Installation and Commissioning Instructions

Application and Installation (A&I)

MotivLine Series 4000 C03

with

- ECU 7/EMU 7
- SAM
- POM

E532256/01E

Power. Passion. Partnership.

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1 Safety

1.1 General conditions

General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention must be observed. This state-of-the-art system has been designed to meet all applicable laws and regulations. The system may nevertheless present a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Non-compliance with the Safety Instructions

Correct use

The system is intended solely for use in accordance with contractual agreements and the purpose envisaged for it on delivery. Any other use is considered improper use. The system manufacturer accepts no liability whatsoever for resultant damage or injury in such case. The system manufacturer will not be liable for any losses and/or damages caused by improper use or actions resulting from personnel while under the influence of alcohol, medication or any other mind altering substances. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the maintenance schedule.

Liability exclusion

In the case of nonobservance of the specifications and information contained in this guideline, the manufacturer shall be released from liability and warranty obligations. No guarantee is provided that information in this guideline covers all requirements with regard to design of the plant or difficulties with installation. For this reason, MTU shall not entertain warranty claims, in particular, claims related to configuration and the installation of bought-in products. Changes that contribute to technical progress can also be made without prior notice.

Due to their diversity, locally valid laws, ordinances and specifications cannot be covered in this document, although they must be observed (see below for examples).

Numerical values in this guideline serve to clarify magnitude and must be regarded as examples.

Proposals included in this guideline for preventing dangerous operational statuses are necessarily of a general nature because, with regard to each partial system used, only the respective OEM (Original Equipment Manufacturer) is familiar with all details of his equipment. The examples do not guarantee prevention of a dangerous operational status in all circumstances.

Each system installation requires an MTU release following the installation inspection (EPQ).

Operational reliability, dependability and a long service life are also influenced by observance of the specified maintenance tasks. During the planning phase and installation of the plant, therefore, care must be taken to ensure easy access for servicing, maintenance and repair tasks.

Safety notifications used in this publication

Safety notifications (DANGER, WARNING, and CAUTION) are used in this manual to alert the owner and/or operator to special instructions concerning a particular procedure that may be hazardous if performed incorrectly.

These safety notifications alone cannot eliminate the hazards that they signal. Strict compliance with these special instructions and common sense operation are critical accident prevention measures. All safety notifications found on the equipment must be observed. Ensure that safety-related labels are legible and not obstructed by dirt, grease or other equipment.

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DANGER	In the event of immediate danger **Consequences: Death or serious injury.** • Preventive measures

WARNING	In the event of possibly dangerous situations. **Consequences: Death or serious injury.** • Preventive measures
CAUTION	In the event of dangerous situations. **Consequences: Slight injury or material damage.** • Preventive measures
NOTICE	**Meaning of NOTICE** • Notice is used throughout the publication to communicate a requirement, recommendation or fact relating to proper use, transport, installation, operation, or maintenance of the equipment but is not hazard related
NOTICE	**Manufacturers' recommendations** • All manufacturers' safety notifications are to be followed regardless of format.

Read and become acquainted with all safety notifications and their meaning before working with this system. Contact an authorized service outlet if clarification is needed.

The manufacturer cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by the manufacturer is used, you must satisfy yourself that it is safe for you and for others. Ensure the product will not be damaged or made unsafe by the transport, installation, commissioning, operation, lubrication, maintenance, repair or storage procedures that you choose.

The information, specifications and illustrations in this manual are on the basis of information available at the time it was written. The information, specifications and illustrations can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before you start any work on the system.

Modifications or conversions

Unauthorized modifications to the system represent a safety risk.

MTU will accept no liability or warranty claims for any damage caused by unauthorized modifications, third-party add-on devices and/or replacement parts. In the event that damage is caused by the use of non-genuine replacement parts, no liability or warranty claims through the system manufacturer will be accepted.

NOTICE	**Manufacturers' safety notifications** • All manufacturers' safety notifications are to be followed. • Unauthorized modifications, third-party add-on devices and replacement parts may compromise the integrity of the equipment, and may present a safety risk.
NOTICE	**Replacement safety labels** • Please contact an authorized service outlet to determine how to obtain replacement labels for parts that have safety labels.

Spare parts

Only genuine MTU spare parts are allowed to be used to replace components or assemblies. The system manufacturer accepts no liability whatsoever for damage or injury resulting from the use of other spare parts and the warranty shall be voided in such case.

Reworking components

Repair must be carried out in workshops authorized by MTU.

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1.2 Personnel and organizational requirements

Publication notice

For the remainder of this publication:

- The term “work”, “working” or “all work” is used in reference to work done on the system and is defined as one or more of the following actions: transport, installation, commissioning, operation, maintenance, repair and/or storage.
- The term “certified personnel” refers to a certified technician who has successfully completed training at MTU's certified training center and who has also been instructed on the system work by means of this publication, with special attention paid to the safety notifications. MTU's factory certified technician training classes are available in various locations to meet worldwide needs.
- The term “operator” or “third party user” is the person involved with the transport, installation, commissioning, operation, maintenance and/or repair that does not require him/her to be an MTU certified technician, but who must read and have full understanding of this publication, especially the safety notifications, before proceeding with any operation.
- The term “owner” or “person responsible for the engine operation” is the person who either owns the system or facility within which it resides. He/she generally schedules or directs the work being done on or with the system.
- The term “third-party” or “add-on” generally refers to items not designed by or purchased from MTU; whereas, “genuine” or “factory” means it was designed by or purchased from MTU.

Personnel and organizational requirements

This publication must be provided to all certified personnel involved in any or all work being done on the system and should be located in the vicinity of the system to be accessible at all times.

In general, operational checks can be performed by non-certified personnel following the published instructions. All other work on the system must be carried out by properly certified personnel.

All personnel working on the system must ensure that all safety notifications and informational messages are read and understood before any work is performed on the system.

In addition, observe the following:

- All work on the system shall be carried out by trained and qualified personnel only.
- The specified legal minimum age must be observed.
- The operator must specify the responsibilities of the operating, maintenance and repair personnel.
- Owners are responsible for instructing personnel who only occasionally work on the system, prior to requesting the work be performed. This personnel must be instructed repeatedly.

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1.3 Safety requirements in general

Working on an engine

Mechanical equipment can cause bodily harm and pose life-threatening danger when improperly transported, installed, commissioned, operated, maintained or repaired. Do not work on this engine unless you have read and understood the instructions and safety notifications contained in this publication. Failure to follow the instructions or heed the safety notifications could result in injury or death.

NOTICE	**Persons performing work on equipment** • Every person performing work on the equipment should read and become acquainted with all cautions and symbols before operating or repairing this product.
NOTICE	**Permission for working on the equipment** • Always obtain permission from the person in charge before commencing work on the equipment.
NOTICE	**Additional safety standards** • Additional national safety standards exist. The manufacturer recommends owners, operators and certified technicians become familiar with national safety standards, where available. • Operators should refer to the safety requirements for operators in this publication.

General safety requirements for operators

In addition, read and understand the following:

- Never carry out maintenance and/or repair work with the engine running, unless specified in the procedure and only in accordance with the applicable safety messages.
- Never work on the engine or other engine components without following proper lifting requirements.
- Never attempt to rectify faults or carry out repairs without the necessary certification and required special tool.
- Strictly adhere to the maintenance and repair schedule.
- Perform tasks as described.
- Use proper, calibrated tools and equipment.
- Always ensure that nobody is standing in the danger zone prior to barring over the engine.
- After completing work on the engine, check that all protective devices and safety guards have been installed. Remove all tools and loose objects from the engine vicinity.
- Ensure persons not involved in the work on the engine keep clear.
- Observe special cleanliness when conducting maintenance and repair work on the engine.
- For the identification and layout of the spare parts during maintenance or repair work, take photos or use the spare parts catalog.
- Regularly practice procedures to be prepared in cases of emergency.
- Be familiar with the engine controls and displays.
- Observe the displays and monitoring units with regard to present operating status and warning or alarm messages.

The following steps must be taken if a malfunction of the system occurs or is displayed:

1. Acknowledge the message and take appropriate action.
2. Notify the supervisory personnel in charge.
3. Carry out emergency actions (e.g. emergency engine stop), if required.

Personal protection

To reduce the risk of injury:

- Never work on the system while under the influence of alcohol, medication or any other mind-altering substances.
- Use the necessary protective equipment for the given work to be done.
- Wear protective clothing and approved safety shoes for all work.
- Use face, eye, ear and nose protection.

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WARNING

Personal injury

- To avoid injury when working near or on an operating engine, use care when working around moving belts and rotating parts.
- Do not remove or discard safety guards.
- Remove loose items of clothing and jewelry, and tie back or contain long hair that could be caught in any moving or rotating part.

WARNING

Risk of injury

- To avoid injury from flying debris when using compressed air, wear protective clothing and adequate eye and ear protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

NOTICE

Equipment requirements

- Personal protective equipment includes, but is not limited to, safety stands, safety shoes, safety glasses, safety goggles, safety helmet, gloves, ear protection, dust mask, respirator and apron.

NOTICE

Acceptable footwear

- Bare feet, sandals or sneakers are not acceptable footwear.

Noise control

Permanent hearing loss can result from exposure to high noise levels. Noise can lead to an increased risk of accident if acoustic signals, warning shouts or sounds indicating danger are drowned.

WARNING

Engine noise above 85 dB (A).

Risk of damage to hearing!

- Wear ear protectors.

WARNING

Risk of injury from hazardous noise levels

- To avoid injury from hazardous noise levels, be cognizant of surroundings knowing that ear protection may block out warning shouts or sounds indicating danger. This includes audible alarms and human warnings.

CAUTION

Loud noise

- To avoid injury from loud noise, wear hearing protection when the engine is running.

Electric shock

Accidental contact with electrical equipment can cause severe injury or death if the equipment is not properly grounded. The frame and external electrically conductive parts of this equipment must be properly connected to an approved earth ground, in accordance with applicable electrical codes. A grounding lug is provided for this purpose.

Hazardous voltages are present at power terminals of this equipment. Contact with terminals can result in extremely dangerous and possibly lethal electric shock.

Open or poorly insulated conductors are extremely dangerous during operation.

In case of an accidental electrical event, the owner is responsible to have appropriate procedures and equipment in place.

In case of an accidental shock:

1. Shut down the engine immediately.
2. If the engine cannot be shut down, free the victim from contact with a dry non-conductor. Avoid direct contact with the victim until free of the conductor.
3. If the victim is unconscious and you are qualified to administer artificial respiration, administer artificial respiration and seek medical help immediately.

DANGER

Danger to life
- To avoid injury or death from electric shock, all codes, standards, regulations, and laws pertaining to the installation must be strictly followed.

DANGER

Danger to life
- To avoid injury or death from electric shock, exercise extreme caution when working on or around electrical components.

DANGER

Danger to life
- To avoid injury or death from electric shock, do not tamper with interlocks.

DANGER

Danger to life
- To avoid injury or death from electric shock, be sure the main switch is in "OFF" position when servicing any part of the electrical system.

WARNING

Electric shock
- To avoid injury from electrical shock, use care when disconnecting battery cables. Always remove the negative side of the battery first.

WARNING

Risk of injury from electric shock
- To avoid injury from electric shock, disconnect battery ground cable when servicing any part of the electrical system.

WARNING

Risk of injury from electric shock
- To avoid injury from electric shock, remove fuse in DC system when servicing any part of the electrical system.

WARNING

Risk of injury from electric shock
- To avoid injury from electric shock, remove all electrical power before removing protective shields for service or maintenance.

Transport, handling and lifting

The owner is responsible to:
- Ensure a clear path is available during transport of the engine/system.
- Ensure a proper location is available for the engine.
- Provide proper equipment to transport the engine.
- Ensure that forklift/crane operators are certified.
- Ensure that lifting and handling of heavy objects are performed or supervised by personnel knowledgeable with lifting procedures.
- Ensure that proper equipment is provided and maintained for lifting the engine.
- Ensure that proper procedures as provided by the manufacturer are followed when lifting and handling the engine.

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DANGER

Danger to life
- To avoid injury or death from falling objects, ensure a proper lifting device is used and that all personnel stand clear when heavy objects are lifted or suspended.

DANGER

Danger to life
- To avoid injury or death from falling objects, ensure a proper lifting device is used and follow the proper lifting and handling procedures.

DANGER	**Danger to life** • To avoid injury or death from falling objects, ensure that all lifting tools and equipment are maintained according to manufacturers' guidelines.
DANGER	**Danger to life** • To avoid injury or death from falling objects, use lifting devices with adequate capacity.
DANGER	**Danger to life** • To avoid injury or death from falling objects, ensure that lifting brackets are evenly loaded.
DANGER	**Danger to life** • To avoid injury or death from falling, use suitable ladders and work platforms.
DANGER	**Danger to life** • To avoid injury or death from impact, prevent equipment from swinging while suspended.
WARNING	**Personal injury** • To avoid injury from lifting heavy objects, use adequate mechanical lifting equipment or seek assistance.

Housekeeping

To reduce the risk of injury:

- All safety devices, guards or shields must be properly installed.
- The engine vicinity must be kept clean.
- All removed parts, replacement parts, tools and equipment used for installation and maintenance are promptly removed from the engine vicinity.
- All spilled liquids are cleaned up immediately with suitable cleaning agents or in accordance with published MTU Fluids and Lubricants Specifications.

DANGER	**Danger to life** • To avoid injury or death from rotating belts and fans, do not crank or start the engine with the safety guards removed.
CAUTION	**Injury from tripping hazards** • To avoid injury from tripping hazards, keep all tools and parts off of the floor.
CAUTION	**Injury from slipping and falling** • To avoid injury from slipping and falling, clean up spilled liquids with suitable cleaning agents or as defined by the manufacturer's specifications.
NOTICE	**Storage of parts** • Removed parts and replacement parts shall be properly stored to ensure protection from dust, moisture and impact.

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1.4 Safety requirements for start-up and operation

Safety requirements for start-up

Prior to initial operation of the engine, install and check the engine or assembly according to the MTU specifications.

Before putting the engine/system into operation, always ensure:

- all maintenance and repair work is completed,
- all loose parts have been removed from rotating machine components,
- all persons are clear of the danger zone of moving machine components.

Immediately after putting the engine or system into operation, make sure that all control and display instruments as well as the signaling and alarm systems work properly.

Safety requirements for operation

Emergency procedures must be practiced regularly.

The operator must be familiar with the controls and displays.

The operator must be familiar with the consequences of any operations performed.

During operation, the display instruments and monitoring units must be permanently observed with regard to present operating status, violation of limit values and warning or alarm messages.

The following steps must be taken if a malfunction of the system occurs or is displayed:

1. Acknowledge the message and take appropriate action.
2. Notify the supervisory personnel in charge.
3. Carry out emergency actions (e.g. emergency engine stop), if required.

Engine operation

The following conditions must be fulfilled before starting the engine:

- Wear ear protection.
- Ensure that the engine room is well ventilated.
- Do not inhale engine exhaust gases.
- Ensure that the exhaust pipework is free of leaks and that the gases are discharged to atmosphere.
- Mop up any spilled fluids and lubricants immediately or soak up with a suitable binding agent.
- Protect battery terminals, battery charger terminals and cables against accidental contact.
- When the engine is running, never release coolant, oil, fuel, compressed-air or hydraulic lines.

Operation of electrical equipment

When operating electrical equipment, certain components of this equipment are live.

Observe the safety instructions for these devices.

DANGER	**Electric shock** • To avoid injury or death from electrical shock, use extreme care when performing operational checks.

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1.5 Safety requirements for maintenance and repair

Safety requirements for maintenance and repair work

- Maintenance and repair work to be carried out by qualified and authorized personnel only.
- Allow the engine to cool down before starting maintenance work (risk of explosion of oil vapors).
- Before starting work, relieve pressure in systems and compressed-air lines which are to be opened.
- Take special care when removing vent screws or plugs from engine. In order to avoid discharge of highly pressurized liquids, hold a cloth over the screw or plug.
- Take special care when draining hot fluids.
- When changing the engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.
- Allow the engine / system to cool down before starting to work.
- Observe the maintenance and repair instructions.
- Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.
- Secure the engine to prevent unintentional start-up.
- Disconnect the battery when electrical starters are fitted.
- Close the main valve on the compressed-air system and vent the compressed-air line when air starters are fitted.
- Use only proper, calibrated tools. Observe the specified tightening torques during assembly/disassembly.
- Carry out work only on assemblies and/or units which are properly secured.
- Never use lines for climbing.
- Keep fuel injection lines and connections clean.
- Always seal connections with caps or covers if a line is removed or opened.
- Take care not to damage lines, in particular fuel lines, during maintenance and repair work.
- Ensure that all retainers and dampers are installed correctly.
- Ensure that all fuel injection lines and pressurized oil lines have sufficient distance to other components to avoid contact with them. Do not place fuel or oil lines near hot components.
- Do not touch elastomer seals if they have carbonized or resinous appearance unless hands are properly protected.
- Note cooling time for components which are heated for installation or removal.
- When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.
- Observe special cleanliness when conducting maintenance and repair work on the assembly or system. After completion of maintenance and repair work, make sure that no loose objects are in/on the assembly or system.
- When working with starters containing a beryllium copper pinion, breathing protection with a filter class P2 must be used during maintenance work to avoid health hazards caused by the beryllium pinion. Do not use compressed air jets to clean out the interior of the flywheel housing or the starter. Clean the flywheel housing inside with a class H dust removal device as an additional measure.

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

WARNING

Risk of injury and burning
- To avoid injury from being burnt by hot liquid, take precaution when draining hot liquids.
- Wear protective gloves and allow adequate time for the engine to cool down before draining hot liquids into the appropriate heat-proof container.

WARNING

Risk of injury and burning
- To avoid injury from being burnt by hot components, avoid contact with exhaust manifolds, turbochargers, heat shields and extended exhaust piping.
- Wear protective gloves, clothing and footwear and allow adequate time for the engine to cool down before removing any components.

WARNING

Risk of injury from exhaust gases

- To avoid injury from exhaust gases, ensure that all exhaust system connections are properly connected and that ventilation is adequate to prevent buildup of exhaust gas.

NOTICE

Climbing pressurized lines

- Never use pressurized lines for climbing or support.

Hydraulic installation and removal

Before starting work, pay attention to the following:

- Vent the hydraulic installation/removal tool, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the tool with the piston retracted.
- For hydraulic removal, screw on the tool with the piston extended.
- Check the function and safe operating condition of tools and fixtures to be used. Use only the specified fixtures for hydraulic removal and installation procedures.
- Observe the maximum permissible push-on pressure specified for the equipment.
- Do not attempt to bend or apply force to lines.
- For a hydraulic installation/removal tool with central expansion pressure supply, screw spindle into shaft end until correct sealing is achieved.
- During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

Working on electrical/electronic assemblies

- De-energize the appropriate areas prior to working on assemblies.
- Do not damage cabling during removal work. When reinstalling ensure that cabling is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface. Damaged cables can result in false fault codes.
- Do not secure cables on lines carrying fluids.
- Do not use cable ties to secure cables.
- Always use connector pliers to tighten connectors.
- Subject the device or system to a function check on completion of all repair work.
- Store spare parts properly prior to replacement, in particular protect them against moisture.
- Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, in particular protect them against moisture and impact and wrap them in antistatic packaging.
- Upon completion of the installation, maintenance and repair work, all cables which may have become loose must be correctly connected and secured.

DANGER

Danger to life

- To avoid injury or death from electric shock, disconnect all electrical power, and lockout and tagout the equipment before removing protective shields for service or maintenance.

DANGER

Danger to life

- To avoid injury or death from electric shock and/or moving engine/equipment parts, do not remove a lockout tag unless proper authorization is obtained and the lockout tag is removed following the manufacturer's instructions.

DANGER

Danger to life

- To avoid injury or death from electric shock, do not tamper with any interlocks in the system.

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CAUTION	**Damage to equipment from live voltages** • To avoid damage to equipment from live voltages in the electronic control and monitoring system, comply with the operating instructions given with this equipment.
CAUTION	**Damage to equipment from handling in transit** • To avoid damage to equipment from handling in transit, suitably pack electronic components when being returned for core credit, repair, warranty and/or analysis.
CAUTION	**Damage to equipment from false cable connection** • To avoid damage to equipment, correctly connect and secure all cables prior to energizing the system.
CAUTION	**Damage to equipment from chafing of cables** • To avoid damage to equipment from chafing of cables, use cable clamps to limit vibration and restrict motion, and grommets to properly install wiring harnesses.

Working with laser equipment

Laser equipment can generate extremely intensive, concentrated radiation. When working with laser equipment, always wear special laser-protection goggles.

Laser equipment must be fitted with the protective devices necessary for safe operation according to type and application.

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

WARNING	**Risk of injury and burning** • To avoid injury from laser devices, always ensure that laser beam does not come in contact with eyes and always wear special laser-protection goggles.
WARNING	**Risk of injury and burning** • To avoid injury from laser devices, always ensure the laser beam does not come in contact with skin.
WARNING	**Risk of injury and burning** • To avoid injury from laser equipment, follow manufacturer's recommendations for proper use.
WARNING	**Risk of injury and burning** • To avoid injury from laser equipment, ensure proper protective devices are installed and functioning properly.
WARNING	**Risk of injury and burning** • To avoid injury from laser equipment, ensure proper signage is displayed and easily visible while laser is in operation.

Tools

A tool is generally a device that is used to accomplish an operation or task.

A tool is also any entity used to interface between two or more domains that facilitates more effective action of one domain upon the other.

The owner is responsible to:

- Provide proper tools for working on the engine/system.
- Ensure that all tools are properly maintained, calibrated and free from defects.

The technician is responsible to:

- Use proper tools for working on the engine/system.
- Ensure that all tools are properly maintained, calibrated and free from defects.

WARNING

Risk of injury
- To avoid injury from improper tool use, always use tools for their intended purpose.

WARNING

Risk of injury
- To avoid injury from improper tool use, always use proper ergonomic techniques.

WARNING

Risk of injury
- To avoid injury from improper tool use, always use proper tool techniques.

Moving parts

Moving parts – belts and fans

DANGER

Danger to life
- To avoid injury or death from rotating belts and fans, do not crank or start the engine with the safety guards removed.

Moving parts – engine

DANGER

Danger to life
- To avoid injury or death from moving parts, ensure safety guards are in place and secured.

Heat, pressure, exhaust and chemical ingestion

Hot liquids, parts and surfaces

The owner is responsible for:

- Proper use of add-on heat generating devices, such as a fuel heater.

The operator or technician is responsible to:

- Use proper tools, materials, containers and protective clothing when working with hot liquids, parts and surfaces.

WARNING

Risk of injury and burning
- To avoid injury from being burnt by hot liquid, take precaution when draining hot liquids.
- Wear protective gloves and allow adequate time for the engine to cool down before draining hot liquids into the appropriate heat-proof container.

WARNING

Risk of injury and burning
- To avoid injury from being burnt by hot liquid, take precautions when the radiator or heat exchanger pressure cap is removed.
- Wear protective gloves, face shield and goggles and allow adequate time for the engine to cool down before removing the radiator or heat exchanger pressure cap.

WARNING

Risk of injury and burning
- To avoid injury from being burnt by hot components, avoid contact with exhaust manifolds, turbochargers, heat shields and extended exhaust piping.
- Wear protective gloves, clothing and footwear and allow adequate time for the engine to cool down before removing any components.

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NOTICE

Hot components
- All exhaust components are extremely hot when the engine is running and remain hot for an extended period of time after the engine is shut down.
- Other components are hot when the engine is running and remain hot for an extended period of time after the engine is shut down.
- Adequate time should be allowed to cool all components prior to working on or near the unit.

Pressurized liquids and compressed air

The operator or technician is responsible to:
- Use proper tools, materials, containers and protective clothing when working with pressurized air and liquids.

The pressure at which the air is kept can be read off at pressure gauges which must be connected to the compressed air vessels and the compressed air lines.

When working with compressed air, the following safety precautions must be constantly observed:
- Always pay special attention to the pressure level in the compressed air network and pressure vessel.
- Ensure devices and equipment connected must either be designed for this pressure or, if the permitted pressure for the connected elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection.
- Ensure the hose coupling and connections are securely attached.
- Always wear protective goggles when blowing off tools or chips.
- Ensure the snout of the air nozzle has a protective disc (e.g. rubber disc) to prevent air-borne particles from being deflected, thereby preventing injury to eyes.
- Always shut off compressed air lines before compressed air equipment is disconnected from the supply line or before equipment or tools are exchanged.
- Ensure authorized use of compressed air. For example, forcing flammable liquids (e.g. hazard class AI, AII and B) out of containers, carries the risk of explosion.
- Never force compressed air into thin-walled containers (e.g. containers made of tin, plastic or glass) for drying purposes or to check for leaks as it results in a risk of shattering.
- Never use compressed air to clean contaminated clothing while it is being worn.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Risk of injury
- To avoid injury from pressurized systems, relieve pressure in systems and compressed-air lines which are to be opened, prior to starting work.

WARNING

Injury from flying debris
- To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

WARNING

Risk of injury
- To avoid injury from engine fluids, consult appropriate Material Safety Data Sheets for proper handling, use and storage information. If contact with fluid has occurred, immediately seek medical attention.

WARNING

Risk of injury
- To avoid injury, never use compressed air to clean contaminated clothing while being worn.

WARNING

Risk of injury
- To avoid injury, never use compressed air to force flammable liquids out of containers.

NOTICE

Liquids under pressure
- The engine contains fuel, oil and coolant under pressure.
- Engine oil and coolant are relatively low pressure; sections of the fuel system are under high pressure.

NOTICE

Regulated air pressure
- Compressed air used with shop air tools is regulated by OSHA to 276 kPa (40 psi).

NOTICE

Climbing pressurized lines
- Never use pressurized lines for climbing or support.

NOTICE

Compressed air
- Compressed air is air compressed at excess pressure and is stored in vessels from which it can be extracted.

Exhaust fumes

WARNING

Risk of injury from exhaust gases
- To avoid injury from exhaust gases, ensure that all exhaust system connections are properly connected. Only the hydraulic installation and removal equipment specified in the work schedule and in the assembly instructions must be used and ensure ventilation is adequate to prevent buildup of exhaust gas.

Paint and paint fumes

WARNING

Injury from fire
- To avoid injury from fire, do not smoke or use an open flame at any time when paint is being handled.

WARNING

Injury from combustible materials
- To avoid injury from combustible materials, properly store paint and painting supplies in a suitable paint locker and in accordance with the manufacturer's specifications.

WARNING

Injury from paint fumes
- To avoid injury from paint fumes, ensure ventilation is adequate to prevent buildup of fumes, wear proper protective clothing and use a respirator.

CAUTION

Damage to equipment
- To avoid damage to equipment, mask off the ECU prior to applying any paint.

Chemical contact and ingestion

WARNING

Personal injury
- To avoid injury from contacting and ingesting acids, alkaline solutions, coolant, fuel, paint and preservatives, immediately consult appropriate Material Safety Data Sheets and appropriate medical personnel when contact or ingestion has occurred.

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WARNING

Personal injury
- To avoid injury from chemical contact, wear protective clothing to prevent contact with skin from battery acid or alkaline electrolytes or caustic byproducts.

WARNING

Personal injury
- To avoid injury from chemical contact, do not fill coolant or fuel tanks while the engine is running.

WARNING

Personal injury
- To avoid injury from chemical contact, check battery polarity before connecting the cables to the battery.

WARNING

Personal injury
- To avoid injury from chemical contact, wash skin immediately with water for at least 15 minutes.
- Avoid prolonged contact with skin.
- After contact with electrolyte or byproduct immediately seek medical attention.

WARNING

Personal injury
- To avoid injury from chemical contact, flush eyes immediately with water for at least 15 minutes after contact with electrolyte or byproduct and immediately seek medical attention.

Batteries

The owner is responsible to:
- Ensure that servicing of batteries is performed or supervised by personnel knowledgeable with batteries and required battery service procedures.
- Keep unauthorized personnel away from batteries.

The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. It is electrically conductive and corrosive.

Spilled electrolyte is to be washed down with an acid-neutralizing agent. A common practice is to use a solution of 1 pound (500 grams) bicarbonate of soda solution to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.

DANGER

Danger to life
- To avoid injury or death from explosion, refrain from smoking or using an open flame when near batteries.

DANGER

Fire and explosion
Risk of serious injury - danger to life!
- Refrain from opening, dismantling or mutilating the battery/batteries.

WARNING

Battery explosion and acid burn
- To avoid injury from battery explosion or contact with battery acid, work in a well ventilated area, wear protective clothing, and avoid sparks or flames near the battery.
- Ensure only the negative lead is removed from the battery.
- If you come in contact with battery acid, flush your skin with water, apply baking soda or lime to help neutralize the acid, flush your eyes with water, and get medical attention immediately.

WARNING

Risk of injury
- To avoid injury from electrical shock, disconnect the battery charger.

WARNING	Fire **Risk of injury!** • Keep sparks and open flames away from the battery/batteries.
WARNING	**Personal injury** • To avoid injury from chemical contact, wear protective clothing to prevent contact with skin from battery acid or alkaline electrolytes or caustic byproducts.
WARNING	**Injury from chemical contact** • To avoid injury from chemical contact, wash skin immediately with water after contact with electrolyte or byproduct, apply baking soda or lime to help neutralize the acid and seek medical attention immediately.
WARNING	**Personal injury** • To avoid injury from chemical contact, flush eyes immediately with water for at least 15 minutes after contact with electrolyte or byproduct and immediately seek medical attention.
WARNING	**Personal injury** • To avoid injury from sparks, check battery polarity before connecting the cables to the battery.
WARNING	Lifting heavy objects **Risk of injury!** • Use proper techniques for moving battery/batteries. • Seek assistance.
WARNING	**Risk of injury from electric shock** • To avoid injury from electric shock, use care when disconnecting battery cables. Always remove the negative side of the battery first.
NOTICE	Incorrect battery selection and installation **Damage to battery/batteries** • Size battery/batteries appropriately according to the application. • Install battery/batteries away from environmental contaminants. • Protect battery/batteries from vibration.
NOTICE	**Battery recommendations** • Remove watches, rings, or other metal objects. • Use tools with insulated handles. • Wear eye protection and protective clothing. • Avoid placing tools on the battery. • Disconnect ground first; connect ground last.

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1.6 Explosion hazard when removing inspection port cover on engine

Cautions

DANGER	Explosion hazard due to oil vapors. **Risk of serious injury – danger to life!** • Allow the engine to cool down before opening the crankcase! • Avoid open flames, electrical sparks and ignition sources.

Safety instructions

Before starting maintenance work, allow the engine to cool down for at least 10 min. (danger of explosion due to oil vapors).

1.7 Safety requirements for putting the engine/system into or out of operation and storage

Safety precautions when putting the engine/system into operation

Prior to initial operation:
- The engine/system must undergo a successful commissioning inspection.
- The engine/system must be securely grounded in accordance with the requirements in applicable national, state or local codes.
- All maintenance and repair work must be completed.
- All loose components must be removed from the engine vicinity.
- No persons or loose components should be within close proximity to the engine when putting it into operation.

WARNING	**Risk of injury from exhaust gases** • To avoid injury from exhaust gases, ensure that all exhaust system connections are properly connected. Only the hydraulic installation and removal equipment specified in the work schedule and in the assembly instructions must be used and ensure ventilation is adequate to prevent buildup of exhaust gas.

WARNING	**Risk of injury from slipping and falling** • To avoid injury from slipping and falling, immediately clean up spilled liquids with suitable cleaning agents or as defined by the manufacturer’s specifications.

Immediately after putting the engine/system into operation, perform an operational check (exercising check), making sure all control and display instruments, as well as the signaling and alarm systems, work properly.

Displays and alarms while the engine running

Immediately after beginning operation of the engine, all control and display instruments, as well as the display and alarm systems, must be verified to be working properly.

The following steps must be taken if a malfunction of the system occurs or is displayed:
1. Acknowledge the message and take appropriate action.
2. Notify the supervisory personnel in charge.
3. Carry out emergency actions (e.g. emergency engine stop), if required.

CAUTION	**Damage to the equipment** • To avoid damage to the equipment from an existing fault, do not attempt to restart until the cause for shutdown has been identified and corrected.

Safety precautions when putting the engine/system out of operation and storing

The owner is responsible to:
- Provide published preservation and storage specifications relating to the engine.
- Ensure that a proper location for the engine is available during storage.

The technician or operator is responsible to:
- Inform the owner that the engine will be placed out of service.
- Obtain approval from the owner to place the engine out of service.

DANGER	**Electric shock** • To avoid injury or death from electrical shock, disconnect all electrical power, and lockout and tagout the equipment before removing protective shields for service or maintenance.

DANGER	**Danger to life** • To avoid injury or death from electric shock, do not tamper with interlocks.

WARNING

Personal injury
- To avoid injury from acids, alkaline solutions, coolant, fuel, engine oil, paint and preservatives, consult appropriate Material Safety Data Sheets for proper handling, use and storage information. Seek immediate medical attention if chemical contact has occurred.

WARNING

Personal injury
- To avoid injury from chemical contact while performing out-of-service procedures, be cautious when handling acids, alkaline solutions, coolant, fuel, paint and preservatives. Follow the chemical manufacturer's usage, handling and disposal instructions.

WARNING

Personal injury
- To avoid injury from chemical contact, wear protective clothing and gloves to prevent contact with skin.

NOTICE

Lock and tag general
- Lock and tag is a safety procedure which is used in industry settings to ensure that machines are properly shut off and not started prior to the completion of maintenance or servicing work.
- Lock and tag works in conjunction with a lock usually locking the device or warning tag, and placed in such a position that no hazardous power sources can be turned on while working on the equipment.

NOTICE

Storage near magnetic devices not allowed.
- Storage of the equipment near magnetic devices is not allowed.

Lockout/Tagout – Negative side of battery

WARNING

Electric shock
- To avoid injury from electrical shock, use care when disconnecting battery cables. Always remove the negative side of the battery first.

WARNING

Battery explosion and acid burn
- To avoid injury from battery explosion or contact with battery acid, work in a well ventilated area, wear protective clothing, and avoid sparks or flames near the battery.
- Ensure only the negative lead is removed from the battery.
- If you come in contact with battery acid, flush your skin with water, apply baking soda or lime to help neutralize the acid, flush your eyes with water, and get medical attention immediately.

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1.8 Safety requirements for welding work

The following safety information must be observed when welding:

- The welding unit ground connection must not be more than 60 cm (2 ft.) from the weld point.
- If components (e.g. exhaust manifold) are to be welded, they must be removed from the engine.
- Do not use the assembly or system as ground terminal.
- It is not necessary to remove the connector and the connections when carrying out welding operations on the manufacturer's electronics if the master switch for power supply is switched from "ON" to "OFF" and the wire is disconnected from the negative and positive poles on the battery.

The owner is responsible to:

- Ensure that welding is performed by personnel certified to use welding equipment.
- Ensure that all welding equipment is in good working order and is safe for use, if the welding equipment is supplied by the owner.
- Keep unauthorized personnel away from the engine and surrounding area during welding.

The technician is responsible to:

- Ensure that all welding equipment is in good working order and is safe for use, if the welding equipment is supplied by the technician.

DANGER	**Danger to life** • To avoid injury or death from fire, keep sparks and open flames away from the battery(s).
DANGER	**Danger to life** • To avoid injury or death from sudden starting while welding, follow appropriate lockout/tagout procedures.
WARNING	**Risk of injury** • To avoid injury from welding, ensure use of proper safety equipment while welding.
WARNING	**Risk of injury** • To avoid injury from welding, ensure use of proper clothing is used while welding. Examples of proper clothing include an arc welder's face plate or gas welder's goggles, welding gloves, protective apron, long sleeve shirt, head protection and safety shoes.
WARNING	**Risk of injury** • To avoid injury from welding sparks and slag, use proper shielding and barricades.
NOTICE	**Welding work requirements** • Never carry out welding work on the engine or engine-mounted units. Cover the engine when welding in its vicinity!
NOTICE	Welding current passes through the engine resulting in burnt/scorched bearings, sliding surfaces and tooth flanks. This can lead to bearing seizure and/or other material damage. **Damage to equipment** • Use an appropriate grounding surface while welding.
NOTICE	Welding current induces interference voltage (i.e. via wiring harnesses) **Damage to electrical system** • Avoid routing the welding lead over or near electrical system.

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Arc welding

The welding lead current may induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Oxygen gas welding

A gas leak from a cylinder may lead to fire or an explosion. The gases in oxygen/acetylene cylinders used in gas welding and cutting are under high pressure. A sudden release of cylinder pressure may turn the cylinder into a dangerous projectile.

DANGER	Danger to life • To avoid injury or death from fire, always use protective caps around the valves on the cylinders during transportation.
DANGER	Danger to life • To avoid injury or death from explosion, always use protective caps around the valves on the cylinders during transportation.
DANGER	Danger to life • To avoid injury from sudden release of pressure, always use protective caps around the valves on the cylinders during transportation.
WARNING	Risk of injury • To avoid injury from flying projectiles, always ensure proper handling of cylinders.
WARNING	Risk of injury • To avoid injury from fumes, always perform welding or cutting operations in a well ventilated area.
WARNING	Risk of injury • To avoid injury from fumes, always ensure the cylinder valves are shut off except when welding.
WARNING	Risk of injury • To avoid injury from falling cylinders, use chains, brackets or other restraining devices to secure cylinders during active use, storage and transportation.
WARNING	Risk of injury • To avoid injury from mishandling, always use protective caps around the valves on the cylinders during transportation.
WARNING	Risk of injury from fire • To avoid injury from fire, check for fuel or oil leaks before welding and do not carry an open flame near the engine.
CAUTION	Risk of injury • To avoid injury from mishandling, always position cylinders upright.
CAUTION	Risk of injury • To avoid injury from lifting, use proper lifting equipment when handling oxygen and acetylene cylinders.

1.9 Auxiliary materials, fire prevention and environmental protection

Auxiliary materials

When using fluids, lubricants and other chemical substances, follow the safety instructions applicable to the product. Take care when handling hot, chilled or caustic materials. When using flammable materials, avoid sparks, flames and do not smoke.

Fluids and lubricants

Use only fluids and lubricants that meet the requirements of this publication. Fluids and lubricants must be kept in suitable, properly designated containers.

Fuel

NOTICE	Fuel vapor • Fuel vapors are both toxic and flammable.

NOTICE	Fuel valves • Ensure the fuel valves are tightly closed and all fuel has been vented before starting any repair work on the fuel system.

Lead

NOTICE	Lead • When working with lead or lead-containing pastes, avoid direct contact to the skin and do not inhale lead vapors. Wear protective clothing and proper respiratory equipment

Acids and alkaline solutions

NOTICE	Acids and alkaline solutions • When working with acids and alkalis, wear protective goggles or face mask, gloves and protective clothing.

Paints

NOTICE	Paints • When painting anywhere other than in spray booths equipped with extractors, ensure good ventilation.

Liquid nitrogen

DANGER	Suffocation from liquid nitrogen fumes **Risk of serious injury - danger to life!** • Ensure the room is well-ventilated.

WARNING	Liquid nitrogen exists at extremely cold temperatures **Risk of injury - frostbite!** • Wear protective clothing, gloves, a face shield and safety glasses.

WARNING	Personal injury • To avoid injury when using liquid nitrogen, store liquid nitrogen in regulation containers.

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CAUTION

Damage to equipment
- To avoid damage to equipment, ensure proper handling of all liquid nitrogen containers.

NOTICE

Liquid nitrogen handling
- Liquid nitrogen is stored in containers at high pressure.
- Liquid nitrogen is a colorless clear liquid.

NOTICE

Storage of liquid nitrogen
- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.

Used oil

NOTICE

Used oil
- Used oil may contain health-threatening combustion residues.

Fluoroelastomers (e.g., Viton®)

The operator or technician is responsible to use proper tools, materials, containers and protective clothing when working with fluoroelastomer parts.

Fluoroelastomer parts must be washed with lime water (calcium hydroxide solution) before reusing.

Viton® is a registered trademark of DuPont Performance Elastomers L.L.C.

WARNING

Injury from degraded fluoroelastomer parts
- To avoid injury from degraded fluoroelastomer parts, wear eye protection (goggles or face shield) and neoprene or PVC gloves when handling fluoroelastomer parts.

WARNING

At temperatures exceeding 300 °C (572 °F) fluoroelastomer material decomposes, hydrogen fluoride vapors are released resulting in extremely corrosive acid.
Risk of burning!
- Do not handle fluoroelastomer parts at elevated temperatures.
- Do not touch fluoroelastomer parts if they have decomposed (carbonized or resinous appearance); wear protective gloves.

NOTICE

Handling fluoroelastomer parts
- Discard protective clothing after handling degraded fluoroelastomer parts.

Fire prevention

Certain engine components, engine oil, grease, fuel and fuel vapors pose a fire risk.

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Injury from combustible materials
- To avoid injury from combustible materials which may start a fire, properly store paint and painting supplies in a suitable paint locker.

⚠ WARNING	**Personal injury** • To avoid injury from fire, keep all potential ignition sources away from diesel fuel including open flames, sparks, cutting, welding or grinding. Do not smoke when handling diesel fuel or refueling.

⚠ WARNING	Fire **Risk of injury!** • Keep sparks and open flames away from the battery/batteries.

⚠ WARNING	**Personal injury** • To avoid injury from sparks, check battery polarity before connecting the cables to the battery. Always disconnect and reconnect the negative terminal first to avoid sparking.

NOTICE	**Fire prevention** • Even small quantities of oil or fuel on hot components may cause fires. • Fuel and oil leaks, as well as excess grease must be cleaned immediately. • Textiles soaked with fluids and lubricants must not be left near or on the equipment. • Combustible materials must not be stored on or near the equipment. • Components must be free of fuel and oil prior to welding. (Note: Clean components where fuel and oil are present with a noncombustible cleaning fluid before welding). • Ground leads must be connected last and removed first when starting the engine with an auxiliary/external power source. (Note: Connect the ground lead from the power source to the ground lead of the engine or to the ground terminal of the starter to avoid sparks in the vicinity of the battery). • Fire-fighting equipment (fire extinguishers) must be available for use. (Note: Operators must be familiar with the use of fire-fighting equipment. The type of fire-fighting equipment should comply with national, state and local codes). • Unauthorized modifications, such as applying insulation to hot surfaces, may increase the risk of fire. • A potential hazard may occur if fluoroelastomer parts are raised to a temperature above 316 ºC (600ºF) in a fire for example. Fluoroelastomer will decompose (indicated by charring or the appearance of a black, sticky mass) and produce hydrofluoric acid. This acid is extremely corrosive and, if touched by bare skin, may cause severe burns (the symptoms could be delayed for several hours).

Environmental protection

Dispose of used fluids, lubricants, materials and filters in accordance with local regulations. Manipulation of the injection control system can influence the engine performance and exhaust emissions. As a result, compliance with environmental regulations may no longer be guaranteed. Only fuels of the specified quality required to achieve emission limits must be used. For example, in Germany, the VAwS (which are the national regulations governing the use of materials that may affect water quality) is applicable. This means work must only be carried out by authorized specialist companies. The manufacturer of this engine is such a company.

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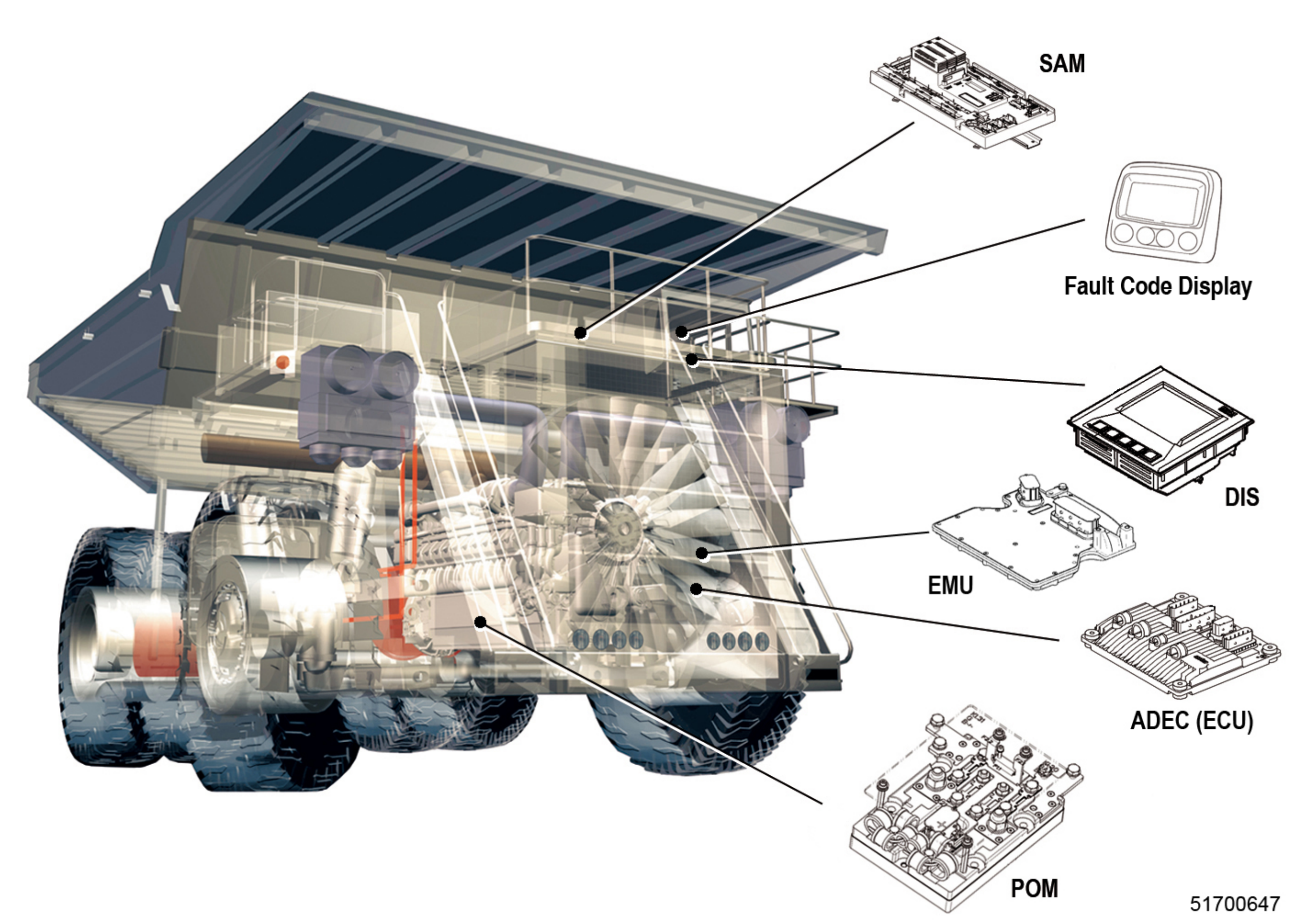
2 Motivline devices

2.1 General Information

2.1.1 The MTU MotivLine® system

Overview



The MTU MotivLine® system was specially developed for use in heavy-duty haul trucks and excavators. This new MTU drive and automation system is geared to the requirements and to the engines used in these applications (12, 16 and 20V4000C03).

In the cab, clearly organized display instruments and easily operated switches facilitate the driver's work. Starting the engine, for example, merely requires briefly pressing the engine start pushbutton. A status lamp then indicates whether engine priming is successful. When the pushbutton is pressed again, the engine starts without further delay and runs up to idling speed.

System devices

The overall system contains the following devices:

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- ECU
  The Engine Control Unit (ECU). This unit (also known as ADEC = Advanced Diesel Engine Controller) is geared to the common rail technology of Series 4000. The Engine Control Unit is factory-installed on the engine.
- EMU (option)
  The Engine Monitoring Unit extends the engine monitoring scope to include individual cylinder exhaust gas temperatures. It is also directly installed on the engine.
- SAM
  This device (Service and Application Module) interconnects the various units (e.g. fan and its control system) and the other electronic systems of the vehicle. Controls and indicators are also connected here.

ECU and SAM form the basic equipment of the system.

Expansions/options

The following devices are also available (as options or on request) for more convenient installation or for easier operation:

- POM (optional)
  The Power Output Module (POM) considerably simplifies the wiring of the MotivLine system: Factory-installed on the engine, this module interconnects the starters, the generator and the other devices (through a precut wiring harness) of the MTU MotivLine range of products. The customer need only provide the two power supply cables (+ and -) from the vehicle's voltage supply. The elaborate separate wiring of the starters and of the generator to the ECU and SAM is thus no longer required. The POM also performs other monitoring functions.
- DIS (optional)
  This display (DIS) shows different engine operating data on a color monitor.
- Fault Code Display (on request)
  This is a small LCD display showing important engine operating data.

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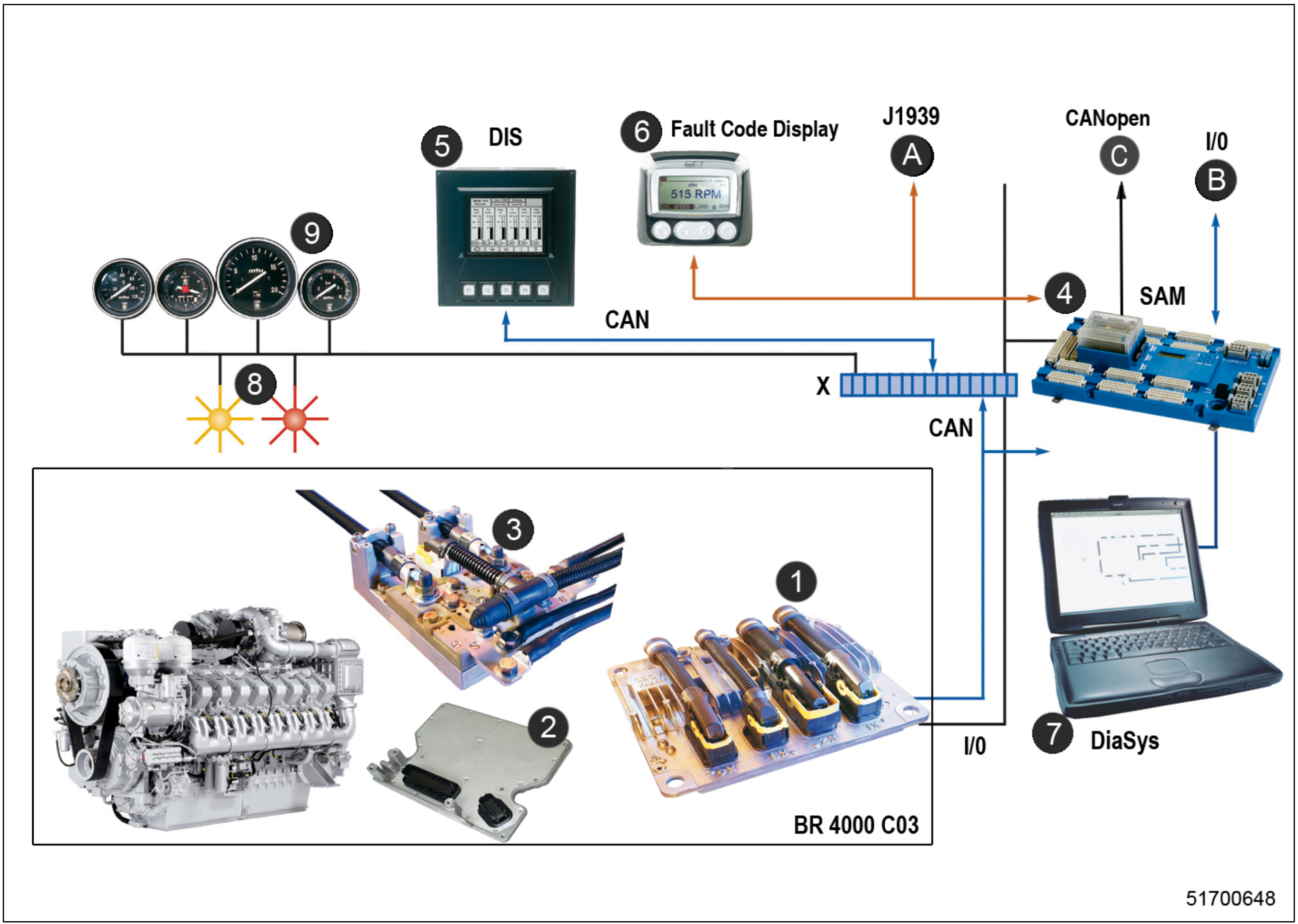
Structure



1 ADEC – Engine Control Unit ECU-7
2 EMU additional Engine Monitoring Unit for individual cylinder exhaust gas temperatures
3 POM – Power Output Module (optional)
4 SAM – Service and Application Module (central processing unit)
5 Color display (optional)
6 Display (monochrome, on request)
7 DiaSys® dialog unit (diagnostic and programming system, auxiliary equipment)
8 Alarm indicator lamps (OEM)
9 Display instruments (OEM)
A J1939 CAN interface (optional)
B Parallel inputs and outputs
C Optional CANopen interface – alternative to A (J1939)
X Terminal block

The ECU (1), SAM (4) and DIS (5) devices are interconnected via a redundant CAN bus (MTU field bus). The POM ((3) if applicable) is connected via a separate CAN interface of the Engine Control Unit. The display instruments (9, if applicable) are controlled via corresponding outputs at the SAM; indicator lamps for single-point alarms are also controlled by the SAM. The two red and yellow alarm indicator lamps (8) are activated directly by the ECU. The dialog unit (7) with the DiaSys® dialog software can be connected to a corresponding socket of the SAM (required only for initial start-up and in maintenance/repair operations).

The PowerView display (6) is available on request and is connected to the J1939 CAN (A) of the SAM.

All parallel-wired signals of the ECU and of the SAM (B) are routed via a terminal block, where they are available for further wiring/connection.

Benefits

MotivLine offers the following benefits for end-users and OEMs:

- The Engine Control Unit is precisely tuned to the engine
- The entire engine wiring is factory-installed, so that at the engine only 2 cables with connectors (also factory-installed) need be plugged into the Engine Control Unit:
  - System wiring harness
  - Power supply wiring harness
- All engine wiring for the battery-charging generator, starters and oil priming pump is factory-installed when the POM is used.
- Two other external sensors (engine coolant level and water level in the fuel prefilter) required for engine operation are also connected via cables (available in suitable lengths) plugged into the Engine Control Unit.
- There are only a few, but highly integrated, devices. Outside of the engine only a single device in the switchgear cabinet is required and, if desired, a device in the vicinity of the driver (display). In addition there are (at least 2) alarm indicator lamps and (optionally) up to four display instruments as well as several control pushbuttons.
- The Engine Control Unit is precisely factory-adjusted to the engine and the plant; subsequent changes are possible on location by means of a dialog system (auxiliary equipment, optional).
- Malfunctions in the electronic system are signaled by different displays.
- Malfunctions in engine operation are depicted on a display of the SAM, on request also in the cab on a large color display (optional) and/or a small PowerView Display (optional, on request).
- The fans and the preheating are controlled by the MTU electronics; external control systems are no longer needed for this purpose.
- Adaptation of external devices is possible by means of CANopen and J1939 (application engineering must consult with the MTU Application Center).
- All controlling and monitoring in daily operation of the engine is fully automatic. Besides issuing a start or stop command, the operating personnel need not carry out any other actions.
- Besides the two (standard) cables provided for connecting the Engine Control Unit, other MTU-tested components are available (optionally, on request) for wiring the system.

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2.1.2 Scope of delivery

Basic equipment

The basic equipment includes the following devices, assemblies and components:

Engine sensors, actuators

All sensors and actuators are directly installed on the engine.

External sensors

External sensors are included for:
- Level switch for “water in fuel prefilter” for installation in the fuel prefilter
- Level switch for “coolant level” for installation in the coolant storage tank

Connecting cables for external sensors

Connection of the external sensors to the engine wiring harness via one (plug-in) cable each; available lengths:
- 5 m
- 10 m

Engine wiring

- Engine wiring harness for connecting all sensors to the Engine Control Unit
- Connector for further wiring to external sensors
- Connection possibility for ventilation control
- Connection possibility for oil priming pump (optional)
- Connection possibility for wiring harness at POM (optional)

Injector wiring

Connection of all injectors to Engine Control Unit (ECU)

Engine Control Unit ECU (ADEC)

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

Engine Monitoring Unit EMU

Additional engine monitoring (individual cylinder exhaust gas temperatures) (engine-mounted)

Connecting cable for Engine Control Unit to plant/supply voltage (ECU)

Connecting cables from the two plug connectors X1 and X3 of the Engine Control Unit for connection to a terminal block (cable here has open end); available lengths:
- 10 m
- 15 m
- 25 m

Connecting cable for Engine Monitoring Unit to plant/supply voltage (EMU)

Connecting cable from plug connector X11 of the additional Engine Monitoring Unit for connection to a terminal block (cable here has open end); available lengths:
- 10 m
- 15 m
- 25 m

Interface and Adaptation Module (SAM)

Central device for connecting all other external sensors and interfaces for the vehicle electronics; this includes:
- as loose part, a CF card (memory card) with order-specific files for the initial installation
- one set of connectors
- two resistors with 121 Ω for terminating the CAN buses

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Options

Optional Power Output Module (POM)

Fully automatic control and monitoring of the starters and the generator:
- POM device (installed on the engine)
- Wiring harness between starters, generator and Engine Control Unit (via engine wiring harness)
- Factory-installed wiring of all cables for high capacity (starters, generator) directly at engine

If POM used, the OEM need connect only a suitable voltage supply to the POM (2 cables).

Display DIS 10

Engine operating data can be displayed on color monitor

Fault Code Display

Only on request: Display of engine operating data on a small LCD monitor

J1939 interface

This interface is provided as a printed-circuit board of type CCB2. It is plugged into slot 3 of the interface and adaptation module (SAM) by the factory on delivery.

Second speed sensor

For other devices at the vehicle a second speed sensor can be provided. This sensor is fully separate from the MTU system. The speed signal can therefore be directly picked up at the sensor's connector.

Pedal

Speed setpoint control unit

Remote services

GSM telemetry unit with license agreement to transmit engine data (separate documentation available)

Display instruments (on request only)

Pointer instruments to display the following engine operating data:
- Engine speed
- Coolant temperature
- Lube oil pressure

OEM parts

The OEM must provide the following parts:
- Indicators (indicator lamps, display instruments)
- Controls, e.g. pushbuttons for start, stop, override, a key switch, etc.
- Installation possibility (switchgear cabinet or similar) for SAM
- Cable for connecting all devices and sensors to SAM
- Depending on the desired equipment, the OEM can provide the following other sensors and connect them to SAM:
  - Pt100: exhaust gas temperature sensors, A and B sides
  - 0 ... 20 mA: external pressure sensors 1 and 2
  - 0 .... 20 mA: sensor for “air filter clogged”
  - 0 .... 20 mA: external engine protection
- In addition, the OEM must provide all switchgear for activating the different functions of the SAM.

TIM ID: 0000017734 - 003

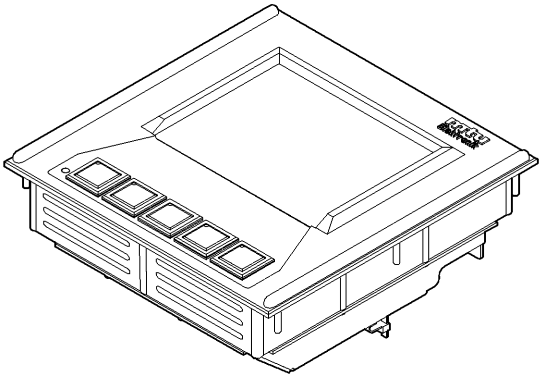
2.1.3 Operator devices

The MMI of MotivLine

The “man-machine interface”, i.e. all parts required for the driver in order to operate the system which are located near the driver's seat, consists of the following devices.

The following units are not included in the MTU scope of delivery (exception: DIS10 and PowerView):

DIS 10



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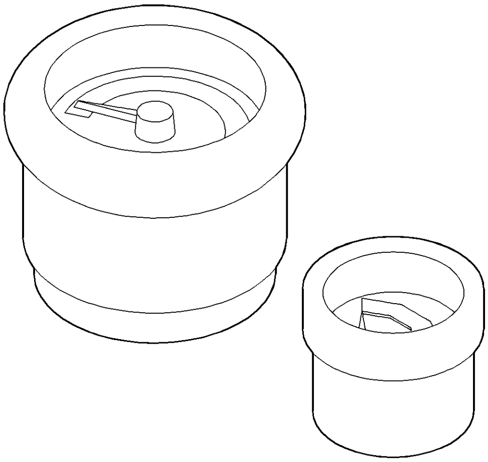
This display shows various engine operating data in the form of bar graphs. More system information regarding the plant is available on other screen pages. For this purpose the DIS 10 has five function keys, the functions of which are displayed in the bottom line of the screen.

Fault Code Display

The display is currently only available on request.

Display instruments



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For the engine operating data, outputs are available for analog display instruments:

- Engine speed
- Coolant temperature
- Lube oil pressure

Another output supplies a voltage proportional to the fan speed.

Pushbuttons

The following pushbuttons (at least) must be connected to operate the system:

- Key switch
- Start pushbutton
- Stop pushbutton
- Emergency stop pushbutton
- Override pushbutton
- Alarm reset pushbutton

Other inputs are available, see below.

Indicator lamps

At least two indicator lamps are required for the alarms:

- Combined YELLOW alarm
- Combined RED alarm

In addition, a “READY TO START” indicator lamp should be provided(→ Page 37).

Other outputs are available, see below.

Further information

The presence of the indicators and controls depends on the application engineering and configuration of the OEM. This also applies to any lettering and colors of the controls and displays and to their arrangement.

The function and operation of all indicators and controls that can be connected to the MTU devices (maximum scope) is explained below. The “ADEC” and “SAM” columns indicate the device to which the signal is wired.

Indicator lamps and pushbuttons

Altogether the following controls can be present:

Type	Inscription	ADEC	SAM	Meaning/function
Key switch	-	X	X	• For switching the entire system on/off and for engine start/engine stop
Pushbutton	START	X	X	• Pressing the pushbutton initiates the automatic engine start sequence.
Pushbutton	STOP	X	X	• Pressing the pushbutton initiates the stop sequence without switching off the Engine Control Unit
Pushbutton	EMERGENCY STOP (external)	X	-	• Pressing the pushbutton initiates an emergency stop.
Pushbutton	ALARM RESET	X	-	• Pressing the pushbutton switches alarm signaling off. • Pressing the pushbutton acknowledges an alarm.
Pushbutton	OVERRIDE	X	-	• Pressing the pushbutton triggers a temporary bypass of the safety system.
Pushbutton	BINARY OUTPUT TEST (lamp test)	-	X	• Pressing the pushbutton switches binary outputs on for test purposes (which ones these are can be programmed, e.g. all outputs with indicator lamps).
Pushbutton	TURNING	-	X	• Pressing the pushbutton cranks the engine on the starter without injecting fuel.

TIM ID: 0000017750 - 003

Type	Inscription	ADEC	SAM	Meaning/function
Indicator lamp	OVERRIDE ACTIVE	-	X	• Indicates the (current) override status
Indicator lamp	READY FOR START	-	X	• Indicates the state of the oil priming pump and the status of the start sequence.
Pushbutton	MANUAL EXT. FAN ON	-	X	• Pressing the pushbutton activates all fans.

Alarm indicator lamps

The alarm indicator lamps provide information on the operating states of the engine. Altogether the following alarm indicator lamps can be present:

Color	Inscription	Meaning/function
Red	RED ALARM	• Combined alarm indicator lamp lights up if a so-called “red alarm” was tripped; if necessary the engine was shut down automatically.
Yellow	YELLOW ALARM	• Combined alarm indicator lamp lights up if a so-called “yellow alarm” was tripped; if necessary the engine power was automatically reduced or limited.
Red	LUBE OIL PRESSURE LOW	Lights up when the lube oil pressure is too low.
Red	COOLANT PRESSURE LOW	Lights up when the coolant pressure is too low.
Yellow	COOLANT TEMPERATURE HIGH WARNING	Lights up when the coolant temperature is too high.
Yellow	ENGINE COLD	Lights up when the coolant temperature is too low.
Red	CHARGE AIR COOLANT TEMPERATURE HIGH	Lights up when the charge-air coolant temperature is too high.
Red	OVERSPEED ALARM	Lights up when the overspeed limit was exceeded (engine might have been shut down, programmable).
Red	CRANKCASE PRESSURE HIGH	Lights up when the crankcase pressure is too high.

Indicator lamps

The indicator lamp provides information on the operational status of the plant.

Color	Inscription	Meaning/function
Yellow	READY FOR START	• Lights up when an engine start can be initialized (START possible, results initially in oil priming if necessary) • Flashes as long as the oil priming pump is in operation. • Lights up again as soon as the required oil pressure is established and the engine can be started (START now starts the engine). • Goes out when the engine speed increases to over 300 rpm.
Yellow	TORQUE LIMITATION ACTIVE	Torque is limited to 4000 Nm, operational availability is restricted

TIM ID: 0000017750 - 003

Color	Inscription	Meaning/function
Yellow	SPEED WINDOW 1	Engine speed is inside the defined speed window 1 (speeds can be configured in ECU)
Yellow	SPEED WINDOW 2	Engine speed is inside the defined speed window 2 (speeds can be configured in ECU)
Yellow	PREHEATING ACTIVE	Preheater is switched on
Yellow	ENGINE STOP FOLLOW UP ACTIVE	The engine is shut down after a defined time providing that it has cooled down and the temperature has fallen below a certain limit.

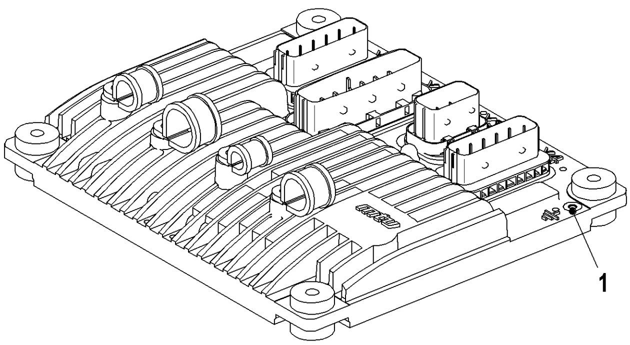
TIM ID: 0000017750 - 003

2.1.4 Diagnosis and tools

Device-specific diagnosis

Some of the devices in the system feature display options to enable the operator to make a rough diagnosis locally in the event of a system malfunction. These are:

- A diagnostic lamp on the ECU (flashing codes: see chap. “Diagnostic lamps of the devices”)



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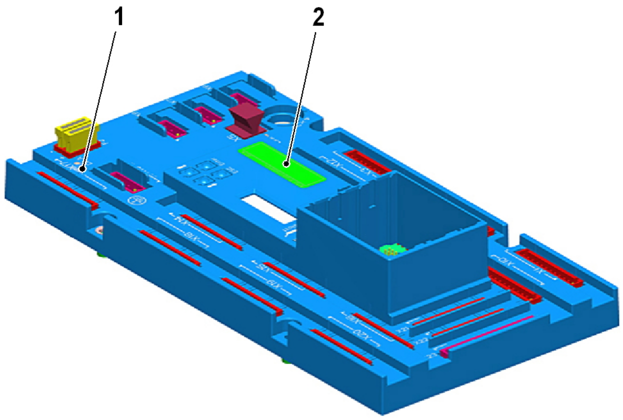
1 Diagnostic lamp

- A diagnostic lamp and a two-line LCD display at the SAM



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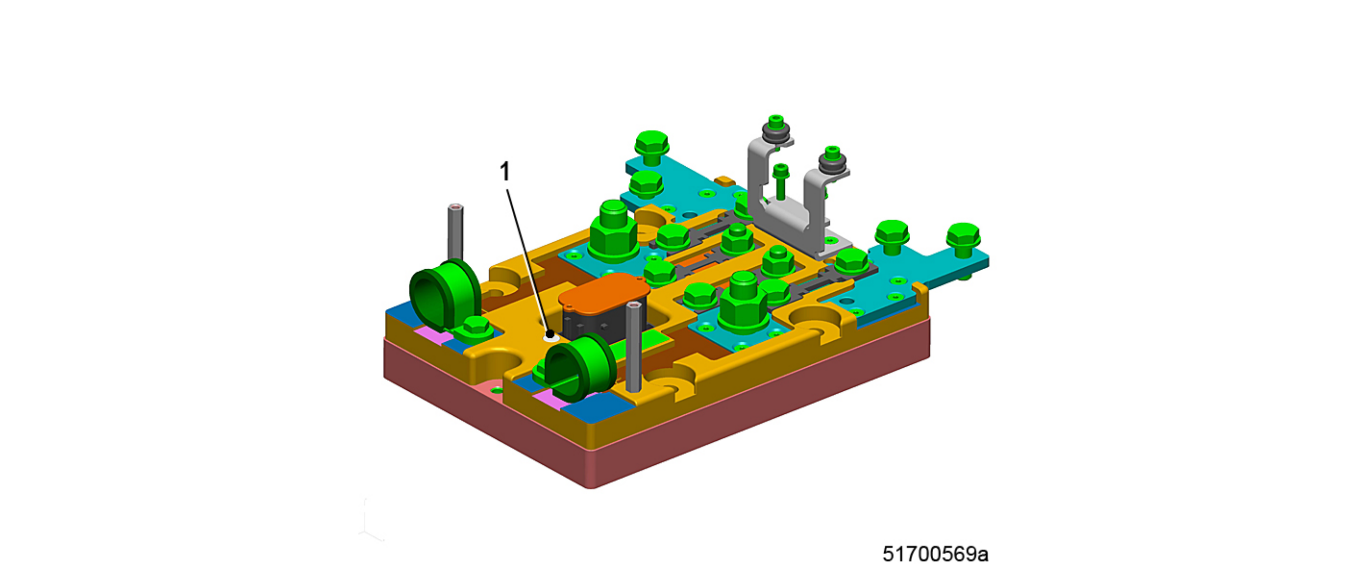
1 Diagnostic lamp
2 LCD display

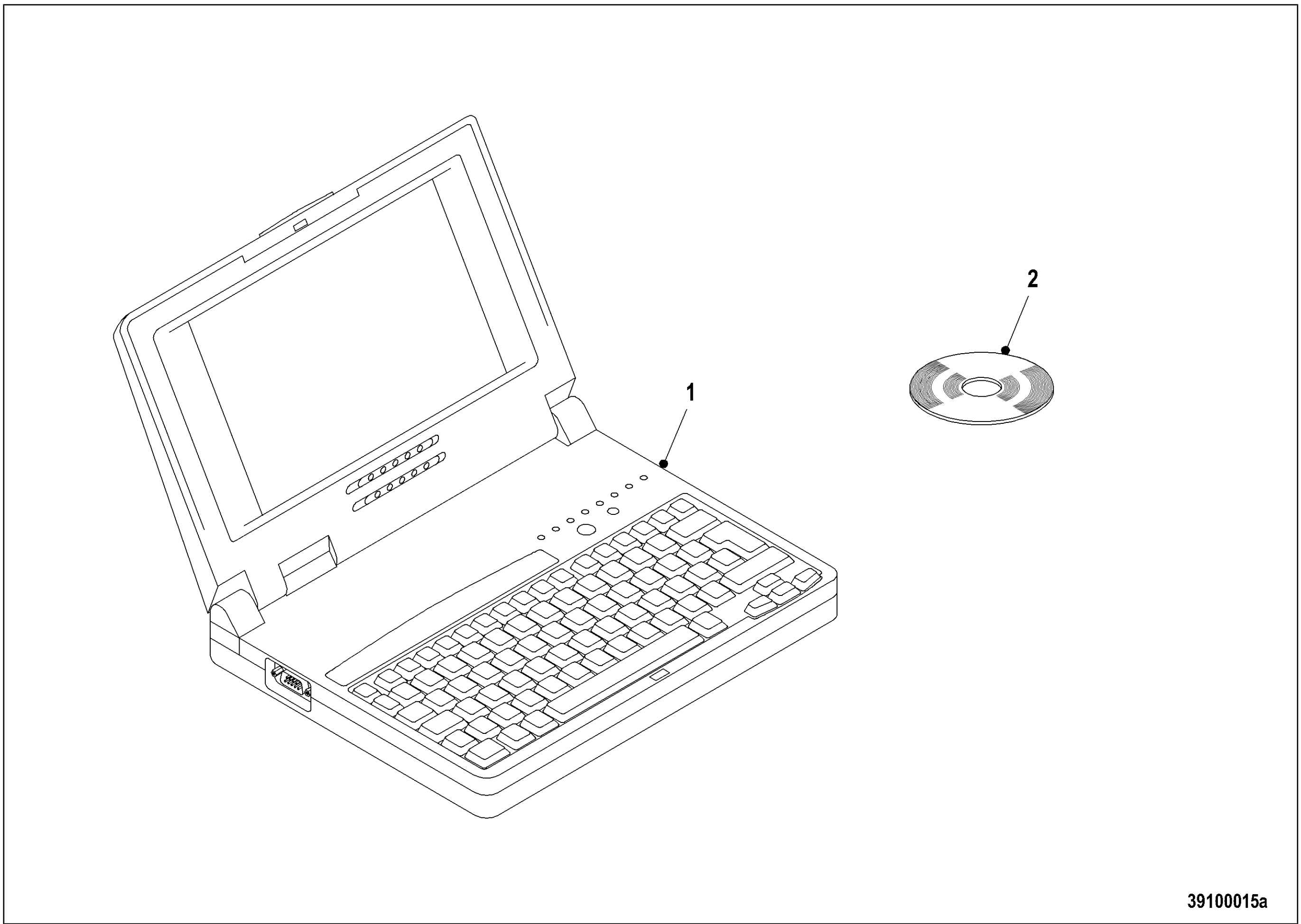
- A diagnostic lamp at the POM (flashing codes: see chap. “Diagnostic lamps of the devices”)

TIM ID: 0000017747 - 003



1 Diagnostic lamp

Tools



1 Laptop
2 CD with DiaSys® software

TIM ID: 0000017747 - 003

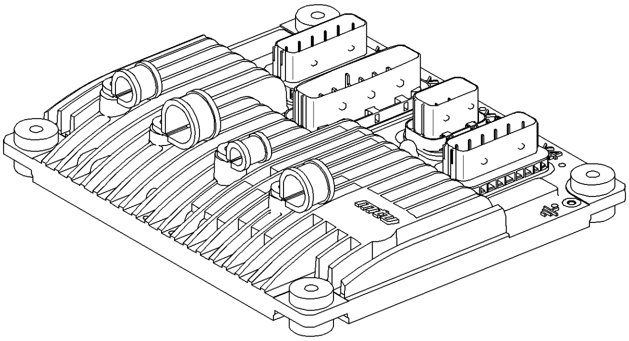
The dialog system DiaSys®, comprising a laptop computer with the DiaSys® program (software allowing direct access to the parameters of the units in the system), a user dongle (hardlock) and a “USB to CAN Converter”, is available for more sophisticated fault diagnosis in the electronic system.

However, this system is primarily intended for in-depth diagnosis and changing the settings of the Engine Control Unit and of the SAM.

2.2 Engine governor ECU 7 (ADEC)

2.2.1 ECU – Use and functions

Engine Control Unit ECU 7



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Central open- and closed-loop controller for the engine

- Conversion of setpoint signals from the monitoring, control and remote control systems into signals to the engine
- Control of the injection system
- Control of other actuators on the engine
- Acquisition and evaluation of engine operating states
- Limit value monitoring
- In the event of inadmissible states and limit value violations: Initiation of power reduction, power limitation, engine stop or emergency engine stop (configurable)
- Transfer of fault signals to the control and monitoring system
- Download of engine and plant-related settings
- Self-monitoring
- Diagnosis with dialog unit (laptop)

TIM ID: 0000008496 - 002

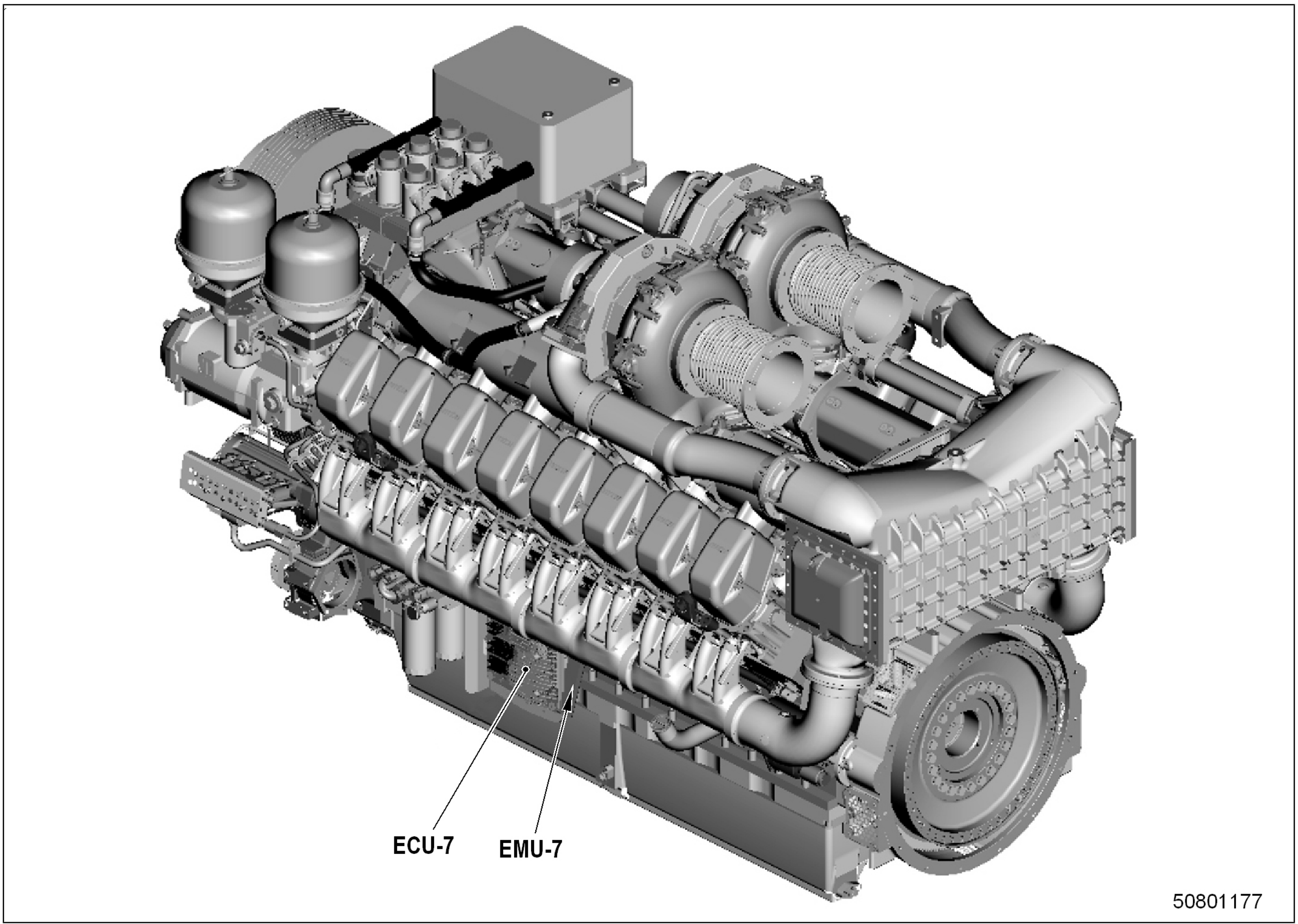
2.2.2 Installation on the engine

Specification

The Engine Control Unit is designed in regard of mechanical configuration and thermal capability to facilitate mounting directly on the engine (→ Page 44):

- Housing temperature range during operation from –40 °C to +75 °C
- Ambient temperature during operation: up to 110 °C
- Relative air humidity: 95% at 55 °C
- Shock resistance: 15 g along all axes
- Degree of protection IP69K, i.e. dust-proof and waterproof under direct water jet up to 100 bar (all connectors inserted and locked)
- Salt spray-proof
- Resistant to chemicals (incl. biodiesel)

Mechanical installation



ECU-7 Engine Control Unit ECU (ADEC)
EMU -7 Supplementary engine monitoring unit (option)

TIM ID: 0000017744 - 003

On C&I engines, the Engine Control Unit is located on an inspection port cover underneath the exhaust elbow, next to the oil filters.

The additional Engine Monitoring Unit EMU-7 is mounted on the Engine Control Unit when included.

2.2.3 Technical data – ECU 7

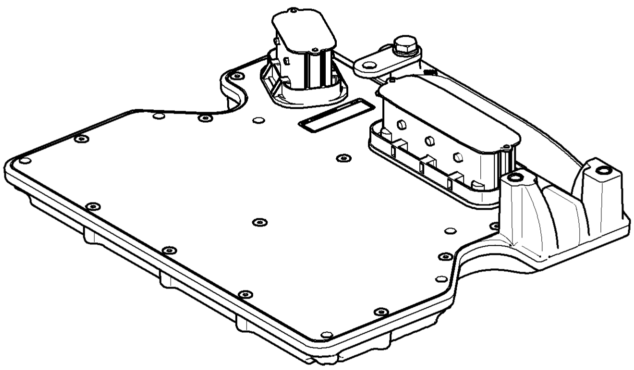
Term	Unit	Value
Housing material		AlSi10Mg
Dimensions (length x width x height)	mm	361 x 315 x 63
Draw-out clearance (height)	mm	135
Weight (without cable connection)	kg	5.5
Installation position		As desired
Operating voltage.	VDC	20 … 32 (operation, injection without reduction of performance) 16,8 … 20 (operation, injection with reduction of performance) 11 … 16,8 (interactive mode, without injection) (EN 50155; STANAG 1008)
Supply resistance	Ω	0.25 (maximum) ($R_{i, voltage source}$ + R_{line} + $R_{contact}$)
Current consumption	A	0.2 … 17 (typical) 24 (maximum, at 24 VDC) 5A_{pp}AC / 200 … 400 Hz Approx. 7 mA with ignition OFF Approx. 250 mA with ignition ON (without injection)
Thermal dissipation loss	W	35 (maximum)
Ground connection		Required, via grounding strip
EMC protection		IEC 60533: 1999
Insulation resistance		10 MΩ (IEC 60092-504) U_{test} ≥ 50 VDC (device removed for test) 500 VDC (EN 50155)
ESD protection		EN 61000-4-2: 2002, IEC 61000-4-2
Ambient temperature during operation	°C	–40 … +75
Storage temperature range	°C	–40 … +85
Housing temperature	°C	105 (maximum; for a maximum of 30 min.)
Relative air humidity	%	0 … 95, condensing
Degree of protection		Connected: IP69K (IEC 60529, DIN 40050) Not connected: IP 20 With connector protective cap: IP 54
Shock resistance		15 g (11 ms duration) (IEC 68-2-27)
Vibrostability		3.7 g*ms; 31.5 … 150 Hz; 11 g peak (IEC 60068-2-6) 0.00057 g^2/Hz at 5 Hz 0.06 g^2/Hz at 31.5 Hz 0.06 g^2/Hz at 150 Hz 0.00057 g^2/Hz at 1000 Hz 0.00057 g^2/Hz at 1500 Hz
MTBF	h	20000 (at 75° ambient temperature)

TIM ID: 0000016863 - 002

2.3 EMU 7 – Technical Data, Functions und Parameters – Optional Scope

2.3.1 EMU – Use and functions

Engine Monitoring Unit EMU 7



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Additional monitoring unit for the engine

- Conversion of monitoring system setpoint signals into signals to the engine
- Acquisition of sensor signals and evaluation of engine operating states
- Monitoring of limit value violation
- In the event of inadmissible states and limit value violations: Tripping alarm messages
- Transmission of fault messages to the Monitoring and Control System
- Automatic download of engine and plant-related settings
- Self-monitoring

TIM ID: 0000022572 - 002

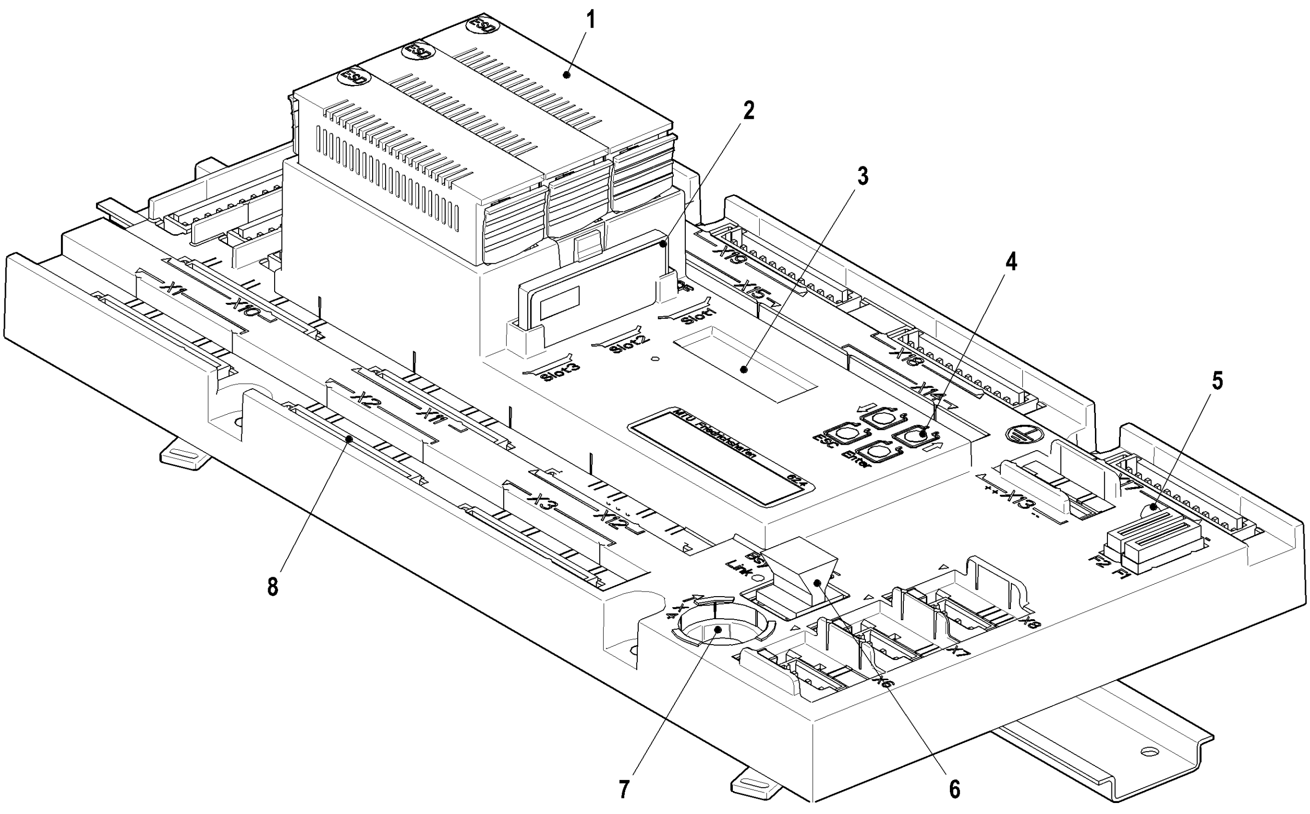
2.3.2 EMU 7 – Technical Data

Term	Unit	Value
Housing material		AlSi10Mg
Dimensions (length x width x height)	mm	318 x 263 x approx. 70
Draw-out clearance (height)	mm	116
Weight (without cable connections)	kg	3.3
Installation position		As desired
Operating voltage	VDC	16.8 ... 32 (operation) (STANAG 1008, Ed. 8: 1994) 11 ... 16.8 (dialog)
Supply impedance	Ω	0.25 (max.)
Power consumption	A	0.1 to 3.5 (typ.) 5.5 (max., at 24 VDC)
Heat dissipation	W	6 (max.)
Load impedance, switching outputs	Ω	32 … 20000
Grounding		Required, via grounding strip
EMC protection		IEC 60533: 1999 (Marine) MIL-STD-461E: 1999 (surface ships) EN 50121-3-2: 2001 (Rail) EN 50155: 2004 (Rail) EN 61000-6-2: 2002 (CE classification industrial) EN 61000-6-4: 2004 (CE classification industrial)
Dielectric strength		> 2 MΩ (IEC 60092-504) U_{test} ≥ 50 VDC (device removed for test)
ESD protection		EN 61000-4-2: 2002, IEC 61000-4-2
Operational ambient temperature	°C	–40 … +75
Storage temperature	°C	–40 … +85
Housing temperature	°C	80 (max.)
Relative air humidity	%	0 … 95, condensing
Degree of protection (mated)		IP69K (IEC 60529, DIN 40050)
Shock resistance		11 g (duration 11 ms) (IEC 68-2-27)
Vibrostability		3.7 grms; 31.5 … 150 Hz; 11 g peak (IEC 60068-2-6) 0.00057 g^2/Hz at 5 Hz 0.06 g^2/Hz at 31.5 Hz 0.06 g^2/Hz at 150 Hz 0.00057 g^2/Hz at 1000 Hz 0.00057 g^2/Hz at 1500 Hz
MTBF	h	20000 (at 75° ambient temperature)

TIM ID: 0000023328 - 001

2.4 SAM – Technical Data, Functions and Parameters

2.4.1 SAM central processing unit – Use and functions



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1 Cassettes with I/O component groups (including CAN interface)
2 SAM software and redundant data storage on CF card (supplied as loose part)
3 Fault code display
4 Pushbuttons for operating the display
5 Diagnostic lamp (→ Page 304)
6 Ethernet connection – access to Web page
7 Diagnostics interface (dialog unit connection)
8 SAM
Connector assignment: (→ Page 79)

Central data processing and control unit of the system

- Conversion of the input signals from the monitoring/control unit and speed demand of the external system into control signals for the Engine Control Unit
- Acquisition and evaluation of power train operating states
- Conversion of acquired values, feedback signals, fault messages etc. into displays/alarms
- Monitoring of the compliance with limit values
- In the event of inadmissible states and limit value violations: Triggering of warnings, power reduction, engine stop, depending on the application engineering.
- Data storage, life data

Control functions

- Acquisition of the speed demand of the external system via CAN
- Generation of the speed demand for the Engine Control Unit

Engine-related features

- Collective exhaust gas monitoring
- Control of preheaters and monitoring of the preheating system
- Fan control
- Monitoring of filter maintenance
- Pressure monitoring

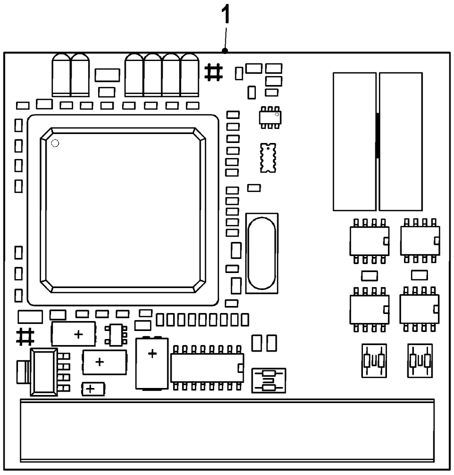
Display and signaling features

- Acquisition of binary signals (e.g. switches, buttons)
- Control of instruments
- Control of indicator lamps
- Alarm output on integrated minidisplay

Additional features

- Web page
- Monitoring of the Engine Control Unit
- External log for connection to customer systems

CANopen and J1939 (Option)



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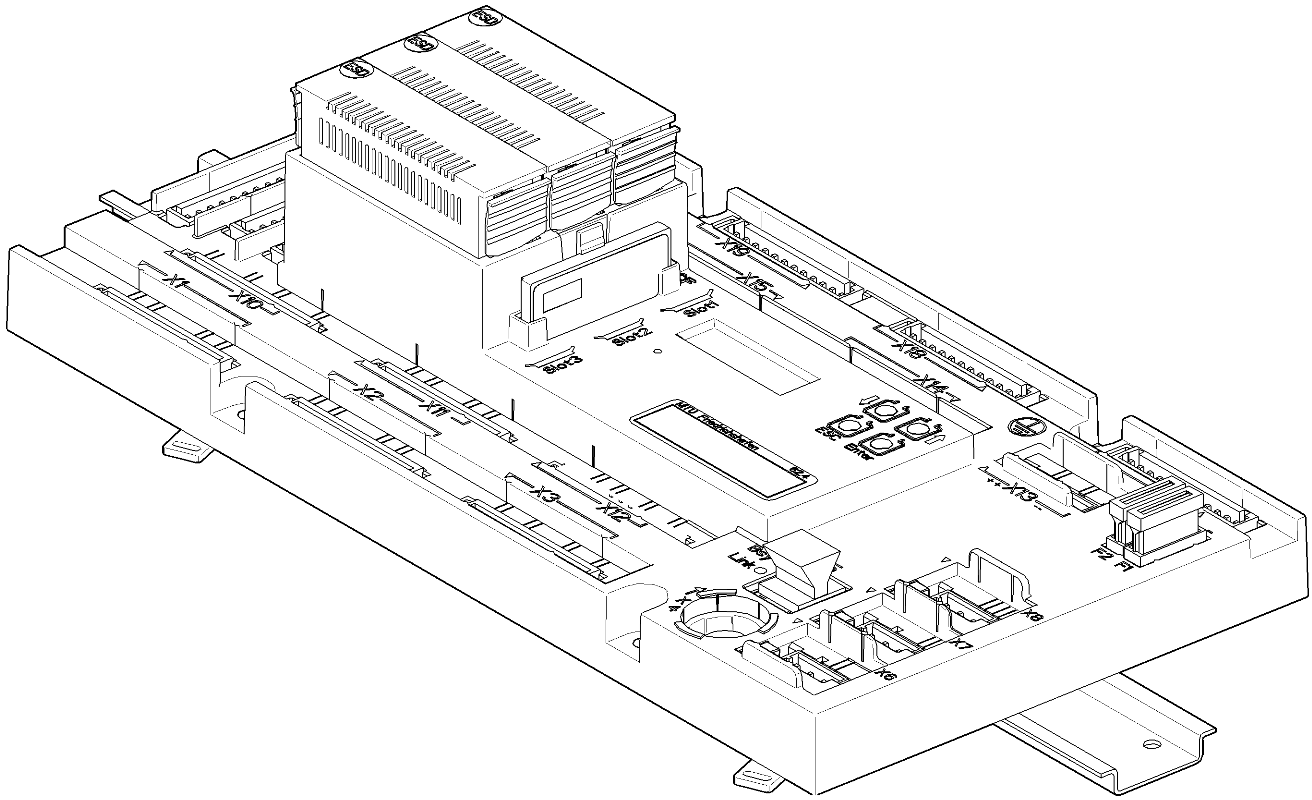
A CANopen or J1939 interface is available (option). A CCB2-type (1) board is inserted in slot 3 of the SAM for this purpose.

The interface must be activated in the SAM parameter settings with DiaSys.

TIM ID: 0000023337 - 002

2.4.2 SAM



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Use/application

- Installation in enclosed control cabinets.
- Suitable for mounting on mounting rails (rail installation) or for installation with screws on the rear wall of the cabinet (fixed installation).
- Suitable for connection wires or leads up to AWG16 (US) (1.5 mm²).

Technical data

Term	Unit	Value
Installation position		As desired, ensuring that the installed fault display is legible.
Operating voltage	VDC	24 rated value (-30%; +30%, temporary -50%)
Power consumption	W	Below 7 (0.25A at 24V) without additional loads.
Degree of protection:		IP 40 according to DIN 40 050
Shock: Rail mounting Fixed mounting		 10 g, 11 ms 30 g, 11 ms
Vibrations:		

Term	Unit	Value
Rail mounting	Hz	2 - 12.8:Xpp < ± 3mm 12.8 - 1000:a < 1g [rms]
Fixed mounting	Hz	2 - 12.8: Xpp < ± 3 mm 12.8 - 100:a < 4g [rms]
Ambient temperature:	°C	-40 – +70 with circulating ambient air.
Storage temperature:	°C	-40 - +100
Relative humidity	%	5 – 97, no condensation.
Color:		Blue (RAL5015)
Material:	%	Polycarbonate, reinforced with 10 % fiberglass.
Dimensions:	mm	L x W x H (295 x 151 x 75)
Weight:	kg	Approx. 1.6

Note: Values stated above may be restricted when MCS 5 extension modules are used.

EMI/EMC – Electromagnetic interference (general)

The SAM has been tested according to the following standards and meets the relevant limit values:

Standard	Test
EN 55011	(Conducted emission) 10 kHz – 30 MHz, class A
EN 55011	(Radiated emission) 30 MHz – 1 GHz
IEC-60533:1999	(Conducted emission) 10 kHz – 30 MHz (type test)
EC-60533:1999	(Radiated emission) 150 kHz – 2 GHz (type test)
EN 61000-4-2	(ESD interference immunity) ±8 kV
EN 61000-4-3	(Radiated interference immunity) 80 MHz – 2 GHz
EN 61000-4-4	(Burst interference immunity) ±2 kV
EN 61000-4-5	(Surge interference immunity) ±1 kV/±2 kV
EN 50155	(Surge interference immunity) ±1.8 kV
EN 61000-4-17	(LF line-related interference) 0.03 – 10 kHz/3 Veff
EN 61000-4-29	(Line fluctuations/STANAG 1008)
IEC 60092-504	(Dielectric strength) 550 VAC/10 mA
EN 50155	(Isolation) 500 V/10 Mohm

Requirements for fulfillment of EMI/EMC limit values are as follows:

- If the housing is not grounded via the mounting plate, it must be connected to housing ground e.g. by means of a cable with a minimum cross-section of 2.5 mm^2. Cable length shall not exceed 10 cm.
- Only twisted-conductor cables may be used to connect sensors and actuators. The maximum length of unshielded cables is 5 m, of shielded cables 50 m (provided wiring harness resistance allows for this). Shielding shall be connected in the switchgear cabinet.

TIM ID: 0000008286 - 003

Electrical requirements

Term	Unit	Value
Operating voltage:	V	24, -30 % to +30 % (+16.8 – +32) Permissible residual ripple less than 5% acc. to STANAG 1008. Note: The processor is automatically reset if the voltage falls below 7 V.
Power supply:	W	Below 7 W. Without activated loads at SAM outputs Additional output power amperage of positive or negative line may not exceed 10 A DC.
Power connection terminals:	mm	5.08 terminals (spring-type terminals) • A wire diameter of AWG14 (US) or 2.5 mm² is recommended.
Electrical isolation:	V	• Supply ground is common reference potential (Common Ground) for all SAM electronics. This applies to the entire I/O range with the exception of certain electrically isolated channels. • SAM electronics ground is not connected to housing ground. • If signal cable shields are used, these must be connected to housing ground. • Unless specified otherwise, the maximum DC insulation voltage is 500.

Mechanical design

Term	Unit	Value
Installation position		• Horizontal (to ensure visibility of the fault display and labels on the SAM housing). • Note that space is required to connect cabling at the top and bottom when installing the SAM in control cabinets. • The device heats up as a result of power loss from the SAM. Heat from the SAM is dissipated through the rear panel. Ensure that heat can be conducted away from the rear panel of the SAM to the mounting frame. Avoid any additional heating of the SAM by neighboring devices.

Signal connections

The SAM module is easily replaced. The input and output signal cables are equipped with modular connectors. Common function channels are grouped together.

The wires are connected using spring terminals.

It is possible to connect two wires to one terminal if the wires are connected in a double core sleeve using crimp technology. For example, a Phoenix AL-TWIN 2* 0.75-10 may be used.

The connector modules are connected by clicking them in place. The connector modules have code pins to prevent polarity reversal.

TIM ID: 0000008286 - 003

Terminals

Term	Unit	Value
Terminal strip modules:		WAGO spring terminals
Current-carrying capacity (at 70 °C):	A	10 per contact
Rated voltage:	V	250

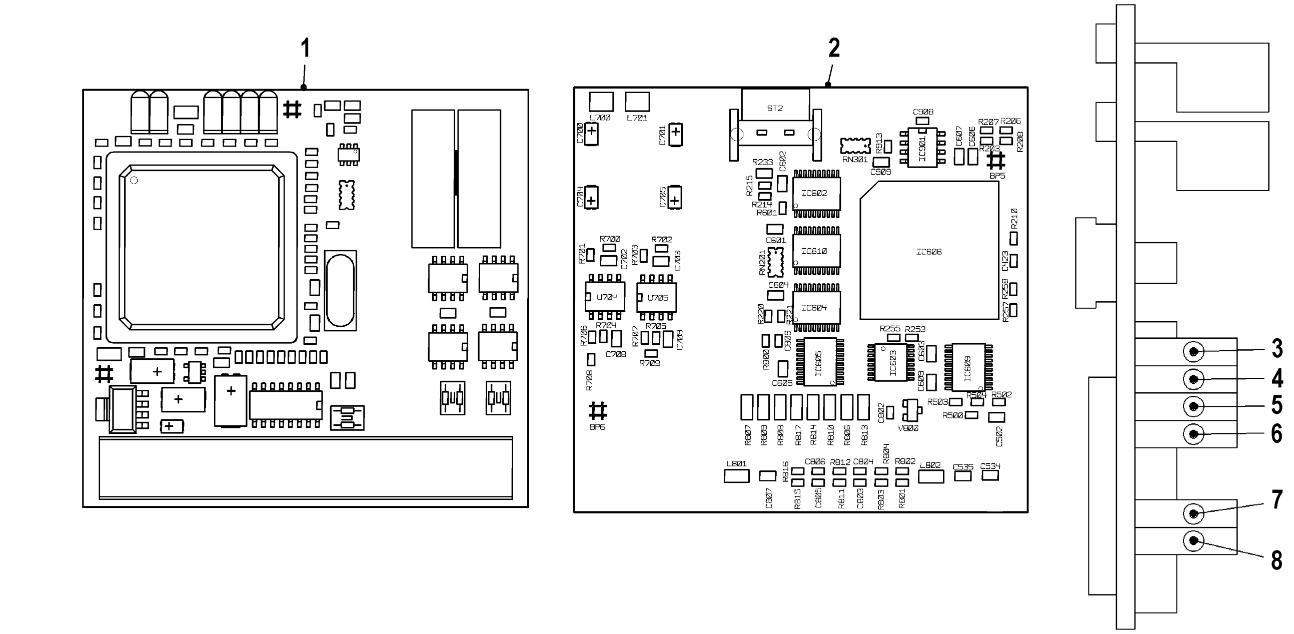
Term	Unit	Value
Rated surge voltage:	V	2500
Wire cross-sections:	mm^2	Up to 1.5 or AWG15
Clamping range:	mm^2	0.08 – 1.5 or AWG15

Other terminals (RM 5.08) are used for power supply and CAN bus connections.

Additional printed circuit boards in slots 1 to 3

Observe the relevant technical data applicable to the printed circuit boards concerned when additional boards are used in the SAM.

2.4.3 CCB 2 – Technical data



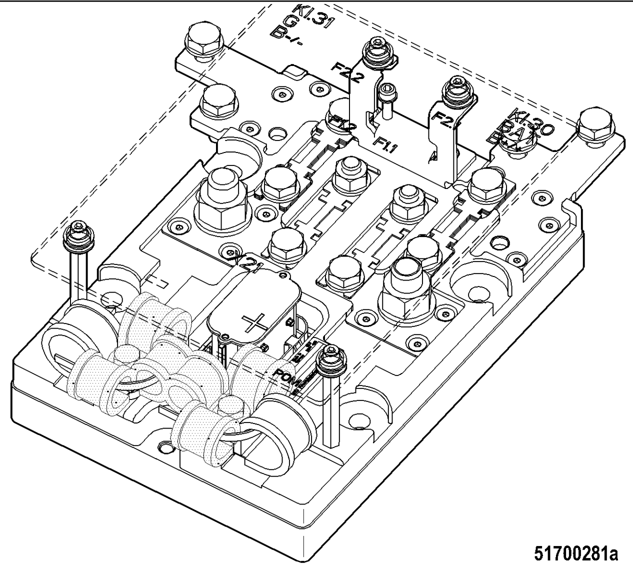
1 Component side
2 Soldering side
3 LED (yellow) “CAN1 SAEJ1993”
4 LED (yellow) “CAN2 CANopen”
5 LED (yellow) “CAN Hi PLD”
6 LED (yellow) “INFO”
7 LED (red) “ERROR”
8 LED (green) “RUN”

Term	Unit	Value
Input voltage	VDC	+5 (–5 %, +3 %) from SAM +24 V (±5 %) from SAM
Power consumption	mA	at 5 VDC < 600 at 24 VDC < 60
Power loss	W	Approx. 4

Table 1: CCB 2 – Technical data

2.5 Power Output Module (POM)

2.5.1 Power Output Module (POM) – Purpose and functions



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Connection device for starter and generator

- Translation of the specifications from the control system into control signals for the two starters
- Recording and analysis of the operating states of the starters and generator
- Compressed-air starting: recording of the starting-air pressure
- Implementation of recorded values
- Communication with the engine governor via a CAN bus

Control and monitoring functions

- Switching the starters on and off
- Monitoring and charge checking of the generator
- Detection of a defective fuse in the positive path of the starter power supply (fuse F2.2)

CAN interface

Communication with the engine governor occurs via the CAN-3 of the engine governor (the POM has only one CAN bus port).

