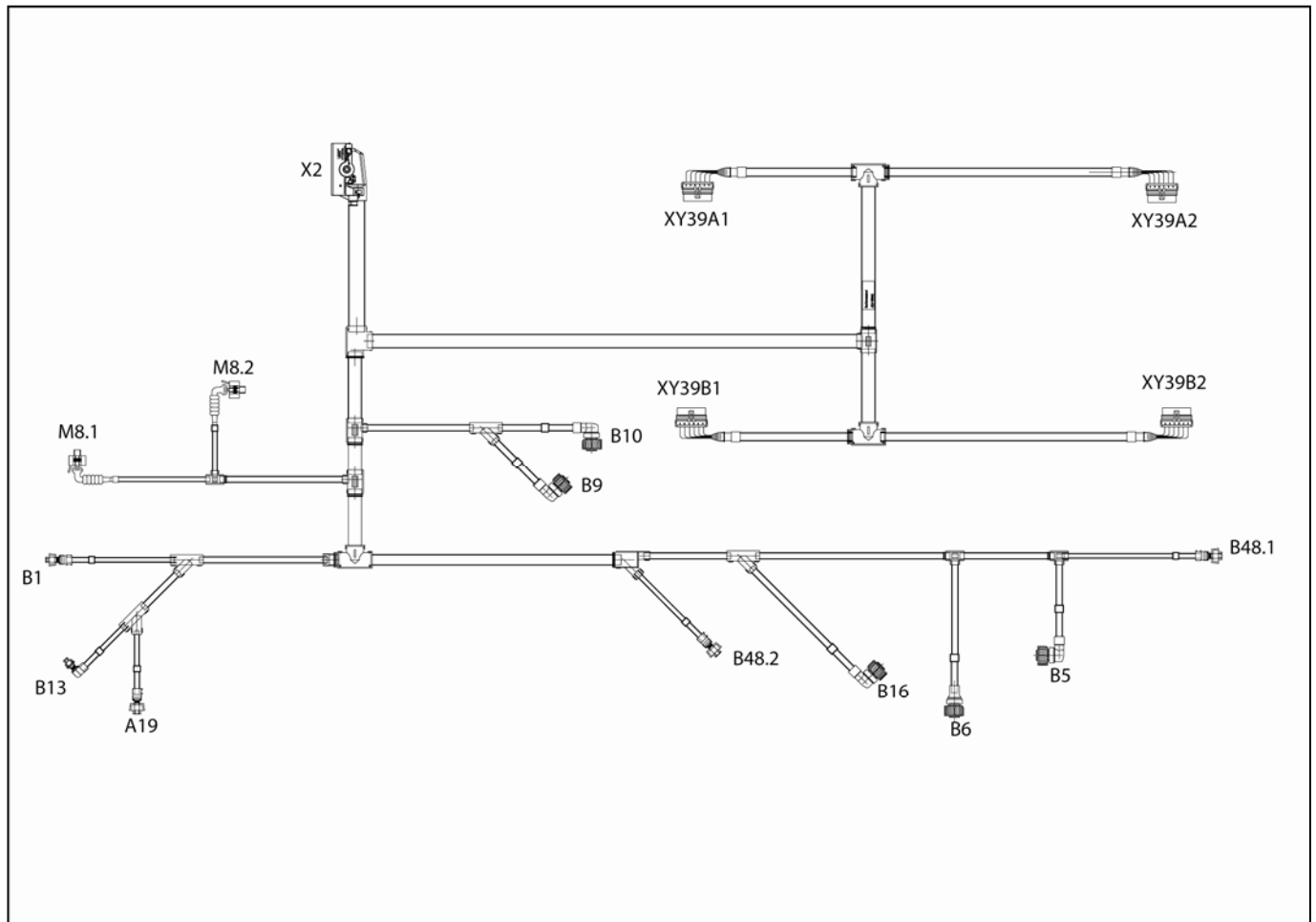
X2	ECU8 Engine Control Unit connector
XY39A2	Injector connection A-2
XY39A1	Injector connection A-1
B16	Coolant pressure
B6	Coolant temperature
B48	High-pressure fuel
B5	Lube oil pressure
B9	Charge-air temperature
B10	Charge-air pressure
B1	Camshaft speed
A19	Engine Identity Label EIL
B13	Crankshaft speed
M8	Fuel pump HPP

5.2.1.2 Series 1600 8V (eight-cylinder V engine)



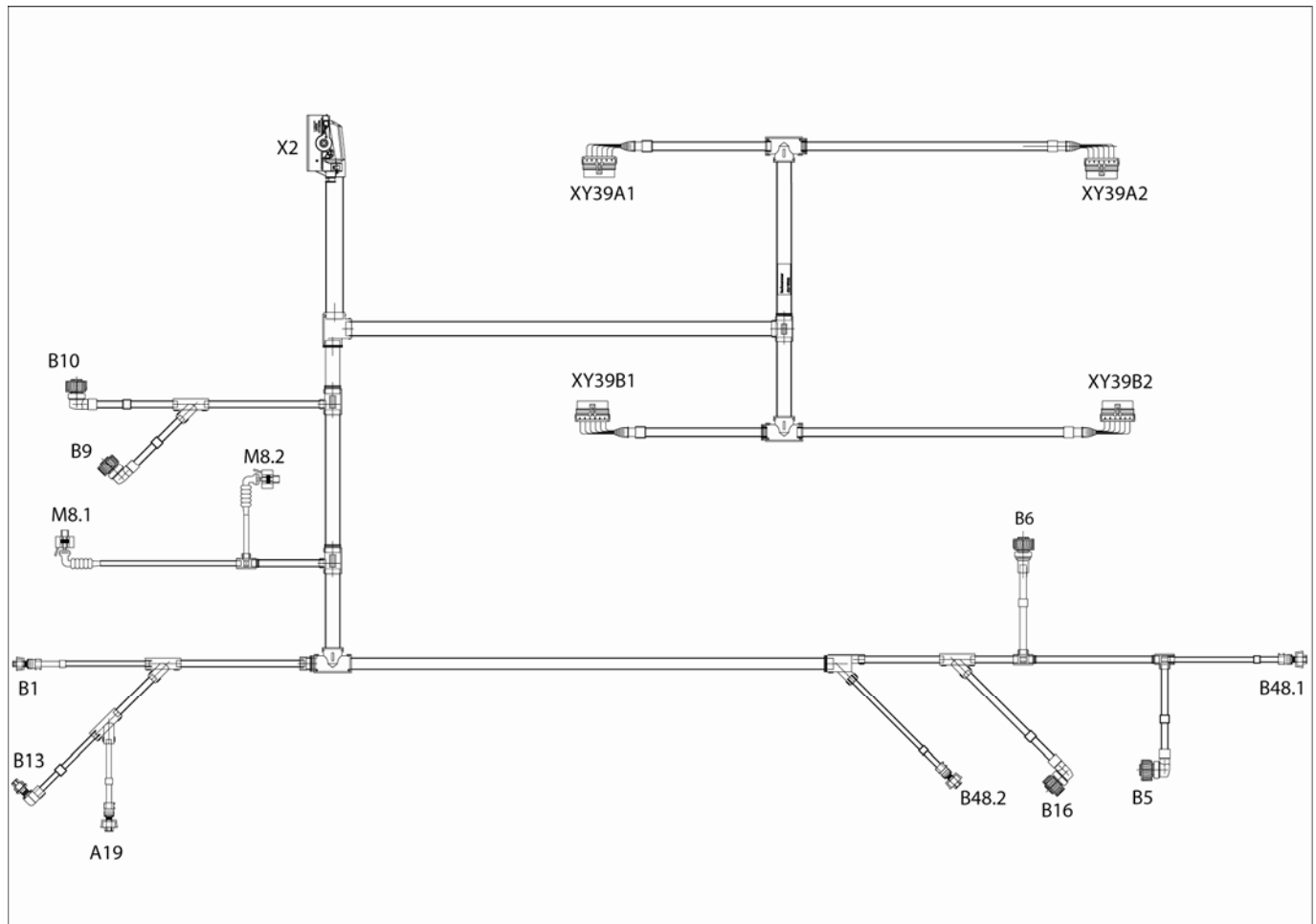
X2	ECU8 Engine Control Unit connector
XY39A1	Injector connection A side 1
XY39A2	Injector connection A side 2
XY39B1	Injector connection B side 1
XY39B2	Injector connection B side 2
B48.1	High-pressure fuel A
B5	Lube oil pressure
B6	Coolant temperature
B16	Coolant pressure
B48.2	High-pressure fuel B
A19	Engine Identity Label EIL
B13	Crankshaft speed
B1	Camshaft speed
M8.1	Fuel pump HPP A
M8.2	Fuel pump HPP B
B10	Charge-air pressure
B9	Charge-air temperature