2.5.2 POM – Technical data

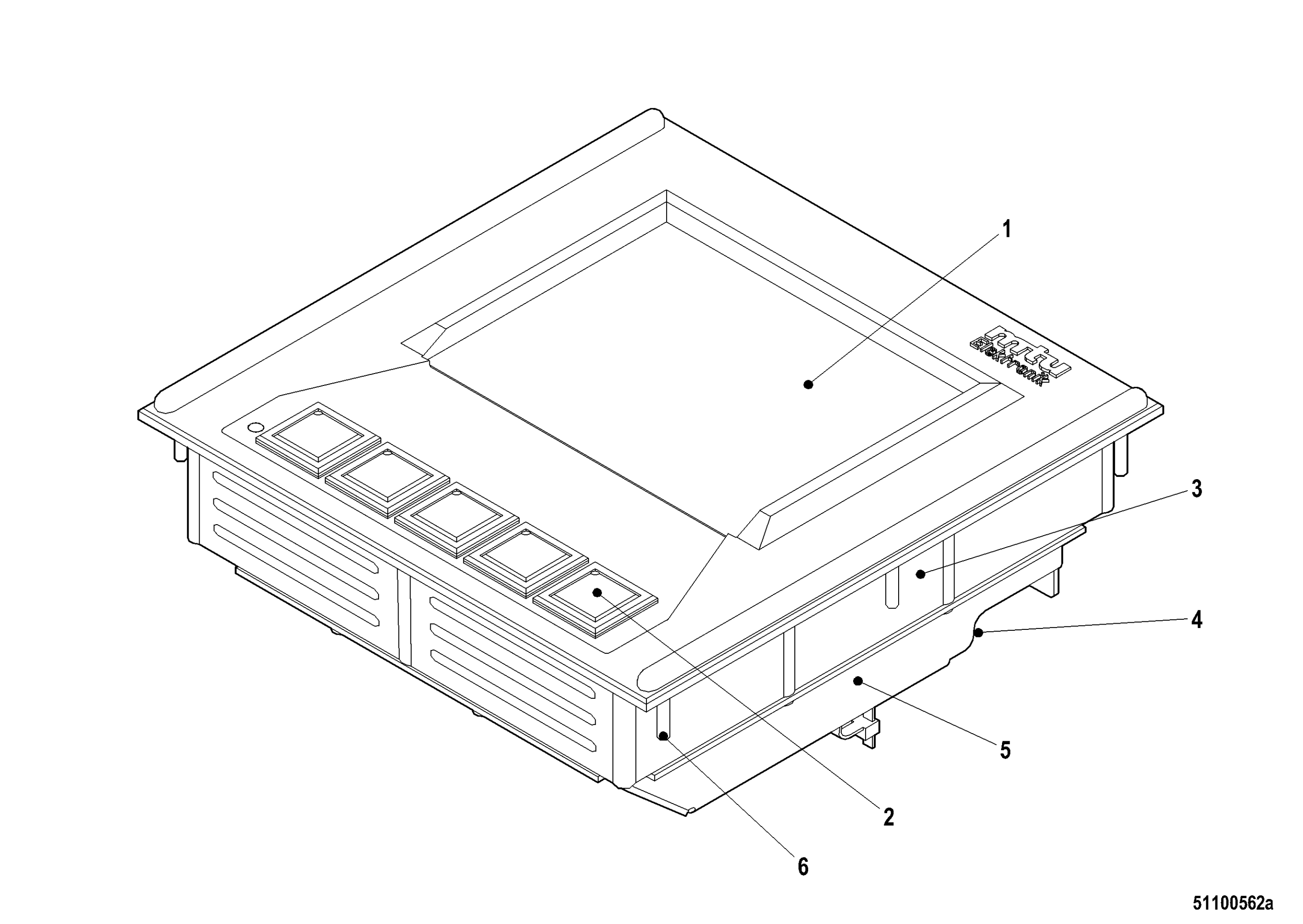
Term	Unit	Value
Housing material		AlMg3 and HGW272.4
Dimensions (length x width x height)	mm	260 x 186 x 113.5 (without terminal links)
Weight	kg	5.7
Installation position		Arbitrary
Operating voltage	V DC	16 … 32 (without restriction) 7 … 16 (standby, no start sequence) < 7 (device switched off) (EN 50155; STANAG 1008)
Current consumption	A	< 150 mA (standby) 120 A (maximum, with start sequence) < 20 mA in powerdown
Grounding		Not required, fulfilled by securing screw at cylinder block
EMC protection		EN 50121-3-2: 2001 (railway) EN 50155: 2004 (railway) EN 61000-6-2: 2002 (CE classification industrial) EN 61000-6-4: 2004 (CE classification industrial) EN 55025: 2003 (C&I international) EN 13309: 2000 (C&I international) DIN ISO 7637-2: 2002 (C&I international) DIN ISO 7637-3: 1995 (C&I international)
Insulation strength		10 MΩ (IEC 60092-504) U_{test} ≥ 50 V DC (device for test removed) 500 V DC (EN 50155)
ESD protection		EN 61000-4-2: 2002, IEC 61000-4-2 (CE, railway) ISO 10605: 2001 (C&I international)
Ambient temperature in operation	°C	–40 … +90
Storage temperature range	°C	–40 … +90
Housing temperature	°C	105 (maximum; for at most 30 min.)
Relative air humidity	%	0 … 95, bedewed
Protection class		Plugged in: IP69K (IEC 60529, DIN 40050) Not plugged in: IP 20 With connector protective cap: IP 54
Shock resistance		15 g (11 ms period) (IEC 68-2-27)
Vibration resistance		4 grms; 10 … 2000 Hz; 12 g peak (IEC 60068-2-6) 0.008 g^2/Hz at 10 Hz 0.008 g^2/Hz at 2000 Hz

TIM ID: 0000017730 - 001

2.6 Display DIS 10

2.6.1 Display DIS 10 – Structure

External structure



1 Display
2 Function keys F1 to F5
3 Housing upper section
4 Opening for connectors
5 Housing lower section
6 Stud M4

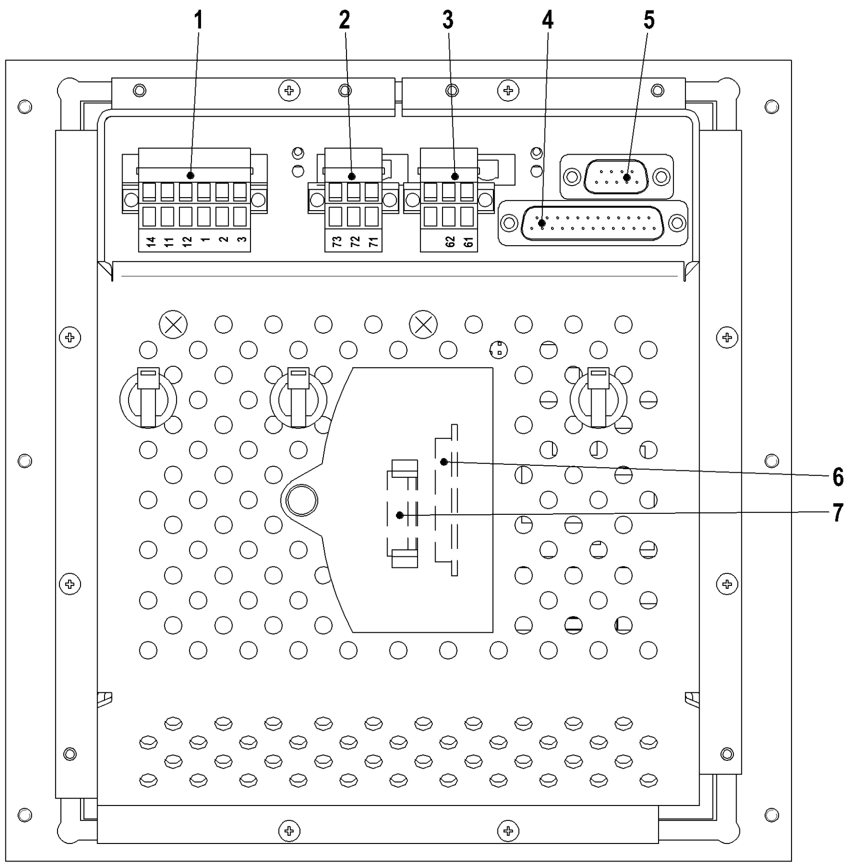
The display complies with ISO standard 9001 (quality assurance in design, development, production, installation and service).

Furthermore, the equipment provides CE conformity according to the following guidelines:

- Directive 89/336/EEC – Directive on electromagnetic compatibility – dated May 3, 1989 with amendment dated April 28, 1992 (guideline 92/31/EEC)
- Directive 73/23/EEC – Low voltage guideline – dated February 19, 1973 with amendment dated July 22, 1993 (directive 93/68/EEC)

The plug-in connections are accessible from the rear side of the unit. The battery compartment and the memory module (MEM) are arranged under a cover at the back side of the unit.

TIM ID: 0000008765 - 002



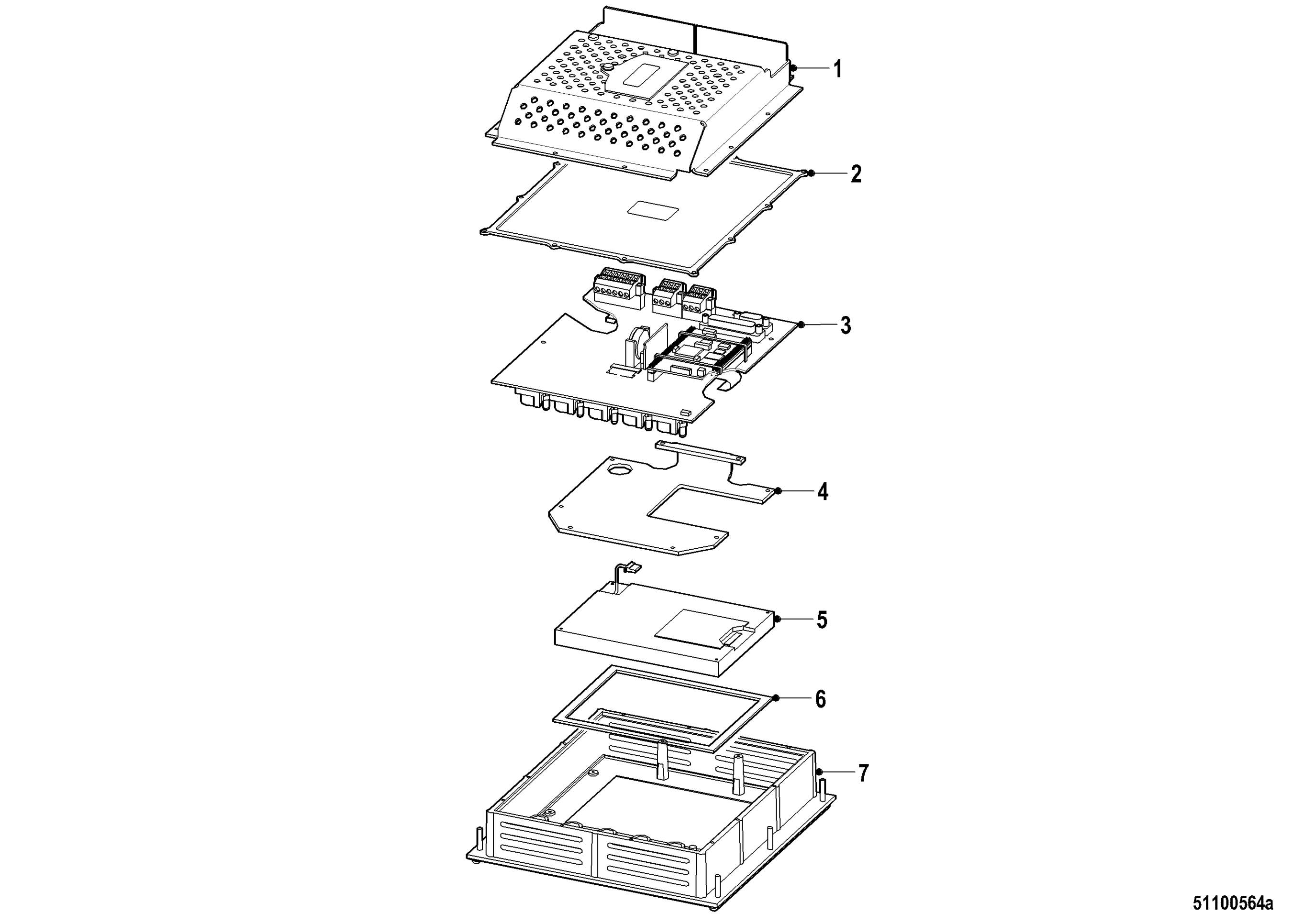
1 Terminal block ST 1
2 Terminal block CAN 2
3 Terminal block CAN 1
4 Sub-D-Multiple-pin Connector COM 1 (25-pin) , RS232/RS422
5 Sub-D-Multiple-pin Connector COM 1 (9-pin) , RS232/RS422
6 Memory module (MEM)
7 Battery

Connections and interfaces

Three terminal blocks (1), (2) and (3) as well as the two D-Sub multiple pin connectors (4) and (5) are located on the rear side of the display.

- Terminal block ST 1 (1) for operating voltage connection (+24 V DC), floating relay output for horn
- Terminal block CAN 2 (2) for CAN 2 (redundant bus) connection
- Terminal block CAN 1 (3) for CAN 1 (default bus) connection
- Sub-D multiple pin connectors (4), RS 422 interface for connection of modem (for remote diganosis) or of a cable for a direct connection to a service PC
- Sub-D multiple pin connectors (5) 9-pole RS 232 interface for connection of modem (for remote diganosis) or of a cable for a direct connection to a service PC

Display DIS 10 assemblies



1 Housing lower section
2 Gasket
3 Printed circuit board IDB
4 Adapter plate
5 Display 5.7`
6 Gasket
7 Housing upper section

TIM ID: 0000008765 - 002

2.6.2 Display DIS 10 – Technical data

DIMENSIONS

Term	Unit	Value
Width (front panel)	mm	222
Height (front panel)	mm	224
Depth	mm	76
Installation depth behind front panel	mm	98
Required space behind front panel	mm	approx. 125
Installation opening	mm x mm	195 x 218
Bore diameter	mm	5
Bore hole spacing	mm x mm	209 x 198
Weight	kg	1.9

OPERATING CONDITIONS

Term	Unit	Value
Operating voltage	VDC	24
Operating voltage, residual ripple	%	max. 5
Operating voltage, min.	V	12
Operating voltage, max.	V	31.2
Operating temperature, min.	°C	-0
Operating temperature, max.	°C	+55
Current consumption approx.	mA	600
Storage temperature, min.	°C	-20
Storage temperature, max.	°C	+60
Shock resistance	g	15 g, duration 11 ms
Vibrostability 2 Hz to 13 Hz	mm	±1.5
Vibration 13 Hz to 100 Hz	g	±1
Ambient conditions, rel. humidity, non-condensing	%	97

SAFETY

Term	Unit	Value
Degree of protection acc. to DIN 40050, front side		IP54
Degree of protection acc. to DIN 40050, rear side		IP10
Insulation resistance (under laboratory conditions); IEC 92–504	MΩ	>10 (50 V DC)
Dielectric strength (under laboratory conditions); IEC 92–504, housing front panel relative to electronics ground	V AC	min. 500

TIM ID: 0000016926 - 002

Term	Unit	Value
EMC protection		IEC 1000-4-2 to 1000-4-6, degree of severity 3, EN 50 022 class A

ELECTROMAGNETIC COMPATIBILITY (EMC)

Compliance with the EMC limit values of the above-mentioned standard is based on the following prerequisites:

- Only shielded bus cables are used. The inner shield must be connected to pin 3 of the bus connector, the outer shield must be connected to ship's ground.
- The grounding cable must not exceed 30 cm in length. It must have a cross-section of at least 2.5 mm^2

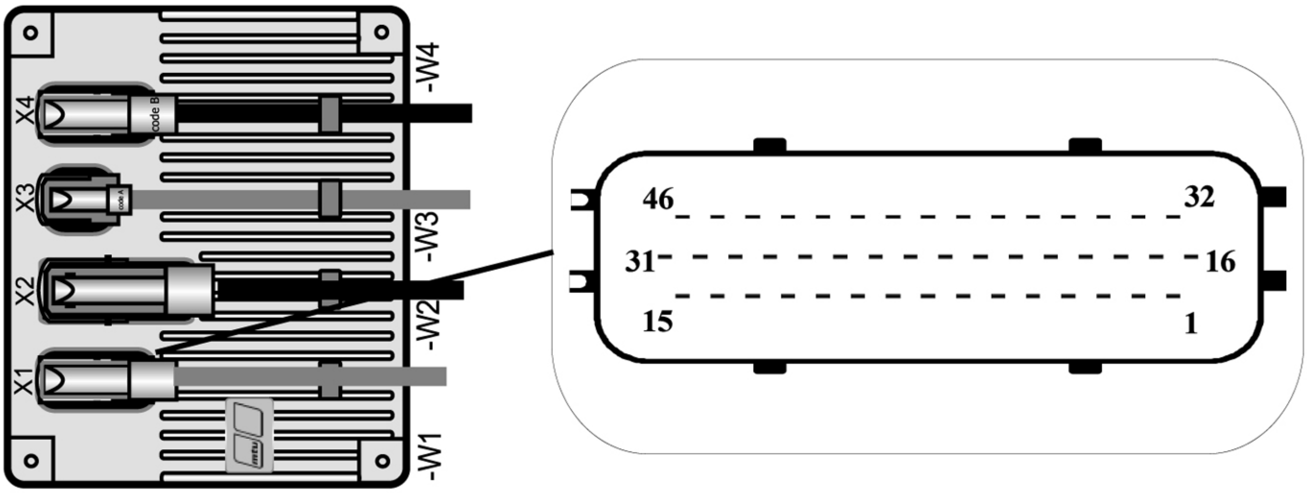
TIM ID: 0000016926 - 002

3 Cable connector

3.1 Connectors of Engine Control Unit ECU 7 (ADEC)

Connector assignment

Pin assignment X1



50800857a

This connector is the interface to the plant:

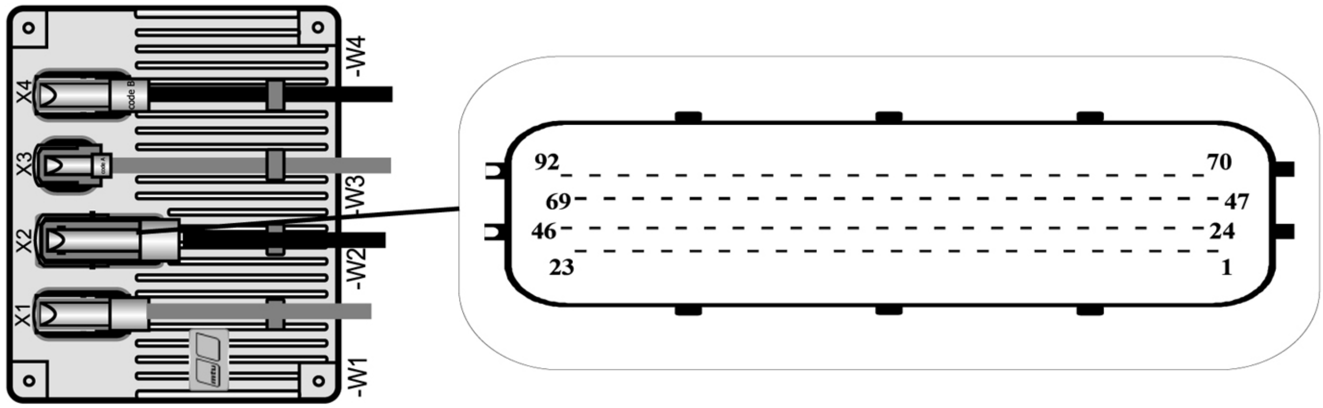
The following table shows the pin assignment of connector X1. The brief specification contains definitions of the most important characteristics of a channel.

Designation	Pin X1	Wire no.	Signal type	Brief specification	Description
CAN1_P	19	1	CAN1_P_H	50 V isolated	
CAN1_P	35	2	CAN1_P_L		
CAN1_P	20	3	CAN1_P_GND		CAN Bus 1
CAN2_P	33	5	CAN2_P_H	50 V isolated	
CAN2_P	18	6	CAN2_P_L		
CAN2_P	34	4	CAN2_P_GND		CAN Bus 2
DI1	43	21	DI1_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Engine stop

Designation	Pin X1	Wire no.	Signal type	Brief specification	Description
DI1	28	22	DI1_L	50 V isolated	Engine stop
DI2	42	19	DI2_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Torque limitation
DI2	27	20	DI2_L	50 V isolated	Torque limitation
DI3	41	17	DI3_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Increase idling speed
DI3	26	18	DI3_L	50 V isolated	Increase idling speed
DI4	40	15	DI4_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Reset alarm
DI4	25	16	DI4_L	50 V isolated	Reset alarm
DI5	39	13	DI5_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Engine protection input (external)
DI5	24	14	DI5_L	50 V isolated	Engine protection input (external)
DI6	38	11	DI6_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Fan on
DI6	23	12	DI6_L	50 V isolated	Fan on
DI7	37	9	DI7_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Start
DI7	22	10	DI7_L	50 V isolated	Start
DI8	36	7	DI8_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Override
DI8	21	8	DI8_L	50 V isolated	Override
ESI	4	35	ESI_IN	<4 V (2 mA) = low/>8 V (4 mA) = high	Emergency stop signal
AI1_2	44	36	AI1_2_5V	5 V/25 mA ±50 V isolated to other potential	5 V supply
AI1	31	39	AI1_U	0...10 V (not isolated to AI2)	Nominal speed setting voltage
AI1	46	23	AI1_I	0...23.7 mA (not isolated to AI2)	Nominal speed setting current
AI2	30	40	AI2_U	0...10 V (not isolated to AI1)	Engine torque setting voltage
AI2	45	24	AI2_I	0...23.7 mA (not isolated to AI1)	Engine torque setting current
AI1_2	29	25	AI1_2_GND	AI_GND ±50 V isolated to other potential	Ground for analog inputs
AO1	7	27	AO1_OUT	0..10 V/8 mA	Fan control 1
AO2	6	28	AO2_OUT	0..10 V/8 mA	Optimum Load
AO1_2_FIP	5	26	AO1_2_FIP_GND	GND	Ground

Designation	Pin X1	Wire no.	Signal type	Brief specification	Description
FIP	8	37	FIP_IN	0..5 V or frequency input	Frequency input speed
TOP1	14	31	TOP1_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/ sink	Yellow alarm
TOP2	13	29	TOP2_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/ sink	Red alarm
TOP1_2	12	30	TOP1_2_GND	LGND (3 A)	Ground
TOP3	11	32	TOP3_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/ sink	“Engine cold” signal
TOP4	10	33	TOP4_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/ sink	Starter ON / speed window (configurable)
TOP3_4	9	34	TOP3_4_GND	LGND (3 A) 17	Ground
FO	15	38	FO_OUT	24 V/1.5 A sink to LGND/<500 Hz	“Optimum load” signal
ITS_O	3		TxD_1	ITS OFF -> ITS_O (3) jumper to ITS_I (2)	Bridge
ITS_I	2		RxD_1	ITS OFF -> ITS_O (3) jumper to ITS_I (2)	Bridge

Pin assignment X2



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The engine sensor system is connected to this connector.

TIM ID: 0000018348 - 002

The following table shows the pin assignment of connector X2. The brief specification shows the most important properties of a channel.

Designation	Pin X2	Signal type	Brief specification	Sensor	Pin	Description
TI1	92	TI1_IN	0...5 V/internal 1k91 pull up to TI_BUF	B6	1	T-Coolant Water Pt1000
TI1	46	TI1_GND	GND	B6	2	
TI2	91	TI2_IN	0...5 V/internal 1k91 pull up to TI_BUF	B9	1	T-Charge Air Pt1000
TI2	69	TI2_GND	GND	B9	2	
TI3	90	TI3_IN	0...5 V/internal 1k91 pull up to TI_BUF	B33	1	T-Rail Fuel
TI3	68	TI3_GND	GND	B33	2	
TI4		TI4_IN	0...5 V/internal 1k91 pull up to TI_BUF			
TI4		TI4_GND	GND			
TI5	88	TI5_IN	0...5 V/internal 1k91 pull up to TI_BUF	B3	1	T-Intake AIr Pt1000
TI5	66	TI5_GND	GND	B3	2	
TI6	87	TI6_IN	0...5 V/internal 1k91 pull up to TI_BUF	B26	1	T-Coolant Intercooler Pt1000
TI6	65	TI6_GND	GND	B26	2	
TI7	86	TI7_IN	0...5 V/internal 1k91 pull up to TI_BUF	B7	1	T-Lube Oil Pt1000
TI7	64	TI7_GND	GND	B7	2	
TI8		TI8_IN	0...5 V/internal 1k91 pull up to TI_BUF			
TI8		TI8_GND	GND			
TI9		TI9_IN	0...5 V/internal 1k91 pull up to TI_BUF			
TI9		TI9_GND	GND			
TI10		TI10_IN	0...5 V/internal 1k91 pull up to TI_BUF			
TI10		TI10_GND	GND			

TIM ID: 0000018348 - 002

Designa-tion	Pin X2	Signal type	Brief specification	Sensor	Pin	Description
TI11		TI11_IN	0...5 V/internal 1k91 pull up to TI_BUF			
TI12		TI12_IN	0...5 V/internal 1k91 pull up to TI_BUF			
PI1	59	PI1_5V_T1	5 V/12 mA/tracker T1	B16	1	P-Coolant Water (0.5-4.5 V) = (0-6 bar)
PI1	82	PI1_IN	0...5 V/internal 47k5 pull down	B16	2	
PI1	60	PI1_GND	GND	B16	4	4
PI2	80	PI2_5V_T2	5 V/12 mA/tracker T2	B50	1	P-Crankcase Air (0.5-4.5 V) = (+/- 70 mbar)
PI2	58	PI2_IN	0...5 V/internal 47k5 pull down	B50	2	
PI2	81	PI2_GND	GND	B50	4	
PI3	56	PI3_5V_T3	5 V/12 mA/tracker T3	B34	1	P-Fuel Line after Filter (0.5-4.5 V) = (0-15 bar)
PI3	79	PI3_IN	0...5 V/internal 47k5 pull down	B34	2	
PI3	57	PI3_GND	GND	B34	4	
PI4	77	PI4_5V_T4	5 V/12 mA/tracker T4	B48	1	P-Rail Fuel (0.5-4.5 V) = (0-2000 bar)
PI4	55	PI4_IN	0...5 V/internal 47k5 pull down	B48	2	
PI4	78	PI4_GND	GND	B48	4	
PI5	53	PI5_5V_T5	5 V/12 mA/tracker T5	B5.1	1	P-Lube Oil (0.5-4.5 V) = (0-10 bar)
PI5	76	PI5_IN	0...5 V/internal 47k5 pull down	B5.1	2	
PI5	54	PI5_GND	GND	B5.1	4	
PI6	74	PI6_5V_T6	5 V/12 mA/tracker T6	B5.3	1	P-Lube Oil bef. Filter (0.5-4.5 V) = (0-10 bar)
PI6	52	PI6_IN	0...5 V/internal 47k5 pull down	B5.3	2	
PI6	75	PI6_GND	GND	B5.3	4	
PI7	50	PI7_5V_T7	Supply 5 V/tracker T7 for PI7.. 48 mA	B10	1	P-Charge Air (0.5-4.5 V) = (0.5-4.5 bar)
PI7	73	PI7_IN	0...5 V/internal 47k5 pull down	B10	2	
PI7	51	PI7_GND	GND	B10	4	

Designa-tion	Pin X2	Signal type	Brief specification	Sensor	Pin	Description
PI8	71	PI8_5V_T 8	Supply 5 V/tracker T8 for PI8.. 48 mA	B43	1	P-Coolant Intercooler (0.5-4.5 V) = (0-6 bar)
PI8	49	PI8_IN	0...5 V/internal 47k5 pull down	B43	2	
PI8	72	PI8_GND	GND	B43	4	
PI9		PI9_5V_T 9	Supply 5 V/tracker T9 for PI9.. 48 mA			
PI9		PI9_IN	0...5 V/internal 47k5 pull down			
PI9		PI9_GND	GND			
PI10		PI10_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PI11		PI11_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PI12		PI12_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PI13		PI13_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PI14		PI14_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PTI		PTI_IN	0...5 V/internal 47k5 pull down (supply 5 V: T7 or T8 or T9)			
PFI1		PFI1_IN	PxI 0...5 V/internal 47k5 pull down/xFI CMOS 3k32 pull up			
PFI2		PFI2_IN	PxI 0...5 V/internal 47k5 pull down/xFI CMOS 3k32 pull up			
PFI3		PFI3_IN	PxI 0...5 V/internal 47k5 pull down/xFI CMOS 3k32 pull up			

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Designa-tion	Pin X2	Signal type	Brief specification	Sensor	Pin	Description
LSI1	22	LSI1_13V_5V_T10	Supply 13 V/5 V for LSI1 max. 12 mA/ channel Tracker 10	F33	1	Coolant Water Level
LSI1	45	LSI1_IN	0...5 V/internal 47k5 pull down PI/ pull up LSI	F33	3	
LSI1	23	LSI1_GND	GND	F33	2	
LSI2	43	LSI2_13V_5V_T11	Supply 13 V/5 V for LSI2 max. 12 mA/ channel Tracker 11	F70	1	Water Fuel Prefilter Level
LSI2	21	LSI2_IN	0...5 V/internal 47k5 pull down PI/ pull up LSI	F70	3	
LSI2	44	LSI2_GND	GND	F70	2	
LSI3	27	LSI3_13V_5V_T12	Supply 13 V/5 V for LSI3 max. 12 mA/ channel Tracker 12	F46	1	Fuel Leakage Filter
LSI3	5	LSI3_IN	0...5V/Intern 47k5 pull down PI/ pull up LSI	F46	3	
LSI3	28	LSI3_GND	GND	F46	2	
ASI1	42	ASI1_L	<-130 mV = low <0 mV = high	B13	2	n-Crankshaft
ASI1	20	ASI1_H		B13	1	
ASI2	41	ASI2_L	<-130 mV = low <0 mV = high	B1	2	n-Camshaft
ASI2	19	ASI2_H		B1	1	
FI1	18	FI1_H	<-630 mV = low >540 mV = high	B44	1	n-Turbo Charger
FI1	40	FI1_L		B44	2	
FI2		FI2_H	<-630 mV = low >540 mV = high			
FI2		FI2_L				
FI3		FI3_H	<-630 mV = low >540 mV = high			
FI3		FI3_L				
FI4		FI4_H	<-630 mV = low >540 mV = high			
FI4		FI4_L				
TO1		TO1_OUT	24 V/1.5 A			
TO1		TO1_GND	LGND			

Designa-tion	Pin X2	Signal type	Brief specification	Sensor	Pin	Description
TO2		TO2_OUT	24 V/1.5 A			
TO2		TO2_GND	LGND			
TO3	13	TO3_OUT	24 V/1.5 A	XM2	1	Priming Pump
TO3	35	TO3_GND	LGND	XM2	2	
TO4		TO4_OUT	24 V/1.5 A			
TO4		TO4_GND	LGND			
PWM_CM1	16	PWM_CM1_OUT	24 V/3 A with current measurement (CM)	M8	1	High Pressure Pump
PWM_CM1	38	PWM_CM1_GND	LGND	M8	2	
CAN3_E	1	CAN3_E_H	50 V isolated	X21.2	1	POM (optional)
CAN3_E	24	CAN3_E_L		X21.2	2	
CAN3_E	2	CAN3_E_GND		X21.2	3	

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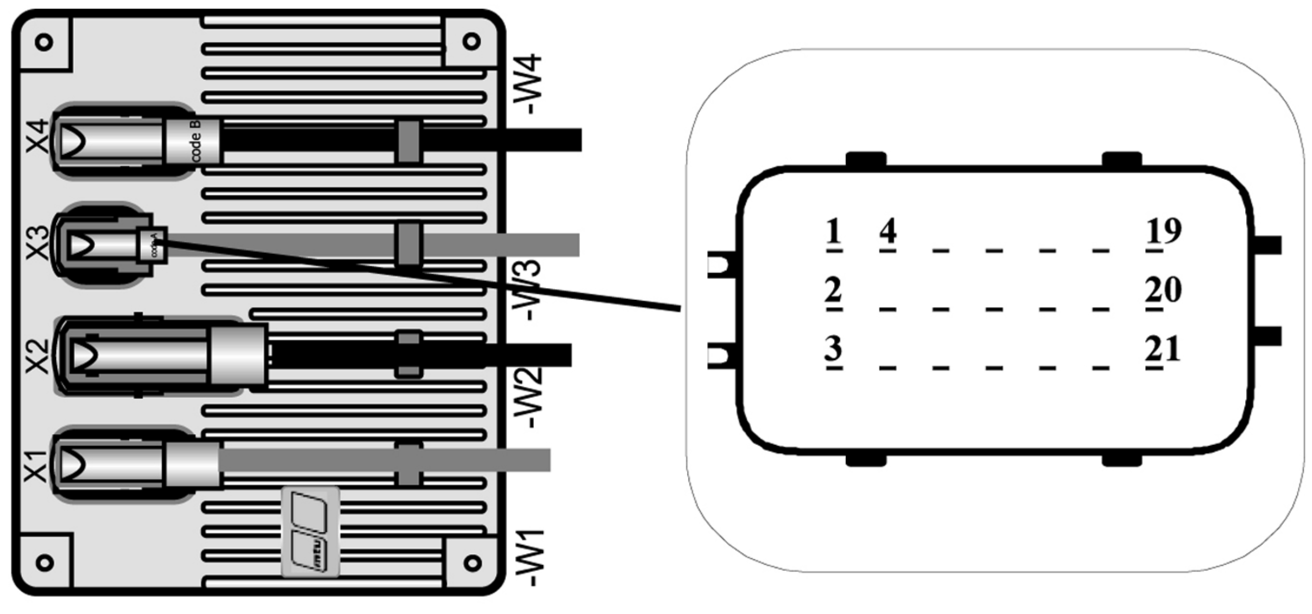
Pin assignment X3



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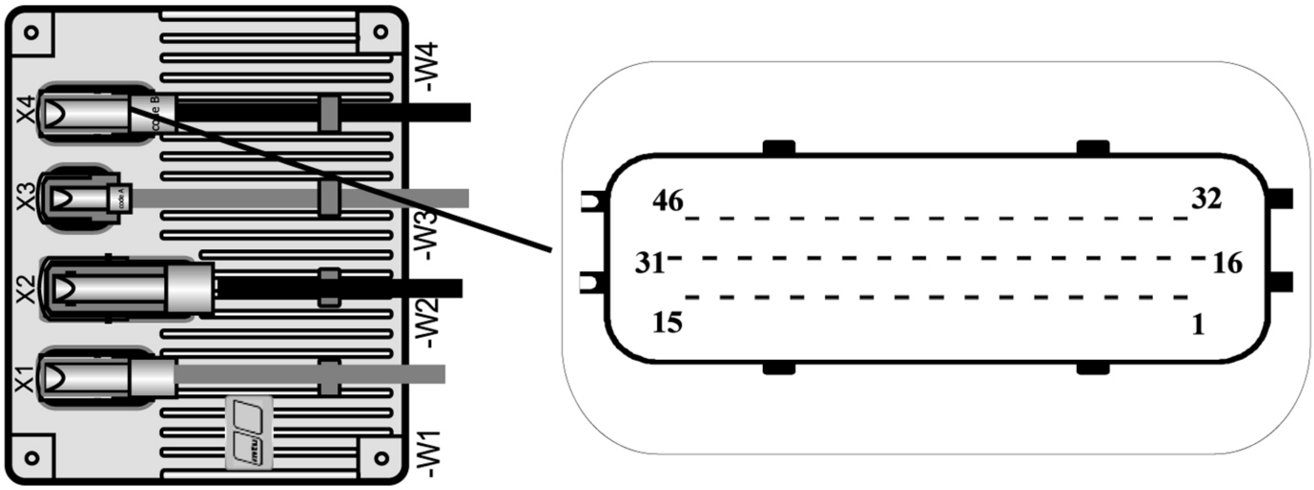
The supply voltage as well as the “Ignition” signal is supplied via this connector.

The following table shows the pin assignment of connector X3. The brief specification shows the most important properties of a channel.

Designation	Pin X3	Signal type	Brief specification
POWER	3	+24 V	24 V/30 A
POWER	6	+24 V	
POWER	9	+24 V	
POWER	12	+24 V	
POWER	1	GND	GND/30 A
POWER	4	GND	
POWER	7	GND	
POWER	10	GND	
IGI	16	IGI_24 V	24 V/10 mA (bridge to IGI_IN to disable IGI function)
IGI	13	IGI_IN	<4 V (2 mA) = low, >8 V (4 mA) = high

Pin assignment X4



50800860a

All injectors of the engine are connected to this connector.

The following table shows the pin assignment of connector X4. The brief specification shows the most important properties of a channel.

Designa-tion	Pin X4	Signal type	Brief specifi-cation	Sensor	Pin	Description
IO11	39	IO11_H	24 V/17 A; 42 V/10 A	Y39A1	1	Injection Valve A1
IO11	23	IO11_L	Bank 1		2	
IO12	38	IO12_H	24 V/17 A; 42 V/10 A	Y39A5	1	Injection Valve A5
IO12	22	IO12_L	Bank 1		2	
IO13	37	IO13_H	24 V/17 A; 42 V/10 A	Y39A2	1	Injection Valve A2
IO13	21	IO13_L	Bank 1		2	
IO14	36	IO14_H	24 V/17 A; 42 V/10 A	Y39A3	1	Injection Valve A3
IO14	20	IO14_L	Bank 1		2	

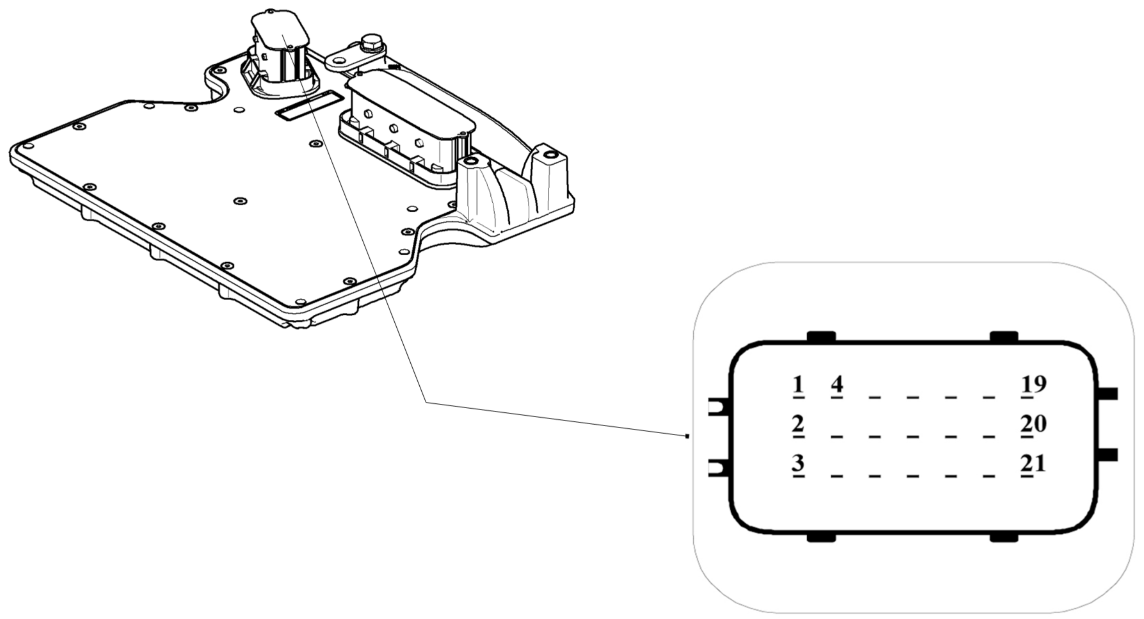
Designa-tion	Pin X4	Signal type	Brief specifi-cation	Sensor	Pin	Description
IO15	35	IO15_H	24 V/17 A; 42 V/10 A	Y39A4	1	Injection Valve A4
IO15	19	IO15_L	Bank 1		2	
IO21	46	IO21_H	24 V/17 A; 42 V/10 A	Y39B5	1	Injection Valve B5
IO21	45	IO21_L	Bank 2		2	
IO22	44	IO22_H	24 V/17 A; 42 V/10 A	Y39B2	1	Injection Valve B2
IO22	43	IO22_L	Bank 2		2	
IO23	42	IO23_H	24 V/17 A; 42 V/10 A	Y39B3	1	Injection Valve B3
IO23	26	IO23_L	Bank 2		2	
IO24	41	IO24_H	24 V/17 A; 42 V/10 A	Y39B4	1	Injection Valve B4
IO24	25	IO24_L	Bank 2		2	
IO25	40	IO25_H	24 V/17 A; 42 V/10 A	Y39B1	1	Injection Valve B1
IO25	24	IO25_L	Bank 2		2	
IO31	11	IO31_H	24 V/17 A; 42 V/10 A	Y39A8	1	Injection Valve A8
IO31	27	IO31_L	Bank 3		2	
IO32	12	IO32_H	24 V/17 A; 42 V/10 A	Y39A7	1	Injection Valve A7
IO32	28	IO32_L	Bank 3		2	
IO33	14	IO33_H	24 V/17 A; 42 V/10 A	Y39A10	1	Injection Valve A10
IO33	30	IO33_L	Bank 3		2	
IO34	13	IO34_H	24 V/17 A; 42 V/10 A	Y39A6	1	Injection Valve A6
IO34	29	IO34_L	Bank 3		2	
IO35	15	IO35_H	24 V/17 A; 42 V/10 A	Y39A9	1	Injection Valve A9
IO35	31	IO35_L	Bank 3		2	
IO41	2	IO41_H	24 V/17 A; 42 V/10 A	Y39B7	1	Injection Valve B7
IO41	1	IO41_L	Bank 4		2	
IO42	4	IO42_H	24 V/17 A; 42 V/10 A	Y39B10	1	Injection Valve B10
IO42	3	IO42_L	Bank 4		2	
IO43	8	IO43_H	24 V/17 A; 42 V/10 A	Y39B6	1	Injection Valve B6

Designa-tion	Pin X4	Signal type	Brief specifi-cation	Sensor	Pin	Description
IO43	7	IO43_L	Bank 4		2	
IO44	6	IO44_H	24 V/17 A; 42 V/10 A	Y39B9	1	Injection Valve B9
IO44	5	IO44_L	Bank 4		2	
IO45	10	IO45_H	24 V/17 A; 42 V/10 A	Y39B8	1	Injection Valve B8
IO45	9	IO45_L	Bank 4		2	
PWM1	33	PWM1_OUT	24V/3A/< 500Hz			
PWM1	17	PWM1_GND	LGND			
PWM2	32	PWM2_OUT	24V/3A/< 500Hz			
PWM2	16	PWM2_GND	LGND			
PWM_CM2	34	PWM_CM2_OUT	24V/3A/< 500Hz	XXy44	1	FAN Control
PWM_CM2	18	PWM_CM2_GND	LGND (10 mΩ)		2	

3.2 Connectors of individual exhaust gas temperature monitoring unit EMU 7

Connector assignment

Pin assignment X11



256-EMU7-002

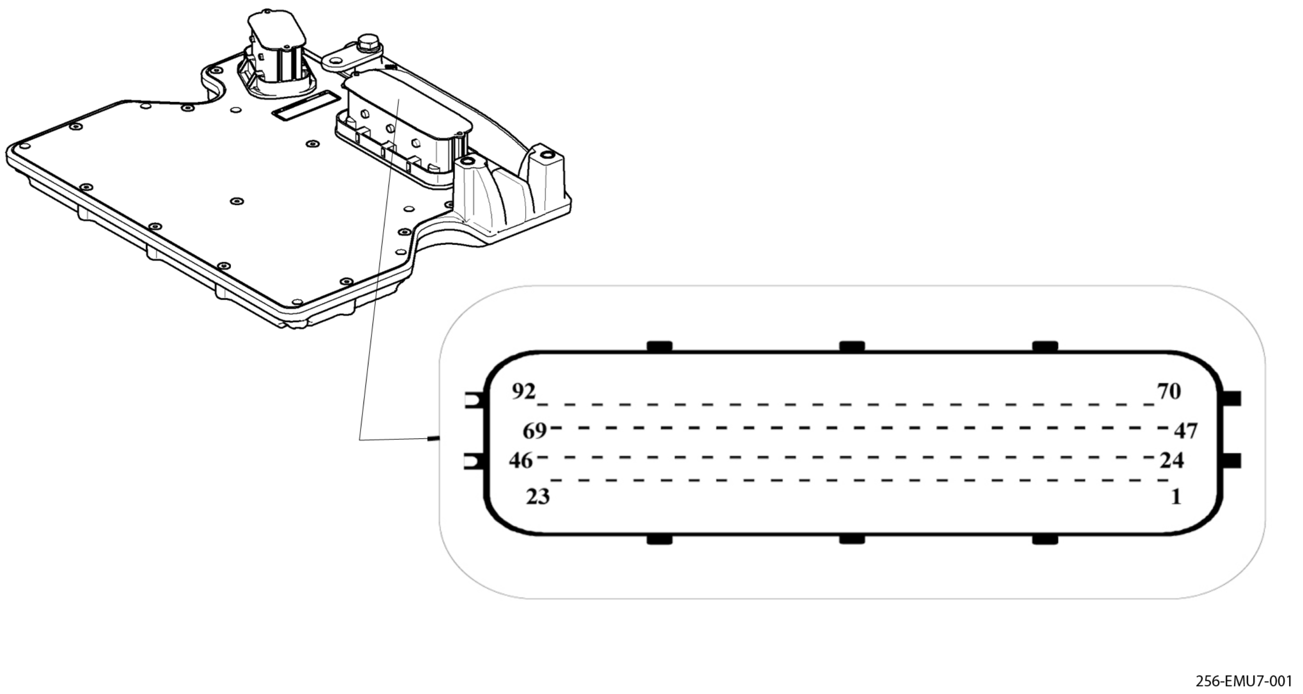
This connector is the interface to the plant:

The following table shows the pin assignment of connector X11. The brief specification contains definitions of the most important characteristics of a channel.

Designation	Pin X11	Core number	Jumper	Description
Power +24V	3	1		24V / 5.5A
Power GND	1	2		Ground
CAN 1 H out	6	11	To core 13:	Can Bus 1
CAN 1 L out	9	12	To core 14:	
CAN 1 H in		13	To core 11:	
CAN 1 L in		14	To core 12:	
CAN 1 GND	12	15		

Designation	Pin X11	Core number	Jumper	Description
CAN 2 GND	21	16		CAN Bus 2
CAN 2 H out	15	17	To core 19:	
CAN 2 L out	18	18	To core 20:	
CAN 2 H in		19	To core 17:	
CAN 2 L in		20	To core 18:	

Pin assignment X12



The engine sensor system (individual exhaust gas temperature sensors) is connected to this connector.

The following table shows the pin assignment of connector X12. The brief specification shows the most important properties of a channel.

Designation	Signal type	Pin X12	Sensor		Pin	Description
TIE 1	TIE H 1	92	T-EXH CYL A1	B4A1	1	T-Exhaust Single Cyl A1 NiCr-Ni 0-800°C
	TIE L 1	69			2	
TIE 2	TIE H 2	46	T-EXH CYL A2	B4A2	1	T-Exhaust Single Cyl A2 NiCr-Ni 0-800°C
	TIE L 2	23			2	

Designation	Signal type	Pin X12	Sensor		Pin	Description
TIE 3	TIE H 3	91	T-EXH CYL A3	B4A3	1	T-Exhaust Single Cyl A3 NiCr-Ni 0-800°C
	TIE L 3	68			2	
TIE 4	TIE H 4	45	T-EXH CYL A4	B4A4	1	T-Exhaust Single Cyl A4 NiCr-Ni 0-800°C
	TIE L 4	22			2	
TIE 5	TIE H 5	90	T-EXH CYL A5	B4A5	1	T-Exhaust Single Cyl A5 NiCr-Ni 0-800°C
	TIE L 5	67			2	
TIE 6	TIE H 6	44	T-EXH CYL A6	B4A6	1	T-Exhaust Single Cyl A6 NiCr-Ni 0-800°C
	TIE L 6	21			2	
TIE 7	TIE H 7	89	T-EXH CYL A7	B4A7	1	T-Exhaust Single Cyl A7 NiCr-Ni 0-800°C
	TIE L 7	66			2	
TIE 8	TIE H 8	43	T-EXH CYL A8	B4A8	1	T-Exhaust Single Cyl A8 NiCr-Ni 0-800°C
	TIE L 8	20			2	
TIE 9	TIE H 9	88	T-EXH CYL A9	B4A9	1	T-Exhaust Single Cyl A9 NiCr-Ni 0-800°C
	TIE L 9	65			2	
TIE 10	TIE H 10	42	T-EXH CYL A10	B4A10	1	T-Exhaust Single Cyl A10 NiCr-Ni 0-800°C
	TIE L 10	19			2	
TIE 11	TIE H 11	87	T-EXH CYL B1	B4B1	1	T-Exhaust Single Cyl B1 NiCr-Ni 0-800°C
	TIE L 11	64			2	
TIE 12	TIE H 12	41	T-EXH CYL B2	B4B2	1	T-Exhaust Single Cyl B2 NiCr-Ni 0-800°C
	TIE L 12	18			2	
TIE 13	TIE H 13	86	T-EXH CYL B3	B4B3	1	T-Exhaust Single Cyl B3 NiCr-Ni 0-800°C
	TIE L 13	63			2	
TIE 14	TIE H 14	40	T-EXH CYL B4	B4B4	1	T-Exhaust Single Cyl B4 NiCr-Ni 0-800°C
	TIE L 14	17			2	
TIE 15	TIE H 15	85	T-EXH CYL B5	B4B5	1	T-Exhaust Single Cyl B5 NiCr-Ni 0-800°C
	TIE L 15	62			2	
TIE 16	TIE H 16	39	T-EXH CYL B6	B4B6	1	T-Exhaust Single Cyl B6 NiCr-Ni 0-800°C
	TIE L 16	16			2	
TIE 17	TIE H 17	84	T-EXH CYL B7	B4B7	1	T-Exhaust Single Cyl B7 NiCr-Ni 0-800°C
	TIE L 17	61			2	

Designation	Signal type	Pin X12	Sensor		Pin	Description
TIE 18	TIE H 18	38	T-EXH CYL B8	B4B8	1	T-Exhaust Single Cyl B8 NiCr-Ni 0-800°C
	TIE L 18	15			2	
TIE 19	TIE H 19	83	T-EXH CYL B9	B4B9	1	T-Exhaust Single Cyl B9 NiCr-Ni 0-800°C
	TIE L 19	60			2	
TIE 20	TIE H 20	37	T-EXH CYL B10	B4B10	1	T-Exhaust Single Cyl B10 NiCr-Ni 0-800°C
	TIE L 20	14			2	

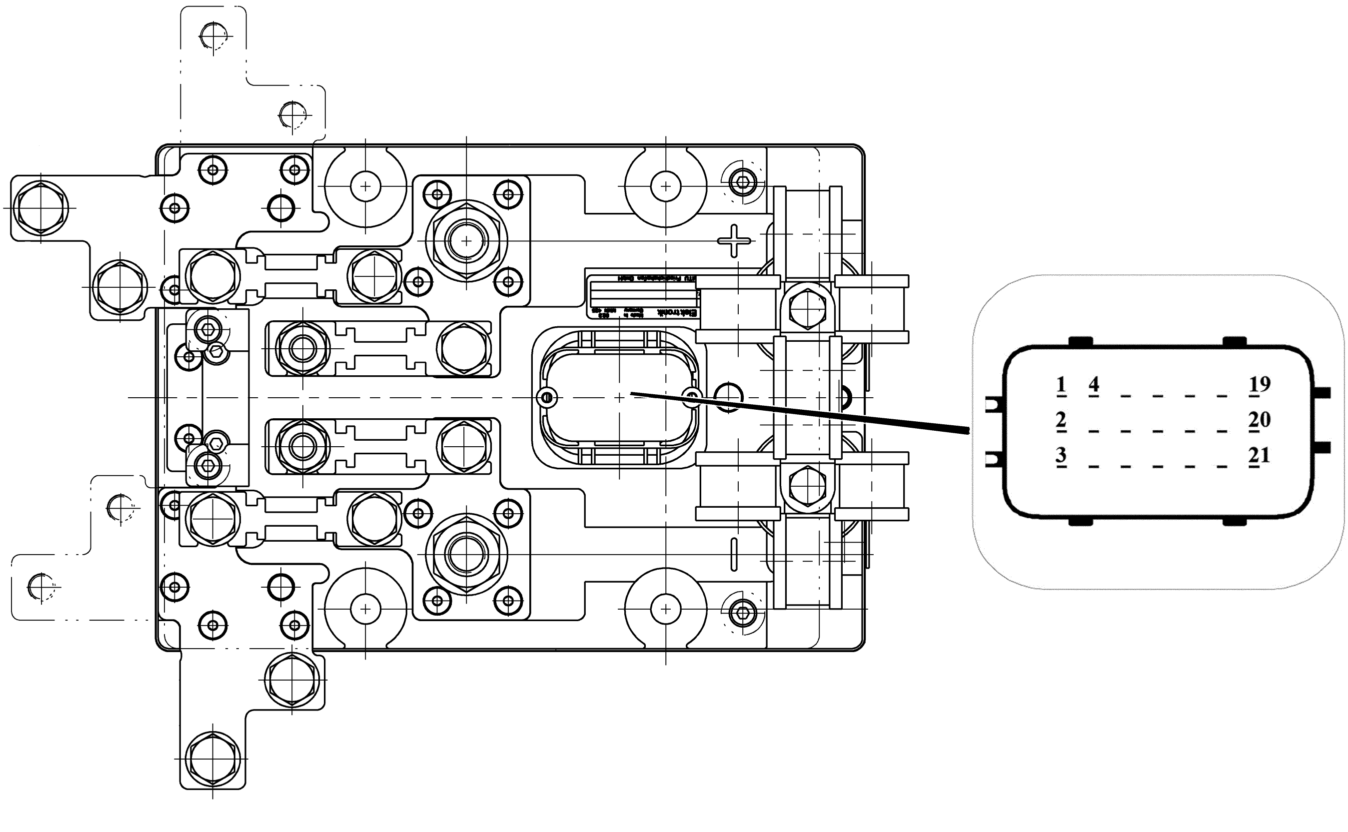
3.3 Connector of Power Output Module POM

Number of inputs and outputs

Plant side		
Designation	**Number**	**Brief description (basis of abbreviation)**
DI	3	Digital Input (±50 isolated)
CAN	1	Controller Area Network
PI	1	Pressure Input
TOH	2	Transistor output high current (high switch)
TO	2	Transistor Output engine side (high switch)
ID	1	Identification (MTU only)

Connector assignment

Pin assignment X1



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This connector (X1) forms the interface with the engine and the Engine Control Unit. Connector X21 of the wiring harness separately supplied for the POM is connected here.

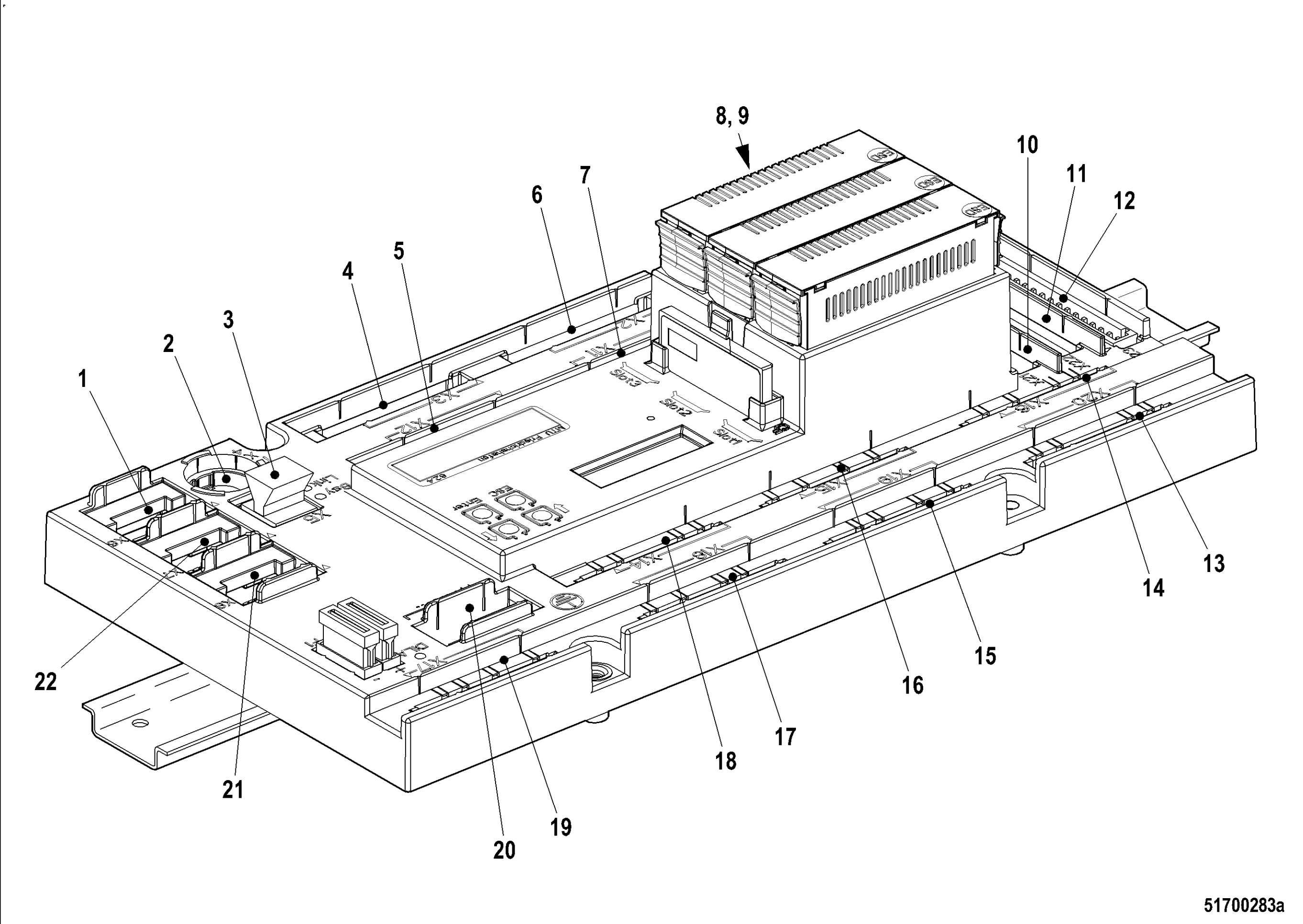
The following table shows the pin assignment of connector X1. The brief specification contains definitions of the most important characteristics of a channel.

TIM ID: 0000017762 - 002

Designation	Pin X1	Signal type	Brief specification
TOH1	2	TOH1	24 V / 60 A
	3	TOH1	24 V / 60 A
TOH2	1	TOH2	24 V / 60 A
	4	TOH2	24 V / 60 A
TO1	10	TO1	24 V / 1.5 A
TO2	13	TO2	24 V / 1.5 A
	7	GND	LGND / 2*1.5A
Generator	19	B+	Battery 24 V
	16	D+	Charge control
PI	15	PI1	0..5 V / internal pull-down 47k5
	12	+5Buf	5 V buffer
	9	GND	GND
ID	11	ID	0..5 V / internal pull-up 20k to 5V
	17	GND	GND
DI1	6	DI1	< 4 V = low / > 9 V = high
DI2	5	DI2	< 4 V = low / > 9 V = high
DI3	8	DI3	< 4 V = low / > 9 V = high
	14	GND	GND
CAN	18	CAN_HIGH	500 V isolated CAN
	20	CAN_LOW	500 V isolated CAN
	21	CAN_GND	500 V isolated CAN

TIM ID: 0000017762 - 002

3.4 Connector assignment of Service and Application Module SAM



1 X6 — CAN_1
2 X4 — Dialog
3 X5 — LAN
4 X3 — binary inputs
5 X12 — binary inputs
6 X2 — binary inputs
7 X11 — binary inputs/analog inputs
8 X1 — analog outputs
9 X10 — analog outputs/connection to slot 2
10 X21 — connection to slot 1
11 X22 — connection to slot 1/2
12 X23 — CAN interfaces/connection to slot 3
13 X20 — analog inputs
14 X16 — analog inputs
15 X19 — frequency inputs/binary inputs, ground switching
16 X15 — relay outputs
17 X18 — binary outputs with power drivers
18 X14 — serial interface
19 X17 — binary outputs with power drivers
20 X13 — voltage supply
21 X8 — CAN_3
22 X7 — CAN_2

Connector X1

Connector pin no.	Group	Signal	Channel
1	V_OUT C_OUT Instrument Driver	V_OUT1: Instr. Engine Speed	V_OUT1
2		V_OUT2: Instr. T-Coolant	V_OUT2
3		V_OUT3: Rockford Speed	V_OUT3
4		V_OUT4: Instr. P-Lube Oil	V_OUT4
5		V_OUT5: Spare	V_OUT5
6		Curr_out	C_OUT1
7			C_OUT2
8			C_OUT3
9			C_OUT4
10		V/I_GND	GND for V_OUT and C_OUT
11			Lbatt+
12			LGND

Connector X2

Connector pin no.	Group	Signal	Channel
1	B_IN Binary inputs (electrically isolated)	B_IN 13: BI Fuel Filter Diff Switch	OKI13_H; Signal + 24 V
2			OKI13_L; Signal GND
3		B_IN 14: Spare	OKI14_H; Signal + 24 V
4			OKI14_L; Signal GND
5		B_IN 15: Spare	OKI15_H; Signal + 24 V
6			OKI15_L; Signal GND
7		B_IN 16: OC Disable Cylinder Cut Off	OKI16_H; Signal + 24 V
8			OKI16_L; Signal GND
9		B_IN 17: Spare	OKI17_H; Signal + 24 V
10			OKI17_L; Signal GND
11		B_IN 18: Spare	OKI18_H; Signal + 24 V
12			OKI18_L; Signal GND

TIM ID: 0000017763 - 003

Connector X3

Connector pin no.	Group	Signal	Channel
1	B_IN Binary inputs (electrically isolated)	B_IN 1: OC Aux. Protection Switch	OKI1_H; Signal + 24 V
2			OKI1_L; Signal GND
3		B_IN 2: OC Binary Out Test	OKI2_H; Signal + 24 V
4			OKI2_L; Signal GND
5		B_IN 3: Request Test Overspeed	OKI3_H; Signal + 24 V
6			OKI3_L; Signal GND
7		B_IN 4: Ext.Reset Trip Fuel Consumption	OKI4_H; Signal + 24 V
8			OKI4_L; Signal GND
9		B_IN 5: OC Start Interlock	OKI5_H; Signal + 24 V
10			OKI5_L; Signal GND
11		B_IN 6: OC Park Break Interlock	OKI6_H; Signal + 24 V
12			OKI6_L; Signal GND

Connector X4

Connector socket for dialog unit (laptop with CAN interface and DiaSys® software

Connector X5

LAN connector

Connector X6

Connector pin no.	Group	Signal	Channel
3	BUS_LINK	CAN_1	CAN1H
2			CAN1L
1			GND_CAN1

Connector X7

Connector pin no.	Group	Signal	Channel
3	BUS_LINK	CAN_2	CAN2H
2			CAN2L
1			GND_CAN2

Connector X8

Connector pin no.	Group	Signal	Channel
3	BUS_LINK	CAN_3	CAN3H
2			CAN3L
1			GND_CAN3

TIM ID: 0000017763 - 003

Connector X10

Connector pin no.	Group	Signal	Channel
1	I/O_EXPAND	Slot_2	PIN_9
2			PIN_10
3			PIN_11
4			PIN_12
5			PIN_13
6			PIN_14
7			PIN_15
8			PIN_16
9	V_OUT Instrument Driver	V_OUT6: Spare	V_OUT6
10		V_OUT7: Instr. Fan Control 1	V_OUT7
11		V_OUT8: Instr. Fan Control 2	V_OUT8
12		V/I_GND	GND1

Connector X11

Connector pin no.	Group	Signal	Channel
1	B_IN Binary inputs (electrically isolated)	B_IN 19: Rating Switch 1	OKI19_H; Signal + 24 V
2			OKI19_L; Signal GND
3		B_IN 20: Rating Switch 2	OKI20_H; Signal + 24 V
4			OKI20_L; Signal GND
5	A_IN_ISO Analog Inputs (electrically isolated)	A_IN_ISO1	Signal + 24 V
6			Signal GND
7		A_IN_ISO2	Signal + 24 V
8			Signal GND
9		A_IN_ISO3	Signal + 24 V
10			Signal GND
11		A_IN_ISO4	Signal + 24 V
12			Signal GND

TIM ID: 0000017763 - 003

Connector X12

Connector pin no.	Group	Signal	Channel
1	B_IN Binary inputs (electrically isolated)	B_IN 7: BI Preheat Unit ON	OKI7_H; SIgnal + 24
2			OKI7_L; Signal GND
3		B_IN 8: BI Preheat Unit ON	OKI8_H; SIgnal + 24
4			OKI8_L; Signal GND
5		B_IN 9: OC Alarm Reset	OKI9_H; SIgnal + 24
6			OKI9_L; Signal GND
7		B_IN 10: Spare	OKI10_H; SIgnal + 24
8			OKI10_L; Signal GND
9		B_IN 11: Spare	OKI11_H; SIgnal + 24
10			OKI11_L; Signal GND
11		B_IN 12: OC Neutral	OKI12_H; SIgnal + 24
12			OKI12_L; Signal GND

Connector X13

Connector pin no.	Group	Signal	Channel
1	Power_Supply	+Ubatt	Vbatt+
2			Vbatt+
3		-Ubatt	Vbatt-
4			Vbatt-

Connector X14

Connector pin no.	Group	Signal	Channel
1	RS 422		COM1
2	RS 422		NC1
3	RS 422		NO1
4	RS 422		COM2
5	RS 422		NC2
6	RS 422		NO2
7	P_IN	P_IN8: OC Alternate Minimum VSG	+24 V
8			GND
9	PWM_OUT1	Fan Control 1	+24 V
10			LOW
11	PWM_OUT2	Fan Control 2	+24 V
12			LOW

TIM ID: 0000017763 - 003

Connector X15

Connector pin no.	Group	Signal	Channel
1	BR_OUT Relay outputs	BR_OUT1: BO NT/HT Valve after Filter	COM1
2			NC1
3			NO1
4		BR_OUT2: BO NT/HT Valve before Filter	COM2
5			NC2
6			NO2
7		BR_OUT3: BO Preheat Unit ON Valve	COM3
8			NC3
9			NO3
10		BR_OUT4: Spare	COM4
11			NC4
12			NO4

Connector X16

Connector pin no.	Group	Signal	Channel
1	A_IN Multi-Analog Analog inputs with common ground	A_IN5: AIN P-Fuel Filter Diff	+ 5V Supply Voltage A_IN5
2			Signal A_IN5
3			GND A_IN5
4		A_IN6: AIN Air Filter Restriction	+ 5V Supply Voltage A_IN6
5			Signal A_IN6
6			GND A_IN6
7		A_IN7: AIN Fuel Filter Restriction	+ 5V Supply Voltage A_IN7
8			Signal A_IN7
9			GND A_IN7
10		A_IN8: AIN Aux. Engine Protection	+ 5V Supply Voltage A_IN8
11			Signal A_IN8
12			GND A_IN8

TIM ID: 0000017763 - 003

Connector X17

Connector pin no.	Group	Signal	Channel
1	BT_OUT Power Drivers Transistor outputs with common ground	GND	GND Common Ground BIN-OUT 1 ... 10
2		Power	+LBatt
3		BT_OUT_1: BO Torque Limitation act	BT_OUT_CH1
4		BT_OUT_2: BO Speed Window 1	BT_OUT_CH2
5		BT_OUT_3: BO Speed Window 2	BT_OUT_CH3
6		BT_OUT_4: BO Preheat Unit ON	BT_OUT_CH4
7		BT_OUT_5: BO LO Preheat Unit ON	BT_OUT_CH5
8		BT_OUT_6: BO HI Preheat Unit ON	BT_OUT_CH6
9		BT_OUT_7: Spare	BT_OUT_CH7
10		BT_OUT_8: BO Overspeed Alarm	BT_OUT_CH8
11		BT_OUT_9: BO Ready for Start	BT_OUT_CH9
12		BT_OUT_10: BO Preheating Lamp	BT_OUT_CH10

Connector X18

Connector pin no.	Group	Signal	Channel
1	BT_OUT Power Drivers Transistor outputs with common ground	BT_OUT_11: BO HI T-Coolant	BT_OUT_CH11
2		BT_OUT_12: BO HI T-Charge Air	BT_OUT_CH12
3		BT_OUT_13: BO LO P-Coolant	BT_OUT_CH13
4		BT_OUT_14: BO LO P-Lube Oil	BT_OUT_CH14
5		BT_OUT_15: BO HI P-Crankcase	BT_OUT_CH15
6		BT_OUT_16: BO Override Active	BT_OUT_CH16
7		BT_OUT_17: BO Shutter 1 ON	BT_OUT_CH17
8		BT_OUT_19: BO Shutter 2 ON	BT_OUT_CH18
9		BT_OUT_19: BO Engine Stop follow-up Active	BT_OUT_CH19
10		BT_OUT_20: Spare	BT_OUT_CH20
11		GND	BT_OUT11-20 GND
12		+24 V	+24 Supply Voltage Output

TIM ID: 0000017763 - 003

Connector X19

Connector pin no.	Group	Signal	Channel
1	F_IN Frequency input	F_IN1: Spare	F_IN1Signal
2			F_IN1GND
3		F_IN2: Spare	F_IN2 Signal
4			F_IN2 GND
5	P_IN Transistor outputs, ground switching	P_IN1: OC Engine Stop	P_IN1
6		P_IN2: BI Disable Preh. Unit Control	P_IN2
7		P_IN3: OC Engine Start	P_IN3
8		P_IN4: Spare	P_IN4
9		P_IN5: Spare	P_IN5
10		P_IN6: OC Manual Extern Fan ON	P_IN6
11		P_IN7: Request Manual Turning	P_IN7
12		GND	GND

Connector X20

Connector pin no.	Group	Signal	Channel
1	A_IN Multi-Analog Analog inputs with common ground	A_IN1: AIN T-Exhaust A	+ 5V Supply Voltage A_IN1
2			Signal A_IN1
3			GND A_IN1
4		A_IN2: AIN T-Exhaust B	+ 5V Supply Voltage A_IN2
5			Signal A_IN2
6			GND A_IN2
7		A_IN3: AIN Pressure 1	+ 5V Supply Voltage A_IN3
8			Signal A_IN3
9			GND A_IN3
10		A_IN4: AIN Pressure 2	+ 5V Supply Voltage A_IN4
11			Signal A_IN4
12			GND A_IN4

Connector X23

Connector pin no.	Group	Signal	Channel
1	J1939	CAN_L	
2		CAN_H	
3		CAN_GND	

TIM ID: 0000017763 - 003

Connector pin no.	Group	Signal	Channel
4	CANopen	CAN_GND	
5		CAN_L	
6		CAN_H	
7			
8			
9			
10			
11			
12			
13			
14	Spare	CAN_H	
15		CAN_GND	
16		CAN_L	

TIM ID: 0000017763 - 003

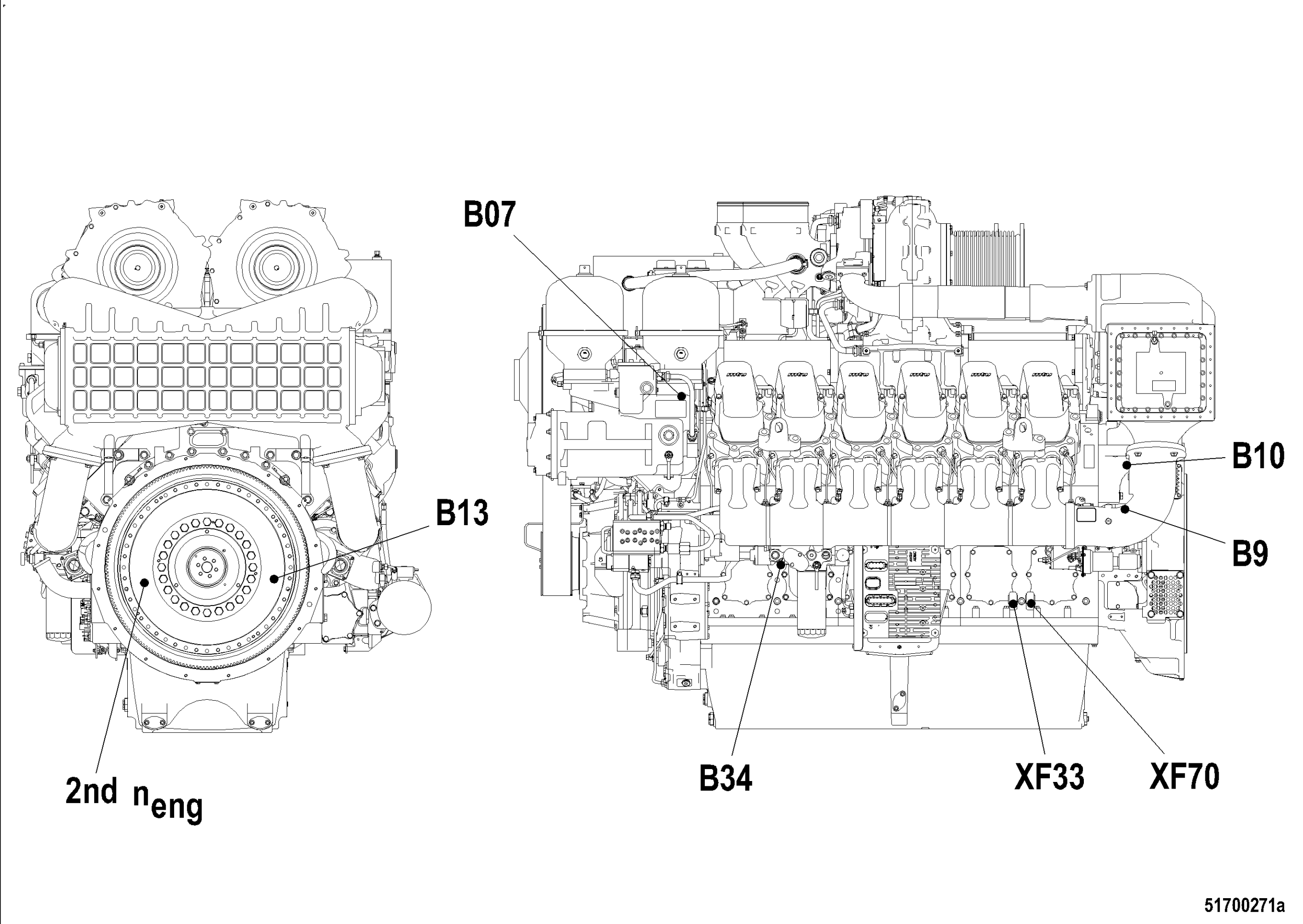
TIM ID: 0000017763 - 003

4 Sensors

4.1 Attachment locations of the sensors

4.1.1 Sensors on the 12V4000C03 engine

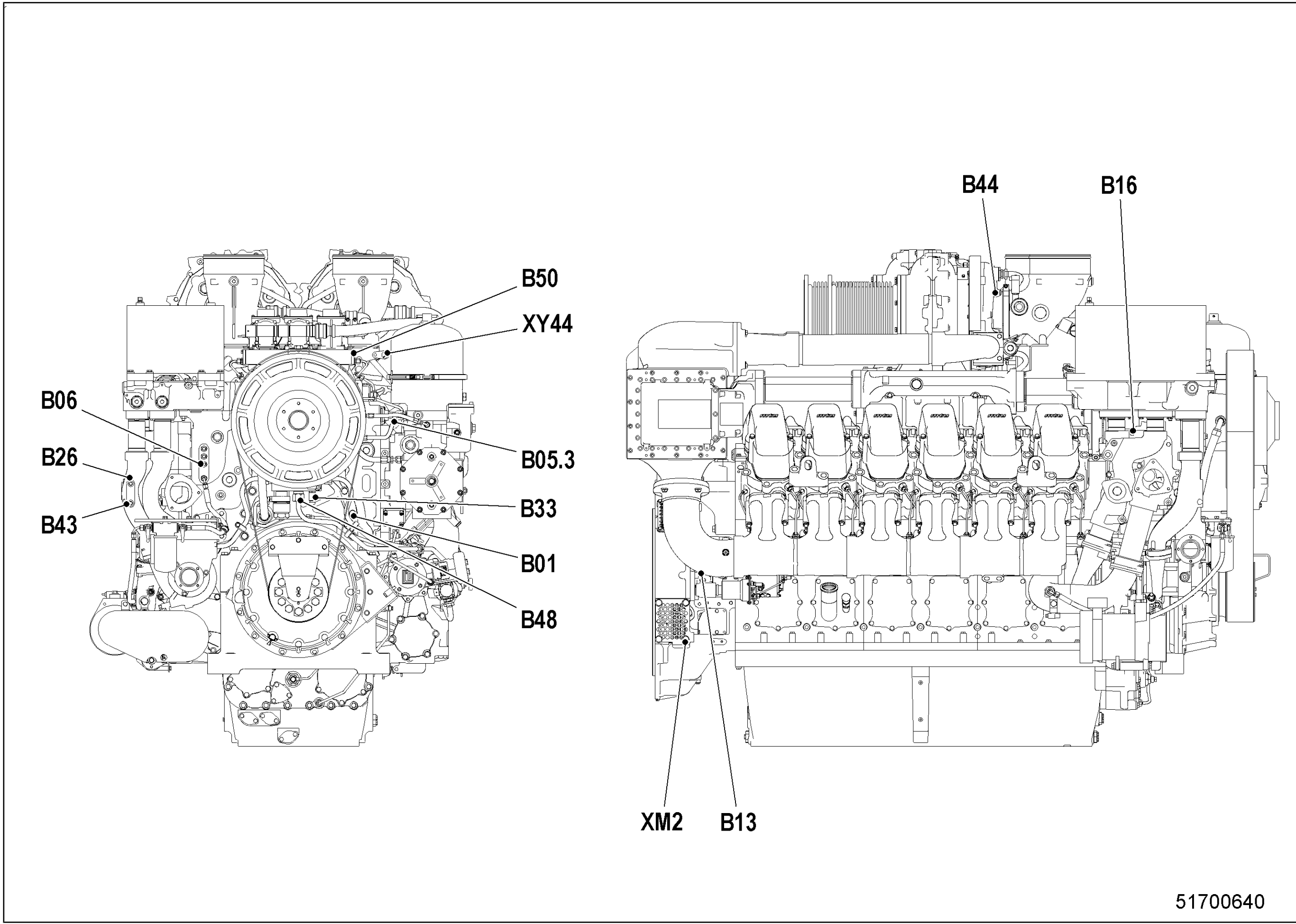
On driving end (driving end and left side)



B07	Lube oil temperature	B13	Crankshaft speed	XF70	Fuel prefilter water level connector
B09	Charge-air temperature	B34	Fuel pressure after filter	2nd n_{eng}	Optional: second crankshaft speed sensor, for systems at the vehicle
B10	Charge-air pressure	XF33	Coolant level connector		

TIM ID: 0000017758 - 002

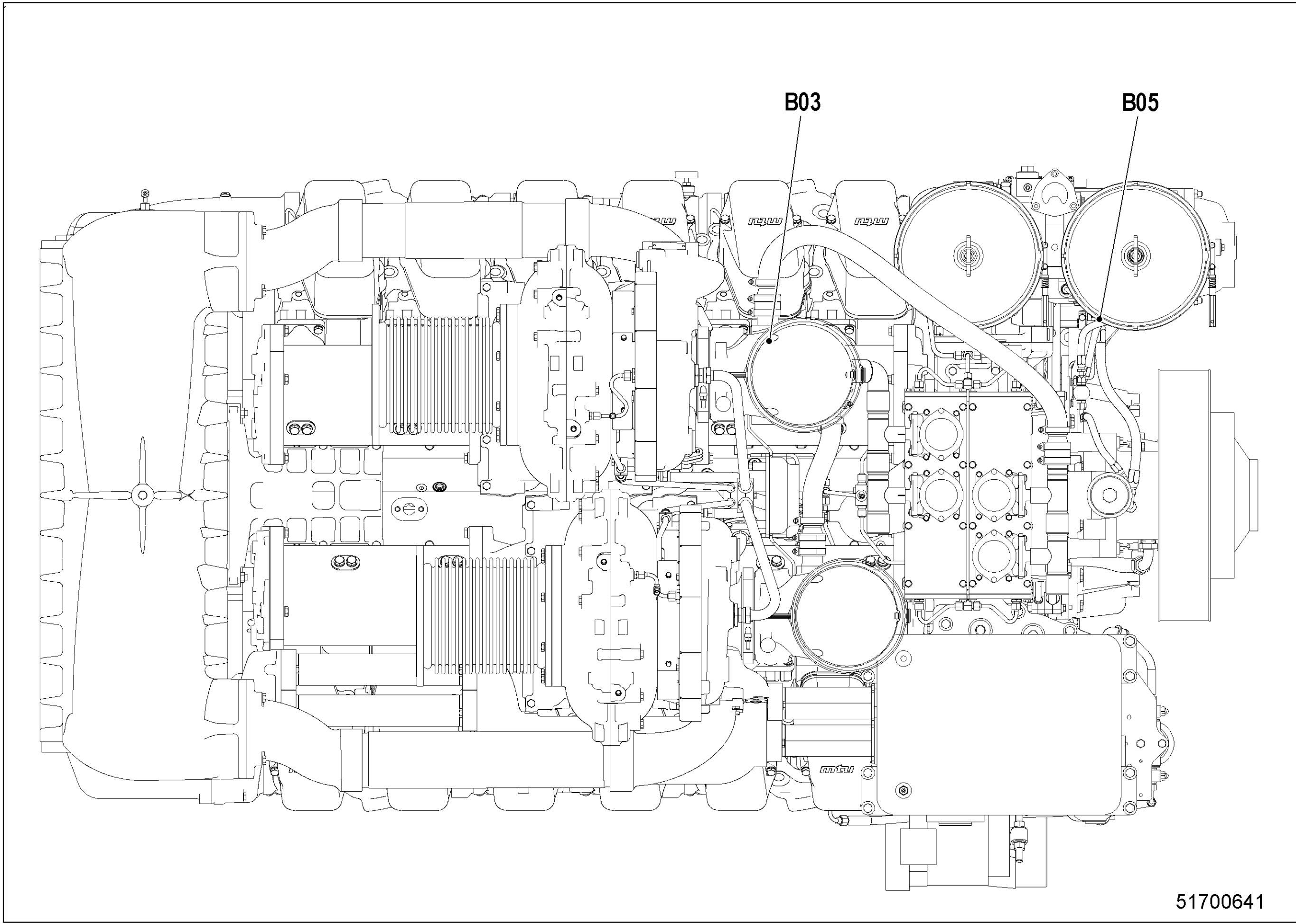
Free end (free end and right side)



B01	Camshaft speed
B05.3	B5.3 lube oil pressure after filter
B06	Coolant temperature
B13	Crankshaft speed
B16	Coolant pressure
B26	Intercooler coolant temperature
B33	Fuel temperature
B43	Intercooler coolant pressure
B44	Exhaust turbocharger speed
B48	Fuel pressure
B50	Crankcase pressure
XM2	Oil priming pump
XY44	Engine wiring harness (XY44 for ventilation control)

TIM ID: 0000017758 - 002

Top side

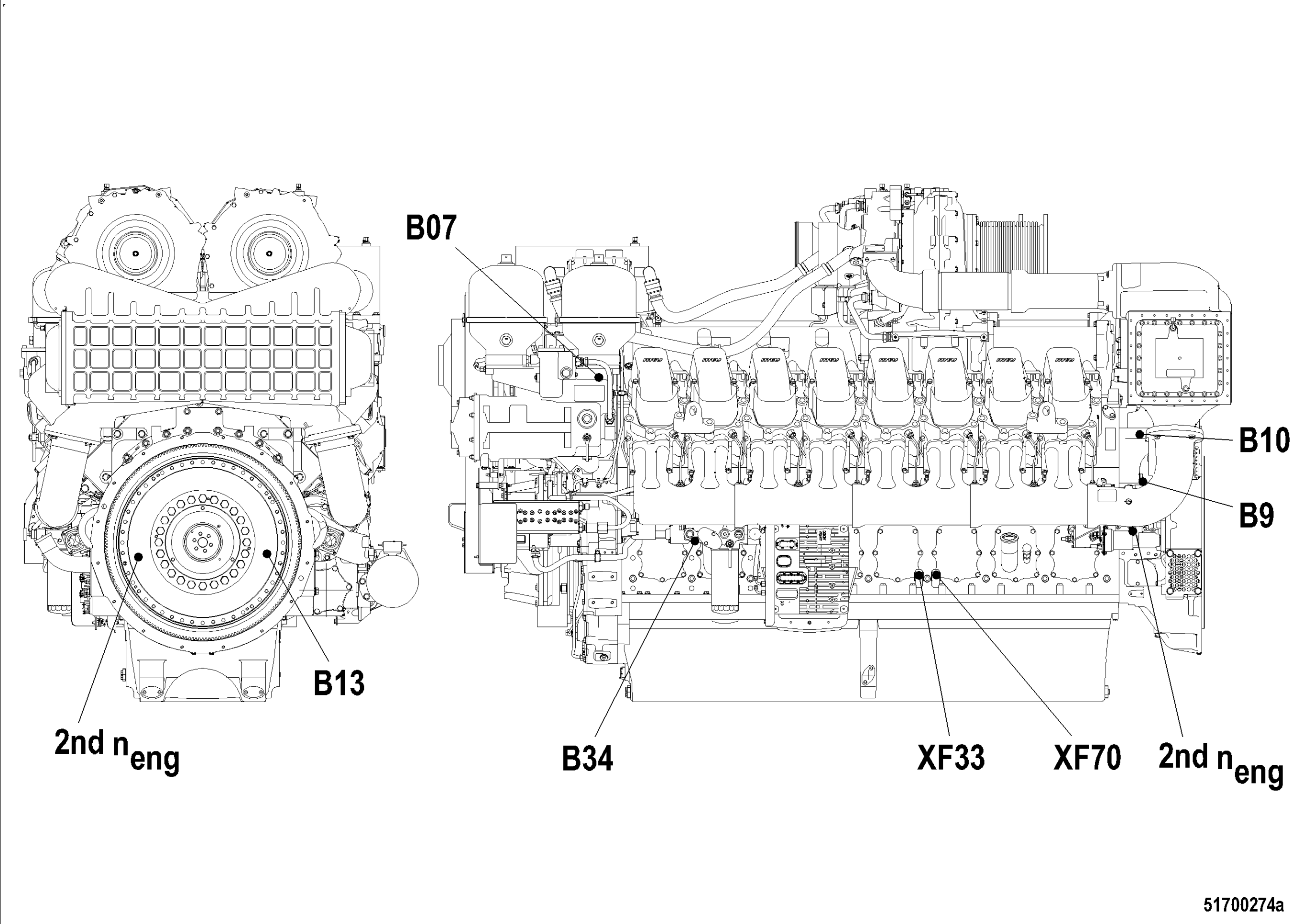


B03 Intake air temperature

B05 Lube oil pressure before filter

4.1.2 Sensors on the 16V4000C03 engine

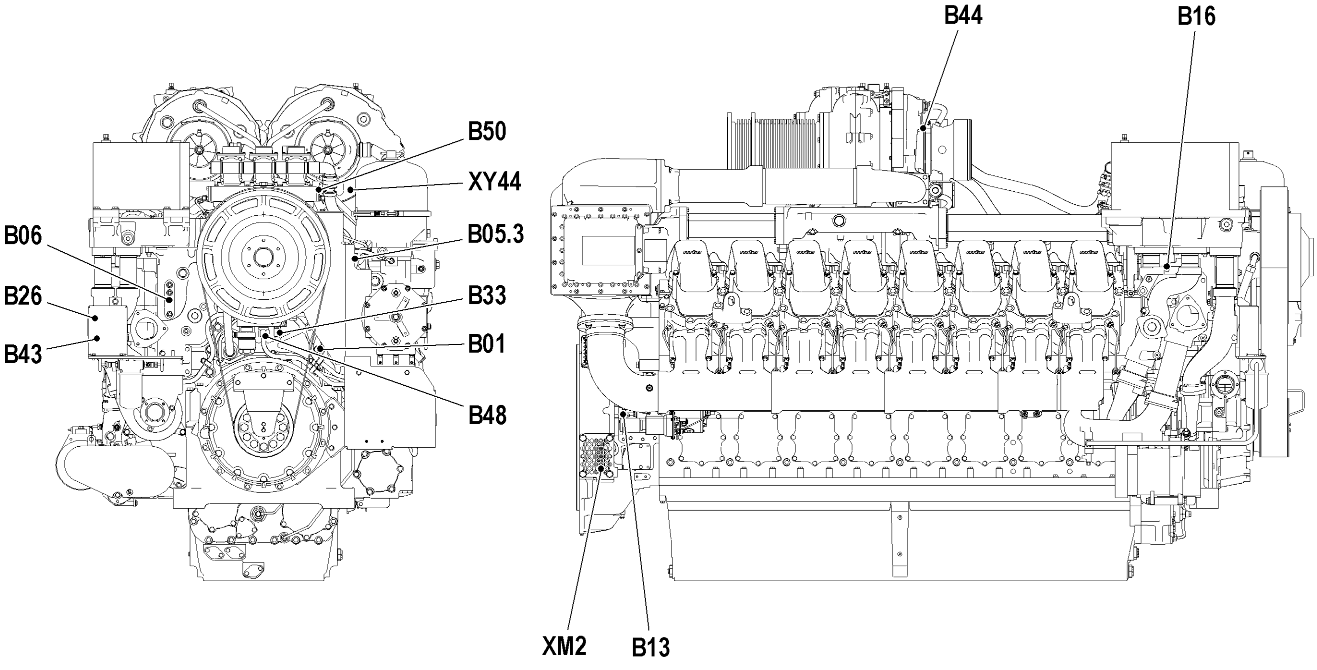
On driving end (driving end and left side)



B07	Lube oil temperature	B13	Crankshaft speed	XF70	Fuel prefilter water level connector
B09	Charge-air temperature	B34	Fuel pressure after filter	2nd n_{eng}	Optional: second crankshaft speed sensor, for systems at the vehicle
B10	Charge-air pressure	XF33	Coolant level connector		

TIM ID: 0000017759 - 002

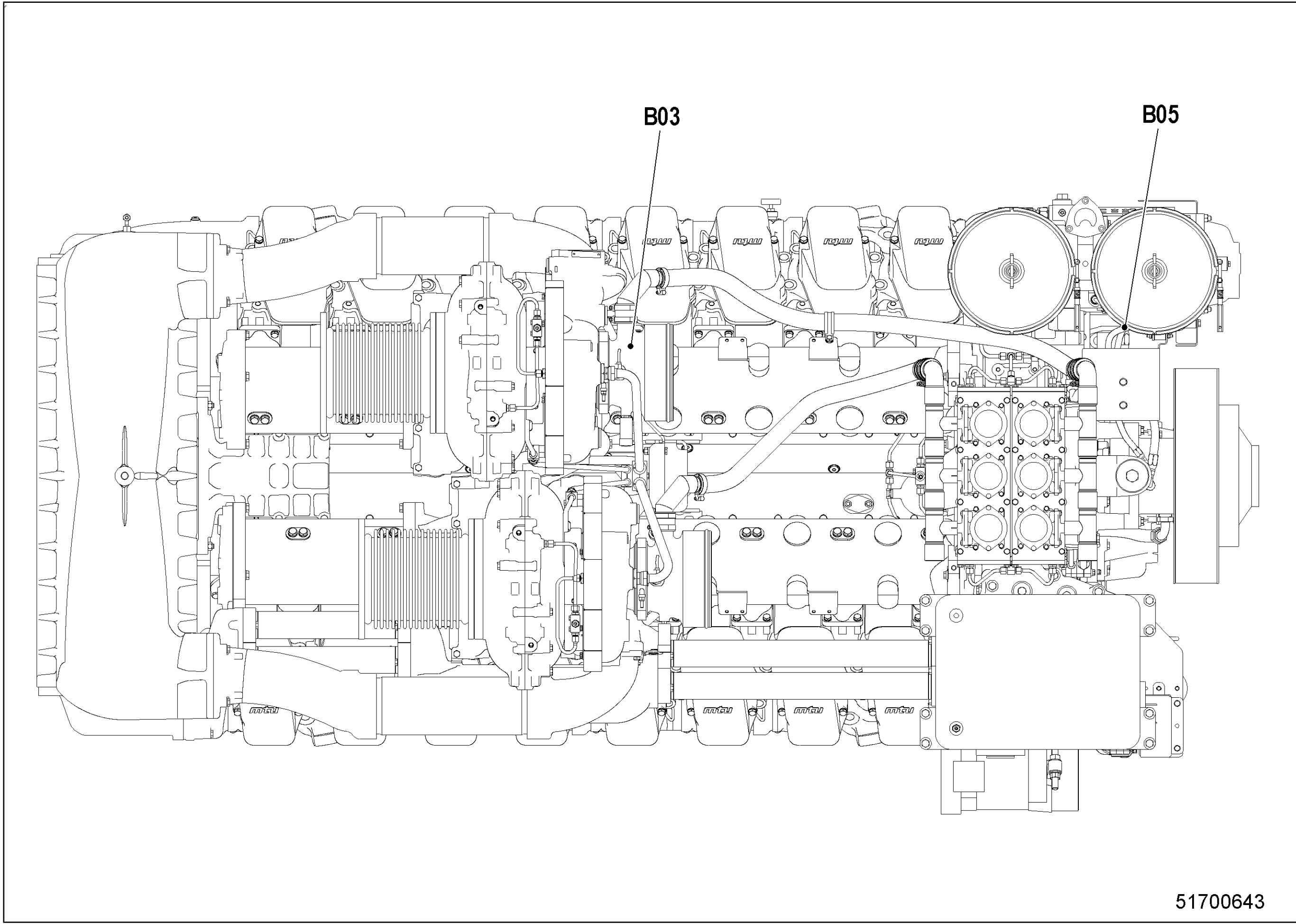
Free end (free end and right side)



B01	Camshaft speed	B26	Intercooler coolant temperature	B50	Crankcase pressure
B05.3	Lube oil pressure after filter	B33	Fuel temperature	XM2	Oil priming pump
B06	Coolant temperature	B43	Intercooler coolant pressure	XY44	Engine wiring harness (XY44 for ventilation control)
B13	Crankshaft speed	B44	Exhaust turbocharger speed		
B16	Coolant pressure	B48	Fuel pressure		

TIM ID: 0000017759 - 002

Top side



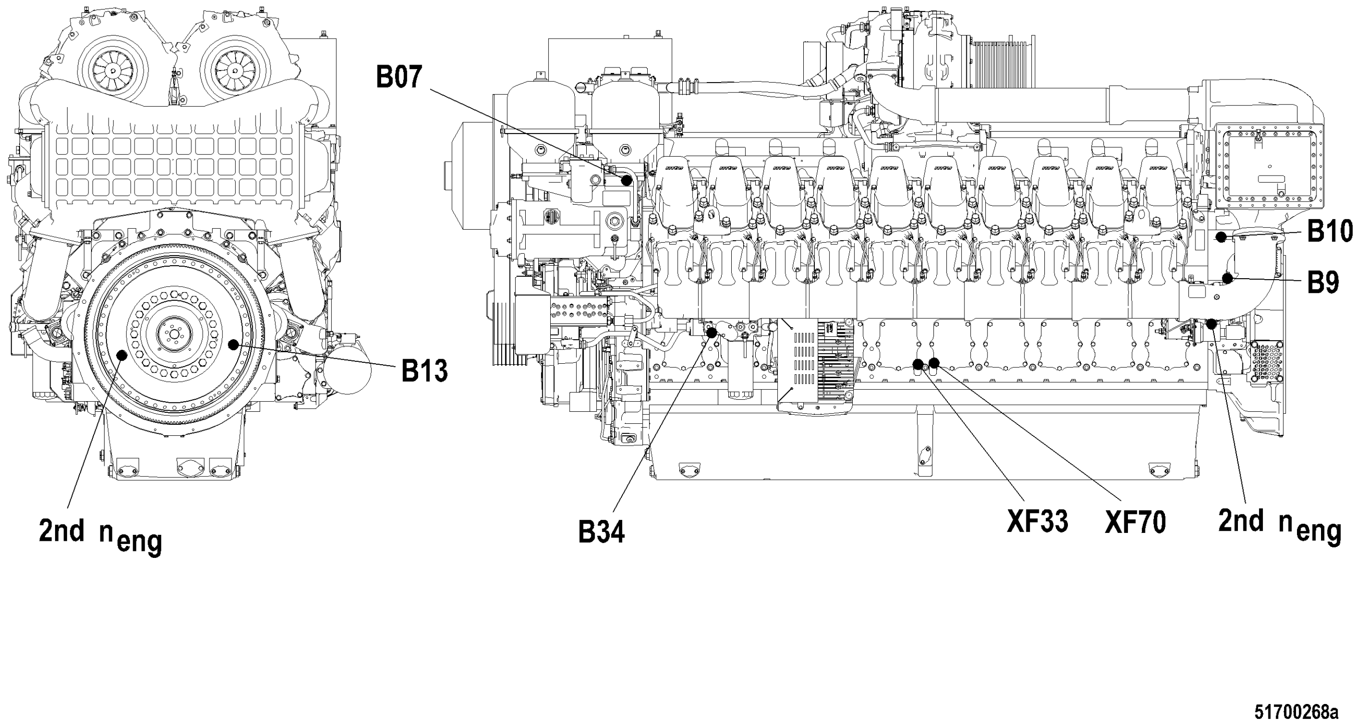
B03 Intake air temperature

B05 Lube oil pressure before filter

TIM ID: 0000017759 - 002

4.1.3 Sensors on the 20V4000C03 engine

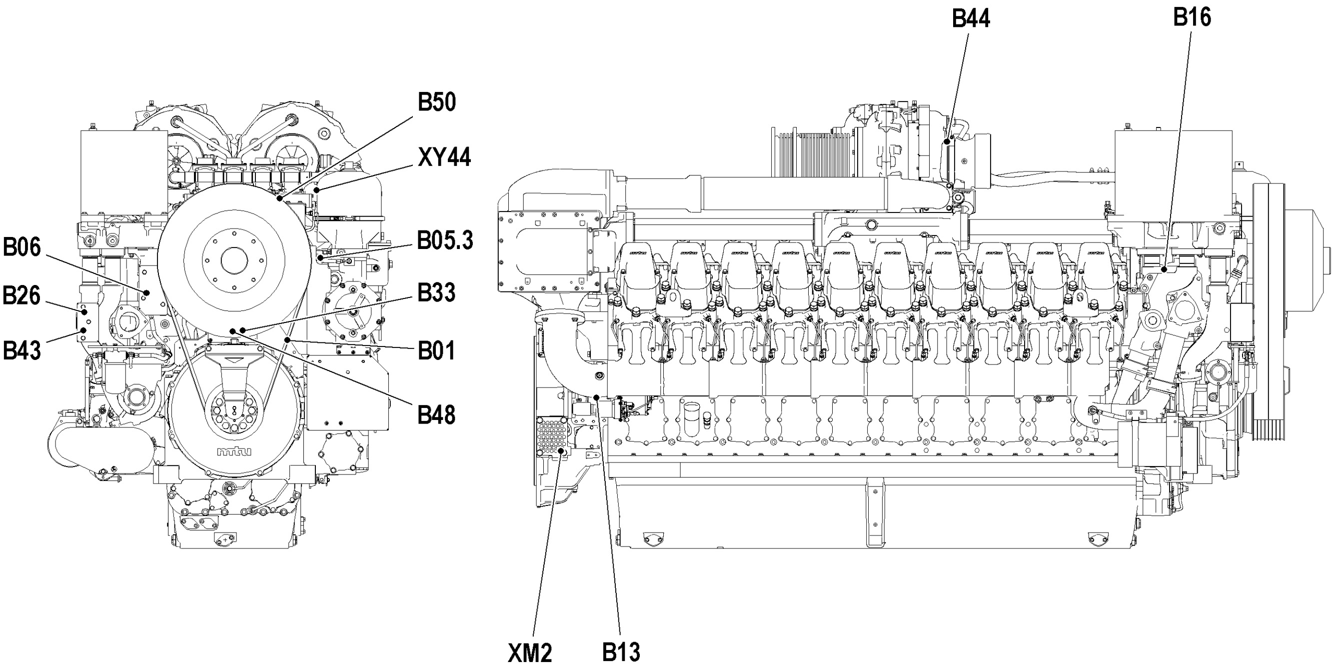
On driving end (driving end and left side)



B07	Lube oil temperature	B13	Crankshaft speed	XF70	Fuel prefilter water level connector
B09	Charge-air temperature	B34	Fuel pressure after filter	2nd n_{eng}	Optional: second crankshaft speed sensor, for systems at the vehicle
B10	Charge-air pressure	XF33	Coolant level connector		

TIM ID: 0000017760 - 002

Free end (free end and right side)



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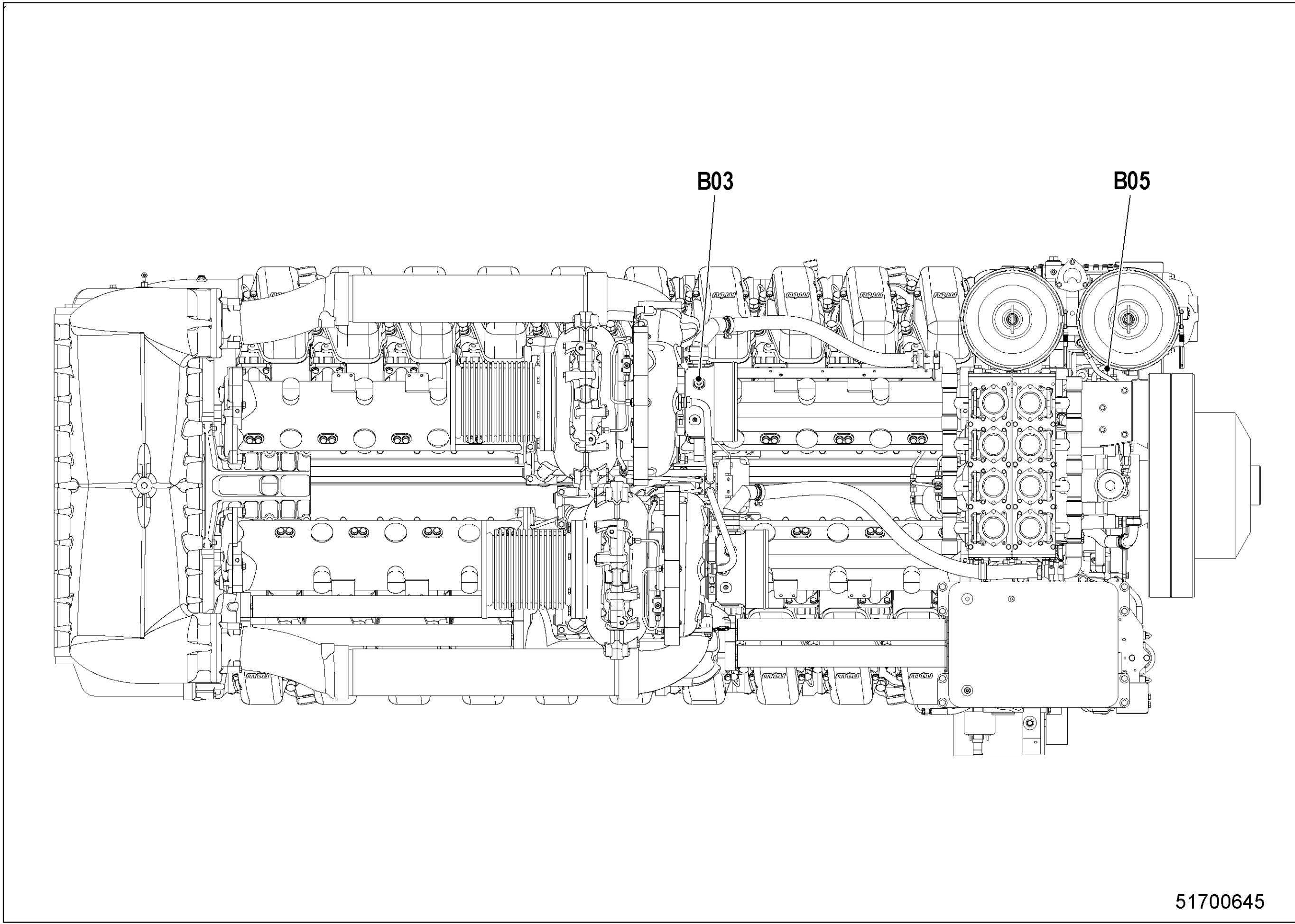
B01 Camshaft speed
B05.3 Lube oil pressure after filter
B06 Coolant temperature
B13 Crankshaft speed
B16 Coolant pressure
B26 Intercooler coolant temperature
B33 Fuel temperature
B43 Intercooler coolant pressure
B44 Exhaust turbocharger speed
B48 Fuel pressure
B50 Crankcase pressure
XM2 Oil priming pump
XY44 Engine wiring harness (XY44 for ventilation control)

TIM ID: 0000017760 - 002

Top side



B03 Intake air temperature

B05 Lube oil pressure before filter

4.2 Sensor Types Used

4.2.1 Sensor types

Sensors used

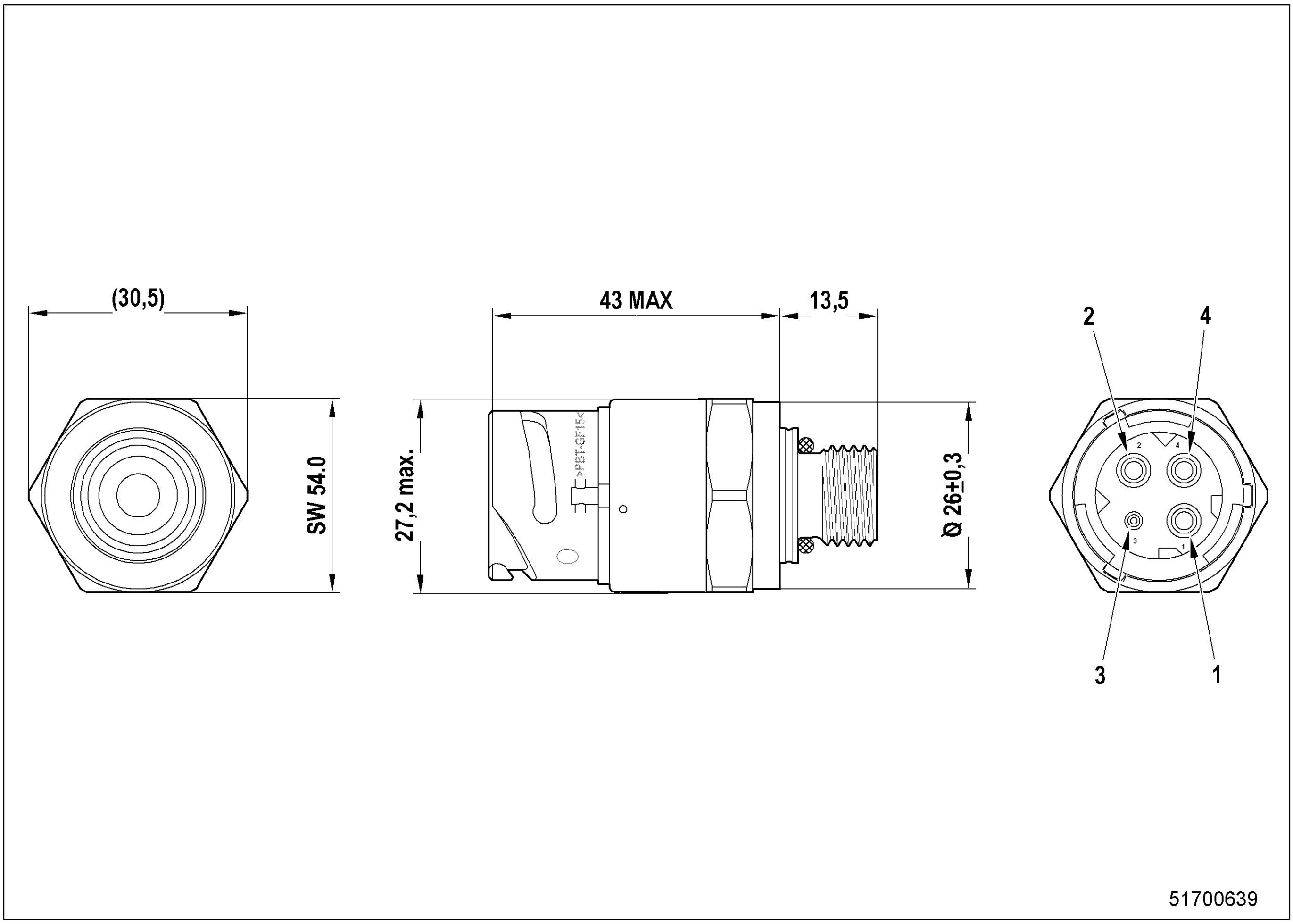
Different sensors are used for recording the engine operating data:
- Pressure sensors
- Temperature sensors
- Speed sensors

For each sensor the individual subsections give the following information:
- Sensor no.
- Mechanical design
- Measurand (use)
- Schematic diagram
- Cable connector with pin assignment

Pressure sensors

Sensor B5.1, B5.3 (0 ... 10 bar)

Mechanical design



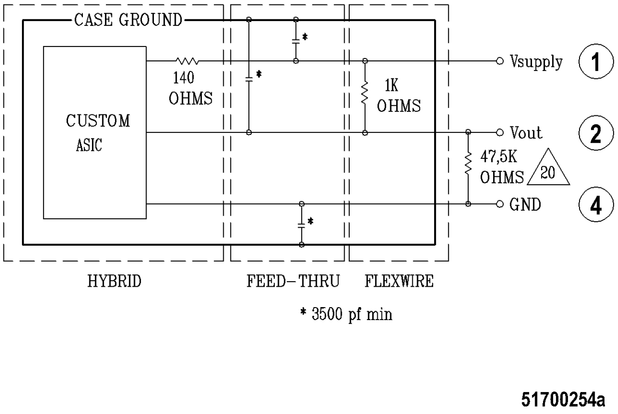
1 Pin 1: Supply voltage
2 Pin 2: Output voltage
3 Pin 3: Ventilation
4 Pin 4: Ground

Use

The sensor us used for:

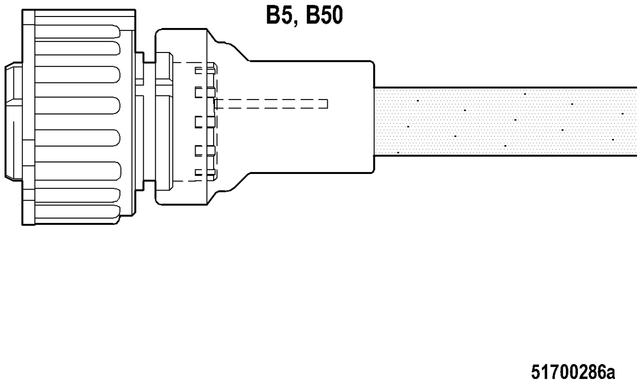
- B5.1: Lube oil pressure before filter
- B5.3: Lube oil pressure after filter

Block diagram



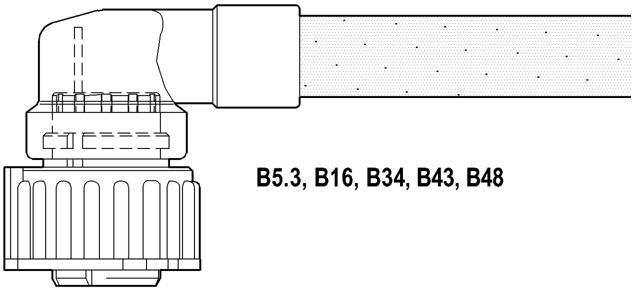
1 Supply voltage
2 Output voltage
4 Ground

Cable connector



B5.1 Cable connector

TIM ID: 0000017765 - 003



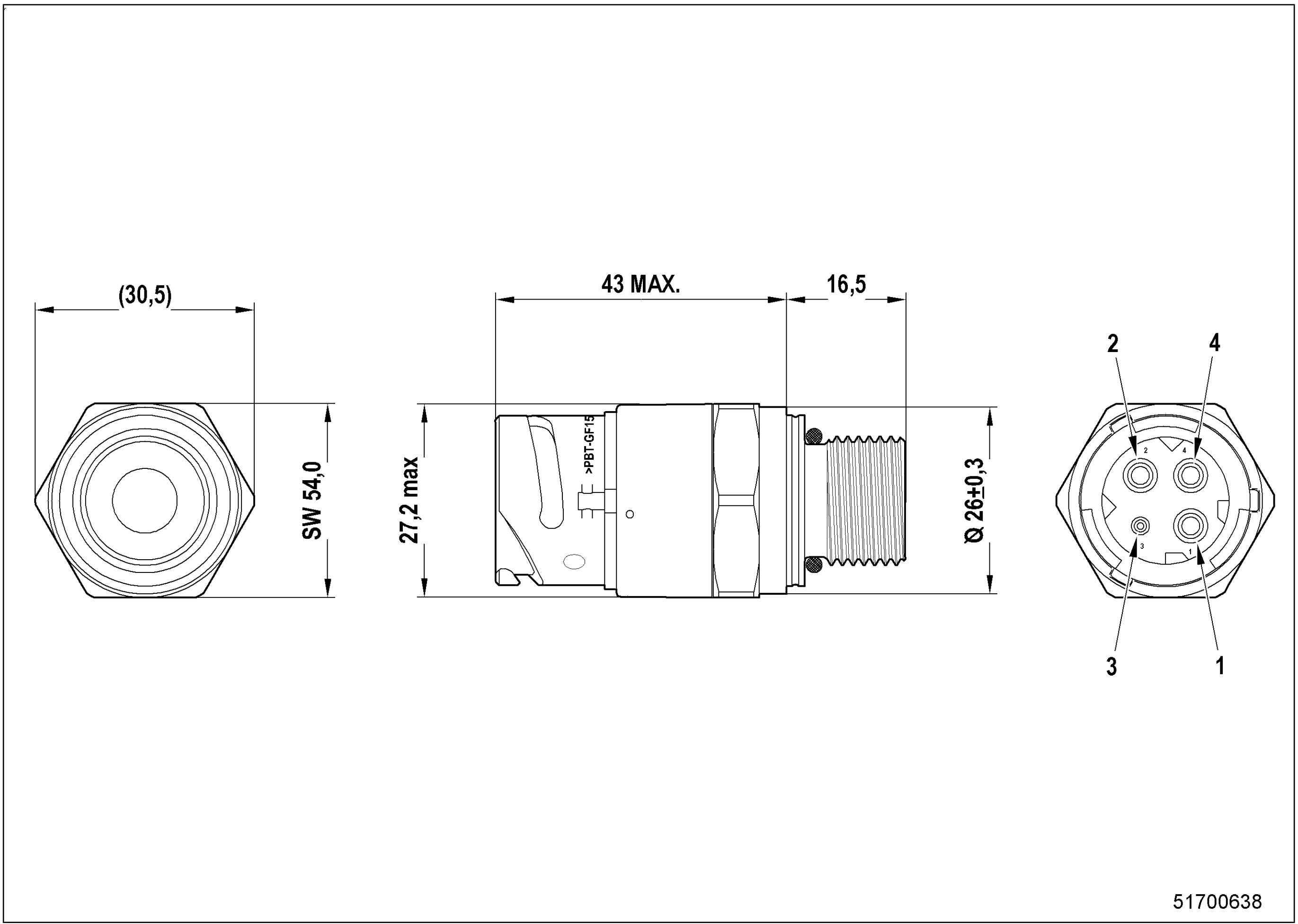
51700287a

B5.3 Cable connector

Pin assignment	
Pin no.	Signal
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for 0 ... 10 bar
3	Ventilation
4	Ground (not connected to the housing) GND

Sensor B10 (0 ... 4.5 bar)

Mechanical design



1 Pin 1: Supply voltage
2 Pin 2: Output voltage
3 Pin 3: Ventilation
4 Pin 4: Ground

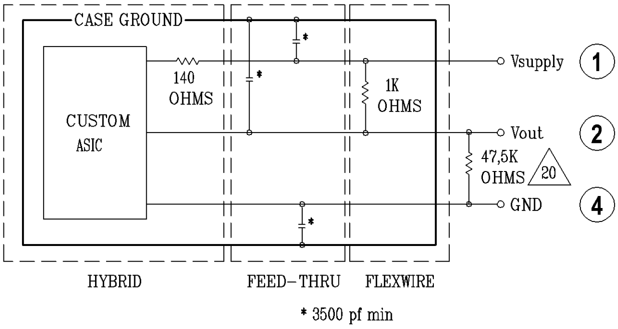
Use

The sensor us used for:

- Charge-air pressure

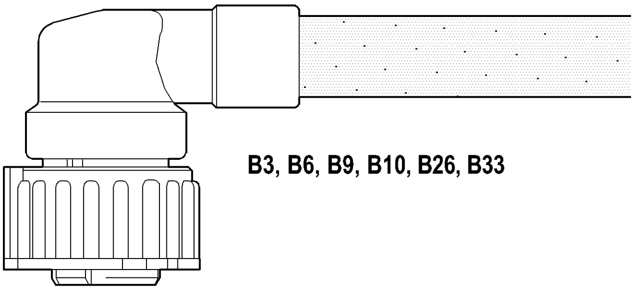
TIM ID: 0000017765 - 003

Block diagram



1 Supply voltage
2 Output voltage
4 Ground

Cable connector

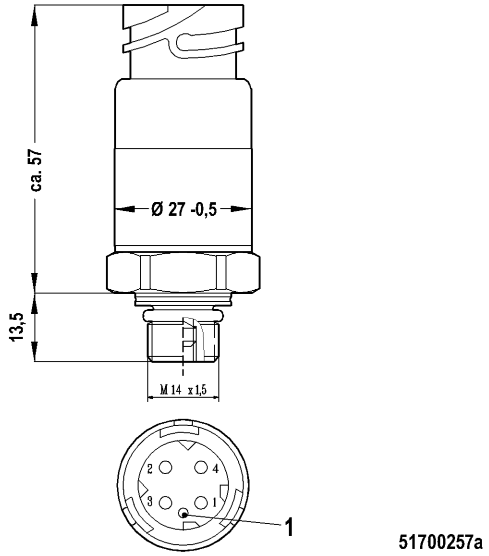


Pin assignment	
Pin no.	**Signal**
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for 0 ... 4.5 bar
3	Ventilation
4	Ground (not connected to the housing) GND

TIM ID: 0000017765 - 003

Sensor B16, B43 (0 ... 6 bar)

Mechanical design



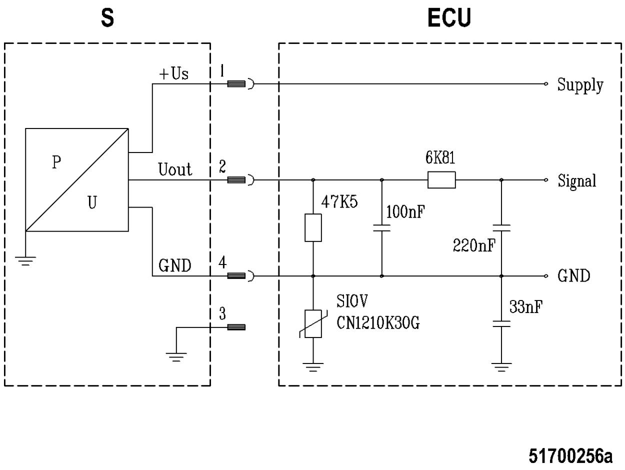
1 Ventilation

Use

The sensor us used for:

- B16: Coolant pressure
- B43: Intercooler coolant pressure

Block diagram

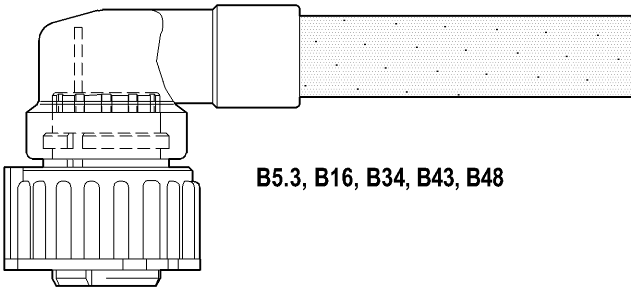


S Sensor

ECU Engine Control Unit

TIM ID: 0000017765 - 003

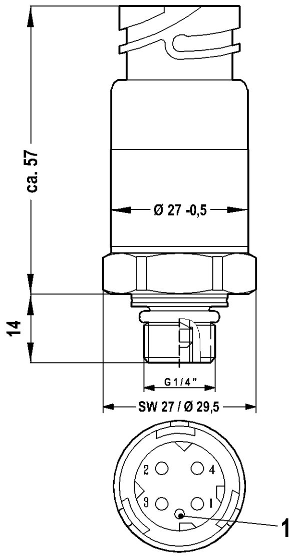
Cable connector



Pin assignment	
Pin no.	Signal
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for 0 ... 6 bar
3	Housing (ground)
4	Ground (not connected to the housing) GND

Sensor B34 (0 ... 15 bar)

Mechanical design



1 Ventilation

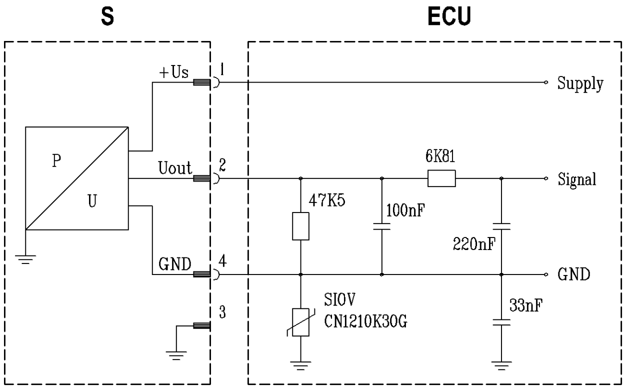
TIM ID: 0000017765 - 003

Use

The sensor us used for:

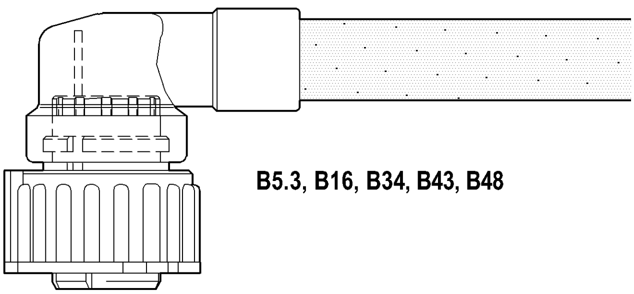
- Fuel pressure after filter

Block diagram



S Sensor ECU Engine Control Unit

Cable connector

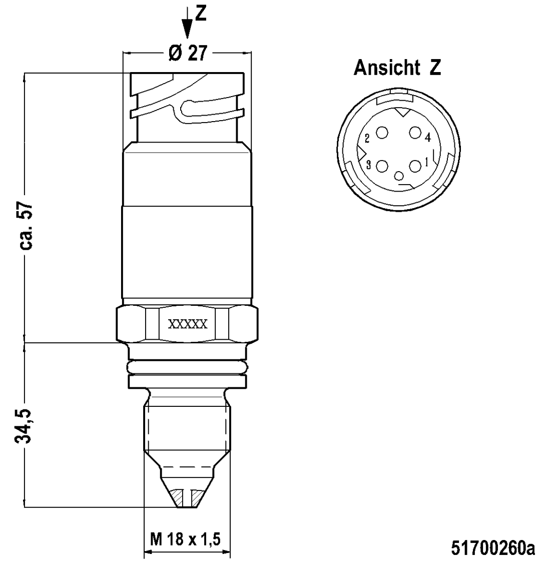


Pin assignment	
Pin no.	Signal
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for 0 ... 15 bar
3	Housing (ground)
4	Ground (not connected to the housing) GND

TIM ID: 0000017765 - 003

Sensor B48 (0 ... 2000 bar)

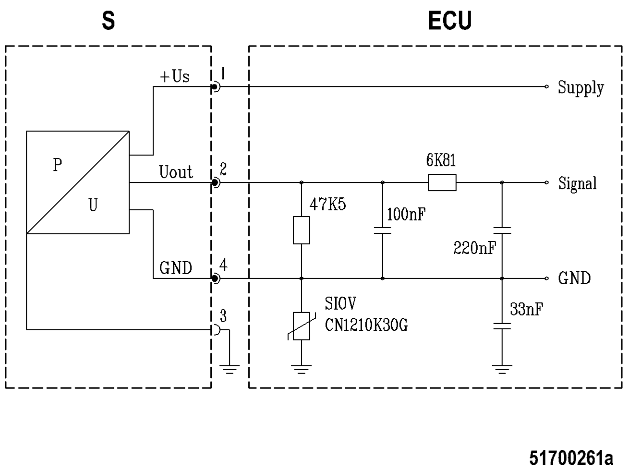
Mechanical design



Use

The sensor us used for:
- High-pressure fuel

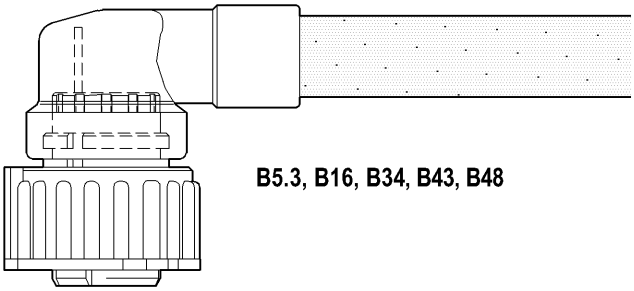
Block diagram



S Sensor
ECU Engine Control Unit

TIM ID: 0000017765 - 003

Cable connector

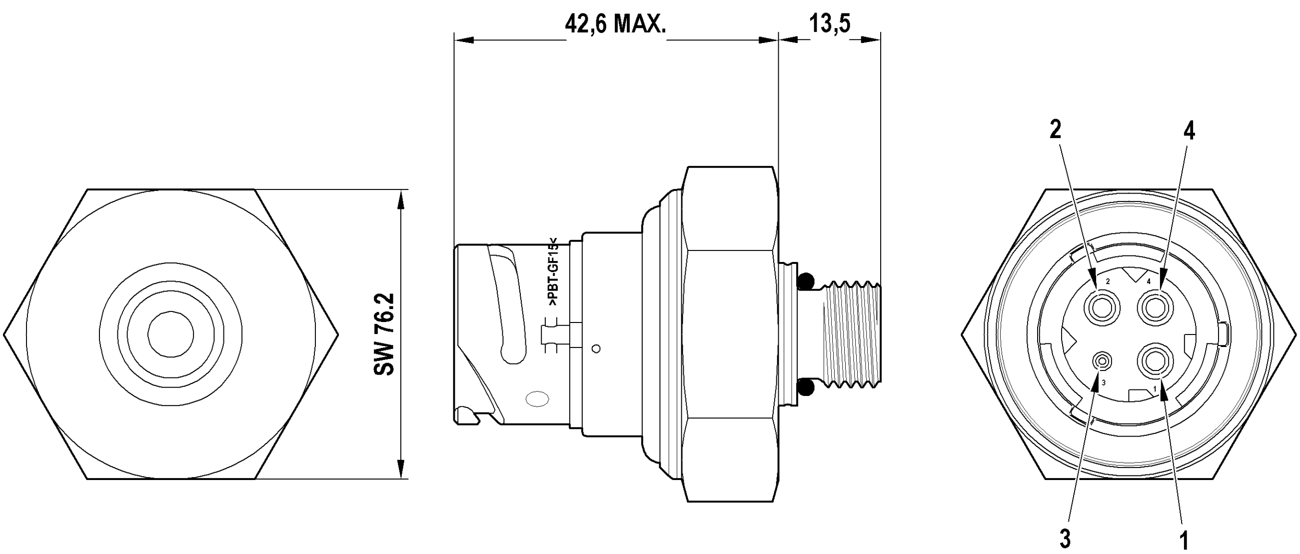


Pin assignment	
Pin no.	Signal
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for 0 ... 2000 bar
3	Housing (ground)
4	Ground (not connected to the housing) GND

TIM ID: 0000017765 - 003

Sensor B50 (-70 ... +70 mbar)

Mechanical design



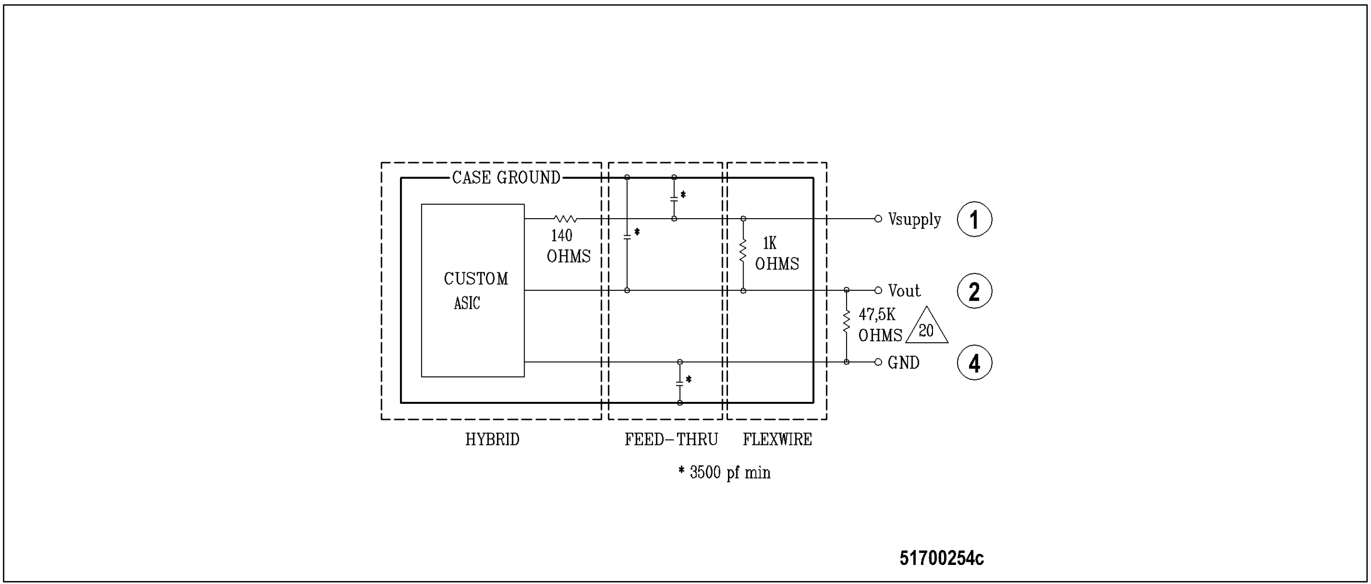
51700637

1 Pin 1: Supply voltage
2 Pin 2: Output voltage
3 Pin 3: Ventilation
4 Pin 4: Ground

Use

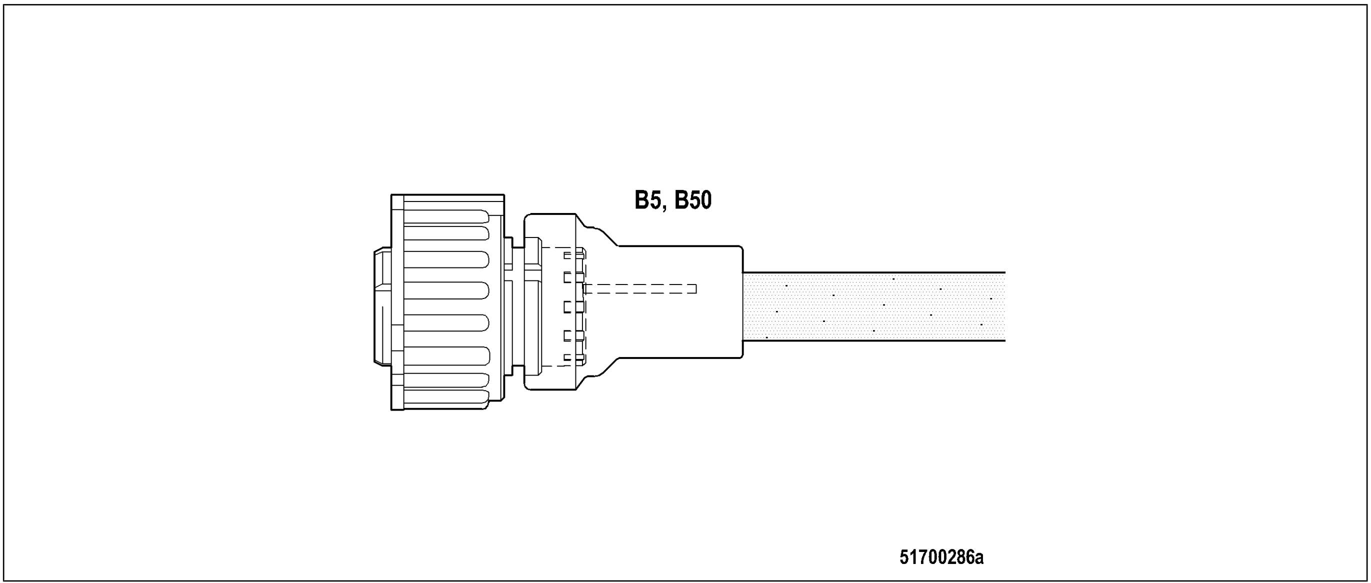
The sensor us used for:
- Crankcase pressure

Block diagram



1 Supply voltage 2 Output voltage 4 Ground

Cable connector



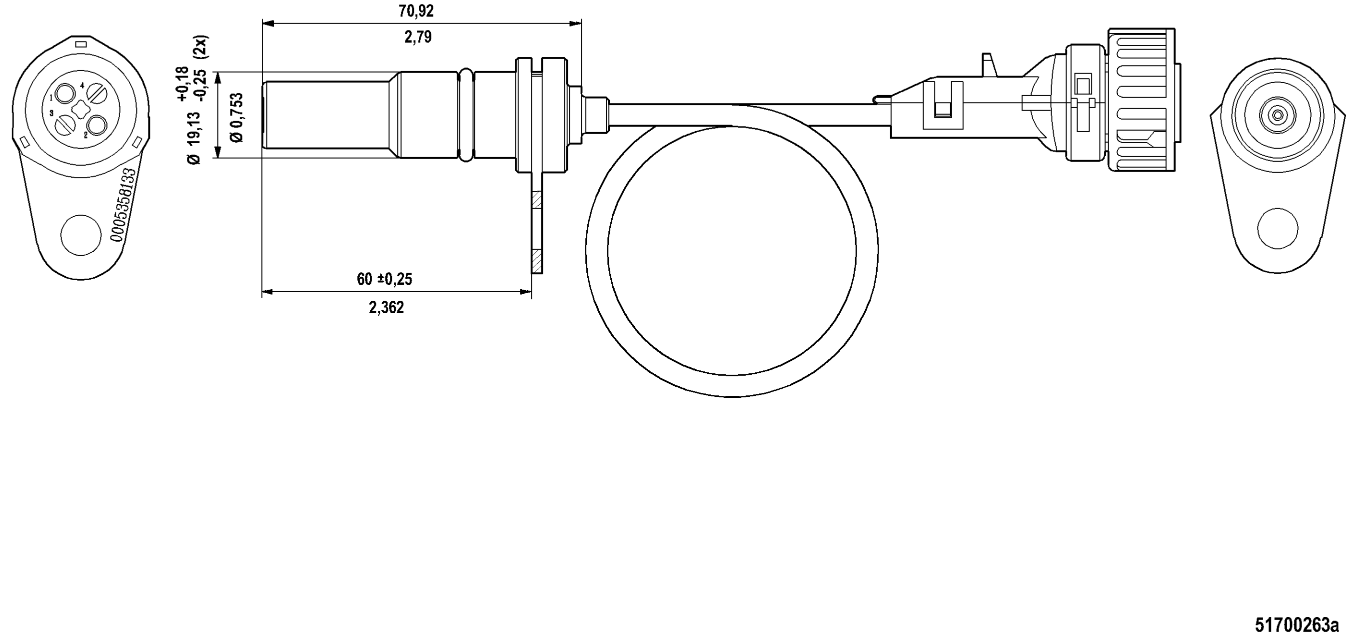
Pin assignment	
Pin no.	**Signal**
1	Supply voltage $+U_b$: 5 V DC
2	Output voltage $+U_a$: 0.5 ... 4.5 V DC for -70 ... +70 mbar
3	Ventilation
4	Ground (not connected to the housing) GND

TIM ID: 0000017765 - 003

Speed sensors

Sensor B1, B13

Mechanical design



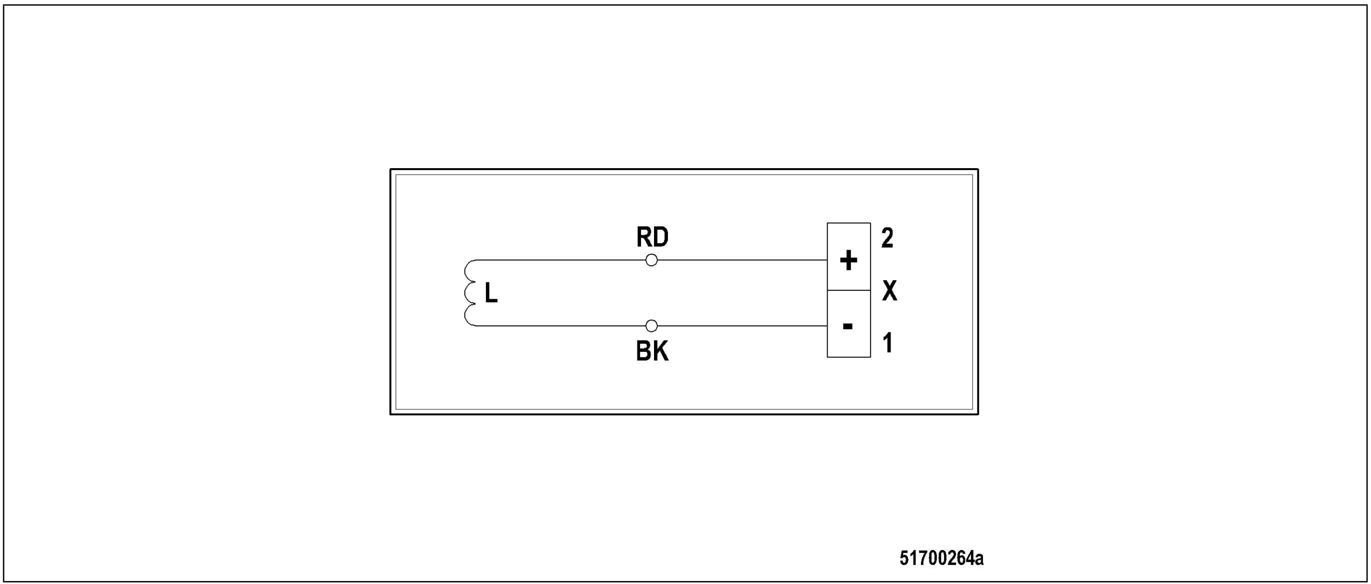
Use

The sensor us used for:

- B1: Camshaft speed
- B13: Crankshaft speed
- Optional: Second speed sensor at the crankshaft, separate from the MotivLine® MTU system; can be used as speed transmitter for electronics (OEM) at the vehicle

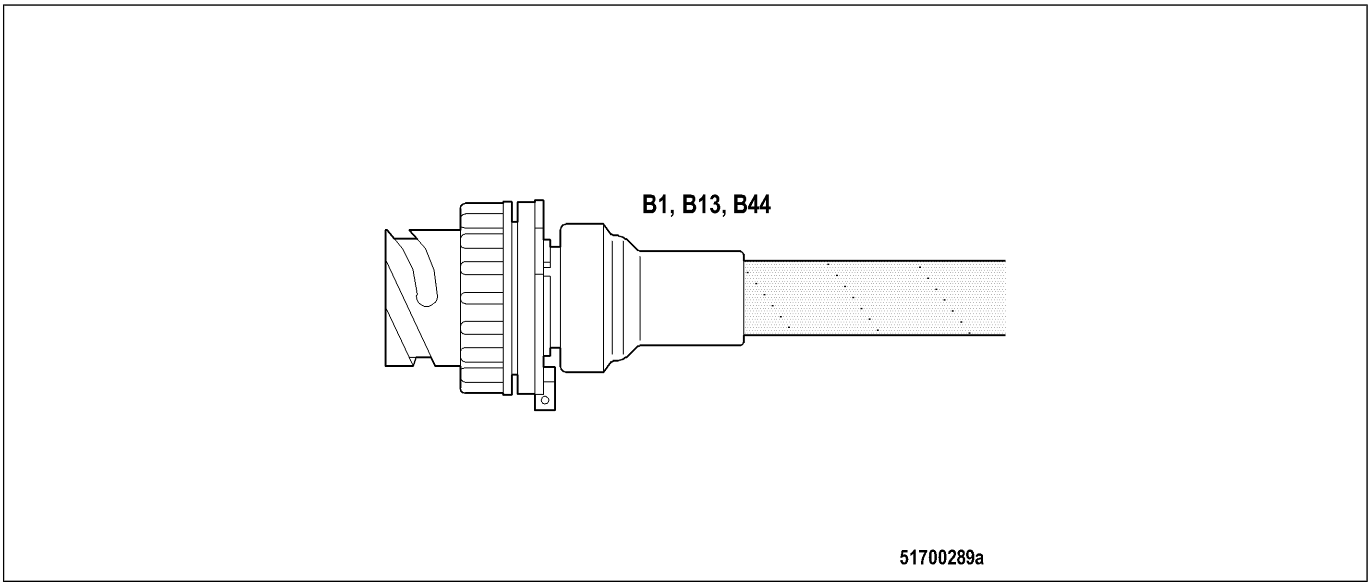
TIM ID: 0000017765 - 003

Block diagram



L	Coil	RD	Red cable color
X	Connector	BK	Black cable color

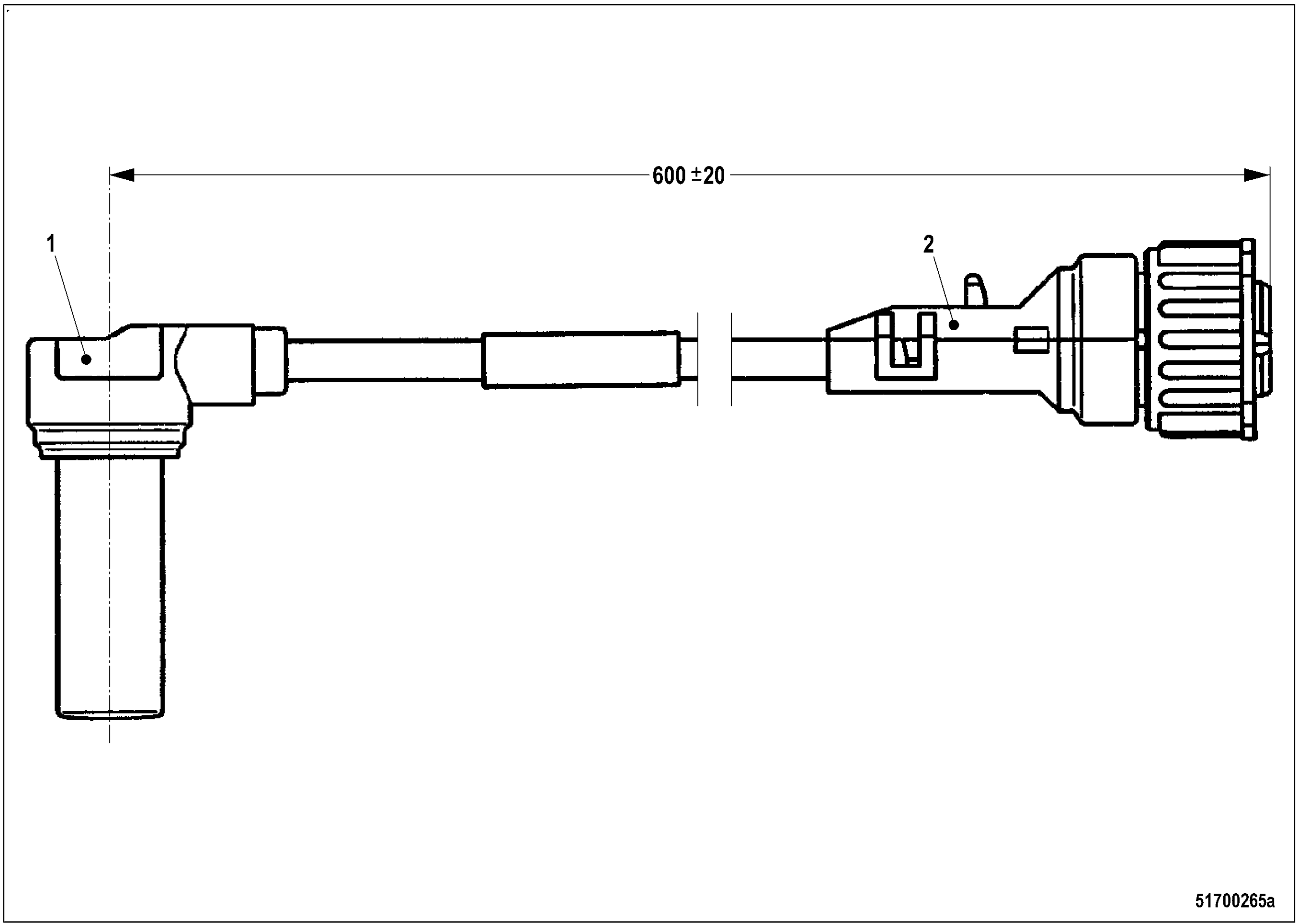
Cable connector



Pin assignment	
Pin no.	Signal
1	Black
2	Red

Sensor B44

Mechanical design

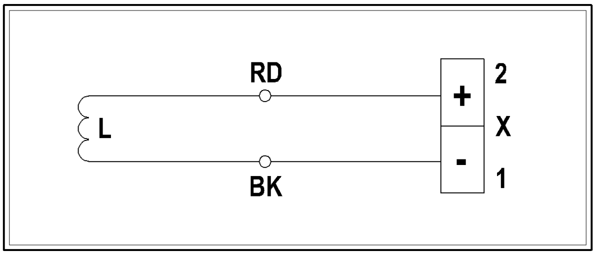


1 Sensor
2 Cable connector

Use

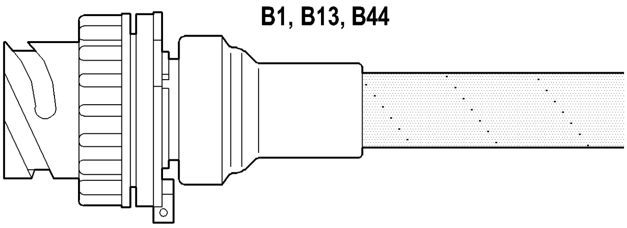
The sensor us used for:
- Exhaust turbocharger speed

Block diagram



L Coil
X Connector
RD Red cable color
BK Black cable color

Cable connector

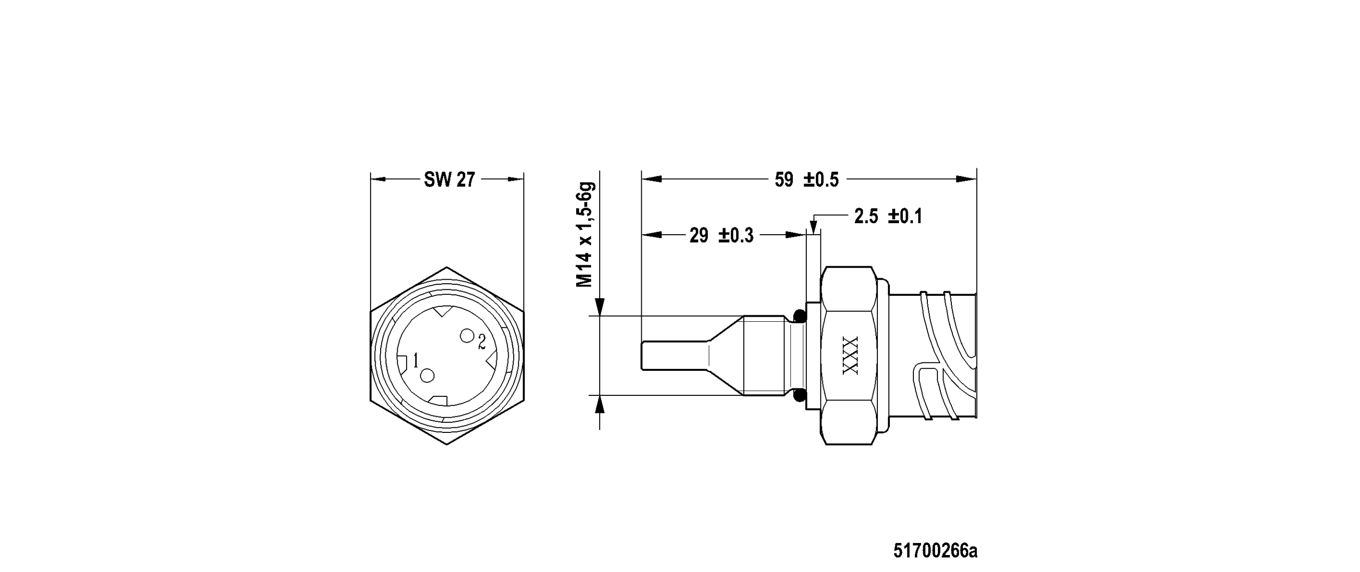


Pin assignment	
Pin no.	Signal
1	Black
2	Red

Temperature sensors

Sensor B3, B6, B7, B9, B26, B33 (-40 ... 150 °C)

Mechanical design

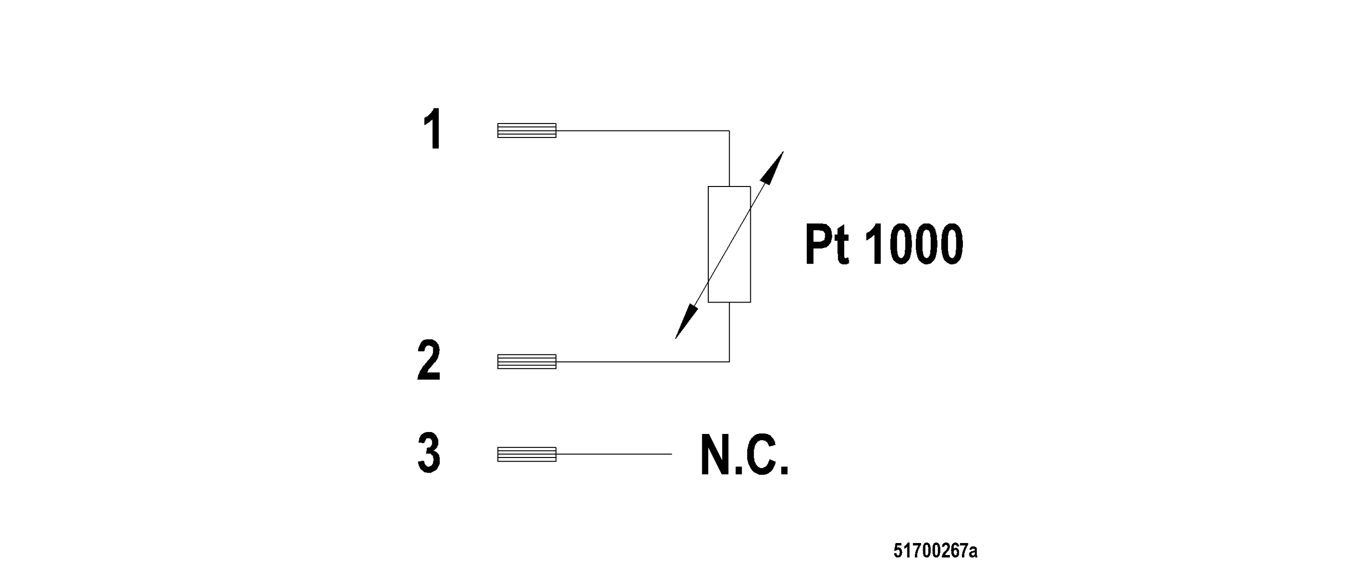


Use

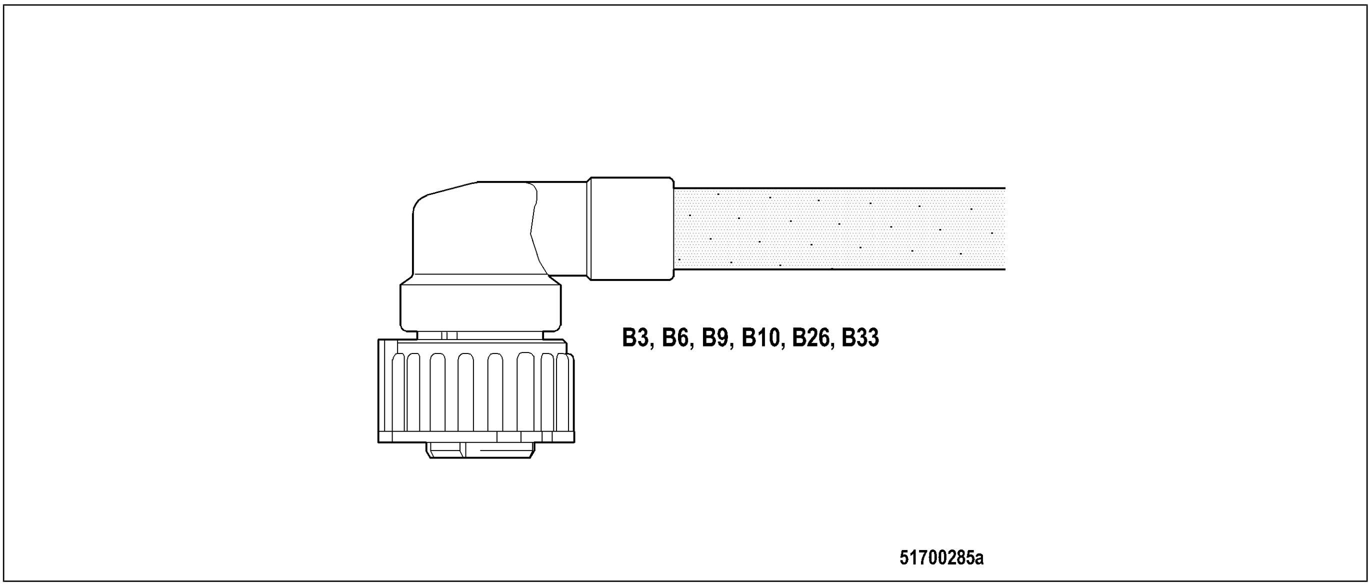
The sensor us used for:

- B3: Intake air temperature
- B6: Coolant temperature
- B7: Lube oil temperature
- B9: Charge-air temperature
- B26: Intercooler coolant temperature
- B33: Rail fuel temperature

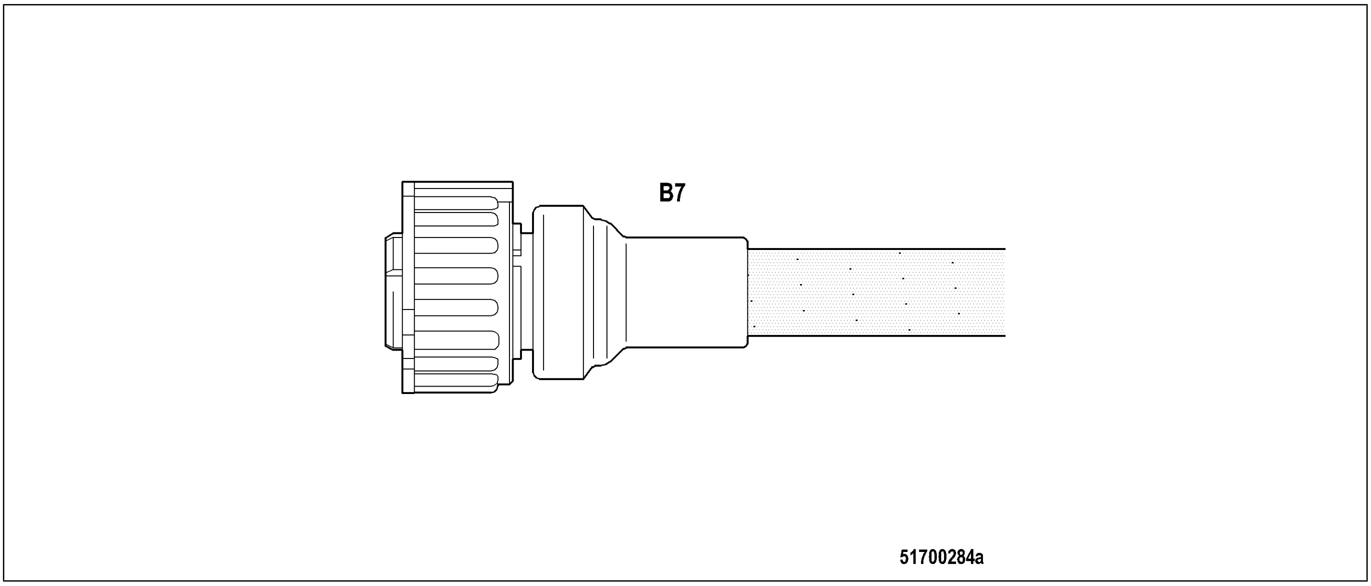
Block diagram



Cable connector



B3 Cable connector
B6 Cable connector
B9 Cable connector
B26 Cable connector
B33 Cable connector



B7 Cable connector

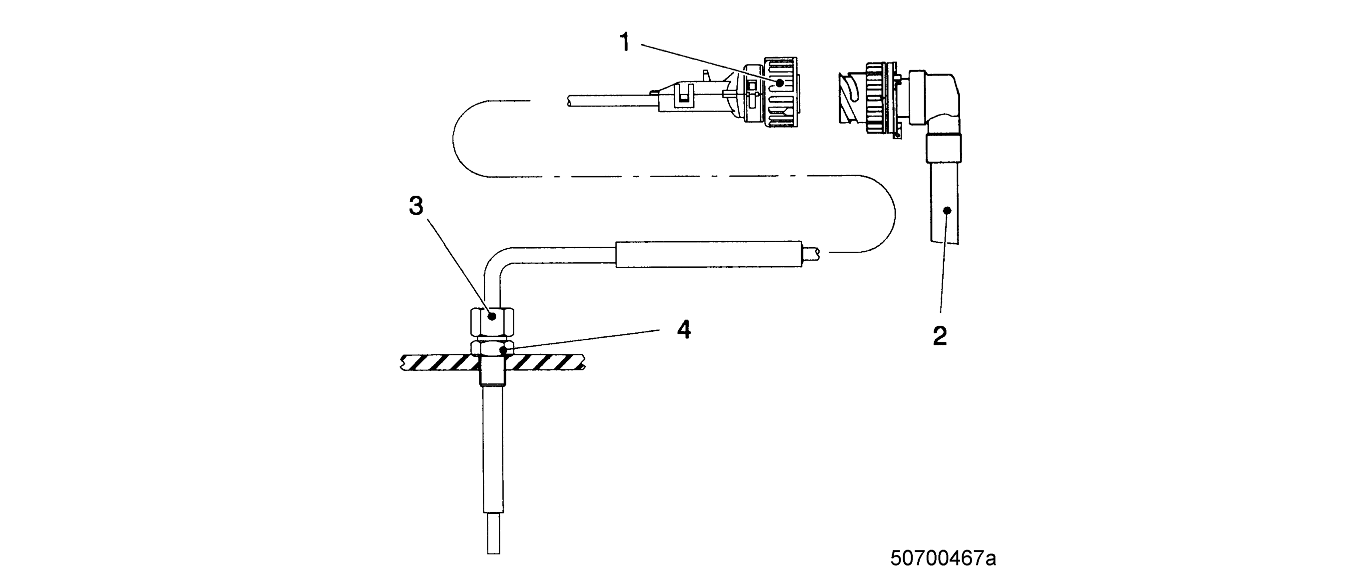
Pin assignment	
Pin no.	**Signal**
1	Pt1000: 0° C: 1000 Ω ... 100° C: 1385 Ω
2	

These sensors are used to measure exhaust gas temperatures at the individual cylinders.

Exhaust gas temperature sensors

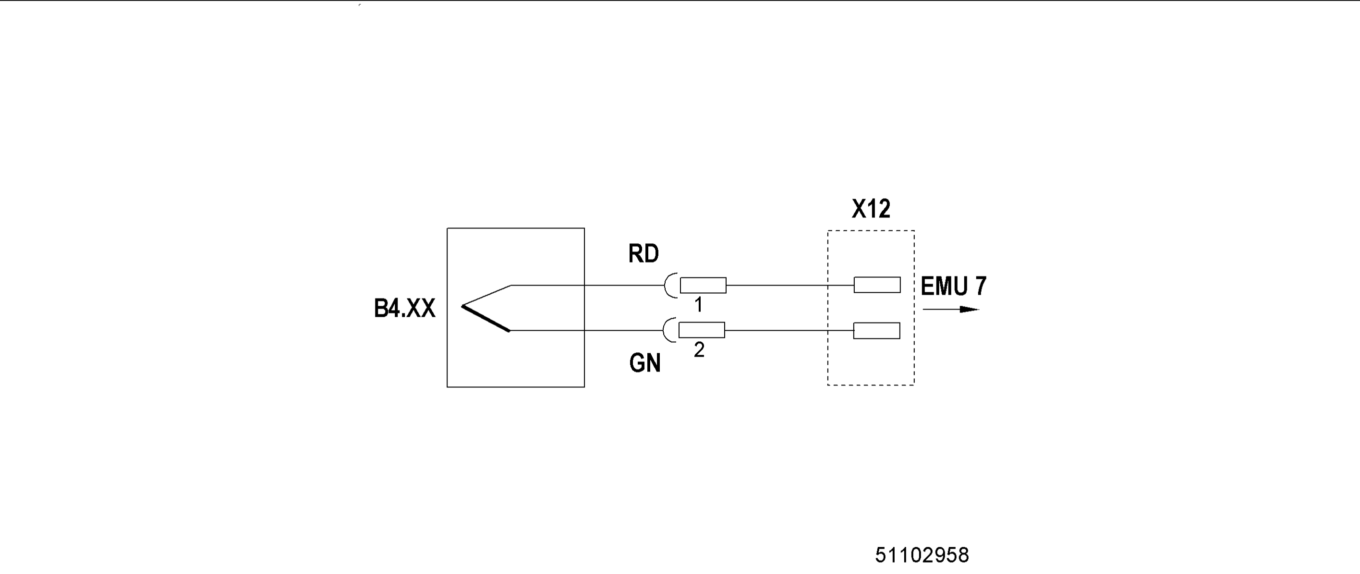
Sensors B4.1....B4.20

Mechanical design and connectors



1	Plug connector	3	Hex head A/F 19
2	Engine wiring harness to EMU	4	Locknut

Block diagram



B4.XX	Exhaust gas temperature sensor	X12	EMU connector

TIM ID: 0000017765 - 003

4.2.2 External sensors

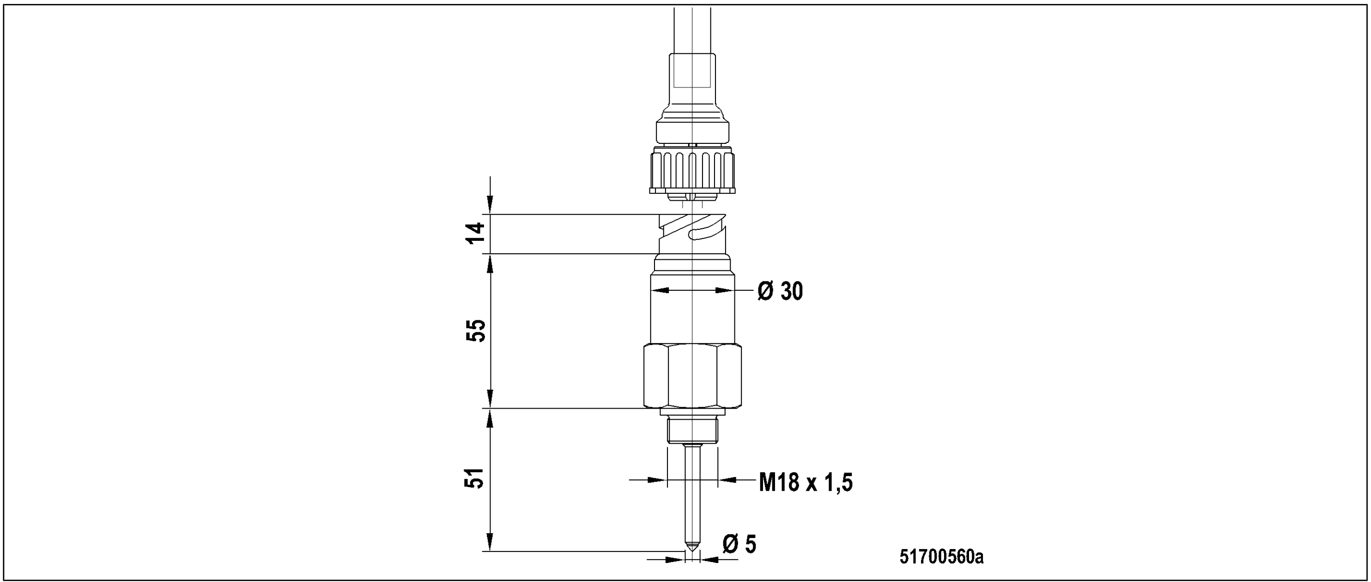
Use

Two separate sensors are included with delivery for measuring the coolant level and the water level in the fuel prefilter.

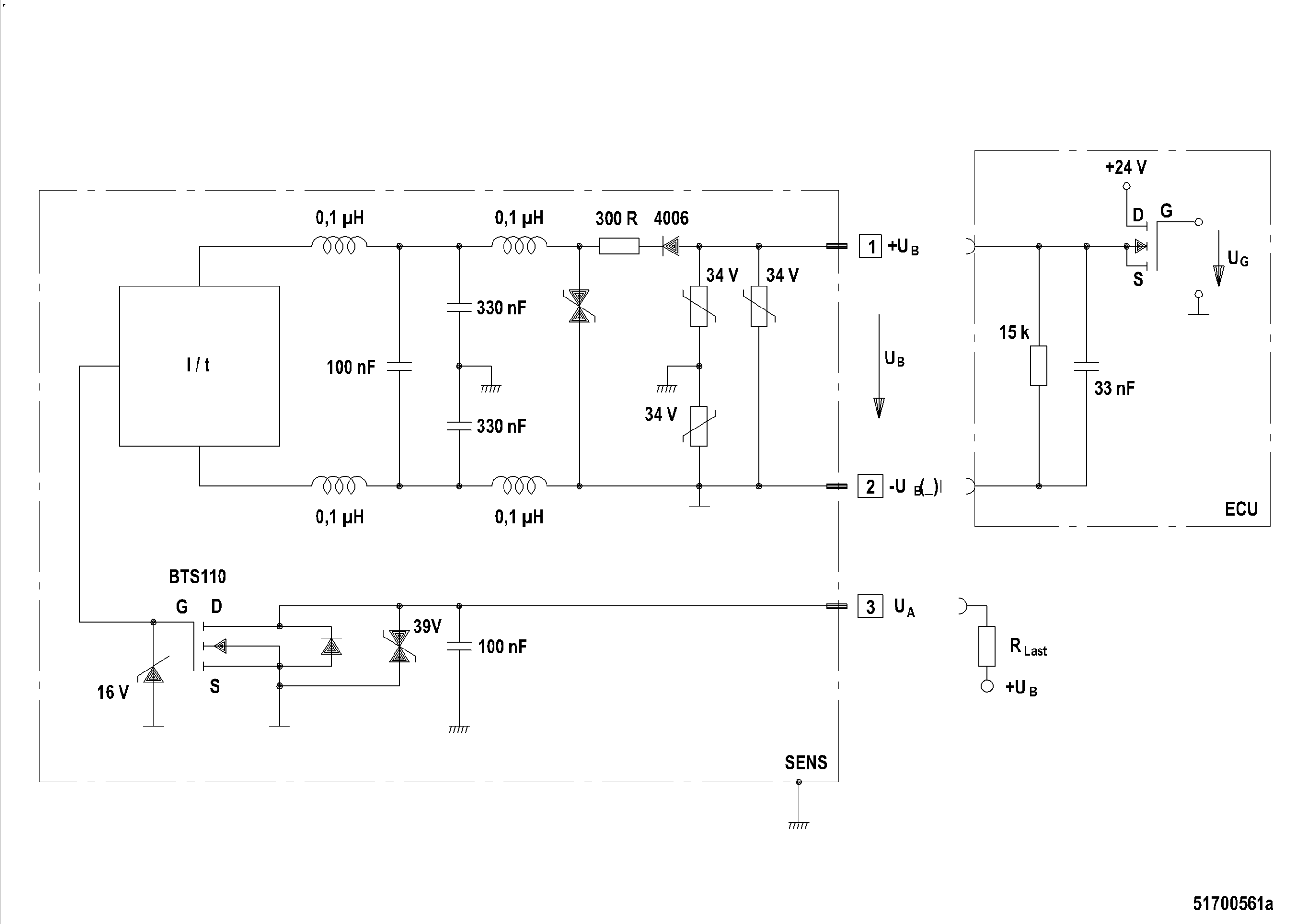
Sensors

Structure

The sensors used are level monitors that switch to ground following a delay time on detecting that the specified level (with respect to the installation height) has been exceeded or is no longer attained.



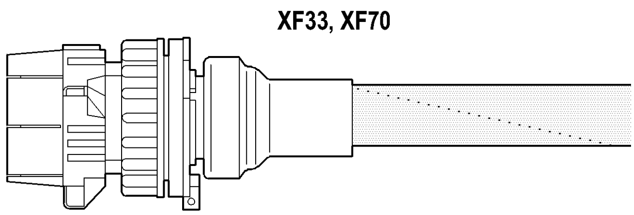
Connection diagram



SENS Sensor, internal circuitry

ECU Engine Control Unit ECU 7 (ADEC)

Cable connector

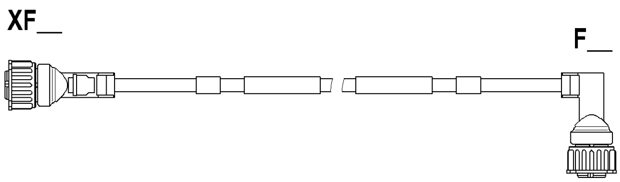


TIM ID: 0000017764 - 002

Pin assignment	
Pin no.	**Signal**
1	Supply voltage $+U_b$: 24 VDC
2	Ground (not connected to the housing) GND
3	Output

On an inspection port cover next to the Engine Control Unit are located the two cable connectors XF33 and XF70 for connecting the two connecting cables to the sensors. Note that the connectors are not coded. When plugging in, therefore, make sure that the correct sensor is connected to the correct connector XF....

Connecting cable



XF__ Connection at the engine wiring harness — inspection port cover

F__ Connection of the corresponding sensor

The two connecting cables are available in different lengths:

- 5 m
- 10 m

TIM ID: 0000017764 - 002

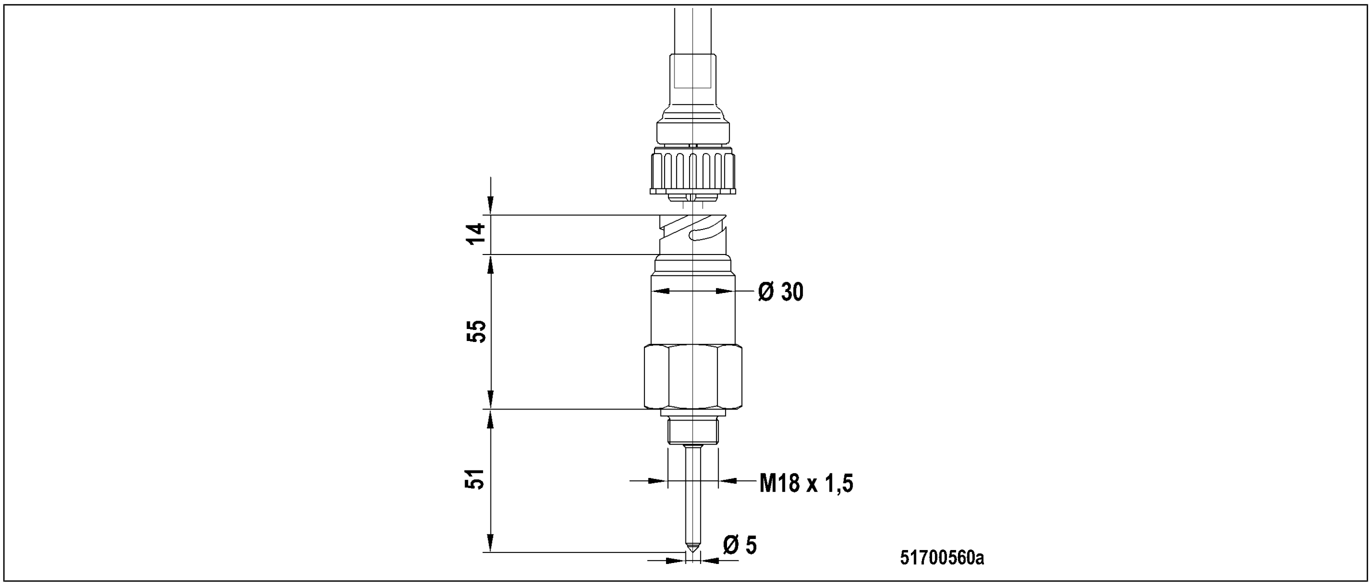
4.2.3 Optional sensors

Leak fuel level

Sensor F46 is available as an option to measure the leak fuel level. It is connected via the cable harness to input LSI3 of Engine Control Unit ECU7.

Sensor design

The sensors used are level monitors that switch to ground following a delay time on detecting that the specified level (with respect to the installation height) has been exceeded or is no longer attained.



TIM ID: 0000035200 - 001

5 Cabling

5.1 Power supply

General information

The OEM is responsible for the application engineering of the voltage supply (including key switches and start push-buttons).

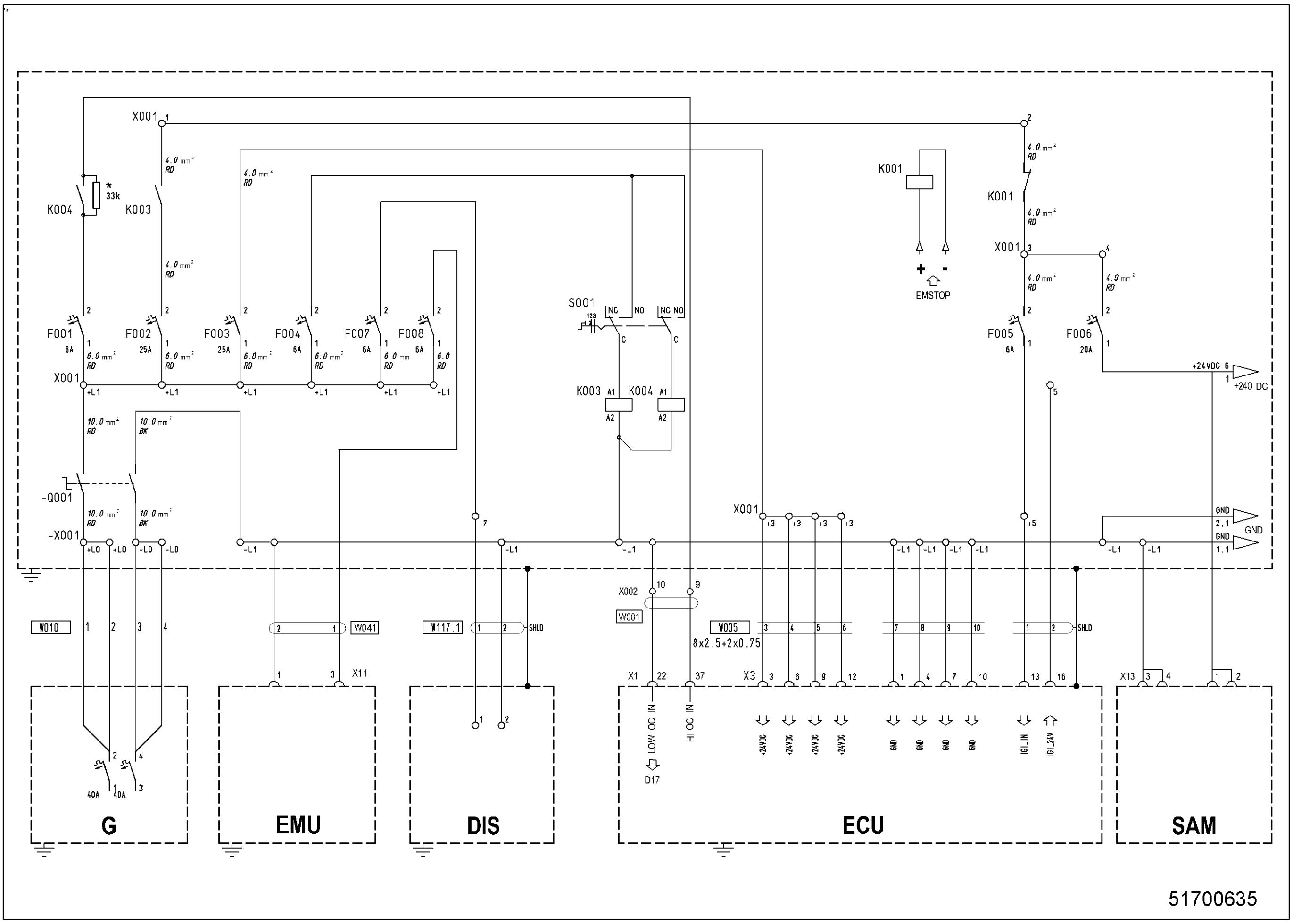
This section gives recommendations for a voltage distribution that is easy to wire.

The following basic things must be considered in the application engineering of the voltage supply:

- 2-pole master switch available
- All devices individually protected by power circuit breakers
- System switched on and started by a 2-staged key switch
- Manual emergency stop triggered by interrupting the voltage at the “ignition” input (IGI_IN) of the Engine Control Unit
- Cable cross sections are tapered after each fuse protection

The following recommendation takes into account all the above requirements. Generally all cable connections and the distribution must proceed through terminal blocks.

Example of a voltage distribution layout (recommendation)



G	Voltage supply at the vehicle	F	Power circuit breaker (see below)	X	Terminal blocks
DIS	DIS 10 display (optional)	Q001	Master switch	EMST	Emergency stop input from outside
ECU	ECU-7 Engine Control Unit (ADEC)	S001	Key switch	OP	(electrically isolated 24 V DC relay input)
SAM	Service and Application Module	K	Relay	GND	Ground

Master switch

The supply voltage for the entire electronic engine management system is switched on and off at master switch Q001.

Power circuit breaker

Power circuit breakers exist for the following areas:

- F001; 6A: input DI7 at the Engine Control Unit, start signal
- F002, 25A: prefuse for F005 and F006
- F003, 25A: Engine Control Unit supply voltage
- F004, 6A: “System on/Start” key switch
- F005, 6A: input IGI-IN at Engine Control Unit: Ignition ON
- F006: 25A: voltage supply for MTU single devices
- F007: 6A: supply voltage for DIS 10 (only if available, optional)

Key switch

In position 1 the Engine Control Unit is switched off at its input IGI_IN and the supply to the MTU single devices (power circuit breakers F005 and F006).

In position 2 the Engine Control Unit is switched on, and all MTU single devices are started up (supply is switched on at K003).

Position 3 triggers the start command. To this end 24 V DC is applied to input DI7 of the Engine Control Unit (via relay K004). This position of the key switch must be equipped with an automatic spring return, so that the key switch automatically returns to position 1 when the key is released.

Emergency stop

An emergency stop is triggered by actuating relay K001. That is, the NC contact of this relay interrupts the supply to the input IGI-IN at the Engine Control Unit (ignition ON) (in wiring harness X3). The Engine Control Unit then stops the fuel injection, and the engine stops.

This shutdown has the same effect as a shutdown by the key switch.

Emergency stop counter

Shutting down the engine by means of a complete de-energization of the Engine Control Unit is NOT PERMITTED.

If the engine is nevertheless shut down in this way, this event will be recorded in an internal memory (counter). When the Engine Control Unit is switched on again, alarm no. 549: “AL Voltage interruption detected” will be generated and written to the fault memory.

IMPORTANT NOTE:

WARNING
Shutting down the engine be switching off the ECU supply voltage may damage the engine. The "pressure relief valve" may be damaged if the HP fuel pump is not controlled properly.

Cable cross sections

For the main power supply we recommend a cross section of at least 10 mm^2. Following the subdistribution over the individual power circuit breakers the cross section should be reduced to 6 mm^2. The outputs of the power circuit breakers are then further wired with 4 mm^2.

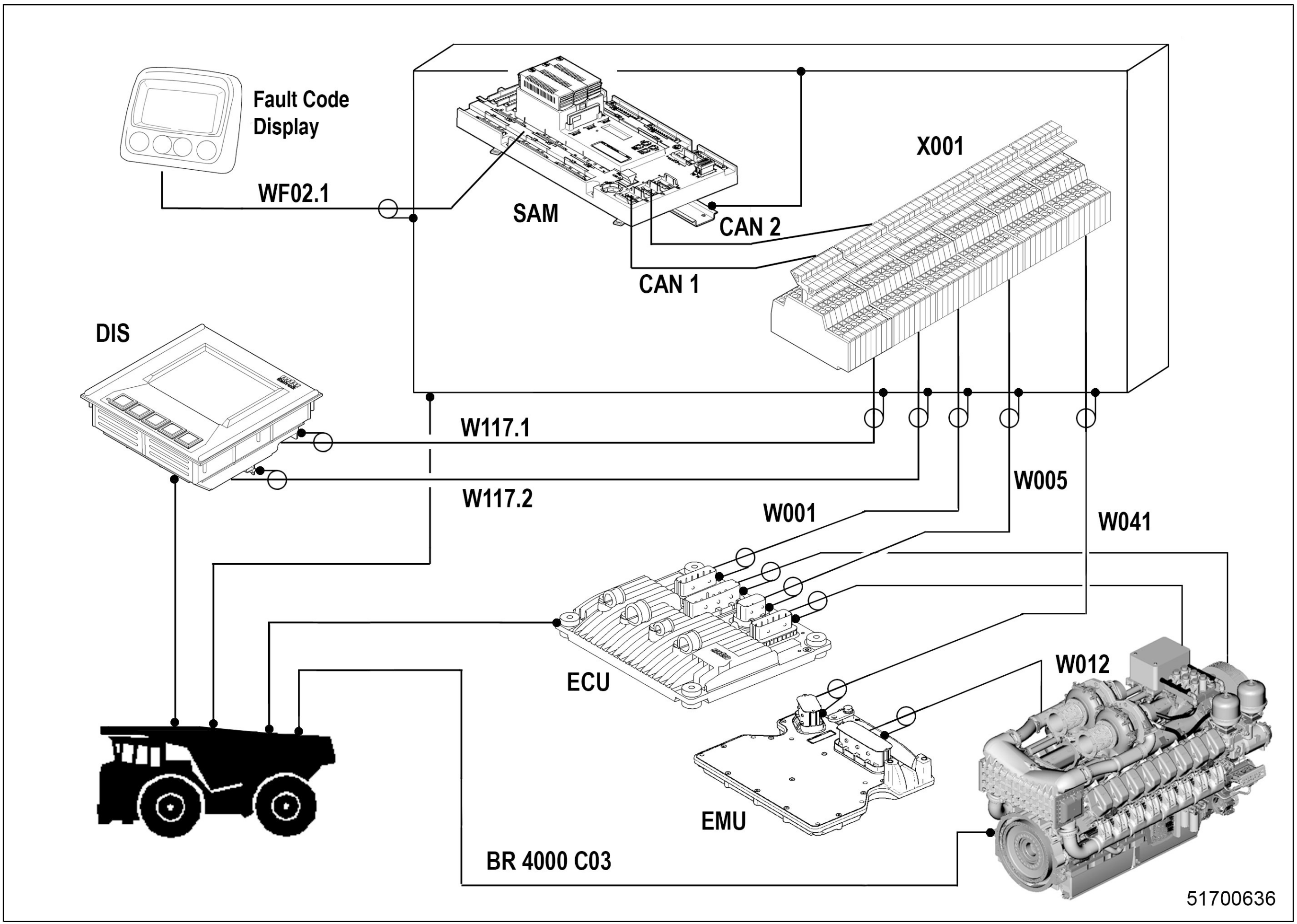
This continuous tapering of the cross section ensures that no cable is overloaded and thereby runs the risk of becoming overheated.

TIM ID: 0000017732 - 002

5.2 Grounding concept

The grounding concept provides for a complete separation between the vehicle mass and the mass of the supply voltage.

THE GROUND OF THE SUPPLY VOLTAGE (–LO, GND) MUST THEREFORE NOT BE CONNECTED TO THE VEHICLE GROUND CHASSIS) AT ANY POINT!



In detail, the following ground connections must exist:

- The shielding of the two cables W001 and W005 is connected at the controller end by the connector to the housing of the Engine Control Unit (factory-installed).
- The shielding of the two cables W001 and W005 must be connected on the side of the open end to the housing in which the SAM is installed (to be arranged by the OEM, e.g. by means of corresponding cable entries).
- The housing of the Engine Control Unit is connected to the crankshaft housing of the engine (factory installed).
- The shielding of the engine wiring harnesses is connected to the housing of the Engine Control Unit (factory installed).
- The cable W117.1 (power supply of the display DIS 10) must be shielded (provision by OEM). The shielding must be attached to the housing at the display (to be arranged by the OEM). The shielding at the other end of the cable must be connected to the switchgear cabinet or the mounting plate in/on which the SAM is installed (to be arranged by the OEM).
- The cable W117.2 (redundant CAN bus of the display DIS 10) must be shielded with 3 strands (provision by OEM). The shielding must be attached to the housing at the display (to be arranged by the OEM). The shielding at the other end of the cable must be connected to the switchgear cabinet or the mounting plate in/on which the SAM is installed (to be arranged by the OEM). The CAN lines (GND) must NOT be connected to the housings.
- The cable WF02.1 (CAN bus of the PowerView Display) must be shielded (provision by OEM). The shield must be cut off at the display and insulated or connected to the console plate (to be arranged by the OEM). The (plastic) housing of the PowerView has no jack for the shielding. The shielding at the other end of the cable must be connected to the housing in which the SAM is installed (to be arranged by the OEM). The CAN line (GND) must NOT be connected to the switchgear cabinet or the mounting plate.
- The switchgear cabinet/the mounting plate in/on which the SAM is located must be connected to the vehicle chassis (to be arranged by the OEM).
- The display housing must be connected to the vehicle chassis (to be arranged by the OEM).
- The engine must be grounded by a ground strap. Details on the execution, cross-sections and other information are given in the “Series 4000 C&I Installation Manual” and in the corresponding MTN standard on “Grounding Engines and Plants” (to be arranged by the OEM).

TIM ID: 0000017731 - 003

5.3 CAN bus

General information

For the sake of the highest possible signal-to-noise ratio and therefore maximum operational reliability, the CAN bus must be carefully wired according to specifications. Failure of the CAN bus in any case will lead to serious restrictions up to total failure of the drive.

The implementation of the CAN bus is therefore crucial for the reliability of the entire system.

Requirements on cable

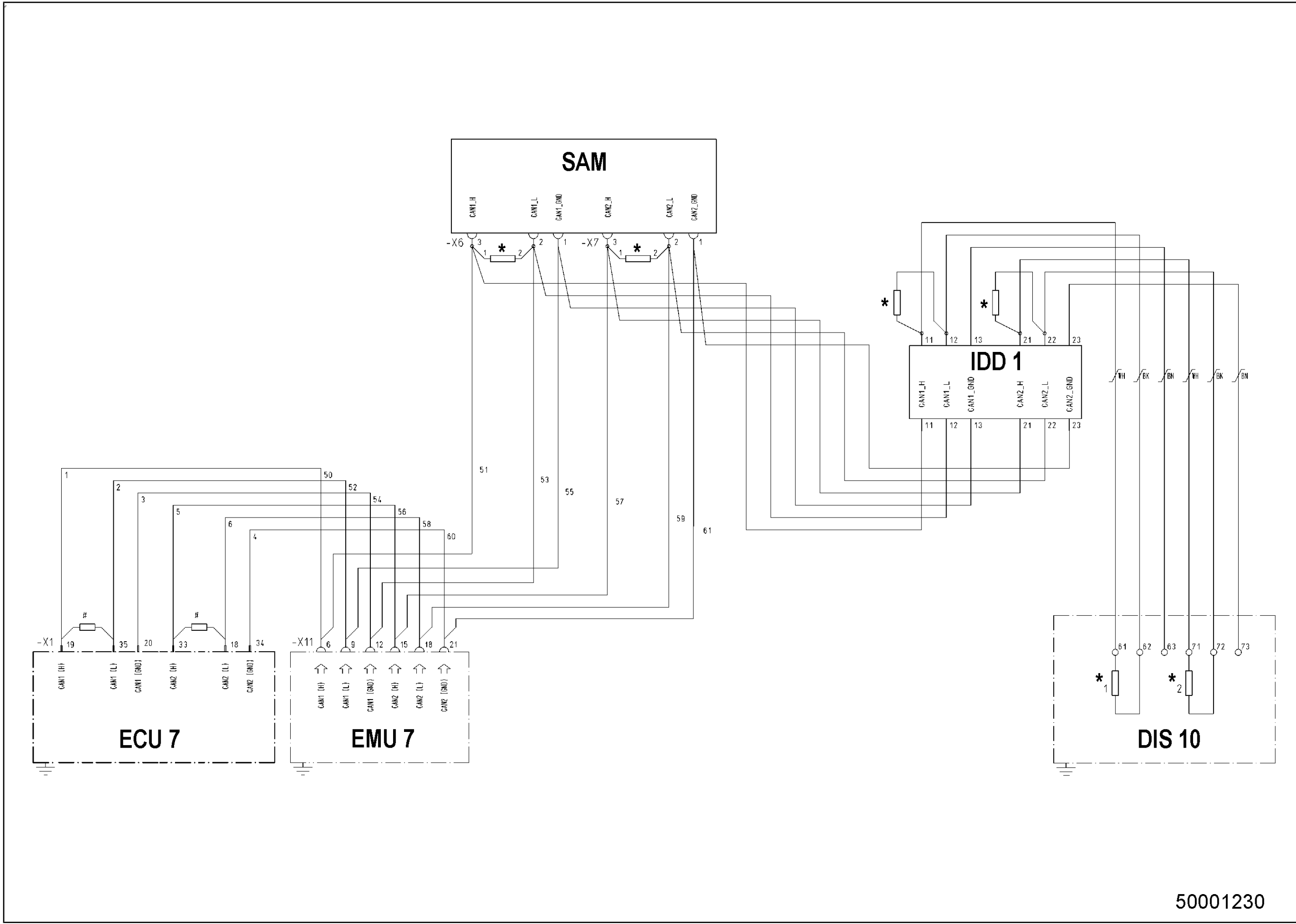
The employed cable must have at least the following electrical properties:

- Impedance Z: 120 Ω (± 10%)
- Specific resistance r_b: max. 50 mΩ/m at 20° C
- Specific signal delay t_p: 5 ns/m
- Specific capacities:
  - between the conductors c_b: max. 75 pF/m
  - Conductor to shielding c_s: max. 110 pF/m

Block diagram

The illustration gives an example of the schematic layout of this CAN bus system. A DIS 10 display is also connected here.

TIM ID: 0000017739 - 002



* Alternatively: Resistors may be used only at the end of the bus, i.e. either at the SAM (if the bus ends here) OR at the IDD OR at the DIS. The resistors at the ECU are soldered into the connectors.

Keep in mind the following when connecting the CAN buses:

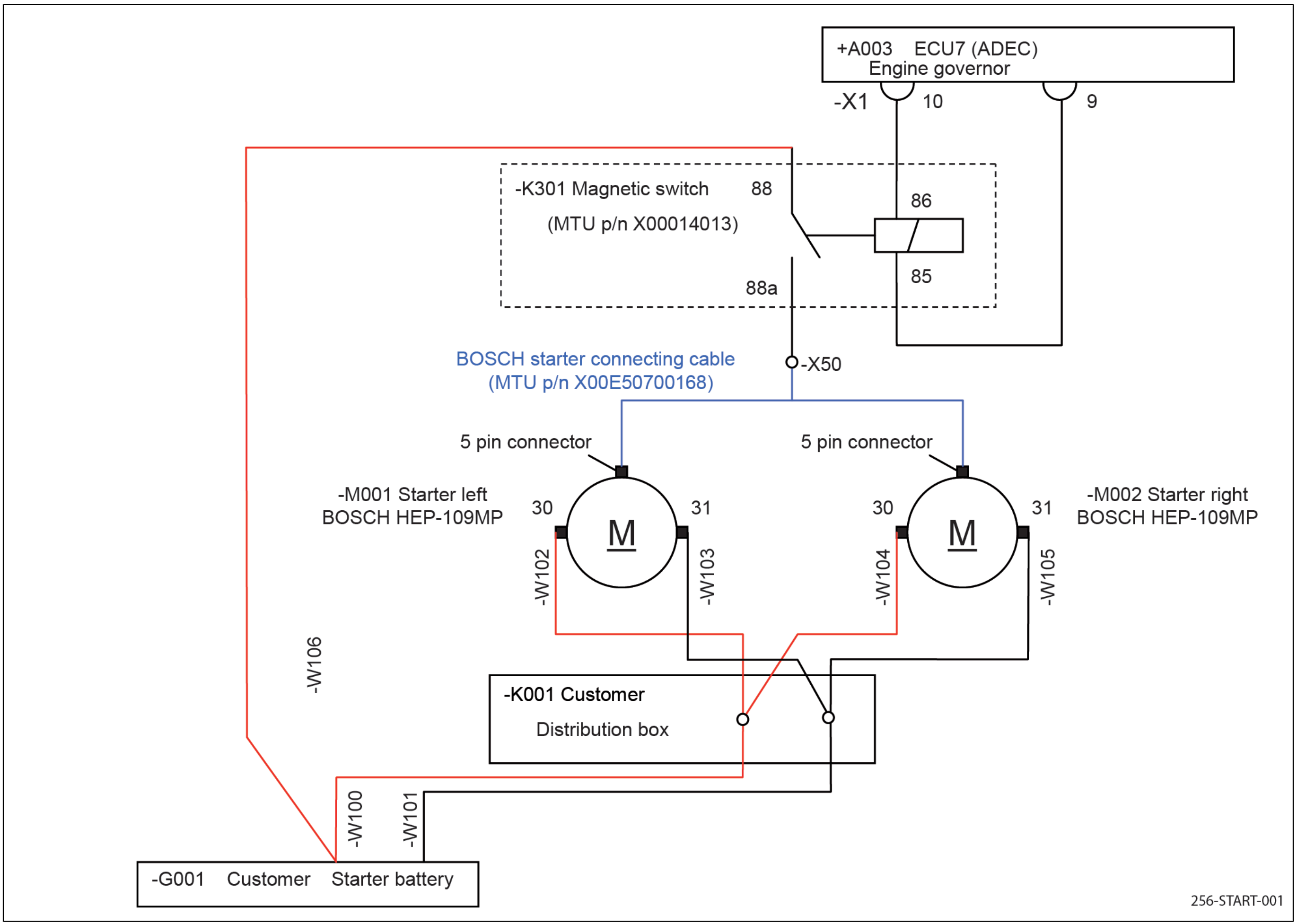
- One CAN bus termination resistor (120 Ω) each must be connected to the connectors at the ends of both CAN buses. The two resistors at the SAM are connected if no display is available, so that the bus terminates at X6 or X7 (and therefore at the SAM). In connecting the display you must also connect the resistors to the terminals 61/62 or 71/72 of the display.
- The shielding of the bus cable (at the display end) must be connected to the housing of the display or the console front (if the latter is electrically conductive) (→ Page 123).
- The shielding of the bus cable (at the SAM end) must be connected to the housing/cable entry of the switchgear cabinet/the mounting plate. Within the switchgear cabinet the (twisted) bus cable need not be shielded (→ Page 123).
- The CAN_GND jacks must NOT be connected to the shielding, the ground of the operating voltage or the vehicle mass.

TIM ID: 0000017739 - 002

5.4 Starter

General information

Series 4000 engines used in C&I applications are equipped with 2 starters.



Pay attention to the following points when connecting the two starters:

- Cables -W102 and -W104 (see figure above) must be exactly the same length, as any difference would lead to unequal voltage drop with the result that the starters would be unable to perform equivalently.
- The same applies to cables -W103 and -W105
- Connection to the starter battery should therefore established in a Y-form (see figure).
- Cables -W102 to -W105 as well as -W100 and -W101 must be connected in a distributor housing (-K001) provided by the customer.
- The subsequent connection to the starter battery must then be established directly without any other terminal point in addition.

The following cable cross-sections are required for connection:

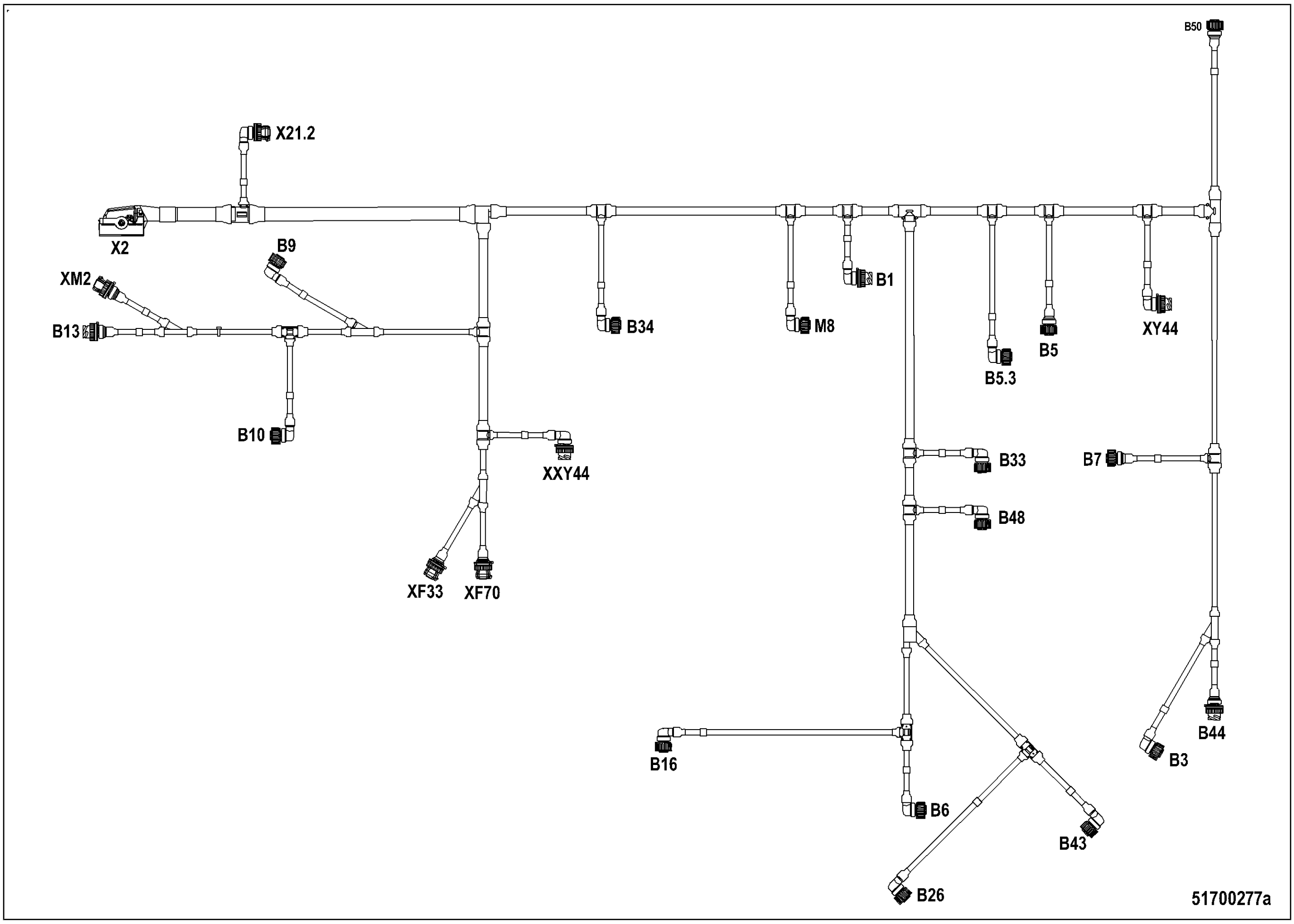
- -W100/-W101: 150 mm^2
- -W102/-W103/-W104/-W105: 95 mm^2

Note:
Read and observe the installation instructions in MTU drawing XZ59317200002.

5.5 Engine-Mounted Wiring Harnesses

5.5.1 Sensor wiring harnesses

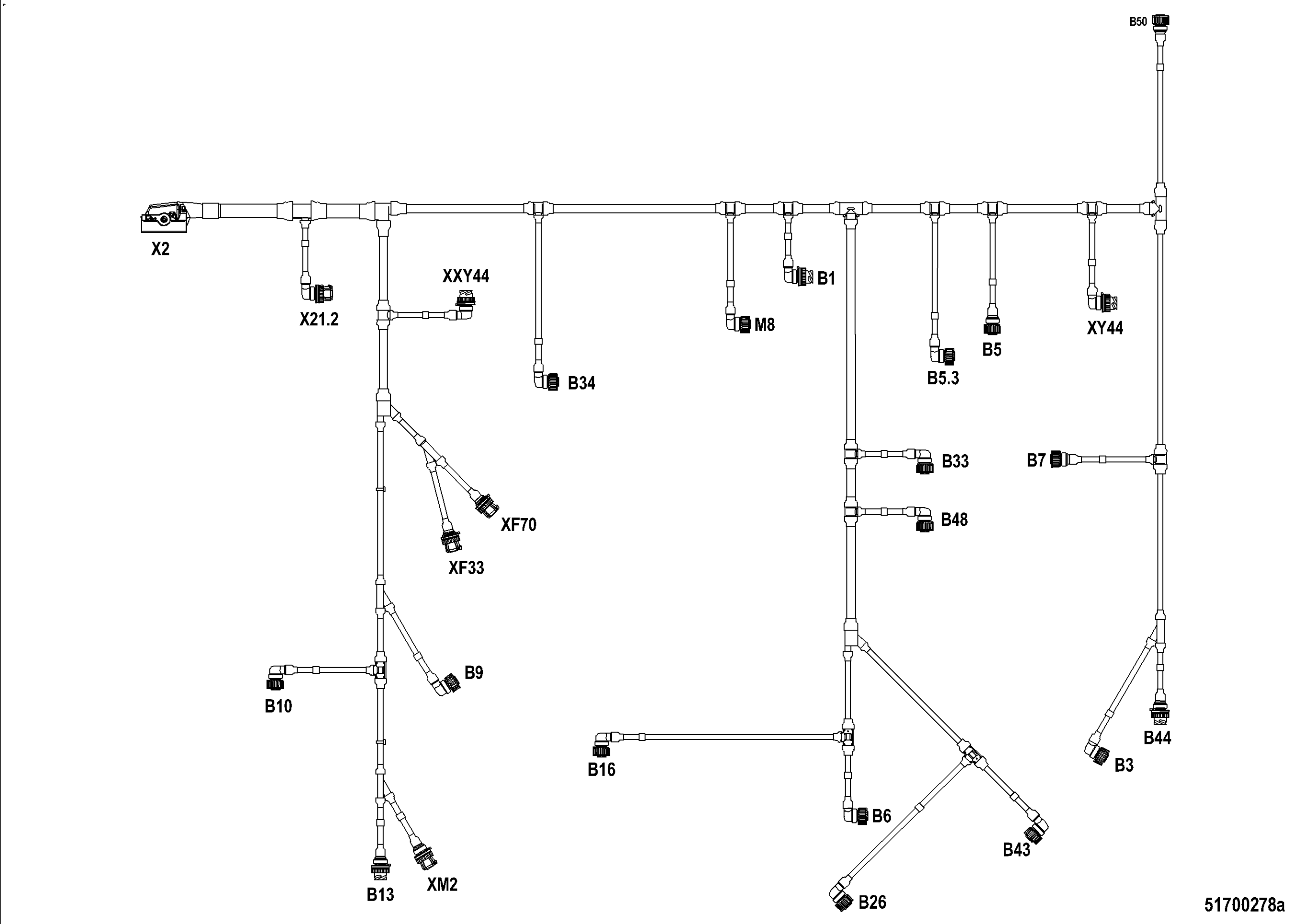
12V4000C03



B1	Camshaft speed
B3	Intake air temperature
B5 (B5.1)	Lube oil pressure after filter
B5.3	Lube oil pressure before filter
B6	Coolant temperature
B7	Lube oil temperature
B9	Charge-air temperature
B10	Charge-air pressure
B13	Crankshaft speed
B16	Coolant pressure
B26	Intercooler coolant temperature
B33	Fuel temperature
B34	Fuel pressure after filter
B43	Intercooler coolant pressure
B44	Exhaust turbocharger speed
B48	High-pressure fuel
B50	Crankcase pressure
M8	HP pump interphase transformer
X2	Engine Control Unit X2
X21.2	POM wiring harness (option)
XF33	Coolant level
XF70	Fuel prefilter water level
XM2	Oil priming pump cable
XXY44	Fan control
XY44	Engine wiring harness (XY44 for ventilation control)

TIM ID: 0000017753 - 002

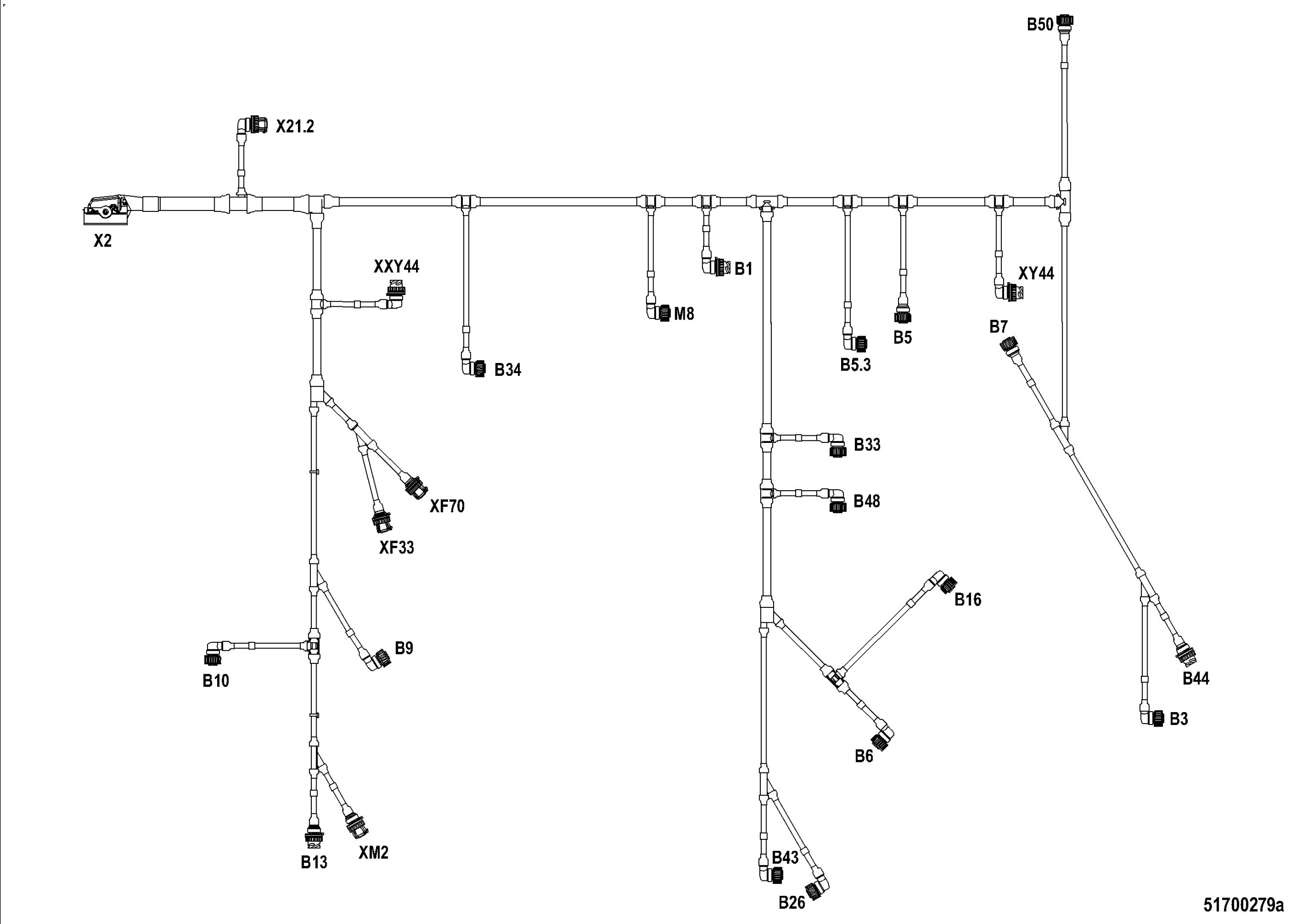
16V4000C03



B1	Camshaft speed	B16	Coolant pressure	X2	Engine Control Unit X2
B3	Intake air temperature	B26	Intercooler coolant temperature	X21.2	POM wiring harness (option)
B5 (B5.1)	Lube oil pressure after filter	B33	Fuel temperature	XF33	Coolant level
B5.3	Lube oil pressure before filter	B34	Fuel pressure after filter	XF70	Fuel prefilter water level
B6	Coolant temperature	B43	Intercooler coolant pressure	XM2	Oil priming pump cable
B7	Lube oil temperature	B44	Exhaust turbocharger speed	XXY44	Fan control
B9	Charge-air temperature	B48	High-pressure fuel	XY44	Engine wiring harness (XY44 for ventilation control)
B10	Charge-air pressure	B50	Crankcase pressure		
B13	Crankshaft speed	M8	HP pump interphase transformer		

TIM ID: 0000017753 - 002

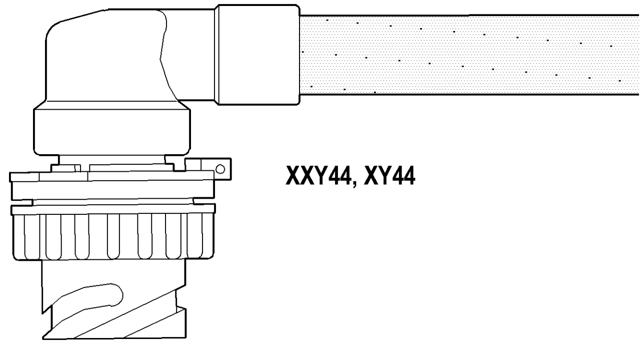
20V4000C03



- B1 Camshaft speed
- B3 Intake air temperature
- B5 Lube oil pressure after filter (B5.1)
- B5.3 Lube oil pressure before filter
- B6 Coolant temperature
- B7 Lube oil temperature
- B9 Charge-air temperature
- B10 Charge-air pressure
- B13 Crankshaft speed
- B16 Coolant pressure
- B26 Intercooler coolant temperature
- B33 Fuel temperature
- B34 Fuel pressure after filter
- B43 Intercooler coolant pressure
- B44 Exhaust turbocharger speed
- B48 High-pressure fuel
- B50 Crankcase pressure
- M8 HP pump interphase transformer
- X2 Engine Control Unit X2
- X21.2 POM wiring harness (option)
- XF33 Coolant level
- XF70 Fuel prefilter water level
- XM2 Oil priming pump cable
- XXY44 Fan control
- XY44 Engine wiring harness (XY44 for ventilation control)

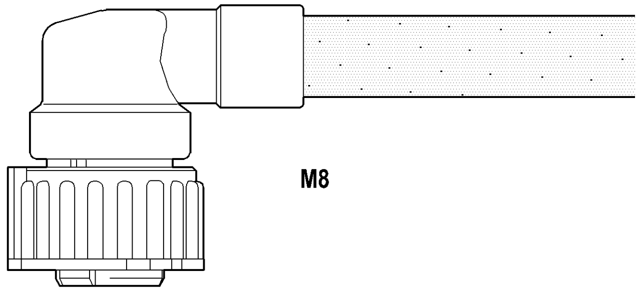
TIM ID: 0000017753 - 002

Connector XXY44



The injector wiring harness is connected to connector XY44. This plug connector loops the output PCM_CM2 from connector X4 of the Engine Control Unit (→ Page 61) to the control valve of the fan (Y44).