5.2.1.3 Series 10V (ten-cylinder V engine)



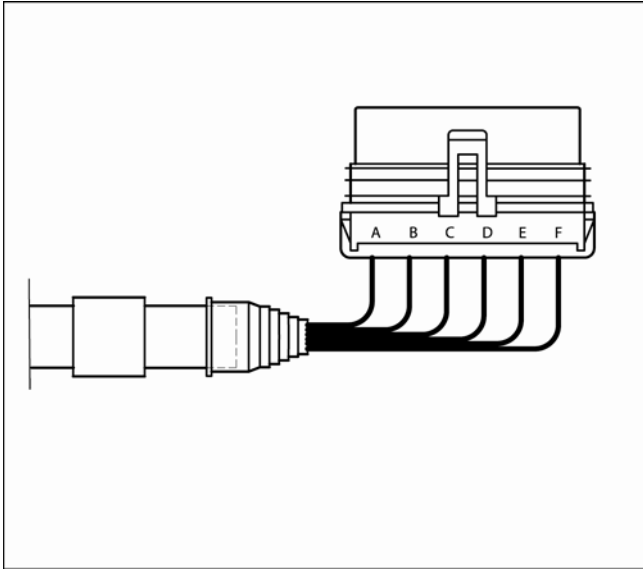
X2	ECU8 Engine Control Unit connector
XY39A1	Injector connection A side 1
XY39A2	Injector connection A side 2
XY39B1	Injector connection B side 1
XY39B2	Injector connection B side 2
B6	Coolant temperature
B48.1	High-pressure fuel A
B5	Lube oil pressure
B16	Coolant pressure
B48.2	High-pressure fuel B
A19	Engine Identity Label EIL
B13	Crankshaft speed
B1	Camshaft speed
M8.1	Fuel pump HPP A
M8.2	Fuel pump HPP B
B10	Charge-air pressure
B9	Charge-air temperature

5.2.1.4 Series 12V (twelve-cylinder V engine)



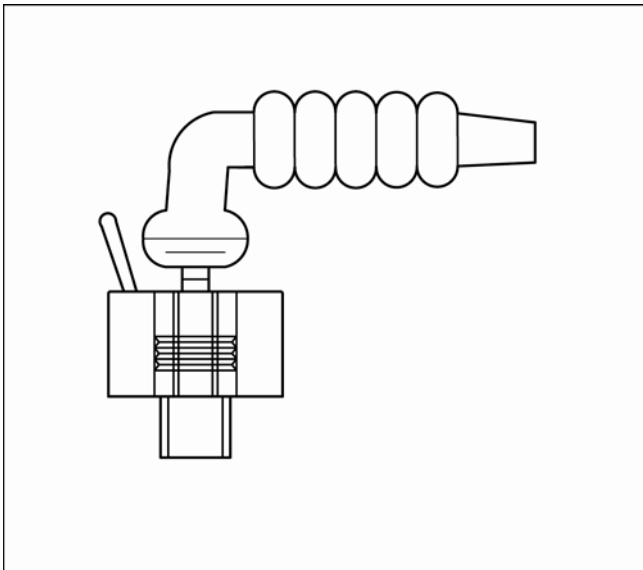
X2	ECU8 Engine Control Unit connector
XY39A1	Injector connection A side 1
XY39A2	Injector connection A side 2
XY39B1	Injector connection B side 1
XY39B2	Injector connection B side 2
B6	Coolant temperature
B48.1	High-pressure fuel A
B5	Lube oil pressure
B16	Coolant pressure
B48.2	High-pressure fuel B
A19	Engine Identity Label EIL
B13	Crankshaft speed
B1	Camshaft speed
M8.1	Fuel pump HPP A
M8.2	Fuel pump HPP B
B9	Charge-air temperature
B10	Charge-air pressure

5.2.1.5 Connectors XY39A1 ... XY39B2



The injector wiring harness is connected to the XY39A1/XY39A2/XY39B/1XY39B2 connectors. The connections of the injector wiring harness are designed as “Window Gasket” and are located in the cylinder heads.

5.2.1.6 M8.1/M8.2 Connector



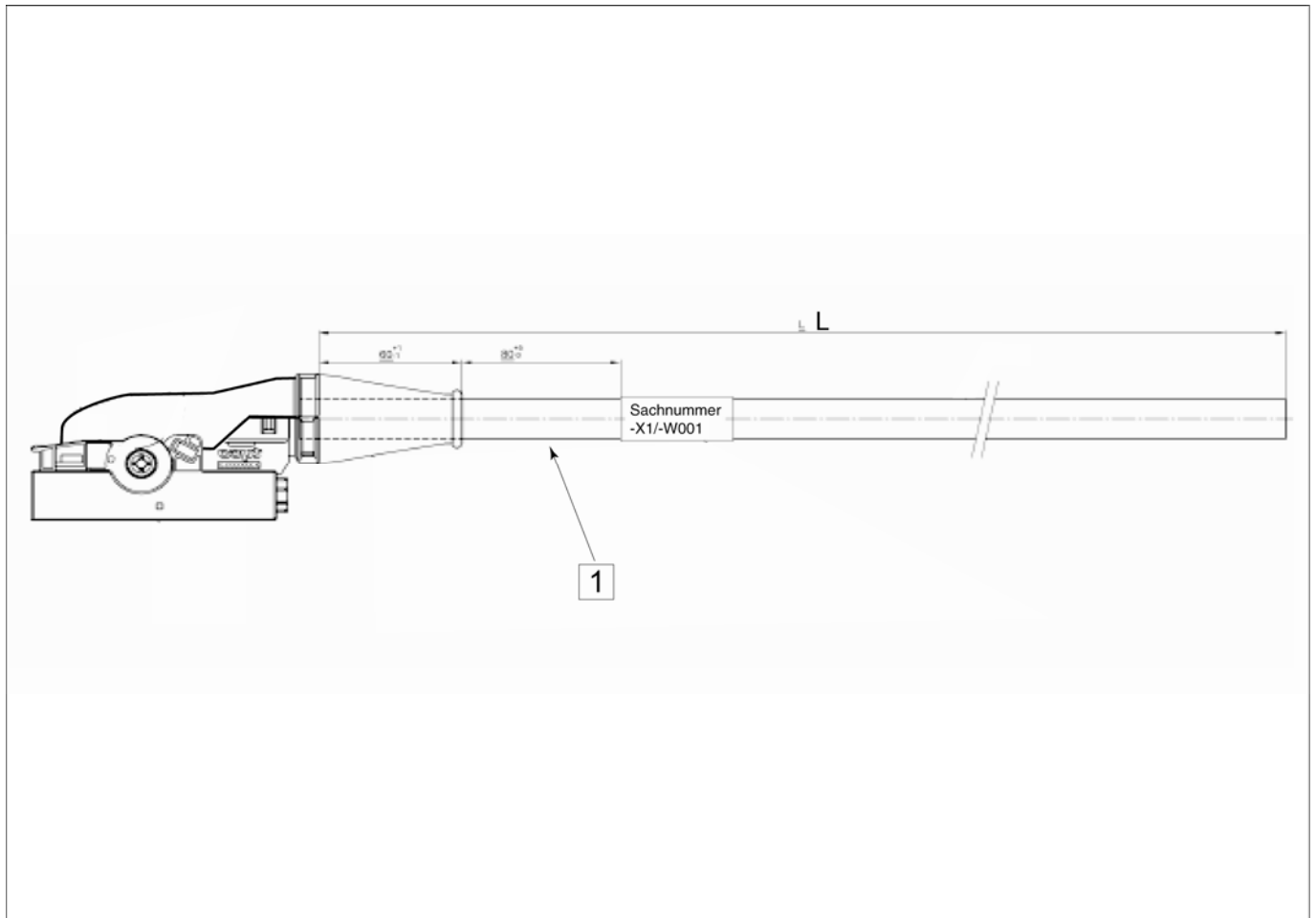
The purpose of this connector is to connect the following:

- M8.1 Fuel pump HPP A
- M8.2 Fuel pump HPP B

5.3 System cable

5.3.1 System wiring harness

The wiring harness W01 is used to connect the ECU8 Engine Control Unit to the higher-level controls and the power supply (terminal block) . The wiring harness W01 has a 62-pin connector (X1) on one end. The open end must be connected to a terminal block.