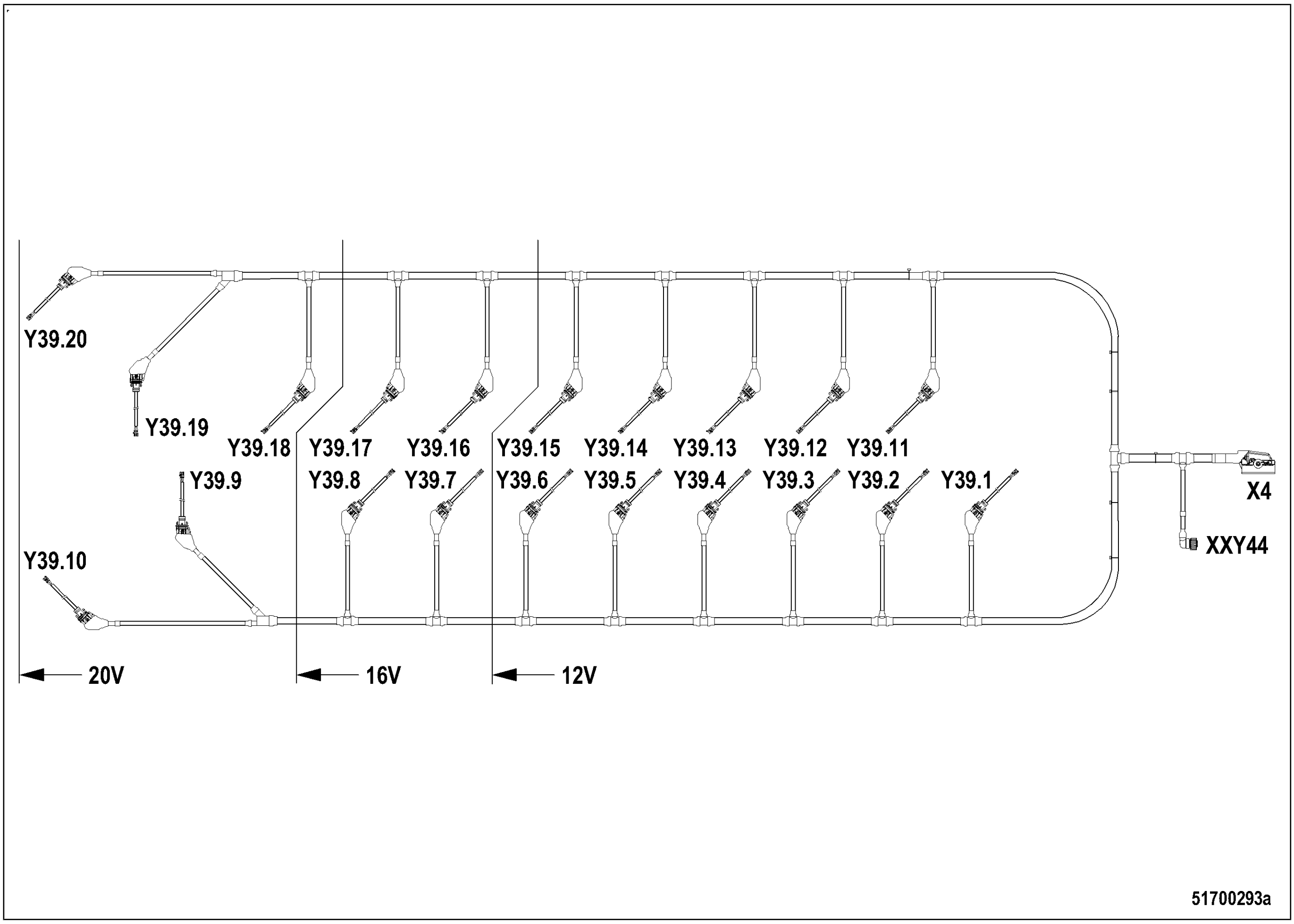
Connector M8



This connector connects the HP pump (interphase transformer).

5.5.2 Injector wiring harness

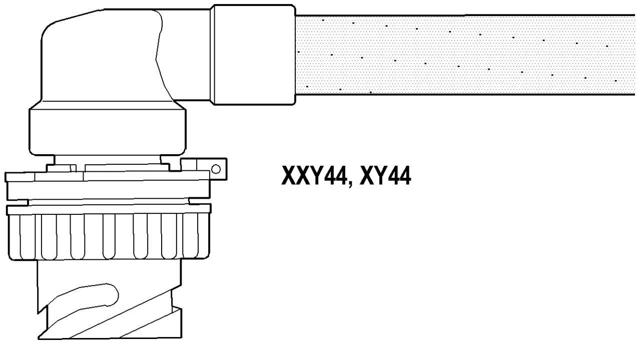
The wiring harness for connecting the injectors differs for the different engines only by the number of injector connectors. Note that the consecutive numbering of the injectors on the B-side of the engine always starts with Y39.11. The 12 and 16-cylinder engines accordingly lack the numbers Y39.7...10 and Y39.9...10, respectively.



- Y39.1 Injector A1
- Y39.2 Injector A2
- Y39.3 Injector A3
- Y39.4 Injector A4
- Y39.5 Injector A5
- Y39.6 Injector A6
- Y39.7 Injector A7 (16 V and 20 V engines only)
- Y39.8 Injector A8 (16 V and 20 V engines only)
- Y39.9 Injector A9 (20 V engines only)
- Y39.10 Injector A10 (20 V engines only)
- Y39.11 Injector B1
- Y39.12 Injector B2
- Y39.13 Injector B3
- Y39.14 Injector B4
- Y39.15 Injector B5
- Y39.16 Injector B6
- Y39.17 Injector B7 (16 V and 20 V engines only)
- Y39.18 Injector B8 (16 V and 20 V engines only)
- Y39.19 Injector B9 (20 V engines only)
- Y39.20 Injector B10 (20 V engines only)
- XXY44 Connection to sensor wiring harness XXY44; ECU output PWM CM2 for fan

TIM ID: 0000017756 - 002

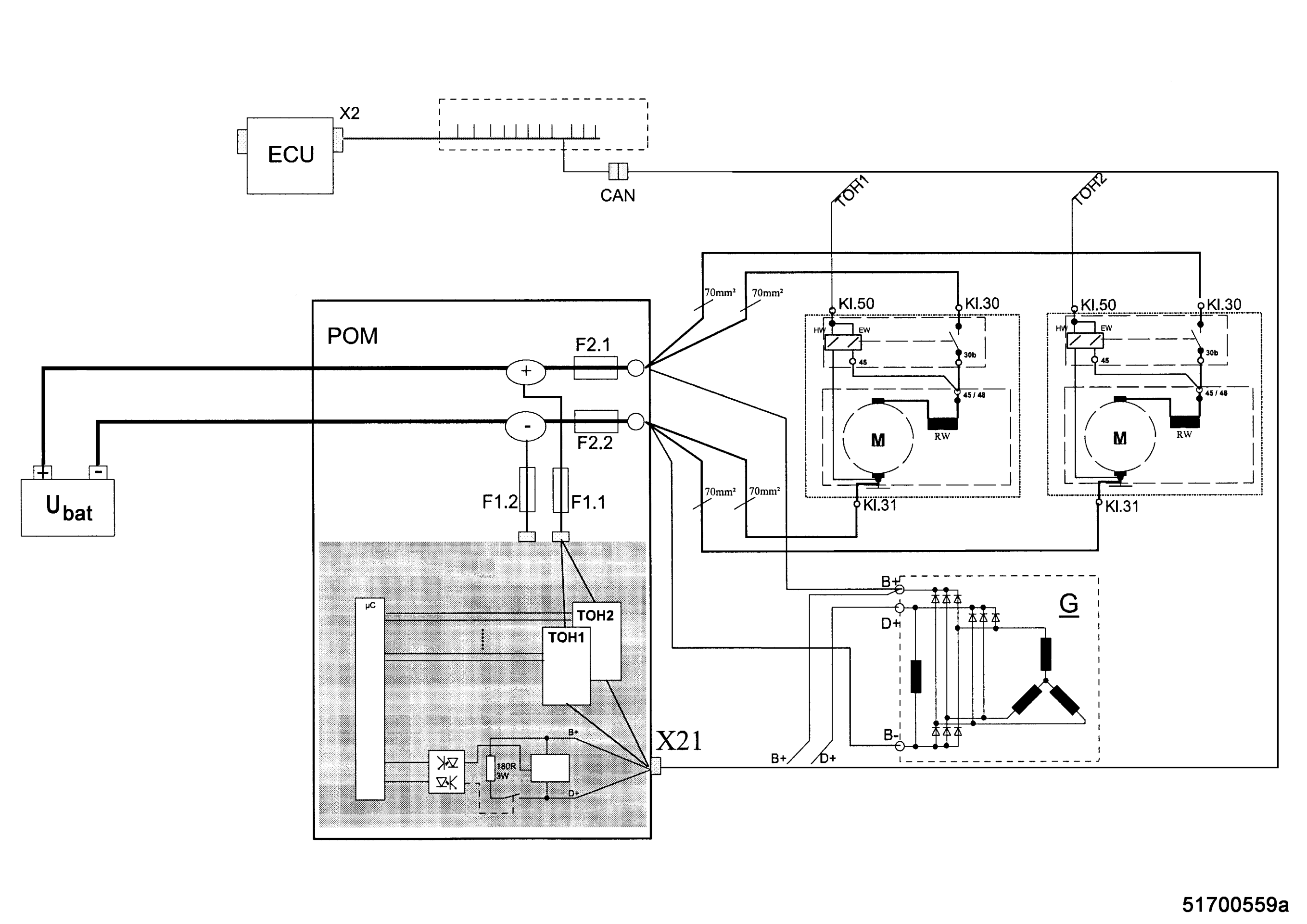
Connector XXY44



The sensor wiring harness (→ Page 128) is connected to connector XXY44. This plug connector loops the output PCM_CM2 from connector X4 of the Engine Control Unit (→ Page 61) to the control valve of the fan (Y44).

5.6 POM wiring harness

Circuitry principle



X21	POM connector (→ Page 77), there X1	G	Battery-charging generator	ECU	Engine Control Unit
CAN	CAN bus wiring CAN_3 between ECU and POM, located in connector X21.2	M	Starter		

A POM is connected to the starters and the generator (if available) via the corresponding wiring harness. Connector X21.2 at the sensor wiring harness makes the connection to the rest of the electronic engine management system (→ Page 128).

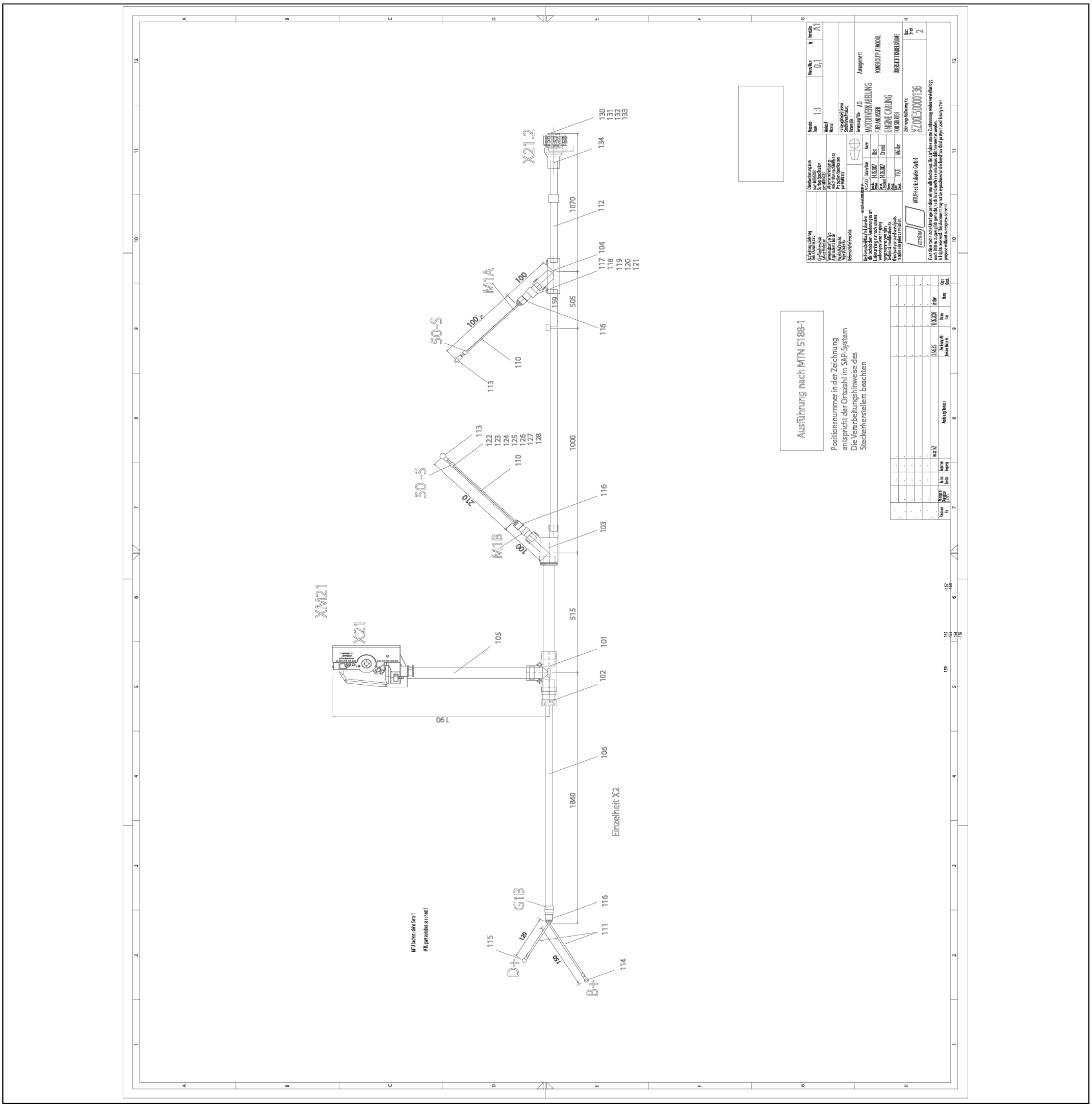
The OEM must connect the two + and – studs of the POM to the power supply at the vehicle. The cables must have the required cross sections.

Further wiring work by the OEM is not required if the POM is used.

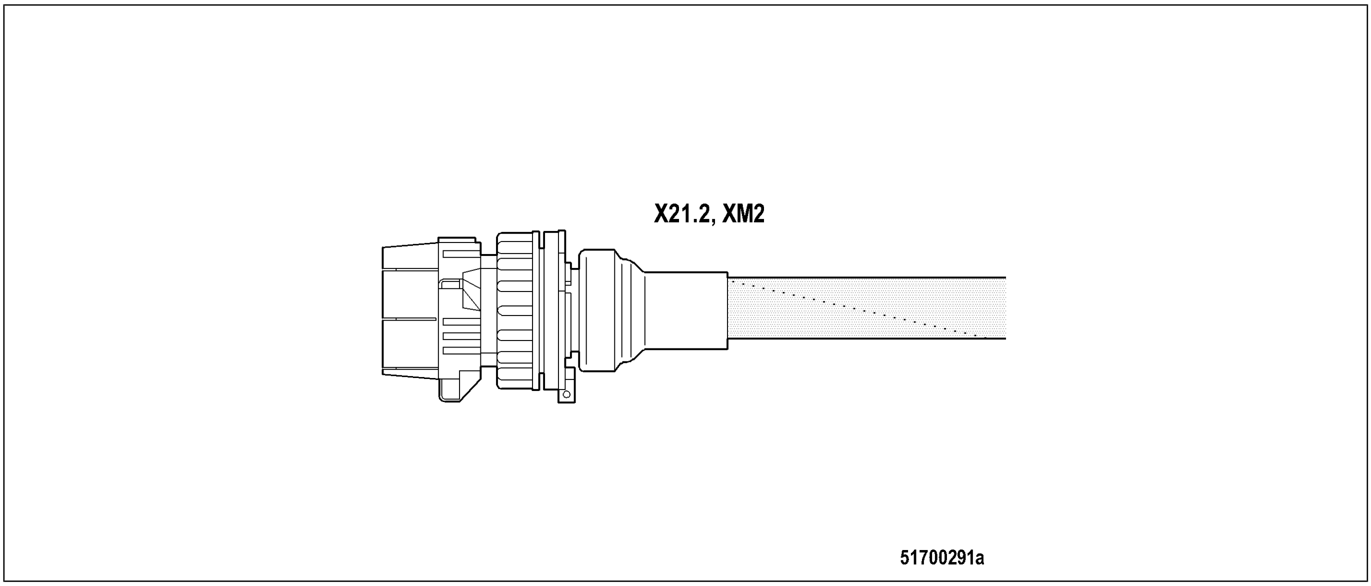
Wiring harness

The wiring harness for connecting the POM differs for the different engines and equipment as follows:

- Different lengths for the different engines
- Different types of starters:
  - Bosch starter: XM1A and XM1B as plug connection
  - DELCO starter: M1A and M1B as cable with cable ring for connection to terminal 50-S of the starters (DELCO starters only through the end of 2007)
- With or without generator: without generator the cable end with the two terminals B+ and D+ does not apply



D+ Generator connection D+ (only if generator available)
B+ Generator connection B+ (only if generator available)
X21 POM cable connector
XM1B Starter on B-side, Bosch, (alternatively: Cable ring for terminal 50-S, DELCO)
XM1A Starter on A-side, Bosch, (alternatively: Cable ring for terminal 50-S, DELCO)
X21.2 Connection to engine wiring harness



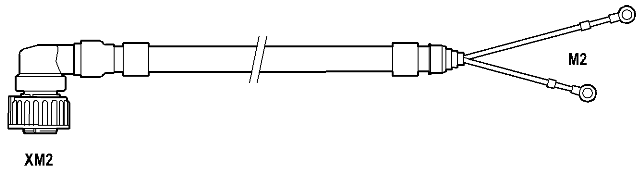
X21.2 Cable connector at engine wiring harness

TIM ID: 0000017755 - 003

5.7 Oil priming pump wiring harness VSP (option)

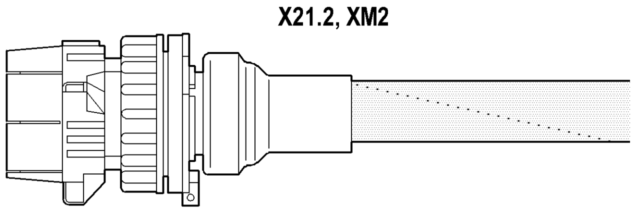
The engine is optionally equipped with an oil priming pump. The electrical actuation occurs fully automatically via the Engine Control Unit (ECU) during the starting sequence. The connection to the electronic engine management system is established via connector XM2 (which is not assigned in the case of engines without oil priming pump). Here the control cable to the oil priming pump is connected.

All cables shown here are included in the scope of delivery of the oil priming pump.



XM2 Connection to engine wiring harness

M2 Cable rings for connecting the relay in the oil priming pump

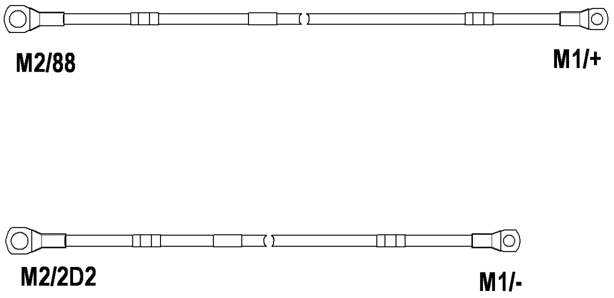


XM2 Cable connector at engine wiring harness

TIM ID: 0000017766 - 002

The supply voltage for the oil priming pump is tapped at one of the starters, since the starters and oil priming pump cannot be in operation simultaneously (automatic control of the starting sequence).

For this purpose two cables with a cross section of 16 mm^2 are used.



51700586a

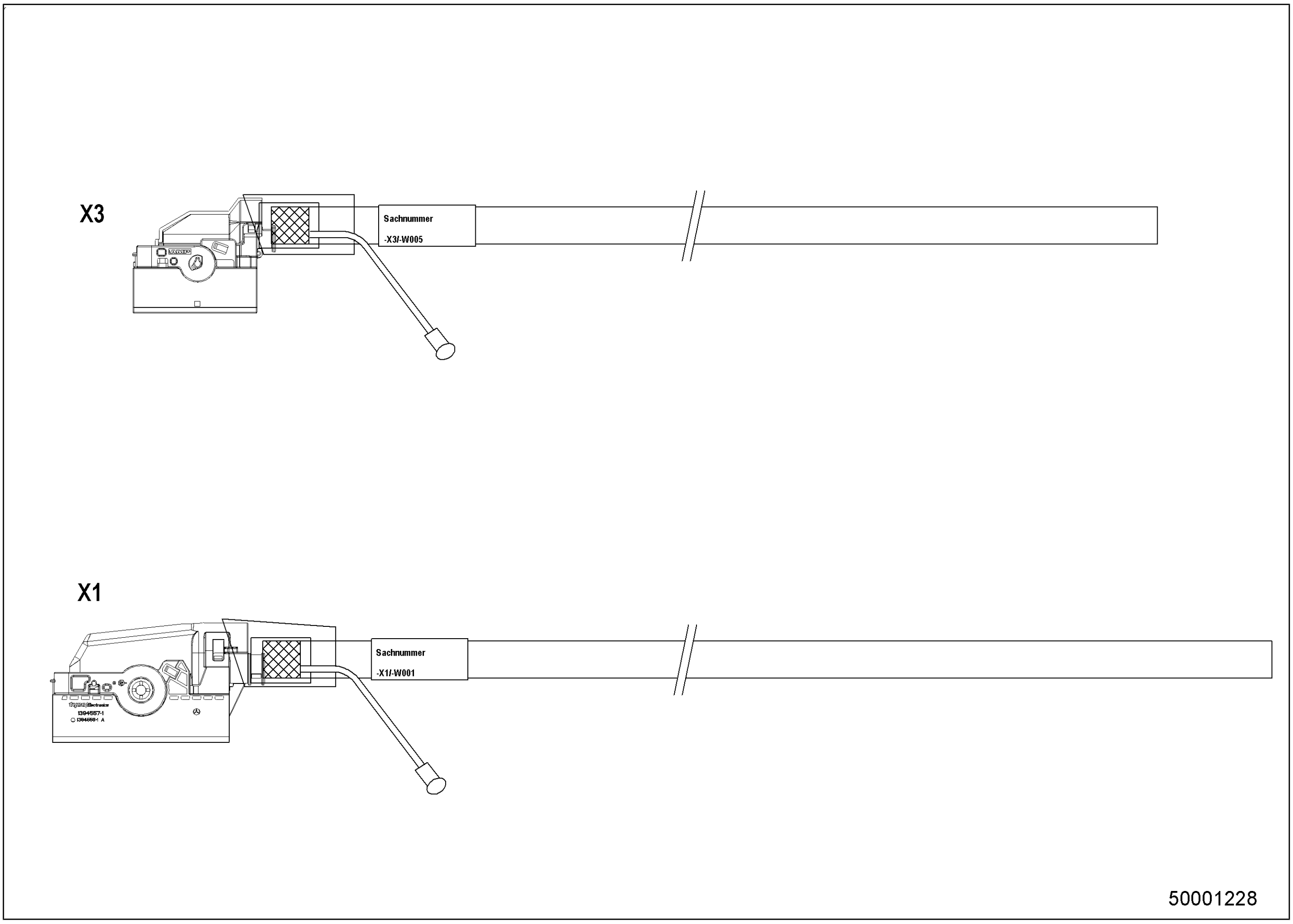
TIM ID: 0000017766 - 002

5.8 Plant Cables

5.8.1 Wiring harnesses on the vehicle

ECU

The two male connectors X1 and X3 are available for connecting the Engine Control Unit (ECU) to the other devices and to the power supply. For these connections the corresponding cables with connectors attached at one end and the other end open are included with delivery.



X3 Connecting cable ECU - power supply
X1 Connecting cable ECU - CAN and parallel-wired signals

Cable W1 has the following assignment:

Designa-tion	Core W1	Signal type	Brief specification	Signal
CAN1_P	1	CAN1_P_H	50 V isolated	Default CAN bus
CAN1_P	2	CAN1_P_L		
CAN1_P	3	CAN1_P_GND		
CAN2_P	5	CAN2_P_H	50 V isolated	Redundant CAN bus
CAN2_P	6	CAN2_P_L		
CAN2_P	4	CAN2_P_GND		

Designa-tion	Core W1	Signal type	Brief specification	Signal
DI1	21	DI1_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Stop
DI1	22	DI1_L	50 V isolated	
DI2	19	DI2_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Torque limitation
DI2	20	DI2_L	50 V isolated	
DI3	17	DI3_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Idling speed increase
DI3	18	DI3_L	50 V isolated	
DI4	15	DI4_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Alarm reset
DI4	16	DI4_L	50 V isolated	
DI5	13	DI5_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Additional engine protection
DI5	14	DI5_L	50 V isolated	
DI6	11	DI6_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Rockford fan ON, manually
DI6	12	DI6_L	50 V isolated	
DI7	9	DI7_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Engine start
DI7	10	DI7_L	50 V isolated	
DI8	7	DI8_H	< 4 V (< 1.1 mA) = low > 8 V (> 1.5 mA) = high	Safety system override
DI8	8	DI8_L	50 V isolated	
ESI	—	ESI_IN	<4 V (2 mA) = low/>8 V (4 mA) = high	Not used
AI1_2	36	AI1_2_5V	5 V/25 mA ±50 V isolated to other potential	5 V supply for AI inputs, not used
AI1	39	AI1_U	0...10 V (not isolated to AI2)	Nominal speed setting, voltage (alternatively to AI1_I))
AI1	23	AI1_I	0...23.7 mA (not isolated to AI2)	Nominal speed setting, current (alternatively to AI1_U))
AI1_2	25	AI1_2_GND	AI_GND ±50 V isolated to other potential	Ground for AI inputs
AI2	40	AI2_U	0...10 V (not isolated to AI1)	Engine torque specification, voltage (alternatively to AI2_I)
AI2	24	AI2_I	0...23.7 mA (not isolated to AI1)	Engine torque specification, current (alternatively to AI2_U)
AO1	27	AO1_OUT	0..10 V/8 mA	Additional fan control
AO2	28	AO2_OUT	0..10 V/8 mA	Load signal 0 ... 10 V

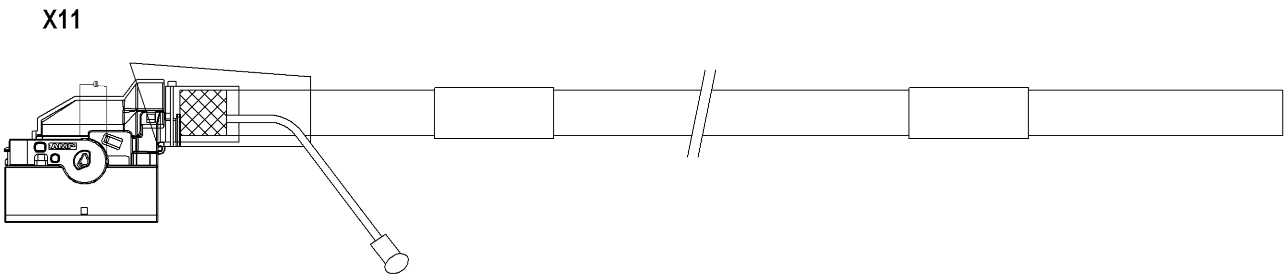
Designa-tion	Core W1	Signal type	Brief specification	Signal
AO1_2_FIP	26	AO1_2 GND	GND	Ground to AO1 and AO2
FIP	37	FIP_IN	0..5 V or frequency input	Speed demand via frequency (optional)
TOP1	31	TOP1_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/sink	Combined YELLOW alarm
TOP2	29	TOP2_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/sink	Combined RED alarm
TOP1_2	30	TOP1_2_GND	LGND (3 A)	Ground to TOP1 and TOP2
TOP3	32	TOP3_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/sink	“Engine cold” signal
TOP4	33	TOP4_OUT	24 V/TOP1+..+TOP4 = 3 A; max. 1.5 A source/sink	Starter ON
TOP3_4	34	TOP3_4_GND	LGND (3 A) 17	Ground to TOP3 and TOP4
FO	38	FO_OUT	24 V/1.5 A sink to LGND/ <500 Hz	Load signal (optional)
ITS_O	—	TxD_1	ITS OFF -> ITS_O (3) Jumper to ITS_I (2)	For internal use only
ITS_I	—	RxD_1	ITS OFF -> ITS_O (3) Jumper to ITS_I (2)	
FGND	—	—	NC	

Cable W5 has the following assignment:

Designa-tion	Core W3	Signal type	Brief specification	Signal
POWER	3	+24 V	24 V/30 A	Power supply
POWER	4	+24 V		
POWER	5	+24 V		
POWER	6	+24 V		
POWER	7	GND	GND/30 A	Voltage supply ground
POWER	8	GND		
POWER	9	GND		
POWER	10	GND		
IGI	2	IGI_24 V	24 V/10 mA	Not used
IGI	1	IGI_IN	<4 V (2 mA) = low >8 V (4 mA) = high	Ignition ON

EMU

Connector X11 is provided to connect individual cylinder exhaust gas temperature monitoring EMU to the other devices and the power supply. For this connection a corresponding cable with a connector attached at one end and the other end open is included in the scope of delivery.



X11 Connecting cable EMU - CAN and power supply

Cable W41 has the following assignment:

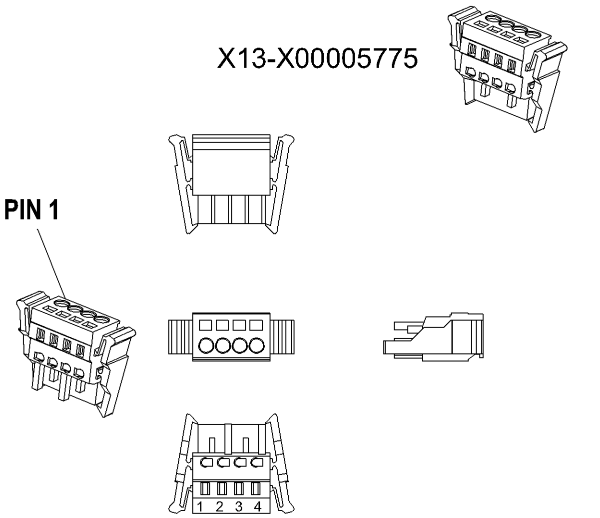
Designation	Core W41	Signal type	Brief specification	Signal
POWER	1	+24 V	24 V / 5.5 A	Power supply
POWER	2	GND	Ground	
CAN 1 H	11	CAN bus	HIGH level	Jumper to wire 13
CAN 1 L OUT	12	CAN bus	LOW level	Jumper to wire 14
CAN 1 H IN	13	CAN bus	HIGH level	Jumper to wire 11
CAN 1 L IN	14	CAN bus	LOW level	Jumper to wire 12
CAN 1 GND	15	CAN bus	CAN ground	
CAN 2 GND	16	CAN bus	CAN ground	
CAN 2 H	17	CAN bus	HIGH level	Jumper to wire 19
CAN 2 L OUT	18	CAN bus	LOW level	Jumper to wire 20
CAN 2 H IN	19	CAN bus	HIGH level	Jumper to wire 17
CAN 2 L IN	20	CAN bus	LOW level	Jumper to wire 18

TIM ID: 0000017757 - 002

5.8.2 SAM connector set

To manufacture the cables at the plant, a pre-labeled connector set mounted on the SAM is included in the delivery, namely a set of plug connectors with spring tension clamps; installation of the cables requires no end sleeves or screw terminals. Handling is similar to that for terminal blocks (→ Page 145).

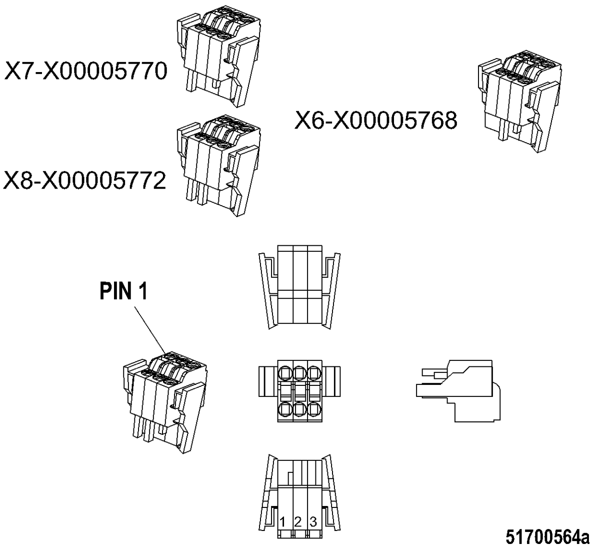
Voltage supply X13



51700565a

This is a 4-pole connector, with each set of 2 adjacent pins being electrically interconnected in the SAM. The power supply MUST be connected via both pins of a pair of contacts respectively (2 pins for +24V and 2 pins for GND). The current flowing over the pin may be too high if only one pin is connected. Strands with cross sections up to 2.5 mm^2 can be connected.

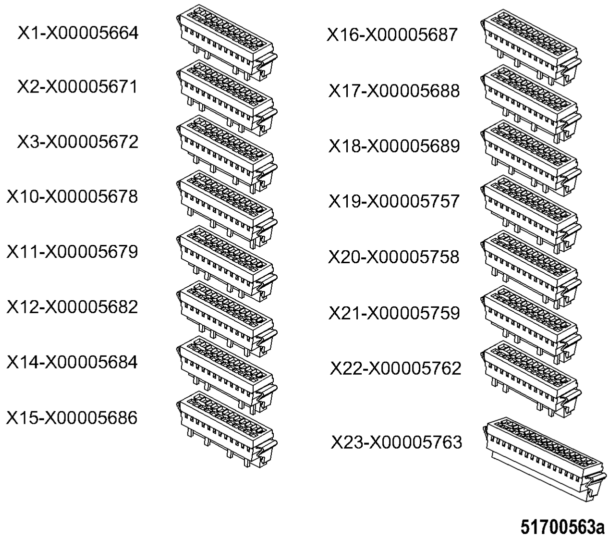
CAN connectors X6, X7 and X8



51700564a

These connectors connect the CAN buses. The CAN GND (always at pin 1) must NOT be connected to other grounding components or connectors. The connectors are jumpered internally thus making it possible to connect both the CAN cables to the Engine Control Unit ADEC and the termination resistors or the cables for onward connection of the CAN bus (e.g. to DIS10) to separate terminals.

I/O connectors



These 12 and 16-pole connectors connect all input and output signals to the SAM.

TIM ID: 0000017742 - 002

6 Processing Specifications

6.1 Preparing terminal strips or terminal blocks (spring terminals)

Preconditions

- Cables are routed properly.
- Cables are long enough.

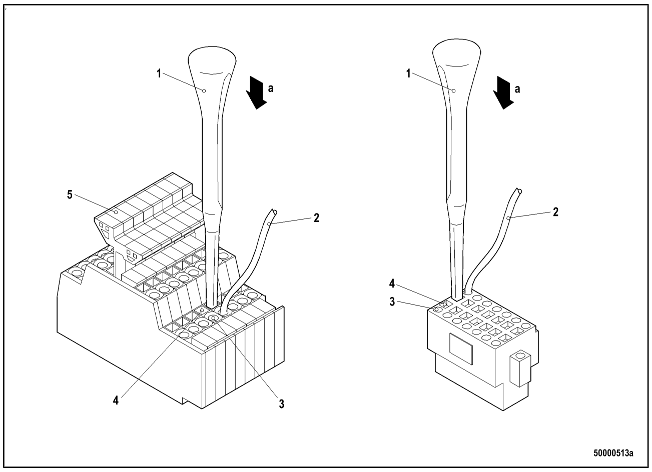
Special tools

Designation / Use	Part No.	Qty.
Actuator tool	0015383830	1

Cutting individual wires to size

1. Determine the terminal to which the wire concerned is to be connected (→ terminal diagram or wiring diagram).
2. Cut each wire to a suitable length.

Connecting wires (illustration of terminal block and connector type are examples, delivered assemblies may vary)



1. Strip back the insulation on the first wire by approx. 8 mm.
2. For litz wires: Twist litz.
3. Do not fit wire-tip sleeves!
4. Route wire to the associated terminal (→ terminal diagram or wiring diagram).
   Note:
   Never use metal-tipped screwdrivers as an actuator tool!
5. Press the actuator tool (1) firmly into the square hole (4) in the direction indicated by the arrow (a). Bend the inscription tag (5) to one side if necessary.
6. Insert wire (2) into round hole (3).
7. Remove actuator tool.
8. Connect all other wires in the same way.

Final steps

1. Check firm seating of all connections which have been established.
2. Bundle individual wires appropriately with cable ties.
3. Remove all foreign bodies (bits of cable, pieces of cable tie etc.) from the housing.

TIM ID: 0000016698 - 003

TIM ID: 0000016698 - 003

7 ADEC and SAM - Functions and Parameters

7.1 Engine Governor Functions

7.1.1 ECU signals

Engine-side – Plant side

The channels of the different inputs and outputs at Engine Control Unit are divided into two groups:

- Channels at engine end
- Channels at plant

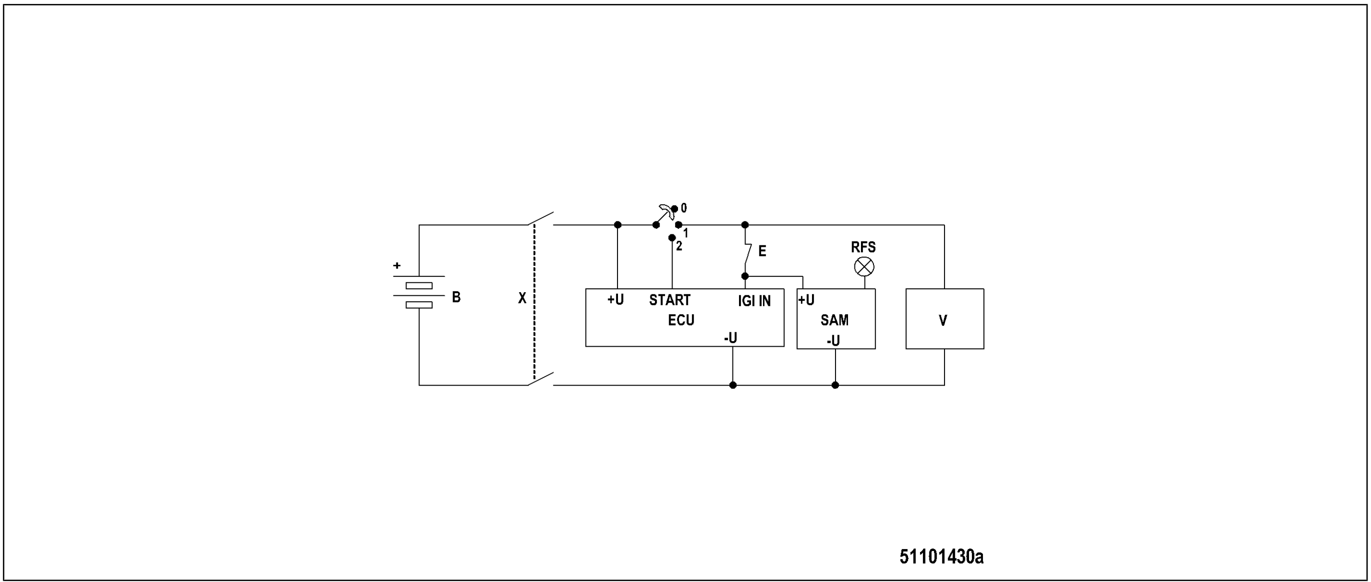
All channels at the engine end lie on the connector X2 (with exception of the injectors and of PWM_CM2, which lie on the connector X4). All sensors and actuators of the engine are connected here, via the engine wiring harness factory installed and connected to the engine.

The two external sensors F33 and F70 are also connected here. Since they are not directly attached to the engine, however, the engine wiring harness has two connectors (XF33 and XF70, mounted on an inspection port cover). One cable each of a suitable length for the sensor concerned can be connected to these two connectors (→ Page 117).

Supply

The power supply is connected to connector X3 (see wiring diagram).

Schematic circuit diagram



B	Battery	RFS	"Ready for start" indicator lamp	E	Emergency stop (NC contact)
+U	Engine Control Unit operating voltage	V	Vehicle		
0-1-2	Key switch	X	Battery master switch		

Supply

The power supply must meet the following requirements:

- STANAG 1008
- EN50155
- Power consumption approx. 17A (without load at SAM)

Ignition input (IGI)/emergency stop

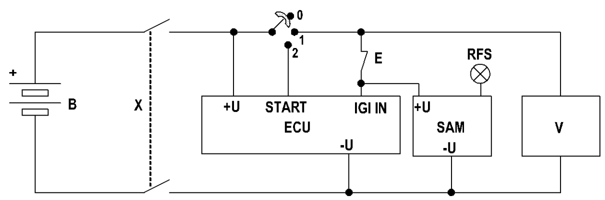
Technical data

- Control via:
  - Supply +24 V DC, $+U_{batt}$
- Channel specification
  - Voltage: 0 ... 46 V DC
  - Current: Approx. 4.8 mA at 24 V DC
  - Electrical isolation: No
  - Pin not connected or U_{in} < 4 V: ignition OFF; U_{in} > 11 V: Ignition ON

Required settings:

None

Schematic circuit diagram



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B	Battery	SAM	Module	+U	Positive supply voltage
ECU	Engine Control Unit	V	Vehicle	IGI IN	Boot power supply
+U	Operating voltage	E	Relay contact to disconnect from the power supply in the event of an emergency stop being triggered (→ Page 121)		

The IGI input switches on the Engine Control Unit. Switching off the input causes an immediate engine stop by switching off the actuation of the injectors.

The Engine Control Unit switches to “sleep mode” after a certain time.

A special feature of the IGI input is that it may be used as an emergency stop input. In this case an NC contact is connected upstream of the input. If the level at the input drops to LOW (below 4 V), the output amplifier for the injectors is switched off by the hardware. The engine stops immediately.

Emergency stop input (ESI)

This input is not used for C&I applications. The channel offers a further possibility for triggering an emergency stop. For C&I applications, this input should not be connected or connected to GND.

TIM ID: 0000017740 - 002

Binary inputs DI 1 ... 8

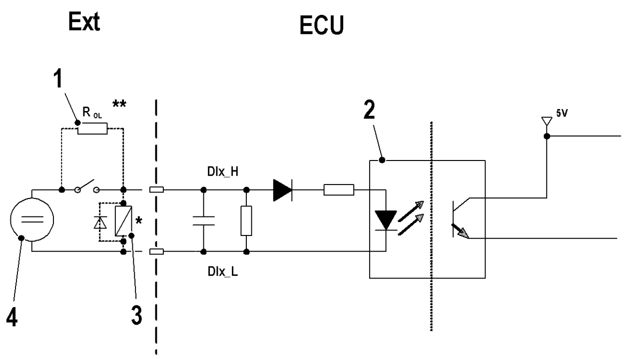
Technical data

- Channel specification
  - Switches: external voltage or $+U_{bat}$
  - Input voltage 0 ... 32 V DC
  - LOW detection: $U_{in} < 4$ V
  - HIGH detection: $U_{in} > 8$ V
  - Input impedance: 12.1 kΩ
  - Input filter: f < 19 Hz
  - Electrical isolation: Up to 50 VDC
  - Cable break monitoring: Current monitoring with R_{OL} = 33 kΩ ± 10%, see figure

Required settings:

- Open line (cable break monitoring active)
- Logic: “Active High” or “Active Low”

Schematic circuit diagram



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1 Resistor for cable break monitoring
2 Optocoupler
3 Inductive load
4 Voltage source
* A free-wheeling diode must be provided for inductive loads.
** Cable break monitoring is only possible when no load is connected in parallel to input DI.

DI 1 – Engine stop

The engine stop signal is activated as soon as this input is switched off. The signal is stored until the engine has come to a standstill.

Parameter:

- Cable break monitoring DI1: 2.9902.001
- Logic DI1: 2.9910.015
- Stop stored: 2.7001.009

DI 2 – Torque limitation

When this input is switched on, the maximum engine torque is limited to an adjustable value. This value can be attained only if no other power limitation is active, however (e.g. power limitations to protect the engine)

Parameter:

- Cable break monitoring DI2: 2.9902.011
- Logic DI2: 2.9910.025

TIM ID: 0000017740 - 002

DI 3 – Increase idling speed

After switching on this input, the idling speed is increased to a defined (adjustable) value.

Parameter:
- Cable break monitoring DI3: 2.9902.021
- Logic DI3: 2.9910.035

DI 4 – Alarm reset

Stored alarms are reset by activating this input.

Alarms leading to a yellow or red alarm are stored. Indication via the corresponding binary output remains unchanged until canceled via the “Alarm reset” input.

Parameter:
- Cable break monitoring DI4: 2.9902.031
- Logic DI4: 2.9910.045

DI 5 – Auxiliary engine protection input

If this input is active, the engine is protected by one of the following measures (adjustable):
- Warning
- Power limitation or power reduction
- Shutdown

Parameter:
- Cable break monitoring DI5: 2.9902.041
- Logic DI5: 2.9910.055

DI 6 – Rockford fan ON – manual

The fan is driven directly by the engine via a belt. The power transmission and the resulting fan speed are influenced by a multi-disk clutch (Rockford Clutch) controlled by the oil pressure. The oil pressure is controlled by an electrically operated valve. The control current for the valve is pulse-width modulated (PWM).

If input DI 6 is activated, the clutch is closed. The fan speed increases to the maximum speed (minimum PWM) depending on the engine speed.

Parameter:
- Cable break monitoring DI6: 2.9902.051
- Logic DI6: 2.9910.065

DI 7 – Engine start

Activating this input initiates the automatic engine starting sequence. The signal must be applied throughout the entire starting sequence. An interruption cancels the starting sequence.

Parameter:
- Cable break monitoring DI7: 2.9902.061
- Logic DI7: 2.9910.075

DI 8 – Override

The “Override” function is used to suppress safety functions that would result in a power reduction or the automatic shutdown of the engine in the event of a limit value violation (incl. overspeed!). Internal performance maps cannot be bypassed.

When the “Override” function is switched on, engine protection functions, e.g. engine shutdown, are ignored.

Parameter:
- Cable break monitoring DI8: 2.9902.071
- Logic DI8: 2.9910.085

TIM ID: 0000017740 - 002

Analog inputs AI 1 ... 2

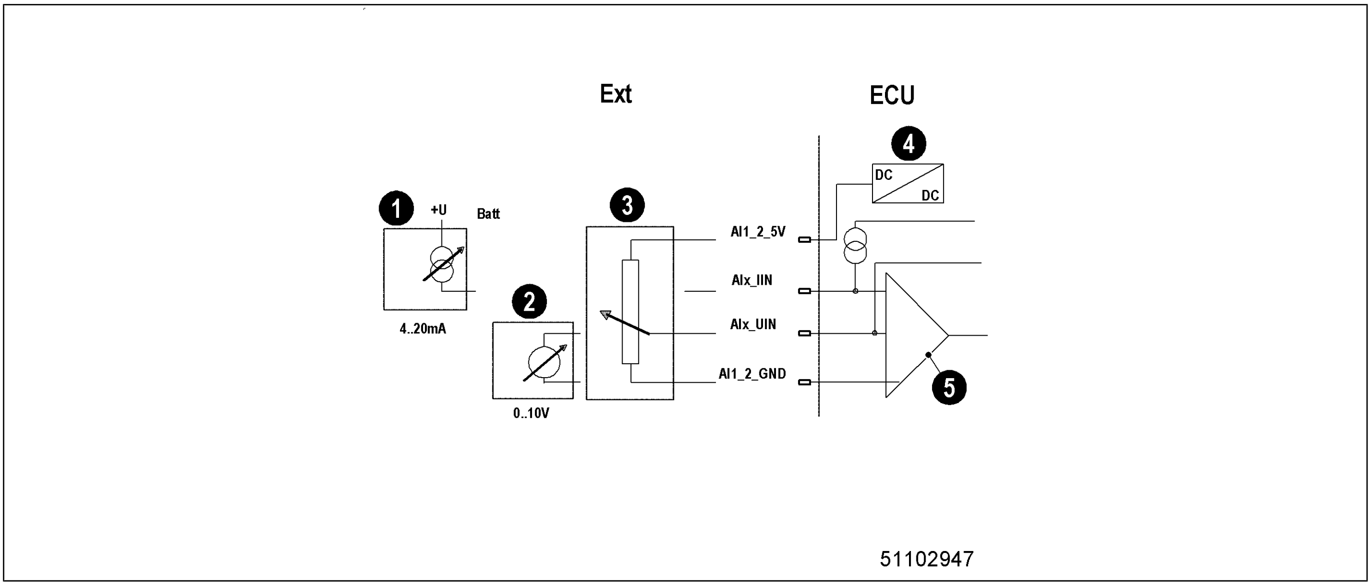
Technical data

- Channel specification
  - Sensors: Power sources, voltage sources or potentiometer
  - Sensor supply: 5 V DC ± 3%, max 25mA (AI 1_2_5 V)
  - Voltage input: 0 ... 10 V DC, input impedance 100 kΩ, filter 200 Hz
  - Current: 0 ... 20 mA nom., 0 ... 25 mA max.; compliance voltage 4.5 V at 20 mA
  - Electrical isolation: 50 VDC
  - Voltage input fault detection: U > 10 V
  - Current input fault detection: I < 4 mA, I > 20 mA
  - Power supply protection: Short circuit to GND, overvoltage 36 VDC

Required settings:

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

Schematic circuit diagram



1 Control via current source
2 Control by voltage source
3 Control by resistor
4 Supply voltage for potentiometer connection
5 Input amplifier

AI 1 – Speed demand

The engine speed can be set between idling speed and rated speed (maximum speed). This analog signal allows the speed to be set at a certain value whereby 4 mA / 0 V corresponds to idling speed and 20 mA/10 V to rated speed. Sudden changes in speed are executed along 3 programmable speed ramps (acceleration ramp or deceleration ramp).

Parameter:

- Configuration: 2.9900.001
- Curves:
  - Voltage: 2.0401.010
  - Current: 2.0401.012
  - Frequency: 2.0401.014

AI 2 – Torque request

This signal corresponds to the torque setting in torque-controlled systems. For a fuel injection governor this corresponds to the load specification in %.

Parameter:
- Configuration: 2.9900.011

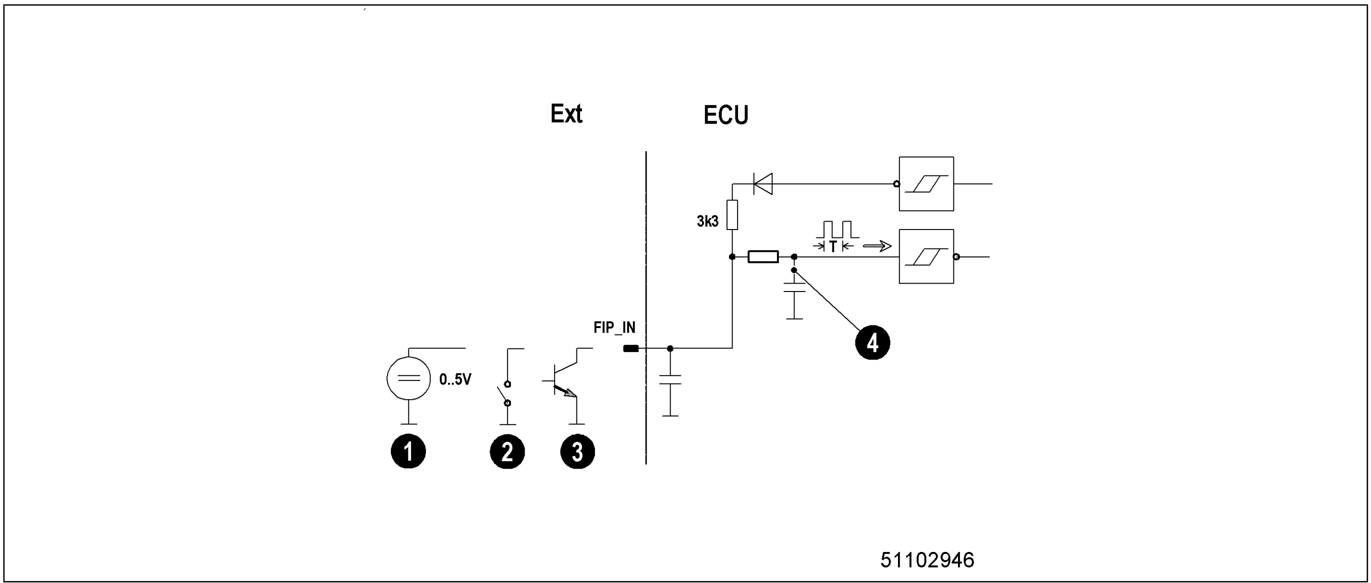
Frequency input FIP

Channel specification/technical data

- Sensor: 0 ... 5 V DC
- High/Low hysteresis: High for U_{in} > 2.1 V, Low for U_{in} < 0.7 V
- Measuring range: 10 ... 1000 Hz
- Pull-up resistor: 3.3 kΩ
- Filter: 14.5 kHz
- Electrical isolation: None
- Overvoltage protection: ± 46 VDC

The engine speed can be set between idling speed and rated speed (maximum speed). This frequency input allows an engine speed change. The correlation between frequency and corresponding speed can be adjusted via a curve (default: 5Hz/min $^{-1}$).

Schematic circuit diagram



1 Control via current source
2 Control via switch/relay
3 Control via transistor switch
4 Filter with f_g = 14.5 kHz

Transistor outputs TOP 1 ... 4

Channel specification/technical data

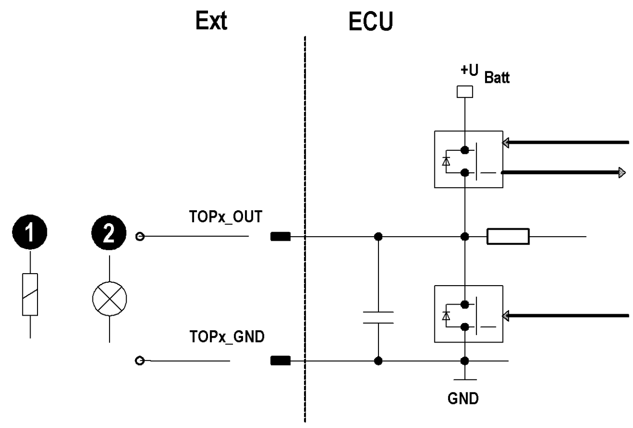
- Control of:
  - Lamps
  - Relay
  - Digital inputs
- Channel specification
  - I_{Load} of an output: 1.5 A at 32 V
  - Total output current of TOPs 1 ... 4 must not exceed 3 A at 32 V
  - Output voltage without load: From “Low Switch” approx. 5 V, from “High Switch” approx. 0 V
  - Max. inductivity of load: 140 mH
  - Electrical isolation: None
  - Short-circuit protection: Yes
  - Cable break monitoring: only possible if R_L is less than 25 kΩ

TIM ID: 0000017740 - 002

Required settings:

- “Low Switch” or “High Switch”:
- Cable break monitoring on/off

Schematic circuit diagram



1 Inductive load
2 Resistive load
* A free-wheeling diode must be provided for inductive loads.

TOP 1 – Yellow alarm

This output is switched on as soon as a yellow alarm (warning) is indicated. The output is briefly switched off and then back on again should another alarm occur.

Parameter:
- Active level: 2.1050.005
- “Low Switch” or “High Switch”: 2.1050.010

TOP 2 – Red alarm

This output is switched on as soon as a red alarm is indicated. The output is briefly switched off and then back on again should another alarm occur.

Parameter:
- Active level: 2.1050.006
- “Low Switch” or “High Switch”: 2.1050.011

TOP 3 – "Engine cold" signal

This output is switched on when the engine temperature falls below the limit value (adjustable), measured at various measuring points on the engine.

Parameter:
- Active level: 2.1050.007
- “Low Switch” or “High Switch”: 2.1050.012

TOP 4 – Starter On (alternatively: speed window)

The function of this output is adjustable:
- Starter ON: The output is used to switch on the starter.
- Engine running: the output is switched on as soon as the engine speed exceeds 300 rpm.
- Speed window: the output is switched on when the engine speed is between two (programmable) speed values (e.g. for engagement/disengagement)

Parameter:

- Active level: 2.1050.008
- “Low Switch” or “High Switch”: 2.1050.013

Frequency output FO – Engine load signal

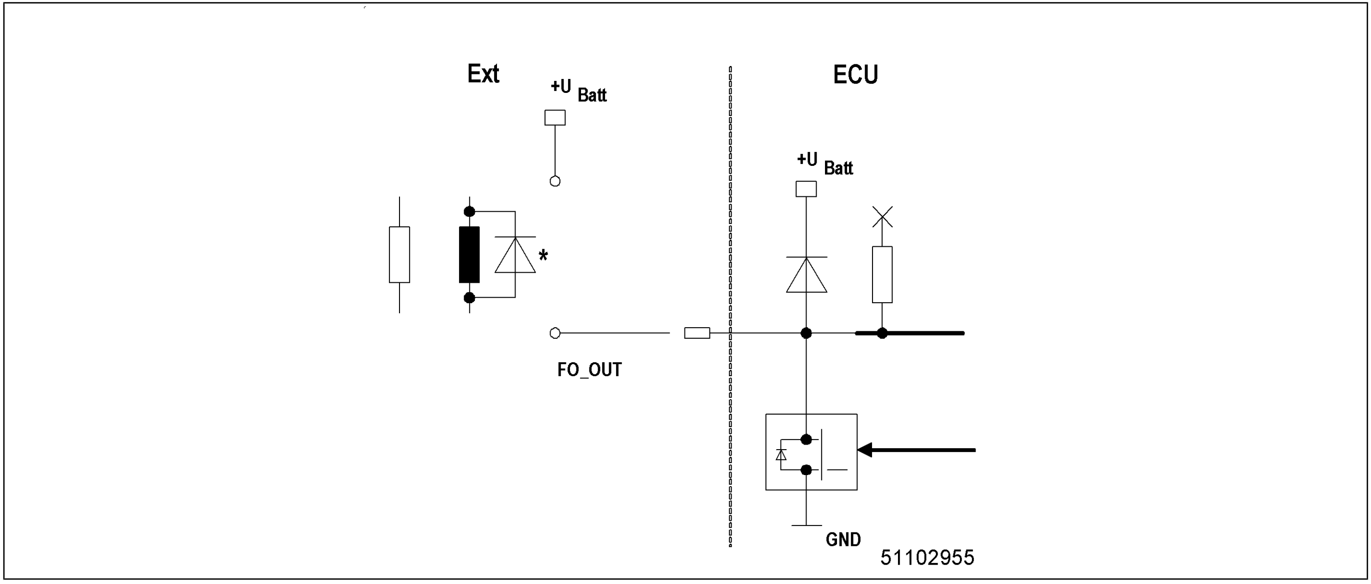
Channel specification/technical data

- Control of:
  - Linear solenoids (external diode required)
  - Lamps
  - Relay
  - Digital inputs
- Channel specification
  - I_{load} of an output: 1.5 A at 32 V
  - Output voltage without load, transistor off: Approx. 11 V “off”
  - Voltage range: 11 ... 32 V
  - Switching frequency: 16 .... 1000 Hz
  - Pulse width: 0% off / 5% ... 95% / 100% on
  - Electrical isolation: None
  - Short-circuit protection: Yes
  - Overcurrent-proof: Yes
  - Overcurrent detection: Yes, channel is switched off

Required settings:

None

Schematic circuit diagram



Resistive load * Inductive load * A free-wheeling diode must be provided for inductive loads.

The engine load signal is an analog output signal (frequency). Also see Chapter: “AO 2 – Optimum load”.

TIM ID: 0000017740 - 002

Analog outputs AO 1 ... 2

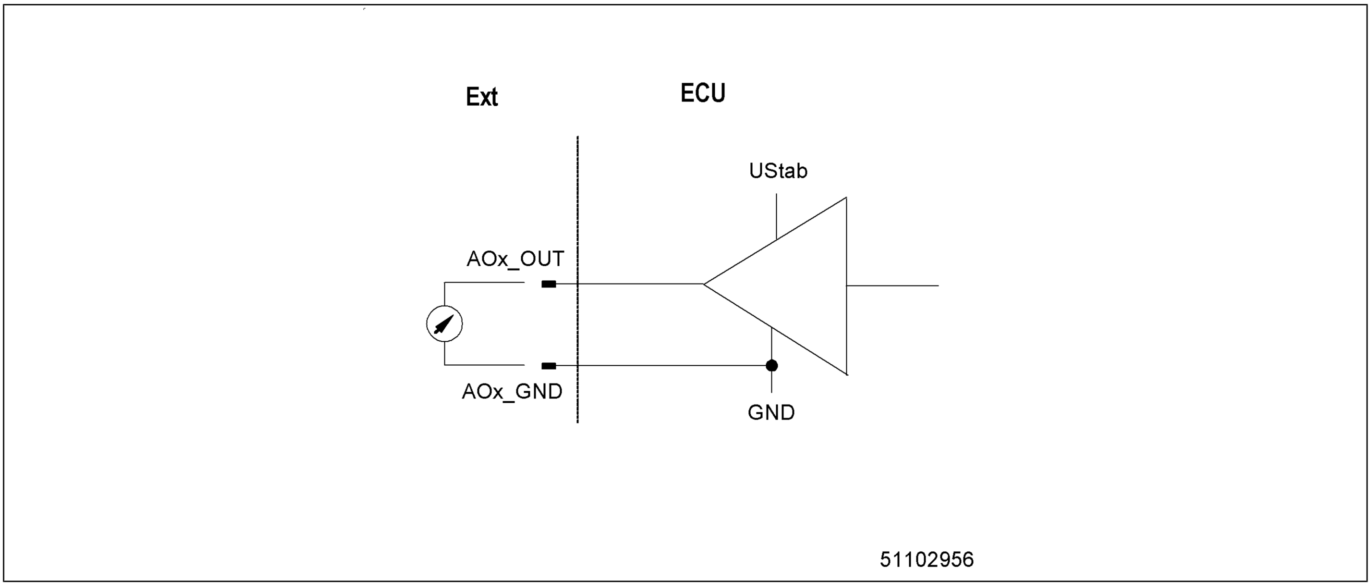
Channel specification/technical data

- Control of:
  - Display instruments
  - Analog inputs
- Channel specification
  - Output voltage: 0 ... 10 V
  - Output voltage without load: Approx. 0V
  - Short-circuit current: 17 mA
  - I_{max}: 0 ... 8 mA at 10 V
  - Settling time: 45 ms
  - Electrical isolation: None
  - Cable break monitoring: No
  - Overvoltage protection: 36 V DC

Required settings:

None

Schematic circuit diagram

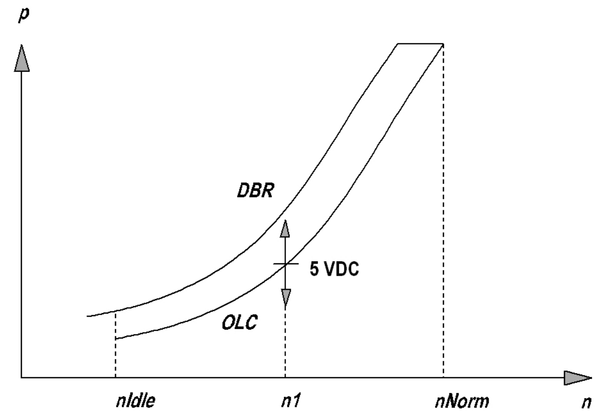


AO 1 – Fan control 1

This output signal is equivalent to the signal for the Rockford fan control (PWM signal)

TIM ID: 0000017740 - 002

AO 2 – Optimum load



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The engine load signal is an analog output signal (between 0.5 VDC and 10 VDC) which is defined as follows:

- 5 V DC: engine load lies on the optimum on the load curve
- U < 5 VDC: Engine load is located above the load curve for the optimum (overload)
- U > 5 V DC: Engine load is located below the load curve for the optimum (underload)

The load curve for the optimum is the adjusted curve with an optimum ratio between fuel consumption and power reserve. If this ratio is on the load curve for the optimum, the ratio is at the optimum point.

Any deviation indicates an overload or underload.

The output “AO 2 – Optimum load” indicates the current operating point of the engine relative to the programmed load curve for the optimum. Any deviation from this curve towards underload results in an increase of this voltage. Any deviation from this curve towards overload results in a reduction of this voltage.

The ratio between the deviation and the load curve can be programmed.

The engine load signal forms the basis for the vehicle control system requesting an increase or decrease in the engine speed. A signal for limiting the power request may also occur.

CAN interfaces 1 ... 2

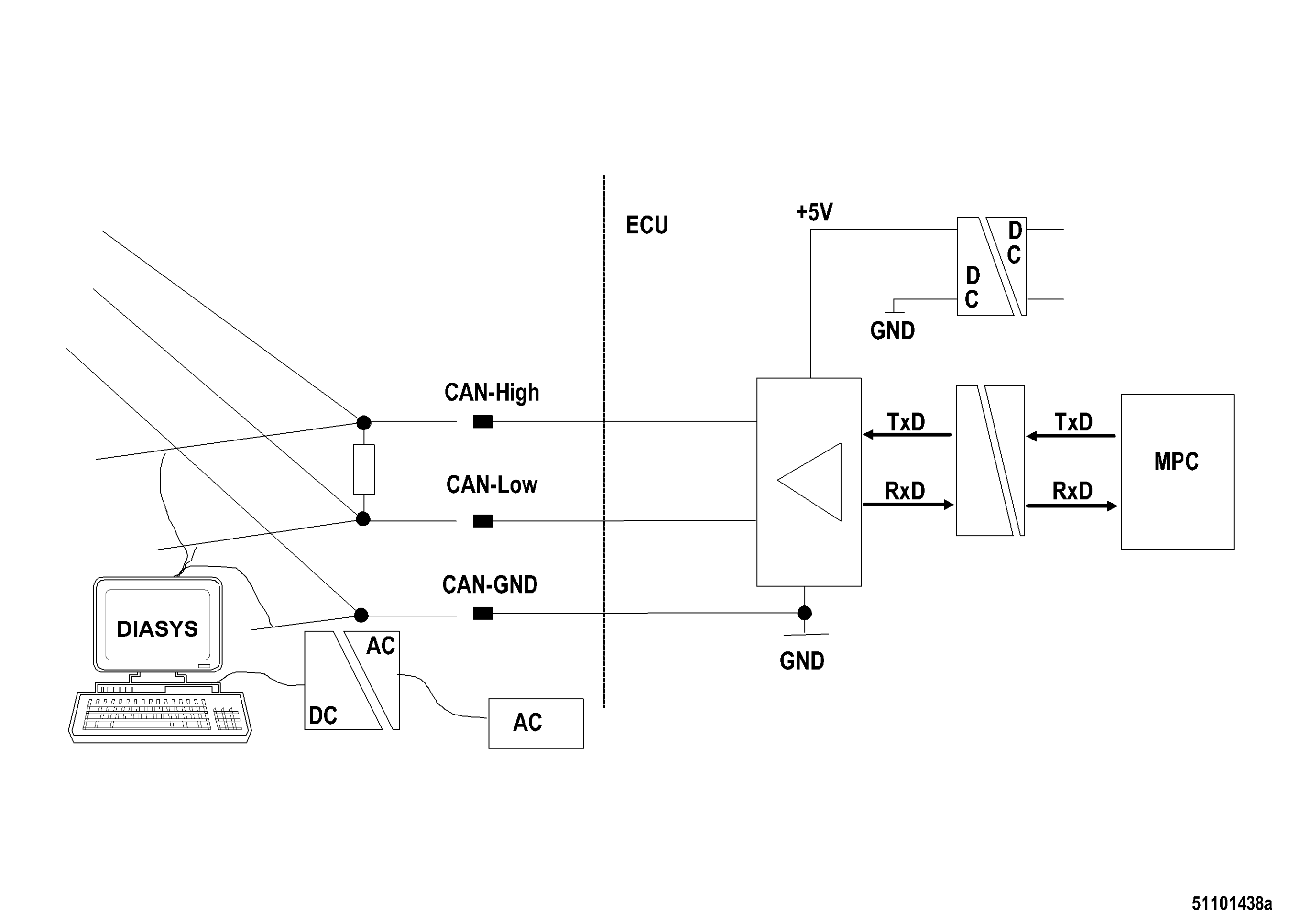
Channel specification/technical data

- Channel type: Controller Area Network (CAN) serial interface
- Control of:
  - CAN bus
- Channel specification
  - High-speed CAN as per ISO 11898 (24 V)
  - PCS-5 protocol
  - CAN specification 2.0B 11/29 bit identifier
  - Electrical insulation from ECU-GND

Required settings:

None

Schematic circuit diagram



CAN	Controller Area Network	DC	DC voltage	RxD	Received data
GND	Ground	AC	AC voltage		
ECU	Engine Control Unit	TxD	Transmission data		

CAN 1 – PCS-5

This CAN interface is used to connect the Engine Control Unit to all other MTU devices via the CAN bus. This is the default bus.

CAN 2 – PCS-5

This CAN interface is also used to connect the Engine Control Unit to all other MTU devices via the CAN bus. This is the redundant bus.

TIM ID: 0000017740 - 002

7.1.2 Safety features of the Engine Control Unit

Engine safety
Alarm types

Type 1 — OEM alarms

OEM alarms have the following characteristics:

- Always assigned to the red summary alarm
- Alarm must be reset manually by the operator (activation of ECU-7 input DI4 or J1939/CANOpen interface or ignition off/on)
- Only for the 2nd limit value (Protection Module of the Engine Control Unit)
- Transmission of an alarm message of its own to the serial interface of the SAM (CANOpen or J1939).
- This can be evaluated for (additional) responses by the vehicle controller.
- OEM selects appropriate system response to protect the engine:

- Warning
- Torque reduction or torque limitation
- Engine shutdown

There are two different types of OEM alarm:

- Type 1a: The alarm starts and blocks the Crash Recorder

  The Crash Recorder is a feature with its own memory area in the ADEC. It is tripped by certain red alarms (Type 1a OEM alarm) which means that important engine operating values before, during and after the alarm are stored. The memory areas (20s to 1 hour) are clearly defined and are initiated by predefined red alarms. This feature facilitates evaluation of the operating states preceding engine damage.

- Type 1b: The alarm does not start the Crash Recorder.

Type 2 — Single-point alarms of the Engine Control Unit

Single-point alarms of the Engine Control Unit have the following characteristics:

- Assigned to the yellow summary alarm (in case of 1st limit value violation) or red (in case of 2nd limit value violation
- Transmission of an alarm message of its own to the serial interface of the SAM (CANOpen or J1939).
- This can be evaluated for (additional) responses by the vehicle controller.
- No modification of the appropriate system response by the OEM possible, a warning is always issued

Type 3 — Summary alarms of the Engine Control Unit

Summary alarms of the Engine Control Unit have the following characteristics:

- Indication of recurring alarms
- Assigned to the yellow summary alarm (1st limit value violation)
- Output via the summary message “AL ECU Fault/See Fault Code” to the serial interface of the SAM (CANOpen or J1939). All active type 3 summary alarms are also transmitted cyclically to the serial interface of the SAM (CANOpen or J1939) in the form of running fault codes.
- The alarm can also be identified by reading off the SAM display, using the dialog system DiaSys ® or viewing the corresponding process variables at the serial interface of the SAM (CANOpen or J1939).
- No separate transmission via the serial interface of the SAM (CANOpen or J1939) takes place
- No modification of the appropriate system response by the OEM possible, a warning is always issued

Engine protection

The following instructions must be followed to protect the engine in case of alarm:

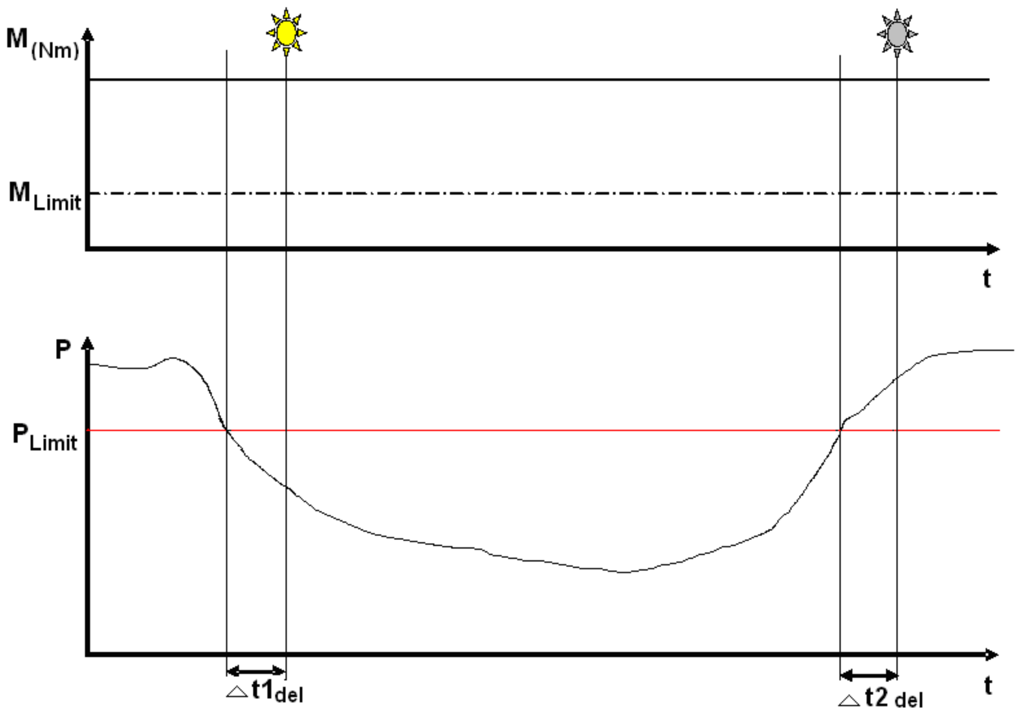
- Program the desired response of the engine governor in the ECU-7 (see description of system responses for Type1 OEM alarms)
- Have the engine serviced as soon as possible following a yellow alarm.
- Shut the engine down immediately if a red alarm is signaled (if this has not already been realized by a function programmed in the Engine Control Unit)

Warning

When a fault is detected a yellow or red alarm is signaled when the alarm timeout has expired.
The engine is not limited or shut down if only a “Warning” is programmed for the fault concerned.

Appropriate counteraction to protect the engine is at the discretion of the user.

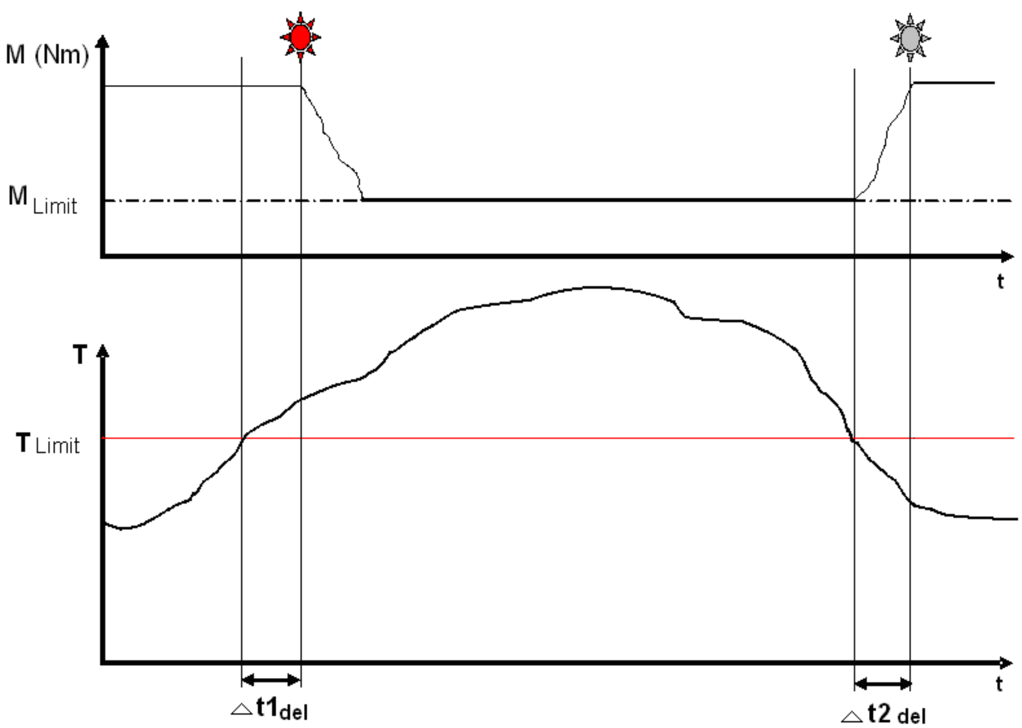
The user is solely responsible for preventing engine damage in this moment.



-M (Nm) Torque in Newton meters
-M Limit Limited torque
-P Pressure (monitored measurand)
-P Limit Limit value
-t Time axis
-t1del Alarm On timeout
-t1del Alarm Off timeout

Torque reduction

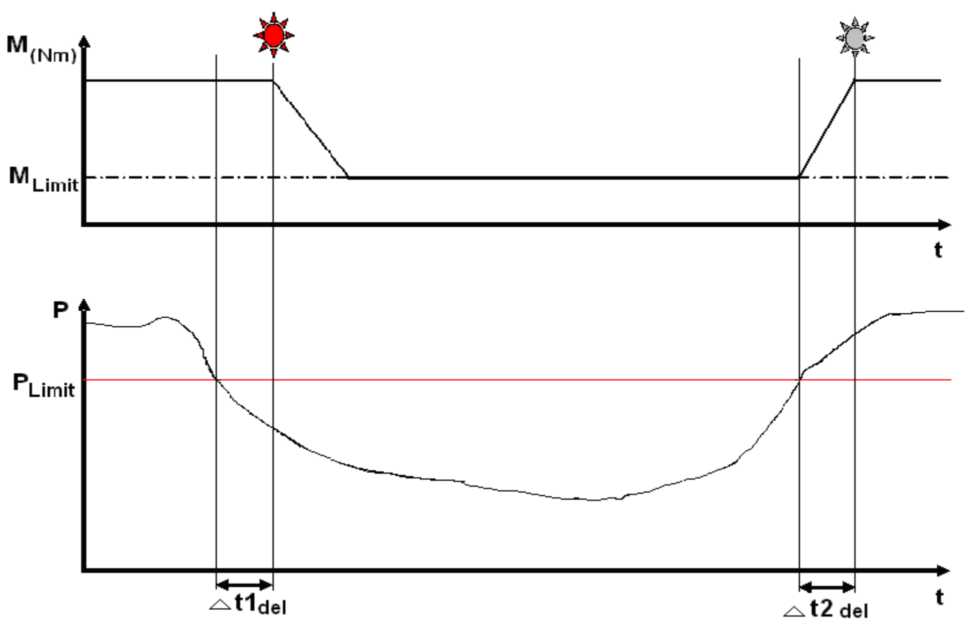
- The alarm is signaled after the timeout has expired when a fault is determined.
- Torque reduction is initiated if temperature limit values are violated, see Engine response table.
- Torque is reduced by a P/I controller when a red alarm is signaled.
- The P/I controller reduces the torque proportionally to the rise in temperature to a minimum value of 4000 Nm.
- This reduction can be suppressed by initiating the “Safety System Override” function
- (activating input DI8 at the Engine Control Unit).
- Torque is only reduced to 4000 Nm. Further reduction is not envisaged in order to maintain limited operational availability of the vehicle.



-M (Nm) Torque in Newton meters
-M Limit Limited torque
-T Temperature (monitored measurand)
-T Limit Limit value
-t Time axis
-t1del Alarm timeout
-t2del Alarm timeout

Torque limitation

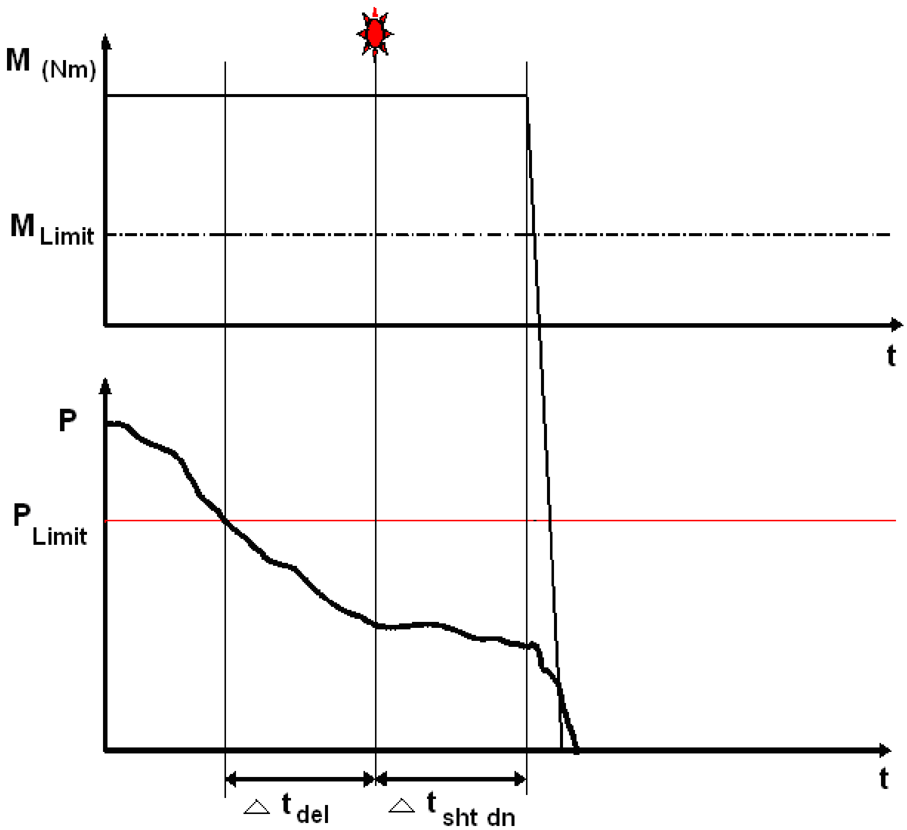
- The alarm is signaled after the timeout has expired when a fault is determined.
- Torque limitation is initiated if pressure limit values are violated, see Engine response table.
- Torque is limited to a fixed value when an alarm is signaled. The limit value is approached along a defined ramp (500Nm/s).
- Limitation can be suppressed by initiating the “Safety System Override” function (activating input DI8 at the Engine Control Unit).
- Torque is only limited to 4000 Nm. Further limitation is not envisaged in order to maintain limited operational availability of the vehicle.



-M (Nm) Torque in Newton meters
-M Limit Limited torque
-P Pressure (monitored measurand)
-P Limit Limit value
-t Time axis
-t1del Alarm timeout
-t2del Alarm timeout

Engine shutdown

- When a fault is detected the alarm is signaled after the timeout has expired. The second limit value of the governor safety function is used by default for engine shutdown.
- The engine is shut down when the shutdown timeout has expired.
- The engine is always shut down even when the limit value is no longer violated during the shutdown timeout.
- Installation of a “Safety System Override” switch is urgently recommended to maintain operational availability of the vehicle in hazardous situations if an “engine shutdown” is programmed in response to violation of a limit value. A warning horn should also be installed to signal this operating status. This ensures the driver's attention in case of a red alarm.
- Shutdown can be suppressed by initiating the “Safety System Override” function before the shutdown timeout has expired (activating input DI8 at the Engine Control Unit). This prevents the engine being stopped.



-M (Nm) Torque in Newton meters
-M Limit Limited torque
-P Pressure (monitored measurand)
-P Limit Limit value
-t Time axis
-tdel Alarm timeout
-tsht dn Shutdown timeout (default for trucks/loaders is 15s)

Override

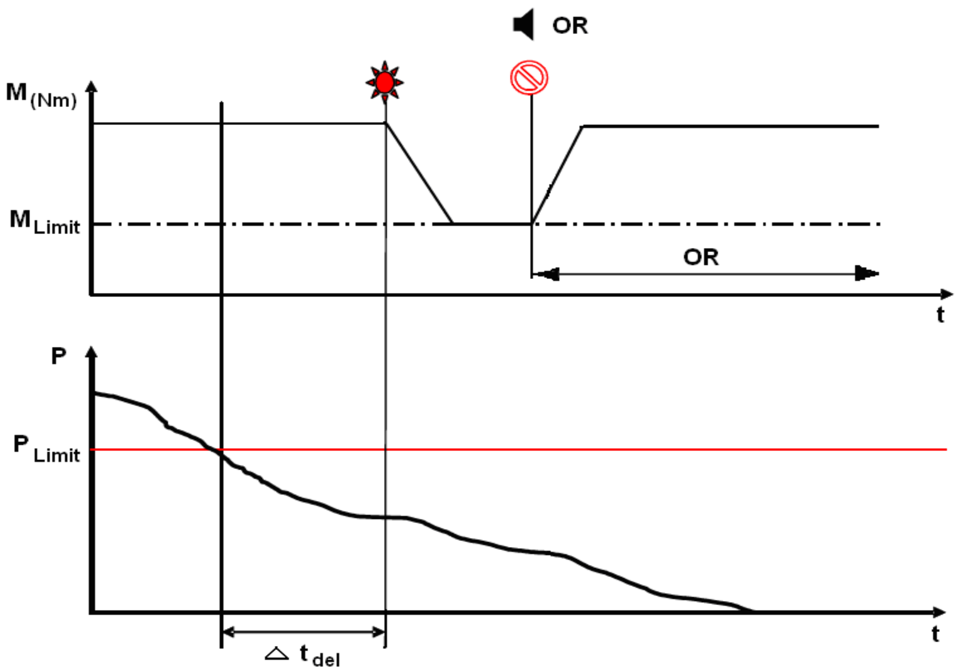
Basically any response of the Engine Control Unit to protect the engine can be suppressed by the operator. This is realized by the “Safety System Override” function. This allows the user to maintain normal operation of the vehicle even when a red alarm is signaled to maneuver the vehicle to safety or bring it to a standstill.

THE ENGINE IS NO LONGER PROTECTED IN THIS OPERATING MODE. USERS ACT AT THEIR OWN DISCRETION AND ARE SOLELY RESPONSIBLE — THIS MAY RESULT IN DESTRUCTION OF THE ENGINE.

Once the “Safety System Override” function has been switched on it remains active until the input IGI_IN (Ignition On) of the Engine Control Unit is switched off. The “Override active” output BT_OUT16 of the SAM is activated when the function is switched on.

It is recommended to use this output to activate a horn.

To alert the user to the potential danger for the engine.
The “Safety System Override” function does not take the cause of the alarm into account in any way. Thus, operating the engine with “Safety System Override” activated my lead to severe engine damage — even to the extent of total destruction.
The function is optional. Input DI8 of the Engine Control Unit must be activated by a switch (not a momentary-contact pushbutton!) to realize this function.



The diagram illustrates the Override function using torque limitation as an example

- -M (Nm) Torque in Newton meters
- -M Limit Limited torque
- -P Pressure (monitored measurand)
- -P Limit Limit value
- -t Time axis
- -t del Alarm timeout
- -OR Override active

Timeout settings

The following alarm timeouts are set (by default):

Temperatures and general alarms	Limit value 1 (yellow alarm)	15s
	Limit value 2 (red alarm)	1s
Pressures	Limit value 1 (yellow alarm)	3s
	Limit value 2 (red alarm)	0s

Exceptions are programmed for the following alarms:

Alarm	Limit value 1 (yellow)	Limit value 2 (red)
Exhaust turbocharger speed	3s	1s
Engine overspeed	Not used	0s
Crankcase pressure	1s	1s
Coolant level	15s	Not used
Water in fuel prefilter	15s	Not used
Lube oil differential pressure	3s	1s
Beginning of injection incorrect	3s	Not used
Misfire	3s	Not used
Undefined injection	3s	Not used
Fuel under-/overpressure rail deviation	20s	20s

Recommended engine response for truck/loader (default settings)

The following settings are recommended for red alarms and are programmed as defaults:

Engine data	Name in Engine Control Unit	Engine protection	
Pressures		**Response**	**Override**
Engine lube oil pressure (2nd limit value)	SS P-Lube Oil	Limitation	Yes
Lube oil differential pressure (2nd limit value)	SS P-Differential Lube Oil	Limitation	Yes
Engine crankcase pressure (2nd limit value)	SS P-Crank Case	Limitation	Yes
Engine coolant pressure(2nd limit value)	SS P-Coolant	Limitation	Yes
Engine intercooler pressure (2nd limit value)	SS P-Coolant Intercooler	Limitation	Yes
Temperatures			
Engine coolant temperature (2nd limit value)	SS T-Coolant	Reduction	Yes
Engine intercooler temperature (2nd limit value)	SS T-Coolant Intercooler	Reduction	Yes
Fuel temperature before HP pump (2nd limit value)	SS T-Fuel	Reduction	Yes
Engine lube oil temperature (2nd limit value)	SS T-Lube Oil	Reduction	Yes
Exhaust turbocharger speed (2nd limit value)	SS ETC1 Overspeed	Reduction	Yes

Recommended engine response for excavators

Engine data	Name in Engine Control Unit	Engine protection	
Pressures		**Response**	**Override**
Engine lube oil pressure (2nd limit value)	SS P-Lube Oil	Shutdown	Yes
Lube oil differential pressure (2nd limit value)	SS P-Differential Lube Oil	Shutdown	Yes
Engine crankcase pressure (2nd limit value)	SS P-Crank Case	Shutdown	Yes
Engine coolant pressure(2nd limit value)	SS P-Coolant	Shutdown	Yes
Engine intercooler pressure (2nd limit value)	SS P-Coolant Intercooler	Shutdown	Yes
Temperatures			
Engine coolant temperature (2nd limit value)	SS T-Coolant	Reduction	Yes
Engine intercooler temperature (2nd limit value)	SS T-Coolant Intercooler	Reduction	Yes
Fuel temperature before HP pump (2nd limit value)	SS T-Fuel	Shutdown	Yes
Engine lube oil temperature (2nd limit value)	SS T-Lube Oil	Shutdown	Yes
Exhaust turbocharger speed (2nd limit value)	SS ETC1 Overspeed	Shutdown	Yes

Information on settings for the OEM

1. The driver is responsible for initiating a manual emergency stop in case of a red alarm
The “Stop Engine” indicator lamp instructs the driver to shut the engine down **IMMEDIATELY** in order to avoid severe engine damage. Damage incurred by continued operation in such situations is neither covered by the terms of the warranty or any other agreements defining maximum costs, nor is it afforded consideration in maintenance and repair calculations.

2. Automatic shutdown by the Engine Control Unit
A correct shutdown in case of a red alarm as described above depends solely on the proper response of the driver. In order to afford the engine better protection in case of inadmissible operating states, the automatic shutdown functions should therefore be activated. When these functions are active, the Engine Control Unit automatically shuts the engine down should such operating states arise.
However, shutdown can be prevented with the “Override” function should the driver require continued operation for any reason (e.g. to protect life and limb).
Even if these functions can be activated/deactivated on an optional basis, their use is urgently recommended in order to afford the engine an optimum degree of protection.
All engine responses must be defined and appropriately programmed by agreement between OEM and end-user.

3. Customer-specific engine protection functions
The end-user must ensure that all engine protection functions take effect as required and that operating personnel is trained accordingly. Consequential damage is neither covered by the terms of the warranty or any other agreements defining maximum costs, nor is it afforded consideration in maintenance and repair calculations, should the operating personnel or the OEM decide against an engine shutdown requested by the system (whether by ignoring the “Stop Engine” indicator lamp or by activating the “Override” function).

The defined settings must be recorded on an "OEM/Customer-Engine Security Setting Request Form".

This form must be signed by the OEM and submitted to MTU.

7.2 EMU functions

7.2.1 EMU test – Individual cylinder exhaust gas temperature

The EMU is set/configured by the data record of the ECU-7. The parameters of the EMU-7 are compared with the associated ECU-7 parameters on the MCS-5 bus when the system is switched on. If the parameters in the EMU deviate from those in the ECU, the parameters are transferred from the ECU to the EMU.

Any changes to the EMU parameters must be made in the ECU via the corresponding parameters in the ECU. The parameters in the EMU are then automatically overwritten with the new values the next time the system is switched on. Any changes made by a dialog with the EMU are overwritten at the next power-up. Such changes should therefore be avoided.

Activating EMU functions:

Individual cylinder exhaust gas temperature monitoring is activated by activating the associated input channels:

ECU Parameter	Name	EMU Parameter
1.0600.024	Channel Deactivation Slot 9	PR092
1.0600.023	Channel Deactivation Slot 8	PR093
1.0600.022	Channel Deactivation Slot 7	PR094
1.0600.021	Channel Deactivation Slot 6	PR095
1.0600.020	Channel Deactivation Slot 5	PR096
1.0600.019	Channel Deactivation Slot 4	PR097
1.0600.018	Channel Deactivation Slot 3	PR098
1.0600.017	Channel Deactivation Slot 2	PR099

Hi/Lo limit monitoring

Fault messages for excessively high or low exhaust gas temperatures are output on the display (SAM and DIS10) when the timeout has expired should one or more temperatures violate the admissible upper/lower limit values. A yellow summary alarm is transmitted to the ECU by PV 001901 and signaled via the “Yellow alarm” status lamp.

2D parameters

ECU Parameter	Name	EMU Parameter
1.0600.001	T-Exhaust Limit HI	PR004
1.0600.002	T-Exhaust Limit LO	PR005

1D parameters

ECU Parameter	Name	EMU Parameter
1.0600.010	Delay LO/HI T-Exhaust	PR013

HIHI/LOLO limit monitoring

The second limit value is monitored by calculating a weighted average of the active cylinders and determining the highest and lowest temperature values.

The value for the upper and lower HIHI/L2L T-Exhaust limit for the individual cylinder exhaust gas temperature is generated using the offset performance maps depending on the average exhaust gas temperature.

ECU Parameter	Name	EMU Parameter
1.0600.025	T-Exhaust Limit HIHI Offset	PR105
1.0600.026	T-Exhaust Limit LOLO Offset	PR106

An “AL T-Exhaust Single Out Of Range“alarm is output on the display (SAM and DIS10) by PV 002620 when a (fixed) 3-second timeout has expired should the highest/lowest exhaust gas temperature violate this second upper limit L2H T-Exhaust. A red summary alarm is transmitted to the ECU by PV001902 and signaled by the status lamp.

Monitoring is subjected to an internal plausibility check which outputs the “AL Exh. Mon. Fail“ alarm (PV002512) in case of contradictory data and the ECU is switched off. A yellow summary alarm is transmitted to the ECU by PV001901 and signaled by the status lamp.

If the EMU fails to receive the PV001011 (Cylinder Cut Out Code) message within 30 seconds of system start and when cylinder A1 is deactivated by PR097, the alarm “AL Exh. Mon. Fail“ (PV002512) is output on the display.

Appropriate fault messages for the affected cylinders indicating faulty exhaust gas temperature sensors are output on the display should one or more temperature sensors fail. A yellow summary alarm is transmitted to the ECU by PV001901 and signaled by the status lamp.

7.2.2 Other EMU parameters

The following ECU parameters are transmitted to a parameter of the EMU-7 to monitor other functions not used in this project.

2D parameters

ECU Parameter	Name	EMU Parameter
1.0400.002	P-Lube Oil Limit LOLO	PR001
1.0400.001	P-Lube Oil Limit LO	PR002
1.0600.003	P-Raw Water Limit LO	PR003

1D parameters

ECU Parameter	Name	EMU Parameter
1.0300.603	T-Coolant Limit HI	PR006
1.0300.623	T-Coolant Limit HIHI	PR007
1.0600.008	P-Oil Top Up Pump Limit LO	PR008
1.0600.014	Power Red. if SS T-Coolant	PR009
1.0600.015	Max. Allowed Speed Difference	PR010
1.2500.025	Engine Running Switchpoint HI	PR011
1.0300.183	Engine Overspeed Limit	PR012
2.0312.231	Delay HI T-Coolant	PR014
2.0312.271	Delay SS T-Coolant	PR015

ECU Parameter	Name	EMU Parameter
1.1005.001	Delay Monitoring Release	PR016
2.0311.751	Delay LO P-Lube Oil	PR017
2.0311.791	Delay SS P-Lube Oil	PR018
1.0600.007	Delay LO P-Raw Water	PR019
1.0600.009	Delay LO P-Top Up Pump	PR020
1.0600.011	T-Coolant MAXDIFF	PR021
1.0600.012	T-Coolant HYST	PR022
1.0600.013	Delay TD T-Coolant	PR023
1.0600.004	P-Lube Oil MAXDIFF	PR024
1.0600.005	P-Lube Oil HYST	PR025
1.0600.006	Delay TD P-Lube Oil	PR026
1.0600.016	Delay_SD_Speed	PR027
2.0311.799	Config. P-Lube oil	PR100
2.0312.279	Config T-Coolant	PR101
2.0311.399	Config Overspeed	PR102
1.0600.027	SS T-Coolant Hysteresis	PR110

The following ECU parameters are transmitted to a parameter of the EMU for the (**unused**) bearing temperature monitoring feature.

ECU Parameter	Name	EMU Parameter
1.0600.028	UL T-Bearing Diff	PR141
1.0600.029	U1L T-Bearing	PR143
1.0600.030	U2L T-Bearing	PR144
1.0600.031	Delay HI T-Bearing	PR146
1.0600.032	Delay HIHI T-Bearing	PR147
1.0600.033	Bearing Mask	PR300
1.0600.063	EMU Bearing Stop Mask	PR428, Bit 0
1.0600.064	EMU Bearing Override Mask	PR428, Bit1
1.0600.065	UL T-Bearing Mean	PR429
1.0600.066	Delay HI T-Bearing Mean	PR430

The following ECU parameters are transmitted to a parameter of the EMU-7 for the (**unused**) splash oil temperature monitoring feature and static and dynamic offset compensation of the measuring circuit.

ECU Parameter	Name	EMU Parameter
10.600.034	U1L T-Splash Oil Diff	PR400
10.600.035	U2L T-Splash Oil Diff	PR401
10.600.036	Delay HI T-Splash Oil Diff	PR402
10.600.037	Delay HIHI T-Splash Oil Diff	PR403
10.600.038	U1L Offset Correction	PR404
10.600.039	U2L Offset Correction	PR405
10.600.040	Delay HI Offset Correction	PR406
10.600.041	Delay HIHI Offset Correction	PR407
10.600.042	UL SD T-Splash Oil Gradient	PR408
10.600.043	LL SD T-Splash Oil Gradient	PR409
10.600.044	Delay HI T-Splash Oil Gradient	PR410
10.600.045	Delay LO T-Splash Oil Gradient	PR411

ECU Parameter	Name	EMU Parameter
10.600.046	LL T-Splash Oil Mean Diff	PR412
10.600.047	Delay LO T-Splash Oil Mean Dif	PR413
10.600.048	T1 Splash Oil Filter	PR414
10.600.049	LL T-Lube Oil SO	PR415
10.600.050	T-Lube Oil Hyst SO	PR416
10.600.051	LL Engine Speed SO	PR417
10.600.052	Engine Speed Hyst SO	PR418
10.600.053	Delay Splash Oil Control	PR419
10.600.054	Engine Speed Grad SO	PR420
10.600.055	Engine Speed Grad Hyst SO	PR421
10.600.056	Delay Engine Speed Grad SO	PR422
10.600.057	SO Offset Int Static (OKS)	PR423
10.600.058	SO Offset Int Dynamic (OKA)	PR424
10.600.059	T-Splash Oil Channel Mask	PR425
10.600.060	T-SO Security Shutdown	PR426, Bit 0
10.600.061	T-Splash Oil Stop/Overr Mask	PR426, Bit 1
10.600.062	T-Splash Oil Calibration Mask	PR427

Use of individual cylinder exhaust gas temperature measuring points:

Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
T-Exhaust A1	002201	IN					X	X
T-Exhaust A2	002202	IN					X	X
T-Exhaust A3	002203	IN					X	X
T-Exhaust A4	002204	IN					X	X
T-Exhaust A5	002205	IN					X	X
T-Exhaust A6	002206	IN					X	X
T-Exhaust A7	002207	IN					X	X
T-Exhaust A8	002208	IN					X	X
T-Exhaust A9	002209	IN					X	X
T-Exhaust A10	002210	IN					X	X
T-Exhaust B1	002211	IN					X	X
T-Exhaust B2	002212	IN					X	X
T-Exhaust B3	002213	IN					X	X
T-Exhaust B4	002214	IN					X	X
T-Exhaust B5	002215	IN					X	X

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
T-Exhaust B6	002216	IN					X	X
T-Exhaust B7	002217	IN					X	X
T-Exhaust B8	002218	IN					X	X
T-Exhaust B9	002219	IN					X	X
T-Exhaust B10	002220	IN					X	X
T-Exhaust Mean	002221	Out						
T-Exhaust Max	002222	Out						
T-Exhaust Min	002223	Out						
U1L T-Exhaust	002224	Out						
L1L T-Exhaust	002225	Out						
U2L T-Exhaust	002226	Out						
L2L T-Exhaust	002227	Out						
T-Exhaust Cylinder Mask	002230	Out						
T-Exhaust Mean Failure	002237	Out	X		X		X	X
HI T-Exhaust A1	002301	Out	X		X		X	X
HI T-Exhaust A2	002302	Out	X		X		X	X
HI T-Exhaust A3	002303	Out	X		X		X	X
HI T-Exhaust A4	002304	Out	X		X		X	X
HI T-Exhaust A5	002305	Out	X		X		X	X
HI T-Exhaust A6	002306	Out	X		X		X	X
HI T-Exhaust A7	002307	Out	X		X		X	X
HI T-Exhaust A8	002308	Out	X		X		X	X
HI T-Exhaust A9	002309	Out	X		X		X	X
HI T-Exhaust A10	002310	Out	X		X		X	X
HI T-Exhaust B1	002311	Out	X		X		X	X
HI T-Exhaust B2	002312	Out	X		X		X	X
HI T-Exhaust B3	002313	Out	X		X		X	X
HI T-Exhaust B4	002314	Out	X		X		X	X
HI T-Exhaust B5	002315	Out	X		X		X	X
HI T-Exhaust B6	002316	Out	X		X		X	X
HI T-Exhaust B7	002317	Out	X		X		X	X

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
HI T-Exhaust B8	002318	Out	X		X		X	X
HI T-Exhaust B9	002319	Out	X		X		X	X
HI T-Exhaust B10	002320	Out	X		X		X	X
LO T-Exhaust A1	002401	Out	X		X		X	X
LO T-Exhaust A2	002402	Out	X		X		X	X
LO T-Exhaust A3	002403	Out	X		X		X	X
LO T-Exhaust A4	002404	Out	X		X		X	X
LO T-Exhaust A5	002405	Out	X		X		X	X
LO T-Exhaust A6	002406	Out	X		X		X	X
LO T-Exhaust A7	002407	Out	X		X		X	X
LO T-Exhaust A8	002408	Out	X		X		X	X
LO T-Exhaust A9	002409	Out	X		X		X	X
LO T-Exhaust A10	002410	Out	X		X		X	X
LO T-Exhaust B1	002411	Out	X		X		X	X
LO T-Exhaust B2	002412	Out	X		X		X	X
LO T-Exhaust B3	002413	Out	X		X		X	X
LO T-Exhaust B4	002414	Out	X		X		X	X
LO T-Exhaust B5	002415	Out	X		X		X	X
LO T-Exhaust B6	002416	Out	X		X		X	X
LO T-Exhaust B7	002417	Out	X		X		X	X
LO T-Exhaust B8	002418	Out	X		X		X	X
LO T-Exhaust B9	002419	Out	X		X		X	X
LO T-Exhaust B10	002420	Out	X		X		X	X
SD T-Exhaust A1	002451	Out	X		X		X	X
SD T-Exhaust A2	002452	Out	X		X		X	X
SD T-Exhaust A3	002453	Out	X		X		X	X
SD T-Exhaust A4	002454	Out	X		X		X	X
SD T-Exhaust A5	002455	Out	X		X		X	X
SD T-Exhaust A6	002456	Out	X		X		X	X
SD T-Exhaust A7	002457	Out	X		X		X	X
SD T-Exhaust A8	002458	Out	X		X		X	X

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
SD T-Exhaust A9	002459	Out	X		X		X	X
SD T-Exhaust A10	002460	Out	X		X		X	X
SD T-Exhaust B1	002461	Out	X		X		X	X
SD T-Exhaust B2	002462	Out	X		X		X	X
SD T-Exhaust B3	002463	Out	X		X		X	X
SD T-Exhaust B4	002464	Out	X		X		X	X
SD T-Exhaust B5	002465	Out	X		X		X	X
SD T-Exhaust B6	002466	Out	X		X		X	X
SD T-Exhaust B7	002467	Out	X		X		X	X
SD T-Exhaust B8	002468	Out	X		X		X	X
SD T-Exhaust B9	002469	Out	X		X		X	X
SD T-Exhaust B10	002470	Out	X		X		X	X
T-Exh. Failure Map 1	002490	Out						
T-Exh. Failure Map 2	002491	Out						
T-Exh. Failure Map 3	002492	Out						
T-Exh. Failure Map 4	002493	Out						
AL Exhaust Monitoring Fail	002512	Out	X		X		X	X
AL CombAl Exh. Mon. without SD	002520	Out	X		X		X	X
EMU 24V	002600	IN						
EMU 5V	002601	IN						
EMU 11V	002602	IN						
EMU -7V	002603	IN						
AL EMU 11V	002612	Out	X		X		X	X
AL EMU -7V	002613	Out	X		X		X	X
AL T-Exh. Out of Range Limit2	002620	Out	X		X		X	X
AL Combined Alarm Exhaust Mon	002517	Out	X		X		X	X
AL EMU Combined Alarm	002793	Out	X	X	X		X	X
EMU1 Channel switch off Slot 9	002992	Out						
EMU1 Channel switch off Slot 8	002993	Out						
EMU1 Channel switch off Slot 7	002994	Out						
EMU1 Channel switch off Slot 6	002995	Out						

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
EMU1 Channel switch off Slot 5	002996	Out						
EMU1 Channel switch off Slot 4	002997	Out						
EMU1 Channel switch off Slot 3	002998	Out						
EMU1 Channel switch off Slot 2	002999	Out						
T-Exh. Failure Map 1	009490	Out						
T-Exh. Failure Map 2	009491	Out						
T-Exh. Failure Map 3	009492	Out						
T-Exh. Failure Map 4	009493	Out						

7.2.3 Other EMU parameters (not used)

The EMU features additional functions, parameters and measurands which are not activated for mining applications:

Measuring-point list of unused (not used) process variables:

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Engine Speed (EMU)	002002							
SS Overspeed (EMU)	002003							
SS Oilmist Sensor	002004							
SS Overspeed (EMU)	002006							
P-Lube Oil (EMU)	002026							
L1L P-Lube Oil (EMU)	002027							
L2L P-Lube Oil (EMU)	002028							
LO P-Lube Oil (EMU)	002029							
SS P-Lube Oil (EMU)	002030							
Engine Running	002068							
Engine Speed EMU Norm 0-100%	002102							
T-Coolant (EMU)	002126							
U1L T-Coolant (EMU)	002127							

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
U2L T-Coolant (EMU)	002128							
HI T-Coolant (EMU)	002129							
SS T-Coolant (EMU)	002130							
UL Engine Speed	002162							
UL Engine Speed Internal (EMU)	002163							
UL Engine Speed 0-100%	002176							
AL EMU TranOut 2 Open Load	002181							
EMU TranOut 2 Open Load	002186							
AL EMU TranOut 2 Short Circuit	002191							
T-Bearing 1	002251							
T-Bearing 2	002252							
T-Bearing 3	002253							
T-Bearing 4	002254							
T-Bearing 5	002255							
T-Bearing 6	002256							
T-Bearing 7	002257							
T-Bearing 8	002258							
T-Bearing 9	002259							
T-Bearing 10	002260							
T-Bearing 11	002261							
T-Bearing Mean	002270							
UL T-Bearing Mean	002271							
HI T-Bearing Mean	002272							
UL T-Bearing Difference	002273							
U1L T-Bearing	002274							
U2L T-Bearing	002275							
Comb AL T-Bearing (intern)	002276							
T-Bearing Mean Failure	002277							
HI T-Bearing 1	002351							
HI T-Bearing 2	002352							
HI T-Bearing 3	002353							

HI T-Bearing 4	002354							
Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
HI T-Bearing 5	002355							
HI T-Bearing 6	002356							
HI T-Bearing 7	002357							
HI T-Bearing 8	002358							
HI T-Bearing 9	002359							
HI T-Bearing 10	002360							
HI T-Bearing 11	002361							
SS T-Bearing 1	002371							
SS T-Bearing 2	002372							
SS T-Bearing 3	002373							
SS T-Bearing 4	002374							
SS T-Bearing 5	002375							
SS T-Bearing 6	002376							
SS T-Bearing 7	002377							
SS T-Bearing 8	002378							
SS T-Bearing 9	002379							
SS T-Bearing 10	002380							
SS T-Bearing 11	002381							
P-Raw Water	002501							
LL P-Raw Water	002502							
LO P-Raw Water	002503							
P-Oil Refill Pump	002504							
LL P-Oil Re-Fill Pump	002505							
LO P-Oil Refill Pump	002506							
Security Shutdown EMU	002509							
DUM Request Power Reduc	002510							
Test Overspeed Activated (EMU)	002511							
AL Press Monitoring Fail (EMU)	002513							
Engine Speed Internal (EMU)	002514							
SS Security Channel Def EMU	002516							

TD T-Coolant	002518							
TD P-Lube Oil	002519							
Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
TEST Engine Speed gradient	002650							
T-Splash Oil B1 (Sensor)	002701							
T-Splash Oil B2 (Sensor)	002702							
T-Splash Oil B3 (Sensor)	002703							
T-Splash Oil B4 (Sensor)	002704							
T-Splash Oil B5 (Sensor)	002705							
T-Splash Oil B6 (Sensor)	002706							
T-Splash Oil B7 (Sensor)	002707							
T-Splash Oil B8 (Sensor)	002708							
T-Splash Oil B9 (Sensor)	002709							
T-Splash Oil B10 (Sensor)	002710							
T-Splash Oil B1 Filtered	002711							
T-Splash Oil B2 Filtered	002712							
T-Splash Oil B3 Filtered	002713							
T-Splash Oil B4 Filtered	002714							
T-Splash Oil B5 Filtered	002715							
T-Splash Oil B6 Filtered	002716							
T-Splash Oil B7 Filtered	002717							
T-Splash Oil B8 Filtered	002718							
T-Splash Oil B9 Filtered	002719							
T-Splash Oil B10 Filtered	002720							
T-Splash Oil B1	002721							
T-Splash Oil B2	002722							
T-Splash Oil B3	002723							
T-Splash Oil B4	002724							
T-Splash Oil B5	002725							
T-Splash Oil B6	002726							
T-Splash Oil B7	002727							
T-Splash Oil B8	002728							

T-Splash Oil B9	002729							
T-Splash Oil B10	002730							
T-Splash Oil B1 Delta	002731							
Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
T-Splash Oil B2 Delta	002732							
T-Splash Oil B3 Delta	002733							
T-Splash Oil B4 Delta	002734							
T-Splash Oil B5 Delta	002735							
T-Splash Oil B6 Delta	002736							
T-Splash Oil B7 Delta	002737							
T-Splash Oil B8 Delta	002738							
T-Splash Oil B9 Delta	002739							
T-Splash Oil B10 Delta	002740							
T-Splash Oil B1 Offs Static	002741							
T-Splash Oil B2 Offs Static	002742							
T-Splash Oil B3 Offs Static	002743							
T-Splash Oil B4 Offs Static	002744							
T-Splash Oil B5 Offs Static	002745							
T-Splash Oil B6 Offs Static	002746							
T-Splash Oil B7 Offs Static	002747							
T-Splash Oil B8 Offs Static	002748							
T-Splash Oil B9 Offs Static	002749							
T-Splash Oil B10 Offs Static	002750							
T-Splash Oil B1 Offs Adaptiv	002751							
T-Splash Oil B2 Offs Adaptiv	002752							
T-Splash Oil B3 Offs Adaptiv	002753							
T-Splash Oil B4 Offs Adaptiv	002754							
T-Splash Oil B5 Offs Adaptiv	002755							
T-Splash Oil B6 Offs Adaptiv	002756							
T-Splash Oil B7 Offs Adaptiv	002757							
T-Splash Oil B8 Offs Adaptiv	002758							
T-Splash Oil B9 Offs Adaptiv	002759							

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
T-Splash Oil B10 Offs Adaptiv	002760							
T-Splash Oil B1 Offset	002761							
T-Splash Oil B2 Offset	002762							
T-Splash Oil B3 Offset	002763							
T-Splash Oil B4 Offset	002764							
T-Splash Oil B5 Offset	002765							
T-Splash Oil B6 Offset	002766							
T-Splash Oil B7 Offset	002767							
T-Splash Oil B8 Offset	002768							
T-Splash Oil B9 Offset	002769							
T-Splash Oil B10 Offset	002770							
HI T-Splash Oil B1	002771							
HI T-Splash Oil B2	002772							
HI T-Splash Oil B3	002773							
HI T-Splash Oil B4	002774							
HI T-Splash Oil B5	002775							
HI T-Splash Oil B6	002776							
HI T-Splash Oil B7	002777							
HI T-Splash Oil B8	002778							
HI T-Splash Oil B9	002779							
HI T-Splash Oil B10	002780							
SS T-Splash Oil B1	002781							
SS T-Splash Oil B2	002782							
SS T-Splash Oil B3	002783							
SS T-Splash Oil B4	002784							
SS T-Splash Oil B5	002785							
SS T-Splash Oil B6	002786							
SS T-Splash Oil B7	002787							
SS T-Splash Oil B8	002788							
SS T-Splash Oil B9	002789							
SS T-Splash Oil B10	002790							

T-Splash Oil Mean (Internal)	002791							
Comb AL T-Splash Oil (Intern)	002795							
Channel Mask-T-Splash Oil	002798							
Engine Running EMU(Intern)	002799							
Splash Oil Active (Internal)	002800							
Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
U1L T-Splash Oil B1	002801							
U1L T-Splash Oil B2	002802							
U1L T-Splash Oil B3	002803							
U1L T-Splash Oil B4	002804							
U1L T-Splash Oil B5	002805							
U1L T-Splash Oil B6	002806							
U1L T-Splash Oil B7	002807							
U1L T-Splash Oil B8	002808							
U1L T-Splash Oil B9	002809							
U1L T-Splash Oil B10	002810							
U2L T-Splash Oil B1	002811							
U2L T-Splash Oil B2	002812							
U2L T-Splash Oil B3	002813							
U2L T-Splash Oil B4	002814							
U2L T-Splash Oil B5	002815							
U2L T-Splash Oil B6	002816							
U2L T-Splash Oil B7	002817							
U2L T-Splash Oil B8	002818							
U2L T-Splash Oil B9	002819							
U2L T-Splash Oil B10	002820							
Static Splash Oil Cal Active	002821							
Dynamic Splash Oil Cal Active	002822							
MG Splash Oil Cal Active	002823							
AL Splash Oil Cal not Poss	002824							
Splash Oil Calibration Poss	002825							
AL Splash Oil B1 Cal not Poss	002831							

AL Splash Oil B2 Cal not Poss	002832							
AL Splash Oil B3 Cal not Poss	002833							
AL Splash Oil B4 Cal not Poss	002834							
AL Splash Oil B5 Cal not Poss	002835							
AL Splash Oil B6 Cal not Poss	002836							
AL Splash Oil B7 Cal not Poss	002837							
Name of meas. point	**PV No. (Process Variable)**	**Direction**	**Display on FCB**	**Communication ECU**	**Communication DIS**	**Discrete I/O SAM**	**J1939 Transmission**	**CANOpen Transmission**
AL Splash Oil B8 Cal not Poss	002838							
AL Splash Oil B9 Cal not Poss	002839							
AL Splash Oil B10 Cal not Poss	002840							
T-Splash Oil Mean	002841							
T-Splash Oil Mean Failure	002843							
Engine Speed EMU(Internal)	002850							

7.3 Service and Automation Module SAM

7.3.1 SAM signals

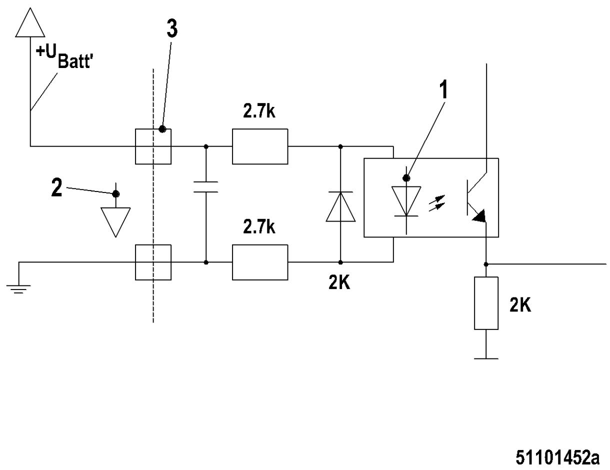
At the SAM the different vehicle signals are adapted.
Changing parameters is possible only by means of the DiaSys® dialog system .

Binary inputs B_IN 1 ... 20

Channel specification/technical data

- Control via:
  - External supply
  - 24 V $+U_{bat}$
- Channel specification:
  - Voltage: $+U_{bat\_GND}$ ... $+U_{bat}$
  - LOW detection: U_{in} < 9 V
  - HIGH detection: U_{in} > 12 V
  - Input impedance: Approx. 5.5 kΩ
  - Current: To U_{bat}: 5 mA; to GND: 0 mA
  - DC isolation: Yes, 500 V DC
  - Input filter: Low-pass 500 Hz

Schematic circuit diagram



1 Optocoupler 2 Input U_{in} 3 Input I_{in}

Channel no.	Channel	Signal type	Type	PV	Designation
21	B_IN1	NO	B	PV006100	OC Aux. Protection Switch
22	B_IN2	NO	B	PV005010	OC Binary Out Test
23	B_IN3	NO	B	PV001811	Request Test Over-speed
24	B_IN4	NO	B	PV005715	Ext. Reset Trip Fuel Consumption
25	B_IN5	NO	B	PV005020	OC Start Interlock

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Channel no.	Channel	Signal type	Type	PV	Designation
26	B_IN6	NO	B	PV005030	OC Park Brake Interlock
27	B_IN7	NO	B	PV005531	BI Preheat Unit ON
28	B_IN8	NO	B	PV005532	BI Burner ON
30	B_IN10	NO	B	PV005016	OC Alarm Reset
32	B_IN12	NO	B	PV005040	OC Neutral
33	B_IN13	NO	B	PV005610	BI Fuel Filter Diff Switch
36	B_IN16	NO	B	PV005070	OC Disable Cylinder Cut Off
39	B_IN19	NO	B	PV001905	Rating Switch 1
40	B_IN20	NO	B	PV001906	Rating Switch 2

Binary inputs with common ground P_IN 1 ... 8

Channel specification/technical data

- Control via:
  - Switch to $+U_{bat}$
- Channel specification:
  - Voltage range: U_{bat_GND} ... $+U_{bat}$
  - Impedance: Approx. 6.9 kΩ
  - Input current to $+U_{bat}$: 3.5 mA
  - Input current to U_{bat_GND}: 22 µA
  - Switching to $+U_{bat}$
    U_{in} > 10 V: Closed (high)
    U_{in} < 9 V: Open (low)
  - Electrical isolation: No

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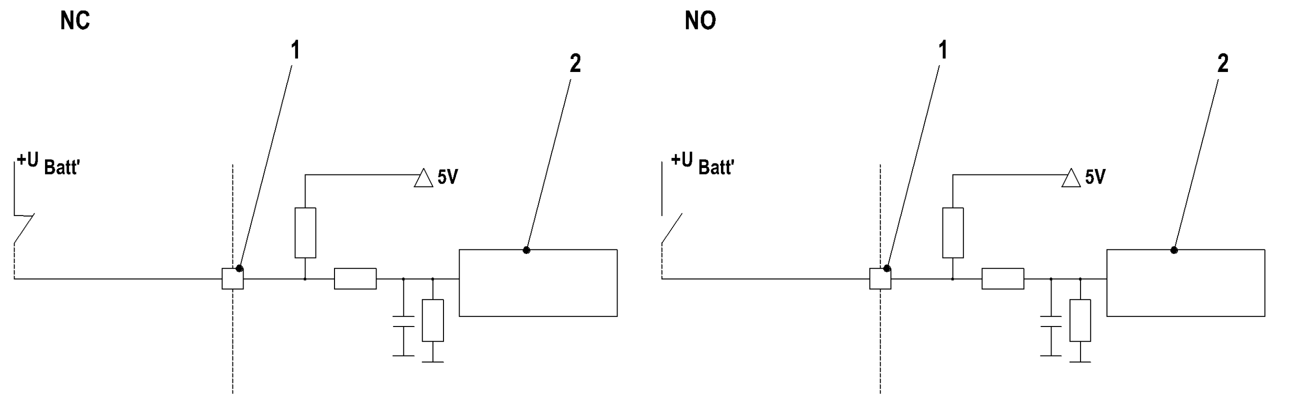
Schematic circuit diagram



NC Normally Closed contact
NO Normally Open contact

1 Input
2 Signal acquisition

Channel no.	Channel	Signal type	Type	PV	Designation
41	P_IN1	NC_HI	B	PV005050	OC Engine Stop
42	P_IN2	NO_HI	B	PV005500	BI Disable Preheat-ing Unit Control
43	P_IN3	NO_HI	B	PV005060	OC Engine Start
46	P_IN6	NO_HI	B	PV006500	OC Manual Extern Fan ON
47	P_IN7	NO_HI	B	PV001831	Request Manual Turning
48	P_IN8	NO_HI	B	PV005080	OC Alternate Mini-mum VSG

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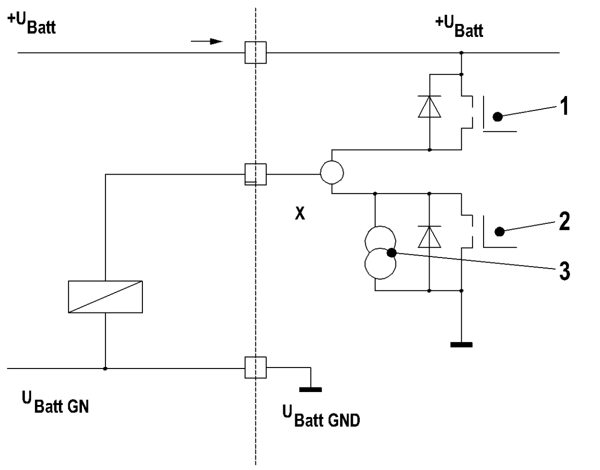
Binary transistor outputs BT_OUT 1 ... 20

Channel specification / Technical data

- Control of:
  - Loads
- Channel specification:
  - I_{max}: 0.5 A
  - I_{max} with channel switched off: 50 ... 150 µA
  - High-active
  - DC isolation: No
  - Short circuit protection: Yes
- Required settings:
  - System response

Schematic circuit diagram



Channel no.	Channel	Signal type	Type	PV	Designation
49	BT_OUT1	BinHI	B	PV005550	BTOUT1 Torque Limitation act.
51	BT_OUT2	BinHI	B	PV005560	BTOUT2 Speed Window 1
53	BT_OUT3	BinHI	B	PV005570	BTOUT3 Speed Window 2
55	BT_OUT4	BinHI	B	PV005524	BO Preheat Unit ON
57	BT_OUT5	BinHI	B	PV005525	BO LO Preheat Unit ON
59	BT_OUT6	BinHI	B	PV005526	BO HI Preheat Unit ON
63	BT_OUT8	BinHI	A	PV005200	BO Overspeed Alarm
65	BT_OUT9	BinHI	B	PV005210	BO Ready for Start
67	BT_OUT10	BinHI	B	PV005527	BO Preheating Lamp

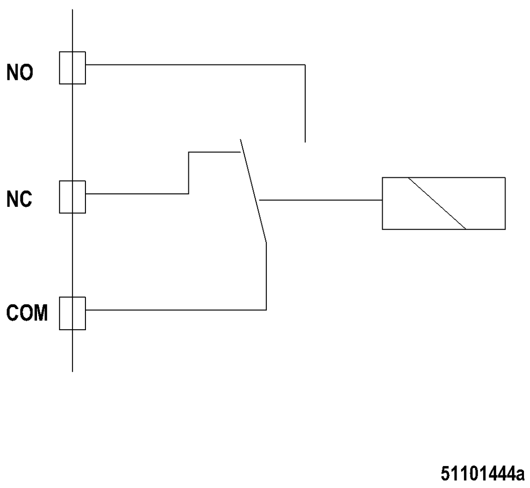
Channel no.	Channel	Signal type	Type	PV	Designation
69	BT_OUT11	BinHI	B	PV005220	BO HI T-Coolant
71	BT_OUT12	BinHI	B	PV005230	BO HI T-Charge Air
73	BT_OUT13	BinHI	B	PV005240	BO LO P-Coolant
75	BT_OUT14	BinHI	B	PV005250	BO LO P-LubeOil
77	BT_OUT15	BinHI	B	PV005260	BO HI P-Crankcase
79	BT_OUT16	BinHI	B	PV005280	BO Override Active
81	BT_OUT17	BinHI	B	PV006510	BO Shutter 1 ON
83	BT_OUT18	BinHI	B	PV006520	BO Shutter 2 ON
85	BT_OUT19	BinHI	B	PV005055	BO Engine Stop fol-low-up Active

Relay outputs BR_OUT 1 ... 4

Channel specification/technical data

- Voltage range: U < 36 V
- NO — COM — NC
- Impedance “On”: R < 20 mΩ
- I_{max}: 1 A
- DC isolation: < 300 V
- Required settings:
    - Reason for switching

Schematic circuit diagram



Channel no.	Channel	Signal type	Type	PV	Designation
89	REL1	Bin	B	PV005521	BO NT/HT Valve after Filter
91	REL2	Bin	B	PV005522	BO NT/HT Valve before Filter

Channel no.	Channel	Signal type	Type	PV	Designation
93	REL3	Bin	B	PV005523	BO Preheat Unit ON Valve

Analog inputs A_IN 1 ... 8

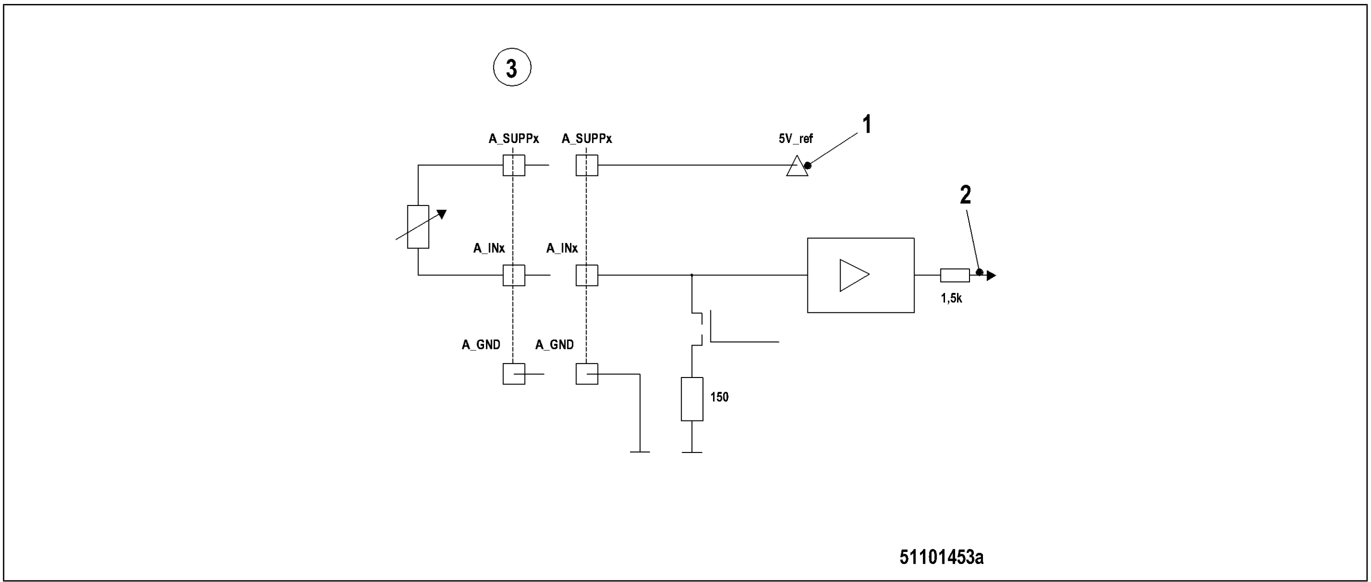
Possible applications

Analog channels may be used for the following different input signals:
- 0 - 10 V
- 4 .. 20 mA
- Pt100
- Pt1000

Channel specification/technical data

- Measurement of:
  - Pt100, extended
- Channel specification:
  - Temperature measuring current: Pt100 4 mA
  - Temperature input impedance: 1 kΩ
  - Sensor supply: 5 V, max. 20 mA

Schematic circuit diagram, temperature



1 U_{ref} 2 A/D channel 3 Pt100 input

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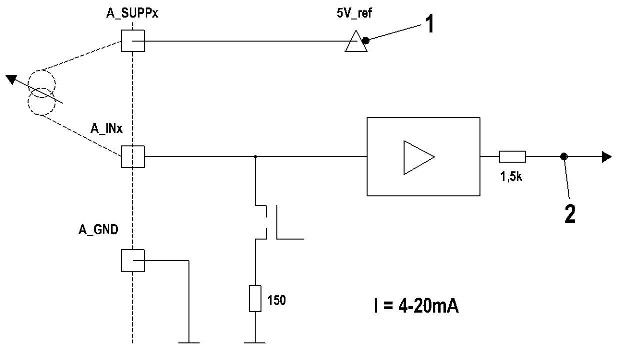
Schematic circuit diagram 4 ... 20 mA



1 U_{ref} 2 A/D channel 3 Input 0 ... 24 mA

Channel no.	Channel	Signal type	Type	PV	Designation
1	A_IN1	Pt100e3	A	PV006010	AIN T-Exhaust A
2	A_IN2	Pt100e3	A	PV006020	AIN T-Exhaust B
3	A_IN3	4-20mA	A	PV006030	AIN Pressure 1
4	A_IN4	4-20mA	A	PV006050	AIN Pressure 2
5	A_IN5	4-20mA	A	PV005620	AIN P-Fuel Filter Diff
6	A_IN6	4-20mA	A	PV006070	AIN Air Filter Restriction
7	A_IN7	4-20mA	A	PV006080	AIN Fuel Filter Restriction
8	A_IN8	4-20mA	A	PV006090	AIN Aux Engine Protection

Analog outputs V_OUT 1 ... 8

Channel specification/technical data

- Control of:
  - Analog display instruments
  - Analog inputs
- Channel specification:
  - Output voltage 0 ... 10 V
  - Voltage output current-carrying capacity: I_{max}: 0 ... 8 mA at 10 V
  - Potential: U_{batt_GND}
  - Short-circuit protection: Yes

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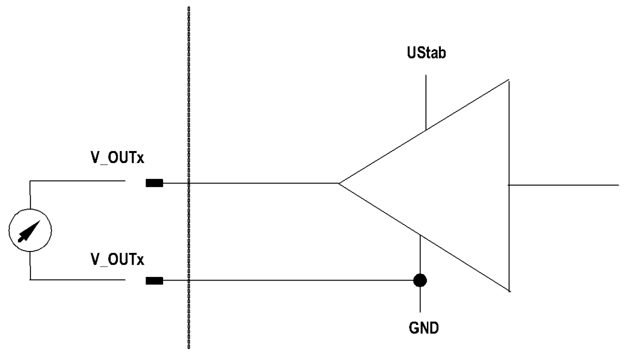
Schematic circuit diagram



Channel no.	Channel	Signal type	Type	PV	Designation
101	A_OUT1	0-10V	A	PV006300	Instrument Engine Speed
103	A_OUT2	0-10V	A	PV006310	Instrument T-Coolant
105	A_OUT3	0-10V	A	PV006320	Instrument Rockford-Speed
107	A_OUT4	0-10V	A	PV006330	Instrument P-Lube Oil
113	A_OUT7	0-10V	A	PV006340	Instrument Fan Control 1
115	A_OUT8	0-10V	A	PV006350	Instrument Fan Control 2

Pulse-width-modulated outputs PWM_OUT 1 ... 2

Channel no.	Channel	Signal type	Type	PV	Designation
14	I_PWM_CH1	0-1.5 A or 0-100 % PWM	A	-	FAN 1
15	I_PWM_CH2	0-1.5 A or 0-100 % PWM	A	-	FAN 2

Serial interfaces

CAN interfaces 1 ... 3

CAN1 – PCS5 CAN

The hardware of the CAN interface corresponds to the definition in ISO 11998. The controller supports CAN version 2.0B (11/29 bit identifier). All interfaces are electrically isolated from each other and from the SAM electronics. The interface operates at 5 V level.

CAN communication is not interrupted if a connector is unplugged at the SAM. The cable connector must feature a termination resistor (121Ω, see wiring diagram).

- Online self-test: Yes (by bus timeout monitoring application software)
- Offline diagnosis: Yes (by offline test software: Feedback of transmitted messages)

This interface is used for the default bus.

CAN2 – PCS5 CAN

See “CAN1 – PCS5 CAN”. This interface is used for the redundant bus.

CAN3 – N.c.

This interface is not used for C&I applications.

RS232/RS422

This interface is not used for the C&I application.

Ethernet

This interface is used for the C&I application to connect a PC for displaying the Web page of the Engine Control Unit.

SAM internal channels

Channel no.	Channel	Signal type	Type	PV	Designation
13	U_LBATT+	SuppVolt24	A	PV005001	SAM Supply Voltage
16	E_TEMP	SB_Temp	A	PV005002	SAM Internal Temperature

Frequency inputs F_IN 1 ... 2

Frequency inputs are not used for C&I applications:

Activating and deactivating channels

The various channels are generally set, i.e. activated and deactivated, in the context of the function which uses the inputs and outputs. However, it is possible to deactivate the inputs and outputs directly regardless of the function using a bit pattern, if necessary.

Parameter

No.	Default	Unit	Designation	Settings
PR0020	0	digit	Channel Deactivation C1-16	Bit-coded value which deactivates SAM channels 1..16. Setting the bits inverts current channel deactivation.
PR0021	0	digit	Channel Deactivation C17-32	Bit-coded value which deactivates SAM channels 17..32. Setting the bits inverts current channel deactivation.
PR0022	0	digit	Channel Deactivation C33-48	Bit-coded value which deactivates SAM channels 33..48. Setting the bits inverts current channel deactivation.
PR0023	0	digit	Channel Deactivation C49-64	Bit-coded value which deactivates SAM channels 49..64. Setting the bits inverts current channel deactivation.

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No.	Default	Unit	Designation	Settings
PR0024	0	digit	Channel Deactivation C65-80	Bit-coded value which deactivates SAM channels 65..80. Setting the bits inverts current channel deactivation.
PR0025	0	digit	Channel Deactivation C81-96	Bit-coded value which deactivates SAM channels 81..96. Setting the bits inverts current channel deactivation.
PR0026	0	digit	Channel Deactivation C97-112	Bit-coded value which deactivates SAM channels 97..112. Setting the bits inverts current channel deactivation.
PR0027	0	digit	Channel Deactivation C113-116	Bit-coded value which deactivates SAM channels 113..116. Setting the bits inverts current channel deactivation.
PR0028	0	digit	Slot 1 Channel Deactivation	Bit-coded value which deactivates channels 1..16 of slot 1. Setting the bits inverts current channel deactivation.
PR0029	0	digit	Slot 2 Channel Deactivation	Bit-coded value which deactivates channels 1..16 of slot 2. Setting the bits inverts current channel deactivation.
PR0030	0	digit	Slot 3 Channel Deactivation	Bit-coded value which deactivates channels 1..16 of slot 3. Setting the bits inverts current channel deactivation.

Example: Slot 4 channel deactivation

Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bit field	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

0001 (bin) = 8 (dec)

7.3.2 Fan control

Basic fan control principle

Fan control is an integral function of the SAM and offers the possibility of controlling one or two fans and two independently controllable shutters (option). Closed-loop control is realized with two internal engine temperatures, the HT coolant temperature (T-Coolant) and the LT coolant temperature (T-Coolant Intercooler).

Fast and efficient closed-loop control of the coolant temperature is ensured using the internal engine sensors, the signals of which are transmitted from the Engine Control Unit ADEC to the plant module SAM via the MTU CAN bus.

One or two fans may be used depending on the configuration.

- When one fan is used (e.g. common fan for HT and LT coolers), the SAM module controls the fan based on the higher demand defined by one of the two coolant temperatures.
- When two fans are used (e.g. separate fan for HT and LT cooler), each fan is controlled independently based on the relevant coolant temperature.

Two different control modes are provided for open- or closed-loop control of the fans:

- 2-point control
- PI control

2-point control
2-point control operates on the ON - OFF principle. When fan control is required, the fan is immediately activated with the 100% (= ON) set value via the switching output until the temperature, minus a hysteresis, has fallen below the limit value. The fan is subsequently deactivated (i.e. 0 % (= OFF) set value) until the temperature exceeds the limit value once more.
The controller operates on the basis of the current coolant temperature and the quantity of fuel injected, i.e. engine power. The reference temperatures vary in accordance with the quantity of fuel. This is explained in more detail below.

PI control
The PI controller controls the fan as a function of the two coolant temperatures HT and NT, when the temperatures are greater than the limit value. The fans are controlled by a linear "pilot control" at temperatures below this limit value. Two independent fans or one common fan are used for the two temperatures depending on the configuration.
Pilot control is realized by calculating the difference between the set and actual coolant temperature values. In this case, the set value varies depending on the operating state, and is calculated as a function of the current injection quantity by means of a 2D performance map. The set value is calculated from the difference in temperature between the actual and set temperature by means of a second 2D performance map. A PWM signal of between 0 and 100% or a current signal of between 0 and 1500 mA is output as a set value, whereby 100% or I_{max} means that the fans are not activated and 0% or 0 mA means that the fans are fully activated (reason for this inverse control: Safety feature as the solenoid valve is fully open in the de-energized state).

Depending on the parameter settings, the fans can be directly controlled via a solenoid valve (e.g. hydrostatically) using a current signal, or using the PWM signal via hardware which activates the fan.

The SAM additionally allows control of external shutters installed upstream of the cooler. Controlling these shutters facilitates warming in cold regions for example. The cooler, and thus also the engine, can therefore be kept warm by closing the shutters covering the cooler. The shutters are then opened on reaching a temperature limit referenced to the engine power requirement.

Shutter control is always available as the function operates independently of the fan control.

The required settings and the associated measuring points are explained in detail below.

Fan control presetting

Parameters 250 and 251 must be activated to activate the PWM outputs for setting a PWM or current signal (see PR164).

No.	Presetting	Unit	Designation	Settings
PR250	0	Binary	FAN 1 control ON	0 = Fan function deactivated 1 = Fan function activated
PR251	0	Binary	FAN 2 control ON	0 = Fan function deactivated 1 = Fan function activated

Note: If PR251 Fan 2 control ON is activated (= 1), PR152 must also be configured accordingly (see below).

Fan 2 configuration

PR152 makes the basic setting defining whether a cooling system is controlled by one or two fans. If just one fan is used, it is controlled by the HT coolant temperature (PV001126) or the LT coolant temperature (PV001137) depending on which temperature has the higher requirement for the fan. If two fans are used, one is controlled by the HT coolant temperature and the second by the LT coolant temperature.

No.	Presetting	Unit	Designation	Settings
PR152	1	Binary	Configuration Fan 2	0 = Fan 2 deactivated, note PR250! Fan 1 is controlled depending on the requirements of T-Coolant or T-Coolant Intercooler 1 = Fan 2 activated, fan is controlled according to T-Coolant Intercooler.

Note: When only one fan is used (PR152= 0) the output for the second fan must deactivated (PR251=0) as the SAM otherwise signals an alarm: Wire Break Fan 2.

Output configuration

The PWM outputs PWM_OUT1 and 2 can be configured either as PMW outputs (0-100% pulse/pause ratio) or as current outputs (0-1500mA).

No.	Presetting	Unit	Designation	Settings
PR164	1	Binary	PWM output configuration	0 = Fan setpoint value is output as a current signal e.g. 1500mA -> 0% fan power , 0mA -> 100% fan power 1 = Fan setpoint value is output as a PWM signal 0-100% fan power

Current limitation output configuration

Parameters 181 and 211 set the maximum current output by the analog outputs of the SAM to control the fans.

No.	Presetting	Unit	Designation	Settings
PR181	500	mA	Valve current max 1	Value range: 0-1500mA, to be adapted to suit project requirements
PR211	500	mA	Valve current max 2	Value range: 0-1500mA, to be adapted to suit project requirements

Fan control power-up timeout from engine start

It is possible to set a timeout following which fan control is active after the engine has been started.

No.	Presetting	Unit	Designation	Settings
PR166	0	sec	Delay Shutter / Fan 1	Value range: 0-600 seconds, timeout for activation of fan control in the SAM
PR167	0	sec	Delay Shutter / Fan 2	Value range: 0-600 seconds, timeout for activation of fan control in the SAM

Additional parameters:

The following parameters are set such that they do not need changing. However, it is necessary to check their function and correctness when commissioning prototypes or conducting radiator tests.

No.	Presetting	Unit	Designation	Settings
PR170	0	%	L-PI T-cool / Injct-Quantity	Value range: 0-100% PI set value with reference to injection quantity
PR171	0	%	L-VS T-cool / Injct-Quantity	Value range: 0-100% pilot set value with reference to injection quantity
PR175	1	dec	P-Value (mA/degC)	P - Proportion mA / degC
PR176	0.1	dec	I-Value (mA/degC)	I - Proportion for controller fan 1
PR177	1	dec	Output scale	Output scale
PR178	1000	dec	I-Limit (mA)	Limit value for the I proportion of the controller
PR180	0	degC	Valve convert temp to %	Pilot control of fan current 1 of temperature VS_diff
PR182	0	mA	Limit_disable_I_gov	The I proportion of the controller is deactivated when the current is below this value
PR210	0	degC	Valve convert temp to % 2	Pilot control of fan current 2 of temperature VS_diff
PR212	0	mA	Limit_disable_I_gov 2	The I proportion of the controller is deactivated when the current is below this value, fan 2
PR230	0	%	L-PI T-cool / Injct-Quantity	Value range: 0-100% PI set value with reference to injection quantity, fan 2
PR231	0	%	L-VS T-cool / Injct-Quantity	Value range: 0-100% pilot set value with reference to injection quantity
PR235	1	dec	P-Value (mA/degC)	P - Proportion mA / degC, fan 2
PR236	0.1	dec	I-Value (mA/degC)	I - Proportion for controller fan 2
PR237	1	dec	Output scale	Output scale, fan 2
PR238	1000	dec	I-Limit (mA)	Limit value for the I proportion of the controller, fan 2
PR252	10	sec	Delay time WB Fan control	Alarm timeout for wire break on fan channels
PR253	0	%	WB Fan detection limit	Current deviation in % for wire break monitoring with reference to the current set value
PR254	1	Binary	WB Monitoring on	0 = Wire break monitoring deactivated, both fans 1 = Wire break monitoring activated, both fans
PR255	50	mA	Min current WB monitoring Fan	Fan current limit value at which wire break is detected

Selecting the fan controller

The fans can be controlled by a temperature-dependent 2-point closed-loop control (Fan On / Fan Off).

No.	Presetting	Unit	Designation	Settings
PR165	0	Binary	Governorselect Fan-control	0 = Operates as a 2-point controller 1 = Operates as a PI controller

To select the number of fans used PR250 and 251 see chapter “Presetting fan control“.

Note: If parameter PR251 Fan 2 control ON is activated (value 1), PR152 must also be configured accordingly.

Fan 2 and shutter 2 can be parameterized such that they are exclusively controlled by LT temperature (PV001137). Fan 1 and shutter 1 are then only controlled by HT temperature (PV001126). When PR152 is deactivated, the SAM controls fan 1 and shutter 1 depending on the requirements of the two coolant temperatures.

Shutter control

Air flaps (so-called shutters) can be controlled by two binary outputs of the SAM. The shutters are controlled independently of the fans. This is realized by 2-point closed-loop control (open/closed) activated by the outputs BT_OUT17 Shutter 1 (PV006511) and BT_OUT18 Shutter 2 (PV006521) as a function of HT coolant temperature or LT coolant temperature.
The two shutters open and close with a hysteresis (default is 2°C).

The table below shows the opening temperatures of shutter 1 with reference to the HT temperature (PV001126) and the injection quantity (PV001004) of the engine.

No.	Engine injection quantity	Shutter switching thresholds
PR154	0%	77 degC
	25%	77 degC
	50%	77 degC
	75%	67 degC
	100%	57 degC

Note: The values for shutter switching threshold 1 must be set according to customer requirements.

The temperature hysteresis for closing the shutters can be set with the following parameters.

No.	Presetting	Unit	Designation	Settings
PR155	2	degC	Shutter 1 off Hyst.	The hysteresis for closing the shutters

The table below shows the opening temperatures of shutter 2 with reference to the LT temperature (PV001137) and the injection quantity (PV001004) of the engine.

No.	Engine injection quantity	Shutter switching thresholds
PR158	0%	77 degC
	25%	77 degC
	50%	77 degC
	75%	67 degC
	100%	57 degC

Note: The values for shutter switching threshold 2 must be set according to customer requirements.

The temperature hysteresis for closing the shutters can be set with these parameters.

No.	Presetting	Unit	Designation	Settings
PR159	2	degC	Shutter 2 off Hyst.	The hysteresis for closing the shutters

2-point fan control

Parameter 165 must be set to “0” in order to use 2-point control to control the fans.
The 2-point fan control always operates as a function of HT coolant temperature (PV001126) or LT coolant temperature (PV001137) with output PWM_OUT1 for fan 1 and, if two separate fans are used also with the output PWM_OUT2 for fan 2 (see chapter “Presetting fan control“). The PWM outputs are configured as switches for the selected controller type (2-point). The switching thresholds for fan control take effect in relation to the current injection quantity (PV001004) of the engine.

The controller allows a timeout to be set after which fan control is active when the engine is started (see chapter “Presetting fan control“).

The table below shows the fan activation temperatures at the corresponding HT coolant temperature with reference to the injection quantity (PV001004) of the engine.

No.	Engine injection quantity	Fan 1 On switching thresholds
PR156	0%	82 degC
	25%	82 degC
	50%	82 degC
	75%	72 degC
	100%	62 degC

Note: The values for 2-point control of fan 1 must be set according to customer requirements.

The temperature hysteresis for switching off fan 1 can be set with the following parameters.

No.	Presetting	Unit	Designation	Settings
PR157	4	degC	Stop Fan 1 Hyst.	The hysteresis for switching off the fan

The table below shows the fan activation temperatures at the corresponding LT coolant temperature.

Note: If parameter PR251 Fan 2 control ON is activated (value 1), PR152 must also be configured accordingly.

Fan 2 can be parameterized such that it is exclusively controlled by LT temperature (PV001137). The reference values for this closed-loop control are set with PR160. Fan 1 and shutter 1 are then only controlled by HT temperature (PV001126). When PR152 is deactivated, the SAM controls the fan depending on the HT temperature switching threshold or the LT temperature switching threshold shown below with reference to the injection quantity (PV001004) of the engine.

No.	Injection quantity	Fan 2 On switching thresholds
PR160	0%	82 degC
	25%	82 degC
	50%	82 degC
	75%	72 degC
	100%	62 degC

Note: The values for 2-point control of fan 2 must be set according to customer requirements.

The temperature hysteresis for switching off fan 2 can be set with the following parameters.

No.	Presetting	Unit	Designation	Settings
PR161	4	degC	Stop Fan 2 Hyst.	The hysteresis for switching off the fan

Manual Extern Fan On

The fan can be controlled at a fixed speed or by a defined set-point value with the “Manual Extern Fan On“ request. The function is activated by activating the binary input P_IN6. with High level (+24V) and controls both fans (if used) to this set-point value. The default set-point value is 50% for both fans.

No.	Presetting	Unit	Designation	Settings
PR260	50	%	Manual Fan 1 On Speed Demand %	Value range adjustable between 0 and 100%
PR261	50	%	Manual Fan 2 On Speed Demand %	Value range adjustable between 0 and 100%

PI fan control

The two fans are controlled as a function of the two coolant temperatures HT (PV001126) and NT (PV001137). A PI controller regulates the fans when the temperatures exceed a limit value. The fans are controlled by a “pilot control” below this limit value. Two independent fans or one common fan are used for the two temperatures depending on the configuration (PR152, see chapter “Presetting fan control”). Parameter 165 must be set to “1” in order to use the PI controller to control the fans.

No.	Presetting	Unit	Designation	Settings
PR165	0	Binary	Governorselect Fan-control	0 = Operates as a 2-point controller 1 = Operates as a PI controller

The value 0% or 0 mA is preset to relieve the solenoid valves when the engine is at a standstill. During engine start, the valves are fully closed by a set-point value of 100% or I_{max}.

No.	Presetting	Unit	Designation	Settings
PR280	5	%	Min PMW Fan1 Speed Sig.	Value range 0 - 100% min. set-point value for fan 1 in % (PWM)
PR281	95	%	Max PMW Fan1 Speed Sig.	Value range 0 - 100% max. set-point value for fan 1 in % (PWM)
PR290	5	%	Min PMW Fan2 Speed Sig.	Value range 0 - 100% min. set-point value for fan 2 in % (PWM)
PR291	95	%	Max PMW Fan2 Speed Sig.	Value range 0 - 100% max. set-point value for fan 2 in % (PWM)

Note: The operating range setting of the PWM signals should remain unchanged for reasons associated with wire break monitoring!

Pilot control Fan T-Coolant

Pilot control is realized by calculating the difference between the set and actual HT coolant temperature values (PV001126). In this case, the set value varies depending on the operating state, and is calculated as a function of the current injection quantity (PV001004) by means of a 2D performance map (PR171). The set value is calculated from the difference in temperature between the actual and set temperature by means of a second 2D performance map (PR180). A signal between 0 and 100% is output as set-point value, whereby 100% means that the fans are not activated, and 0% means that the fans are fully activated (reason for inverse control: Safety feature as the solenoid valve is fully open in the de-energized state).

Coolant temperature set-point value fan1:

No.	**Injection quantity of engine**	**0%**	**30%**	**50%**	**70%**	**100%**
PR171	Pilot control temperature set-point value	93°C	93°C	93°C	93°C	93°C

Pilot control set-point value fan1:

No.	**Temperature difference (Act.-Set)**	**0°C**	**1°C**	**2°C**	**3°C**	**4°C**	**5°C**	**6°C**	**7°C**	**8°C**	**9°C**
PR180	Pilot control fan set-point value (PWM)	95%	85.7%	76.4%	67.1%	57.8%	48.5%	39.2%	30%	60%	60%

Note: The settings of the 2D performance maps should remain unchanged, however the function must be checked and possibly adapted during prototype commissioning or when testing the cooler.

PI control T-Coolant

A PI control is imposed on the pilot control when the HT coolant temperature (PV001126) exceeds a set limit (PR170), i.e. the set-point values of pilot control and PI control are added together to form a resultant set-point value. In this case, the limit varies depending on the operating state, and is calculated as a function of the current injection quantity (PV001004) by means of a 2D performance map (PR170). A signal between 0 and 100% is output as set-point value, whereby 100% means that the fans are not activated, and 0% means that the fans are fully activated (reason for inverse control: Safety feature as the solenoid valve is fully open in the de-energized state).

PI set-point value fan1

No.	**Injection quantity PV001216**	**0%**	**25%**	**40%**	**70%**	**100%**
PR170	Pilot control temperature set-point value	100°C	100°C	100°C	100°C	100°C

Note: The settings of the 2D performance maps should remain unchanged, however the function must be checked and possibly adapted during prototype commissioning or when testing the cooler.

Pilot control Fan T-Coolant Intercooler
Pilot control is realized by calculating the difference between the set and actual LT coolant temperature values (PV001137). In this case, the set value varies depending on the operating state, and is calculated as a function of the current injection quantity (PV001004) by means of a 2D performance map (PR231). The set value is calculated from the difference in temperature between the actual and set temperature by means of a second 2D performance map (PR210). A signal between 0 and 100% is output as set-point value, whereby 100% means that the fans are not activated, and 0% means that the fans are fully activated (safety feature: Solenoid valve is fully open in the de-energized state).

Intercooler coolant temperature set-point value fan1:

No.	Injection quantity PV001216	0%	30%	50%	70%	100%
PR231	Pilot control temperature set-point value	52℃	52℃	52℃	52℃	52℃

Pilot control set-point value fan1:

No.	Temperature difference (Act.-Set)	0℃	0.5℃	1℃	1.5℃	2℃	2.5℃	3℃	3.1℃	3.2℃	3.3℃
PR210	Pilot control fan set-point value	100%	88.5%	77%	65.5%	54%	42.5%	30%	30%	30%	30%

Note: The settings of the 2D performance maps should remain unchanged, however the function must be checked and possibly adapted during prototype commissioning or when testing the cooler.

PI control T-Coolant Intercooler:

A PI control is imposed on the pilot control when the LT coolant temperature (PV001137) exceeds a set limit (PR230), i.e. the set-point values of pilot control and PI control are added together to form a resultant set-point value. In this case, the limit varies depending on the operating state, and is calculated as a function of the current injection quantity (PV001004) by means of a 2D performance map (PR230). A signal between 0 and 100% is output as set-point value, whereby 100% means that the fans are not activated, and 0% means that the fans are fully activated (reason for inverse control: Safety feature as the solenoid valve is fully open in the de-energized state).

PI set-point value fan1:

No.	Injection quantity PV001216	0%	25%	40%	70%	100%
PR230	Pilot control temperature set-point value	55℃	55℃	55℃	55℃	55℃

Note: The settings of the 2D performance maps should remain unchanged, however the function must be checked and possibly adapted during prototype commissioning or when testing the cooler.

Combined PI control T-Coolant/T-Coolant Intercooler

On combined cooling systems with one fan the engine coolant circuit and the intercooler coolant circuit are controlled with just one fan. Combined fan control is activated automatically if fan 2 is deactivated by PR152 (= 0). In this operating mode, both the set-point value for engine coolant temperature (PV001126) and the set-point value for intercooler coolant temperature (PV001137) affect control of fan 1, whereby always the higher set-point value request determines the controlled variable.

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANopen Transmission
Fan Control Fan 1 PWM ACTUAL	900051	OUT				x		
Config PWM_OUT1	900052	IN						
Frequency PWM_OUT1	900053	OUT				X		
Fan Control Fan 2 PWM ACTUAL	900061	OUT				X		
Config PWM_OUT2	900062	IN						
Frequency PWM_OUT2	900063	OUT				X		
PI1_I_res	901500	IN						
PI2_I_res	901501	IN						
PI1_P_res	901503	IN						
PI2_P_res	901504	IN						
OC Manual Extern Fan ON	600500	IN				x		
BO Shutter 1 ON	600510	OUT				x		
Shutter 1 ON	600511	OUT					X	X
BO Shutter 2 ON	600520	OUT				X		
Shutter 2 ON	600521	OUT					X	X
Current Fan Control Fan 1	600530	OUT				X		
WB Fan Control Fan 1	600531	OUT	X			X		
PWM Fan Control Fan 1	600532	OUT				X		
BO Fan Control Fan 1	600535	OUT				X		
Current Fan Control Fan 2	600540	OUT				X		
WB Fan Control Fan 2	600541	OUT	X			X		
PWM Fan Control Fan 2	600542	OUT				X		
BO Fan Control Fan 2	600545	OUT				X		
PI Gov_1 Current Out	600551	OUT						
Precontrol_1 Current Out	600554	OUT						
Combined Fan_1 Current Out	600555	OUT						
Disable I-Gov	600560	IN						
Max Diff_Wirebreak FAN1	600570	OUT						
Max Diff_Wirebreak FAN2	600571	OUT						
PI Gov_2 Current Out	600591	IN						
Precontrol_2 Current Out	600594	OUT						
Combined Fan_2 Current Out	600595	OUT						
Disable I-Gov Fan 2	600600	IN						
Engine Speed	001002	IN		X	X	X	X	X
T-Coolant	001126	IN		X	X	X	X	X
T-Coolant Intercooler	001137	IN		X			X	X
Injection Quantity	001004	IN		X				

7.3.3 Monitoring and Protection

7.3.3.1 T-Exhaust Monitoring

T-Exhaust Monitoring A

This function is for monitoring exhaust gas temperature of the engine A bank on the plant side. The PT100 sensors required to measure exhaust gas temperature must be installed in the exhaust pipework on the plant side. Two different temperature limits can be monitored.

Temperature acquisition T-Exhaust A

The exhaust gas temperature is read in as a PT100 signal (PV006010) via input A_IN1. The signal is not accepted if it violates the admissible tolerated range, and a fault message “SD T-Exhaust A” (PV006019) is output. Temperature monitoring activation can be set via a parameter (PR660).

No.	Default	Unit	Designation	Settings
PR660	FALSE	**Binary**	Cfg T-Exhaust A Monitoring	0 = U1H T-Exhaust A alarm deactivated 1 = U1H T-Exhaust A alarm activated

Monitoring of T-Exhaust A Limit 1 Hi

A Yellow alarm “HI T-Exhaust A” (PV006012) is generated if the temperature (PV006010) violates the first upper limit value (PR662). The alarm is output following a delay (PR663), a hysteresis (PR664) and a minimum pulse time (PR665). The alarm can be activated or deactivated by a parameter (PR661).

No.	Default	Unit	Designation	Settings
PR661	FALSE	Binary	U1H T-Exhaust A active	0= Alarm deactivated 1 = Alarm activated
PR662	700	°C	U1H T-Exhaust A	Upper limit 1: T-Exhaust A
PR663	2	s	U1H T-Exhaust A Delay	Upper limit 1: T-Exhaust A
PR664	10	°C	U1H T-Exhaust A Hysteresis	Upper limit 1: T-Exhaust A Hysteresis
PR665	5	s	U1H T-Exhaust A min pulse t	Upper limit 1: T-Exhaust A min pulse t

The fault message is output by the SAM as a Yellow alarm “HI T-Exhaust A” (PV006012). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring of T-Exhaust A Limit 2 HiHi

A Red alarm “HIHI T-Exhaust A” (PV006013) is generated if the temperature (PV006010) violates the second upper limit value (PR667). The alarm is output following a delay (PR668), a hysteresis (PR669) and a minimum pulse time (PR670). The alarm can be configured as a Red alarm with engine stop (PR671) as an alternative. The alarm can be activated or deactivated by a parameter (PR666).

No.	Default	Unit	Designation	Settings
PR666	FALSE	Binary	U2H T-Exhaust A active	0= Alarm deactivated 1 = Alarm activated
PR667	700°C	°C	U1H T-Exhaust A	Upper limit 2: T-Exhaust A
PR668	2	s	U2H T-Exhaust A Delay	Upper limit 2: T-Exhaust A
PR669	10	°C	U2H T-Exhaust A Hysteresis	Upper limit 2: T-Exhaust A Hysteresis
PR670	5	s	U2H T-Exhaust A min pulse t	Upper limit 2: T-Exhaust A min pulse t
PR671	FALSE	Binary	U2H T-Exhaust A Engine Stop	0= No engine stop in case of limit violation 1= Engine stop in case of limit violation

The fault message is output by the SAM as a Red alarm “HIHI T-Exhaust A” (PV006013). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006014) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN T-Exhaust A	006010	In			x			
HI T-Exhaust A	006012	Out	x				x	x
HIHI T-Exhaust A	006013	Out	x				x	x
SD T-Exhaust A	006019	Out	x				x	x
T-Exhaust A Engine Stop	006014	Out		x				

T-Exhaust Monitoring B

This function is for monitoring exhaust gas temperature of the engine B bank on the plant side. The PT100 sensors required to measure exhaust gas temperature must be installed in the exhaust pipework on the plant side. Two different temperature limits can be monitored.

Temperature acquisition T-Exhaust B

The exhaust gas temperature is read in as a PT100 signal (PV006020) via input A_IN2. The signal is not accepted if it violates the admissible tolerated range, and a fault message “SD T-Exhaust B” (PV006029) is output. Temperature monitoring activation can be set via a parameter (PR680).

No.	Default	Unit	Designation	Settings
PR680	FALSE	**Binary**	Cfg T-Exhaust B Monitoring	0 = U1H T-Exhaust B alarm deactivated 1 = U1H T-Exhaust B alarm activated

Monitoring of T-Exhaust B Limit 1 Hi

A Yellow alarm “HI T-Exhaust B” (PV006022) is generated if the temperature (PV006020) violates the first upper limit value (PR682). The alarm is output following a delay (PR683), a hysteresis (PR684) and a minimum pulse time (PR685). The alarm can be activated or deactivated by a parameter (PR681).

No.	Default	Unit	Designation	Settings
PR681	FALSE	Binary	U1H T-Exhaust B active	0= Alarm deactivated 1 = Alarm activated
PR682	700°C	°C	U1H T-Exhaust B	Upper limit 1: T-Exhaust B
PR683	2	s	U1H T-Exhaust B Delay	Upper limit 1: T-Exhaust B
PR684	10	°C	U1H T-Exhaust B Hysteresis	Upper limit 1: T-Exhaust B Hysteresis
PR685	5	s	U1H T-Exhaust B min pulse t	Upper limit 1: U1H T-Exhaust B min pulse t

The fault message is output by the SAM as a Yellow alarm “HI T-Exhaust B” (PV006022). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring of T-Exhaust B Limit 2 HiHi

A Red alarm “HIHI T-Exhaust B” (PV006023) is generated if the temperature (PV006020) violates the second upper limit value (PR687). The alarm is output following a delay (PR688), a hysteresis (PR689) and a minimum pulse time (PR690). The alarm can be configured as a Red alarm with engine stop (PR691) as an alternative. The alarm can be activated or deactivated by a parameter (PR686).

No.	Default	Unit	Designation	Settings
PR686	FALSE	Binary	U2H T-Exhaust B active	0= Alarm deactivated 1 = Alarm activated
PR687	700°C	°C	U1H T-Exhaust B	Upper limit 2: T-Exhaust B
PR688	2	s	U2H T-Exhaust B Delay	Upper limit 2: T-Exhaust B
PR689	10	°C	U2H T-Exhaust B Hysteresis	Upper limit 2: T-Exhaust B Hysteresis
PR690	5	s	U2H T-Exhaust B min pulse t	Upper limit 2: U1H T-Exhaust B min pulse t
PR691	FALSE	Binary	U2H T-Exhaust B Engine Stop	0= No engine stop in case of limit violation 1= Engine stop in case of limit violation

The fault message is output by the SAM as a Red alarm “HIHI T-Exhaust B” (PV006023). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006024) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN T-Exhaust B	006020	In			x			
HI T-Exhaust B	006022	Out	x				x	x
HIHI T-Exhaust B	006023	Out	x				x	x
SD T-Exhaust B	006029	Out	x				x	x
T-Exhaust B Engine Stop	006024	Out		x				

7.3.3.2 Air Filter Restriction

This function is used to monitor the air filter installed on the plant. The air filter limit is monitored whereby alarm priority and response can be adjusted.

Air filter differential pressure acquisition

The differential pressure is read in via input A_IN6 as a 4-20mA signal (PV006070). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and a "SD Air Filter Restr." fault message (PV006170) is output. When a valid signal is received the current value is converted into a differential pressure (PV006075) for internal processing. The conversion factor can be adjusted via a parameter (PR346) in this case.

The following conversion factor is set by default:

No.	Input current A_IN6	Pressure
PR346	4mA	0 mbar
	20mA	100 mbar

Pressure monitoring activation can be set via a parameter (PR340)

No.	Default	Unit	Designation	Settings
PR340	FALSE	Binary	Air Filter Restr. Monitor. ON	0 = Air Filter Restr. Monitoring and Alarm OFF 1 = Air Filter Restr. Monitoring and Alarm ON

Air filter differential pressure monitoring Limit 1 Hi

One of the following alarms is generated if the differential pressure violates the first upper limit value (PR342) depending on the selected alarm priority (Message, Yellow alarm, Red alarm or Red alarm with engine stop) (PR341).

- "HI Air Filter Restr. (MG)" (PV006071)
- "HI Air Filter Restr. (Y)" (PV006072)
- "HIHI Air Filter Restr. (R)" (PV006073)

The alarm is generated following a delay (PR344), a hysteresis (PR343) and a minimum pulse time (PR345). The alarm can be activated or deactivated by a parameter (PR341).

No.	Default	Unit	Designation	Settings
PR341	0	digit	Selector AL Air Filter Restr.	0 = No Protection 1 = Message 2 = Yellow alarm 3 = Red alarm 4 = Red alarm with Security Stop
PR342	500	mbar	Level Air Filter Restr. HI	Protection Level for HI Alarm in mbar
RP343	50	mbar	Hyst. Air Filter Restr. HI	Hysteresis for HI Alarm Protection Level in mbar
PR344	2	s	Delay Time Air Filter HI ON	Delay for HI limit violation
PR345	2	s	Delay Time Air Filter HI OFF	Delay for HI level lower limit violation

The fault message is output by the SAM as an alarm (see above). The alarm is prioritized as a Message, Yellow alarm or Red alarm depending on the configuration. The alarm is output via the relevant alarm lamp on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006074) remain stored until acknowledged by Alarm Reset.

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN P-Diff. Air filter	006070	In			x		*	*
Hi P-Diff Air Filter (MSG)	006071	Out	x					
Hi P-Diff Air Filter (Yel)	006072	Out	x					
Hi P-Diff Air Filter (Red)	006073	Out	x					
Hi P-Diff Air Filter (Common al.)	009910	Out					x	x
SD P-Diff Air Filter	006170	Out	x				x	x
Engine Stop	006074	Out		x				

7.3.3.3 Differential fuel pressure monitoring at the fuel prefilter

Two different monitoring features are provided to monitor the differential fuel pressure in the fuel prefilter of the plant.

The SAM controller supports two monitoring variants:

- Variant 1: Monitoring by differential pressure switch
- Variant 2: Monitoring by differential pressure sensor

Both variants are described in more detail below:

<u>Activating differential fuel pressure monitoring at the fuel prefilter</u>

Differential fuel pressure monitoring at the fuel prefilter (variants 1 and 2) is activated via PR400. The following settings are available for function selection:

- Deactivated (PR = 0),
- Variant 1 active (PR = 1) or
- Variant 2 active (PR = 2)

No.	Default	Unit	Designation	Settings
PR420	0	digit	Cfg Fuel Filter Diff Monitor	0 = Fuel Prefilter Differential Monitoring deactivated 1 = Fuel Prefilter Differential Monitoring by differential pressure switch 2 = Fuel Prefilter Differential Monitoring by differential pressure sensor

<u>Monitoring by differential pressure switch</u>

The differential pressure switch is read in via input B_IN13. Yellow alarm “HI Fuel Pre Filter Rstr” (PV005615) is raised when the differential pressure switch is tripped (PV005610). The engine does not respond (power reduction/shutdown). The alarm is output via the alarm lamps on the ECU and is represented on the SAM display. The alarm is to be generated following a delay (PR433) and a minimum pulse time (PR434). Input B_IN13 can be connected either as a make contact or a break contact (PR432).

No.	Default	Unit	Designation	Settings
PR432	0	Binary	NO/NC Config Fuel Filter Diff. Switch	0= Differential pressure switch as make contact 1 = Differential pressure switch as break contact
PR433	0	s	Delay Fuel Prefilter Diff SW	Fuel prefilter differential pressure switch delay time

PR434	0	s	Fuel Prefilt Diff SW min Puls	Fuel prefilter differential pressure switch minimum pulse time

Monitoring by differential pressure sensor (4-20mA)

The differential pressure sensor is read in via input A_IN4 as a 4-20mA signal (PV005620). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and the “SD AIN P-Fuel Filter Diff” fault message (PV005630) is output. When a valid signal is received the current value is converted into a differential pressure (PV005635) for internal processing. The conversion factor can be adjusted via a parameter (PR435) in this case.

The following conversion factor is set by default:

No.	Input current A_IN5	Differential pressure
PR435	4mA	0 mbar
	20mA	5000 mbar

Monitoring by differential pressure sensor (4-20mA) Limit 1

A Yellow alarm (PV005615) is generated if the differential pressure (PV005635) violates the first upper limit value (PR421). The alarm is generated following a delay (PR423), a hysteresis and a minimum pulse time. The alarm can be activated or deactivated by a parameter (PR421).

No.	Default	Unit	Designation	Settings
PR421	FALSE	Binary	Alarm On	0= Alarm deactivated 1 = Alarm activated
PR422	1800	mbar	U1H Fuel Prefilt Diff. Pressure	Upper limit 1: Differential pressure fuel prefilter
PR423	30	s	U1H P-Fuel Prefilt Diff Delay	Upper limit 1: Differential pressure fuel prefilter delay
PR424	100	mbar	U1H P-Fuel Prefilter Diff Hyst	Upper limit 1: Differential pressure fuel prefilter hysteresis
PR425	100	mbar	U1H P-Fuel Prefilt Diff Pulse	Upper limit 1: Differential pressure fuel prefilter minimum pulse time

The fault message is output by the SAM as a “HI Fuel Pre Filter Rstr” Yellow alarm which is output via the alarm lamps at the ECU and visualized on the SAM display.

Monitoring by differential pressure sensor (4-20mA) Limit 2

A Red alarm is generated if the differential pressure (PV005635) violates the second upper limit value (PR427). The alarm is output following a delay (PR428), a hysteresis (PR429) and a minimum pulse time (PR430). The alarm can be configured as a Red alarm with engine stop (PR431) as an alternative. The alarm can be activated or deactivated by a parameter (PR426).

No.	Default	Unit	Designation	Settings
PR426	FALSE	Binary	Alarm On	0= Alarm deactivated 1 = Alarm activated
PR427	2000	mbar	U2H Fuel Prefilter Diff. Pressure	Upper limit 2: Differential pressure fuel prefilter
PR428	30	s	U2H P-Fuel Prefilt Diff Delay	Upper limit 2: Differential pressure fuel prefilter delay
PR429	1000	mbar	U2H P-Fuel Prefilter Diff Hyst	Upper limit 2: Differential pressure fuel prefilter hysteresis
PR430	5	s	U2H P-Fuel Prefilt Diff Pulse	Upper limit 2: Differential pressure fuel prefilter minimum pulse time
PR431	FALSE	Binary	Fuel Prefilter U2H Engine Stop	0= No engine stop in case of limit violation 1= Engine stop in case of limit violation

The fault message is output by the SAM as Red alarm “HiHi P-Fuel Prefilter Diff.” (PV005625). The alarm is output via the alarm lamps on the ECU and visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV005640) remain stored until acknowledged by Alarm Reset..

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN Fuel Prefilter Diff. Pres. (mA)	005620	In						
Fuel Prefilter Diff Switch	005610	In						
SD AIN Prefilter Diff. Pressure	005630	Out	x				x	x
Prefilter Diff. Pressure	00535	Out			X			
HI Prefilter Diff. Pressure	005615	Out	X				X	X
HIHI Prefilter Diff. Pressure	005625	Out	X				X	X
Engine Stop	005640	Out		x				

7.3.3.4 Auxiliary Pressure Monitoring

Pressure 1

This is a function for monitoring a random pressure sensor. Excessively high and low pressures are monitored each with two different limits.

Pressure acquisition Pressure 1

The pressure sensor is read in via input A_IN3 as a 4-20mA signal (PV006030). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and a “SD AIN Pressure 1” fault message (PV006045) is output. When a valid signal is received the current value is converted into a differential pressure (PV006035) for internal processing. The conversion factor can be adjusted via a parameter (PR462) in this case.

The following conversion factor is set by default:

No.	Input current A_IN3	Pressure
PR462	4mA	0 mbar
	20mA	10,000 mbar

Pressure monitoring activation must be set via a parameter (PR440).

Default values:

No.	Default	Unit	Designation	Settings
PR440	0	Binary	Pressure monitoring active	0 = Pressure sensor 1 monitoring deactivated 1 = Pressure sensor 1 monitoring active

Monitoring Pressure 1 Limit 1 Hi

A Yellow alarm “HI Pressure 1” (PV006031) is generated if the differential pressure (PV006035) violates the first upper limit value (PR442). The alarm is output following a delay (PR443), a hysteresis (PR444) and a minimum pulse time (PR445). The alarm can be activated or deactivated by a parameter (PR441).

No.	Default	Unit	Designation	Settings
PR441	FALSE	Binary	U1H Pressure 1 active	0= Alarm deactivated 1 = Alarm activated
PR442	8500	mbar	U1H Pressure 1	Upper limit 1: Pressure sensor 1
PR443	2	s	U1H Pressure 1 Delay	Upper limit 1: Pressure sensor 1 delay
PR444	1000r	mbar	U1H Pressure 1 Hysteresis	Upper limit 1: Pressure sensor 1 hysteresis
PR 445	5	s	U1H Pressure 1 minimum pulse t	Upper limit 1: Pressure sensor 1 minimum pulse time

The fault message is output by the SAM as a Yellow alarm “HI Pressure 1” (PV006031). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring Pressure 1 Limit 2 HiHi

A Red alarm “HIHI Pressure 1” (PV006033) is generated if the differential pressure (PV006035) violates the first upper limit value (PR447). The alarm is generated following a delay (PR448), a hysteresis (PR449) and a minimum pulse time (PR450). The alarm can be configured as a Red alarm with engine stop (PR465) as an alternative. The alarm can be activated or deactivated by a parameter (PR446).

No.	Default	Unit	Designation	Settings
PR446	FALSE	Binary	U2H Pressure 1 active	0= Alarm deactivated 1 = Alarm activated
PR447	9500	mbar	U2H Pressure 1	Upper limit 2: Pressure sensor 1
PR448	2	s	U2H Pressure 1 Delay	Upper limit 2: Pressure sensor 1 delay
PR449	1000	mbar	U2H Pressure 1 Hysteresis	Upper limit 2: Pressure sensor 1 hysteresis
PR450	5	s	U2H Pressure 1 minimum pulse t	Upper limit 2: Pressure sensor 1 minimum pulse time
PR465	FALSE	Binary	Pressure 1 U2H Engine Stop	0= No engine stop in case of limit violation 1= Engine stop in case of limit violation

The fault message is output by the SAM as a Red alarm “HIHI Pressure 1” (PV006033). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006046) remain stored until acknowledged by Alarm Reset.

Monitoring Pressure 1 Limit 1 Lo

A Yellow alarm “Lo Pressure 1” (PV006032) is generated if the differential pressure (PV006035) violates the first lower limit value (PR452). The alarm is output following a delay (PR453), a hysteresis (PR454) and a minimum pulse time (PR455). The alarm can be activated or deactivated by a parameter (PR451).

No.	Default	Unit	Designation	Settings
PR451	FALSE	Binary	U1L Pressure 1 active	0= Alarm deactivated 1 = Alarm activated
PR452	3000	mbar	U1L Pressure 1	Lower limit 1: Pressure sensor 1
PR453	2	s	U2H Pressure 1 Delay	Lower limit 1: Pressure sensor 1 delay
PR454	1000	mbar	U2H Pressure 1 Hysteresis	Lower limit 1: Pressure sensor 1 hysteresis
PR455	5	s	U1L Pressure 1 minimum pulse t	Lower limit 1: Pressure sensor 1 minimum pulse time

The fault message is output by the SAM as a Yellow alarm “Lo Pressure 1” (PV006032). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring Pressure 1 Limit 2 LoLo

A Red alarm “LOLO Pressure 1” (PV006034) is generated if the differential pressure (PV006035) violates the second lower limit value (PR457). The alarm (PV006034) is generated following a delay (PR458), a hysteresis (PR459) and a minimum pulse time (PR460). The alarm can be configured as a Red alarm with engine stop (PR466) as an alternative. The alarm can be activated or deactivated by a parameter (PR456).

No.	Default	Unit	Designation	Settings
PR456	FALSE	Binary	U2L Pressure 1 active	0= Alarm deactivated 1 = Alarm activated
PR457	2000	mbar	U2L Pressure 1	Lower limit 2: Pressure sensor 1
PR458	2	s	U2L Pressure 1 Delay	Lower limit 2: Pressure sensor 1 delay
PR459	1000	mbar	U2L Pressure 1 hysteresis	Lower limit 2: Pressure sensor 1 hysteresis
PR460	5	s	U2L Pressure 1 minimum pulse t	Lower limit 2: Pressure sensor 1 minimum pulse time
PR466	FALSE	Binary	Pressure 1 U2L Engine Stop	0= No engine stop in case of low limit violation 1= Engine stop in case of low limit violation

The fault message is output by the SAM as a Red alarm “LoLo Pressure 1” (PV006034). The alarm is signaled via the alarm lamps on the ECU and appears on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006047) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
Pressure 1 (mA)	006030	In						
SD AIN Pressure 1	006045	Out	x				x	x
Pressure 1 (bar)	006035	Out			X			
HI Pressure 1	006031	Out	X				X	X
HIHI Pressure 1	006033	Out	X				X	X
LO Pressure 1	006032	Out	X				X	X
LOLO Pressure 1	006034	Out	x				X	X
Engine Stop U2H	006046	Out		x				
Engine Stop U2L	006047	Out		x				

Pressure 2

This is a function for monitoring a random pressure sensor. Excessively high and low pressures are monitored each with two different limits.

Pressure acquisition Pressure 2

The pressure sensor is read in via input A_IN34 as a 4-20mA signal (PV006050). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and a “SD AIN Pressure 2” fault message (PV006065) is output. When a valid signal is received the current value is converted into a differential pressure (PV006055) for internal processing. The conversion factor can be adjusted via a parameter (PR492) in this case.

The following conversion factor is set by default:

No.	Input current A_IN4	Pressure
PR492	4mA	0 mbar
	20mA	10,000 mbar

Pressure monitoring activation must be set via a parameter (PR470)

No.	Default	Unit	Designation	Settings
PR470	**0**	**Binary**	Pressure monitoring active	0 = Pressure sensor 1 monitoring deactivated 1 = Pressure sensor 1 monitoring active

Monitoring Pressure 2 Limit 1 Hi

A Yellow alarm “HI Pressure 2” (PV006051) is generated if the differential pressure (PV006055) violates the first upper limit value (PR472). The alarm is generated following a delay (PR473), a hysteresis (PR474) and a minimum pulse time (PR475). The alarm can be activated or deactivated by a parameter (PR471).

No.	Default	Unit	Designation	Settings
PR471	FALSE	Binary	U1H Pressure 2 active	0= Alarm deactivated 1 = Alarm activated
PR472	8500	mbar	U1H Pressure 2	Upper limit 1: Pressure sensor 2
PR473	2	s	U1H Pressure 2 Delay	Upper limit 1: Pressure sensor 2 delay
PR474	1000	mbar	U1H Pressure 2 Hysteresis	Upper limit 1: Pressure sensor 2 hysteresis
PR475	5	s	U1H Pressure 2 minimum pulse t	Upper limit 1: Pressure sensor 2 minimum pulse time

The fault message is output by the SAM as a Yellow alarm “HI Pressure 2” (PV006051). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring Pressure 2 Limit 2 HiHi

A Red alarm “HIHI Pressure 2” (PV006053) is generated if the differential pressure (PV006055) violates the second upper limit value (PR477). The alarm is generated following a delay (PR478), a hysteresis (PR479) and a minimum pulse time (PR480). The alarm can be configured as a Red alarm with engine stop (PR495) as an alternative. The alarm can be activated or deactivated by a parameter (PR476).

No.	Default	Unit	Designation	Settings
PR476	FALSE	Binary	U2H Pressure 2 active	0= Alarm deactivated 1 = Alarm activated
PR477	9500	mbar	U2H Pressure 2	Upper limit 2: Pressure sensor 2
PR478	2	s	U2H Pressure 2 Delay	Upper limit 2: Pressure sensor 2 delay
PR479	1000	mbar	U2H Pressure 2 Hysteresis	Upper limit 2: Pressure sensor 2 hysteresis
PR480	5	s	U2H Pressure 2 minimum pulse t	Upper limit 2: Pressure sensor 2 minimum pulse time
PR495	FALSE	Binary	Pressure 2 U2H Engine Stop	0= No engine stop in case of limit violation 1= Engine stop in case of limit violation

The fault message is output by the SAM as a Red alarm “HIHI Pressure 2” (PV006053). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006066) remain stored until acknowledged by Alarm Reset.

Monitoring Pressure 2 Limit 1 Lo

A Yellow alarm “Lo Pressure 2” (PV006052) is generated if the differential pressure (PV006055) violates the first lower limit value (PR482). The alarm is output following a delay (PR483), a hysteresis (PR484) and a minimum pulse time (PR485). The alarm can be activated or deactivated by a parameter (PR481).

No.	Default	Unit	Designation	Settings
PR481	FALSE	Binary	U1L Pressure 2 active	0= Alarm deactivated 1 = Alarm activated
PR482	3000	mbar	U1L Pressure 2	Lower limit 1: Pressure sensor 2
PR483	2	s	U2H Pressure 2 Delay	Lower limit 1: Pressure sensor 2 delay
PR484	1000	mbar	U2H Pressure 2 Hysteresis	Lower limit 1: Pressure sensor 2 hysteresis
PR485	5	s	U1L Pressure 2 minimum pulse t	Lower limit 1: Pressure sensor 2 minimum pulse time

The fault message is output by the SAM as a Yellow alarm “Lo Pressure 2” (PV006032). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display.

Monitoring Pressure 2 Limit 2 LoLo

A Red alarm “LOLO Pressure 2” (PV006054) is generated if the differential pressure (PV006055) violates the second lower limit value (PR487). The alarm (PV006054) is generated following a delay (PR488), a hysteresis (PR489) and a minimum pulse time (PR490). The alarm can be configured as a Red alarm with engine stop (PR496) as an alternative. The alarm can be activated or deactivated by a parameter (PR486).

No.	Default	Unit	Designation	Settings
PR486	FALSE	Binary	U2L Pressure 2 active	0= Alarm deactivated 1 = Alarm activated
PR487	2000	mbar	U2L Pressure 2	Lower limit 2: Pressure sensor 2
PR488	2	s	U2L Pressure 2 Delay	Lower limit 2: Pressure sensor 2 delay
PR489	1000	mbar	U2L Pressure 2 hysteresis	Lower limit 2: Pressure sensor 2 hysteresis
PR490	5	s	U2L Pressure 2 minimum pulse t	Lower limit 2: Pressure sensor 2 minimum pulse time
PR496	FALSE	Binary	Pressure 2 U2L Engine Stop	0= No engine stop in case of low limit violation 1= Engine stop in case of low limit violation

The fault message is output by the SAM as a Red alarm “LoLo Pressure 2” (PV006054). The alarm is output via the alarm lamps on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006067) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
Pressure 2 (mA)	006050	In						
SD AIN Pressure 2	006065	Out	x				x	x
Pressure 2 (bar)	006055	Out			X			
HI Pressure 2	006051	Out	X				X	X
HIHI Pressure 2	006053	Out	X				X	X
LO Pressure 2	006052	Out	X				X	X
LOLO Pressure 2	006054	Out	x				X	X
Engine Stop U2H	006066	Out		x				
Engine Stop U2H	006067	Out		x				

7.3.3.5 Fuel Filter Restriction

This function is used to monitor the fuel filter installed on the plant. The fuel filter limit is monitored whereby alarm priority and response can be adjusted.

Fuel filter differential pressure acquisition

The differential pressure is read in via input A_IN5 as a 4-20mA signal (PV006080). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and a “SD Fuel Filter Restr.” fault message (PV006180) is output. On receiving a valid signal, the current value is converted into a differential pressure (PV006085) for processing. The conversion factor can be adjusted via a parameter (PR356) in this case

The following conversion factor is set by default:

No.	Input current A_IN5	Pressure
PR356	4mA	0 mbar
	20mA	1,000 mbar

Pressure monitoring activation can be set via a parameter (PR350)

No.	Default	Unit	Designation	Settings
PR350	FALSE	Binary	Fuel Filter Restr. Monitor. ON	0 = Fuel Filter Restr. Monitoring and Alarm OFF 1 = Fuel Filter Restr. Monitoring and Alarm ON

<u>Fuel filter differential pressure monitoring Limit 1 Hi</u>

One of the following alarms is generated if the differential pressure violates the first upper limit value (PR352) depending on the selected alarm priority (Message, Yellow alarm, Red alarm or Red alarm with engine stop) (PR351).

- “HI Fuel Filter Restr. (MG)” (PV006081)
- “HI Fuel Filter Restr. (Y)” (PV006082)
- “HIHI Fuel Filter Restr. (R)” (PV006083)

The alarm is generated following a delay (PR354), a hysteresis (PR353) and a minimum pulse time (PR355). The alarm can be activated or deactivated by a parameter (PR351).

No.	Default	Unit	Designation	Settings
PR351	0	digit	Selector AL Fuel Filter Restr.	0 = No Protection 1 = Message 2 = Yellow alarm 3 = Red alarm 4 = Red Alarm with Security Stop)
PR352	500	mbar	Level Fuel Filter Restr. HI	Protection Level for HI Alarm
RP353	50	mbar	Hyst. Fuel Filter Restr. HI	Hysteresis for HI Alarm Protection Level
PR354	2	s	Delay Time Fuel Filter HI ON	Delay for HI level limit violation
PR355	2	s	Delay Time Fuel Filter HI OFF	Delay for HI lower limit violation

The fault message is output by the SAM as an alarm (see above). The alarm is prioritized as a Message, Yellow alarm or Red alarm depending on the configuration. The alarm is output via the relevant alarm lamp on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006084) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN P-Diff. Fuel filter	006080	In			x		x	x
Hi P-Diff Fuel Filter (MSG)	006081	Out	x					
Hi P-Diff Fuel Filter (Yel)	006082	Out	x					
Hi P-Diff Fuel Filter (Red)	006083	Out	x					x
Hi P-Diff Fuel Filter (Common al.)	009920	Out					x	x
SD P-Diff Fuel Filter	006180	Out	x				x	x
Engine Stop	006084	Out		x				

7.3.3.6. Aux Engine Protection

Aux Engine Protection Monitoring

This feature is used to monitor a range of sensors installed on the plant and to protect the engine itself and the plant in general. The Aux Engine Protection Signal limit is monitored whereby alarm priority and response can be adjusted.

Aux Engine Protection acquisition

The Aux Engine Protection Signal is read in via input A_IN7 as a 4-20mA signal (PV006090). The signal is not accepted if it violates the admissible tolerated range (<2 mA or >22 mA) and a “SD Aux Engine Protection” fault message (PV006190) is output. Signal monitoring activation can be set via a parameter (PR360)

No.	Default	Unit	Designation	Settings
PR360	FALSE	**Binary**	Aux Protection Monitoring ON	0 = Aux. Engine Protection Monitoring and Alarm OFF 1 = Aux. Engine Protection Monitoring and Alarm ON

Aux Engine Protection Signal Limit 1 Hi monitoring

One of the following alarms is generated if the current signal violates the first upper limit value depending on the selected alarm priority (Message, Yellow alarm, Red alarm or Red alarm with engine stop) (PR361).

- “HI Aux Engine Protection (MG)” (PV006091)
- “HI Aux Engine Protection (Y)” (PV006092)
- “HIHI Aux Engine Protect. (R)” (PV006093)

The alarm is generated following a delay (PR364), a hysteresis (PR363) and a minimum pulse time (PR365). The alarm must be realized such that it can be activated or deactivated by a parameter (PR361).

No.	Default	Unit	Designation	Settings
PR361	0	digit	Selector AL Aux Protection	0 = No Protection 1 = Message 2 = Yellow alarm 3 = Red alarm 4 = Red alarm with Security Stop
PR362	15mA	mbar	Level Aux Protection HI	Protection Level for HI Alarm
PR363	5	mbar	Hyst. Aux Protection HI	Hysteresis for HI Alarm Protection Level
PR364	2	s	Delay Time Aux Protect HI ON	Delay time for HI level limit violation
PR365	2	s	Delay Time Aux Protect HI OFF	Delay Time for under-run the HI Level

The fault message is output by the SAM as an alarm (see above). The alarm is prioritized as a Message, Yellow alarm or Red alarm depending on the configuration. The alarm is output via the relevant alarm lamp on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006094) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN Aux Engine Protection Signal	006090	In			x			
Hi Aux Engine Protection (MSG)	006091	Out	x					
Hi Aux Engine Protection (Yel)	006092	Out	x					
Hi Aux Engine Protection (Red)	006093	Out	x					
Hi Aux Engine Protection (Common al.)	009930	Out					x	x
SD Aux Engine Protection	006190	Out	x				x	x
Engine Stop	006094	Out		x				

Aux Engine Protection Switch

This feature is used to monitor a range of plant safety switches to protect the engine itself and the plant in general. The Aux Engine Protection Signal is monitored for Active High whereby alarm priority and response can be adjusted.

<u>Aux Engine Protection acquisition</u>

The Aux Engine Protection Signal is read in via input B_IN1 as a binary signal (PV006100). Signal monitoring activation can be set via a parameter (PR370).

No.	Default	Unit	Designation	Settings
PR370	FALSE	Binary	switch	0 = Aux Protection Switch OFF 1 = Aux Protection Switch ON

Aux Engine Protection Signal Limit 1 Hi monitoring

One of the following alarms is generated on detecting a High level at the input of the “OC Aux. Protection Switch” signal (PV006100)depending on the selected alarm priority (Message, Yellow alarm, Red alarm or Red alarm with engine stop).

- “AL Aux Protection Switch (MG)” (PV006101)
- “AL Aux Protection Switch (Y)” (PV006102)
- “AL Aux Protection Switch (R)” (PV006103)

The alarm is generated following a delay (PR372) and a minimum pulse time (PR373). The alarm can be activated or deactivated by a parameter.

No.	Default	Unit	Designation	Settings
PR371	0	digit	Select AL Aux Protect. Switch	=0 No Protection =1, Message; =2, Yellow Alarm; =3 Red Alarm =4 Red Alarm with Security Stop
PR372	2	s	Delay Time Protect-Switch ON	Delay time
PR373	2	s	Delay Time Protect-Switch OFF	Minimum pulse time

The fault message is output by the SAM as an alarm (see above). The alarm is prioritized as a Message, Yellow alarm or Red alarm depending on the configuration. The alarm is output via the relevant alarm lamp on the ECU and is visualized on the SAM display. When engine stopping is set, the Red alarm and the engine stop (PV006104) remain stored until acknowledged by Alarm Reset.

Measuring point use

Measuring point name	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Commun ication DIS	Discrete I/O SAM	J1939 transmission	CANopen transmission
AIN Aux Engine Prot. Switch	006100	In			x			
Hi Aux Engine Prot. Switch (MSG)	006101	Out	x					
Hi Aux Engine Prot. Switch (Yel)	006102	Out	x					
Hi Aux Engine Prot. Switch (Red)	006103	Out	x					
CAN AL Aux. Engine Prot. Sw	009940	Out					x	x
Engine Stop	006104	Out		x				

7.3.4 Display instruments

Engine speed

The engine speed is output according to the set scale as a 0-10V signal via output A_OUT1.

Instr.-Scale Engine speed

No.	Output voltage A_OUT1 (PV006300)	Speed (PV001002)
PR101	0V	0 rpm
	10V	2000rpm

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Engine speed	001002	IN		X	X		X	X
Instr. Engine speed	006300	OUT				X		

Coolant temperature

The coolant temperature is output according to the set scale as a 0-10V signal via output A_OUT2.

Instr.-Scale T-Coolant

No.	Output voltage A_OUT2	Coolant temp.
PR102	0V	0°C
	10V	150°C

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
T-Coolant	001126	IN		X	X		X	X
Instr. T-Coolant	006310	OUT				X		

Rockford Fan Speed Demand

The control signal for the Rockford fan clutch is output according to the set scale as a 0-10V signal via output A_OUT3.

Instr.-Scale Rockford Speed

No.	Output voltage A_OUT3	Rockford Fan Speed.
PR103	0V	0%
	10V	100%

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Rockford Fan Speed	001223	IN		X	X		X	X
PWM fan control output	006320	OUT				X		

P-Lube Oil

The lube oil pressure is output according to the set scale as a 0-10V signal via output A_OUT4.

Instr.- Scale P-Lube Oil

No.	Output voltage A_OUT4	Lube oil pressure
PR104	0V	0 bar
	10V	10 bar

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
P-Lube Oil	001026	IN		X	X		X	X
Instr. P-Lube Oil	006330	OUT				X		

SAM fan request for FAN 1

The control signal for the SAM fan control for fan 1 (engine coolant) is output according to the set scale as a 0-10V signal via output A_OUT7.

Instr.- Scale Fan Speed 1

No.	Output voltage A_OUT7	Fan speed
PR107	0V	0 %
	10V	100 %

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
PWM Fan Control Fan 1	006532	IN			X		X	X
Instr. Fan Control 1	006340	OUT				X		

SAM fan request for FAN 2

The control signal for the SAM fan control for fan 2 (intercooler coolant) is output according to the set scale as a 0-10V signal via output A_OUT8.

Instr.- Scale Fan Speed 2

No.	Output voltage A_OUT8	Fan speed
PR108	0V	0 %
	10V	100 %

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
PWM Fan Control Fan 2	006542	IN			X		X	X
Instr. Fan Control 2	006350	OUT				X		

7.3.5 Binary output test (Lamp Test)

A testing feature is realized with which all binary outputs of the ADEC and the SAM can be activated to facilitate testing the status of the lamps and hardware outputs. The function can be initiated either automatically when the system is switched on or alternatively on request via J1939 or a discrete SAM input. For each output the function, i.e. initiation when Binary Output Test is activated, can be switched on and off by a parameter.

No.	Presetting	Unit	Designation	Settings
PR070	1	Binary	BIN_OUT1_TEST Torque Limit	1= Activated 0= Deactivated
PR071	1	Binary	BIN_OUT2_TEST Speed Window 1	1= Activated 0= Deactivated
PR072	1	Binary	BIN_OUT3_TEST Speed Window 2	1= Activated 0= Deactivated
PR073	1	Binary	BIN_OUT4_TEST Preheat Unit ON	1= Activated 0= Deactivated
PR074	1	Binary	BIN_OUT5_TEST Lo Preh. Unit ON	1= Activated 0= Deactivated
PR075	1	Binary	BIN_OUT6_TEST HI Preh. Unit ON	1= Activated 0= Deactivated
PR077	1	Binary	BIN_OUT8_TEST Overspeed Alarm	1= Activated 0= Deactivated
PR078	1	Binary	BIN_OUT9_TEST Ready for Start	1= Activated 0= Deactivated
PR079	1	Binary	BIN_OUT10_TEST Preheat Lamp	1= Activated 0= Deactivated
PR080	1	Binary	BIN_OUT11_TEST HI T-Coolant	1= Activated 0= Deactivated
PR081	1	Binary	BIN_OUT12_TEST HI T-Charge Air	1= Activated 0= Deactivated
PR082	1	Binary	BIN_OUT13_TEST LO P-Coolant	1= Activated 0= Deactivated
PR083	1	Binary	BIN_OUT14_TEST LO P-Lube Oil	1= Activated 0= Deactivated
PR084	1	Binary	BIN_OUT15_TEST HI P-Crankcase	1= Activated 0= Deactivated
PR085	1	Binary	BIN_OUT16_TEST Override On	1= Activated 0= Deactivated
PR086	0	Binary	BIN_OUT17_TEST Shutter 1 ON	1= Activated 0= Deactivated
PR087	0	Binary	BIN_OUT18_TEST Shutter 2 ON	1= Activated 0= Deactivated
PR088	1	Binary	BIN_OUT19_Stop Follow-Up ON	1= Activated 0= Deactivated
PR090	0	Binary	BIN_OUT_R1_TEST NTHT a. Filter	1= Activated 0= Deactivated
PR091	0	Binary	BIN_OUT_R2_TEST NTHT b. Filter	1= Activated 0= Deactivated
PR092	0	Binary	BIN_OUT_R3_TEST Preheat Valve	1= Activated 0= Deactivated

Manual test:

The manual lamp test can be activated by discrete input B_IN2 or via a control signal on the J1939 CAN bus. The control signal (CAN or discrete) must be activated with the following parameters in this case.

No.	Presetting	Unit	Designation	Settings
PR885	**0**	Binary	CAN Binary Output Test Config.	1= Activated 0= Deactivated
PR886	**1**	Binary	HW Binary Output Test Config.	1= Activated 0= Deactivated

Automatic test:

In addition to manual request (e.g. via J1939), the Binary Output Test function can be executed automatically after the SAM has booted. The SAM activates all parameterized lamp outputs for a set time after booting. Furthermore, the “Lamp Test” request is transmitted to the ADEC via the CAN bus in this period. The automatic lamp test can be switched on and off by a parameter.

No.	Presetting	Unit	Designation	Settings
PR096	0	Binary	Automatic Lamp Test Active	1= Activated 0= Deactivated
PR097	0	sec	Delay Time after SAM bootup	
PR098	5	sec	Lamp Test Signal Period	

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Binary Out Test	005010	IN				X		
CAN Lamp Test	009817	IN					X	X
Bin Out Test Automatic Active	005011	Out				X		
Binary Out Test Plant Active	005012	Out		X		X		
BTOUT1 Torque Limitation Act.	005550	Out				X		
BTOUT2 Speed Window 1	005560	Out				X		
BTOUT3 Speed Window 2	005570	Out				X		
BO Preheat Unit ON	005524	Out				X		
BO LO Preheat Unit ON	005525	Out				X		
BO HI Preheat Unit ON	005526	Out				X		
BO Overspeed Alarm	005200	Out				X		
BO Ready for Start	005210	Out				X		
BO Preheating Lamp	005527	Out				X		
BO HI T-Coolant	005220	Out				X		
BO HI T-Charge Air	005230	Out				X		
BO LO P-Coolant	005240	Out				X		
BO LO P-Lube Oil	005250	Out				X		
BO HI P-Crankcase	005260	Out				X		
BO Override Active	005280	Out				X		

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
BO Shutter 1 ON	006510	Out				X		
BO Shutter 2 ON	006520	Out				X		
BO Engine Stop follow-up active	005055	Out				X		
BO NT/HT Valve after Filter	005521	Out				X		
BO NT/HT Valve before Filter	005522	Out				X		
BO Preheat Unit ON Valve	005523	Out				X		

7.3.6 Miscellaneous inputs and outputs

7.3.6.1 Status of lamps/signals

BT_Out1 - Torque Reduction

A signal is output via output BT_OUT1 when the ADEC activates power reduction (Torque Reduction). The signal can be configured as High Active or Low Active as desired. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR110	0	Binary	NC-Config Torque Limit Act.	0 = Output for "Torque Limit Active" is configured as Normally Open; 1 = Output for "Torque Limit Active" is configured as Normally Closed
PR070	1	Binary	BIN_OUT1_TEST Torque Limit	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
Power Reduction Active	001009	OUT		X			X	X
BTOUT1 Torque Limitation Act.	005550	OUT				X		

BT_Out2 - Speed Window 1

A function to monitor engine speed can be activated in the ADEC. A 24V signal is output via SAM output BT_OUT2 when the engine speed lies withing a defined speed window or speed range (configurable in ADEC). The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR071	1	Binary	BIN_OUT2_TEST Speed Window 1	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
Speed Window 1	001076	OUT		X			X	X
BTOUT2 Speed Window 1	005560	OUT				X		

BT_Out3 - Speed Window 2

A function to monitor engine speed can be activated in the ADEC. A 24V signal is output via SAM output BT_OUT2 when the engine speed lies withing a defined speed window or speed range (configurable in ADEC). The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR072	1	Binary	BIN_OUT3_TEST Speed Window 2	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
Speed Window 2	001077	OUT		X			X	X
BTOUT3 Speed Window 2	005570	OUT				X		

BT_Out16 - Override Active

A 24V signal is output via SAM output BT_OUT16 when Override is activated (see also chapter “Override”). The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR085	1	Binary	BIN_OUT16_TEST Override On	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
Override Feedback for ECU	001066	OUT		X			X	X
BO Override Active	005280	OUT				X		

7.3.6.2 Alarm lamps/signals

BT_Out8 - Overspeed Alarm

An alarm is tripped in the ADEC if the engine speed exceeds an upper limit. A 24V signal is output via SAM output BT_OUT8 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR077	1	Binary	BIN_OUT8_TEST Overspeed Alarm	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
SS Overspeed	001003	OUT	X	X	X	X	X	X
BO Overspeed Alarm	005200	OUT				X		

BT_Out11 - HI T-Coolant

An alarm is tripped in the ADEC if the coolant temperature exceeds a first upper limit. A 24V signal is output via SAM output BT_OUT11 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR080	1	Binary	BIN_OUT11_TEST HI T-Coolant	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
HI T-Coolant	001129	OUT	X	X	X	X	X	X
BO HI T-Coolant	005220	OUT				X		

BT_Out12 - HI T-Charge Air

An alarm is tripped in the ADEC if the charge-air temperature exceeds a second upper limit. A 24V signal is output via SAM output BT_OUT12 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR081	1	Binary	BIN_OUT12_TEST HI T-Charge Air	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
HI T-Charge Air	001133	OUT	X	X	X	X	X	X
BO HI T-Charge Air	005230	OUT				X		

BT_Out13 - LO P-Coolant

An alarm is tripped in the ADEC if the coolant pressure violates a first lower limit. A 24V signal is output via SAM output BT_OUT13 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR082	1	Binary	BIN_OUT13_TEST LO P-Coolant	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
LO P-Coolant after Pump	001039	OUT	X	X	X	X	X	X
BO LO P-Coolant	005240	OUT				X		

BT_Out14 - LO P-Lube Oil

An alarm is tripped in the ADEC if the lube oil pressure violates a first lower limit. A 24V signal is output via SAM output BT_OUT14 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR083	1	Binary	BIN_OUT14_TEST LO P-Lube Oil	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
LO P-Lube Oil	001029	OUT	X	X	X	X	X	X
BO LO P-Lube Oil	005250	OUT				X		

BT_Out15 - HI P-Crankcase

An alarm is tripped in the ADEC if the crankcase pressure exceeds a first upper limit. A 24V signal is output via SAM output BT_OUT15 at the same time. The output can also be activated in conjunction with the Binary Output Test (Lamp Test) function, which tests lamps and hardware outputs (see chapter “Lamp Test”).

No.	Presetting	Unit	Designation	Settings
PR084	1	Binary	BIN_OUT15_TEST HI P-Crankcase	1= Activated 0= Deactivated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Binary Out Test Plant Active	005012	OUT		X		X		
HI P-Crankcase	001034	OUT	X	X	X	X	X	X
BO HI P-Crankcase	005260	OUT				X		

7.3.6.3 Control signals

B_IN3 - Request Test Overspeed

The overspeed limit is reduced to a lower value (value specified by parameter no. 2.2510.001 of the Engine Control Unit) when this input is activated. If the speed programmed here is exceeded (or if the engine speed is already above this value at the time of activation), an emergency stop is tripped with the following response:

- Alarm AL SS Overspeed (PV1003) is tripped
- Engine shuts down
- The alarm is signaled via binary output BT_OUT8.

The alarm is saved and must be reset.
The function is used to check that the "Overspeed" shutdown function operates correctly.

No.	Presetting	Unit	Designation	Settings
PR901	0	Binary	HW Request Test Overspeed	0 = Request Test Overspeed hardwired deactivated 1 = Request Test Overspeed hardwired activated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Request Test Overspeed	001811	IN		X		X		
Test Overspeed Active	001015	OUT		X				
SS Overspeed	001003	OUT	X	x	x		x	x
BO Overspeed Alarm	005200	OUT				X		

B_IN4 - Reset Trip Fuel Consumption

A 24V signal at this input clears the memory in which the trip fuel consumption is stored.

The trip fuel consumption counters are reset when this input is activated.

No.	Presetting	Unit	Designation	Settings
PR891	1	Binary	HW Trip Fuel Consumpt Config	0 = Reset Trip Fuel Consumption hardwired deactivated 1 = Reset Trip Fuel Consumption hardwired activated"

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Ext.Reset Trip Fuel Consumption	005715	IN				X		
Reset TripFuel Cons. Plant Act	009080	IN						
Reset Trip Fuel Counter	009081	IN						
Trip Reset Countdown	009082	IN			x			
Mean Trip Fuel Consumption	001198	OUT		X	x			
CAN Reset Trip Fuel Counter	009841	OUT					x	x
Reset Trip Fuel Counter	001841	OUT		X				

B_IN10 - Alarm Rest/Alarm Acknowledge

Stored alarms are reset by activating this input.
Alarms which lead to a yellow or red alarm are stored. Signaling via the relevant binary output remains unchanged until canceled by the "Alarm Reset" input.

In addition to input B_IN10, alarms can alternatively be reset by input DI_4 at the ADEC or the display DIS10.

No.	Presetting	Unit	Designation	Settings
PR881	1	Binary	Hardwired Alarm Reset Config.	0 = Alarm Reset hardwired deactivated 1 = Alarm Reset hardwired activated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Alarm Reset	005016	IN				X		
Alarm Reset Plant Active	009030	OUT						
Alarm Reset (SAM)	005999	OUT						
Display Acknowledge Button	900901	IN			X			
Display Acknowledged	900900	OUT			X			
Alarm Reset	001816	OUT		X				
Feedback Alarm Reset	001226	IN		X				
CAN Alarm Reset	009816	IN					X	X

B_IN16 - Disable Cylinder Cut Off

The “Cylinder Cut Out” function of the Engine Control Unit is **de**activated when this input is activated. The engine always runs on full, i.e. the Engine Control Unit injects fuel into all cylinders.

No.	Presetting	Unit	Designation	Settings
PR906	1	Binary	HW Disable Cylinder Cut Out :	0 = Disable Cylinder Cut Out hardwired deactivated 1 = Disable Cylinder Cut Out hardwired activated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Disable Cylinder Cut Off	005070	IN				X		
Disable Cylinder Cut Out Active	009150	OUT						
CAN Disable Cylinder Cut Out	009804	IN					X	X
MD Disable Cylinder Cut Out	009988	OUT	X				X	X
Disable Cylinder Cut Out 1	001804	OUT		X				
Disable Cylinder Cut Out 2	001805	OUT		X				

P_IN5 - Request Manual Turning

The starter relay is actuated via the “Starter On” output (at the Engine Control Unit or at the POM) when this input is activated. This cranks the engine at approx. 100 rpm without the Engine Control Unit injecting any fuel, meaning that the engine does not start.

No.	Presetting	Unit	Designation	Settings
PR921	1	Binary	HW Manual Turning	0 = Manual Turning hardwired deactivated 1 = Manual Turning hardwired activated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Request Manual Turning	001831	IN				X		
Status Start Sequence	001021	OUT		X			X	X
Request Manual Turning	001831	OUT		X				

7.3.6.4 Engine rating switches

B_IN19 + B_IN20 - Rating Switch 1+2

These inputs are used to select one of three torque curves. The curves determine the maximum torque at a certain speed and overwrite the DBR curve when B_IN 19 or B_IN20 are activated. B_IN 19 is the LSB (least-significant byte) for the selection; B_IN 19 is the MSB (most-significant byte).