1 Connecting cable ECU8 -X1/-W001

The X1/-W001 cable is assigned as follows: See chap. 3.5.1

6 Inputs and outputs of the system

6.1 Overview of channel assignments

6.1.1 System-side

The system side of the ECU8 Engine Control Unit is assigned as follows:

Channel	Assignment	X1 pin		Cable W1/core no.
POWER	Power supply/3x +24V = Power for switching on the system (emergency stop by switching off power)	24V_DC 24V_DC 24V_DC	58 59 62	RD RD RD
GND	3x GND	GND GND GND	57 60 61	BK BK BK
IGI	Ignition/Ubatt switch → Variant 1 emergency stop	IGI_24 IGI_IN	32 31	42 41
ESI	Engine stop/emergency stop → Variant 2 emergency stop	ESI_IN	36	
DI1	ENGINE STOP	DI1_H DI1_L	10 9	1 2
DI2	Speed droop	DI2_H DI2_L	14 13	3 4
DI3	Idle/mode (fixed speed) or switchover 50/60Hz	DI3_H DI3_L	18 17	5 6
DI4	ALARM RESET	DI4_H DI4_L	22 21	7 8
DI5	SPEED UP	DI5_H DI5_L	26 25	9 10
DI6	SPEED DOWN	DI6_H DI6_L	30 29	11 12
DI7	START	DI7_H DI7_L	34 33	13 14
DI8	OVERRIDE	DI8_H DI8_L	38 37	15 16
AI1	Speed demand (I)/speed demand (U)	AI1_2_5V AI1_U AI1_I	41 46 45	17 19 20
AI2	Engine torque/demand (LSG)	AI2_U AI2_I AI1_2_GND	50 49 42	21 22 18
FIP	Speed demand (speed setting)	FIP_IN	24	27
AO1	Coolant temp.	AO1_OUT	40	23
AO2	Lube oil pressure	AO2_OUT AO1_2_FIP	44 35	24 25
TOP1	YELLOW alarm	TOP1_OUT	12	29
TOP2	RED alarm	TOP2_OUT TOP1_2_GND	11 15	30 28

TOP3	Lube oil stop	TOP3_OUT	20	31
TOP4	Starter ON	TOP4_OUT TOP3_4_GND	19 16	32 33
CAN_P1	CAN-BUS 1/PCS5	CAN1_H CAN1_L CAN1_GND	1 2 5	35 36 37
CAN_P2	CAN-BUS 2/J1939	CAN2_H CAN2_L CAN2_GND	3 4 8	39 40 38
RS485	Internal BUS RS485	RS485_A RS485_B RS485_GND	6 7 23	43 44 47

7 Functions

7.1 ECU8 signals

7.1.1 Engine side - System side

The channels of the different inputs and outputs on the Engine Control Unit ECU8 are divided into 2 groups.

Engine-side channels

System-side channels

All engine-side channels are at connector X2. All of the sensors and actuators of the engine are connected to this factory installed wiring harness.

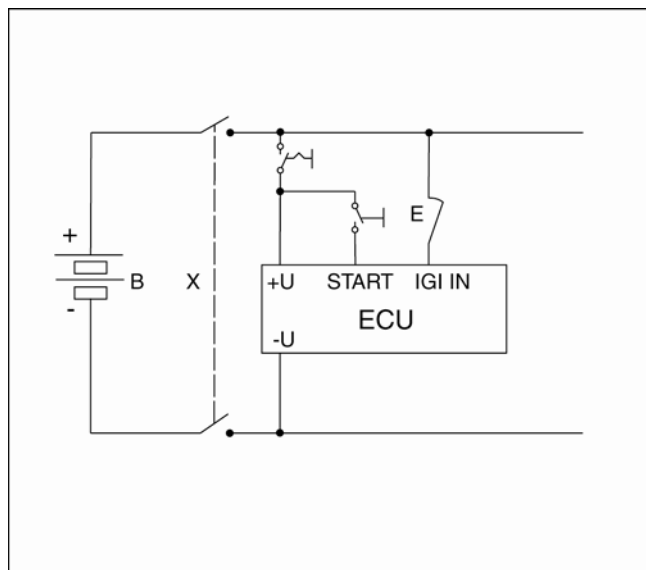
7.1.1.1 General information about the parameters

In the following sections the system-side channels and their functions/parameters will be described. Setting of the parameters is made by creating a data record.

7.1.1.2 Power supply

The power supply is connected to connector X1 (system-side wiring harness)

7.1.1.3 Schematic circuit diagram



- B Battery
- +U Engine Control Unit operating voltage
- V Vehicle
- X Battery master switch
- E Emergency stop (NC contact)
- U GND

7.1.1.4 Ignition IGI input

Technical data

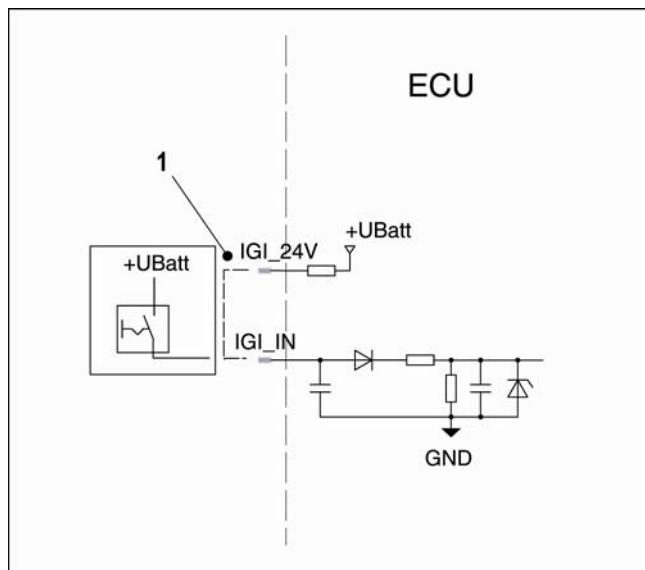
Control via:

Power supply + 24 V DC, +U_{bat}

Channel specification:

- Voltage 0 – 36 V DC
- Current Approx. 4.8 mA at 24 V DC/~5kohm
- Electrical isolation: No

7.1.1.5 Schematic circuit diagram



+UBatt	Operating voltage 24 V DC
IGI_24V	Ignition/+Ubatt switch/emergency stop
IGI_IN	Ignition
GND	Ground

Switching off the ignition function:

Jumper IGI_24V or +Ubat to IGI_IN.

Switching on the ECU8 with the ignition input IGI

1. Power supply +UBatt (24 V) must be applied to ECU8.
2. IGI input level 0V (<4V) ->
 - >9V DC/DC converter will be activated
 - > 11V the blocked output stage can be released by the SW!

Shutting off the ECU8 (with the ignition input IGI)

If the input level of the IGI falls under limit of < 4V, the output stages for the injectors will be shut off. Injection stops and the engine comes to an immediate stop.

7.1.1.6 Emergency stop input ESI

This channel offers another way of triggering an emergency stop.

The ESI input is activated with a normally open contact to UBatt (24V). If this function is not used, the input will not be switched!

7.1.1.7 Technical data

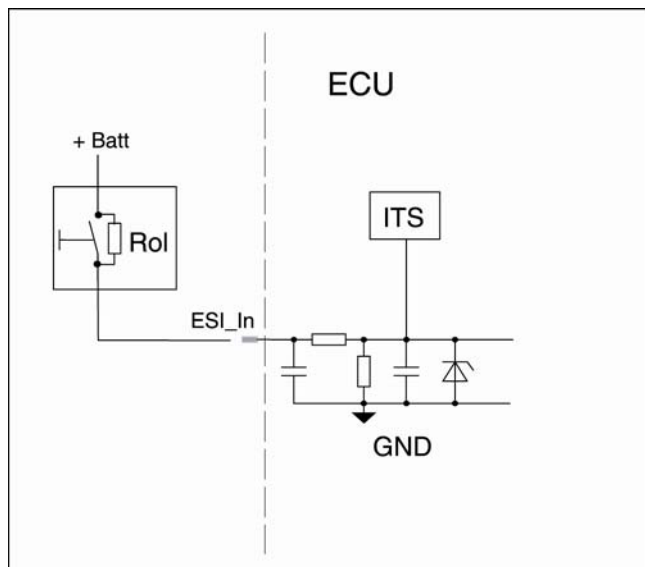
Control via:

Power supply + 24 V DC, +U_{bat}

Channel specification:

- Voltage 0 – 36 V DC
- Current Approx. 4.8 mA at 24 V DC/~5kohm
- Electrical isolation: No
- Power interruption: Monitoring of the input voltage

7.1.1.8 Schematic circuit diagram



+Batt	Operating voltage 24 V DC
Rol	Monitoring of the input voltage (33kohm ± 10%)
TS	Fault detection OFF-LINE
PD	Power driver disable
MPC	MPC port
DC/DC	DC/DC converter
ESI_IN	Ignition 4.8 mA at 24 V DC/~ 5kohm ± 10% (12 to 32V at 33kohm ± 10%)
GND	Ground
DS	Data memory (data storage algorithm)

Detection of a power interruption:

The switch or the control electronics must send a current of 0.4 mA (12 to 32 V at 33kohm ± 10%) to the ECU8 input to be able to detect a line break.

Activation of the emergency stop:

Activation of the emergency stop (U_{in} > 8 V) immediately shuts off the fuel injection which stops the engine.

7.1.2 Binary inputs DI 1 ... 8

7.1.2.1 Technical data

Channel specification:

Switches: External voltage or $+U_{batt}$

Input voltage 0 to 32 V DC

Low detection: $U_{in} < 4 \text{ V}$

High detection: $U_{in} > 8 \text{ V}$

Input impedance: 12.1 kohm

Input filter (fg/-3dB): 19Hz

Scanning frequency: $< 1 \text{ ms}$

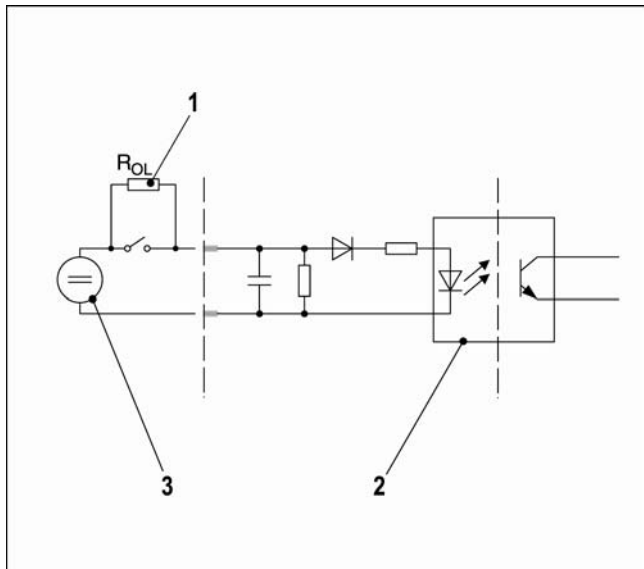
Electrical isolation: 50 V DC

Line break monitoring: Current monitoring with $ROL = 33 \text{ kohm} \pm 10\%$

7.1.2.2 Required settings

- Open line = line break monitoring active
- Logic: "Active high" or "Active low"

7.1.2.3 Schematic circuit diagram



- 1 Resistor for line break monitoring
- 2 Optocoupler
- 3 Inductive load (a free-wheeling diode must be installed for inductive loads)
- 4 Voltage source

Note: Line break monitoring is only possible if no load is connected parallel to input DI 1 to 8

7.1.2.4 D1 - Engine stop

Engine stop signal is activated when this input is shut off. This signal is saved. until the engine is at stand still.

Parameters:

- Open-line monitoring engine stop: (2.7001.804)
- Logic engine stop: (2.7001.805)
- Stop: saved: (2.7001.009)

7.1.2.5 DI 2 – Speed droop

For "genset" applications the frequency can be changed between 50 Hz/60 Hz using this input.

Parameters:

- Open-line monitoring speed droop: (2.1060.834)
- Logic speed droop: (2.1060.835)

7.1.2.6 DI 3 – Increase idle speed/or switchover frequency

Switching on this input increases the idle speed to a predetermined (adjustable) value.

Parameters:

- Open-line monitoring idle speed increase: (2.1060.844)
- Logic idle speed increase: (2.1060.845)
- Open-line monitoring frequency switching: (2.7003.804)
- Logic frequency switching: (2.7003.805)

7.1.2.7 DI 4 – Reset alarm

Actuation of this input will reset saved alarms.

YELLOW and RED alarms are saved. These alarms will be signaled until they are reset with the “Reset alarm” command.

Parameters:

- Open-line monitoring alarm reset: (2.8009.804)
- Logic alarm reset: (2.8009.805)

7.1.2.8 DI 5 – Increase engine speed (speed up)

When this input is activated the engine speed can be raised to any speed between idle speed and rated speed (max. speed).

Parameters:

- Open-line monitoring engine speed increase: (2.1060.804)
- Logic engine speed increase: (2.1060.805)

7.1.2.9 DI 6 – Decrease engine speed (speed down)

When this input is activated the engine speed can be lowered to any speed between rated speed (max. speed) and idle speed.

Parameters:

- Open-line monitoring engine speed decrease: (2.1060.814)
- Logic engine speed decrease: (2.1060.815)

7.1.2.10 DI 7 – Engine start

Actuation of this input activates the engine start program. This signal must be present for the entire start sequence. An interruption will lead to an abort of the start sequence.

Parameters:

- Open-line monitoring engine start: (2.1090.804)
- Logic engine start: (2.1090.805)

7.1.2.11 DI 8 – Override

The “Override” function is used to override certain safety functions. Otherwise, when limits are violated this would lead to a reduction in performance or an emergency stop of the engine. Note: Internal performance maps cannot be overridden!

Parameters:

- Open-line monitoring override: (2.7002.804)
- Logic override: (2.7002.805)

7.1.3 Analog inputs AI 1 ... 2

7.1.3.1 Technical data

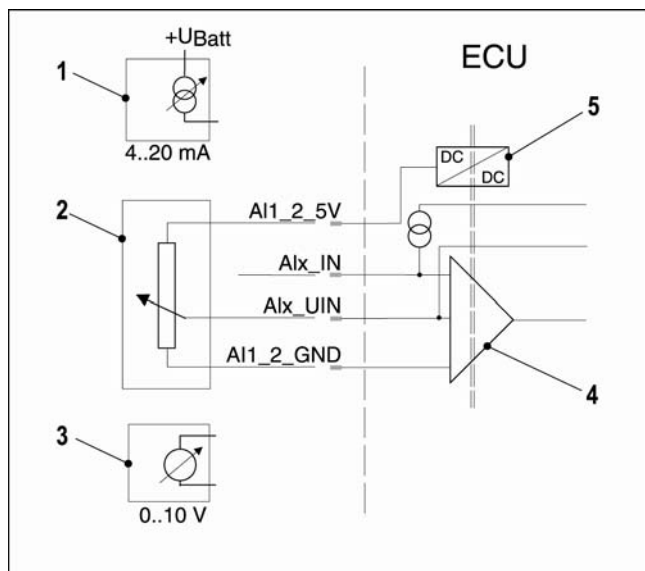
Channel specification

- Sensors: Current sources, voltage sources or potentiometer 1 to 5 kohm
- Power supply: 5 V $\pm$ 3% max. 50 mA
- Voltage input: 0 to 10 V DC (max. 13 V), input impedance 100 kohm, filter 200 Hz (fg/-3 dB)
- Current input: 0 to 25 mA $\pm$ 2% (max. 25 mA), load voltage 4.5 V at 20 mA
- Fault detection of voltage input: $U > 10$ V
- Fault detection of current input: $I < 2$ mA, $I > 22$ mA (overcurrent shutoff ~ 40 mA)
- Electrical isolation: 50 V DC
- Dielectric strength 36 V DC

7.1.3.2 Required settings

- Configuration, voltage input/current input via the connection
- Scaling
- Function

7.1.3.3 Schematic circuit diagram



1. Control via current source
2. Control via resistor
3. Control via voltage source
4. Input amplifier
5. Power supply via potentiometer connection

7.1.3.4 AI 1 - Speed demand

The engine speed can be set between idle speed and rated speed (max. torque). This analog signal enables the speed to be set to a certain value. Changes in the speed are made along a speed ramp which can be programmed as an acceleration ramp or a deceleration ramp.