No.	Presetting	Unit	Designation	Settings
PR911	0	Binary	HW Rating Switch 1	0 = Rating Switch hardwired deactivated 1 = Rating Switch hardwired activated
PR916	0	Binary	HW Rating Switch 2	0 = Rating Switch hardwired deactivated 1 = Rating Switch hardwired activated

Use of measuring points

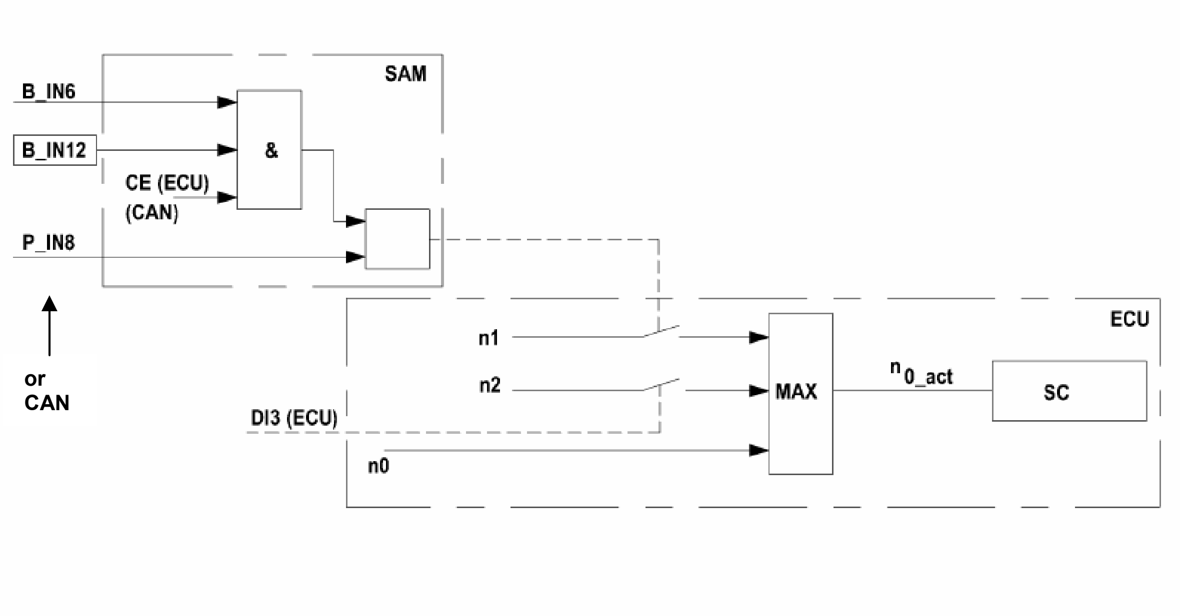
Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Rating Switch 1	001905	OUT		X				
Rating Switch 2	001906	OUT		X				

7.3.6.5 Increase Idle Speed for cold engine operation

B_IN6 Park Brake Interlock+ B_IN12 Neutral

This function allows the engine to run at a different idling speed whenever it is running in cold engine operation and the vehicle is parked. Therefore, the SAM needs an indication that the vehicle is stopped before the function can be
activated. To activate the function, several conditions must be fulfilled:

- The engine is running in cold engine operation and the Engine Control Unit sends the cold engine signal via CAN bus.
- To determine that the vehicle is stopped, the SAM needs a +24V signal at Digital Input B_IN6 “Park Brake Interlock” whenever the parking brake is engaged.
- The transmission control unit must support a +24V signal to the digital input B_IN12 “Neutral” to indicate that the transmission is disengaged.



The function inputs B_IN6, B_IN12 and P_IN8 can also be received via a CAN signal if desired.

No.	Presetting	Unit	Designation	Settings
PR801	1	Binary	Hardwired Park Brake Interlock	0 = Park Brake Interlock hardwired deactivated 1 = Park Brake Interlock hardwired activated"
PR806	0	Binary	Hardwired Neutral	0 = Neutral hardwired deactivated 1 = Neutral hardwired activated

Use of measuring points

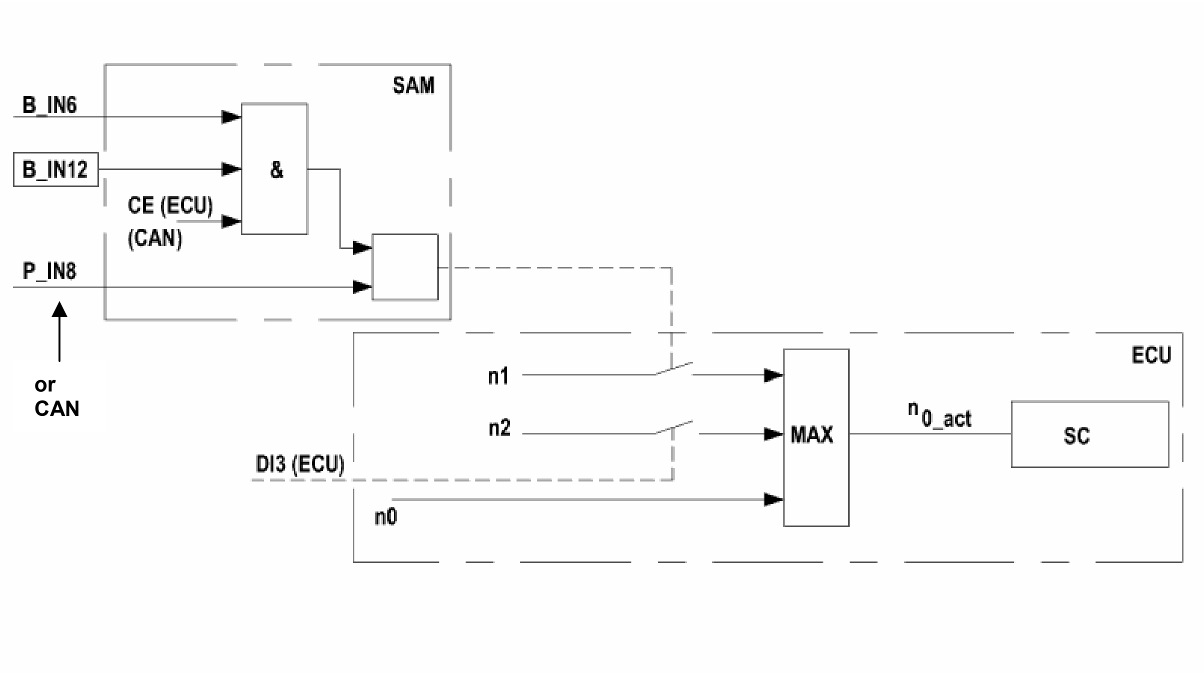
Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Park Brake Interlock	005030	IN				X		
CAN Park Brake Interlock	009730	IN					X	X
OC Neutral	005040	IN				X		
CAN Neutral	009740	IN					X	X
Park Brake Interlock Plant Act	009110	OUT						
Neutral Plant Active	009120	OUT						
Increased Idle Active	001846	OUT		X				

7.3.6.6 Alternative Minimum VSG (Variable Speed Governor)

P_IN8 Alternate Minimum VSG

The Alternate Minimum VSG option allows a customer to switch to an alternative VSG minimum speed operating range when the digital input P_IN 8 is switched to +24V and the VSG is the active governor. The Alternate Minimum VSG/Fast Idle digital input may be used to operate the engine at a higher engine idling speed.

No.	Presetting	Unit	Designation	Settings
PR816	1	Binary	HW Alternate Min. VSG Config	0 = Alternate Minimum VSG hardwired deactivated 1 = Alternate Minimum VSG hardwired activated"



The function inputs B_IN6, B_IN12 and P_IN8 can also be received via a CAN signal if desired.

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Alternate Minimum VSG	005080	IN				X		
CAN Alternate Minimum VSG	009780	IN					X	X
Alternate Min VSG Plant Active	009130	OUT						
Increased Idle Active	001846	OUT		X				

7.3.6.7 Internal measuring channels

For internal use/monitoring, the SAM measures the power supply voltage and the internal board temperature.

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
SAM Supply Voltage	005001	IN				X		
SAM Internal Temperature	005002	INt				X		

7.3.7 Configuration of display DIS10

DIS10 displays engine operating data and system states in color. Navigation between the display pages is facilitated by five keys (F1 … F5), the current function of which is indicated by texts or symbols at the bottom of the display.

Configuration of display DIS10 and I/O control is realized by SAM parameters or CAN objects which are exchanged between the SAM and the DIS10.

Acknowledge Config:

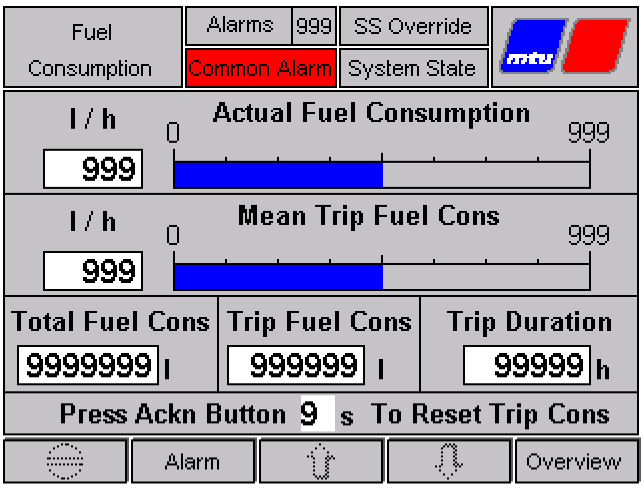
Alarm acknowledgment is configured here. Parallel to Alarm Reset via CAN bus or the discrete input in the ADEC, confirming the fault on the display resets the alarm in ADEC and/or SAM. The function of the Acknowledge button on DIS10 can be set via the SAM as follows.

No.	Presetting	Unit	Designation	Settings
PR120	0	digit	Display Acknowledge Config	0 = All alarms are acknowledged 1 = Single alarm acknowledged

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Display Acknowledged	900900	In			X			
Display Acknowledge Button	900901	In			X			
Display Acknowledge Config	900912	Out			X			
Alarm Reset (SAM)	005999	Out			X			

Reset Trip Fuel:

The trip consumption counter can also be reset via DIS10 as an alternative to resetting via CAN bus or the discrete input on the SAM. To do this the Fuel Consumption Page must be selected and the Acknowledge button pressed for longer than 9 seconds (default value). A counter at the bottom of the display indicates when the 9 seconds have elapsed.



No.	Presetting	Unit	Designation	Settings
PR019	9		Max Count Reset Trip Fuel	Max Pulse (Cycle Time) Count for Reset Trip Fuel.
PR980	0		EOS Fuel Consumption l/h	End of Scale Fuel Consumption Bargraphs. Will be used if value is <>0

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Trip Reset Countdown	005706	Out			X			
Actual Fuel Cons. %/l	005713	Out			X			
Mean Trip Fuel Cons. %/l	005714	Out			X			
Reset TripFuel Counter Release	900902	Out			X			
DIS Page Fuel Cons. Config	900909	Out			X			

Selection of engine type & start page:

Some of the characteristics of the display DIS10 can be modified by the vehicle user on the Parameter Page in the SAM minidialog (see chapter “SAM minidialog menu“):

1. Select Engine 2000/4000:

The correct engine type can be selected on the Parameter Page in the SAM minidialog as barchart scaling in DIS10 varies depending on the engine model and the number of cylinders.

No.	Name
1	12V 4000 C13
2	12V 4000 C23
3	16V 4000 C13
4	16V 4000 C23
5	20V 4000 C13
6	20V 4000 C23

2. Select Start Page

The following pages can be selected as required on the Parameter Page in the SAM minidialog to appear as the Start Page on DIS10.

No.	Name
1	ECU Overview
2	ECU Pressure
3	ECU Temp.
4	AUX Page

Use of measuring points

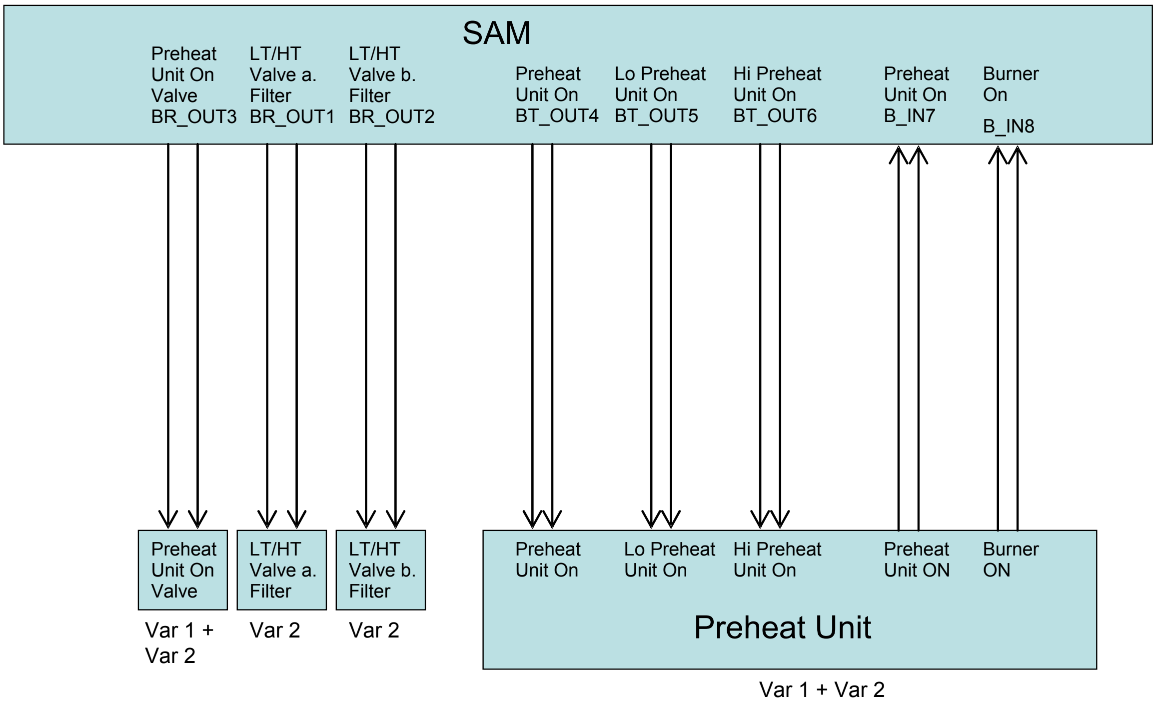
Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Select Engine 2000/4000	900005	Out			X			
Select Display Start Page	900007	Out			X			
Dis Page Config	900910	Out			X			
Dis Node Configuration	900911	Out			X			
Display Acknowledge Config	900912	Out			X			

7.3.8 Cold weather package

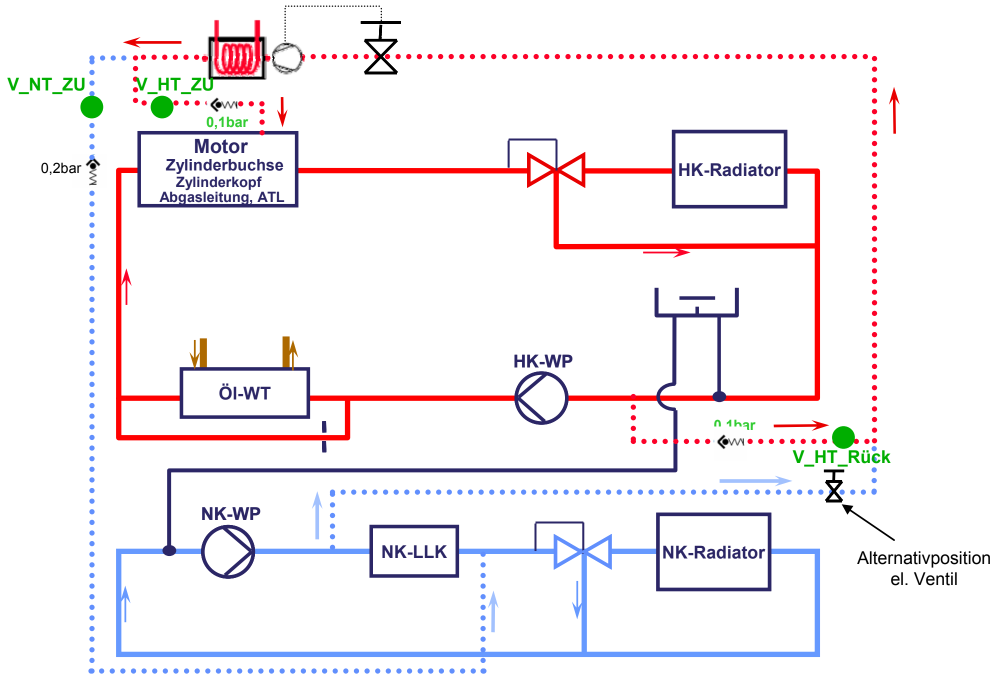
The Cold Weather Package function was designed to control the “Webasto Thermo 300“ preheater. The preheater is used to warm-up both the HT and LT circuits. The SAM monitors and controls the preheater and activates the electrical valves to switch between the two cooling circuits.

The SAM controller supports two possible installation variants:

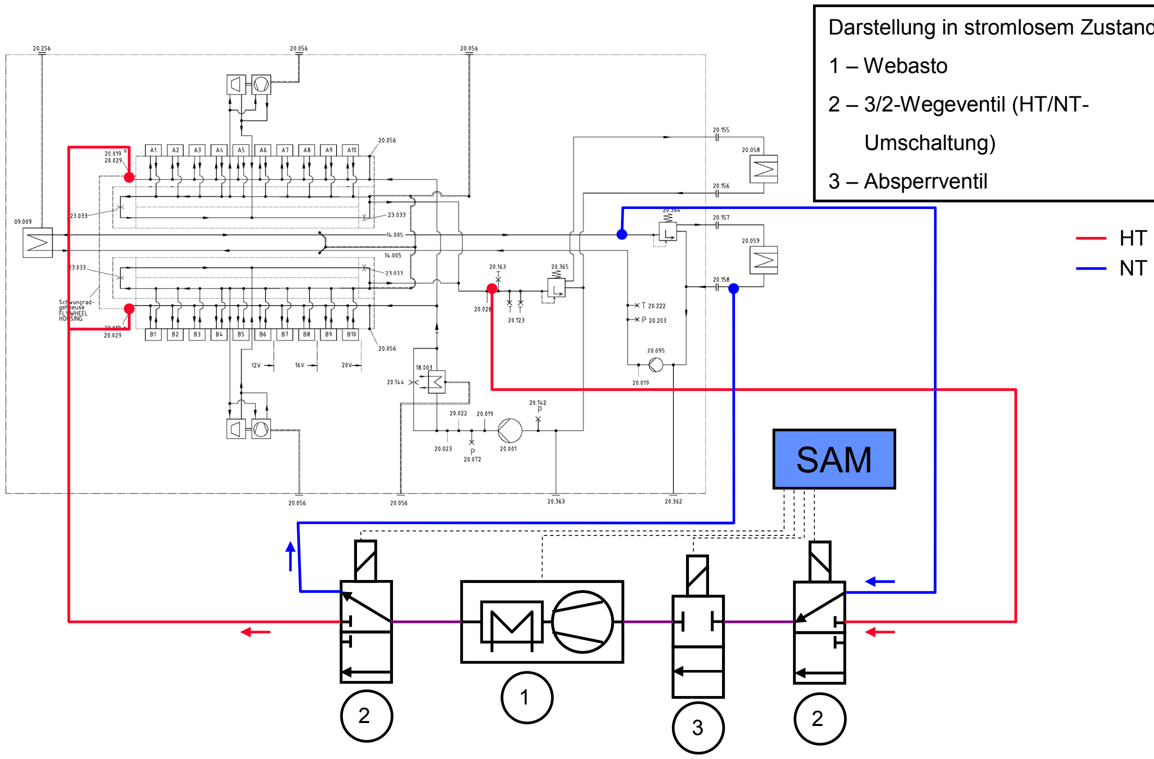
Variant 1: Preheater + 2 electrically-actuated valves
Variant 2: Preheater + 1 electrically-actuated valve



Variant 1:



Variant 2:



Activation of the Cold Weather Package (variants 1+2)

The Cold Weather Package (variants 1 and 2) is activated via PR400. The function can be “Deactivated” by setting the parameter accordingly (PR400 = 0), or “Variant 1 active“ (PR400 = 1) or “Variant 2 active“ (PR400 = 2) can be selected.

No.	Presetting	Unit	Designation	Settings
PR400	0	digit	Preheat Unit Selection	0 = Function deactivated 1 = Variant 1 2 = Variant 2

Temporary deactivation (e.g. for servicing)

When the “Cold Weather Package“ function is activated it can be deactivated either via the discrete input “BI Disable Preh. Unit Control“(P_IN2, PV005500) or via a CAN signal “CAN Disable External Preheat“ (PV009851). This “shutdown function” is activated via parameters PR895 and PR896.
If the parameter concerned is TRUE, the “Cold Weather Package“ can be controlled accordingly via J1939 or CANOpen and SAM input P_IN2 TRUE.

No.	Presetting	Unit	Designation	Settings
PR895	FALSE		CAN Extern Preheat Config	0 = Ext. preheating off via CAN deactivated 1 = Ext. preheating off via CAN activated
PR896	FALSE		Hardwired Ext. Preheat Config	0 = Ext. preheating off via discrete input deactivated 1 = Ext. preheating off via discrete input activated

Webasto control:

The Webasto preheater set for MTU applications has 3 heating stages which can be selected by appropriately activating the digital inputs of the preheater by the SAM (BT_OUT4-6) (see table below). In the present control logics only heating stage 3 is used as temperature regulation is monitored and controlled by the SAM controller.

Overview of heating stages of the Webasto preheater

	Preheat Unit On BT_OUT4 (PV005524)	Lo-Power Preheat Unit On BT_OUT5 (PV005525)	Hi-Power Preheat Unit On BT_OU6 (PV005526)
OFF	FALSE	FALSE	FALSE
Heating stage 1	TRUE	TRUE	FALSE
Heating stage 2	TRUE	FALSE	FALSE
Heating stage 3	TRUE	FALSE	TRUE

Webasto monitoring

The preheater signals its present operating state with two status signals “BI Preheat Unit ON“ (B_IN7, PV005531) and “BI Burner ON“ (B_IN8, PV005532). A yellow alarm must be output if no plausible feedback is signaled after a timeout has elapsed indicating that the preheater control has been switched on. Monitoring can be activated via parameter PR416. Monitoring of the two status signals can be delayed with parameters PR417 and PR418. The minimum holding time for alarm output can be set with parameter PR419.

No.	Presetting	Unit	Designation	Settings
PR416	FALSE	digit	Preheat Unit Monitoring	0 = Preheater monitoring On 1 = Preheater monitoring Off
PR417	5	s	Timeout Preheat ON	Delay time for monitoring the “Preheater is On” feedback signal
PR418	30	S	Timeout Burner ON	Delay time for monitoring the “Burner is On” feedback signal
PR419	2	S	Alarm timeout OFF	Preheater fault minimum pulse time

The fault message is output by the SAM as a yellow “AL 5538 Failure Preheat Unit“ alarm. The alarm is output via the “Yellow alarm” lamp at the ECU and indicated on the SAM display. The alarm is simultaneously transmitted to the vehicle controller on the J1939/CANOpen bus.

Logic Preheat Failure Information

	Input variables			Output variables
No.	Preheat Unit On Demand	Preheat Unit ON Feedback	Burner On Feedback	Failure Preheat Unit
1	FALSE	FALSE	FALSE	FALSE
2	TRUE	FALSE	FALSE	TRUE
3	FALSE	TRUE	FALSE	TRUE
4	TRUE	TRUE	FALSE	FALSE
5	FALSE	FALSE	TRUE	TRUE
6	TRUE	FALSE	TRUE	TRUE
7	~~FALSE~~	~~TRUE~~	TRUE	TRUE
8	~~TRUE~~	~~TRUE~~	TRUE	FALSE

Status message

When the “Cold Weather Package” is activated a flashing code is output via the Preheat Lamp (PV005527) if the coolant temperature in the HT circuit is below the limit value for starting ($T_{Coolant} < T_{Coolant\_StartLimit}$). This temperature value can be set with parameter PR410. A timeout can be set (PR412) when the limit is exceeded. A hysteresis can also be set with parameter PR411 after which the limit value for this temperature ($T_{Coolant\_StartLimit}$) is undershot again.

The flashing frequency can be set with parameter PR651 “Preheat Blink Frequency”. The “Preheat Temp. Not Reached” message is simultaneously transmitted to the higher-level controller on the J1939/CANOpen bus.

A continuous signal is output when the preheater is switched on if the HT coolant temperature exceeds the limit value for starting. The “Preheat System On“ message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on.

No.	Presetting	Unit	Designation	Settings
PR410	20	°C	HT Start Limit	$T_{Coolant\_StartLimit}$, coolant temperature limit value for starting
PR411	15	°C	HT Start Limit Hysteresis	Hysteresis value for low limit violation
PR412	5	s	HT Start Limit Delay Time	Timeout
PR651	3		Preheat Blink Frequency	0 = Preheat lamp is deactivated during priming 1 = Preheat lamp is steady on during priming 2 = Preheat lamp flashes at 0.5 Hz during priming 3 = Preheat lamp flashes at 2 Hz during priming

Solenoid valve control

Variant 1:

Control variant 1 is designed to preheat the HT and LT circuits via a common preheater. Appropriately switching an electrically-actuated 2/2 valve allows heating of the LT or HT circuit as required.

No.	Presetting	Unit	Designation	Settings
PR413	FALSE	digit	Preheat Valve NONC	0 = Preheat valve is High Active 1 = Preheat valve is Low Active

Engine preheating at standstill

The HT circuit of the engine is preheated. The preheater is switched on following the timeout (PR403) and heating stage 3 is selected (see above) if the coolant temperature (PV001126) of the HT circuit lies below Limit 1 (PR401, with hysteresis PR402). The valve “Preheat Unit On Valve” (PV005523) remains deactivated.

The “Preheat HT On“ (PV005535) message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on in this operating mode. Alternatively, operation of the preheater can also be indicated by a status lamp (BT_Out10, PV005527).

The Webasto preheater is switched of again when the coolant temperature (PV001126) of the HT circuit exceeds Limit 1 (PR401) (see above).

No.	Presetting	Unit	Designation	Settings
PR401	60	°C	HT-Limit 1 (Limit for engine at standstill)	Limit value for engine at standstill
PR402	15	°C	HT-Limit 1 Hysteresis	Hysteresis value for low limit violation
PR403	5	s	HT-Limit 1 Timeout	Power-up timeout

LT heating with the engine running:

Preheating the charge-air via the LT coolant circuit is of lower priority, i.e. it is of secondary importance compared to HT coolant preheating. The preheater is switched on following the timeout (PR409) and heating stage 3 is selected (see Preheating with the engine at standstill) if the coolant temperature (PV001137) of the LT circuit lies below the LT-limit (PR407, with hysteresis PR408) when the engine is running. The valve “Preheat Unit On Valve“ (PV005523) is activated when the preheater is switched on.

The “Preheat NT On“ (PV005536) message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on in this operating mode. Alternatively, operation of the preheater can also be indicated by a status lamp (BT_Out10, PV005527).
Preheating is switched off again when the coolant temperature (PV001137) of the LT circuit exceeds the LT-Limit (PR407).

No.	Presetting	Unit	Designation	Settings
PR407	20	°C	LT-Limit (limit for engine running)	Limit value
PR408	15	°C	NT-Limit Hysteresis	Hysteresis value for low limit violation
PR409	5	s	LT-Limit Timeout	Power-up timeout

Summer mode

The preheater must be deactivated by the vehicle controller if preheating is not required (e.g. in summer) (see “Temporary deactivation (e.g. for servicing)“)
In this operating mode the preheater remains switched off and the change-over valves rest in their quiescent state.

Variant 2:

As for variant 1, the variant 2 described below is designed with a common preheater to warm-up the HT and LT circuits. In contrast to variant 1, however, switching between the two circuits is realized by two electrically-actuated 3/2 valves. For this variant, the Webasto preheater must be automatically disconnected by a 2/2 shut-off valve if no coolant preheating is required (e.g. in summer).

No.	Presetting	Unit	Designation	Settings
PR413	FALSE	Binary	Preheat Valve NONC	0 = Preheat Valve Is High Active 1 = Preheat valve is Low Active
PR414	FALSE	Binary	Preheat Valve after Filter NONC	0 = Preheating valve after filter (var. 2) is High Active 1 = Preheating valve after filter (var. 2) is Low Active
PR415	FALSE	Binary	Preheat Valve before Filter NONC	0 = Preheating valve before filter (var. 2) is High Active 1 = Preheating valve before filter (var. 2) is Low Active

Engine preheating at standstill

The HT circuit of the engine is preheated. The preheater is switched on following the timeout (PR403) and heating stage 3 is selected (see “Engine preheating at standstill”) if the coolant temperature (PV001126) of the HT circuit lies below Limit 1 (PR401, with hysteresis PR402). The valve “Preheat Unit On Valve“ (PV005523) is activated when the preheater is switched on. Furthermore, the two valves BO NT/HT Valve after Filter (PV005521) and BO NT/HT Valve before Filter (PV005522) are activated for switching between the two coolant circuits, whereby the HT circuit is cut in.

The “Preheat HT On“ (PV005535) message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on in this operating mode. Alternatively, operation of the preheater can also be indicated by a status lamp (BT_Out10, PV005527).

Preheating is switched of again when the coolant temperature (PV001126) of the HT circuit exceeds Limit 1 (PR401) (see above).

No.	Presetting	Unit	Designation	Settings
PR401	60	°C	HT-Limit 1 (Limit for engine at standstill)	Limit value for engine at standstill
PR402	15	°C	HT-Limit 1 Hysteresis	Hysteresis value for low limit violation
PR403	5	s	HT-Limit 1 Timeout	Power-up timeout

HT heating with the engine running:

The HT circuit has the highest priority as it keeps the entire engine block at the right temperature. The Webasto is switched on following the timeout (PR406) and heating stage 3 is selected (see “LT heating with the engine running”) if the coolant temperature (PV001126) of the HT circuit lies below Limit 2 (PR404, with hysteresis PR405) when the engine is running. The valve “Preheat Unit On Valve (PV005523)“ is activated when the preheater is switched on. Furthermore, the two valves BO LT/HT Valve after Filter (PV005521) and BO LT/HT Valve before Filter (PV005522) are activated for switching between the two coolant circuits, whereby the HT circuit is cut in.

The “Preheat HT On“ (PV005535) message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on in this operating mode. Alternatively, operation of the preheater can also be indicated by a status lamp (BT_Out10, PV005527).
The Webasto preheater is switched off again when the coolant temperature (PV001126) of the HT circuit exceeds Limit 2 (PR404) (see above).

No.	Presetting	Unit	Designation	Settings
PR404	70	°C	HT-Limit 2 (Limit for engine running)	Limit value
PR405	15	°C	HT-Limit 2 Hysteresis	Hysteresis value for low limit violation
PR406	5	s	HT-Limit 2 Timeout	Power-up timeout

LT heating with the engine running:

Preheating the charge-air via the LT coolant circuit is of lower priority, i.e. it is of secondary importance compared to HT coolant preheating. The Webasto is switched on following the timeout (PR409) and heating stage 3 is selected (see above) if the coolant temperature (PV001137) of the LT circuit lies below the LT limit (PR407, with hysteresis PR408) when the engine is running. The valve “Preheat Unit On Valve“ (PV005523) is activated when the preheater is switched on. Furthermore, the two valves BO LT/HT Valve after Filter (PV005521) and BO LT/HT Valve before Filter (PV005522) are deactivated for switching between the two coolant circuits, whereby the LT circuit is cut in.

The “Preheat NT On“ (PV005536) message is transmitted to the higher-level controller on the J1939/CANOpen bus as long as the preheater is switched on in this operating mode.

The Webasto preheater is switched off again when the coolant temperature (PV001137) of the LT circuit exceeds the LT limit (PR407) (see above).

No.	Presetting	Unit	Designation	Settings
PR407	20	°C	LT-Limit (limit for engine running)	Limit value
PR408	15	°C	NT-Limit Hysteresis	Hysteresis value for low limit violation
PR409	5	s	LT-Limit Timeout	Power-up timeout

Summer mode

The preheater must be deactivated by the vehicle controller if preheating is not required (e.g. in summer) (see “Temporary deactivation (e.g. for servicing)“)

In this operating mode the Webasto preheater remains switched off and the change-over valves rest in their quiescent state.

Use of measuring points (variants 1+2)

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
HW Preheat Unit Disable	005500	IN				X		
CAN Preheat Unit Disable	009851	IN					X	X
MD CAN Preheat Unit Disable	009985	Out	X					
T-Coolant	001126	IN		X	X			
T-Coolant Intercooler	001137	IN		X	X			
Engine Running	001068	IN		X	X			
BO NT/HT Valve after Filter	005521	Out				X		
BO NT/HT Valve before Filter	005522	Out				X		
BO Preheat Unit Valve	005523	Out				X		
BO Preheat Unit ON	005524	Out				X		
BO LO Preheat Unit ON	005525	Out				X		
BO HI Preheat Unit ON	005526	Out				X		
BO Preheat LAMP	005527	Out				X		
BI Burner ON	005532	IN				X		
CAN Preheat HT On	005535	Out					X	X
CAN Preheat NT On	005536	Out					X	X
Failure Preheat Unit	005538	Out	X				X	X
External Preheat Disable	005501	Out						
CAN Preheat Temp not reached	005537	Out					X	X
CAN Preheat Unit On HT	005535	Out					X	X
CAN Preheat Unit On LT	005536	Out					X	X

7.4 Additional Functions

7.4.1 Start and Stop Signals

There are two ways of wiring the start/stop signals for Series 4000-03 engines used in mining applications:

1) Start and stop wired to ADEC
Required cable connections
Start and stop signal are wired in the X1 connector (vehicle interface harness, drawing XZ00E50000015).

2) Start and stop wired to SAM
Required cable connections
Start and stop signal are wired to the SAM (connector X19, drawing XZ00E50000016) or sent by CAN bus (J1939 or CANopen). The SAM offers an additional feature called start interlock (connector X3).

7.4.1.1 Start

Start signal (ADEC input DI 7)
X1 pin 22: GND
X1 pin 37: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 37.

Start signal (SAM input P_IN 3)
X1 pin 7: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 7 (must be of the same electrical potential as SAM).

This function can be configured with the following SAM parameter:

No.	Default	Unit	Designation	Settings
PR866	1	Binary	Hardwired Start Configuration	0 = Engine Start hardwired deactivated 1 = Engine Start hardwired activated

Start signal (SAM CAN)
Engine Start (see Chapter CANopen/J1939)

This input is configured as an “active high” input (default setting). An engine start is requested when “True” is sent in the corresponding message on CAN.

This function can be configured with the following SAM parameter:

No.	Default	Unit	Designation	Settings
PR865	0	Binary	CAN Start Config.	0 = Start via CAN deactivated 1 = Start via CAN activated

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Engine Start	005060	IN				X		
Engine Start Active	005065	OUT						
Engine Start	001813	OUT		X				
Engine Start Plant Active	009060	OUT						

ADEC/ECU Parameters

No.	Designation	Settings
2.1090.001	Ignition input IGI activated	IGI input is activated
2.1090.010	Engine Start Clearance	Engine may be started. Bit 0 of the Engine Starting States PV.
2.1090.050	Engine Start Requested	Result of all engine start requests.
2.1090.051	Engine Start Button	Input signal from ECU7. 0 = Start button not pushed. 1 = Start button pushed. Configurable to any ECU7 binary input by Binary Input Configuration.
2.1090.201	CAN Engine Start (LOP)	Starting request via CAN from LOP device (SAM).

2.1090.001 must be “1” to start engine
2.1090.010 must be “1” to start engine
2.1090.050 indicates a start request but not the source of the start request (check PV 2.1090.051 and 2.1090.201)
2.1090.051 indicates that start on ADEC DI 7 is activated
2.1090.201 indicates that start on SAM P_IN 3 is activated (transmitted via CAN bus)

ECU/ADEC Parameters POM

No.	Designation	w/o POM	w. POM
1.4500.001	POM installed	0	1
1.4500.002	Monitoring Suppression/Engine stopped	0	0
1.4500.003	CAN POM Start Monitor Delay Time	4	4
1.4500.005	Starter Engaged Factor	1,3	1,3
1.4500.006	Starter Engaged Time Out	0,8	0,8
1.4500.051	U-Power Supply POM Lower Limit 1	18	18
1.4500.052	U-Power Supply POM Lower Limit 2	13	10
1.1050.004	BinOut TOP4 PV-Number	2.1090.013	0
1.1050.009	BinOut TOP Monitoring Configuration	3	3
1.1050.017	TOP4 Select for Test (Lamp)	0	0

7.4.1.2 Stop

Stop signal (ADEC input DI 1)
X1 pin 28: GND
X1 pin 43: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 43 is not connected to 24 V (safety feature, engine is stopped in case of wire break!).

Stop signal (SAM input P_IN 1)
X1 pin 5: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 5 is not connected to 24 V (must be of the same electrical potential as SAM). This is a safety feature. The engine stops in case of a wire break!

The SAM stop function is only allowed to be deactivated if the ADEC stop function is used with default settings.

No.	Default	Unit	Designation	Settings
PR871	0	digit	Hardwired Stop Configuration	0 = Engine Stop hardwired deactivated 1 = Engine Stop hardwired activated

Stop signal (SAM CAN)
Engine Stop (see Chapter CANopen/J1939)

This input is configured as an “active high” input (default setting). An engine stop is requested when “True” is sent in the corresponding message on CAN.

This function can be configured with the following SAM parameter:

No.	Default	Unit	Designation	Settings
PR870	0	digit	CAN Stop Config.	0 = Stop via CAN deactivated 1 = Stop via CAN activated (SAE J1939 or CANopen see PR800)"

Engine stopping with runout can also be activated in order to allow the engine to cool down gradually and the turbochargers to run out.

Engine Stop follow-up signal

The engine is not immediately shut down following the engine stop request (discrete or CAN). A timer which ensures the necessary minimum runout time is activated instead. The engine is shut down when the timer has expired providing that the engine coolant temperature has fallen below the relevant limit. The engine is only shut down once the temperature has fallen below the limit if the temperature is still too high when the timer expires.
The function is only active when the engine is operating above a minimum temperature. The possibility of a forced stop can be activated as an option. If this is activated, the engine is immediately shut down without awaiting expiry of the runout time when stopping is requested again (2nd actuation).
The possibility of a speed limit can be activated as an option. When this is activated, a speed limit signal is transmitted to the engine when runout is activated.

No.	Default	Unit	Designation	Settings
PR872	0	digit	Engine Stop follow-up active	0 = Engine Stop follow-up deactivated 1 = Engine Stop follow-up activated
PR873	0	digit	Engine Stop follow-up override	0 = Engine Stop follow-up override deactivated 1 = Engine Stop follow-up override activated
PR874	1	S	Engine Stop pulse duration	Minimum pulse duration for engine stop in sec.
PR875	0	digit	Eng. Stop follow-up Idle Active	0 = Engine Stop follow-up forces idle is deactivated 1 = Engine Stop follow-up forces idle is activated"
PR876	600	rpm	Eng. Stop follow-up idle speed	Idle speed when Engine Stop follow-up sequence is activated.
PR877	180	s	Engine Stop follow-up time	Minimum follow-up duration until engine stops in sec.
PR878	90	°C	U1L T-Coolant Stop follow-up	Coolant temperature limit for Engine Stop after follow-up time has expired
PR879	-40	°C	U1H T-Cool.Stop follow-up active	Coolant temperature limit for Engine Stop follow-up activation

Engine Stop follow-up Lamp (SAM output BT_Out 19)

When runout is activated, the follow-up function is signaled via output BT_Out19 “Engine Stop follow-up active” = True (+24V) when Engine Stop has been actuated:
X18 pin 9: +24 V

Engine Stop follow Status (SAM CAN)

When runout is activated, the follow-up function is output via the CAN bus when Engine Stop has been actuated (see Chapter CANopen/J1939)

Use of measuring points:

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Engine Stop	005050	IN				X		
Engine Stop	001814	OUT		X				
Engine Stop Plant active	005051	OUT					X	X
Engine Stop follow-up active	005052	OUT					X	X
Engine Stop follow-up override	005053	OUT						
Engine Stop follow-up time	005054	OUT						
BO Engine Stop follow-up active	005055	OUT				X		
Engine Stop Plant active	009050	OUT						

ECU/ADEC Parameters DiaSys

No.	Designation	Settings
2.7001.001	Stop activated	Engine stop is activated. The reason can be found in PV 2.7001.002 and following.
2.7001.002	STOP BUTTON	Manual stop request by ECU button, configurable to any ECU binary input by Binary Input Configuration.
2.7001.003	Stop FBFE	A stop was performed by the injection system (loss of synchronization and no redundancy available).
2.7001.004	Stop CAN	Result of all manual stop inputs via CAN (SAM).
2.7001.005	Stop Protection	Result of all stop requests by the protection modules
2.7001.007	ESI Input activated	ESI input is activated
2.7001.008	External Stop Activated	Stop activated by external signal (stop button, CAN (SAM))
2.7001.010	Automatic Engine Stop	Security system or engine stalling has stopped the engine
2.7001.011	CAN Request Engine Stop 1	Request for engine stop via CAN (SAM)

2.7001.001	indicates that a stop is activated (for source of stop check PVs 2.7001.002 to 2.7001.011)
2.7001.002	indicates that stop on ADEC DI 1 is activated
2.7001.011	indicates that stop on SAM P_IN 1 is activated

7.4.1.3 Start sequence and priming/starter activation

The start sequence for Series 4000-03 engines is controlled by the ADEC. The ADEC checks the conditions for engine start and controls activation of priming pump and starter.

Start sequence (further details in Attachment 5):

1. Start signal applied (if start clearance, start sequence activated)
2. Priming pump activated until oil pressure OK
3. Starter activated

Priming pump

The priming pump is connected to transistor output TO3 in the X2 sensor harness (drawing XZ00E50000347).

Priming pump on signal (ADEC output TO3)

X2 pin 35: GND
X2 pin 13: +24 V

Starter relay activation (no POM installed)

If no POM is installed the starter relay is activated by the transistor output TOP4 in the X1 harness.

Starter on signal (ADEC output TOP4)

X1 pin 9: GND
X1 pin 10: +24 V

Starter activation (POM installed)

If a POM is installed the starter is activated by the POM. The signal to the starter is wired in the POM harness (X21, drawing XZ00E50000134 and XZ00E50000136).

Starter on signal (POM output TOH1/TOH2)

X21 pin 1: +24 V (TOH1 to starter A side, XM1A pin 1)
X21 pin 2: +24 V (TOH2 to starter B side, XM1B pin 1)

ECU/ADEC Parameters DiaSys Start Sequence

No.	Designation	Settings
2.1090.012	Starting in Progress	Info bit that starting is in progress. 0 = No starting in progress. 1 = Starting in progress. Bit 2 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021).
2.1090.013	Starter ON	Info bit that starter is running. 0 = Starter is not running. 1 = Starter is running. Bit 3 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.014	Prelubrication Pump ON	Activate lubrication unit via CAN. 0 = Lubrication unit OFF. 1 = Lubrication unit ON. Bit 4 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.015	Prelubrication Indication	Indication of priming, reflects activity of priming pump. 0 = Priming pump off. 1 = Priming in progress. Bit 5 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.017	Starter Speed Reached	Info bit that engine has reached the projected starter speed. 0 = Starter speed not reached. 1 = Starter speed reached. Bit 7 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.018	Starter Release Speed Reached	Info bit that engine has reached the projected starter release speed. 0 = Starter release speed not reached. 1 = Starter release speed reached. Bit 8 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.019	XXX SPEED	Info bit that engine has reached the projected engine idle speed. 0 = Engine idle speed not reached. 1 = Engine idle speed reached. Bit 9 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.020	Start aborted	Info bit. 0 = OK. 1 = Start has been aborted. Bit 10 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.021	Restarting	Info bit. 0 = OK. 1 = Engine is being restarted after engine failed to reach projected starter speed within the projected starter time interval. Bit 11 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.024	Engine Start Instruction	Set when engine start request is valid. Signaled back via CAN to Start (button) indicator lamp. Bit 14 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.026	Start Aborted T-Preheat	Info bit. 0 = OK. 1 = Limit 1 of T-Preheat has not yet been reached. Starting procedure is aborted due to this condition. Bit 16 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..
2.1090.027	Start Aborted P-Prelubrication	Info bit. 0 = OK. 1 = Priming limit of T-Lube Oil has not yet been reached. Starting procedure is aborted due to this condition. Bit 17 of the Engine Starting States PV (ADEC-PV 2.1090.062/SAM-PV 001021)..

2.1090.012	indicates that start sequence is in progress
2.1090.014	indicates that the priming pump is on (TO3 activated)
2.1090.013	indicates that starter is on w/o POM: TOP4 activated w. POM TOH1 and TOH2 activated

7.4.1.4 Start Interlock

Start interlock (SAM input B_IN 1)
X3 pin 10: GND
X3 pin 9: +24 V

This input is configured as an “active low” input (default setting). The start interlock function is active if pin 9 is disconnected from power supply - an engine start is not possible). This is a safety feature. The engine does not run in case of a wire break!

This function can be configured with the following SAM parameter. If the start interlock feature is not required no configuration is necessary.

No.	Default	Unit	Designation	Settings
PR861	0	digit	Hardwired Start Interlock Configuration	0 = Start interlock hardwired deactivated 1 = Start interlock hardwired activated"

Start interlock (SAM CAN)
Start interlock (see Chapter CANopen/J1939)

This input is configured as an “active high” input (default setting). An engine start interlock is requested when “True” is sent via CAN.

This function can be configured with the following SAM parameter. If the start interlock feature is not required no configuration is necessary.

No.	Default	Unit	Designation	Settings
PR860	0	digit	CAN Start Interlock Config.	0 = Start interlock via CAN deactivated 1 = Start interlock via CAN activated

Remark: If the start interlock feature is used and the input recognizes “start interlock active” no start request message is broadcast on the CAN bus (refer to 2.1090.201 below).

Use of measuring points:

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
OC Start Interlock	005020	IN				X		
Start Interlock Plant Active	009020	OUT						
Engine Start	001813	OUT		X				
Engine Stop	001814	OUT		X				

7.4.1.5 Ready for start lamp

Ready for start lamp (SAM output BT_OUT 9)
X17 pin 11: +24 V

The ready for start lamp is a recommended feature to display the status of the engine before start and during the start sequence (refer to chapter “Start sequence and priming/starter activation”):

- Lights up if an engine start can be initialized (START possible, leads to priming),
  Remark:
  When Start Interlock is active (see Chapter “Start Interlock”) the “Ready for Start Lamp” or the “Ready for Start Signal” indicates that starting is not possible (lamp/signal = OFF)
- Flashes when the oil priming pump is in operation.
- Lights up again once the required oil pressure is built up and the engine can be started (START now leads to starting of the engine).
- Goes out when the engine speed increases to over 300 rpm.

Ready for Start (SAM CAN)
Ready for Start Status (see Chapter “CANopen/J1939”)

The ready for start signal is a recommended feature to display the status of the engine before priming or start can be initialized.

- Signal is “True” if an engine start can be initialized (START possible, leads to priming)
- Signal is “True” again once the required oil pressure is built up and the engine can be started (START now leads to starting of the engine).

This function can be configured with the following SAM parameter:

No.	Default	Unit	Designation	Settings
PR650	3		Prelube Blinkfrequency	0 = Ready for Start lamp is deactivated during priming 1 = Ready for Start lamp is steady during priming 2 = Ready for Start lamp flashes at 0.5 Hz during priming 3 = Ready for Start lamp flashes at 2 Hz during priming
PR130	0		Delay Time after SAM Bootup for SAM Ready Signal to ECU	

Prelube System On (SAM CAN)

Prelube System On Status (see Chapter “CANopen/J1939”).

- The Prelube System On signal is a recommended feature to display the status of priming sequence.
- Signal is “True” while the priming pump is in operation.

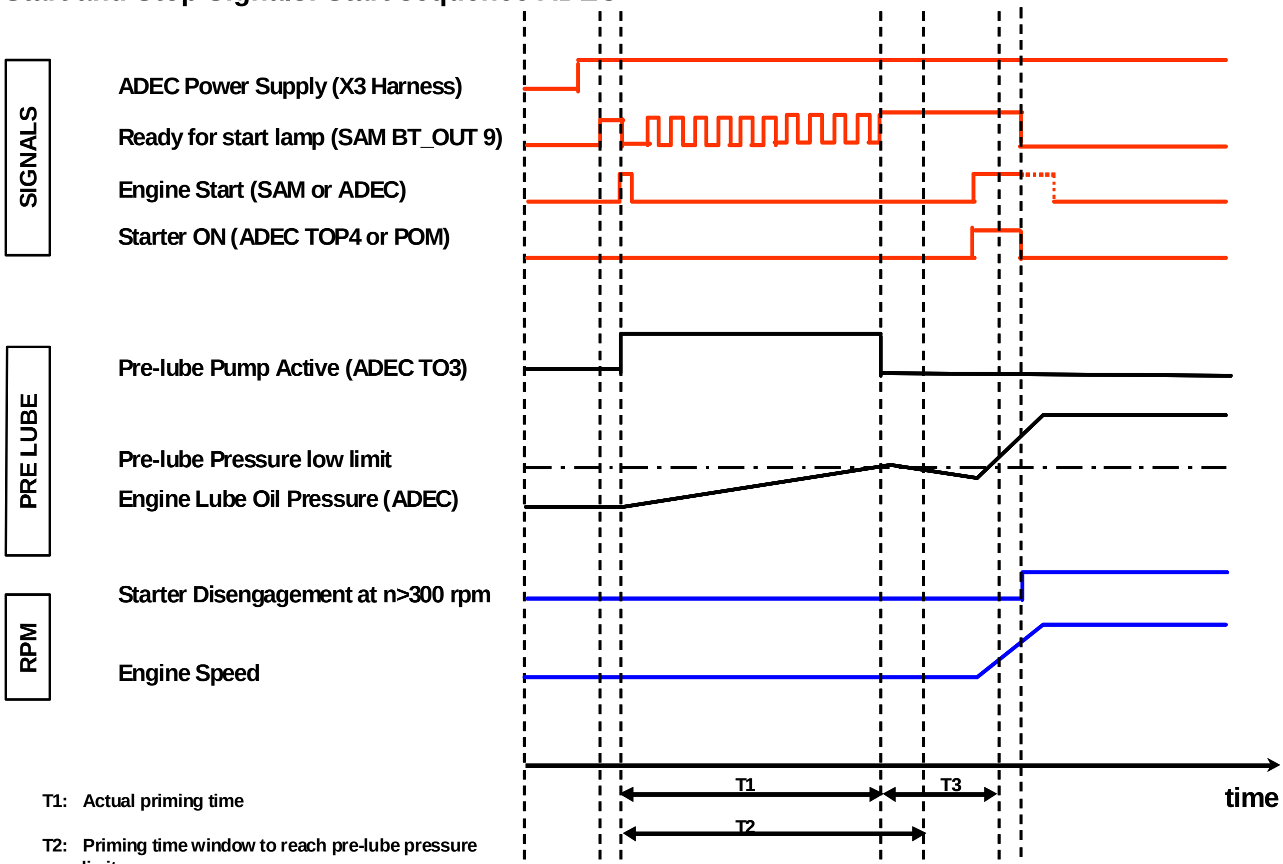
Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Status Start Sequence	001020	IN		X				
BO Ready for Start	005210	Out				X		
Ready for Start	005211	Out						
J1939 Ready for Start	005212	Out					x	x
Prelube System On	005271	OUT					X	X
Start Interlock Plant Active	009020	OUT						
Engine Start	001813	OUT		X				
Engine Stop	001814	OUT		X				
SAM Ready for Start	001903	OUT		X				

ECU/ADEC Parameters

No.	Designation	w/o POM	w. POM
1.1040.003	BinOut TO3 PV-Number	0	2.1090.014
1.1040.007	BinOut TO3 Active Level	0	0
1.1040.009	BinOut Monitoring Configuration	0	4
1.8004.636	AL Wiring TO3	1233	1233
2.1090.100	Enable Starting Procedure	1	1
2.1090.103	Enable Prelubrication on Start	0	1
2.1090.104	Enable Manual Prelubrication	0	0
2.1090.107	Enable Intermittent Oil Priming	0	0
2.1090.920	AL Prelubrication Fault	225	225

Start and Stop Signals: Start sequence ADEC



T1: Actual priming time

T2: Priming time window to reach pre-lube pressure limit

T3: Time window for engine start

7.4.2 J1939/CANOpen bus

Choice between J1939/CANOpen

The choice between J1939/CANOpen must be made on ordering the software as there are two different software versions. Parameter PR701 Interface Configuration (display only) indicates whether the software incorporates a J1939 or a CANOpen interface:

No.	Presetting	Unit	Designation	Settings
PR701	1/2	digit	Interface Configuration	1= J1939 active; 2= CANOpen active

Activating the CCB gateway

Parameter PR700 must be set to 1 to activate the gateway function of the CCB board (J1939 or CANOpen depending on software version). The CCB board remains in sleep mode when the parameter is deactivated (=0). No signals are received or transmitted.

No.	Presetting	Unit	Designation	Settings
PR700	0	Binary	CAN Configruation	0= Deactivated 1= Activated

Selecting the receiving signals

The MTU receiving objects must be configured once the gateway function has been activated. All receiving objects are deactivated by default and must be set accordingly during initial operation of the vehicle.

PGN 65265 Cruise Control/Vehicle Speed

Park Brake Interlock

A binary control signal for the “Park Brake Interlock” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR800	0	Binary	CAN Park Brake Interlock Conf	0= Deactivated 1= Activated
PR801	1	Binary	Hardwired Park Brake Interlock	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Park brake interlock” alarm (009982) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Override

A binary control signal can be read-in via the CAN for the “Override” function. The receiving message is activated by a parameter.

No.	Presetting	Unit	Designation	Settings
PR810	0	Binary	CAN Override Configuration	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Override” alarm (009973) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 65219 Electronic Transmission Controller 5

Neutral

A binary control signal for the “Neutral” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR805	0	Binary	CAN Neutral Configuration	0= Deactivated 1= Activated
PR806	0	Binary	Hardwired Neutral	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Neutral” alarm (009983) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 65325 - Proprietary Comand Signals 1

Speed Setting Limit

A binary control signal can be read-in via the CAN for the “Speed Setting Limit” function. The receiving message is activated by a parameter.

No.	Presetting	Unit	Designation	Settings
PR820	0	Binary	CAN Speed Setting Limit Config	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Speed Setting Limit act” alarm (009979) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. An additional alarm message timeout can be activated via PR702 if necessary.

External Power Curve Limitation

A binary control signal can be read-in via the CAN for the "External Power Curve Limitation" function. The receiving message is activated by a parameter.

No.	Presetting	Unit	Designation	Settings
PR830	0	Binary	CAN Ext.Power Curve Limit Conf	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow "MD CAN Ext Power curve limit" alarm (009981) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Force Max Fan Speed

A binary control signal for the "Force Max Fan Speed" function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other ("OR operation"). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR840	0	Binary	CAN Force Max Fan Speed Conf	0= Deactivated 1= Activated
PR841	0	Binary	HW Force Max Fan Speed Conf	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow "MD Force Max Fan Speed" alarm (009987) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Start Interlock

A binary control signal for the "Start Interlock" function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other ("OR operation"). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR860	0	Binary	CAN Start Interlock Config.	0= Deactivated 1= Activated
PR861	0	Binary	Hardwired Start Interl.Config.	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow "MD CAN Start interlock" alarm (009974) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Start

A binary control signal for the "Start" function can be read-in both via the CAN and via a discrete input of the

SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR865	0	Binary	CAN Start Config.	0= Deactivated 1= Activated
PR866	1	Binary	Hardwired Start Configuration	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Engine Start” alarm (009975) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Alarm Reset

A binary control signal for the “Alarm Reset” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR880	0	Binary	CAN Alarm Reset Configuration	0= Deactivated 1= Activated
PR881	1	Binary	Hardwired Alarm Reset Config.	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Alarm Reset” alarm (009977) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Binary Output Test

A binary control signal for the “Binary Output Test” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR885	0	Binary	CAN Binary Output Test Config.	0= Deactivated 1= Activated
PR886	1	Binary	HW Binary Output Test Config.	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Lamptest” alarm (009978) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Extern Preheat Disable

A binary control signal for the “External Preheat Disable” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR895	0	Binary	CAN Extern Preheat Config	0= Deactivated 1= Activated
PR896	0	Binary	Hardwired Ext. Preheat Config	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Ext Preheating Disable” alarm (009985) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Disable Cylinder Cut Out

A binary control signal for the “Disable Cylinder Cut Out” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR901	0	Binary	HW Request Test Overspeed	0= Deactivated 1= Activated
PR905	0	Binary	CAN Disable Cylinder Cut Out	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Disable Cylinder Cut Out” alarm (009988) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 65326 - Proprietary Command Signals 2

Torque Limit 1

The control signal for torque limitation can be read-in via the CAN for the “Torque Limit 1” function. The receiving message is activated by a parameter.

No.	Presetting	Unit	Designation	Settings
PR850	0	Binary	CAN Torque Limit 1 Config.	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Torque Limit” alarm (1 009971) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

Torque Limit 2

The control signal for torque limitation can be read-in via the CAN for the “Torque Limit 2” function. The receiving message is activated by a parameter.

No.	Presetting	Unit	Designation	Settings
PR855	0	Binary	CAN Torque Limit 2 Config.	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Torque Limit” alarm (2 009972) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 61441 Electronic Brake Controller 1

Stop

A binary control signal for the “Stop” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR870	0	Binary	CAN Stop Config.	0= Deactivated 1= Activated
PR871	0	Binary	Hardwired Stop Configuration	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Engine Stop” alarm (009976) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 64971 Off-Highway Engine Control Selection

Alternate Min. VSG

A binary control signal for the “Alternate Min. VSG” function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other (“OR operation”). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR815	0	Binary	CAN Alternate Min. VSG Config	0= Deactivated 1= Activated
PR816	1	Binary	HW Alternate Min. VSG Config	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow “MD CAN Alternate Minimum” alarm (009984) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 56832 Reset

Trip Fuel Consumption

A binary control signal for the "Trip Fuel Consumption" function can be read-in both via the CAN and via a discrete input of the SAM. Both sources can be requested independently of each other ("OR operation"). Each source is activated by a separate parameter.

No.	Presetting	Unit	Designation	Settings
PR890	0	Binary	CAN Trip Fuel Consumpt Config	0= Deactivated 1= Activated
PR891	1	Binary	HW Trip Fuel Consumpt Config	0= Deactivated 1= Activated
PR702	0	s	Alarm Delay CAN MD Alarms	Alarm delay for MD messages in case of missing CAN messages

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow "MD CAN Reset Trip Fuel counter" alarm (009980) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file. The alarm is simultaneously output via the yellow status lamp at the ADEC. An additional alarm message timeout can be activated via PR702 if necessary.

PGN 0 Torque/Speed Control 1

CAN Speed Demand Configuration

The analog speed setting for the "Speed Demand" function can be set via the CAN bus or by a discrete signal to the ADEC (frequency or voltage). If the speed demand is transmitted via a CAN signal, the receiving message must be activated by the parameter below. In the case of J1939, there is also a possibility of controlling activation of speed demand variably with the CAN message "TSC1 Override Control Mode". Any discrete setting signal applied to the ADEC at the same time is ignored when speed demand is activated via CAN (by parameter or by Override Control mode).

An alarm is tripped when a timeout has elapsed should the CAN connection fail. The system simultaneously switches over automatically to the discrete "Speed demand" configured in the ADEC. An additional alarm message timeout can be activated via PR846 if necessary.

A yellow "MD CAN Speed Demand" (009970) is output at the SAM display. The alarm is simultaneously output via the yellow status lamp at the ADEC.

No.	Presetting	Unit	Designation	Settings
PR845	0	digit	CAN Speed Demand Configuration	0 = Speed Demand via discrete Input (ADEC) activ 1 = Speed Demand via CAN active 2 = SAE J1939 TSC1 Overide Control Mode dependent (J1939 only)
PR970	15	digit	Speed Demand Switch MD Value	Full-scale value
PR846	0	s	Alarm Delay MD Speed Demand	Alarm Delay for MD-Message in case of missing CAN speed demand message

Monitoring of the associated receiving object is activated when the corresponding control signal is activated. The yellow "MD J1939 Override Ctrl. Mode" alarm (009989) is output on the SAM display if the receiving object is not transmitted in the cycle time defined in the EDS file.

Setting CCB gateway monitoring

Both the CAN bus controller for J1939 and CANOpen, and the internal controllers on the CCB board are monitored by the CCB board. The respective states are transmitted in the form of three process variables to the SAM where the are evaluated accordingly. The SAM outputs an alarm when a timeout has elapsed on detecting a fault state.

The timeouts and deactivation of these fault messages can be set with the parameters listed below.

No.	Presetting	Unit	Designation	Settings
PR990	0	digit	CANOpen Error Switch Off	Normal = 0. Each Bit corresponds with the related error code. This parameter will be XOR'ed with the error code of the CCB gateway
PR991	0	digit	J1939 Error Switch Off	Normal = 0. Each Bit corresponds with the related error code. This parameter will be XOR'ed with the error code of the CCB gateway
PR992	0	digit	CCB Error Switch Off	Normal = 0. Each Bit corresponds with the related error code. This parameter will be XOR'ed with the error code of the CCB gateway
PR993	5000	ms	Alarm Delay CCB Error Alarms	Alarm delay for MD messages in case of missing CAN messages

The CCB board is started after a delay following successful booting of the SAM in order to prevent a fault message on the J1939 bus on starting the SAM and the CCB board. The timeouts for CCB start-up and alarm suppression can be set with the parameters listed below.

No.	Presetting	Unit	Designation	Settings
PR015	5	s	CAN Startup Alarm Delay	Timeout for monitoring MD alarms when SAM is switched on.
PR016	10	s	CCB Startup Alarm Delay	Timeout for starting the CCB

Use of measuring points:

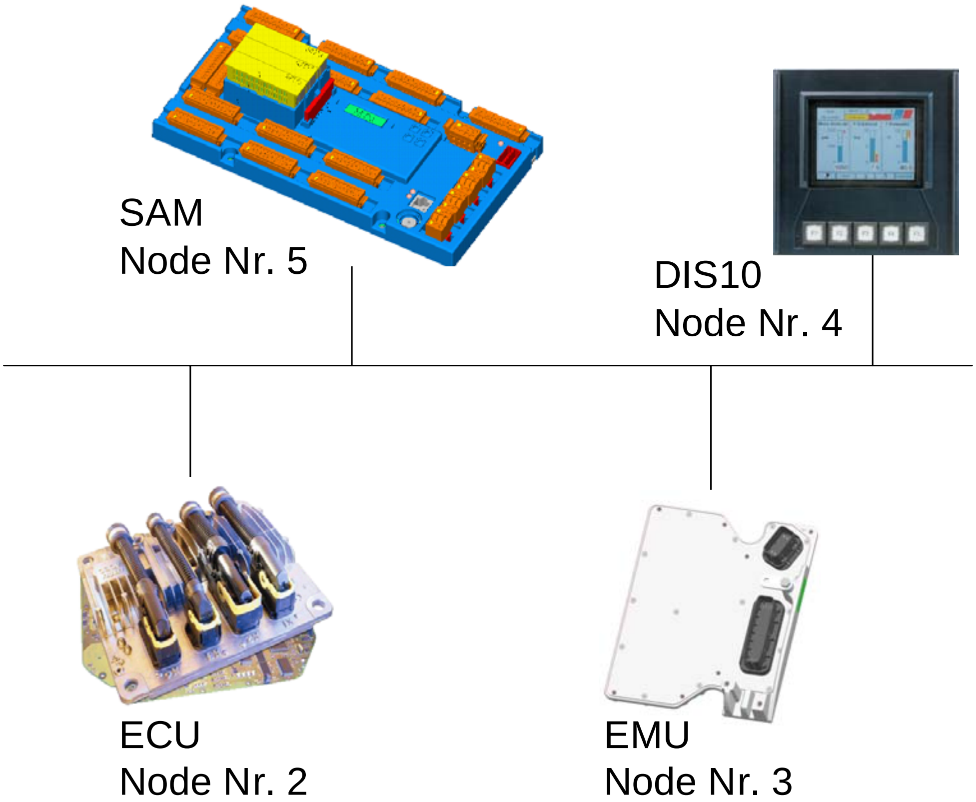
Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discret I/O SAM	J1939 Transmission	CANOpen Transmission
CAN Start Interlock	009720	IN					X	X
CAN Park Brake Interlock	009730	IN					X	X
CAN Neutral	009740	IN					X	X
CAN Alternate Minimum VGS	009780	IN					X	X
CAN Disable Cylinder Cut Out	009804	IN					X	X
CAN Override	009807	IN					X	X
CAN Engine Start	009813	IN					X	X
CAN Engine Stop	009814	IN					X	X
CAN Alarm Reset	009816	IN					X	X

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discret I/O SAM	J1939 Transmission	CANOpen Transmission
CAN Lamp Test	009817	IN					X	X
CAN Speed Sett. Limit Act.	009821	IN					X	X
CAN Reset Trip Fuel Counter	009841	IN					X	X
J1939 TSC1 Override Ctrl. Mode	009844	IN					X	X
CAN Disable External Preheat	009851	IN					X	X
CAN External Power Curve Limit	009857	IN					X	X
CAN Force Max. Fan Speed	009869	IN					X	X
CAN Torque Limit1	009888	IN					X	X
CAN Torque Limit2	009889	IN					X	X
CAN Common Trip By Idle	009890	IN					X	X
Alarm MD Suppression	009907	Out						
CAN AL Air Filter Restr.	009910	Out	X				X	X
CAN AL Fuel Filter Restr.	009920	Out	X				X	X
CAN AL Aux. Engine Protection	009930	Out	X				X	X
CAN AL Aux. Engine Prot. Sw	009940	Out	X				X	X
MD CAN Speed Demand	009970	Out	X				X	X
MD CAN Torque Limit 1	009971	Out	X				X	X
MD CAN Torque Limit 2	009972	Out	X				X	X
MD CAN Override	009973	Out	X				X	X
MD CAN Start interlock	009974	Out	X				X	X
MD CAN Engine Start	009975	Out	X				X	X
MD CAN Engine Stop	009976	Out	X				X	X
MD CAN Alarm Reset	009977	Out	X				X	X
MD CAN Lamp Test	009978	Out	X				X	X
MD CAN Speed Setting Limit act	009979	Out	X				X	X
MD CAN Reset Trip Fuel counter	009980	Out	X				X	X
MD CAN Ext Power curve limit	009981	Out	X				X	X
MD CAN Park brake interlock	009982	Out	X				X	X
MD CAN Neutral	009983	Out	X				X	X
MD CAN Alternate Minimum	009984	Out	X				X	X
MD CAN Ext Preheating Disable	009985	Out	X				X	X

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discret I/O SAM	J1939 Transmission	CANOpen Transmission
MD Force Max Fan Speed	009987	Out	X				X	X
MD Disable Cylinder Cut Out	009988	Out	X				X	X
MD J1939 Override Ctrl. Mode	009989	Out	X				X	X
CCB CANOpen Errorcode	009990	Out						
CCB J1939 Errorcode	009991	Out						
CCB Errorcode	009992	Out						
AL CCB J1939 Error	009995	Out	X				X	X
AL CCB CANOpen Error	009996	Out	X				X	X
AL CCB Error	009997	Out	X				X	X
J1939 Gateway Active	900001	Out	X					
CANOpen Gateway Active	900002	Out	X					
CCB Startup Alarm Delay	900015	Out	X					

7.4.3 MCS-5 bus monitoring

Communication between the MTU components is realized by an internal CAN bus, the so-called MCS-5 bus. The bus is redundant in design whereby the individual components monitor each other reciprocally. An alarm is signaled on the fault code monitor in case of CAN node failure or in the event of a fault in one of the devices.



SAM parameter

No.	Presetting	Unit	Designation	Settings
PR031	26		NMT Switch Off N0-N15	Node Management, 16-bit word Bit = 0: Node is monitored Bit = 1: Node is not monitored Bit 0 = Node 0 Bit 1 = Node 1 Example: 18dec = 10010 = Node 1, node 4 are not monitored
PR032	0		NMT Switch Off N16-N31	Node Management, 16-bit word Bit = 0: Node is monitored Bit = 1: Node is not monitored Bit 0 = Node 0 Bit 1 = Node 1 Example: 18dec = 10010 = Node 17, node 20 are not monitored
PR033	0		ECU Demand Monitored Nodes	Node Management, 16-bit word Bit = 0: Node is monitored Bit = 1: Node is not monitored
PR035	8192		SE-Failure Switch Off	SE fault, 16-bit word Bit = 0: Failure is deactivated Bit = 1: Failure is activated Bit 0 means SE 1 Bit 1 means SE 2
PR017	30	2	MCS-5 Alarm Delay	Timeout for MCS-5 alarm
PR121	65252		Display Node Configuration	32-bit word; Bit = 1: Node is monitored Bit = 0: Node is not monitored

Use of measuring points

Name of meas. point	PV No. (Process Variable)	Direction	Display on FCB	Communication ECU	Communication DIS	Discrete I/O SAM	J1939 Transmission	CANOpen Transmission
Combined Alarm SAM Red	005990	Out		X			X	X
Combined Alarm SAM Yellow	005991	Out		X			X	X
Combined Alarm SAM SysFault	005996	Out	X					
Combined Alarm MCS-5 Failure	005998	Out	X					
ECU Actual Failure Codes	001075	Out	X				X	X

7.4.4 SAM Web Page Dialog

The web page feature enables the possibility, to view detailed data of the engine governor ECU (ADEC) and the alarmlist of the internal alarm memory via a standard PC with an ethernet interface (e. g. a notebook).

For this, it is necessary, to change the network information of the used computer exactly as shown in the following procedure. Otherwise the computer cannot “find” the SAM and the engine governor.

Below are the steps required to connect a standard PC/notebook to the SAM through the Ethernet port (X5 Connector).

Prerequisites:

1) The SAM must be programmed with project software.

2) The IP Configuration file (**IP_CONF.DAT**) needs to be downloaded from the FTP server.

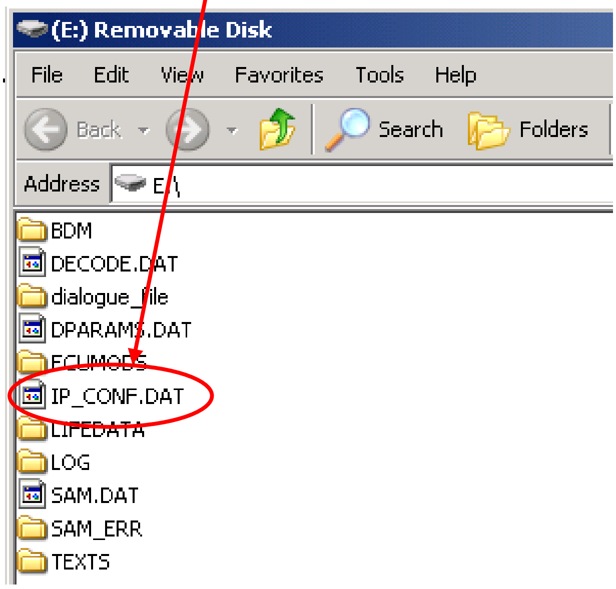
3) Obtain a standard CAT 5 Ethernet cable.

Instructions:

1) Turn off power to the SAM.

2) Remove CF card from the SAM.

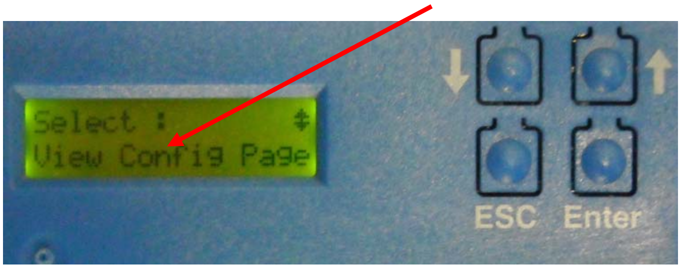
3) Verify with a card reader that the **IP_CONF.DAT** file is on the CF card, if it is not on the card save it in the root directory.



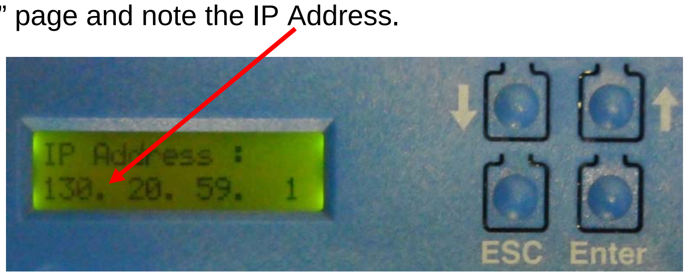
4) Install CF card in SAM.

5) Turn on power to the SAM.

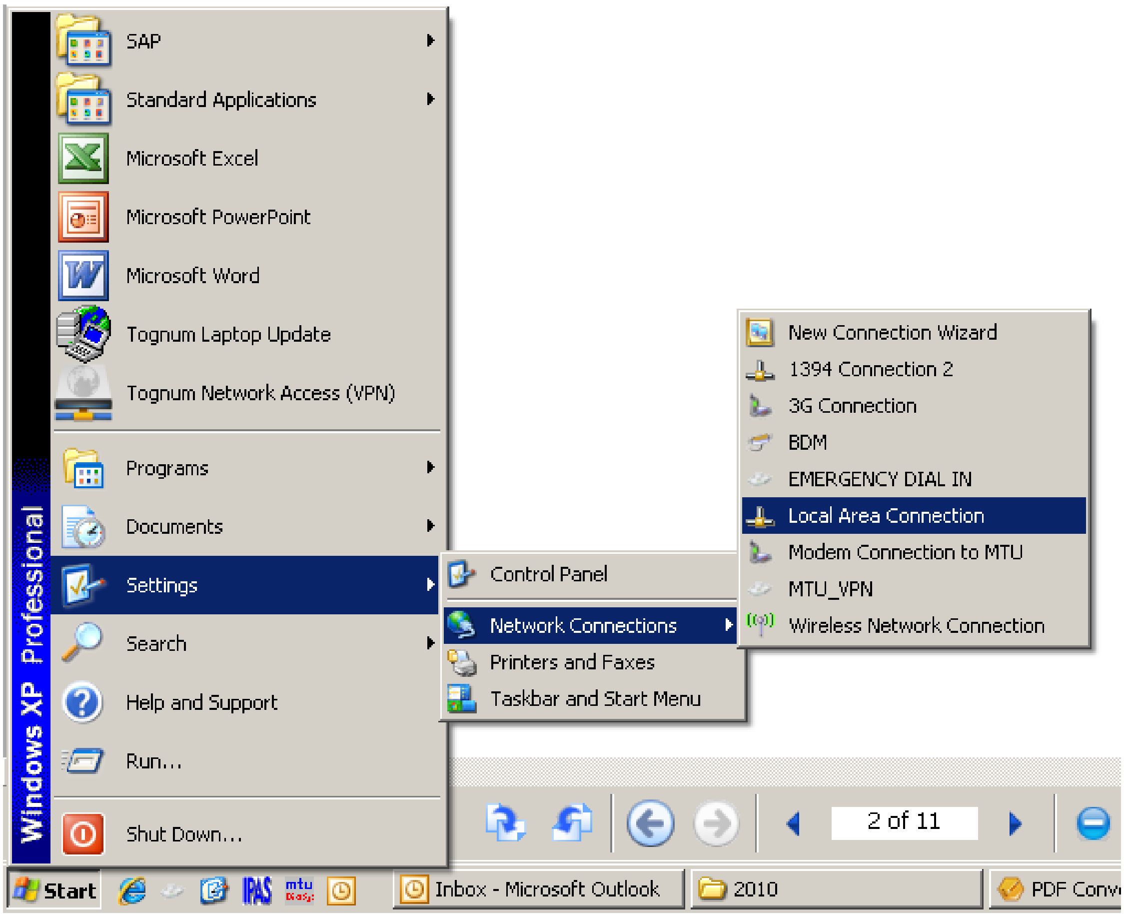
6) Hold both ESC and Enter for 10 seconds, then scroll to "View Config Page" and press Enter.



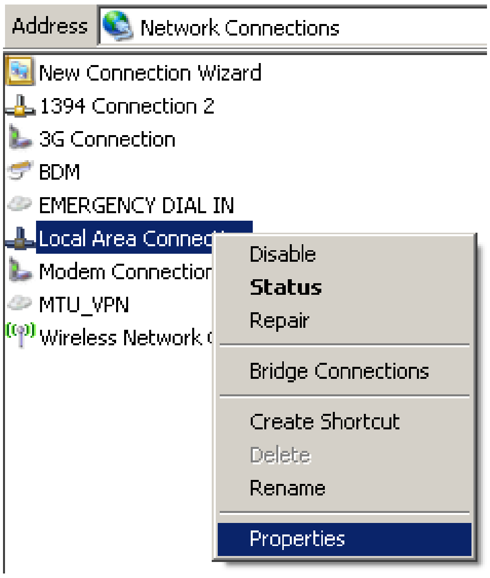
7) Scroll to "IP Address" page and note the IP Address.

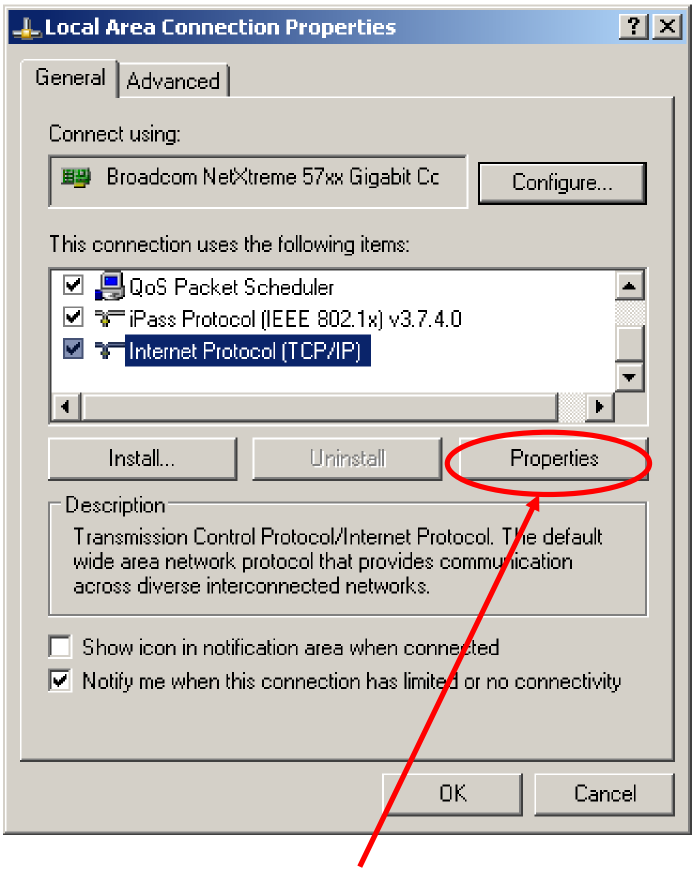


8) On the computer click **Start → Settings → Network Connections → Local Area Connection** (please note that some computers may vary as follows: **Start → Connect to → Show all Connections** then click on "**Local Area Connection**" if this cannot be found contact your IT department).



9) Right click on **Local Area Connection** and choose **Properties**.

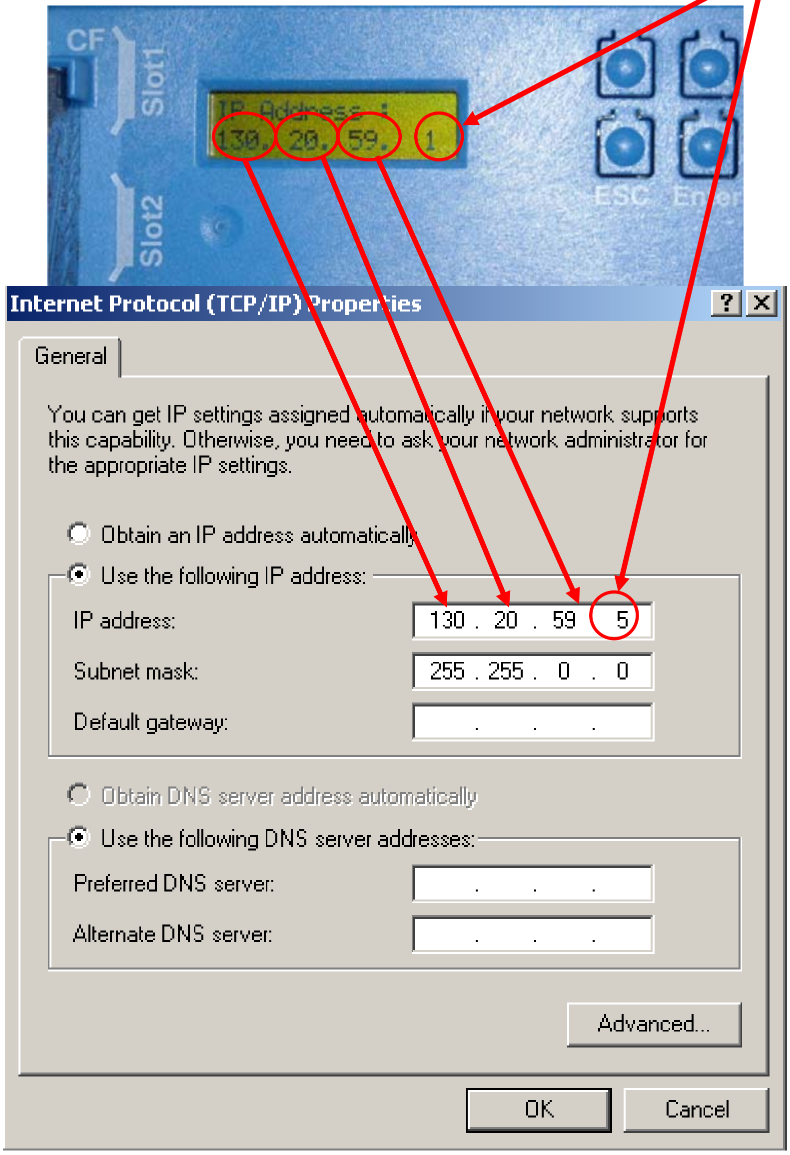




10) Select **Internet Protocol (TCP/IP)** and choose **Properties**.

11) De-Select “**Obtain an IP Address Automatically**” by selecting “**Use the following IP address**”.

12) Enter the first three parts of the SAM IP Address in the IP Address line, the last digit(s) entered must be different than the SAM IP Address.

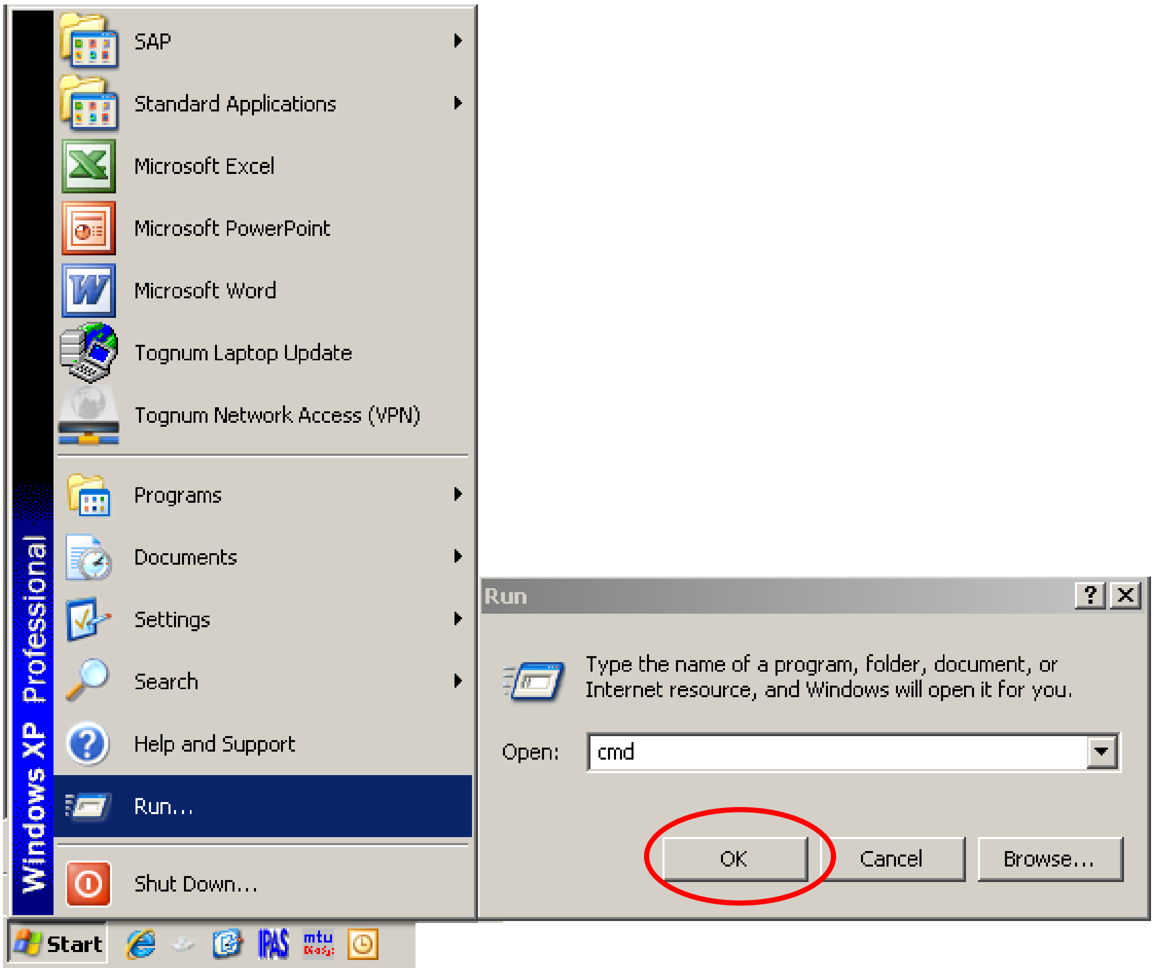


13) Click OK and then close.

14) Remove the connector cap on SAM X5 connector and plug in the CAT 5 crossover cable.

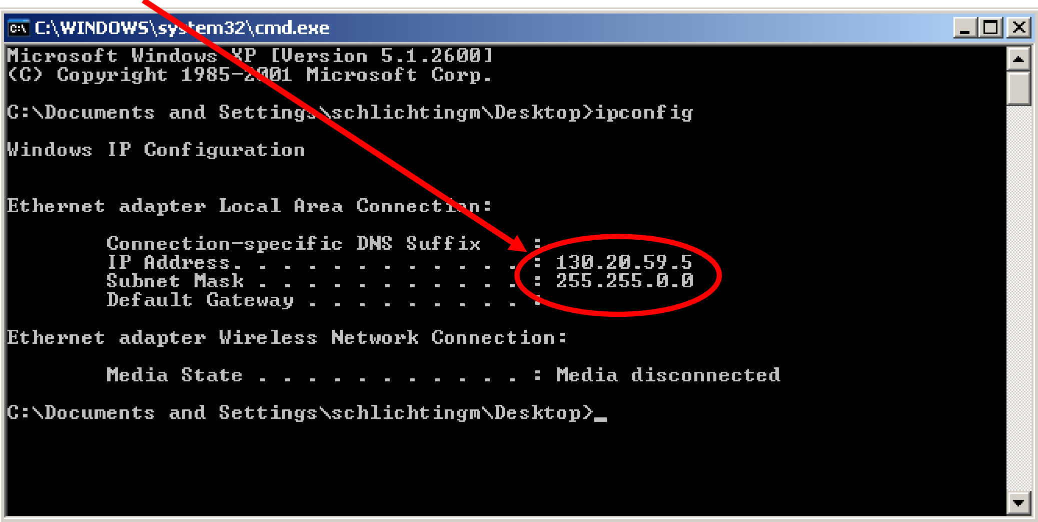
15) Plug the other end of the CAT 5 crossover cable into the PC/notebook.

16) Click on **Start → Run** then type in “**cmd**” and press OK.

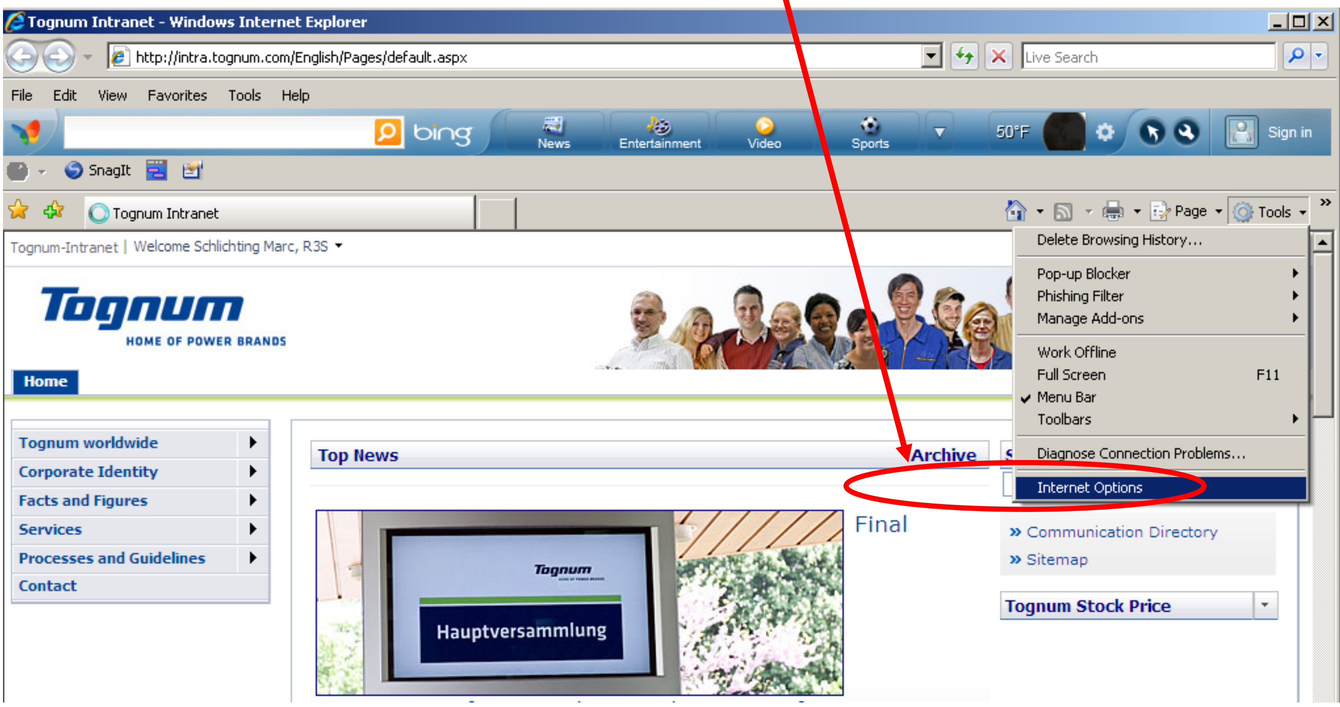


17) Type in **ipconfig** and hit enter.

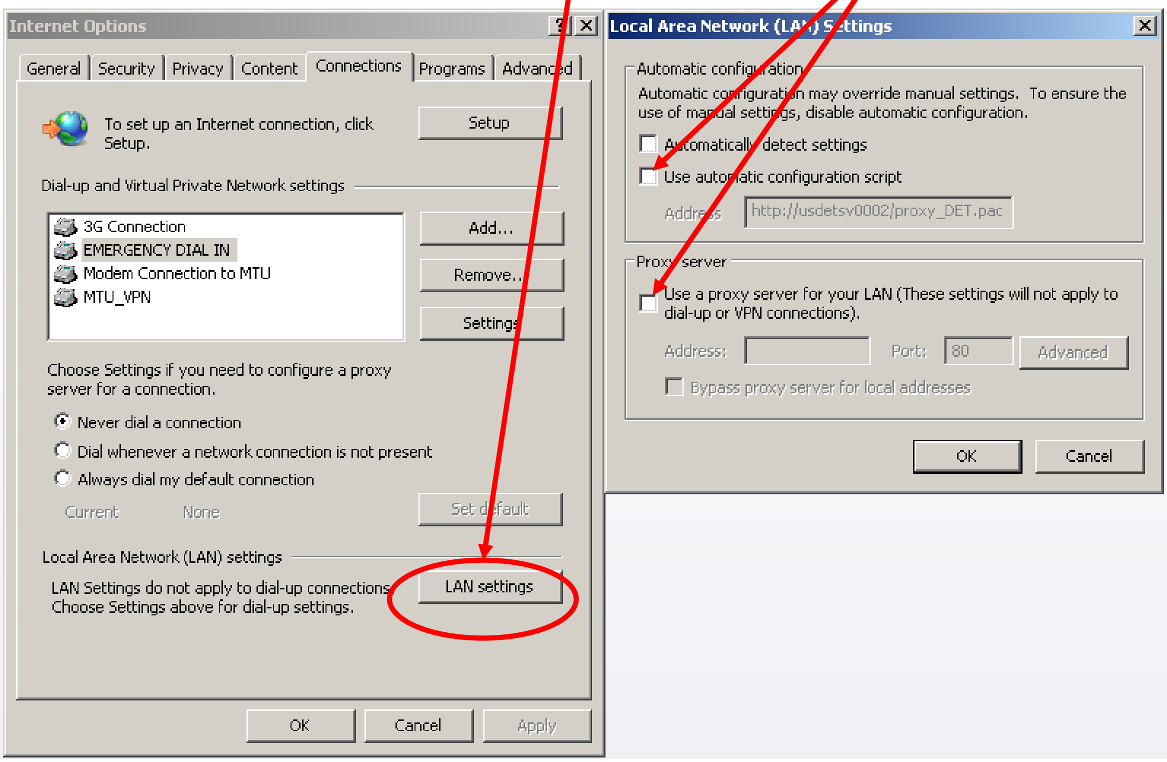
18) Verify that the IP address of the Computer has changed.



19) Close this window and open a web browser, choose **Tools → Internet Options**.



20) Choose the **Connections** tab and click on **LAN settings**, uncheck "**Use automatic configuration script**" and "**Use a proxy server for your LAN**".

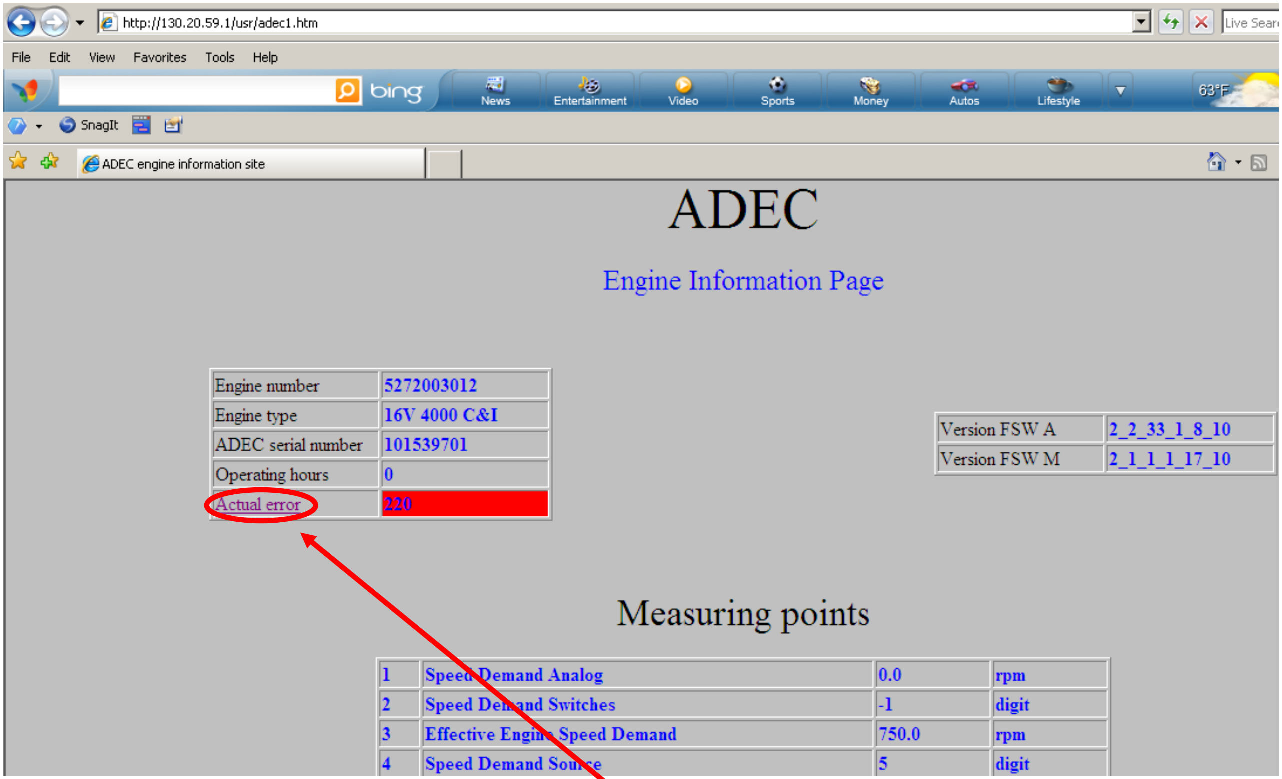


21) Click OK to accept changes for **LAN settings** and **Internet Options**.

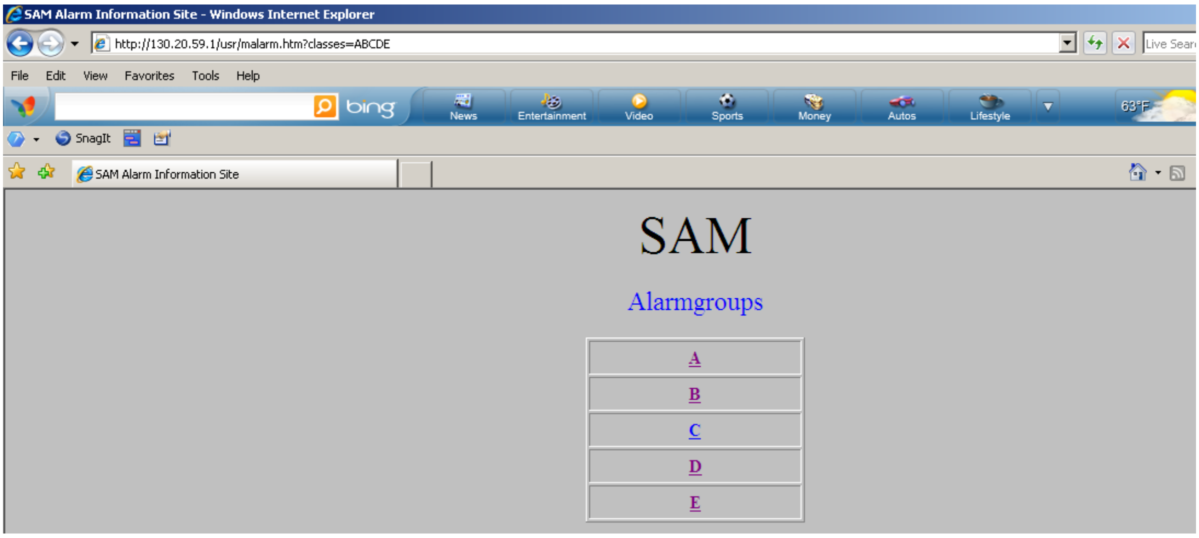
22) The computer is now ready to connect using the Ethernet port (please note: To restore the computers original settings follow these steps in reverse order).

23) Go to the following link http://130.20.59.1/vfs/adec1.cgi (substitute the IP address listed in this example with the one obtained from the SAM (refer to page 2 steps 5 through 7)).

24) A webpage will now be displayed (please note that the actual page and available data might be different than the example shown on the next page) showing analog values as well as the error log. Also note that the page might not automatically update as different values change, in this case the web browser refresh/update button (or the F5 key) can be used to update the displayed information.

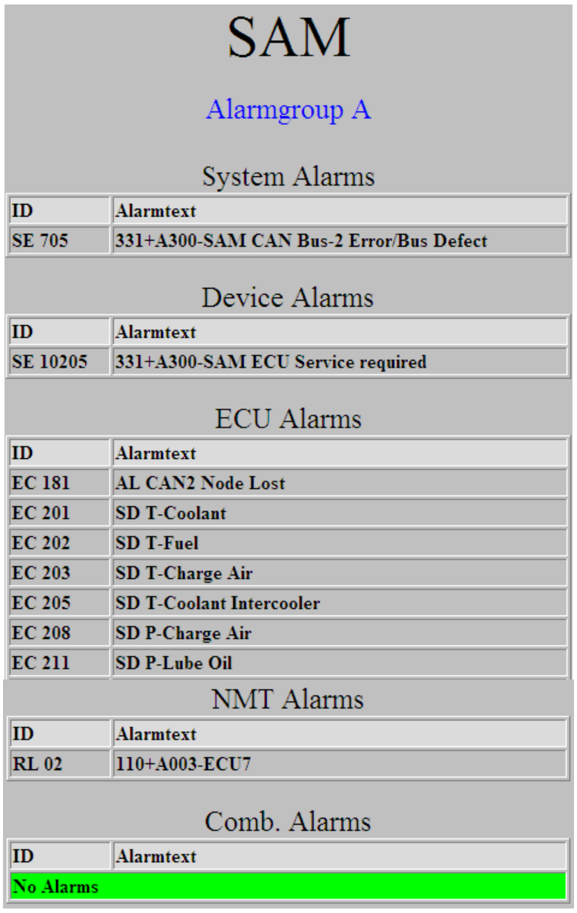


25) Error log page is available by clicking on **Actual error**.



26) **A** - Alarms are currently active, **B** were active less than 1 hour ago, **C** were active between 1 and 4 hours ago, **D** were active between 4 and 12 hours ago and **E** were active more than 12 hours ago.

27) The alarms are broken up into the following categories: **System Alarms**, **ECU Alarms**, **Network Management Alarms** and **Combined Alarms** (or SAM Alarms). Please note that the back button on the web browser can be used to navigate to previous pages.



SAM

Alarmgroup A

System Alarms

ID	Alarmtext
SE 705	331+A300-SAM CAN Bus-2 Error/Bus Defect

Device Alarms

ID	Alarmtext
SE 10205	331+A300-SAM ECU Service required

ECU Alarms

ID	Alarmtext
EC 181	AL CAN2 Node Lost
EC 201	SD T-Coolant
EC 202	SD T-Fuel
EC 203	SD T-Charge Air
EC 205	SD T-Coolant Intercooler
EC 208	SD P-Charge Air
EC 211	SD P-Lube Oil

NMT Alarms

ID	Alarmtext
RL 02	110+A003-ECU7

Comb. Alarms

ID	Alarmtext
No Alarms	

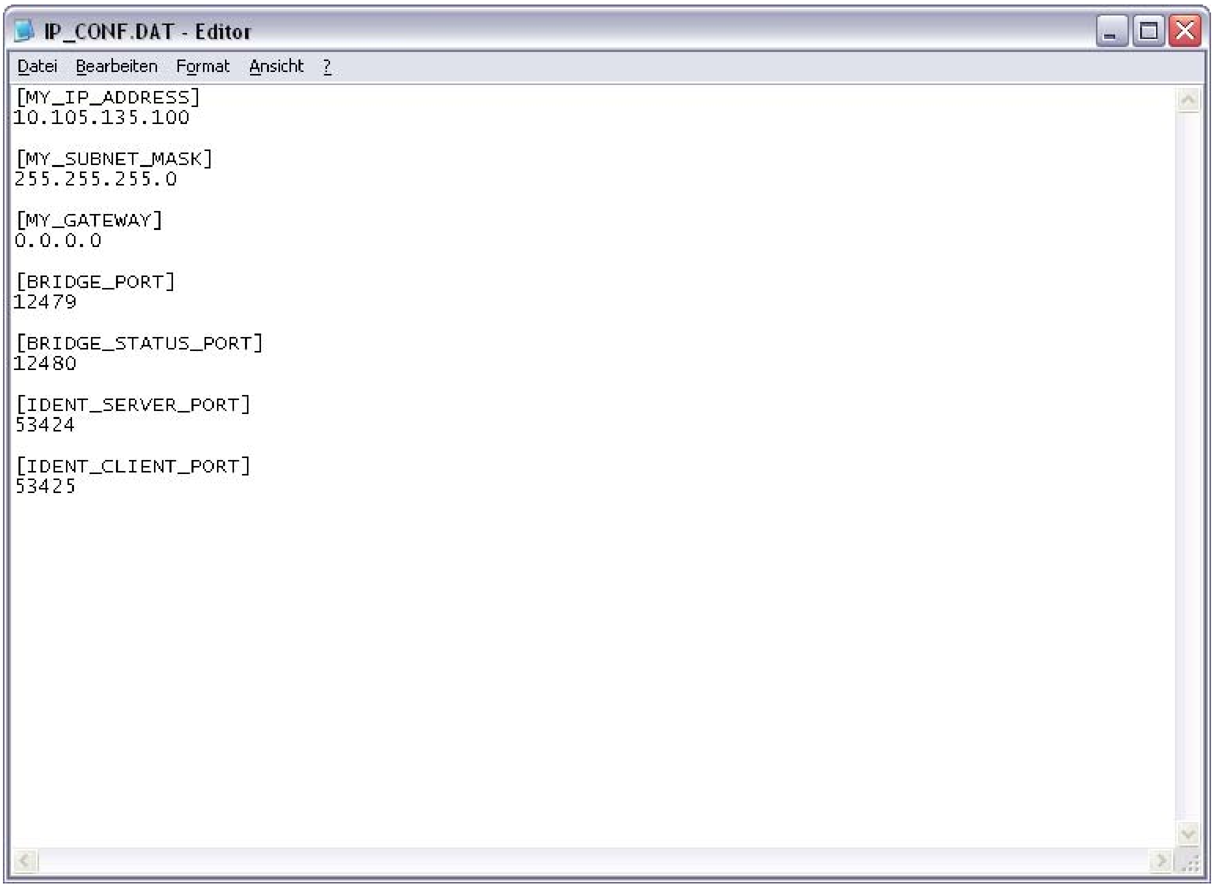
7.4.5 IP configuration

The IP address of the SAM can be adapted to the appropriate network setting at the mine or of the service personnel with the IP_Conf.dat file on the CF card of the SAM.

> **Attention:**
>
> The contents of the CF card may be destroyed by manually modifying the files on the CF card thus rendering it useless.