Parameters:

- Configuration: (2.0280.039)
- Curves for: Voltage (2.0401.010)/current: (2.0401.012)

7.1.3.5 AI 2 – Torque request

This signal is the torque specification for torque-controlled systems. This corresponds to the load specified in % for a fuel injection governor.

Parameters:

- Configuration: (2.0287.039)

7.1.4 Transistor output TOP 1 to 4

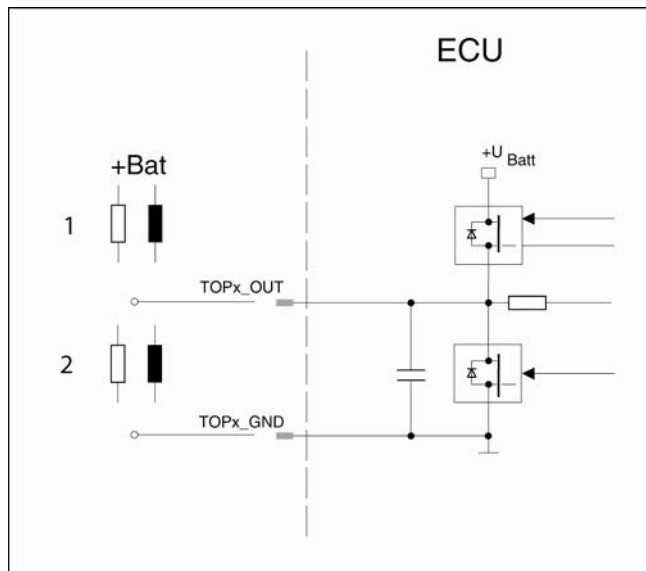
7.1.4.1 Channel specification/technical data

- Control of:
 - Lamps
 - Relays
 - Digital inputs
- Channel specification
 - Loads: 24 V DC consumers, valves
 - Output current DC: 1.4 A at 24 V On
 - Output voltage w/o load: ~ 5 V (high switch) ~ 0 V (low switch)
 - Switching frequency: max. ≤ 2 Hz
 - Load: max. 140 mH inductive
 - Electrical isolation: None
 - Short circuit recognition: Yes
 - Line break monitoring: switched off, only with $R_{load} < 25 \text{ kohm}$
 - Overvoltage protection: up to 36 V (Important: install a free-wheeling diode for inductive loads!)

7.1.4.2 Required settings

- “Low switch” or “High switch”
- Line break monitoring on/off

7.1.4.3 Schematic circuit diagram



1. Inductive load
2. Ohmic load

7.1.4.4 TOP 1 - Yellow alarm

This output switches as soon as a yellow alarm appears.

Parameters:

- Active level: (2.1050.005)
- “Low switch” or “High switch”: (2.1050.010)

7.1.4.5 TOP 2 - Red alarm

This output switches as soon as a red alarm appears. If an additional alarm occurs this output switches off and then on again.

Parameters:

- Active level: (2.1050.006)
- “Low switch” or “High switch”: (2.1050.011)

7.1.4.6 TOP 3 – Oil pressure too low (lube-oil stop)

This output switches as soon as the oil pressure falls below the minimum value (adjustable).

Parameters:

- Active level: (2.1050.007)
- “Low switch” or “High switch”:(2.1050.012)

7.1.4.7 TOP 4 – Starter on

Starter relay, the starter engages when TOP4 is switched.

Parameters:

- Active level: (2.1050.008)
- “Low switch” or “High switch”: (2.1050.013)

7.1.5 Analog outputs AO 1 to 2

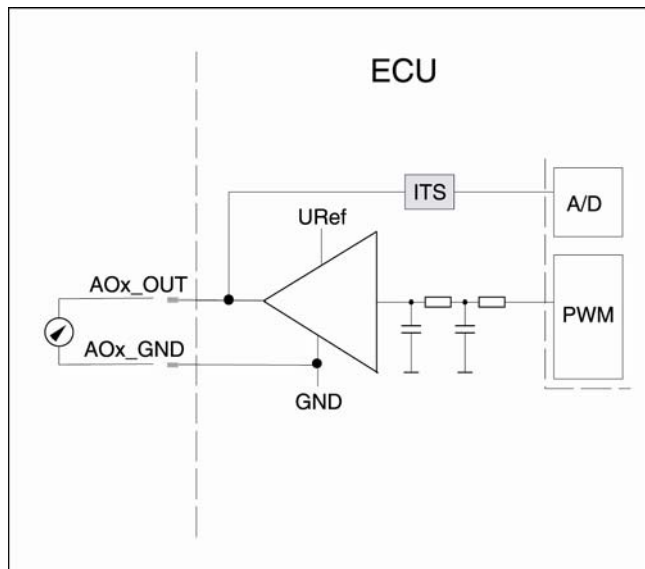
7.1.5.1 Channel specification/technical data

- Control of:
 - Display instrument
 - Analog inputs
- Channel specification
 - Output current: 0 to 8 mA at 10 V
 - Output voltage: 0 to 10 V DC
 - Output voltage w/o load: ~ 0 V
 - Short-circuit current: ~ 18 mA
 - Settling time: 11 ms at 0 to 8 mA
 - Electrical isolation: No electrical isolation
 - Line break monitoring: No
 - Overvoltage protection: up to 36 V DC

7.1.5.2 Required settings

None

7.1.5.3 Schematic circuit diagram



7.1.5.4 AO 1 – Coolant temperature

This signal can be used to actuate a temperature display.

Parameters:

- Voltage output: linear 0 to 100% (12 bit) - > * 0 to 9999 mV

7.1.5.5 AO 2 - Oil pressure

This signal can be used to actuate a pressure display.

7.1.6 CAN interfaces 1 to 2

7.1.6.1 Channel specification/technical data

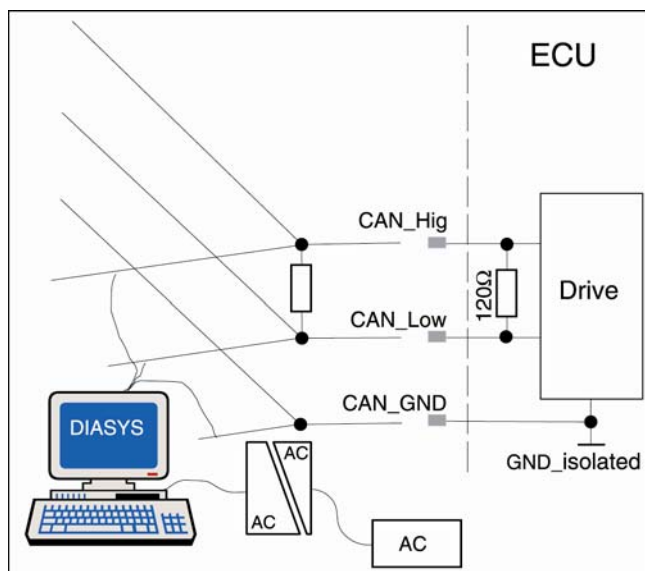
- Channel type: Serial interface, Controller Area Network (CAN)
- Control of:
 - CAN bus
 - Analog inputs
- Channel specification
 - High-speed CAN compatible with ISO 11898 (24 V)
 - CAN specification: Version 2.0B/11/29 bit bus structure.
 - Max. data rate: 1 Mbit/s
 - Max. bus length: 250 m
 - Termination resistor: 120 ohm (to be installed in cable)
 - Short circuit recognition/open circuit: by the CAN controller
 - Electrical isolation: 50 V DC to ECU GND and to CAN_1/CAN_2
 - Overvoltage protection: ± 36 V/50 V DC/12 kV ESD

Note: The 120 ohm terminating resistor must be installed at the end of the line!

7.1.6.2 Required settings

None

7.1.6.3 Schematic circuit diagram



CAN	Controller Area Network	DC	Direct current
GND	Ground	AC	Alternating current
ECU	Engine Control Unit		

7.1.6.4 CAN 1

This CAN interface is used to connect the Engine Control Unit to the other MTU or OEM devices through the CAN bus.

This interface can only transmit, i.e., received objects cannot be evaluated on this bus. All objects transmitted on CAN 2 - J1939 (see below) are also transmitted here.

7.1.6.5 CAN 2 – J1939

This CAN interface is used to connect the Engine Control Unit to the other MTU or OEM devices through the CAN bus.

This interface is capable of transmitting and receiving. The interface definition of the transmit and receive objects complies with the international SAE J1939-Standard.

8 Fault message table

No.	ZKP no.	Name	Description
5	2.0121.931	HI T-Charge Air	Charge-air temperature too high (limit value 1) ==> Check intercooler (Alarm configuration parameter, for explanation see PR 2.8008.100)
6	2.0121.932	SS T-Charge Air	Charge-air temperature too high (limit value 2) ==> Check intercooler (Alarm configuration parameter, for explanation see PR 2.8008.100)
15	2.0100.921	LO P-Lube Oil	Lube-oil pressure too low (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
16	2.0100.922	SS P-Lube Oil	Lube-oil pressure too low (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
30	2.2510.932	SS Engine Overspeed	Engine overspeed (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
31	2.3011.931	HI ETC1 Overspeed	Speed of primary turbocharger too high (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
32	2.3012.932	SS ETC1 Overspeed	Speed of primary turbocharger too high (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
36	2.3013.931	HI ETC2 Overspeed	Speed of 1st secondary turbocharger too high (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
37	2.3013.912	SS ETC2 Overspeed	Speed of 1st secondary turbocharger too high (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
57	2.0101.921	LO P-Coolant	Coolant pressure too low (limit value 1) ==> Check cooling circuit Idle speed not reached ==> Start termination ==> Observe messages (Alarm configuration parameter, for explanation see PR 2.8008.100)
58	2.0101.922	SS P-Coolant	Coolant pressure too low (limit value 2) ==> Engine stop or reduction of injection quantity ==> Check cooling circuit (Alarm configuration parameter, for explanation see PR 2.8008.100)
59	2.0120.933	SS T-Coolant L3	Coolant temperature too high/too low (limit value 3). (Alarm configuration parameter, for explanation see PR 2.8008.100)
60	2.0120.934	SS T-Coolant L4	Coolant temperature too high/too low (limit value 4). (Alarm configuration parameter, for explanation see PR 2.8008.100)
67	2.0120.931	HI T-Coolant	Coolant temperature too high (limit value 1) ==> Check coolant circuit (Alarm configuration parameter, for explanation see PR 2.8008.100)
68	2.0120.932	SS T-Coolant	Coolant temperature too high (limit value 2) ==> Check coolant circuit (Alarm configuration parameter, for explanation see PR 2.8008.100)
81	1.8004.046	AL System Leaks	Pressure gradient in rail is too low when starting or too high when stopping (==> High-pressure system leaks, air in system) (Alarm configuration parameter, for explanation see PR 2.8008.100)
82	2.0104.931	HI P-Fuel (Common Rail)	Rail pressure > set value => DBR reduction, start of injection retarded (==> HP fuel control block sticks or wiring of HP fuel control block) (Alarm configuration parameter, for explanation see PR 2.8008.100)
83	2.0104.921	LO P-Fuel (Common Rail)	Rail pressure < set value => DBR reduction (==> HP fuel control block is faulty or leak in high-pressure system) (Alarm configuration parameter, for explanation see PR 2.8008.100)
89	2.2500.030	SS Engine Speed Low	Engine stalls. The engine speed falls below the limit value of parameter 2.2500.027 (speed limit before engine stalls) and no engine stop command has been applied. When this state occurs, the engine is stopped for safety reasons. (Alarm configuration parameter, for explanation see PR 2.8008.100)
90	2.1090.925	SS Idle Speed Not Reached	Idle speed not reached ==> Start termination ==> Observe messages (Alarm configuration parameter, for explanation see PR 2.8008.100)
91	2.1090.924	SS Disengage Speed Not Reached	Runup speed not reached ==> Start termination ==> Observe messages (Alarm configuration parameter, for explanation see PR 2.8008.100)
92	2.1090.923	SS Starter Speed Not Reached	Starter speed not reached ==> Start termination ==> Starter does not turn or turns too slowly (Alarm configuration parameter, for explanation see PR 2.8008.100)
93	2.1090.922	SS T-Preheat	Preheating temperature too low (limit value 2) ==> Coolant temperature for engine start too low ==> Engine start interlock (Alarm configuration parameter, for explanation see PR 2.8008.100)
94	2.1090.921	LO T-Preheat	Preheating temperature too low (limit value 1) ==> Coolant temperature for engine start too low (Alarm configuration parameter, for explanation see PR 2.8008.100)
95	2.1090.920	AL Prelube Fault	Prelube fault. (Alarm configuration parameter, for explanation see PR 2.8008.100)
102	1.8004.624	AL Counter Faulty	Counter faults. (Alarm configuration parameter, for explanation see PR 2.8008.100)

No.	ZKP no.	Name	Description
104	1.8004.623	AL Operating Hours Counter Faulty	Run-time meter faulty. (Alarm configuration parameter, for explanation see PR 2.8008.100)
118	2.0140.921	LO ECU Power Supply	Power supply too low (limit value 1) ==> Check batteries/generator (Alarm configuration parameter, for explanation see PR 2.8008.100)
119	2.0140.922	LOLO ECU Power Supply	Power supply too low (limit value 2) ==> Check batteries/generator (Alarm configuration parameter, for explanation see PR 2.8008.100)
120	2.0140.931	HI ECU Power Supply	Power supply too high (limit value 1) ==> Check batteries/generator (Alarm configuration parameter, for explanation see PR 2.8008.100)
121	2.0140.932	HIHI ECU Power Supply	Power supply too high (limit value 2) ==> Check batteries/generator (Alarm configuration parameter, for explanation see PR 2.8008.100)
122	2.0132.921	HI T-ECU	Temperature of electronics too high (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
141	1.1088.007	AL Power Too High	This alarm is triggered if the average power has exceeded the specified maximum value give by PR1.1088.001 in that last 24 hours. (Alarm configuration parameter, for explanation see PR 2.8008.100)
142	1.1088.006	AL MCR 1 Hour Exceeded	The alarm is triggered if the MCR was exceeded for longer than 1 hour in the last 12 hours. (Alarm configuration parameter, for explanation see PR 2.8008.100)
180	2.0500.680	AL CAN1 Node Failure	Connection to a node on CAN bus 1 has failed. ==> Check the devices connected to the CAN (Alarm configuration parameter, for explanation see PR 2.8008.100)
181	2.0500.681	AL CAN2 Node Failure	Connection to a node on CAN bus 2 has failed. ==> Check the devices connected to the CAN (Alarm configuration parameter, for explanation see PR 2.8008.100)
182	2.0500.682	AL CAN Incorrectly Parameterized	Incorrect parameters set in data record. (Alarm configuration parameter, for explanation see PR 2.8008.100)
183	2.0500.683	AL CAN No PU Data	A CAN mode has been selected that initiates communications with help of the PU data module. The required PU data module is, however, not present or not valid. ==> Check the devices connected to the CAN (Alarm configuration parameter, for explanation see PR 2.8008.100)
184	2.0500.684	AL CAN PU Data Flash Fault	A program error occurred while trying to copy a received PU data module to the flash module. ==> Electronics service (Alarm configuration parameter, for explanation see PR 2.8008.100)
186	2.0500.686	AL CAN1 Bus Off	CAN controller 1 is in "Bus-Off" mode. => Automatic switchover to CAN2. ==> Possible causes are e.g. short circuit, major interruptions or Baud rate incompatibility. (Alarm configuration parameter, for explanation see PR 2.8008.100)
187	2.0500.687	AL CAN1 Error Passive	CAN controller 1 signaled a warning. ==> Possible causes are e.g. no node, minor interruptions or temporary bus overload. (Alarm configuration parameter, for explanation see PR 2.8008.100)
188	2.0500.688	AL CAN2 Bus Off	CAN controller 2 is in "Bus-Off" mode. => Automatic switchover to CAN 1. ==> Possible causes are e.g. short circuit, major interruptions or Baud rate incompatibility. (Alarm configuration parameter, for explanation see PR 2.8008.100)
189	2.0500.689	AL CAN2 Error Passive	CAN controller 2 signaled a warning. ==> Possible causes are e.g. no node, minor interruptions or temporary bus overload. (Alarm configuration parameter, for explanation see PR 2.8008.100)
201	1.8004.570	SD T-Coolant	Coolant temperature sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B6) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
202	1.8004.572	SD T-Fuel	Fuel temperature sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B33) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
203	1.8004.571	SD T-Charge Air	Charge-air temperature sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B9) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
208	1.8004.566	SD P-Charge Air	Charge-air pressure sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B10) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
211	1.8004.563	SD P-Lube Oil	Lube-oil sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B5) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)