Procedure:

1. Open the IP_Conf.dat file using the Microsoft Editor.



2. Edit the number below “MY_IP_ADDRESS“ to the desired IP address. The address must not be used by any other network device. At least the first two blocks (10.105. in the example) have to match the connected IP network.

TIM ID: 0000020732 - 001

8 Checks and Settings

8.1 The DiaSys® program

Purpose

The DiaSys program is required in order to communicate with the Engine Control Unit (ECU-7 or ADEC) and with SAM for purposes of servicing.

The main functions of the DiaSys program in combination with MotivLine:
- Data interchange with the central database
- Adjustment of controller parameters
- Adjustment of SAM parameters
- Data recorder function

The DiaSys® program features extensive online help to facilitate use and operation of the program.

User group

For the MotivLine application of model series 4000C03 an OEM has available a hardware key with a certain user level, depending on the level of knowledge.

The hardware key enables functions depending on whether an OEM has completed courses of training at MTU, and depending on which ones. The maximum scope for OEMs corresponds to the user group “Product support service”. Here the OEM can make important and safety-relevant changes to the system on the OEM's own authority.

MotivLine device types

The following devices are relevant to MotivLine applications:
- ECU-7 (ADEC)
- MCS-5 / RCS-5 / SAM

The small buttons “  ” may be used to display pictures of the corresponding device or system to facilitate identification.

The pictures disappear when the mouse cursor moves outside them, or when the “ESC” key is pressed on the computer keyboard.

Note:
- Different functions are available in DiaSys depending on whether the Engine Control Unit ECU-7 or SAM is selected.

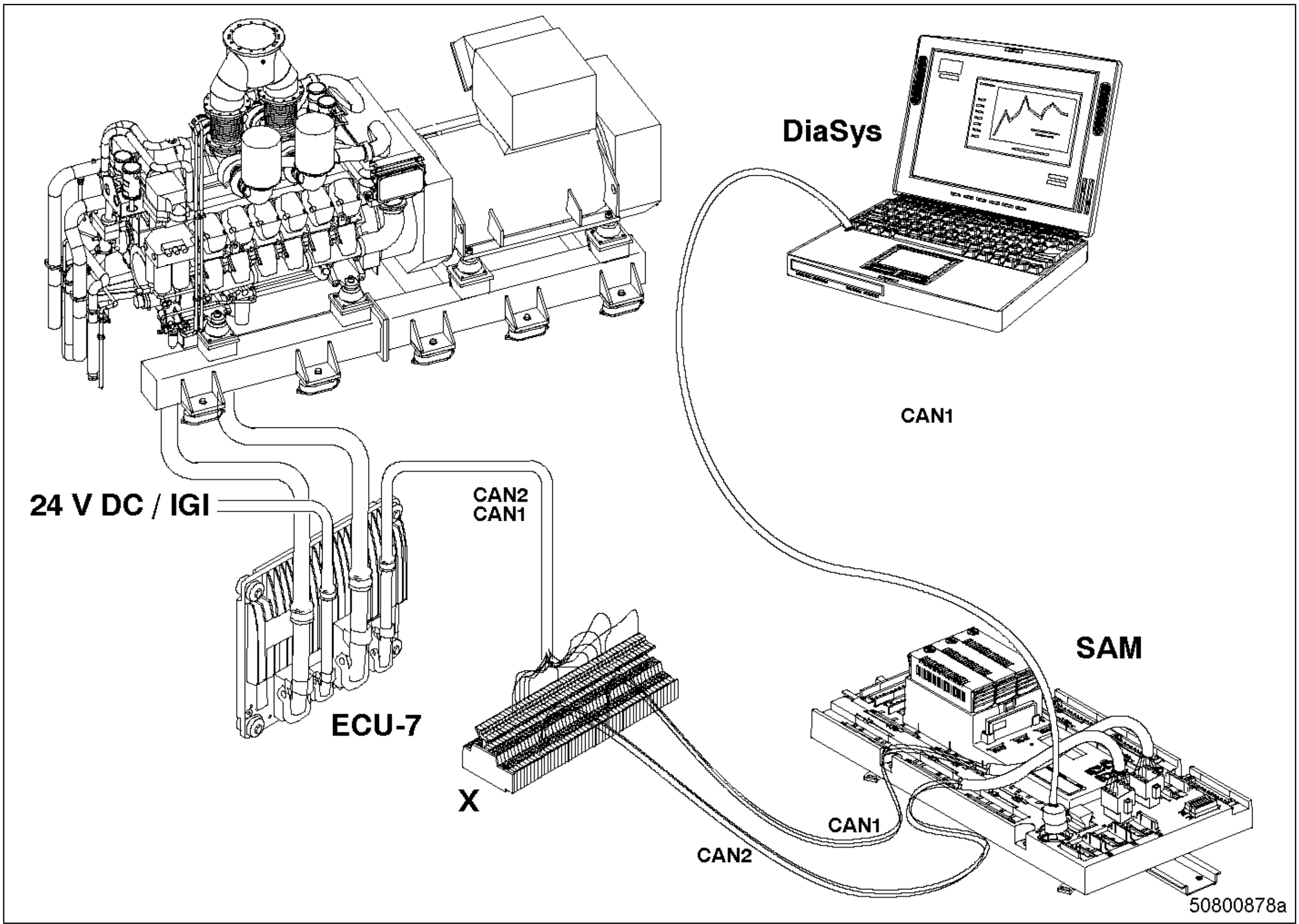
8.2 Purpose of the DiaSys® dialog system

General information

The MTU DiaSys® dialog system is required to adjust the Engine Control Unit ECU and the SAM, and to read out operating data and settings. The dialog system comprises the following components:

- A laptop with the Windows™ operating system and a CAN controller
- The installed software DiaSys® (handling of the dialog system described in the present documentation is based on DiaSys® Version 2.53)
- A connecting cable for connecting to the system in which the Engine Control Unit is integrated (e.g. to SAM dialog connector)

Structure



DiaSys	Dialog unit (laptop with software)	CAN	Controller Area Network, serial data link	X	Terminal block in switchgear cabinet
24 V DC / IGI	Supply voltage and ignition input	ECU 7	Engine Control Unit, also known as ADEC (Advanced Diesel Engine Controller)	SAM	I/O assembly with a connection for the dialog unit (CAN1)

Connection options

The devices of the MTU system are interconnected by a redundant CAN bus (CAN1 and CAN2, with CAN1 being the “default bus” and CAN2 being the “redundant bus”). The dialog unit must be connected to the CAN1 of this redundant bus for accessing the Engine Control Unit.

Access to the CAN bus of the MTU system MotivLine is provided via the dialog socket at the SAM (X4).

TIM ID: 0000017728 - 002

The CAN bus (terminated at both ends with 121 Ω respectively) is accessed by means of the cable supplied with the diagnostic kit. This is then connected to the bus as a “tap line”. This cable must therefore not be extended. Otherwise reflections on the bus could lead to malfunctions (including total failure of the CAN bus).

Software

After program start, a window appears showing the version number of the release. In conjunction with this documentation, the version 2.53 or higher should appear.

IMPORTANT NOTE:
NOTE THAT INCORRECT HANDLING OF THE DIALOG SYSTEM CAN RESULT IN SERIOUS INJURY OR DAMAGE.

The user's attention is drawn to this situation again by a corresponding display window.

Further details on the basic handling of the program are given in the separately documentation (E531920/XX; version XX must be greater than or equal to 03) enclosed with each dialog system.

8.3 SAM and Minidialog

8.3.1 Minidialog

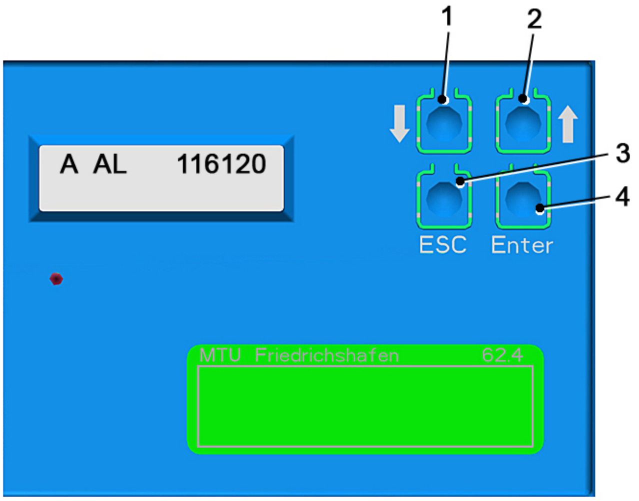
General information

Different types of system information can be retrieved on the Service and Application Module (SAM) display. Furthermore, the display is used to set the engine model and several other options if necessary.

Starting minidialog

The Alarm page appears after switching on. To start the minidialog press the “ESC” and “Enter” pushbuttons at the same time and hold for 5 seconds.
The first menu item: “Select Initial Page” of the main menu appears.

Pushbuttons



42300044a

The following functions are always valid for the SAM pushbuttons

- With the “ENTER” (4) pushbutton:
  - You can navigate to a submenu of the menu item (if available).
  - You can navigate back to the alarm page (if the menu item has no submenus).
  - For settings, you can confirm the setting shown.
- With the ”↑” (2) and “↓” (1) pushbuttons:
  - You can scroll through the menu items in the main menu.
  - You can scroll through the menu items in the submenus (if available).
  - For settings, you can scroll through various settings.
- With the “ESC” (3) pushbutton:
  - You can navigate from the submenu back to the main menu.
  - For settings, you can exit the settings without saving the settings shown.

Display configuration

Representation of the values on the display can be configured. The following parameters can be changed:

TIM ID: 0000017745 - 002

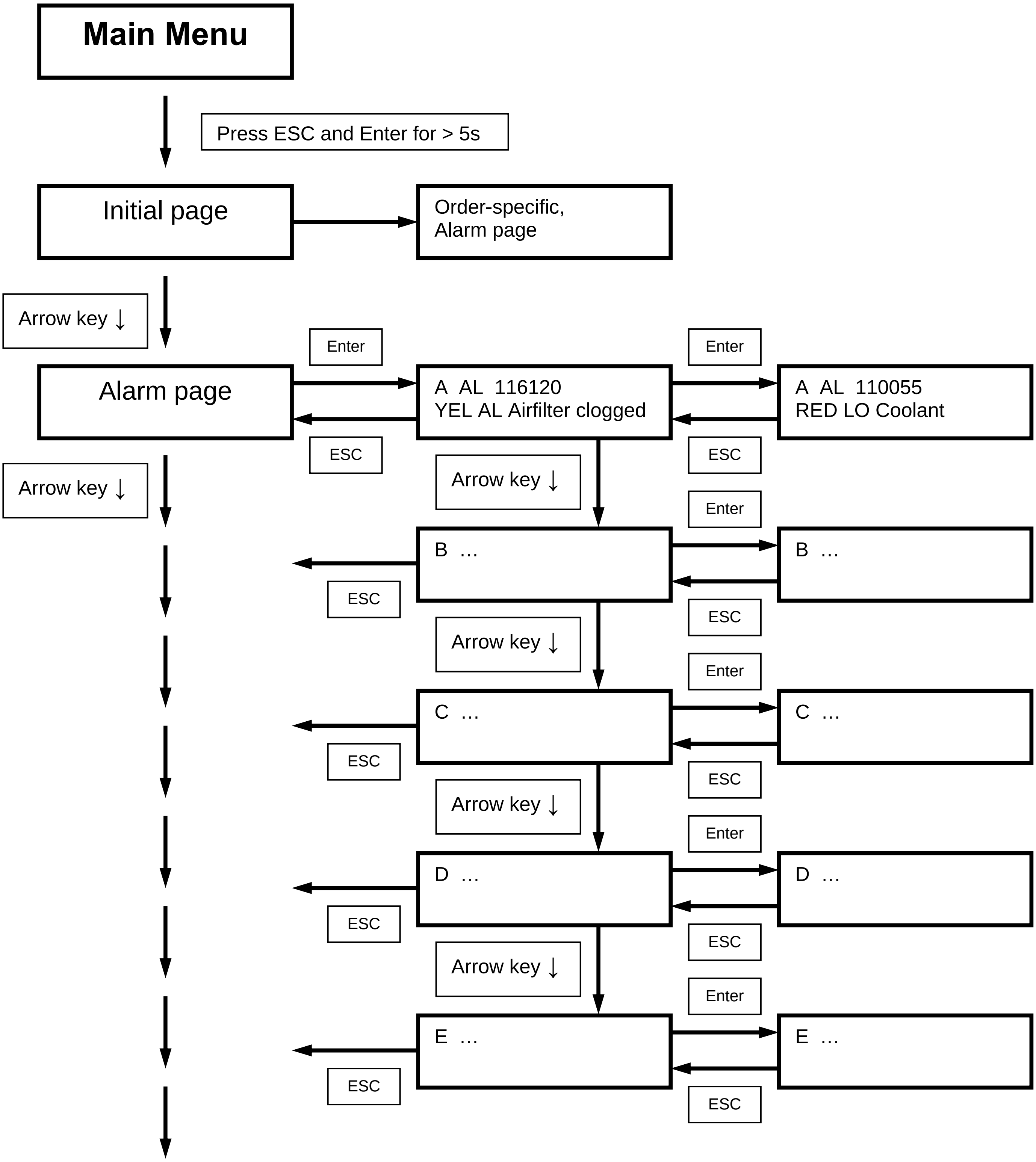
No.	Default	Unit	Designation	Settings
PR0001	1	digit	Conf. SAM Alarm Page Line1	Bit-coded value: Bit 0: 1, no 2. Line in Initial Page, Bit 1: 1, no 2. Line in Service Page Bit 2: 1, no ECU Error Code Text in Initial Page, Bit 3: 1, no ECU Error Code in Service Page Bit 4: 1, no Al Prio in Initial Page, Bit5: 1, no Al Prio Service
PR0002	0	digit	Conf. SAM Alarm Page Line2	Bit-coded value: Bit 0: 1, no 2. Line in Initial Page, Bit 1: 1, no 2. Line in Service Page Bit 2: 1, no ECU Error Code Text in Initial Page, Bit 3: 1, no ECU Error Code in Service Page Bit 4: 1, no Al Prio in Initial Page, Bit5: 1, no Al Prio Service
PR0003	1	digit	Select Initial Page	1= Alarm Page 2 = Error Page
PR0004	2	digit	Select Change to Service Page	1 = Press ESC 2 = Press ESC & ENTER (5s)
PR0005	300	s	Time Back to Initial Page	Time Back to Initial Page in Seconds
PR0006	300	s	Time Back to Alarm Auto Disp	Time Back to Alarm Auto Disp in Seconds
PR0007	3	s	Time Next Alarm	Time Next Alarm in Seconds
PR0008	1	s	Time Next Alarm After Scroll	Time Next Alarm After Scroll in Seconds
PR0009	0	digit	Clear Alarm Page	Bit-coded value: Bit 0: 1 Page "Clear Alarm Page" existing Bit 1: 1 "Clear Alarm Page" in restricted Area

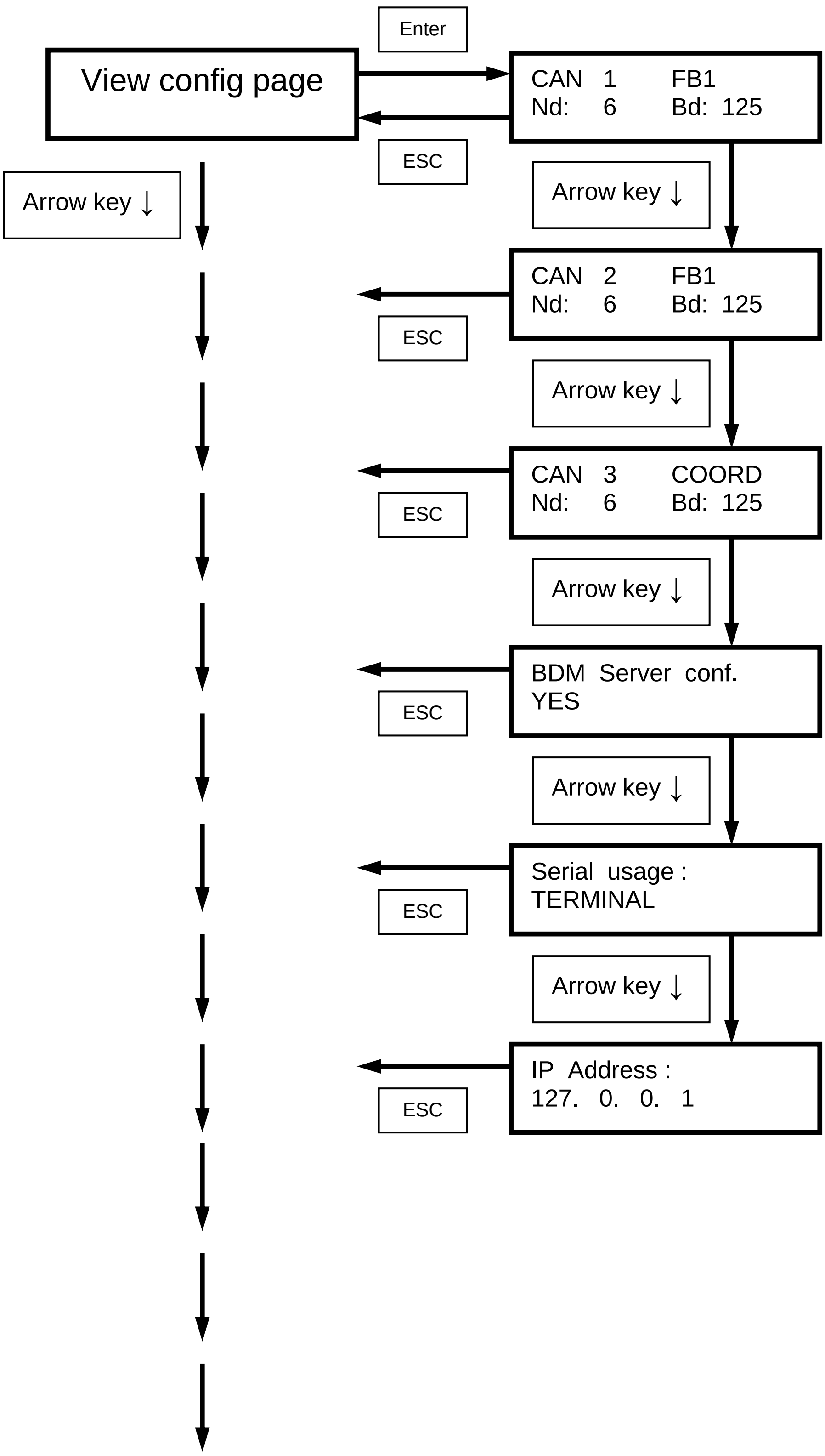
TIM ID: 0000017745 - 002

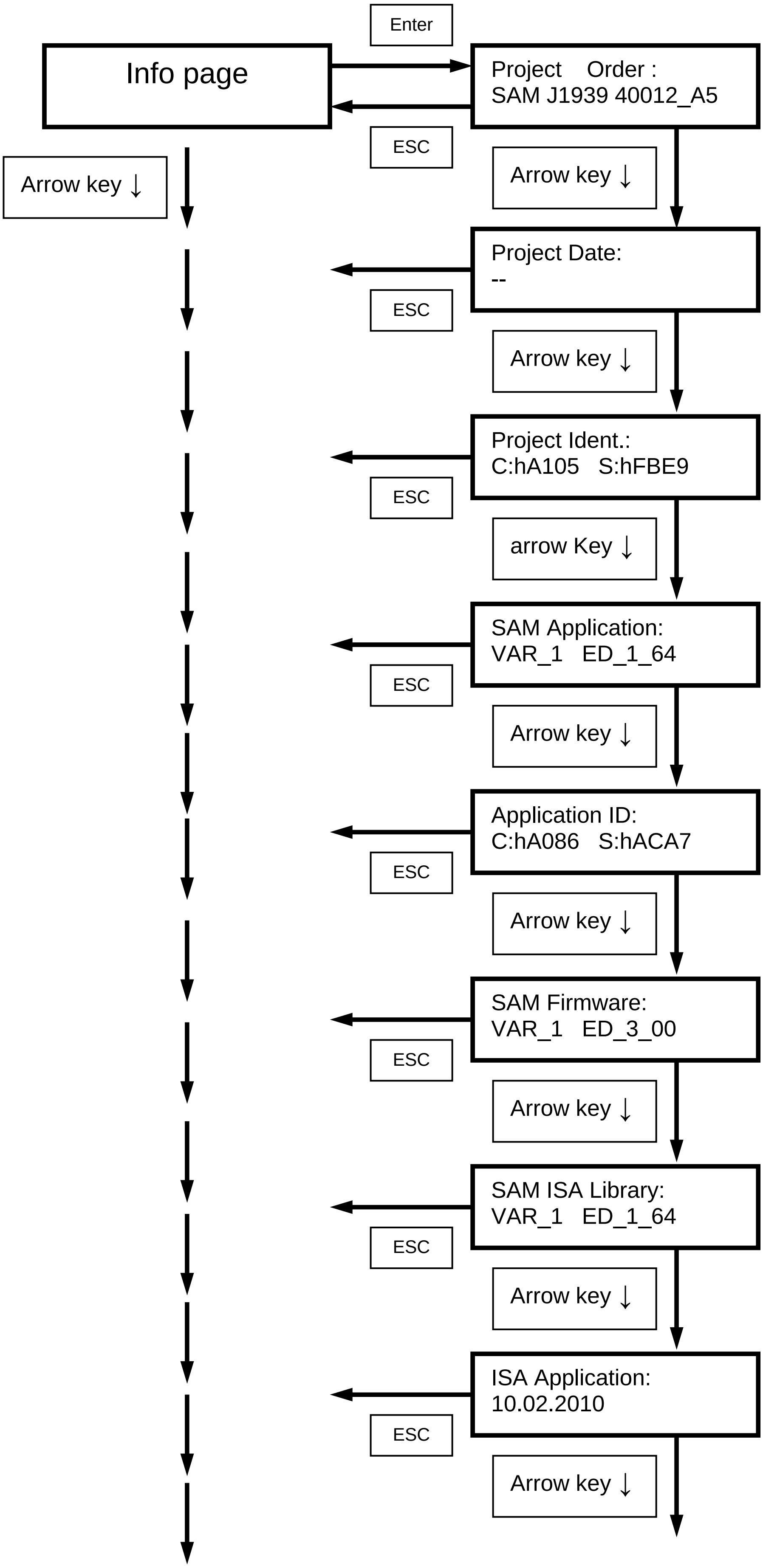
8.3.2 Menu Structure

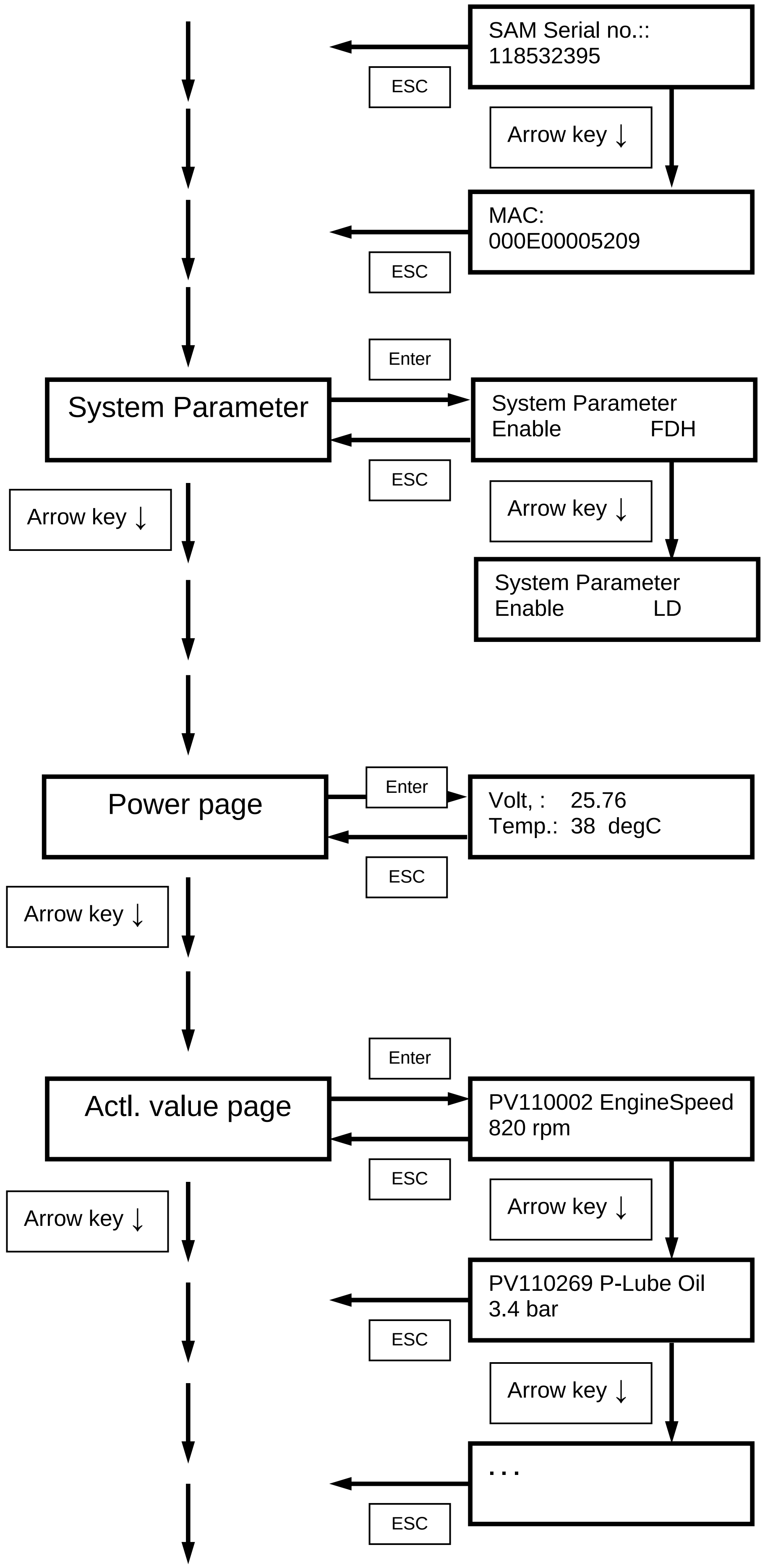
After Start up of the SAM the INITIAL PAGE is automatically selected.

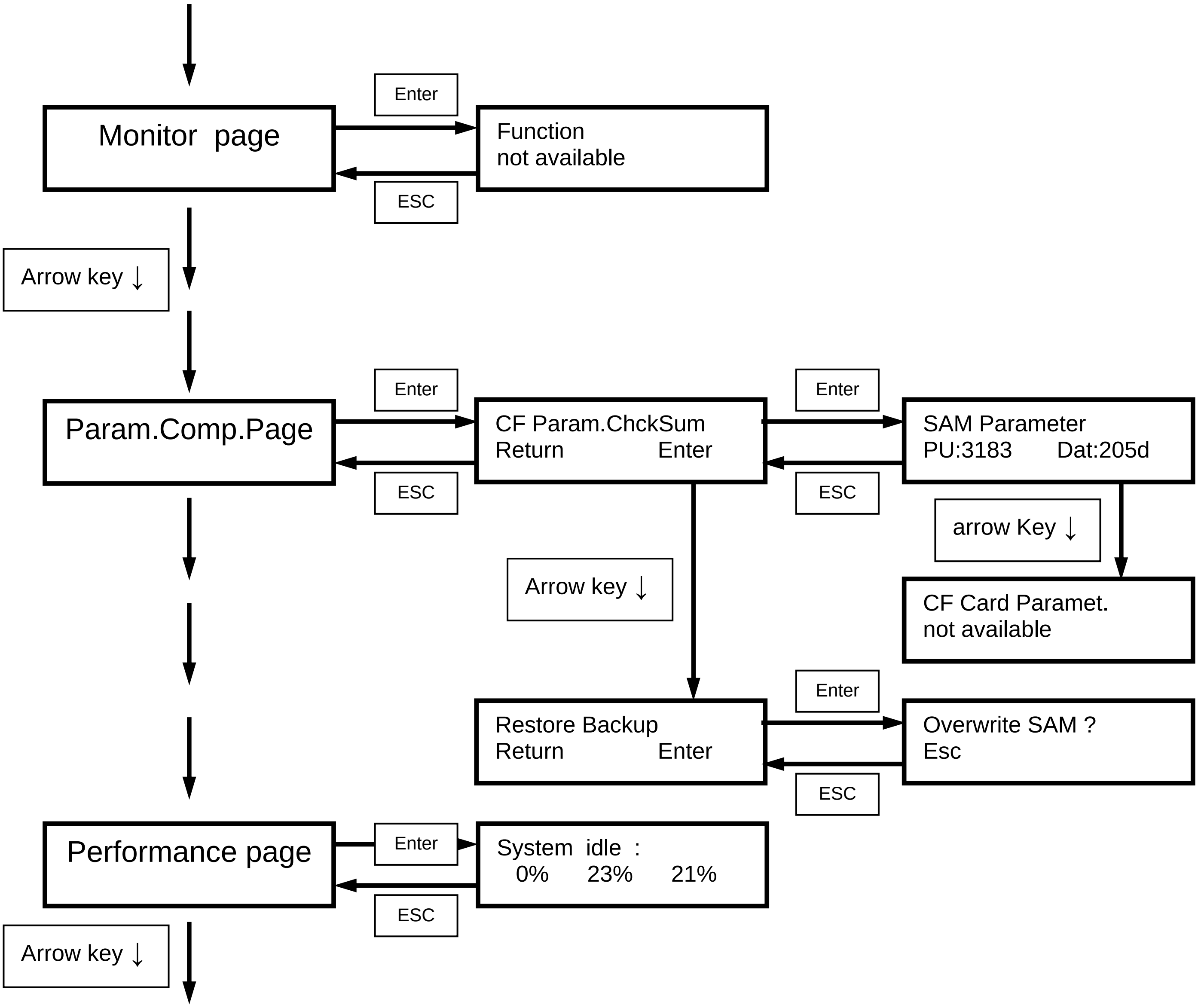
8.3.2.1 SAM Menu

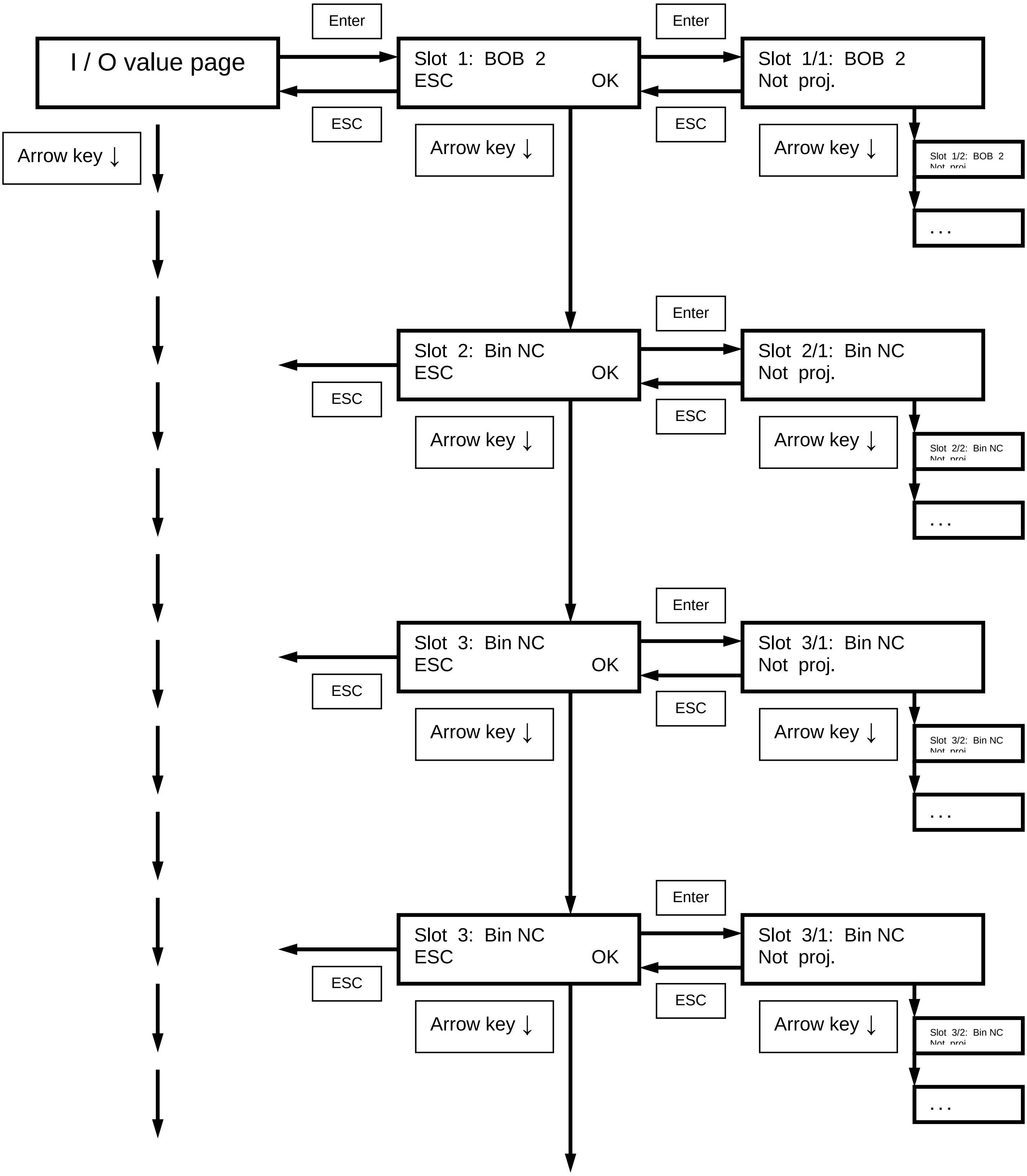


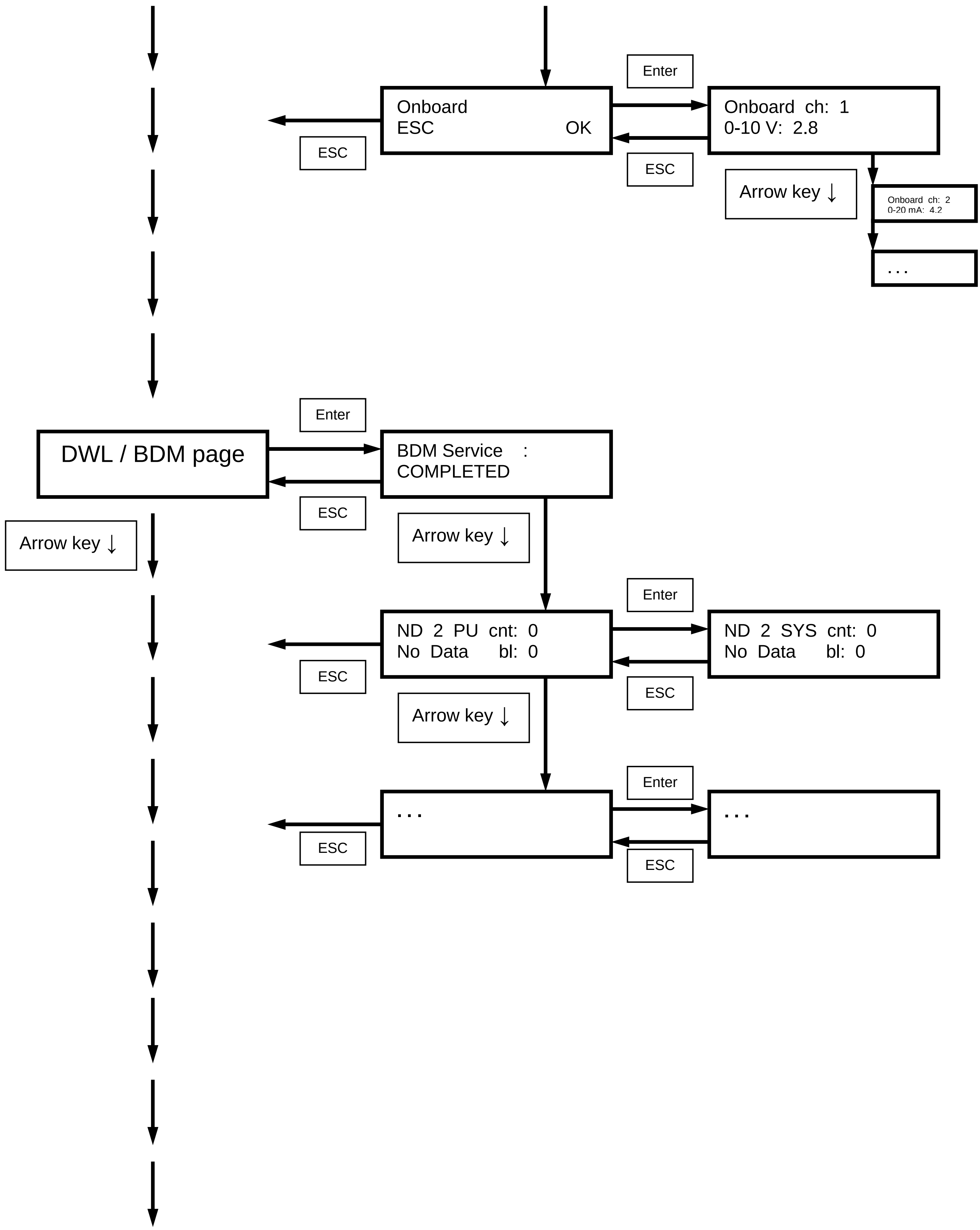

Enter
View config page
ESC
Arrow key ↓
CAN 1 FB1
Nd: 6 Bd: 125
Arrow key ↓
CAN 2 FB1
Nd: 6 Bd: 125
ESC
Arrow key ↓
CAN 3 COORD
Nd: 6 Bd: 125
ESC
Arrow key ↓
BDM Server conf.
YES
ESC
Arrow key ↓
Serial usage :
TERMINAL
ESC
Arrow key ↓
IP Address :
127. 0. 0. 1
ESC

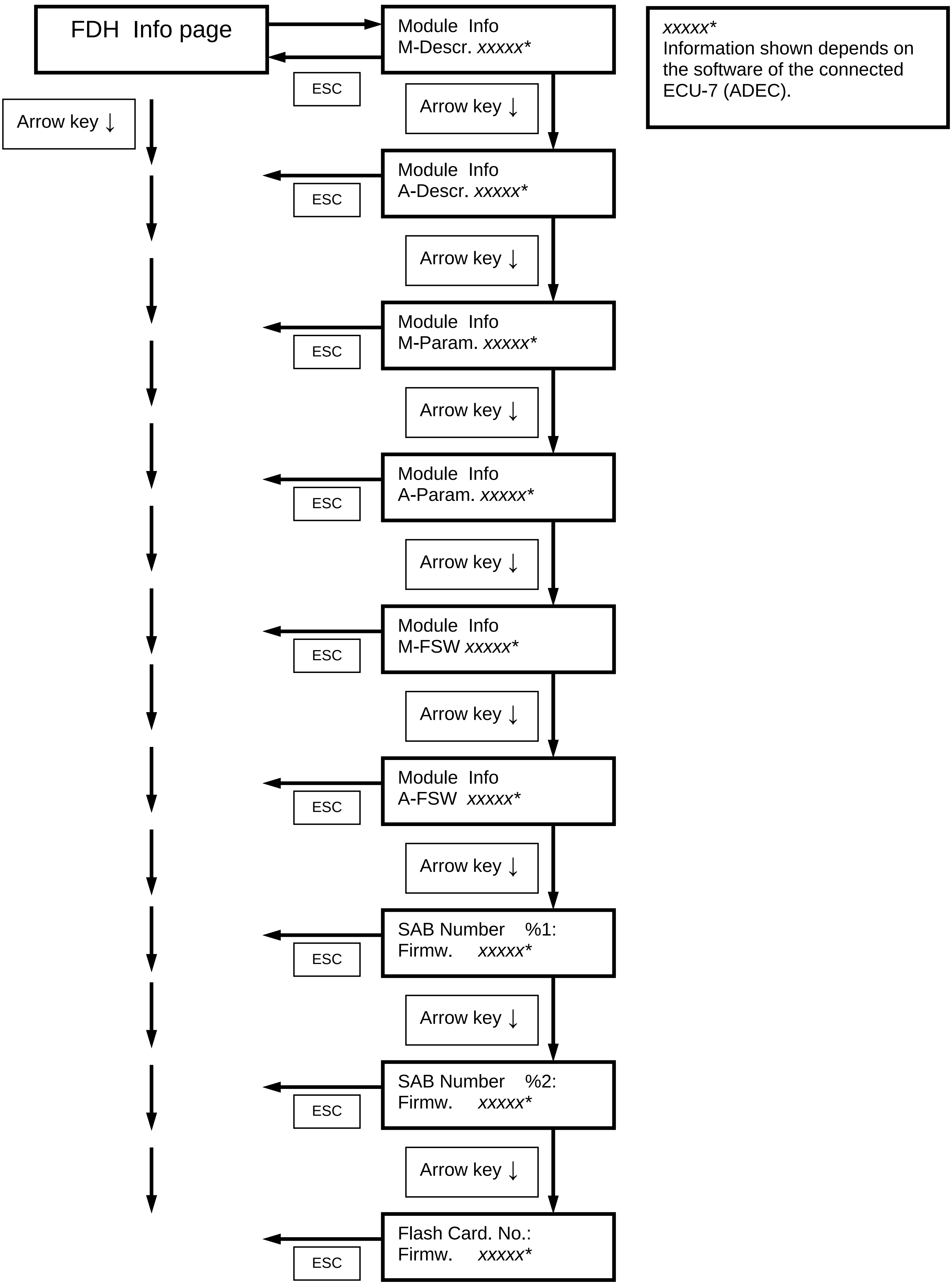

Enter
Info page
Project Order :
SAM J1939 40012_A5
ESC
Arrow key ↓
Arrow key ↓
Project Date:
--
ESC
Arrow key ↓
Project Ident.:
C:hA105 S:hFBE9
ESC
arrow Key ↓
SAM Application:
VAR_1 ED_1_64
ESC
Arrow key ↓
Application ID:
C:hA086 S:hACA7
ESC
Arrow key ↓
SAM Firmware:
VAR_1 ED_3_00
ESC
Arrow key ↓
SAM ISA Library:
VAR_1 ED_1_64
ESC
Arrow key ↓
ISA Application:
10.02.2010
ESC
Arrow key ↓

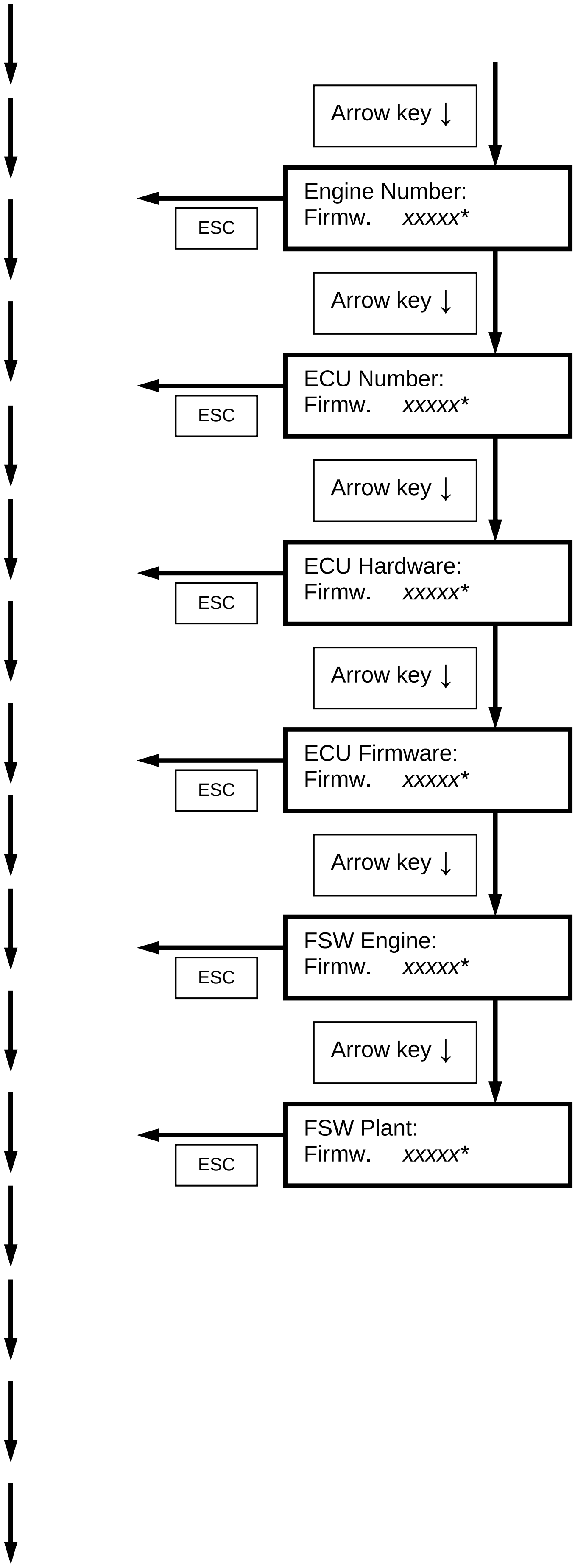

SAM Serial no.::
118532395
ESC
Arrow key ↓
MAC:
000E00005209
ESC
Enter
System Parameter
System Parameter
Enable FDH
ESC
Arrow key ↓
Arrow key ↓
System Parameter
Enable LD
Power page
Enter
Volt, : 25.76
Temp.: 38 degC
ESC
Arrow key ↓
Enter
Actl. value page
PV110002 EngineSpeed
820 rpm
ESC
Arrow key ↓
Arrow key ↓
PV110269 P-Lube Oil
3.4 bar
ESC
Arrow key ↓
. . .
ESC

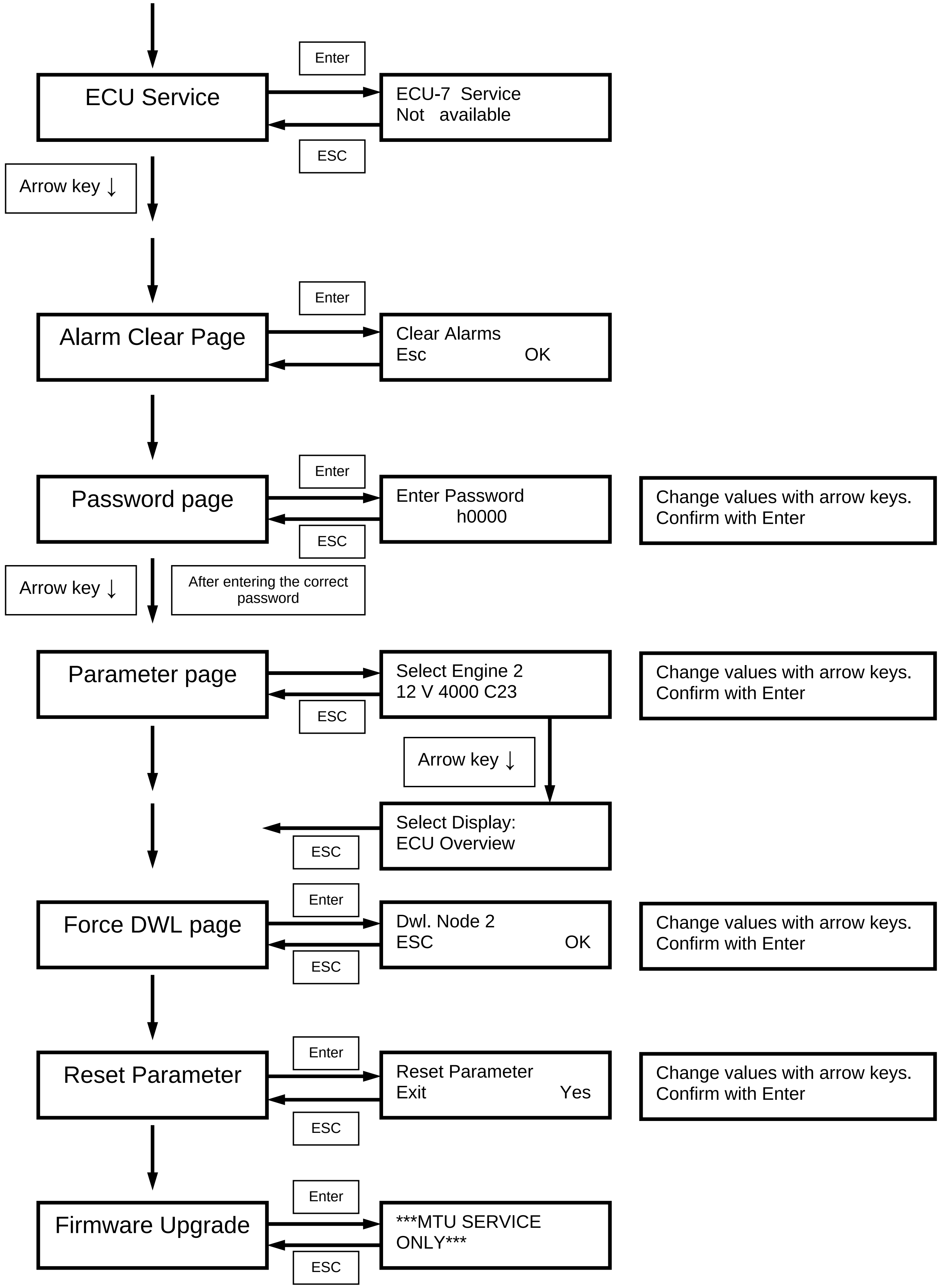

Monitor page
Enter
ESC
Function
not available
Arrow key ↓
Param.Comp.Page
Enter
ESC
CF Param.ChckSum
Return Enter
Enter
ESC
SAM Parameter
PU:3183 Dat:205d
arrow Key ↓
CF Card Paramet.
not available
Arrow key ↓
Restore Backup
Return Enter
Enter
ESC
Overwrite SAM ?
Esc
Performance page
Enter
ESC
System idle :
0% 23% 21%
Arrow key ↓


I / O value page
Enter
ESC
Arrow key ↓
Slot 1: BOB 2
ESC OK
Slot 1/1: BOB 2
Not proj.
Slot 1/2: BOB 2
. . .
Slot 2: Bin NC
ESC OK
Slot 2/1: Bin NC
Not proj.
Slot 2/2: Bin NC
Slot 3: Bin NC
ESC OK
Slot 3/1: Bin NC
Not proj.
Slot 3/2: Bin NC


Enter
Onboard
ESC OK
Onboard ch: 1
0-10 V: 2.8
ESC
ESC
Arrow key ↓
Onboard ch: 2
0-20 mA: 4.2
...
Enter
DWL / BDM page
BDM Service :
COMPLETED
ESC
Arrow key ↓
Arrow key ↓
Enter
ND 2 PU cnt: 0
No Data bl: 0
ND 2 SYS cnt: 0
No Data bl: 0
ESC
ESC
Arrow key ↓
Enter
...
...
ESC
ESC


FDH Info page
Module Info
M-Descr. *xxxxx**
xxxxx*
Information shown depends on the software of the connected ECU-7 (ADEC).
ESC
Arrow key ↓
Arrow key ↓
Module Info
A-Descr. *xxxxx**
ESC
Arrow key ↓
Module Info
M-Param. *xxxxx**
ESC
Arrow key ↓
Module Info
A-Param. *xxxxx**
ESC
Arrow key ↓
Module Info
M-FSW *xxxxx**
ESC
Arrow key ↓
Module Info
A-FSW *xxxxx**
ESC
Arrow key ↓
SAB Number %1:
Firmw. *xxxxx**
ESC
Arrow key ↓
SAB Number %2:
Firmw. *xxxxx**
ESC
Arrow key ↓
Flash Card. No.:
Firmw. *xxxxx**
ESC


Arrow key ↓
Engine Number:
Firmw. xxxxx*
ESC
Arrow key ↓
ECU Number:
Firmw. xxxxx*
ESC
Arrow key ↓
ECU Hardware:
Firmw. xxxxx*
ESC
Arrow key ↓
ECU Firmware:
Firmw. xxxxx*
ESC
Arrow key ↓
FSW Engine:
Firmw. xxxxx*
ESC
Arrow key ↓
FSW Plant:
Firmw. xxxxx*
ESC


Enter
ECU Service
ECU-7 Service
Not available
ESC
Arrow key ↓
Enter
Alarm Clear Page
Clear Alarms
Esc OK
Enter
Password page
Enter Password
h0000
Change values with arrow keys.
Confirm with Enter
ESC
Arrow key ↓
After entering the correct password
Parameter page
Select Engine 2
12 V 4000 C23
Change values with arrow keys.
Confirm with Enter
ESC
Arrow key ↓
Select Display:
ECU Overview
ESC
Enter
Force DWL page
Dwl. Node 2
ESC OK
Change values with arrow keys.
Confirm with Enter
ESC
Enter
Reset Parameter
Reset Parameter
Exit Yes
Change values with arrow keys.
Confirm with Enter
ESC
Enter
Firmware Upgrade
***MTU SERVICE
ONLY***
ESC

8.3.2.2 Configuration SAM Menu

To enter the Configuration-Menu do the following:

- Switch **OFF** the Power Supply of the SAM.
- Press the **ESC** and **Enter** – Keys together.
- Switch **ON** the Power Supply of the SAM.

- Release Keys

```
Release KEYS…
For menu !
```

- Select NO or NOW by using arrow keys ↓↑.

```
Cleanup?        NO
Prev          Next
```

- Confirm settings with ENTER.

```
Cleanup?       NOW
Prev          Next
```

```
CAN 1 node: 06
              Next
```

- Select node no. (5 or 6 regarding plant.txt) by using arrow keys ↓↑.
- Confirm settings with Enter.

```
CAN 1 Baud:    125
Prev          Next
```

- Select baud rate (125) by using arrow keys ↓↑.
- Confirm settings with Enter.

- Repeat settings for CAN 2 and CAN 3.

```
Serial        TERM
Prev          Next
```

- Set Serial Settings to “TERM” by using arrow keys ↓↑.
- Confirm settings with Enter.

Enable BDM:	YES
Prev	Next

- Enable Download-Functionality of SAM by selecting “YES”

Force DWL:	YES
Exit	Save

- Set Force Download to “YES” by using arrow keys ↓↑.
- Confirm settings with Enter.

- Download is activated now.

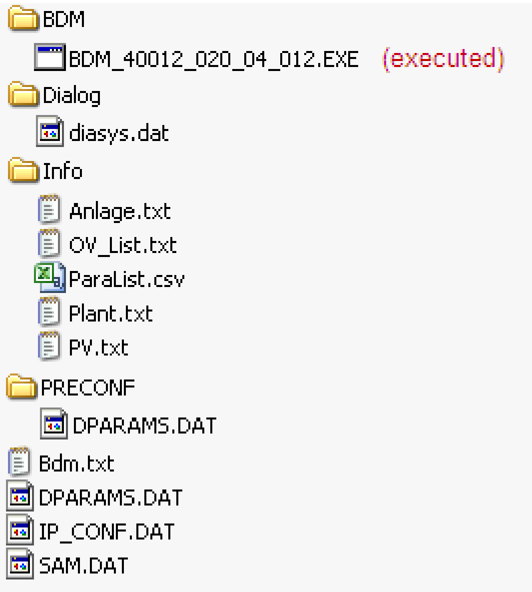
8.4 Customized CF

As of version 40012_A5 (J1939) or 40012_A7(CANOpen) of the software, the SAM has been upgraded to include a feature with which it is possible to deliver customized software.

8.4.1 Structure of the CF card

The directory structure of the CF card with the various files and folders is described briefly below.

Attention:
Modifying the CF card, particularly editing or deleting files and directories, may lead to problems and malfunctions when the SAM accesses the CF card.



<u>/BDM</u>
Contains the software files which must be downloaded to the internal memory of the SAM on first power-up.

<u>/Dialog:</u>
Contains the “diasys.dat” file required for interaction with the MTU dialog system DiaSys. This file can be copied to the local dialog PC to establish a dialog with the SAM.

/Info:
Contains various files with important information about the software, CAN node configuration, and parameters and process variables:
- Anlage.txt → Overview of plant configuration (software and hardware)
- Plant. txt → Overview of plant configuration (summary)
- OV-List.txt → List of process variables with identifier and MUX
- PV.txt → List of all internal process variables
- ParaList.csv → Brief description of the parameters

/PRECONF:
This directory contains customized parameter settings. It is only present when the CF card is preconfigured on delivery.

Files in <root>:
- Bdm.txt → Brief information about the software version
- IP_CONF.DAT → Contains the IP settings for the WEB page (see chapter "IP configuration")
- DPARAMS.DAT → Backup of SAM parameter settings
- ProductInfo.txt → Log file of the manufacturing process (only when manufactured internally at MTU)
- SAM.DAT → Basic configuration of the SAM (node number, baud rate, etc.)

8.4.2 Initial installation of the software when putting into operation

The description below refers to initial installation of the software or initial downloading of the CF card on a SAM which does not yet have any software. Refer to chapter X.X.3 for information about downloading to a SAM which is already programmed with software.

Disconnect the SAM from the supply voltage when installing software for the first time. Subsequently insert the CF card included in the scope of delivery until it noticeably engages in the clip of the CF card slot of the SAM. When the supply voltage is switched back on the SAM automatically loads the basic configuration stored on the CF card and then starts downloading the software. Any customized settings stored on the CF card are automatically transferred to the memory of the SAM on completing the download procedure.

Downloading has been successfully completed when the automatic running fault code display appears on the display of the SAM for approx. 10 seconds. Briefly disconnect the SAM from the power supply to ensure that customized settings are active. The SAM is ready for operation after switching back on again.

8.4.3 Updating software

This description refers to a SAM software update, i.e. the SAM is already programmed with software which is to be updated by means of a new CF card containing a later version of the software.

The procedure is basically the same as that described in chapter 1.2. except that an additional step precedes insertion of the new CF card: Resetting the SAM to its original delivery condition.

To ensure trouble-free downloading of the new software, it is recommended to reset the SAM to its original delivery condition by clearing the memory (equivalent to formatting a hard disk) before downloading the new software. To do this, the old CF card must be removed from the SAM (if this is not already the case). Press and hold down the ESC and ENTER keys before switching on the power supply. Switch on the power supply of the SAM with the keys held down. The “Release KEYS … For menu !“ message appears on the display after power-up.

Release KEYS…
For menu !

Release the ESC and ENTER keys when this message appears. “Configurations requested” appears on the display when the keys are released, this must be confirmed with “ENTER”.

Configuration
requested

The “Cleanup?” prompt appears subsequently appears on the display. Press the UP/DOWN keys to change the selection at the top right from “NO” to “NOW” and subsequently confirm with “ENTER”.

Cleanup?	NO
Prev	Next

On pressing the “Enter” key, the SAM changes enters a safe mode and automatically deletes all data from the internal memory. The process has been completed when the “Startup Error! No valid config.“ message appears on the display.

Startup Error!
No valid config.

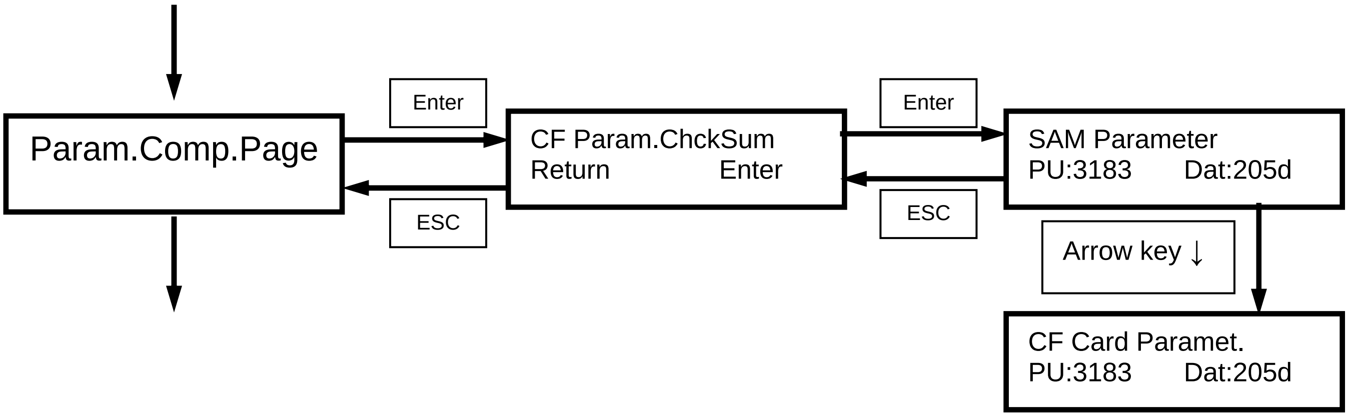
To download the new software proceed in accordance with chapter 8.4.2 of the description for downloading new software.

8.4.4 Checking that customized settings have been loaded

The SAM minidialog features a page dedicated to checking that customized settings have been loaded or to check that the original settings have been overwritten at a later date by changing parameters with DiaSys. Both the parameter setting checksum on the SAM and the checksum of the original settings on the CF card can be displayed on the “Param.Comp.Page”.

Interpretation:

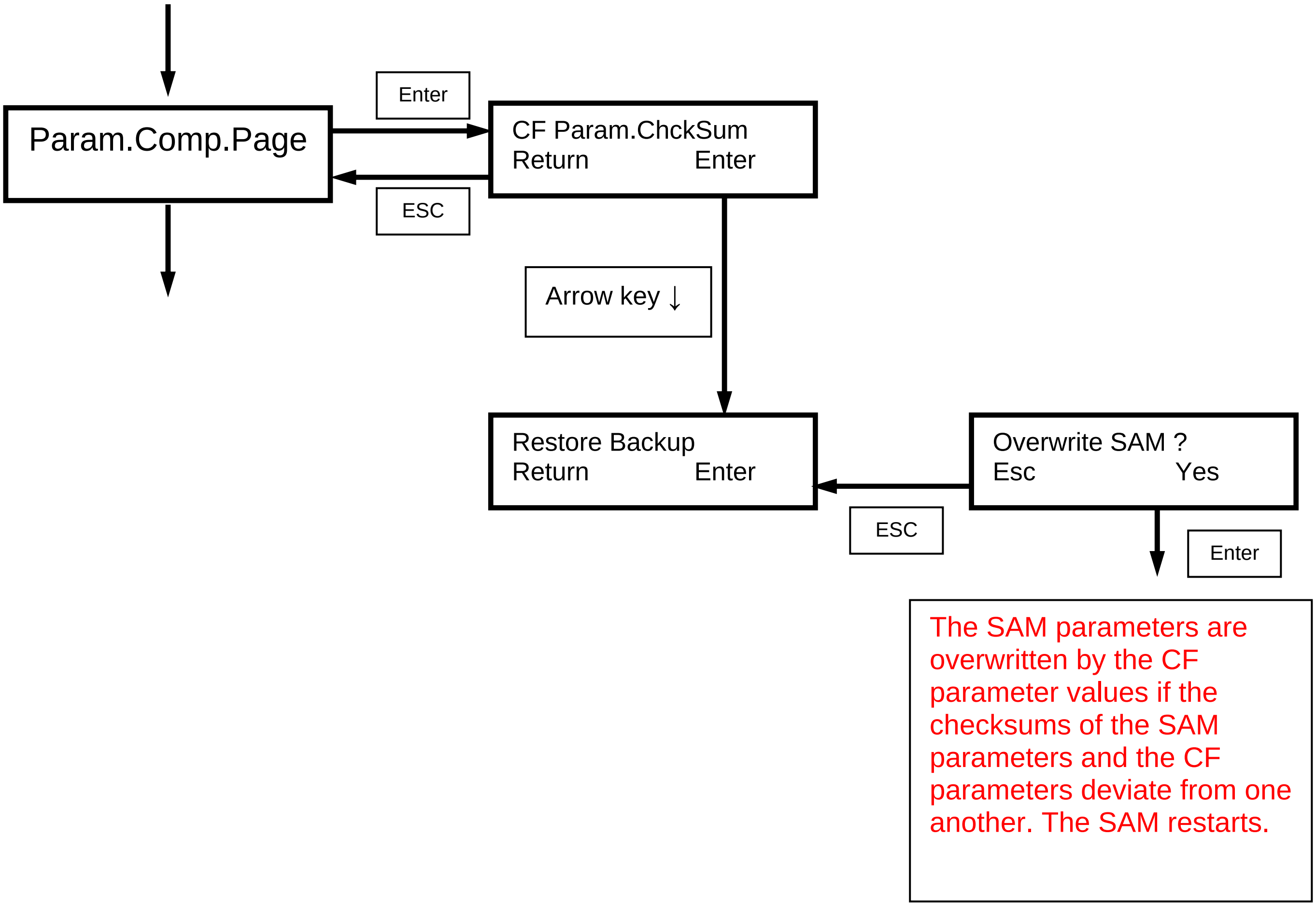
- Customized settings have been loaded when the checksums (PU and Dat.) of the SAM and the CF card match each other.
- The parameter settings of the SAM deviate from the original settings on the CF card if the “Dat” specification in the checksums do not match each other.
- The original settings on the CF card are faulty if the “PU” specification in the checksums do not match each other. The CF card must be replaced by a correctly programmed CF card in this case.



8.4.5 Restoring original customized settings

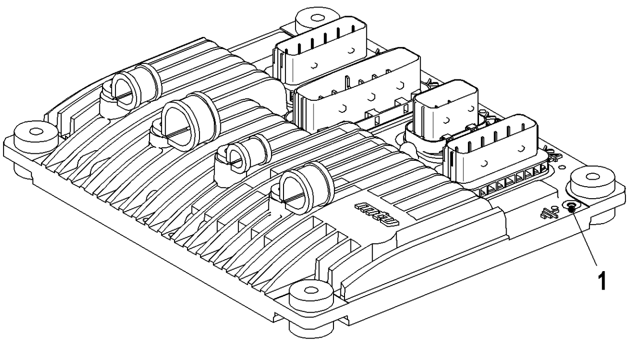
The original settings can be restored with the minidialog if the presettings on the SAM have been overwritten by changing parameters with DiaSys. Open the “Param.Comp.Page” on the SAM minidialog in this case.

The current parameter settings of the SAM can be overwritten with the original customized settings stored on the CF card in the “Restore Backup” menu by confirming with “Yes” (“Enter”).



8.5 Diagnostic lamps of the devices

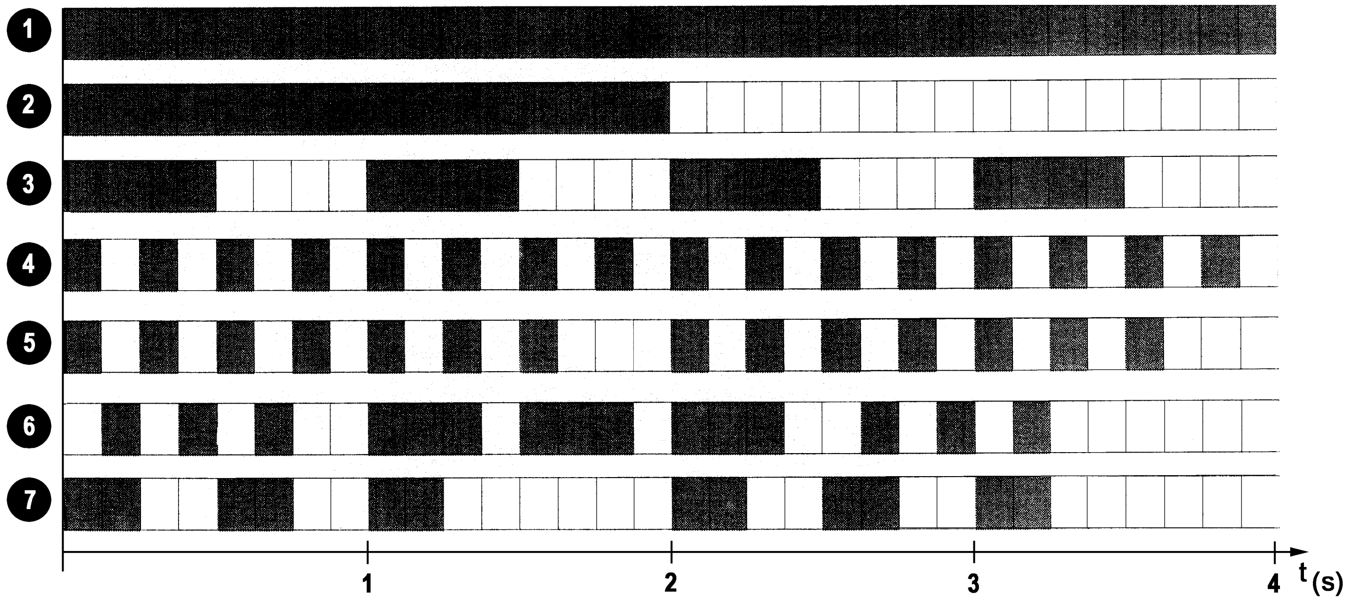
Engine Control Unit ECU



1 Diagnostic lamp

The flash codes of the diagnostic lamp have the following meanings:

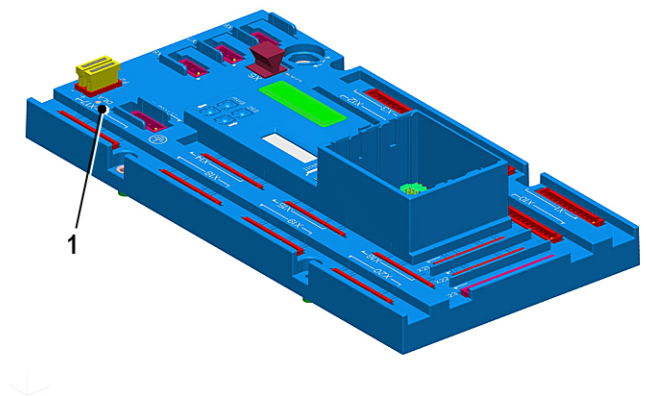
TIM ID: 0000017746 - 002



50800953a

1 Controller is ready for operation
2 Application loader is active
3 Internal error determined by ITS
4 External RAM faulty
5 External FLASH faulty
6 No firmware
7 Application crashed

Service and Application Module (SAM)

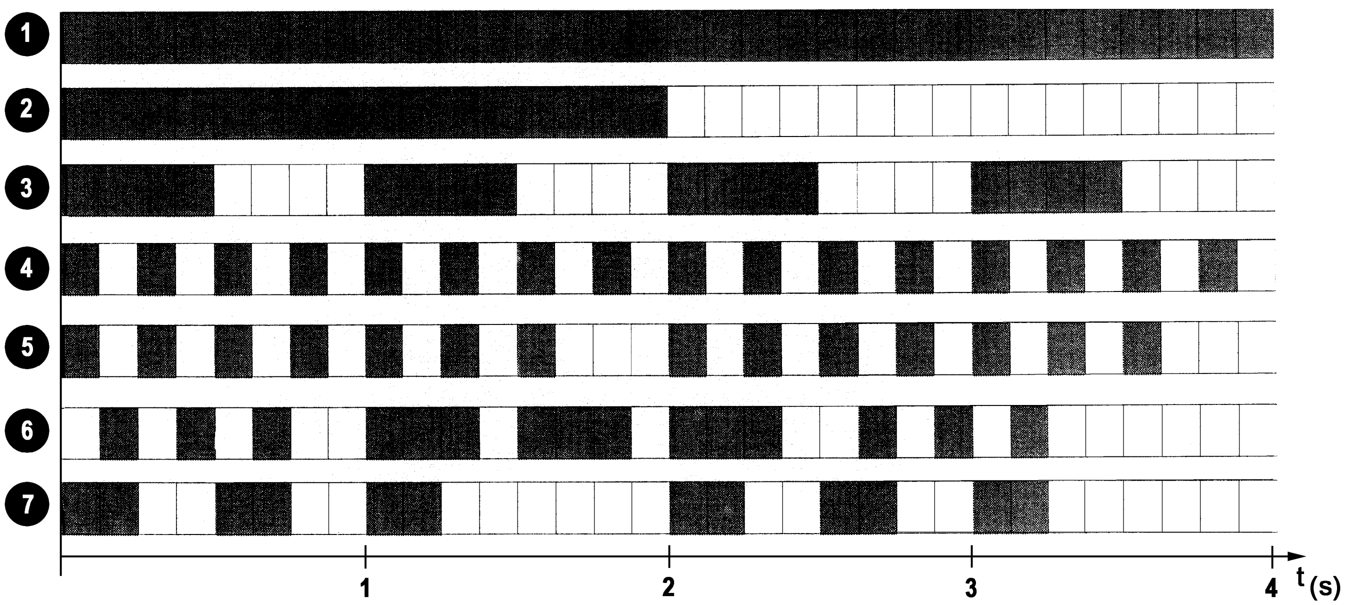


51700570a

1 Diagnostic lamp

TIM ID: 0000017746 - 002

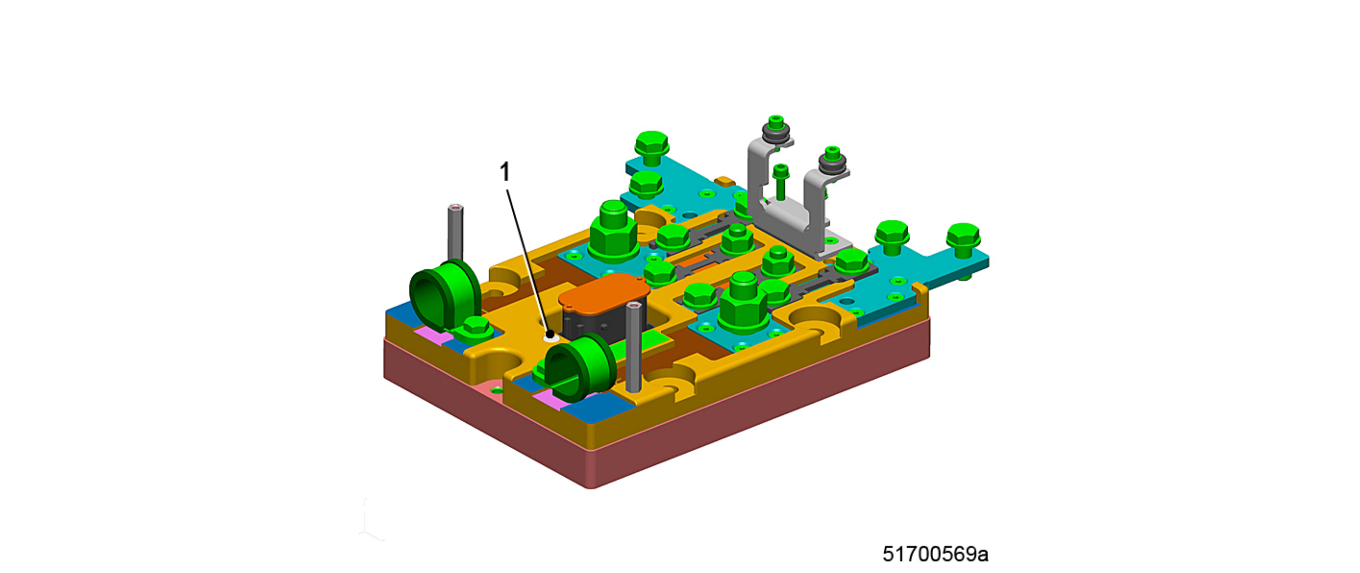
The flash codes of the diagnostic lamp have the following meanings:



1 SAM is ready for operation
2 Application loader is active
3 Internal error determined by ITS
4 External RAM faulty
5 External FLASH faulty
6 No firmware
7 Application crashed

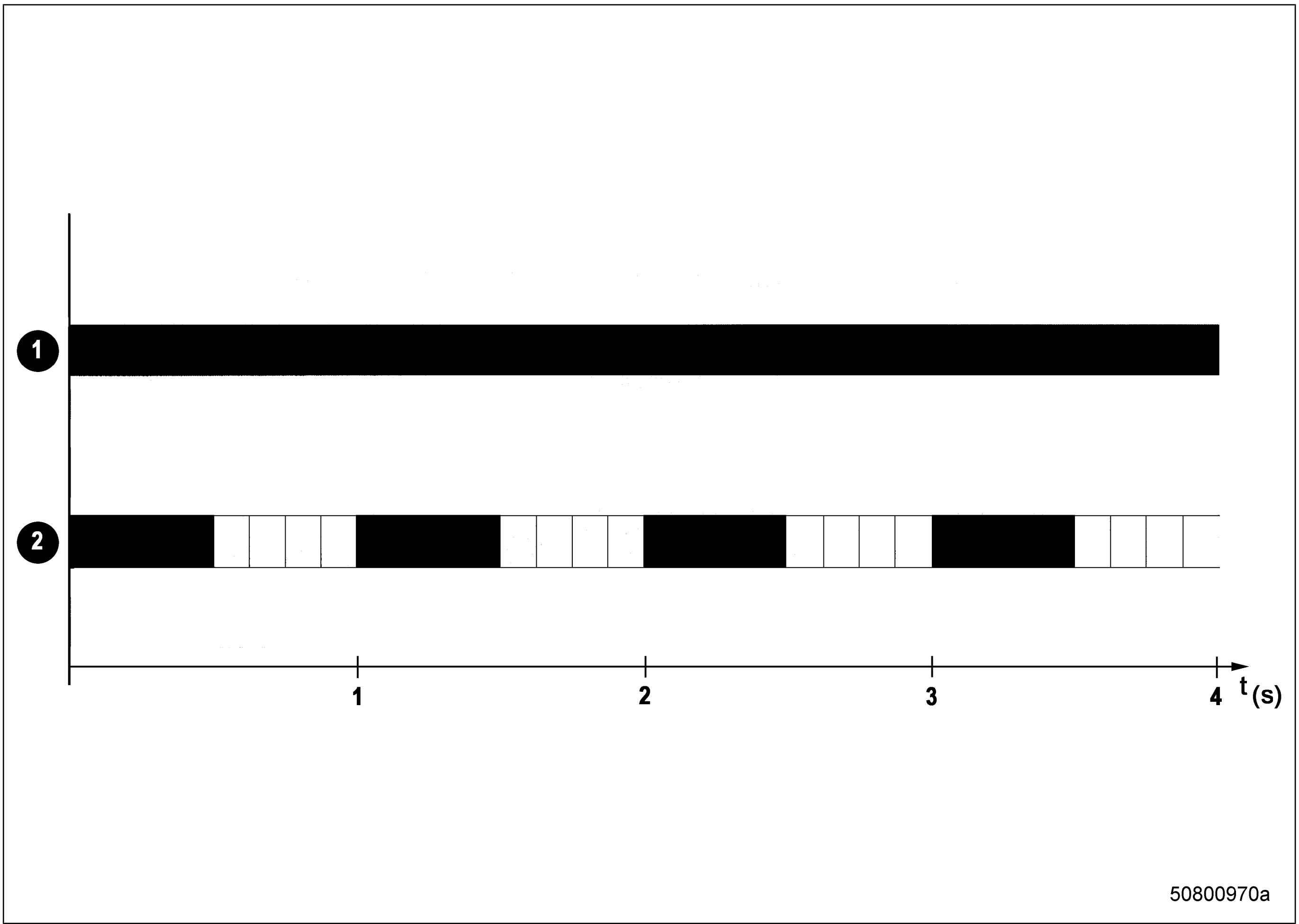
TIM ID: 0000017746 - 002

Power Output Module (POM)



1 Diagnostic lamp

The flash codes of the diagnostic lamp have the following meanings:



1 POM is ready for operation
2 Malfunction

8.6 Field Data Handling

Data handling features are explained in detail in this chapter. Field Data Handling is an extensive feature the purpose of which is to prevent wrongful and unauthorized replacement of the ECU or the SAM. Data stored in the ECU, e.g. performance and running hours, is simultaneously backed up in the SAM. This data can thus be recovered on replacing a faulty ECU.

The most important data transmission cases are then shown
(cases 1 to 7).

SAM parameter

Default values:

PR981	FDH On	: 1 (0 = Deactivated, 1 = Activated)
PR982	Life Data Backup On	: 1 (0 = Deactivated, 1 = Activated)

ECU parameter

The FDH function is activated by parameter 2.4000.001 LifeData Function activated (0 = Deactivated, 1 = Activated).

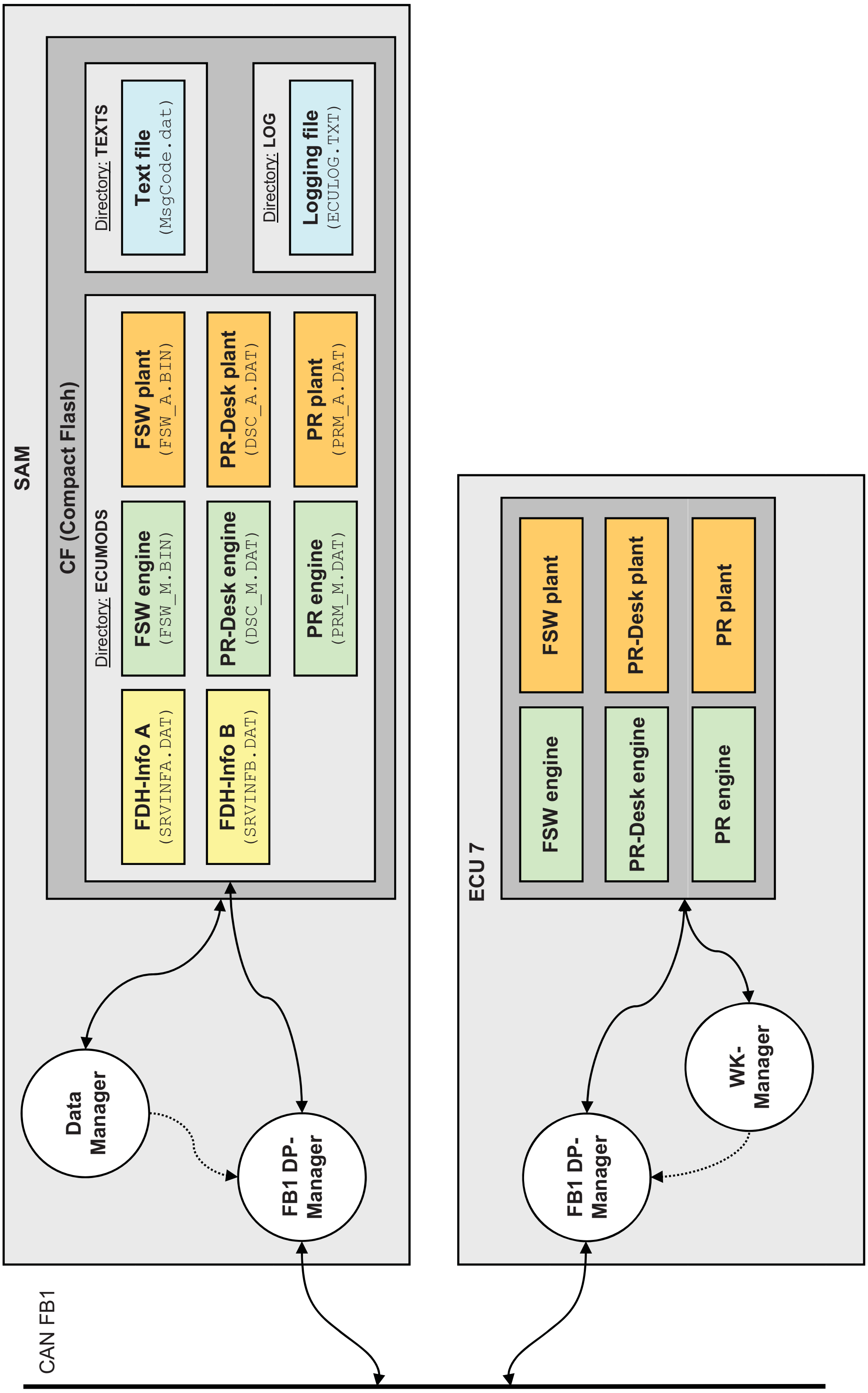
Fault messages which may occur in conjunction with FDH

Fault 555 is activated when maintenance was performed by the ECU function Field Data Handling (FDH) leading to engine parameter changes.
This fault remains active, even after switching off and back on, until a valid release code is entered via the SAM display and key controls. The release code can be requested via the MTU Service Hotline stating the information listed below (consult the service information procedure on the Business Portal)

- Associated alarm configuration parameter is 2.0555.001
- Associated alarm PV is 2.0555.002

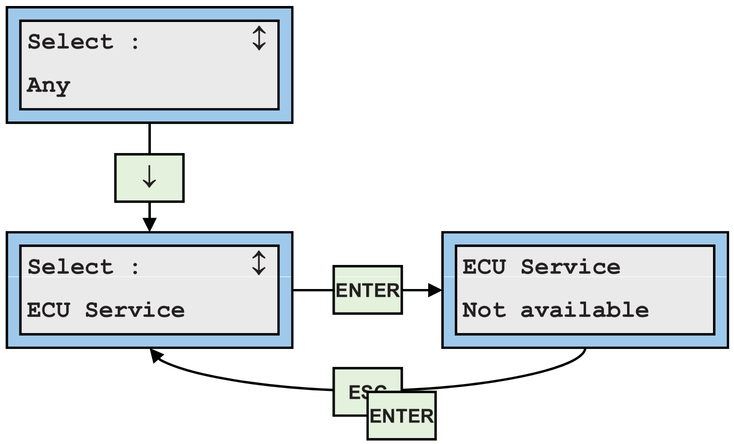
Coding
The alarm can only be canceled be entering a release code.
This code is determined by an internal method involving a coding algorithm on the basis of the engine number and the ECU 7 serial number. The user must read off the two numbers on the SAM display and communicate them to MTU.
The received release code is entered in the SAM display and transmitted to the ECU 7. The ECU 7 then decodes using the same algorithm and signals to the user that enabling has been successful or not.

Overview of CCS modules involved



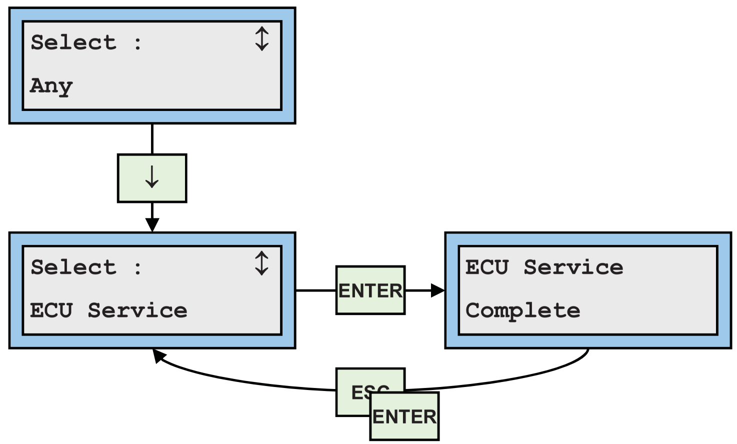
Case 1: *SAM_On* ***AND*** *(ECU_7_Off* ***OR*** *ECU_7_Has_ No_FDH)*

SAM has not yet received command 51 from ECU 7.



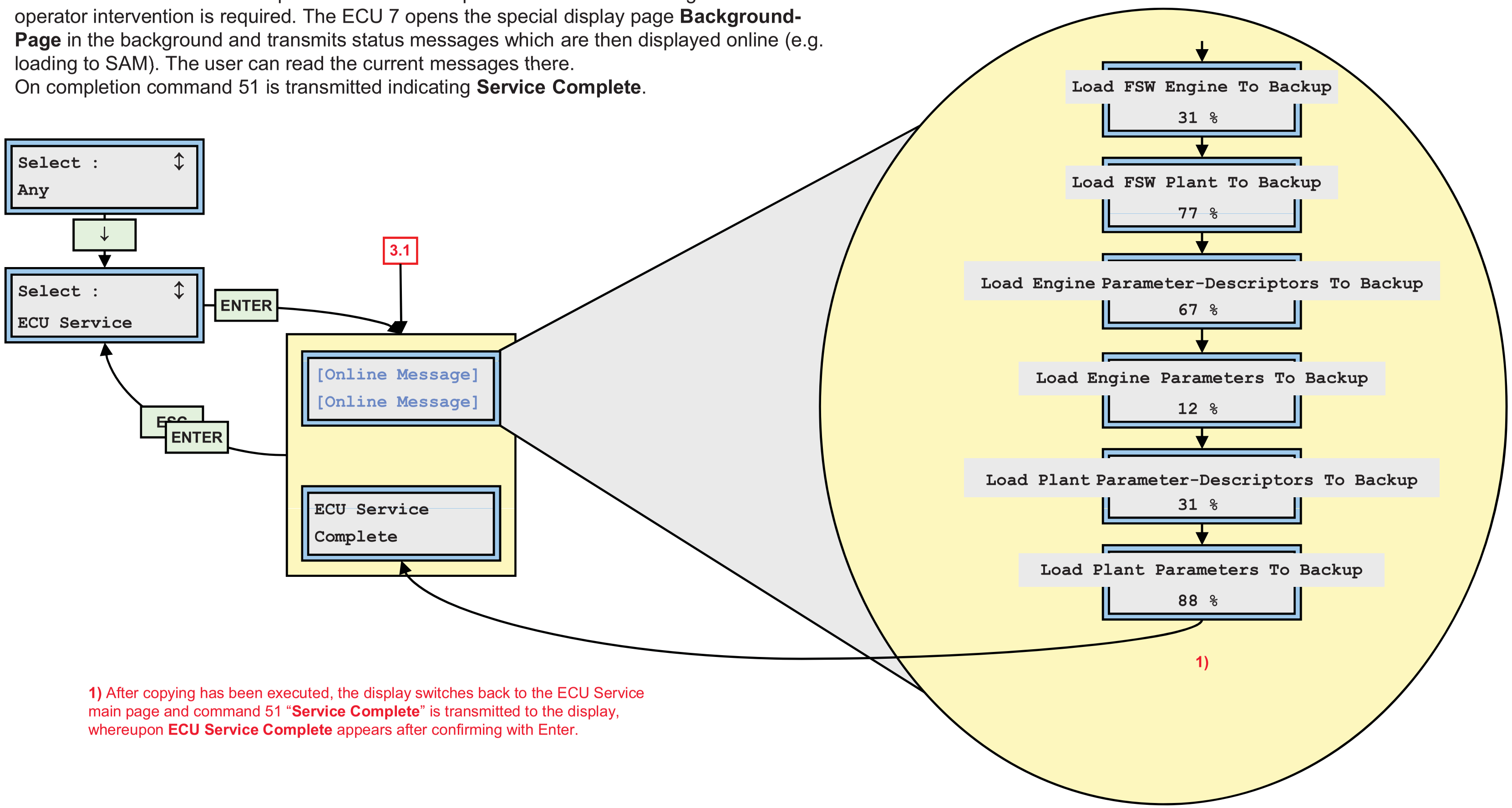
Case 2: *SAM_On* ***AND*** *ECU_7_On* ***AND*** *No_Action_Necessary*

SAM has received command 51 with parameter “Service Complete” from ECU 7.



Case 3: ***(I) SAM_Empty*** ***AND*** ***ECU_7_Full***

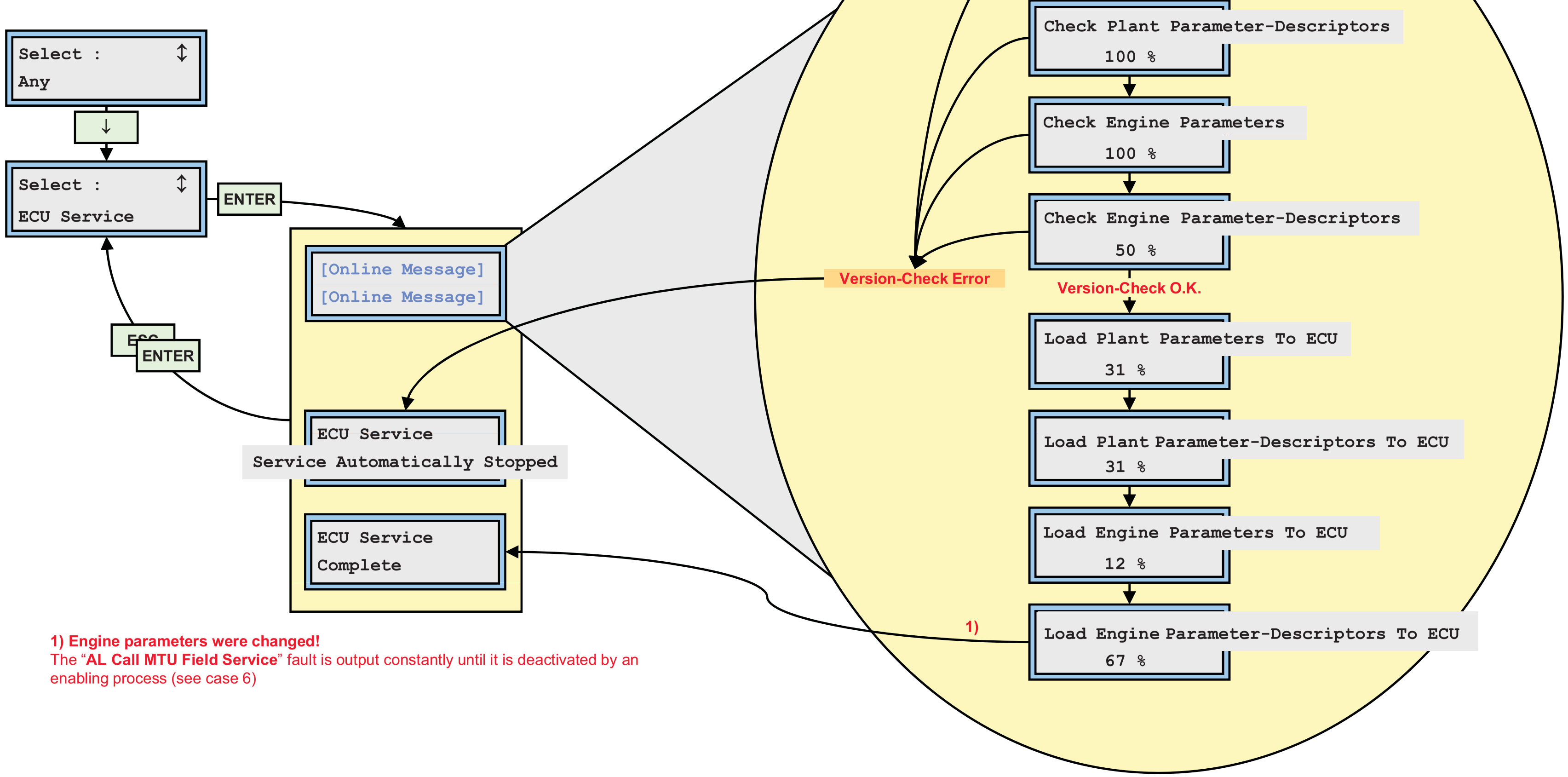
In this case ECU 7 must create a **new** FDH-Info module in the CF and download all data modules involved in the backup to the SAM. These processes run in the background as no operator intervention is required. The ECU 7 opens the special display page **Background-Page** in the background and transmits status messages which are then displayed online (e.g. loading to SAM). The user can read the current messages there.
On completion command 51 is transmitted indicating **Service Complete**.



1) After copying has been executed, the display switches back to the ECU Service main page and command 51 "**Service Complete**" is transmitted to the display, whereupon **ECU Service Complete** appears after confirming with Enter.

Case 4: ***(VI) SAM_Full AND ECU_7_Empty (with firmware 1.2 or 1.3)***

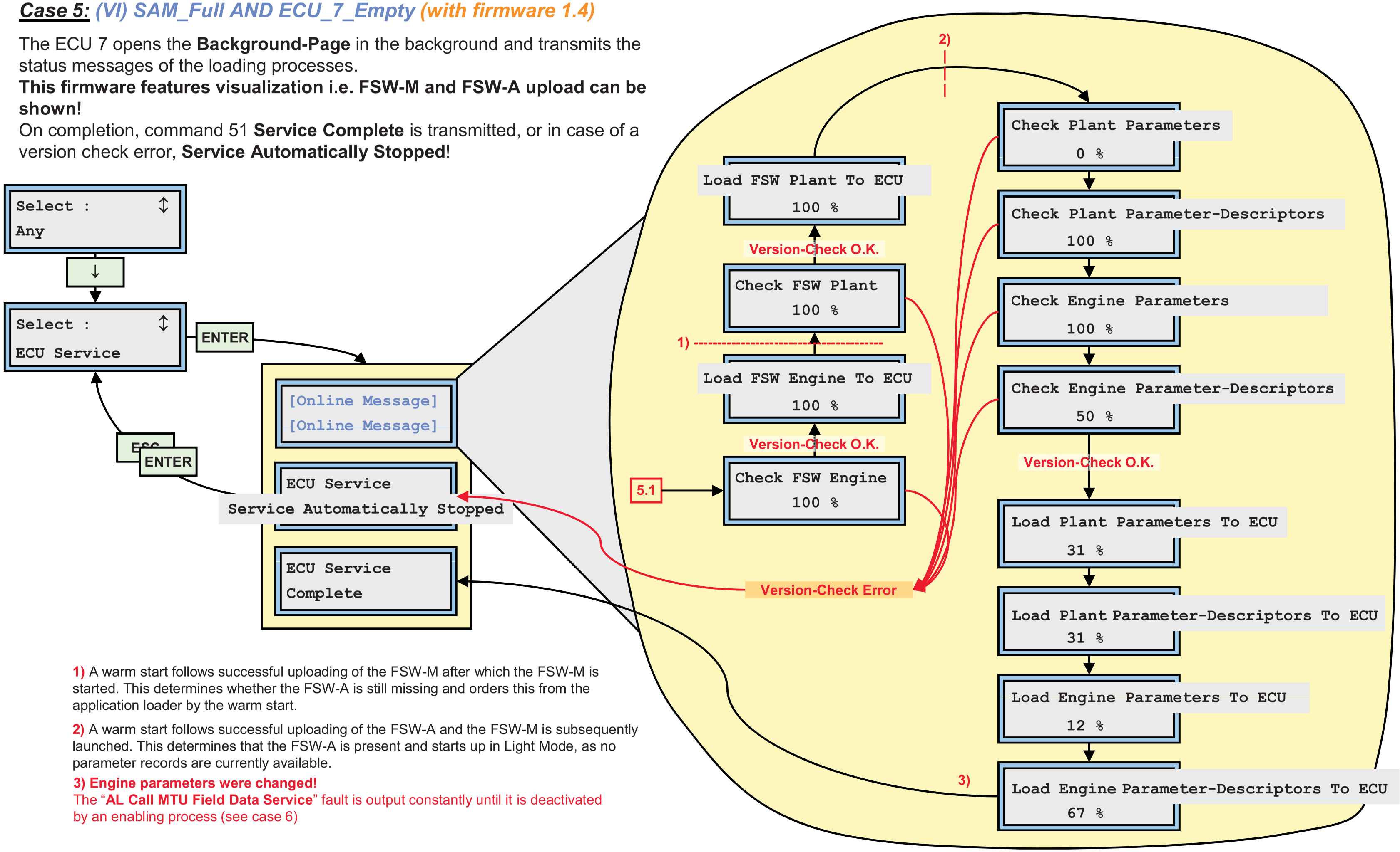
The ECU 7 opens the **Background-Page** in the background and transmits the status messages of the loading processes.
Upload of FSW-M and FSW-A is not shown as these firmwares do not feature visualization functions.
On completion, command 51 **Service Complete** is transmitted, or in case of a version check error, **Service Automatically Stopped** .



1) Engine parameters were changed!
The "**AL Call MTU Field Service**" fault is output constantly until it is deactivated by an enabling process (see case 6)

Case 5: *(VI) SAM_Full AND ECU_7_Empty (with firmware 1.4)*

The ECU 7 opens the **Background-Page** in the background and transmits the status messages of the loading processes.
This firmware features visualization i.e. FSW-M and FSW-A upload can be shown!
On completion, command 51 **Service Complete** is transmitted, or in case of a version check error, **Service Automatically Stopped**!



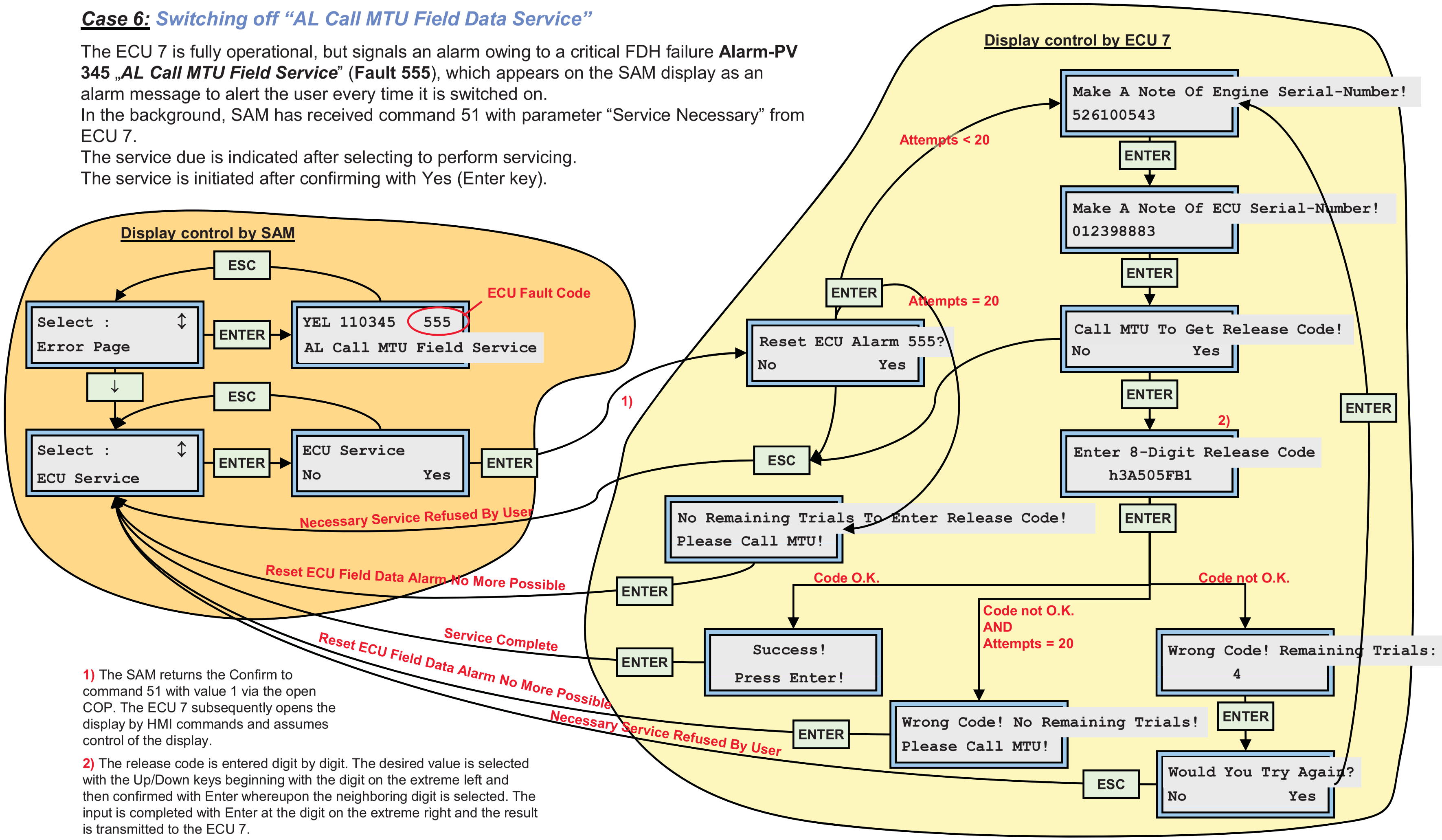
1) A warm start follows successful uploading of the FSW-M after which the FSW-M is started. This determines whether the FSW-A is still missing and orders this from the application loader by the warm start.

2) A warm start follows successful uploading of the FSW-A and the FSW-M is subsequently launched. This determines that the FSW-A is present and starts up in Light Mode, as no parameter records are currently available.

3) Engine parameters were changed!
The "**AL Call MTU Field Data Service**" fault is output constantly until it is deactivated by an enabling process (see case 6)

Case 6: ***Switching off "AL Call MTU Field Data Service"***

The ECU 7 is fully operational, but signals an alarm owing to a critical FDH failure **Alarm-PV 345** „***AL Call MTU Field Service***" (**Fault 555**), which appears on the SAM display as an alarm message to alert the user every time it is switched on.
In the background, SAM has received command 51 with parameter "Service Necessary" from ECU 7.
The service due is indicated after selecting to perform servicing.
The service is initiated after confirming with Yes (Enter key).