No.	ZKP no.	Name	Description
212	1.8004.564	SD P-Coolant	Coolant pressure sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B16) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
215	1.8004.567	SD P-HD	Rail pressure sensor faulty. ==> High pressure regulator in emergency operation ==> Short circuit or wire break ==> Check sensor and wiring (B48) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
216	1.8004.575	SD T-Lube Oil	Lube-oil temperature sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B7) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
219	1.8004.573	SD T-Intake Air	Intake air temperature sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B3) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
229	1.8004.562	AL Stop Camshaft Sensor Faulty	Engine stop due to a faulty camshaft sensor (and a fault in the crankshaft sensor on the previous cycle). Check sensor and wiring to connector B1 and replace as necessary. After restarting engine the fault is rectified. (Alarm configuration parameter, for explanation see PR 2.8008.100)
230	1.8004.498	SD Crankshaft	Crankshaft sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B13) and replace as necessary. After restarting engine the fault is rectified. (Alarm configuration parameter, for explanation see PR 2.8008.100)
231	1.8004.499	SD Camshaft	Camshaft sensor faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B1) and replace as necessary. After restarting engine the fault is rectified. (Alarm configuration parameter, for explanation see PR 2.8008.100)
232	1.3011.128	SD Charger Speed 1	Speed sensor of main charger faulty. ==> Short circuit or wire break ==> Check sensor and wiring (B44.1) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
245	2.8006.589	SD ECU Power Supply	Internal ECU fault. ==> Electronics faulty (Alarm configuration parameter, for explanation see PR 2.8008.100)
266	2.8006.586	SD Speed Demand	Analog speed demand signal faulty. ==> Short circuit or wire break ==> Check speed demand sensor and wiring and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
269	2.8006.588	SD Filtered Analog Load Pulse	Filtered analog load pulse not present. ==> Short circuit or wire break ==> Check wiring and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
270	2.8006.590	SD Frequency Input	Frequency input faulty. ==> Short circuit or wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
321	1.8004.520	AL Cylinder A1 Wiring	Short circuit fault in the injector wiring for cylinder A1. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
322	1.8004.521	AL Cylinder A2 Wiring	Short circuit fault in the injector wiring for cylinder A2. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
323	1.8004.522	AL Cylinder A3 Wiring	Short circuit fault in the injector wiring for cylinder A3. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
324	1.8004.523	AL Cylinder A4 Wiring	Short circuit fault in the injector wiring for cylinder A4. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
325	1.8004.524	AL Cylinder A5 Wiring	Short circuit fault in the injector wiring for cylinder A5. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
326	1.8004.525	AL Cylinder A6 Wiring	Short circuit fault in the injector wiring for cylinder A6. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)

No.	ZKP no.	Name	Description
331	1.8004.530	AL Cylinder B1 Wiring	Short circuit fault in the injector wiring for cylinder B1. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
332	1.8004.531	AL Cylinder B2 Wiring	Short circuit fault in the injector wiring for cylinder B2. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
333	1.8004.532	AL Cylinder B3 Wiring	Short circuit fault in the injector wiring for cylinder B3. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
334	1.8004.533	AL Cylinder B4 Wiring	Short circuit fault in the injector wiring for cylinder B4. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
335	1.8004.534	AL Cylinder B5 Wiring	Short circuit fault in the injector wiring for cylinder B5. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
336	1.8004.535	AL Cylinder B6 Wiring	Short circuit fault in the injector wiring for cylinder B6. Result: Misfire. => Rectify the short circuit in the injector solenoid (positive to negative) e.g. by replacing injector. Fault rectified: each time engine is restarted. (Alarm configuration parameter, for explanation see PR 2.8008.100)
341	1.8004.540	AL Cylinder A1 Open Circuit	Open circuit fault in the injector wiring for cylinder A1. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
342	1.8004.541	AL Cylinder A2 Open Circuit	Open circuit fault in the injector wiring for cylinder A2. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
343	1.8004.542	AL Cylinder A3 Open Circuit	Open circuit fault in the injector wiring for cylinder A3. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
344	1.8004.543	AL Cylinder A4 Open Circuit	Open circuit fault in the injector wiring for cylinder A4. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
345	1.8004.544	AL Cylinder A5 Open Circuit	Open circuit fault in the injector wiring for cylinder A5. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
346	1.8004.545	AL Cylinder A6 Open Circuit	Open circuit fault in the injector wiring for cylinder A6. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
351	1.8004.550	AL Cylinder B1 Open Circuit	Open circuit fault in the injector wiring for cylinder B1. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
352	1.8004.551	AL Cylinder B2 Open Circuit	Open circuit fault in the injector wiring for cylinder B2. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)

No.	ZKP no.	Name	Description
353	1.8004.552	AL Cylinder B3 Open Circuit	Open circuit fault in the injector wiring for cylinder B3. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
354	1.8004.553	AL Cylinder B4 Open Circuit	Open circuit fault in the injector wiring for cylinder B4. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
355	1.8004.554	AL Cylinder B5 Open Circuit	Open circuit fault in the injector wiring for cylinder B5. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
356	1.8004.555	AL Cylinder B6 Open Circuit	Open circuit fault in the injector wiring for cylinder B6. Result: Misfire. => Check injection wiring for breaks and rule out any breaks in the solenoid valve (e.g. by replacing injector). Fault rectified: after each working cycle. (Alarm configuration parameter, for explanation see PR 2.8008.100)
361	1.8004.496	AL Injector Output Stage Low	Internal electronics fault (electronics are probably faulty -> Start ITS). If ITS diagnosis "Electronics OK", observe messages (e.g. wiring fault). If "1.1020.021" bit (Power Stage Failure: Stop Engine) is set, an engine stop will also occur. (Alarm configuration parameter, for explanation see PR 2.8008.100)
362	1.8004.497	AL Injector Output Stage High	Internal electronics fault (electronics are probably faulty -> Start ITS). If ITS diagnosis "Electronics OK", observe messages (e.g. wiring fault). If "1.1020.021" bit (Power Stage Failure: Stop Engine) is set, an engine stop will also occur. (Alarm configuration parameter, for explanation see PR 2.8008.100)
363	1.8004.560	AL Stop Injector Output Stage	Internal electronics fault (electronics are probably faulty -> Start ITS). If ITS diagnosis "Electronics OK", observe messages (e.g. wiring fault). If "1.1020.021" bit (Power Stage Failure: Stop Engine) is set, an engine stop will also occur. (Alarm configuration parameter, for explanation see PR 2.8008.100)
365	1.8004.561	AL Stop MV Wiring GND	Injector wiring fault. Engine stop possible via Protection Module. Possible causes: 1. Short circuit of injector positive connection of one or more injectors to GND 2. Short circuit of injector negative connection of one or more injectors to GND. -> Check wiring and replace wiring harness as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
371	1.8004.634	AL Wiring TO 1	Short circuit or line break at transistor output 1 (TO 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
381	2.8006.638	AL Wiring TOP 1	Short circuit or line break at transistor output 1 system-side (TOP 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
382	2.8006.639	AL Wiring TOP 2	Short circuit or line break at transistor output 2 system-side (TOP 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
383	2.8006.640	AL Wiring TOP 3	Short circuit or line break at transistor output 3 system-side (TOP 3). (Alarm configuration parameter, for explanation see PR 2.8008.100)
384	2.8006.641	AL Wiring TOP 4	Short circuit or line break at transistor output 4 system-side (TOP 4). (Alarm configuration parameter, for explanation see PR 2.8008.100)
390	1.1085.009	AL MCR Exceeded	DBR/MCR function: MCR (continuous max. rate) was exceeded. (Alarm configuration parameter, for explanation see PR 2.8008.100)
408	2.8006.633	AL Open Load Emergency Stop Input ESI	Open circuit at input for emergency stop. ==> Wiring faulty or no resistance through switch (Alarm configuration parameter, for explanation see PR 2.8008.100)
410	2.0141.921	LO U-PDU	Injector voltage too low (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
411	2.0141.922	LOLO U-PDU	Injector voltage too low (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
412	2.0141.931	HI U-PDU	Injector voltage too high (limit value 1).

No.	ZKP no.	Name	Description
			(Alarm configuration parameter, for explanation see PR 2.8008.100)
413	2.0141.932	HIHI U-PDU	Injector voltage too high (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
438	2.0116.921	LO P-Fuel 2 (Common Rail)	Rail pressure < set value => DBR reduction (==> HP fuel control block is faulty or leak in high-pressure system) (Alarm configuration parameter, for explanation see PR 2.8008.100)
439	2.0116.931	HI P-Fuel 2 (Common Rail)	Rail pressure > set value => DBR reduction, start of injection retarded (==> HP fuel control block sticks or wiring of HP fuel control block) (Alarm configuration parameter, for explanation see PR 2.8008.100)
441	1.8004.047	AL System 2 Leaks	Pressure gradient in rail is too low when starting or too high when stopping (==> High-pressure system leaks, air in system) (Alarm configuration parameter, for explanation see PR 2.8008.100)
444	1.8004.578	SD U-PDU	Sensor for injector output stage faulty. ==> ECU7 internal error. Replace ECU7. (Alarm configuration parameter, for explanation see PR 2.8008.100)
445	1.8004.580	SD P-Ambient Air	Ambient air sensor faulty. (Alarm configuration parameter, for explanation see PR 2.8008.100)
446	1.8004.599	SD P-HD2	Rail pressure sensor faulty. ==> High pressure regulator in emergency operation ==> Short circuit or wire break ==> Check sensor and wiring (B48) and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
448	2.0103.931	HI P-Charge Air	Charge-air pressure too high (limit value 1). (Alarm configuration parameter, for explanation see PR 2.8008.100)
449	2.0103.932	SS P-Charge Air	Charge-air pressure too high (limit value 2). (Alarm configuration parameter, for explanation see PR 2.8008.100)
450	2.8006.592	SD Filling Signal in Percent	Input signal for start/end torque faulty. ==> Short circuit or wire break ==> Check signal transmitter and wiring and replace as necessary. After restarting engine the fault is rectified. (Alarm configuration parameter, for explanation see PR 2.8008.100)
454	2.7000.011	SS Power Limit Active	Power reduction activated. (Alarm configuration parameter, for explanation see PR 2.8008.100)
470	1.8004.587	SD T-ECU	Temperature sensor for ECU faulty. ==> Short circuit or wire break ==> Check sensor and wiring and replace as necessary. (Alarm configuration parameter, for explanation see PR 2.8008.100)
472	2.8006.593	AL Stop SD	Engine stopped because channel has a "Faulty sensor". (Alarm configuration parameter, for explanation see PR 2.8008.100)
474	2.8006.655	AL Wiring FO	Line break or short circuit at channel FO. (Alarm configuration parameter, for explanation see PR 2.8008.100)
476	1.8010.007	AL Crash Rec. Init. Fault	Initiation fault of crash recorder. (Alarm configuration parameter, for explanation see PR 2.8008.100)
478	2.8006.001	AL Combined Alarm Yellow (System)	Combined alarm YELLOW from system. (Alarm configuration parameter, for explanation see PR 2.8008.100)
479	2.8006.002	AL Combined Alarm Red (System)	Combined alarm RED from system. (Alarm configuration parameter, for explanation see PR 2.8008.100)
480	2.0291.921	AL Ext. engine protection	External engine protection function active. (Alarm configuration parameter, for explanation see PR 2.8008.100)
510	2.7002.010	AL Override Operated	Override operated. (Alarm configuration parameter, for explanation see PR 2.8008.100)
515	2.1090.926	AL Starter Not Engaged	Starter at POM could not be engaged. => Repeat start. If the number of automatic start attempts in PR 2.1090.134 has been reached, start is terminated. Check POM, starter and wiring. (Alarm configuration parameter, for explanation see PR 2.8008.100)
549	2.7001.952	AL Power interruption detected	This is an alarm from the emergency stop counter. While the engine was running the power supply of the ECU was switched off. This can lead to excessive pressure in the high-pressure system which could damage the engine. (Alarm configuration parameter, for explanation see PR 2.8008.100)
576	1.1075.083	AL ESCM Override	The corrected MCR or DBR/MCR curve exceeded. Engine overload! (Alarm configuration parameter, for explanation see PR 2.8008.100)
594	1.1301.900	AL L1 UDV Faulty	Yellow alarm pressure relief valve of first rail.
595	1.1301.901	AL L2 UDV Faulty	Red alarm pressure relief valve of first rail.
598	1.1302.900	AL L1 UDV Faulty	Yellow alarm pressure relief valve of second rail.
599	1.1302.901	AL L2 UDV Faulty	Red alarm pressure relief valve of second rail.
610	1.1301.902	AL HP Fuel Control Block 1 Wiring	Line break or short circuit at PWMchannel of HP fuel control block. (Alarm configuration parameter, for explanation see PR 2.8008.100)
611	1.1302.902	AL HP Fuel Control Block 2 Wiring	Line break or short circuit at PWMchannel of HP fuel control block 2. (Alarm configuration parameter, for explanation see PR 2.8008.100)

No.	ZKP no.	Name	Description
612	1.1301.903	AL Pressure Regulating Valve 1 Wiring	Line break or short circuit at PWM channel of pressure regulating valve (Alarm configuration parameter, for explanation see PR 2.8008.100)
613	1.1302.903	AL Pressure Regulating Valve 2 Wiring	Line break or short circuit at PWMchannel of pressure regulating valve 2. (Alarm configuration parameter, for explanation see PR 2.8008.100)
615	2.0610.951	AL EIL Protection	Alarm for Protection Module in response to a faulty or manipulated EIL. (Alarm configuration parameter, for explanation see PR 2.8008.100)
616	10.610.952	AL EIL fault	Alarm in case of faulty or manipulated. (Alarm configuration parameter, for explanation see PR 2.8008.100)
692	2.7003.901	AL ECU switch off/on required	ECU configuration changed, switch ECU off and back on (Alarm configuration parameter, for explanation see PR 2.8008.100)
696	2.0560.901	AL Smart Connect USB Error	(Alarm configuration parameter, for explanation see PR 2.8008.100)
697	2.0560.903	AL Smart Connect RS485 Error	(Alarm configuration parameter, for explanation see PR 2.8008.100)
698	2.7001.904	AL SD Stop button	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
700	2.1090.912	AL SD Start button	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
701	2.1060.901	AL SD Up button	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
702	2.1060.903	AL SD Down button	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
703	2.1060.905	AL SD ext. speed demand Change-over switch	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
704	2.1060.907	AL SD Speed increase	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
705	2.1060.909	AL SD Speed limit binary	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
706	2.1060.911	AL SD Speed droop 2 switch	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
707	2.7003.903	AL SD Frequency switch	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
709	2.7002.901	AL SD Override button	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
710	2.8009.901	AL SD Alarm reset	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
711	2.3000.901	AL SD Cylinder cutout	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
712	2.1050.901	AL SD Request Test Bin. Out	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
713	2.0291.901	AL SD Ext. engine protection	Channel signals wire break or internal fault (Alarm configuration parameter, for explanation see PR 2.8008.100)
714	2.1090.914	AL SD Priming Priming signal	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
715	2.1060.915	AL SD Ext. idle increase bin	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
716	2.1060.917	AL SD Idle increase	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)
717	2.1080.901	AL SD Request DBR	Channel signals wire break (Alarm configuration parameter, for explanation see PR 2.8008.100)