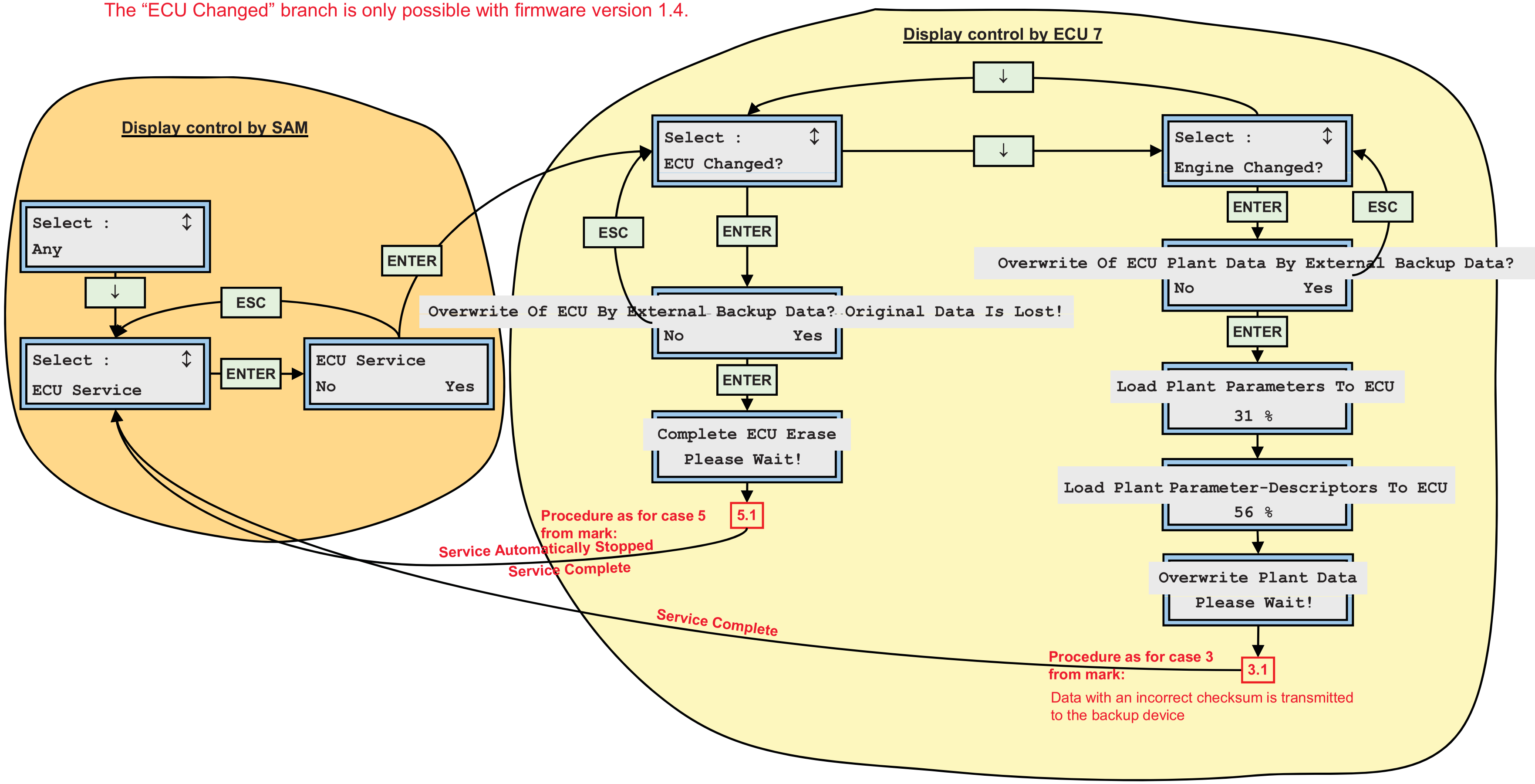
1) The SAM returns the Confirm to command 51 with value 1 via the open COP. The ECU 7 subsequently opens the display by HMI commands and assumes control of the display.

2) The release code is entered digit by digit. The desired value is selected with the Up/Down keys beginning with the digit on the extreme left and then confirmed with Enter whereupon the neighboring digit is selected. The input is completed with Enter at the digit on the extreme right and the result is transmitted to the ECU 7.

Case 7: *(IV) Pool engine replacement* ***OR*** *(V) ECU replacement*

These two cases cannot be differentiated as the engine is unable to transmit the necessary identification information to the ECU (EDM or transponder required).
Alarm-PV 346 "*AL Configuration Changed*" (Fault 544) is output as the system configuration has obviously been changed.

The "ECU Changed" branch is only possible with firmware version 1.4.



Please note!

1) An empty ECU 7 with firmware 1.2 or 1.3 and a SAM which supports FDH, but which has no backup-data stored in the ECU directory of the CF, are required for configuration. It is not possible to load the ECU 7 using DiaSys in this case. The SAM must be switched off for this.

8.7 Troubleshooting starting and stopping the engine

Note:
This chapter contains some MTU drawings as an example. See CIM database and load down the actual version of these drawings.

For engines Series 4000-03 for mining application exist two possibilitiesto wire the start/stop signals:
- Start/stop wired to the ADEC
- Start/stop wired to SAM (start and stop signal are transmitted via CAN)

Start/stop wired to the ADEC

Start and stop signal are wired in the X1 connector (vehicle interface harness, drawing XZ00E50000015).

Stop signal (ADEC input DI 1)

- X1 pin 28: GND
- X1 pin 43: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 43 is not connected to 24 V (safety feature, engine is stopped when wire break!).

Start signal (ADEC input DI 7)

- X1 pin 22: GND
- X1 pin 37: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 37.

Start & stop wired to SAM

Start and stop signal are wired to the SAM (connector X19, drawing XZ00E50000016). The SAM offers an additional feature called start interlock (connector X3).

Stop signal (SAM input P_IN 1)

- X19 pin 5: +24 V

This input is configured as an “active low” input (default setting). The stop is active if pin 5 is not connected to 24 V (safety feature, engine is stopped when wire break!).

Start signal (SAM input P_IN 3)

- X19 pin 7: +24 V

This input is configured as an “active high” input (default setting). An engine start is requested when 24V are applied to pin 37.

This function can be configured with the following SAM parameter:

Parameter 865:	0 - SAM engine start function via CAN deactivated.
	1 - SAM engine start function via CAN activated.
Parameter 866:	0 - SAM engine start function hardwired deactivated.
	1 - SAM engine start function hardwired activated (X19,Pin7).

Start interlock (SAM input B_IN 5)

- X3 pin 10: GND
- X3 pin 9: +24 V

This input is configured as an “active low” input (default setting). The start interlock function is active if pin 9 is disconnected from power supply - an engine start is not possible.

If the start interlock feature is not required the function can be deactivated in the SAM software:

TIM ID: 0000036837 - 001

Parameter 860:	0 – Start Interlock via CAN deactivated	
	1 - Start Interlock via CAN activated.	
Parameter 861:	0 - Start Interlock Hardwired deactivated.	
	1 - Start Interlock Hardwired activated (X3, Pin 9).	

Remark: If the start interlock feature is used and the input recognizes “start interlock active” no start request message is broadcasted on the CAN bus (refer to 2.1090.201 below).

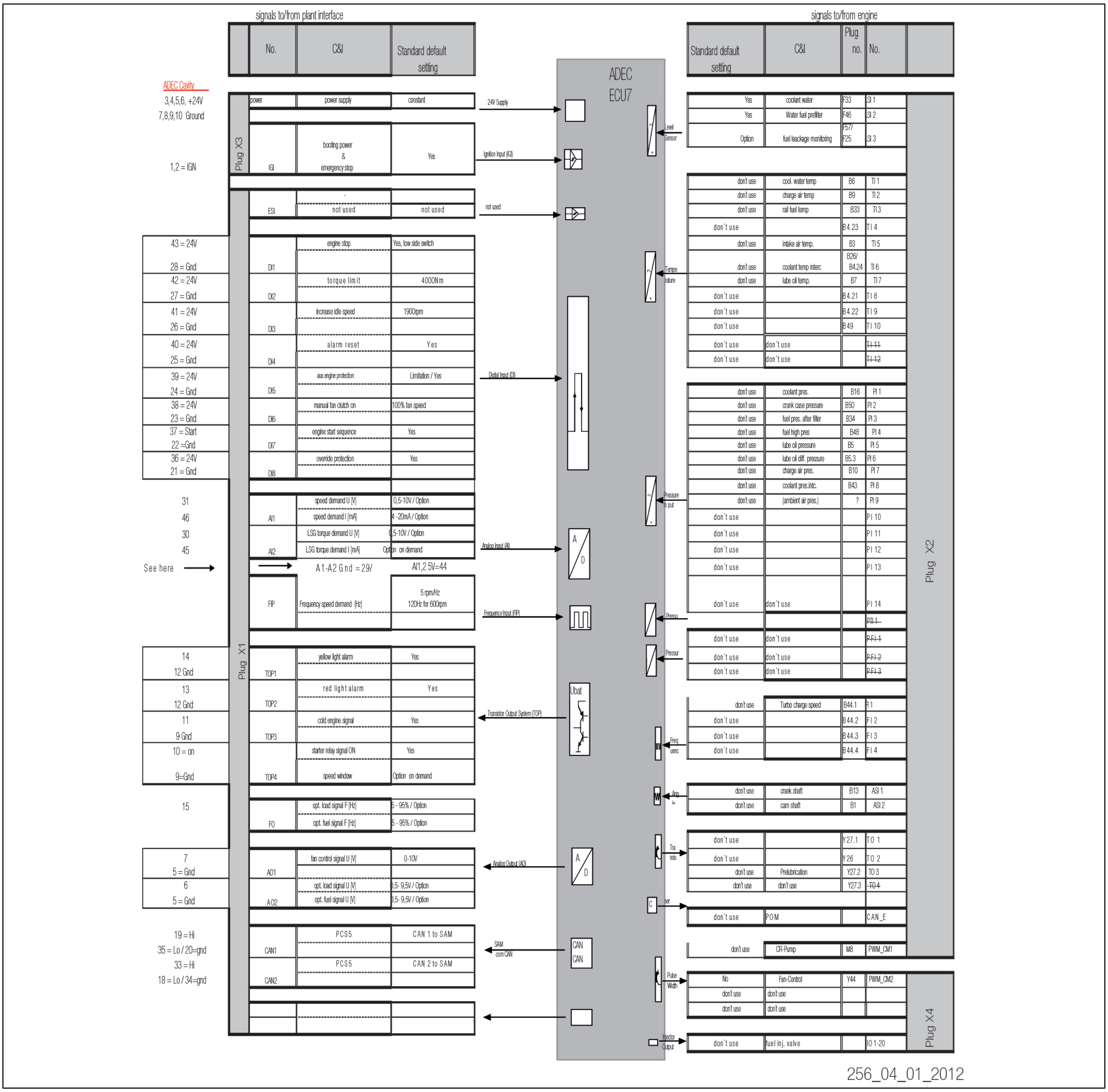
Ready for start lamp (SAM output BT_OUT 9)

- X17 pin 11: +24 V

The ready for start lamp is a recommended feature to display the status of the engine before start and during start sequence:
- Lights up if an engine start can be initialized (START possible, leads toprelubrication)
- Flashes while the oil priming pump is in operation.
- Lights up again once the required oilpressure is built up and the engine canbe started (START now leads to startingof the engine).
- Goes out if the engine speed increases to over 300 rpm.

Remark
With SAM software version 40012_A3 the “Ready for start lamp” does not indicate if stops or the start interlock are active. For this reason an activated ready for start lamp does not guarantee starting of the engine.

TIM ID: 0000036837 - 001



TIM ID: 0000036837 - 001

X1			Pin #
Engine Speed	V_OUT1	10V out	1
	C_OUT1	20ma Out	6
T-Coolant	V_OUT2	10V out	2
	C_OUT2	20ma Out	7
Rockford Fan Speed	V_OUT3	10V out	3
	C_OUT3	20ma Out	8
P-Lube Oil	V_OUT4	10V out	4
	C_OUT4	20ma Out	9
Spare	V_OUT5	10V out	5
	Analog_GND	Gnd	10
	Ubat+24v	+24 v	11
	I_GND	Gnd	12

X2			
Fuel Filter Diff. switch	B_IN13	+24 v	1
	B_IN13	Gnd	2
Spare	B_IN14	+24 v	3
	B_IN14	Gnd	4
Spare	B_IN15	+24 v	5
	B_IN15	Gnd	6
Disable Cylinder Cut Out	B_IN16	+24 v	7
	B_IN16	Gnd	8
Spare	B_IN17	+24 v	9
	B_IN17	Gnd	10
Spare	B_IN18	+24 v	11
	B_IN18	Gnd	12

X3			
Aux. Engine Protection	B_IN1	+24V	1
	B_IN1	Gnd	2
Binary Out Test	B_IN2	+24V	3
	B_IN2	Gnd	4
Test Overspeed	B_IN3	+24V	5
	B_IN3	Gnd	6
Reset Trip Data	B_IN4	+24V	7
	B_IN4	Gnd	8
Start Interlock NC	B_IN5	+24V	9
	B_IN5	Gnd	10
Park Break Interlock	B_IN6	+24V	11
	B_IN6	Gnd	12

X4 Diasys Cable connection			
X5 Ethernet connection			
X6			
CAN 1	CAN1_GND	CAN1_GND	1
	Can_1L	Can_1L	2
	Can_1H	Can_1H	3
X7			
CAN 2	CAN2_GND	CAN2_GND	1
	Can_2L	Can_2L	2
	Can_2H	Can_2H	3
X8			
CAN 3	CAN3_GND	CAN3_GND	1
	Can_3L	Can_3L	2
	Can_3H	Can_3H	3
Slot assembly			
	Slot1		
	Slot2		
CCB 2-03	Slot3		

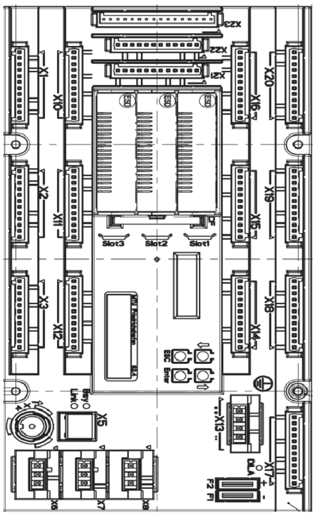
X10			Pin #
Slot2 CH X...			1
Slot2 CH X...			2
Slot2 CH X...			3
Slot2 CH X...			4
Slot2 CH X...			5
Slot2 CH X...			6
Slot2 CH X...			7
Slot2 CH X...			8
Spare	V_OUT6	10V out	9
Fan Control 1	V_OUT7	10V out	10
Fan Control 2	V_OUT8	10V out	11
-	Analog_GND	Gnd	12

X11			
Rating Switch 1	B_IN19	+24V	1
-	B_IN19	Gnd	2
Rating Switch 2	B_IN20	+24V	3
	B_IN20	Gnd	4
Spare	A_IN_ISO1	+24 v	5
	A_IN_ISO1	Gnd	6
Spare	A_IN_ISO2	+24 v	7
	A_IN_ISO2	Gnd	8
Spare	A_IN_ISO3	+24v	9
	A_IN_ISO3	Gnd	10
Spare	A_IN_ISO4	+24 v	11
	A_IN_ISO4	Gnd	12

X12			
Spare	B_IN7	+24V	1
	B_IN7	Gnd	2
Spare	B_IN8	+24V	3
	B_IN8	Gnd	4
Spare	B_IN9	+24V	5
	B_IN9	Gnd	6
Spare	B_IN10	+24V	7
	B_IN10	Gnd	8
Spare	B_IN11	+24V	9
	B_IN11	Gnd	10
NEUTRAL	B_IN12	+24V	11
NEUTRAL	B_IN12	Gnd	12

X13			
SAM Power Supply	+24V_SAM	+24V	1
	+24V_SAM	+24V	2
	GND_SAM	Ground	3
	GND_SAM	Ground	4

X14			
RS422 interface			1
RS422 interface			2
RS422 interface			3
RS422 interface			4
RS422 interface			5
RS422 interface			6
VSG Idle Speed Min	P_IN8	+24V	7
SAM GND		GND	8
Fan Control 1 PWM	PWM_OUT 1	+24 V Out	9
	PWM_OUT	Low Side	10
Fan Control 2 PWM	PWM_OUT 2	+24 V Out	11
	PWM_OUT	Low Side	12



X15			Pin #
NT/HT Valve After Filter	BR_OUT1	+ 24V	1
	BR_OUT1		2
	BR_OUT1	Signal	3
NT/HT Valve Before Filter	BR_OUT2	+ 24V	4
	BR_OUT2		5
	BR_OUT2	Signal	6
Preheation Unit On Valve	BR_OUT3	+ 24V	7
	BR_OUT3		8
	BR_OUT3	Signal	9
Spare	BR_OUT4	+ 24V	10
	BR_OUT4		11
	BR_OUT4	Signal	12

X16			
P-Diff Fuel Prefilter	A_IN5	+5V Out	1
	A_IN5	Signal	2
	A_IN5	Gnd	3
Air Filter Restriction	A_IN6	+5V Out	4
	A_IN6	Signal	5
	A_IN6	Gnd	6
Fuel Filter Restriction	A_IN7	+5V Out	7
	A_IN7	Signal	8
	A_IN7	Gnd	9
Aux. Engine Protection	A_IN8	+5V Out	10
	A_IN8	Signal	11
	A_IN8	Gnd	12

X17			
Batt GND		Gnd	1
Batt +		+ 24V	2
Torque Limitation Active	BT_OUT1		3
Speed Window 1	BT_OUT2		4
Speed Window 2	BT_OUT3		5
Preheat On	BT_OUT4		6
Lo Preheat Mode On	BT_OUT5		7
Hi Preheat Mode On	BT_OUT6		8
Spare	BT_OUT7		9
Overspeed Alarm	BT_OUT8		10
Ready For Start LAMP***	BT_OUT9		11
Preheat Status Lamp	BT_OUT10		12

X18			
HI T-Coolant	BT_OUT11		1
HI T-Charge Air	BT_OUT12		2
LO P-Coolant	BT_OUT13		3
LO P-Lube Oil	BT_OUT14		4
HI P-Crankcase	BT_OUT15		5
Override Active	BT_OUT16		6
Shutter 1	OUT17		7
Shutter 2	BT_OUT18		8
Engine Stop follow up active	BT_OUT19		9
Spare	BT_OUT20		10
Batt GND		Gnd	11
Batt +		+24V	12

X19			Pin #
Spare	F_IN1		1
Spare	F_IN1		2
Spare	F_IN2		3
Spare	F_IN2		4
Engine Stop	P_IN1	+24V	5
External Preheat Enable	P_IN2	+24V	6
Push Button Start	P_IN3	+24V	7
Spare	P_IN4	+24V	8
Spare	P_IN5	+24V	9
Manual Ext. Fan On	P_IN6	+24V	10
Crank W/O start	P_IN7	+24V	11
GND SAM		GND	12

X20			
T-Exhaust A	A_IN1	+5V Out	1
	A_IN1	Signal	2
	A_IN1	Gnd	3
T-Exhaust B	A_IN2	+5V Out	4
	A_IN2	Signal	5
	A_IN2	Gnd	6
Pressure 1	A_IN3	+5V Out	7
	A_IN3	Signal	8
	A_IN3	Gnd	9
Pressure 2	A_IN4	+5V Out	10
	A_IN4	Signal	11
	A_IN4	Gnd	12

X21	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	

X22	
Slot1 CH X...	
Slot1 CH X...	
Slot1 CH X...	
Slot2 CH X...	
Slot2 CH X...	
Slot2 CH X...	
Slot2 CH X...	
Slot2 CH X...	
Slot2 CH X...	

X23			
J1939	Can_L	Can_L	1
	Can_H	Can_H	2
	CAN_GND	CAN_GND	3
CAN OPEN	CAN_GND	CAN_GND	4
	Can_L	Can_L	5
	Can_H	Can_H	6
			7
			8
			9
			10
			11
			12
			13
CAN Spare	Can_1H		14
ISO 11992	CAN_GND		15
	Can_L		16

256_04_02_2012

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DiaSys Parameters ECU 7 (Connect DiaSys Software to ECU)

Stop signals

ZKP No.	Description	Function
2.7001.001	Stop Activated	Engine stop is activated. The reason can be found in PV 2.7001.002 an following.
2.7001.002	Stop Button	Manual stop request by ECU button, configurable to any ECU binary input by Binary Input Configuration.
2.7001.003	Stop FBFE	A stop was performed by the injection system (loss of synchronisation and no available redundancy).
2.7001.004	Stop CAN	Result of all manual stop inputs via CAN.
2.7001.005	Stop Protection	Result of all stop requests by the protection modules
2.7001.007	ESI Input activated	ESI inputisactivated
2.7001.008	ExternalStopActivated	Stop activated by external signal (stop button, CAN)
2.7001.010	Automatic Engine Stop	Security system or engine stalling has stopped the engine
2.7001.011	CAN Request Engine Stop 1	Request of engine stop via CAN

2.7001.001: indicates that a stop is activated (for source of stop check PVs 2.7001.002 to 2.7001.011)
2.7001.002: indicates that stop on ADEC DI1 is activated
2.7001.011: indicates that stop on SAM P_IN 1 is activated

Start signal

ZKP No.	Description	Function
2.1090.001	Ignitioninput IGI activated	IGI inputisactivated
2.1090.010	Engine Start Clearance	Engine may be started. Bit 0 of the Engine Starting States PV.
2.1090.050	Engine Start Requested	Result of all engine start requests.
2.1090.051	Engine Start Button	Input signal from ECU7. 0 = Start button not pushed. 1 = Start button pushed. Configurable to any ECU7 binary input by Binary Input Configuration.
2.1090.201	CAN Engine Start (LOP)	Starting request via CAN from LOP device.

2.1090.001 must be “1” to start engine
2.1090.010 must be “1” to start engine
2.1090.050 indicates a start request but not the source of the start request (check PV 2.1090.051 and 2.1090.201)
2.1090.051 indicates that start on ADEC DI 7 is activated
2.1090.201 indicates that start on SAM P_IN 3 is activated (transmitted via CAN bus).

DiaSys Parameters SAM (Connect DiaSys Software to SAM)

The start interlock can not be checked on the ADEC.

SAM PR	Function
SAM PV5020	if “1” start interlock active, engine can not be started
	if “0” engine start is possible

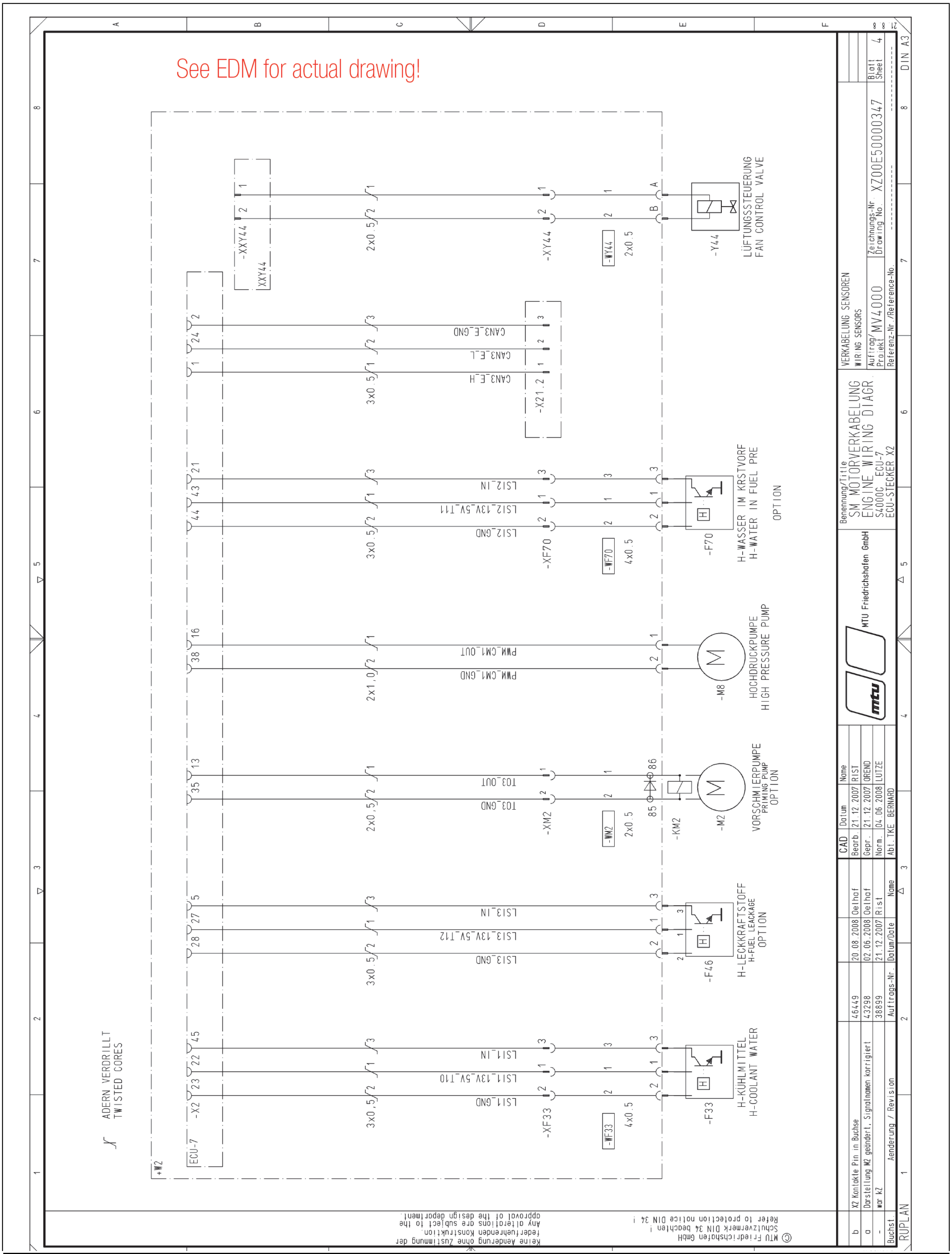
TIM ID: 0000036837 - 001

Start sequence and prelube/starter activation

The start sequence for Series 4000-03 engines is controlled by the ADEC. The ADEC checks for conditions if a engine start is allowed andcontrols activation of prelube pump and starter. Start sequence:

1. Start signal applied (if start clearance, start sequence activated)
2. Prelube pump activated until oil pressure ok
3. Starter activated

TIM ID: 0000036837 - 001


See EDM for actual drawing!
LÜFTUNGSSTEUERUNG
FAN CONTROL VALVE
H-WASSER IM KRSTVORF
H-WATER IN FUEL PRE
OPTION
HOCHDRUCKPUMPE
HIGH PRESSURE PUMP
VORSCHMIERPUMPE
PRIMING PUMP
OPTION
H-LECKKRAFTSTOFF
H-FUEL LEACKAGE
OPTION
H-KÜHLMITTEL
H-COOLANT WATER
ADERN VERDRILLT
TWISTED CORES
VERKABELUNG SENSOREN
WIRING SENSORS
SM MOTORVERKABELUNG
ENGINE WIRING DIAGR
S4000C ECU-7
ECU-STECKER X2
MTU Friedrichshafen GmbH
XZ00E50000347
MV4000
DIN A3
RUPLAN

Prelube pump

The prelube pump is connected to transistor output TO3 in the X2 sensor harness (drawing XZ00E50000347).

If wires from ADEC to relay are swopped the suppression diode most probably is failed. This will lead to a miss function prelube pump.

- Prelube pump on signal (ADEC output TO3)
  - X2 pin 35: GND
  - X2 pin 13: +24 V

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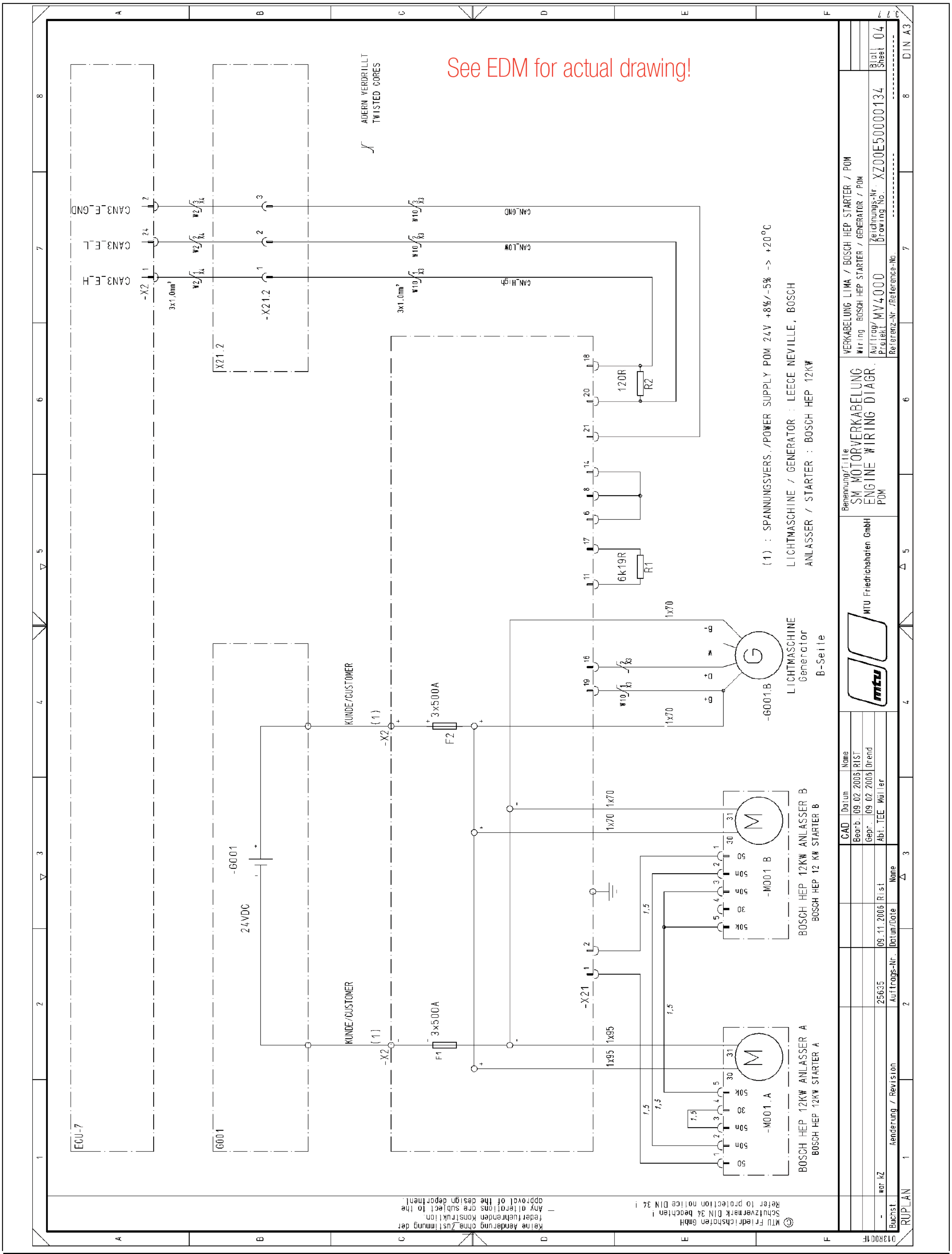

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Starter relay activation (no POM installed)

If no POM is installed the starter relay is activated by the transistor output TOP4 in the X1 harness.
- Starter on signal (ADEC output TOP4)
  - X1 pin 9: GND
  - X1 pin 10: +24 V

Starter activation (POM installed)

If a POM is installed the starter is activated by the POM. The signal to the starter is wired in the POM harness (X21, drawing XZ00E50000134 and XZ00E50000136).)
- Starter on signal (POM output TOH1/TOH2)
  - X21 pin 1: +24 V (TOH1 to starter A side, XM1A pin 1)
  - X21 pin 2: +24 V (TOH2 to starter B side, XM1B pin 1)

DiaSys Parameters ADEC (Connect DiaSys Software to ADEC)

Parameter No.	Description	Function
2.1090.012	Starting in Progress	Info bit that starting is in progress. 0 = No starting in progress. 1 = Starting in progress. Bit 2 of the Engine Starting States PV.
2.1090.013	Starter ON	Info bit that starter is running. 0 = Starter is not running. 1 = Starter is running. Bit 3 of the Engine Starting States PV.
2.1090.014	Prelubrication Pump ON	Activate lubrication unit via CAN. 0 = Lubrication unit OFF. 1 = Lubrication unit ON. Bit 4 of the Engine Starting States PV.
2.1090.015	Prelubrication Indication	Indication of Prelubrication, reflects activity of Prelub pump. 0 = Prelubrication pump off. 1 = Prelubrication in progress. Bit 5 of the Engine Starting States PV.
2.1090.017	Starter Speed Reached	Info bit that engine has reached the projected Starter Speed. 0 = Starter speed not reached. 1 = Starter speed reached. Bit 7 of the Engine Starting States PV.
2.1090.018	Starter Release Speed Reached	Info bit that engine has reached the projected Starter Release Speed. 0 = Starter release speed not reached. 1 = Starter release speed reached. Bit 8 of the Engine Starting States PV.
2.1090.019	Idle Speed Reached	Info bit that engine has reached the projected Engine Idle Speed. 0 = Engine idle speed not reached. 1 = Engine idle speed reached. Bit 9 of the Engine Starting States PV.
2.1090.020	Start Aborted	Info bit. 0 = OK. 1 = Start has been aborted. Bit 10 of the Engine Starting States PV.

Parameter No.	Description	Function
2.1090.021	Restarting	Info bit. 0 = OK. 1 = Engine is beeing restarted after engine failed to reach projected Starter Speed within the projected Starter Time Interval. Bit 11 of the Engine Starting States PV.
2.1090.024	Engine Start Instruction	Set when engine start request is valid. Signaled back via CAN to Start (Button) Indication Light. Bit 14 of the Engine Starting States PV.
2.1090.026	Start Aborted T-Preheat	Info bit. 0 = OK. 1 = Limit 1 of T-Preheat has not yet been reached. Starting procedure is aborded due to this condition. Bit 16 of the Engine Starting States PV.
2.1090.027	Start Aborted P-Prelubrication	Info bit. 0 = OK. 1 = Priming limit of T-Lube Oil has not yet been reached. Starting procedure isaborded due to this condition. Bit 17 of the Engine Starting States PV.

2.1090.012: indicates that start sequence is in progress

2.1090.014: indicates that the prelube pump is on (TO3 activated)

2.1090.013 indicates that starter is on:
- without POM: TOP4 activated
- with POM: TOH1 and TOH2 activated

For detailed Information about the Pin assignment of the ECU see chapter "ECU Signals".

For detailed Information about the Pin assignment of SAM see chapter "SAM Signals".

ECU Parameters for prelube function (Connect DiaSys Software to ADEC)

Parameter		without prelube	with prelube
1.1040.003	BinOut TO3 PV-Number	0	2.1090.014
1.1040.007	BinOut TO3 Active LEvel	0	0
1.1040.009	BinOut Monitoring Configuration	0	4
1.8004.636	AL Wiring TO3	1233	1233
2.1090.100	Enable Starting PRocedure	1	1
2.1090.103	Enable prelubercation function on start	0	1
2.1090.104	Enable manual prelubrication function	0	0
2.1090.107	Enable intermittent oil priming	0	0
2.1090.920	AL prelubrication fault	225	225

ECU Parameters for POM (Connect DiaSys Software to ADEC)

Parameter		without POM	with POM
1.4500.001	POM installed	0	1

Parameter		without POM	with POM
1.4500.002	Monitoring suppression/Engine stop-ped	0	0
1.4500.003	CAN POM Start monitor delay time	4	4
1.4500.005	Starter engaged factor	1, 3	1, 3
1.4500.006	Starter engaged time out	0, 8	0, 8
1.4500.051	U_Power supply POM lower limit 1	18	18
1.4500.052	U_Power supply POM lower limit 2	13	10
2.1050.004	BinOut TOP4 PV-number	02.1090.013	0
2.1050.009	BinOUT TOP Monitoring configuration	3	3
2.1050.017	TOP4 select for test (lamp)	0	0

For detailed information about the start procedure see alsso chapter "Additional Functions - Start and Stop signals".

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9 Appendix A

9.1 Conversion tables

Length

Unit A	multiplied by factor	= Unit B
in	25.4	= mm
ft	0.3048	= m
yd	0.9144	= m
stat. mile	1.609	= km
nm	1.852	= km
yd	3	= ft
yd	36	= in

Unit B	multiplied by factor	= Unit A
mm	0.03937	= in
m	3.281	= ft
km	0.6215	= stat. mile

Area

Unit A	multiplied by factor	= Unit B
in^2	645.16	= mm^2
ft^2	0.0929	= m^2
yd^2	0.8361	= m^2
stat. $mile^2$	2.5889	= km^2

Unit B	multiplied by factor	Unit A
mm^2	0.00155	= in^2
m^2	10.7643	= ft^2
m^2	1.1960	= yd^2
km^2	0.3863	stat. $mile^2$

Volume

Unit A	multiplied by factor	= Unit B
in^3	16387	= mm^3
ft^3	0.02832	= m^3
yd^3	0.7646	= m^3
gallon (US)	3.787	= dm^3
gallon (brit.)	4.546	= dm^3

Unit B	multiplied by factor	= Unit A
cm^3	0.06102	= in^3

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Unit B	multiplied by factor	= Unit A
m^3	35.31	= ft^3
dm^3	0.2642	= gallon (US)
dm^3	0.22	= gallon (brit.)

Speed

Unit A	multiplied by factor	= Unit B
ft/s	0.3048	= m/s
stat. mile/h (mph)	1.609	= km/h
knot (brit.)	1.852	= km/h

Unit B	multiplied by factor	= Unit B
m/s	3.281	= ft/s
km/h	0.6215	= stat. mile/h (mph)
km/h	0.54	= knot (brit.)

Mass

Unit A	multiplied by factor	= Unit B
lb	0.4536	= kg
oz	28.35	= g
ton	1.016	= t

Unit B	multiplied by factor	= Unit A
g	0.03527	= oz
kg	2.205	= lb
t	0.9843	= ton

Force

Unit A	multiplied by factor	= Unit B
lb	0.4536	= kp
lb	4.4483	= N

Unit B	multiplied by factor	= Unit A
kp	2.205	= lb
N	0.101972	= kp
kp	9.80665	= N

Density

Unit A	multiplied by factor	= Unit B
lb s^2/ft^4	515.4	= kg/m^3

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Unit B	multiplied by factor	= Unit A
kg/m^3	0.00194	= $lb\ s^2/ft^4$

Torque

Unit A	multiplied by factor	= Unit B
ft lb	1.3563	= Nm

Unit B	multiplied by factor	= Unit A
Nm	0.7373	= ft lb

Pressure

Unit A	multiplied by factor	= Unit B
lb/sq in (psi)	703.1	= kp/m^2 (mm WS)
lb/sq in (psi)	0.06895	= bar
lb/sq ft	47.883	= Pa
in QS	0.03386	= bar
in QS	345.3	= kp/m^2

Unit B	multiplied by factor	= Unit A
atm	760	= mm QS
atm	1.0133	= bar
atm	10332	= kp/m^2 (mm WS)
atm	1.0332	= kp/cm^2 (at)
atm	14.696	= lb/sq in
bar	14.503	= lb/sq in

Mass moment 2nd degree

Unit A	multiplied by factor	= Unit B
$ft\ lb\ s^2$	1.3563	= $kg\ m^2$

Unit B	multiplied by factor	= Unit A
$kg\ m^2$	0.7373	= $ft\ lb\ s^2$

Energy

Unit A	multiplied by factor	= Unit B
ft lb	1.356	= J
kcal	4186.8	= J
BTU	1055	= J
CHU	1899	= J

Unit B	multiplied by factor	= Unit A
J	0.7376	= ft lb

Unit B	multiplied by factor	= Unit A
J	0.0002389	= kcal
J	0.0009479	= BTU
J	0.00052656	= CHU

Output

Unit A	multiplied by factor	= Unit B
PS	0.7355	= kW
HP	0.7457	= kW
BTU/s	1.055	= kW
kcal/h	1.163	= W
HP	550	= ft lb/s

Unit B	multiplied by factor	= Unit A
kW	1.36	= PS
kW	1.341	= HP
kW	0.9479	= BTU/s
W	0.8598	= kcal/h
ft lb/s	0.0018	= HP

Temperature

	Celsius	Kelvin	Fahrenheit	Réaumur
x °C		= x + 273.15 K	= 9/5x + 32 °F	= (4/5x) °R
x K	= x − 273, 15 °C		= 9/5(x − 273.15) + 32 °F	= 4/5(x − 273.15) °R
x°F	= 5/9(x − 32) °C	= 5/9(x − 32) + 273.15 K		= 4/9(x − 32) °R
x°R	= 5/4x °C	= (5/4x) + 273.15 K	= (9/4x) + 32 °F	

Fuel consumption

Unit A	multiplied by factor	= Unit B
mile/gal (US)	0.4251	= km/l
gal/mile (US)	2.3527	= l/km

Unit B	multiplied by factor	= Unit A
km/l	2.3527	= mile/gal (US)
l/km	0.4251	= gal/mile (US)

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9.2 MTU contacts/service partners

Service

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

Local support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: http://www.mtu-online.com

24h hotline

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you - either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact at Headquarters: Service-support@mtu-online.com

Spare parts service

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

Tel.: +49 7541 908555

Fax.: +49 7541 908121

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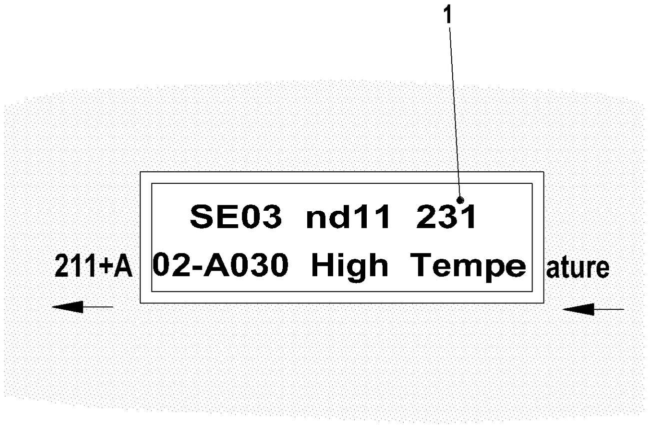
10 Appendix B

10.1 Fault message structure for Series 4000, C&I applications

The fault code numbers are generated by the Engine Control Unit an transmitted to the display.



The fault code (1) comprises three digits. The letter code (e.g. “SE”) states the device or function from which the message originates. The digits define the fault precisely.

Fault messages can also be caused by faulty sensors/actuators. Contact Service to have sensors/actuators checked and replaced as necessary if the troubleshooting measures listed in the tables in Annex A prove unsuccessful.

The table below lists possible fault codes:

Fault code	Designation	Meaning
EC	ECU Code	Engine Control Unit ECU 7 fault codes
AL	AL	SAM alarm message
RL	Redundancy Lost	Redundant CAN (CAN 2) supplies no data - malfunction
DL	Default Lost	Default CAN (CAN 1) supplies no data - malfunction
SE	System Error	System error for various devices on the bus
SD	Sensor Defect	Faulty sensor supplies incorrect or no measured values (out of valid range)

The associated fault codes are explained in the ensuing chapters of the Annex.

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10.2 ECU 7 messages EC

Message		Message text	Meaning	ZKP no.
EC	3	HI T-Fuel	1st limit value violation: Fuel temperature	2.0122.931
EC	4	SS T-Fuel	Engine shutdown due to fuel temperature violation	2.0122.932
EC	5	HI T-Charge Air	1st limit value violation: Charge-air temperature	2.0121.931
EC	6	SS T-Charge Air	Engine shutdown due to charge-air temperature violation	2.0121.932
EC	9	HI T-Coolant Intercooler	1st limit value violation: Intercooler coolant temperature	2.0124.931
EC	10	SS T-Coolant Intercooler	Engine shutdown due to intercooler coolant temperature violation	2.0124.932
EC	15	LO P-Lube Oil	1st low limit value violation: Lube oil pressure	2.0100.921
EC	16	SS P-Lube Oil	Engine shutdown due to low lube oil pressure	2.0100.922
EC	19	HI T-Exhaust A	1st limit value violation: Exhaust gas A temperature	2.0126.931
EC	20	SS T-Exhaust A	Engine shutdown due to exhaust gas A temperature violation	2.0126.932
EC	21	HI T-Exhaust B	1st limit value violation: Exhaust gas B temperature	2.0127.931
EC	22	SS T-Exhaust B	Engine shutdown due to exhaust gas B temperature violation	2.0127.932
EC	23	LO Coolant Level	1st low limit value violation: Coolant level	2.0152.921
EC	24	SS Coolant Level	Engine shutdown due to coolant level	2.0152.912
EC	25	HI P-Diff-Lube Oil	1st limit value violation: Lube oil differential pressure	2.0154.931
EC	26	SS P-Diff-Lube Oil	Engine shutdown due to low lube oil differential pressure	2.0154.932
EC	27	HI Level Leakage Fuel	1st limit value violation: Leak-off fuel level	2.0151.931
EC	29	HI ETC Idle Speed too High	1st limit value violation: Exhaust turbocharger idle speed too high	1.8004.206
EC	30	SS Engine Overspeed	Engine shutdown due to engine overspeeding	2.2510.932
EC	31	HI ETC1 Overspeed	1st limit value violation: Exhaust turbocharger 1 overspeed	2.3011.931
EC	32	SS ETC1 Overspeed	Engine shutdown due to exhaust turbocharger 1 overspeeding	2.3012.932
EC	33	Hi P-Diff-Fuel	1st limit value violation: Fuel differential pressure	2.0114.931
EC	34	SS P-Diff-Fuel	Engine shutdown due to fuel differential pressure	2.0114.932
EC	36	HI ETC2 Overspeed	1st limit value violation: Exhaust turbocharger 2 overspeed	2.3013.931
EC	37	SS ETC2 Overspeed	Engine shutdown due to exhaust turbocharger 2 overspeeding	2.3013.912
EC	38	AL ETC Speed Deviation	Alarm exhaust turbocharger synchronous running deviation	1.8004.205

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Message		Message text	Meaning	ZKP no.
EC	39	AL ETC2 CutIn Failure	Alarm exhaust turbocharger 2 cut-in error	1.8004.204
EC	44	LO Coolant Level Intercooler	1st low limit value violation: Intercooler coolant level	2.0153.921
EC	46	LO Level Lube Oil	1st low limit value violation: Lube oil level	2.0157.921
EC	51	HI T-Lube Oil	1st limit value violation: Lube oil temperature	2.0125.931
EC	52	SS T-Lube Oil	Engine shutdown due to lube oil temperature violation	2.0125.932
EC	53	HI T-Intake Air	1st limit value violation: Intake air temperature	2.0123.931
EC	54	HIHI T-Intake Air	2nd limit value violation: Intake air temperature	2.0123.932
EC	57	LO P-Coolant	1st low limit value violation: Coolant pressure	2.0101.921
EC	58	SS P-Coolant	Engine shutdown due to low coolant pressure	2.0101.922
EC	59	SS T-Coolant L3	Engine shutdown due to coolant L3 temperature violation	2.0120.933
EC	60	SS T-Coolant L4	Engine shutdown due to coolant L4 temperature violation	2.0120.934
EC	63	HI P-Crank Case	1st limit value violation: Crankcase pressure	2.0106.931
EC	64	SS P-Crank Case	Engine shutdown due to low crankcase pressure	2.0106.932
EC	65	LO P-Fuel	1st low limit value violation: Fuel pressure	2.0102.921
EC	66	SS P-Fuel	Engine shutdown due to low fuel pressure	2.0102.922
EC	67	HI T-Coolant	1st limit value violation: Coolant temperature	2.0120.931
EC	68	SS T-Coolant	Engine shutdown due to coolant temperature violation	2.0120.932
EC	81	AL Rail Leakage	Alarm system leak	1.8004.046
EC	82	HI P-Fuel (Common Rail)	1st limit value violation: Fuel pressure (Common Rail)	2.0104.931
EC	83	LO P-Fuel (Common Rail)	1st low limit value violation: Fuel pressure (Common Rail)	2.0104.921
EC	85	HI T-Recirculation	1st limit value violation: Recirculation temperature	2.0128.931
EC	86	SS T-Recirculation	Engine shutdown due to recirculation temperature violation	2.0128.932
EC	89	SS Engine Speed too low	Engine shutdown due to low engine speed	2.2500.030
EC	90	SS Idle Speed Not Reached	Engine shutdown due to low idle speed	2.1090.925
EC	91	SS Release Speed Not Reached	Engine shutdown due to low disengagement speed	2.1090.924
EC	92	SS Starter Speed Not Reached	Engine shutdown due to low starter speed	2.1090.923
EC	93	SS T-Preheat	Engine shutdown due to preheating temperature violation	2.1090.922
EC	94	LO T-Preheat	1st low limit value violation: Preheating temperature	2.1090.921
EC	95	AL Prelubrication Fault	Alarm priming error	2.1090.920
EC	102	AL Fuel Cons. Counter Defect	Alarm consumption counter faulty	1.8004.624

Message		Message text	Meaning	ZKP no.
EC	104	AL Eng Hours Counter Defect	Alarm engine hours counter faulty	1.8004.623
EC	118	LO ECU Power Supply Voltage	1st low limit value violation: ECU Supply Voltage	2.0140.921
EC	119	LOLO ECU Power Supply Voltage	2nd low limit value violation: ECU Supply Voltage	2.0140.922
EC	120	HI ECU Power Supply Voltage	1st limit value violation: ECU Supply Voltage	2.0140.931
EC	121	HIHI ECU Power Supply Voltage	2nd limit value violation: ECU Supply Voltage	2.0140.932
EC	122	HI T-ECU	1st limit value violation: ECU temperature	2.0132.921
EC	141	AL Power too high	Alarm power too high	1.1088.007
EC	142	AL MCR exceeded 1 hour	Alarm MCR exceeded 1 hour	1.1088.006
EC	176	AL LifeData not available	Alarm LifeData not available	2.4000.004
EC	177	AL LifeData restore incomplete	Alarm LifeData restoration incomplete	2.4000.006
EC	180	AL CAN1 Node Lost	Alarm CAN 1 node failure	2.0500.680
EC	181	AL CAN2 Node Lost	Alarm CAN 2 node failure	2.0500.681
EC	182	AL CAN Wrong Parameters	Alarm CAN incorrect parameterization	2.0500.682
EC	183	AL CAN No PU-Data	Alarm CAN no PU data	2.0500.683
EC	184	AL CAN PU-Data Flash Error	Alarm CAN PU data flash error	2.0500.684
EC	186	AL CAN1 Bus Off	Alarm CAN 1 bus off	2.0500.686
EC	187	AL CAN1 Error Passive	Alarm CAN 1 error passive	2.0500.687
EC	188	AL CAN2 Bus Off	Alarm CAN 2 bus off	2.0500.688
EC	189	AL CAN2 Error Passive	Alarm CAN 2 error passive	2.0500.689
EC	190	AL EMU Parameter Not Supported	Alarm EMU parameter not supported	2.0500.690
EC	198	COMB.ALARM YEL PLANT	Combined alarm yellow (plant)	2.8006.003
EC	201	SD T-Coolant	Coolant temperature sensor faulty	1.8004.570
EC	202	SD T-Fuel	Fuel temperature sensor faulty	1.8004.572
EC	203	SD T-Charge Air	Charge-air temperature sensor faulty	1.8004.571
EC	204	SD Level Lube Oil	Lube oil level sensor faulty	1.8004.602
EC	205	SD T-Coolant Intercooler	Intercooler coolant temperature sensor faulty	1.8004.574
EC	206	SD T-Exhaust A	Exhaust gas A temperature sensor faulty	1.8004.576
EC	207	SD T-Exhaust B	Exhaust gas B temperature sensor faulty	1.8004.577
EC	208	SD P-Charge Air	Charge-air pressure sensor faulty	1.8004.566
EC	211	SD P-Lube Oil	Lube oil pressure sensor faulty	1.8004.563
EC	212	SD P-Coolant	Coolant pressure sensor faulty	1.8004.564
EC	213	SD P-Coolant Intercooler	Intercooler coolant pressure sensor faulty	1.8004.569
EC	214	SD P-CrankCase	Crankcase pressure sensor faulty	1.8004.568
EC	215	SD P-HD	High pressure sensor faulty	1.8004.567
EC	216	SD T-Lube Oil	Lube oil temperature sensor faulty	1.8004.575
EC	219	SD T-Intake Air	Intake air temperature sensor faulty	1.8004.573

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Message		Message text	Meaning	ZKP no.
EC	220	SD Level Coolant Water	Coolant level sensor faulty	1.8004.584
EC	221	SD P-Diff Lube Oil	Lube oil differential pressure sensor faulty	1.8004.585
EC	222	SD Level Leakage Fuel	Leak fuel level sensor faulty	1.8004.582
EC	223	SD Level Coolant Intercooler	Intercooler coolant level sensor faulty	1.8004.583
EC	227	SD P-Lube Oil before Filter	Lube oil pressure before filter sensor failure	1.8004.620
EC	228	SD P-Fuel before Filter	Fuel pressure before filter sensor failure	1.8004.595
EC	229	AL Stop Camshaft Sensor Defect	Alarm stop camshaft sensor failure	1.8004.562
EC	230	SD Crankshaft Speed	Crankshaft sensor failure	1.8004.498
EC	231	SD Camshaft Speed	Camshaft sensor failure	1.8004.499
EC	232	SD Charger 1 Speed	Turbocharger 1 speed sensor failure	1.3011.128
EC	233	SD Charger 2 Speed	Turbocharger 2 speed sensor failure	1.3011.129
EC	239	SD P-Diff Fuel	Fuel differential pressure sensor faulty	1.8004.598
EC	240	SD P-Fuel	Fuel pressure sensor failure	1.8004.565
EC	241	SD T-Recirculation	Recirculation temperature sensor faulty	1.8004.581
EC	242	SD T-Coolant (R)	Coolant (R) temperature sensor faulty	1.8004.622
EC	244	SD P-Lube Oil (R)	Lube oil (R) pressure sensor faulty	1.8004.621
EC	245	SD ECU Power Supply Voltage	ECU supply voltage sensor faulty	2.8006.589
EC	266	SD Speed Demand	Nominal speed setting sensor faulty	2.8006.586
EC	267	SD TestBenchSpeedDemand	Test bench setpoint speed sensor faulty	2.8006.587
EC	268	SD Spinning Value	Analog spin value sensor faulty	2.8006.591
EC	269	SD Loadp.Analog filt	Loadp. analog filter sensor faulty	2.8006.588
EC	270	SD Frequency Input	Frequency input sensor faulty	2.8006.590
EC	301	AL Timing Cylinder A1	Alarm due to injector flight time at cylinder A1	1.8004.500
EC	302	AL Timing Cylinder A2	Alarm due to injector flight time at cylinder A2	1.8004.501
EC	303	AL Timing Cylinder A3	Alarm due to injector flight time at cylinder A3	1.8004.502
EC	304	AL Timing Cylinder A4	Alarm due to injector flight time at cylinder A4	1.8004.503
EC	305	AL Timing Cylinder A5	Alarm due to injector flight time at cylinder A5	1.8004.504
EC	306	AL Timing Cylinder A6	Alarm due to injector flight time at cylinder A6	1.8004.505
EC	307	AL Timing Cylinder A7	Alarm due to injector flight time at cylinder A7	1.8004.506
EC	308	AL Timing Cylinder A8	Alarm due to injector flight time at cylinder A8	1.8004.507
EC	309	AL Timing Cylinder A9	Alarm due to injector flight time at cylinder A9	1.8004.508
EC	310	AL Timing Cylinder A10	Alarm due to injector flight time at cylinder A10	1.8004.509
EC	311	AL Timing Cylinder B1	Alarm due to injector flight time at cylinder B1	1.8004.510
EC	312	AL Timing Cylinder B2	Alarm due to injector flight time at cylinder B2	1.8004.511
EC	313	AL Timing Cylinder B3	Alarm due to injector flight time at cylinder B3	1.8004.512
EC	314	AL Timing Cylinder B4	Alarm due to injector flight time at cylinder B4	1.8004.513
EC	315	AL Timing Cylinder B5	Alarm due to injector flight time at cylinder B5	1.8004.514
EC	316	AL Timing Cylinder B6	Alarm due to injector flight time at cylinder B6	1.8004.515

Message		Message text	Meaning	ZKP no.
EC	317	AL Timing Cylinder B7	Alarm due to injector flight time at cylinder B7	1.8004.516
EC	318	AL Timing Cylinder B8	Alarm due to injector flight time at cylinder B8	1.8004.517
EC	319	AL Timing Cylinder B9	Alarm due to injector flight time at cylinder B9	1.8004.518
EC	320	AL Timing Cylinder B10	Alarm due to injector flight time at cylinder B10	1.8004.519
EC	321	AL Wiring Cylinder A1	Alarm due to faulty wiring at injector of cylinder A1	1.8004.520
EC	322	AL Wiring Cylinder A2	Alarm due to faulty wiring at injector of cylinder A2	1.8004.521
EC	323	AL Wiring Cylinder A3	Alarm due to faulty wiring at injector of cylinder A3	1.8004.522
EC	324	AL Wiring Cylinder A4	Alarm due to faulty wiring at injector of cylinder A4	1.8004.523
EC	325	AL Wiring Cylinder A5	Alarm due to faulty wiring at injector of cylinder A5	1.8004.524
EC	326	AL Wiring Cylinder A6	Alarm due to faulty wiring at injector of cylinder A6	1.8004.525
EC	327	AL Wiring Cylinder A7	Alarm due to faulty wiring at injector of cylinder A7	1.8004.526
EC	328	AL Wiring Cylinder A8	Alarm due to faulty wiring at injector of cylinder A8	1.8004.527
EC	329	AL Wiring Cylinder A9	Alarm due to faulty wiring at injector of cylinder A9	1.8004.528
EC	330	AL Wiring Cylinder A10	Alarm due to faulty wiring at injector of cylinder A10	1.8004.529
EC	331	AL Wiring Cylinder B1	Alarm due to faulty wiring at injector of cylinder B1	1.8004.530
EC	332	AL Wiring Cylinder B2	Alarm due to faulty wiring at injector of cylinder B2	1.8004.531
EC	333	AL Wiring Cylinder B3	Alarm due to faulty wiring at injector of cylinder B3	1.8004.532
EC	334	AL Wiring Cylinder B4	Alarm due to faulty wiring at injector of cylinder B4	1.8004.533
EC	335	AL Wiring Cylinder B5	Alarm due to faulty wiring at injector of cylinder B5	1.8004.534
EC	336	AL Wiring Cylinder B6	Alarm due to faulty wiring at injector of cylinder B6	1.8004.535
EC	337	AL Wiring Cylinder B7	Alarm due to faulty wiring at injector of cylinder B7	1.8004.536
EC	338	AL Wiring Cylinder B8	Alarm due to faulty wiring at injector of cylinder B8	1.8004.537
EC	339	AL Wiring Cylinder B9	Alarm due to faulty wiring at injector of cylinder B9	1.8004.538
EC	340	AL Wiring Cylinder B10	Alarm due to faulty wiring at injector of cylinder B10	1.8004.539
EC	341	AL Open Load Cylinder A1	Alarm due to broken wiring at injector of cylinder A1	1.8004.540
EC	342	AL Open Load Cylinder A2	Alarm due to broken wiring at injector of cylinder A2	1.8004.541
EC	343	AL Open Load Cylinder A3	Alarm due to broken wiring at injector of cylinder A3	1.8004.542
EC	344	AL Open Load Cylinder A4	Alarm due to broken wiring at injector of cylinder A4	1.8004.543
EC	345	AL Open Load Cylinder A5	Alarm due to broken wiring at injector of cylinder A5	1.8004.544
EC	346	AL Open Load Cylinder A6	Alarm due to broken wiring at injector of cylinder A6	1.8004.545
EC	347	AL Open Load Cylinder A7	Alarm due to broken wiring at injector of cylinder A7	1.8004.546

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Message		Message text	Meaning	ZKP no.
EC	348	AL Open Load Cylinder A8	Alarm due to broken wiring at injector of cylinder A8	1.8004.547
EC	349	AL Open Load Cylinder A9	Alarm due to broken wiring at injector of cylinder A9	1.8004.548
EC	350	AL Open Load Cylinder A10	Alarm due to broken wiring at injector of cylinder A10	1.8004.549
EC	351	AL Open Load Cylinder B1	Alarm due to broken wiring at injector of cylinder B1	1.8004.550
EC	352	AL Open Load Cylinder B2	Alarm due to broken wiring at injector of cylinder B2	1.8004.551
EC	353	AL Open Load Cylinder B3	Alarm due to broken wiring at injector of cylinder B3	1.8004.552
EC	354	AL Open Load Cylinder B4	Alarm due to broken wiring at injector of cylinder B4	1.8004.553
EC	355	AL Open Load Cylinder B5	Alarm due to broken wiring at injector of cylinder B5	1.8004.554
EC	356	AL Open Load Cylinder B6	Alarm due to broken wiring at injector of cylinder B6	1.8004.555
EC	357	AL Open Load Cylinder B7	Alarm due to broken wiring at injector of cylinder B7	1.8004.556
EC	358	AL Open Load Cylinder B8	Alarm due to broken wiring at injector of cylinder B8	1.8004.557
EC	359	AL Open Load Cylinder B9	Alarm due to broken wiring at injector of cylinder B9	1.8004.558
EC	360	AL Open Load Cylinder B10	Alarm due to broken wiring at injector of cylinder B10	1.8004.559
EC	361	AL Power Stage Low	Alarm injector end stage low	1.8004.496
EC	362	AL Power Stage High	Alarm injector end stage high	1.8004.497
EC	363	AL Stop Power Stage	Alarm stop injector output stage	1.8004.560
EC	365	AL Stop MV-Wiring Ground	Alarm stop solenoid valve wiring ground	1.8004.561
EC	371	AL Wiring TO 1	Alarm wiring fault output TO 1	1.8004.634
EC	372	AL Wiring TO 2	Alarm wiring fault output TO 2	1.8004.635
EC	373	AL Wiring TO 3	Alarm wiring fault output TO 3	1.8004.636
EC	374	AL Wiring TO 4	Alarm wiring fault output TO 4	1.8004.637
EC	381	AL Wiring TOP 1	Alarm wiring fault output TOP 1	2.8006.638
EC	382	AL Wiring TOP 2	Alarm wiring fault output TOP 2	2.8006.639
EC	383	AL Wiring TOP 3	Alarm wiring fault output TOP 3	2.8006.640
EC	384	AL Wiring TOP 4	Alarm wiring fault output TOP 4	2.8006.641
EC	390	AL MCR exceeded	Alarm MCR exceeded	1.1085.009
EC	391	L2 T-Single Exhaust	L2 temperature single exhaust	2.8006.004
EC	392	HI T-Coolant (R)	1st limit value violation: Coolant temperature (R)	2.0129.931

Message		Message text	Meaning	ZKP no.
EC	392	Hi T-Coolant Red	1st limit value violation: Coolant temperature redundant	2.0480.197
EC	393	SS T-Coolant (R)	Engine shutdown due to coolant temperature violation (R)	2.0129.932
EC	393	SS T-Coolant Red	Engine shutdown due to coolant temperature violation redundant	2.0480.199
EC	394	LO P-Lube Oil (R)	1st low limit value violation: Lube oil pressure (R)	2.0112.921
EC	394	Lo P-Lube Oil Red	1st low limit value violation: Lube oil pressure redundant	2.0480.297
EC	395	SS P-Lube Oil (R)	Engine shutdown due to low lube oil pressure (R)	2.0112.922
EC	395	SS P-Lube Oil Red	Engine shutdown due to low lube oil pressure redundant	2.0480.299
EC	396	TD T-Coolant Sensor Deviation	Measured value deviation between first and second coolant temperature sensor	1.0480.193
EC	396	TD T-Coolant	Measured value deviation between first and second coolant temperature sensor	1.8004.626
EC	397	TD P-Oil Sensor Deviation	Measured value deviation between first and second oil pressure sensor	1.0480.293
EC	397	Motorbrake Equipped	Exhaust brake installed	1.0590.001
EC	397	PWM Adaption K1	PWM adaptation K1	1.0590.002
EC	397	PWM Adaption K2	PWM adaptation K2	1.0590.003
EC	397	Solenoid Current Push	Coil current pushing phase	1.0590.004
EC	397	Solenoid Current Hold	Coil current holding phase	1.0590.005
EC	397	Solenoid Push - Hold Time	Coil push-hold period	1.0590.006
EC	397	TD P-Lube Oil	Measured value deviation between first and second lube oil pressure sensor	1.8004.625
EC	400	AL Open Load Digital Input 1	Alarm open line at input DI 1	2.8006.625
EC	401	AL Open Load Digital Input 2	Alarm open line at input DI 2	2.8006.626
EC	402	AL Open Load Digital Input 3	Alarm open line at input DI 3	2.8006.627
EC	403	AL Open Load Digital Input 4	Alarm open line at input DI 4	2.8006.628
EC	404	AL Open Load Digital Input 5	Alarm open line at input DI 5	2.8006.629
EC	405	AL Open Load Digital Input 6	Alarm open line at input DI 6	2.8006.630
EC	406	AL Open Load Digital Input 7	Alarm open line at input DI 7	2.8006.631
EC	407	AL Open Load Digital Input 8	Alarm open line at input DI 8	2.8006.632
EC	408	AL Open Load Emerg. Stop Input ESI	Alarm open line at emergency stop input ESI	2.8006.633
EC	410	LO U-PDU	1st low limit value violation: U-PDU	2.0141.921
EC	411	LOLO U-PDU	2nd low limit value violation: U-PDU	2.0141.922
EC	412	HI U-PDU	1st limit value violation: U-PDU	2.0141.931
EC	413	HIHI U-PDU	2nd limit value violation: U-PDU	2.0141.932
EC	414	HI Level Water Fuel Prefilter	1st limit value violation: Fuel prefilter water level	2.0156.931

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Message		Message text	Meaning	ZKP no.
EC	415	LO P-Coolant InterCooler	1st low limit value violation: Intercooler coolant pressure	2.0107.921
EC	416	SS P-Coolant InterCooler	Engine shutdown due to low intercooler coolant pressure	2.0107.922
EC	417	SD Level Water Fuel Prefilter	Fuel prefilter water level sensor faulty	1.8004.594
EC	418	SD T-Intake Air B	Intake air B temperature sensor faulty	1.8004.603
EC	419	SD T-Coolant b.Engine	Coolant before engine, temperature sensor faulty	1.8004.604
EC	420	AL L1 Aux 1	Alarm due to 1st Aux 1 limit value	2.0160.921
EC	421	AL L2 Aux1	Alarm due to 2nd Aux 1 limit value	2.0160.922
EC	422	SD T-Charge Air B	Charge-air B temperature sensor faulty	1.8004.605
EC	423	LO P-Coolant Diff	1st low limit value violation: Differential coolant pressure	2.0180.921
EC	424	AL L1 Aux 2	Alarm due to 1st Aux 2 limit value	2.0161.921
EC	425	AL L2 Aux2	Alarm due to 2nd Aux 2 limit value	2.0161.922
EC	426	SD Air Mass A	Air mass A sensor faulty	1.8004.606
EC	427	SD Air Mass B	Air mass B sensor faulty	1.8004.607
EC	427	SD Air Humidity	Air mass measuring sensor faulty	1.8004.613
EC	428	AL L1 T-Aux 1	Alarm due to 1st Aux 1 temperature limit value	2.0130.921
EC	429	HI P-Coolant	1st limit value violation: Coolant pressure	2.0101.931
EC	430	Lo P-Coolant before Engine	1st low limit value violation: Coolant pressure before engine	2.0168.921
EC	431	SS P-Coolant before Engine	Engine shutdown due to low coolant pressure before engine	2.0168.922
EC	432	AL L1 T-Aux 2	Alarm due to 1st Aux 2 temperature limit value	2.0131.921
EC	433	AL L2 T-Aux2	Alarm due to 2nd Aux 2 temperature limit value	2.0131.922
EC	434	Hi T-Coolant before Engine	1st limit value violation: Coolant temperature before engine	2.0173.931
EC	435	SS T-Coolant before Engine	Engine shutdown due to coolant temperature before engine violation	2.0173.932
EC	436	AL L1 P-Aux 2	Alarm due to 1st Aux 2 pressure limit value	2.0111.921
EC	437	AL L2 P-Aux2	Alarm due to 2nd Aux 2 pressure limit value	2.0111.922
EC	438	LO P-Fuel 2 (Common Rail)	1st low limit value violation: Fuel pressure 2 (Common Rail)	2.0116.921
EC	439	HI P-Fuel 2 (Common Rail)	1st limit value violation: Fuel pressure 2 (Common Rail)	2.0116.931
EC	440	AL L1 P-Aux 1	Alarm due to 1st Aux 1 pressure limit value	2.0110.921
EC	441	AL Rail 2 Leakage	Alarm system 2 leak	1.8004.047
EC	442	AL L2 P-Aux1	Alarm due to 2nd Aux 1 pressure limit value	2.0110.931
EC	443	HI P-Charge Mix Diff	1st limit value violation: Differential mix pressure	2.0183.931
EC	444	SD U-PDU	U-PDU sensor faulty	1.8004.578

Message		Message text	Meaning	ZKP no.
EC	445	SD P-Ambient Air	Ambient air pressure sensor faulty	1.8004.580
EC	446	SD P-HD2	High pressure sensor 2 faulty	1.8004.599
EC	447	HIHI P-Charge Mix Diff	2nd limit value violation: Differential mix pressure	2.0183.932
EC	448	HI P-Charge Air	1st limit value violation: Charge-air pressure	2.0103.931
EC	449	SS P-Charge Air	Engine shutdown due to low charge-air pressure	2.0103.932
EC	450	SD Idle/End-Torque Input [%]	Filling signal as a percentage sensor failure	2.8006.592
EC	451	HI T-Charge Mix	1st limit value violation: Mixture temperature	2.0169.931
EC	452	HIHI T-Charge Mix	2nd limit value violation: Mixture temperature	2.0169.932
EC	453	LO T-Charge Mix	1st low limit value violation: Mixture temperature	2.0169.921
EC	454	SS Power Reduction Active	Engine shutdown due to active power limitation	2.7000.011
EC	455	AL L1 Aux1 Plant	Alarm due to 1st Aux 1 limit value (plant)	2.8006.650
EC	456	AL L2 Aux1 Plant	Alarm due to 2nd Aux 1 limit value (plant)	2.8006.651
EC	457	LO T-Intake Air	1st low limit value violation: Intake air temperature	2.0123.921
EC	458	LOLO T-Intake Air	2nd low limit value violation: Intake air temperature	2.0123.922
EC	459	SD P-Coolant b.Engine	Coolant before engine pressure sensor failure	1.8004.627
EC	460	HI T-Exhaust EMU	1st limit value violation: Exhaust gas temperature EMU	2.8006.652
EC	461	LO T-Exhaust EMU	1st low limit value violation: Exhaust gas temperature EMU	2.8006.653
EC	462	HI T-Coolant EMU	1st limit value violation: Coolant temperature EMU	2.8006.654
EC	463	SD AUX 2	Sensor failure Aux 2	1.8004.591
EC	464	SD P-AUX 1	Pressure sensor failure Aux 1	1.8004.589
EC	465	SD P-AUX 2	Pressure sensor failure Aux 2	1.8004.588
EC	466	SD T-AUX 2	Temperature sensor failure Aux 2	1.8004.586
EC	467	AL L2 T-Aux1	Alarm due to 2nd Aux 1 temperature limit value	2.0130.922
EC	468	SD T-AUX 1	Temperature sensor failure Aux 1	1.8004.579
EC	469	SD AUX 1	Sensor failure Aux 1	1.8004.590
EC	470	SD T-ECU	ECU temperature sensor faulty	1.8004.587
EC	471	SD Coil Current	HP fuel control block sensor failure	1.8004.592
EC	472	AL Stop SD	Alarm stop sensor failure	2.8006.593
EC	473	AL Wiring PWM_CM2	Alarm due to faulty wiring at PWM_CM2	1.8004.593
EC	474	AL Wiring FO	Alarm due to faulty wiring at output FO	2.8006.655
EC	475	AL CR Trigger Engine Stop	Alarm Common Rail engine shutdown trigger	1.8010.009
EC	476	AL Crash Rec. Init. Error	Alarm crash recorder initialization error	1.8010.007
EC	477	AL Write Mistake Binary Value	Alarm binary data writing error	2.8006.594
EC	478	AL Comb. Alarm Yel (Plant)	Alarm, combined alarm yellow (plant)	2.8006.001
EC	479	AL Comb. Alarm Red (Plant)	Alarm, combined alarm red (plant)	2.8006.002
EC	480	AL Ext. Engine Protection	Alarm external engine protection	2.0291.921

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Message		Message text	Meaning	ZKP no.
EC	481	2:SD Coil Current 2	2:HP fuel control block 2 sensor faulty	1.8004.601
EC	482	SD T-Exhaust C	Exhaust gas C temperature sensor faulty	1.8004.596
EC	483	SD T-Exhaust D	Exhaust gas D temperature sensor faulty	1.8004.597
EC	484	HI T-Exhaust C	1st limit value violation: Exhaust gas temperature C	2.0133.931
EC	485	SS T-Exhaust C	Engine shutdown due to exhaust gas C temperature violation	2.0133.932
EC	486	HI T-Exhaust D	1st limit value violation: Exhaust gas temperature D	2.0134.931
EC	487	SS T-Exhaust D	Engine shutdown due to exhaust gas D temperature violation	2.0134.932
EC	488	HI ETC3 Overspeed	1st limit value violation: Exhaust turbocharger 3 overspeed	2.3014.931
EC	489	SS ETC3 Overspeed	Engine shutdown due to exhaust turbocharger 3 overspeeding	2.3014.932
EC	490	HI ETC4 Overspeed	1st limit value violation: Exhaust turbocharger 4 overspeed	2.3015.931
EC	491	SS ETC4 Overspeed	Engine shutdown due to exhaust turbocharger 4 overspeeding	2.3015.932
EC	492	AL ETC4 CutIn Failure	Alarm exhaust turbocharger 4 cut-in error	1.8004.202
EC	493	AL ETC3 CutIn Failure	Alarm exhaust turbocharger 3 cut-in error	1.8004.203
EC	494	SD Feedback Throttle A	Throttle flap A sensor faulty	1.8004.608
EC	495	SD Feedback Throttle B	Throttle flap B sensor faulty	1.8004.609
EC	496	SD P-Charge Mix A	Charge mix A pressure sensor faulty	1.8004.628
EC	497	SD P-Charge Mix B	Charge mix B pressure sensor faulty	1.8004.629
EC	498	SD P-Charge Mix Diff	Charge mix differential pressure sensor faulty	1.8004.630
EC	499	SD T-Charge Mix	Charge mix temperature sensor faulty	1.8004.632
EC	500	AL Wiring POM Starter 1	Alarm due to faulty wiring at output POM starter 1	1.4500.900
EC	501	AL Wiring POM Starter 2	Alarm due to faulty wiring at output POM starter 2	1.4500.901
EC	502	AL Open Load POM Alternator	Alarm open line at POM generator	1.4500.902
EC	503	AL Battery Not Charging	Alarm battery not charging	1.4500.903
EC	504	AL CAN POM Node Lost	Alarm CAN POM node failure	1.4500.904
EC	505	AL New POM Found	Alarm new POM found	1.4500.905
EC	506	AL Low Starter Voltage	Alarm starter voltage too low	1.4500.906
EC	507	AL POM Error	Alarm POM faulty	1.4500.907
EC	508	AL Wrong POM-ID	Alarm incorrect POM ID	1.4500.908
EC	509	AL Check POM Fuse	Alarm check POM fuse	1.4500.909
EC	510	AL Override applied	Alarm override actuated	2.7002.010
EC	511	HIHI P-Charge Mix A	2nd limit value violation: Pressure mixture A	2.0181.932
EC	512	HIHI P-Charge Mix B	2nd limit value violation: Pressure mixture B	2.0182.932

Message		Message text	Meaning	ZKP no.
EC	513	SD P-Coolant Diff	Coolant differential pressure sensor faulty	1.8004.610
EC	514	Write Error Flash	Flash writing error	1.8004.611
EC	515	AL Starter Not Engaged	Alarm starter not engaged	2.1090.926
EC	516	Oil Level Calibration Error	Oil level calibration error	1.8004.612
EC	517	SD P-Charge Mix before Throttle	Charge mix before throttle pressure sensor faulty	1.8004.631
EC	518	SD Feedback Throttle Bypass	Throttle flap bypass feedback sensor faulty	1.8004.640
EC	519	Oillevel Calibration Error	Oil level calibration error	1.0158.921
EC	520	SD P-Intake Air after Filter A	Intake air after filter A pressure sensor faulty	1.0186.900
EC	521	SS P-Lube Oil Mid Val	Engine shutdown due to low mean lube oil pressure value	2.0480.289
EC	522	SD P-Intake Air after Filter B	Intake air after filter B pressure sensor faulty	1.0187.900
EC	523	SS T-Coolant Red Mid Val	Engine shutdown due to mean coolant temperature value violation	2.0480.189
EC	524	SS Engine Overspeed Mid Val	Engine shutdown due to mean engine overspeeding value	2.0480.089
EC	525	SD P-Lube Oil (R2)	Lube oil (R2) pressure sensor faulty	1.8004.638
EC	526	SD T-Coolant (R2)	Coolant (R2) temperature sensor faulty	1.8004.639
EC	527	TD EngineSpd. Sensor Deviation	Measured value deviation between first and second engine speed sensor	1.0480.093
EC	528	SD Engine Speed 3rd Sensor	3rd engine speed sensor faulty	1.2500.102
EC	529	SS T-Coolant Red2	Engine shutdown due to coolant temperature violation redundant	2.0480.195
EC	530	SS P-Lube Oil Red2	Engine shutdown due to low lube oil pressure redundant	2.0480.295
EC	531	AL Wiring PWM_CM1	Alarm due to faulty wiring at output PWM_CM1	1.1044.900
EC	532	AL Wiring PWM1	Alarm due to faulty wiring at output PWM1	1.1046.900
EC	533	AL Wiring PWM2	Alarm due to faulty wiring at output PWM2	1.1047.900
EC	534	HIHI Power Difference	2nd limit value violation: Power difference	2.1005.931
EC	535	LOLO Power Difference	2nd low limit value violation: Power difference	2.1005.921
EC	537	SD P-Delta Venturi Side A	Delta Venturi pressure A side	1.8004.641
EC	538	SD P-Delta Venturi Side B	Delta Venturi pressure B side	1.8004.642
EC	539	SD P-EGR (Venturi Static)	Exhaust gas recirculation pressure sensor faulty (Venturi static)	1.8004.643
EC	540	SD T-EGR	Exhaust gas recirculation temperature sensor faulty	1.8004.644
EC	541	AL L1 T-EGR	Alarm due to 1st exhaust gas recirculation temperature limit value	2.0193.921
EC	542	AL L2 T-EGR	Alarm due to 2nd exhaust gas recirculation temperature limit value	2.0193.922
EC	543	AL Multiple FDH Slaves	Alarm more than one Field Data Handling slave	2.0555.005
EC	544	AL Configuration Changed	Alarm configuration changed	2.0555.003

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Message		Message text	Meaning	ZKP no.
EC	545	AL L1 P-Ext.Plant1	Alarm due to 1st ext. plant 1 pressure limit value	2.0264.921
EC	546	AL L1 P-Ext.Plant2	Alarm due to 1st ext. plant 2 pressure limit value	2.0265.921
EC	547	AL L1 T-Ext.Plant1	Alarm due to 1st ext. plant 1 temperature limit value	2.0266.921
EC	548	AL L1 T-Ext.Plant2	Alarm due to 1st ext. plant 2 temperature limit value	2.0267.921
EC	549	AL Power Cut-Off detected	Alarm power disruption detected	2.7001.952
EC	550	SS Engine Overspeed Red2	Engine shutdown due to engine overspeeding redundant	2.0480.095
EC	551	SS Engine Overspeed Camshaft	Engine shutdown due to engine overspeeding camshaft	2.2510.933
EC	552	AL GasControlCheck Fault	Alarm gas control test faulty	2.1090.118
EC	553	AL AuxDevices Fault	Alarm auxiliary devices faulty	2.1090.120
EC	554	AL Ignition Fault	Alarm ignition faulty	2.1090.122
EC	555	AL Call MTU Field Service	Alarm, call MTU Field Service	2.0555.001
EC	556	AL GasValve Fault	Alarm gas valve faulty	2.1090.124
EC	557	AL EngineSpeedCollapse Fault	Alarm speed drop fault	2.1090.126
EC	559	AL mixture throttle A fault	Alarm mixture throttle flap A	1.1450.010
EC	560	AL mixture throttle B fault	Alarm mixture throttle flap B	1.1450.013
EC	561	AL Lim Ext.Plant Bin1	Alarm limit value ext. plant Bin1	2.0260.921
EC	562	AL Lim Ext.Plant Bin2	Alarm limit value ext. plant Bin2	2.0261.921
EC	563	AL Lim Ext.Plant Bin3	Alarm limit value ext. plant Bin3	2.0262.921
EC	564	AL Lim Ext.Plant Bin4	Alarm limit value ext. plant Bin4	2.0263.921
EC	565	AL L1 P-Intake Air after Filter A	Alarm due to 1st intake air pressure after filter A limit value	2.0186.921
EC	566	AL L2 P-Intake Air after Filter A	Alarm due to 2nd intake air pressure after filter A limit value	2.0186.931
EC	567	AL L1 P-Intake Air after Filter B	Alarm due to 1st intake air pressure after filter B limit value	2.0187.921
EC	568	AL L2 P-Intake Air after Filter B	Alarm due to 2nd intake air pressure after filter B limit value	2.0187.931
EC	569	AL SAM Missing Data Fault	Alarm SAM missing data fault	2.1090.128
EC	570	L1 Al CAN Max. Retarded Timing	L1 alarm CAN max. retarded ignition timing	2.1200.931
EC	571	L2 Al CAN Max. Retarded Timing	L2 alarm CAN max. retarded ignition timing	2.1200.932
EC	572	L3 Al CAN Max. Retarded Timing	L3 alarm CAN max. retarded ignition timing	2.1200.933
EC	573	SD P-Diff.Manifold Bef. Com-pressor	Differential constant-pressure manifold before compressor pressure sensor faulty	1.0194.900
EC	574	SD M-Air EGR bef. Cooler	Exhaust gas recirculation air before cooler sensor faulty	1.0166.900
EC	575	SD M-Intake Air	M-intake air sensor faulty	1.0167.900
EC	576	AL ESCM Override	Alarm ESCM Override	1.1075.083

Message		Message text	Meaning	ZKP no.
EC	577	SD T-Lube Oil Pan	Lube oil pan temperature sensor faulty	1.0137.900
EC	578	AL L1 T-Lube Oil Pan	Alarm due to 1st lube oil pan temperature limit value	2.0137.921
EC	579	AL MD CAN Request Idle Speed	Alarm MD forced idle	2.1063.511
EC	580	AL MD CAN Speed Limitation	Alarm MD speed limitation demand	2.1063.513
EC	582	AL Emergency Stop Failed	Alarm emergency stop failure	1.1005.006
EC	583	AL Circuit Breaker Closed	Alarm circuit breaker closed	2.0451.005
EC	584	AL CAN Startclearance failed	Alarm CAN start enable failure	2.1090.927
EC	585	AL Motorstart canceled blocked	Alarm engine start attempt suppressed	2.1090.928
EC	586	LO P-Oil Refill Pump	1st low limit value violation: Oil replenishment pump pressure	2.0159.911
EC	588	SD P-Oil Refill Pump	Oil replenishment pump pressure sensor faulty	1.0159.910
EC	589	SD T-EGR Side B	Exhaust gas recirculation B temperature sensor faulty	1.0196.920
EC	590	SD P-Delta Exhaust A	Exhaust A Delta pressure sensor faulty	1.0188.920
EC	591	SD P-EGR B (Venturi Static)	Exhaust gas recirculation B pressure sensor faulty (Venturi static)	1.0195.920
EC	592	SD P-Delta Exhaust B	Exhaust B Delta pressure sensor faulty	1.0189.920
EC	593	AL T-Lube Oil Pan Low	Alarm oil pan lube oil temperature too low	2.1090.929
EC	594	AL L1 PRV Defect	Alarm due to 1st limit value PRV faulty	1.1301.900
EC	595	AL L2 PRV Defect	Alarm due to 2nd limit value PRV faulty	1.1301.901
EC	596	AL Develop PR Set	Alarm test parameter set	1.8004.645
EC	598	AL L1 PRV Defect	Alarm due to 1st limit value PRV faulty	1.1302.900
EC	599	AL L2 PRV Defect	Alarm due to 2nd limit value PRV faulty	1.1302.901
EC	600	SD T-Exhaust A+B	Exhaust gas A+B temperature sensor faulty	1.8004.646
EC	601	SD ETC1+ETC2	Exhaust turbocharger 1 + exhaust turbocharger 2 sensor faulty	1.3011.227
EC	602	AL CAN Engine Start Lock	Alarm CAN start interlock	2.1090.930
EC	603	SD Air Humidity	Air mass measuring sensor faulty	1.0165.900
EC	604	AL Hut Changespeed max.	Alarm hut change speed max.	2.1210.910
EC	605	AL Hut Dev. to high	Alarm Hut deviation too high	1.1210.911
EC	606	AL Double Nodes Lost CAN 1 + 2	Alarm CAN 1 and 2 double node failure	2.0500.691
EC	607	AL MD CAN Stop	Alarm MD stop CAN	2.1063.515
EC	610	AL Wiring Suction Restritor 1	Alarm due to faulty wiring of HP fuel control block 1	1.1301.902
EC	611	AL Wiring Suction Restritor 2	Alarm due to faulty wiring of HP fuel control block 2	1.1302.902
EC	612	AL Wiring Pressure Control Valve 1	Alarm due to faulty wiring of pressure regulating valve 1	1.1301.903

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Message		Message text	Meaning	ZKP no.
EC	613	AL Wiring Pressure Control Valve 2	Alarm due to faulty wiring of pressure regulating valve 2	1.1302.903
EC	614	AL L1 P-Fuel Prefilter Difference	Alarm due to 1st fuel prefilter differential pressure limit value	2.0119.001
EC	615	AL EIL Protection	Alarm Engine Identification Label protection	2.5000.911
EC	616	AL EIL Alarm	Alarm due to Engine Identification Label	2.5000.912
EC	617	LO Actual Value Hu	1st low limit value violation: Current Hu value	2.1210.006
EC	618	LOLO Actual Value Hu	2nd low limit value violation: Current Hu value	2.1210.007
EC	619	HI Actual Value Hu	1st limit value violation: Current Hu value	2.1210.008
EC	620	HIHI Actual Value Hu	2nd limit value violation: Current Hu value	2.1210.009
EC	621	LO Nox Value	1st low limit value violation: Nox value	2.3050.024
EC	622	LOLO Nox Value	2nd low limit value violation: Nox value	2.3050.025
EC	623	HI Nox Value	1st limit value violation: Nox value	2.3050.026
EC	624	HIHI Nox Value	2nd limit value violation: Nox value	2.3050.027
EC	625	SD P-Fuel before Prefilter	Fuel before prefilter pressure sensor faulty	1.8004.600

10.3 SAM alarm messages AL

Alarm			Alarm text	Meaning
AL	2	006	SS Overspeed (EMU)	(Option) Engine overspeed detected by EMU; automatic engine stop
AL	2	029	LO P-Lube Oil (EMU)	(Option) Redundant oil pressure too low (1st limit value; EMU)
AL	2	030	SS P-Lube Oil (EMU)	(Option) Redundant oil pressure too low (2nd limit value; EMU)
AL	2	129	HI T-Coolant (EMU)	(Option) Redundant coolant temperature too high (1st limit value; EMU)
AL	2	130	SS T-Coolant (EMU)	(Option) Redundant coolant temperature too high (2nd limit value; EMU)
AL	2	181	AL EMU TranOut 2 Open Load	(Option) Open load transistor output 2 (EMU)
AL	2	191	AL EMU TranOut 2 Short Circuit	(Option) Short circuit transistor output 2 at EMU
AL	2	272	HI T-Bearing Mean	(Option) Mean bearing temperature too high (EMU)
AL	2	301	HI T-Exhaust A1	Exhaust Temperature of Cylinder A1 too high (EMU)
AL	2	302	HI T-Exhaust A2	Exhaust Temperature of Cylinder A2 too high (EMU)
AL	2	303	HI T-Exhaust A3	Exhaust Temperature of Cylinder A3 too high (EMU)
AL	2	304	HI T-Exhaust A4	Exhaust Temperature of Cylinder A4 too high (EMU)
AL	2	305	HI T-Exhaust A5	Exhaust Temperature of Cylinder A5 too high (EMU)
AL	2	306	HI T-Exhaust A6	Exhaust Temperature of Cylinder A6 too high (EMU)
AL	2	307	HI T-Exhaust A7	Exhaust Temperature of Cylinder A7 too high (EMU)
AL	2	308	HI T-Exhaust A8	Exhaust Temperature of Cylinder A8 too high (EMU)
AL	2	309	HI T-Exhaust A9	Exhaust Temperature of Cylinder A9 too high (EMU)
AL	2	310	HI T-Exhaust A10	Exhaust Temperature of Cylinder A10 too high (EMU)
AL	2	311	HI T-Exhaust B1	Exhaust Temperature of Cylinder B1 too high (EMU)
AL	2	312	HI T-Exhaust B2	Exhaust Temperature of Cylinder B2 too high (EMU)
AL	2	313	HI T-Exhaust B3	Exhaust Temperature of Cylinder B3 too high (EMU)
AL	2	314	HI T-Exhaust B4	Exhaust Temperature of Cylinder B4 too high (EMU)
AL	2	315	HI T-Exhaust B5	Exhaust Temperature of Cylinder B5 too high (EMU)
AL	2	316	HI T-Exhaust B6	Exhaust Temperature of Cylinder B6 too high (EMU)
AL	2	317	HI T-Exhaust B7	Exhaust Temperature of Cylinder B7 too high (EMU)
AL	2	318	HI T-Exhaust B8	Exhaust Temperature of Cylinder B8 too high (EMU)
AL	2	319	HI T-Exhaust B9	Exhaust Temperature of Cylinder B9 too high (EMU)
AL	2	320	HI T-Exhaust B10	Exhaust Temperature of Cylinder B10 too high (EMU)
AL	2	351	HI T-Bearing 1	(Option) bearing temperature 1 too high (1st limit value; EMU)
AL	2	352	HI T-Bearing 2	(Option) bearing temperature 2 too high (1st limit value; EMU)

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Alarm			Alarm text	Meaning
AL	2	353	HI T-Bearing 3	(Option) bearing temperature 3 too high (1st limit value; EMU)
AL	2	354	HI T-Bearing 4	(Option) bearing temperature 4 too high (1st limit value; EMU)
AL	2	355	HI T-Bearing 5	(Option) bearing temperature 5 too high (1st limit value; EMU)
AL	2	356	HI T-Bearing 6	(Option) bearing temperature 6 too high (1st limit value; EMU)
AL	2	357	HI T-Bearing 7	(Option) bearing temperature 7 too high (1st limit value; EMU)
AL	2	358	HI T-Bearing 8	(Option) bearing temperature 8 too high (1st limit value; EMU)
AL	2	359	HI T-Bearing 9	(Option) bearing temperature 9 too high (1st limit value; EMU)
AL	2	360	HI T-Bearing 10	(Option) bearing temperature 10 too high (1st limit value; EMU)
AL	2	361	HI T-Bearing 11	(Option) bearing temperature 11 too high (1st limit value; EMU)
AL	2	371	SS T-Bearing 1	(Option) bearing temperature 1 too high (2nd limit value; EMU)
AL	2	372	SS T-Bearing 2	(Option) bearing temperature 2 too high (2nd limit value; EMU)
AL	2	373	SS T-Bearing 3	(Option) bearing temperature 3 too high (2nd limit value; EMU)
AL	2	374	SS T-Bearing 4	(Option) bearing temperature 4 too high (2nd limit value; EMU)
AL	2	375	SS T-Bearing 5	(Option) bearing temperature 5 too high (2nd limit value; EMU)
AL	2	376	SS T-Bearing 6	(Option) bearing temperature 6 too high (2nd limit value; EMU)
AL	2	377	SS T-Bearing 7	(Option) bearing temperature 7 too high (2nd limit value; EMU)
AL	2	378	SS T-Bearing 8	(Option) bearing temperature 8 too high (2nd limit value; EMU)
AL	2	379	SS T-Bearing 9	(Option) bearing temperature 9 too high (2nd limit value; EMU)
AL	2	380	SS T-Bearing 10	(Option) bearing temperature 10 too high (2nd limit value; EMU)
AL	2	381	SS T-Bearing 11	(Option) bearing temperature 11 too high (2nd limit value; EMU)
AL	2	401	LO T-Exhaust A1	Exhaust Temperature of Cylinder A1 too low (EMU)
AL	2	402	LO T-Exhaust A2	Exhaust Temperature of Cylinder A2 too low (EMU)
AL	2	403	LO T-Exhaust A3	Exhaust Temperature of Cylinder A3 too low (EMU)

Alarm			Alarm text	Meaning
AL	2	404	LO T-Exhaust A4	Exhaust Temperature of Cylinder A4 too low (EMU)
AL	2	405	LO T-Exhaust A5	Exhaust Temperature of Cylinder A5 too low (EMU)
AL	2	406	LO T-Exhaust A6	Exhaust Temperature of Cylinder A6 too low (EMU)
AL	2	407	LO T-Exhaust A7	Exhaust Temperature of Cylinder A7 too low (EMU)
AL	2	408	LO T-Exhaust A8	Exhaust Temperature of Cylinder A8 too low (EMU)
AL	2	409	LO T-Exhaust A9	Exhaust Temperature of Cylinder A9 too low (EMU)
AL	2	410	LO T-Exhaust A10	Exhaust Temperature of Cylinder A10 too low (EMU)
AL	2	411	LO T-Exhaust B1	Exhaust Temperature of Cylinder B1 too low (EMU)
AL	2	412	LO T-Exhaust B2	Exhaust Temperature of Cylinder B2 too low (EMU)
AL	2	413	LO T-Exhaust B3	Exhaust Temperature of Cylinder B3 too low (EMU)
AL	2	414	LO T-Exhaust B4	Exhaust Temperature of Cylinder B4 too low (EMU)
AL	2	415	LO T-Exhaust B5	Exhaust Temperature of Cylinder B5 too low (EMU)
AL	2	416	LO T-Exhaust B6	Exhaust Temperature of Cylinder B6 too low (EMU)
AL	2	417	LO T-Exhaust B7	Exhaust Temperature of Cylinder B7 too low (EMU)
AL	2	418	LO T-Exhaust B8	Exhaust Temperature of Cylinder B8 too low (EMU)
AL	2	419	LO T-Exhaust B9	Exhaust Temperature of Cylinder B9 too low (EMU)
AL	2	420	LO T-Exhaust B10	Exhaust Temperature of Cylinder B10 too low (EMU)
AL	2	503	LO P-Raw Water	(Not used) Raw water pressure too low (EMU)
AL	2	506	LO P-Oil Refill Pump	(Not used) Oil refill unit pressure too low (EMU)
AL	2	512	AL Exhaust Monitoring Fail	Warning: Exhaust Temperature Monitoring fail (EMU)
AL	2	513	AL Press Monitoring Fail (EMU)	Warning: pressure monitoring fail (EMU)
AL	2	516	SS Security Channel Def EMU	Warning: Faulty security channel (EMU)
AL	2	518	SD T-Coolant	Sensor faulty (Coolant Temperature; EMU)
AL	2	519	SD P-Lube Oil	Sensor faulty (oil pressure; EMU)
AL	2	612	AL EMU 11V	Warning: Sensor Voltage for Temperature Measuring out of range (EMU)
AL	2	613	AL EMU -7	Warning: Sensor Voltage for Temperature Measuring out of range (EMU)
AL	2	620	AL T-Ex. Out of Range Limit	Single Exhaust Temperature of Cylinder A1-B10 too low (2nd limit value; EMU)
AL	2	771	HI T-Splash Oil B1	(Option) splash oil temperature B1 too high (1st limit value; EMU)
AL	2	772	HI T-Splash Oil B2	(Option) splash oil temperature B2 too high (1st limit value; EMU)
AL	2	773	HI T-Splash Oil B3	(Option) splash oil temperature B3 too high (1st limit value; EMU)
AL	2	774	HI T-Splash Oil B4	(Option) splash oil temperature B4 too high (1st limit value; EMU)

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Alarm			Alarm text	Meaning
AL	2	775	HI T-Splash Oil B5	(Option) splash oil temperature B5 too high (1st limit value; EMU)
AL	2	776	HI T-Splash Oil B6	(Option) splash oil temperature B6 too high (1st limit value; EMU)
AL	2	777	HI T-Splash Oil B7	(Option) splash oil temperature B7 too high (1st limit value; EMU)
AL	2	778	HI T-Splash Oil B8	(Option) splash oil temperature B8 too high (1st limit value; EMU)
AL	2	779	HI T-Splash Oil B9	(Option) splash oil temperature B9 too high (1st limit value; EMU)
AL	2	780	HI T-Splash Oil B10	(Option) splash oil temperature B10 too high (1st limit value; EMU)
AL	2	781	SS T-Splash Oil B1	(Option) splash oil temperature B1 too high (2nd limit value; EMU)
AL	2	782	SS T-Splash Oil B2	(Option) splash oil temperature B2 too high (2nd limit value; EMU)
AL	2	783	SS T-Splash Oil B3	(Option) splash oil temperature B3 too high (2nd limit value; EMU)
AL	2	784	SS T-Splash Oil B4	(Option) splash oil temperature B4 too high (2nd limit value; EMU)
AL	2	785	SS T-Splash Oil B5	(Option) splash oil temperature B5 too high (2nd limit value; EMU)
AL	2	786	SS T-Splash Oil B6	(Option) splash oil temperature B6 too high (2nd limit value; EMU)
AL	2	787	SS T-Splash Oil B7	(Option) splash oil temperature B7 too high (2nd limit value; EMU)
AL	2	788	SS T-Splash Oil B8	(Option) splash oil temperature B8 too high (2nd limit value; EMU)
AL	2	789	SS T-Splash Oil B9	(Option) splash oil temperature B9 too high (2nd limit value; EMU)
AL	2	790	SS T-Splash Oil B10	(Option) splash oil temperature B10 too high (2nd limit value; EMU)
AL	2	823	MG Splash Oil Cal Active	(Option) Message: splash oil temperature calibration active (EMU)
AL	2	824	AL Splash Oil Cal not Poss	(Option) splash oil temperature calibration fails (EMU)
AL	2	831	AL Splash Oil B1 Cal not Poss	(Option) splash oil temperature calibration B1 fails (EMU)
AL	2	832	AL Splash Oil B2 Cal not Poss	(Option) splash oil temperature calibration B2 fails (EMU)
AL	2	833	AL Splash Oil B3 Cal not Poss	(Option) splash oil temperature calibration B3 fails (EMU)
AL	2	834	AL Splash Oil B4 Cal not Poss	(Option) splash oil temperature calibration B4 fails (EMU)
AL	2	835	AL Splash Oil B5 Cal not Poss	(Option) splash oil temperature calibration B5 fails (EMU)
AL	2	836	AL Splash Oil B6 Cal not Poss	(Option) splash oil temperature calibration B6 fails (EMU)
AL	2	837	AL Splash Oil B7 Cal not Poss	(Option) splash oil temperature calibration B7 fails (EMU)

Alarm			Alarm text	Meaning
AL	2	838	AL Splash Oil B8 Cal not Poss	(Option) splash oil temperature calibration B8 fails (EMU)
AL	2	839	AL Splash Oil B9 Cal not Poss	(Option) splash oil temperature calibration B9 fails (EMU)
AL	2	840	AL Splash Oil B10 Cal not Poss	(Option) splash oil temperature calibration B10 fails (EMU)
AL	5	538	Failure Preheat Unit	Warning: Preheat Unit has an internal malfunction
AL	5	615	HI Fuel Pre Filter Rstr	Fuel prefilter differential pressure to high (1st limit value)
AL	5	625	HIHI Fuel Pre Filter Rstr	Fuel prefilter differential pressure to high (2nd limit value)
AL	5	630	SD AIN P-Fuel Filter Diff	Sensor faulty (Fuel prefilter differential pressure)
AL	6	012	HI T-Exhaust A	T-Exhaust temperature on A-side too high (1st limit value)
AL	6	013	HIHI T-Exhaust A	T-Exhaust temperature on A-side too high (2nd limit value)
AL	6	019	SD T-Exhaust A	Sensor faulty (T-Exhaust temperature on A-side)
AL	6	022	HI T-Exhaust B	T-Exhaust temperature on B-side too high (1st limit value)
AL	6	023	HIHI T-Exhaust B	T-Exhaust temperature on B-side too high (2nd limit value)
AL	6	029	SD T-Exhaust B	Sensor faulty (T-Exhaust temperature on B-side)
AL	6	031	HI Pressure 1	Auxiliary Pressure 1 to high (1st limit value)
AL	6	032	LO Pressure 1	Auxiliary Pressure 1 to low (1st limit value)
AL	6	033	HIHI Pressure 1	Auxiliary Pressure 1 to high (2nd limit value)
AL	6	034	LOLO Pressure 1	Auxiliary Pressure 1 to low (2nd limit value)
AL	6	045	SD AIN Pressure 1	Sensor faulty (Auxiliary Pressure 1)
AL	6	051	HI Pressure 2	Auxiliary Pressure 2 to high (1st limit value)
AL	6	052	LO Pressure 2	Auxiliary Pressure 2 to low (1st limit value)
AL	6	053	HIHI Pressure 2	Auxiliary Pressure 2 to high (2nd limit value)
AL	6	054	LOLO Pressure 2	Auxiliary Pressure 2 to low (2nd limit value)
AL	6	065	SD AIN Pressure 2	Sensor faulty (Auxiliary Pressure 2)
AL	6	071	HI Air Filter Restr. (MG)	Message: Air filter restriction
AL	6	072	HI Air Filter Restr. (Y)	Warning: Air filter restriction
AL	6	073	HIHI Air Filter Restr. (R)	Alarm: Air filter restriction
AL	6	081	HI Fuel Filter Restr. (MG)	Message: Fuel filter restriction
AL	6	082	HI Fuel Filter Restr. (Y)	Warning: Fuel filter restriction
AL	6	083	HIHI Fuel Filter Restr. (R)	Alarm: Fuel filter restriction
AL	6	091	HI Aux Engine Protection (MG)	Message: Aux Engine Protection activated
AL	6	092	HI Aux Engine Protection (Y)	Warning: Aux Engine Protection activated
AL	6	093	HIHI Aux Engine Protect. (R)	Alarm: Aux Engine Protection activated
AL	6	101	AL Aux Protection Switch (MG)	Message: Aux Engine Protection Switch activated
AL	6	102	AL Aux Protection Switch (Y)	Warning: Aux Engine Protection Switch activated

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Alarm			Alarm text	Meaning
AL	6	103	AL Aux Protection Switch (R)	Alarm: Aux Engine Protection Switch activated
AL	6	170	SD Air Filter Restr.	Sensor faulty (Air filter restriction)
AL	6	180	SD Fuel Filter Restr.	Sensor faulty (Fuel filter restriction)
AL	6	190	SD Aux Engine Protection	Sensor faulty (Aux Engine Protection)
AL	6	531	WB Fan Control Fan 1	Wire brake detection on PWM_Out 1: Control signal fan 1
AL	6	541	WB Fan Control Fan 2	Wire brake detection on PWM_Out 2: Control signal fan 2
AL	9	970	MD CAN Speed Demand	Warning: Speed Demand Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	971	MD CAN Torque Limit 1	Warning: Torque Limit 1 Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	972	MD CAN Torque Limit 2	Warning: Torque Limit 2 Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	973	MD CAN Override	Warning: Override Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	974	MD CAN Start interlock	Warning: Start interlock Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	975	MD CAN Engine Start	Warning: Engine Start Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	976	MD CAN Engine Stop	Warning: Engine Stop Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	977	MD CAN Alarm Reset	Warning: Alarm Reset Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	978	MD CAN Lamptest	Warning: Lamptest Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	979	MD CAN Speed Setting Limit act	Warning: Speed Setting Limit active Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	980	MD CAN Reset Trip Fuel counter	Warning: Reset Trip Fuel counter Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	981	MD CAN Ext Power curve limit	Warning: Ext Power curve limit Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	982	MD CAN Park brake interlock	Warning: Park break interlock Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	983	MD CAN Neutral	Warning: Neutral Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	984	MD CAN Alternate Minimum	Warning: Alternate Minimum Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	985	MD CAN Ext Preheating Disable	Warning: Ext Preheating Disable Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	987	MD Force Max Fan Speed	Warning: Force Max Fan Speed Signal on the external CAN-bus is missing (J1939/CANopen)

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Alarm			Alarm text	Meaning
AL	9	988	MD Disable Cylinder Cut Out	Warning: Disable Cylinder Cut Out Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	989	MD J1939 Override Ctrl. Mode	Warning: J1939 Override Ctrl. Mode Signal on the external CAN-bus is missing (J1939/CANopen)
AL	9	995	AL CCB J1939 Error	Warning: Internal Failure Mode on the external CAN-bus Converter detected (J1939)
AL	9	996	AL CCB CANopen Error	Warning: Internal Failure Mode on the external CAN-bus Converter detected (CANopen)
AL	9	997	AL CCB Error	Warning: Internal Failure Mode on the external CAN-bus Converter detected (Common Failure)

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10.4 Alarms Default Lost (DL) and Redundancy Lost (RL)

Alarm		RL fault	Meaning
RL	01	RL Node Lost ECU	ECU has detected that the connection to a node at CAN bus 2 failed.
RL	03	RL Node Lost EMU	EMU has detected that the connection to a node at CAN bus 2 failed.
RL	04	RL Node Lost DIS10	DIS10 has detected that the connection to a node at CAN bus 2 failed.
RL	05	RL Node Lost SAM	SAM has detected that the connection to a node at CAN bus 2 failed.

Alarm		DL fault	Meaning
DL	01	DL Node Lost ECU	ECU has detected that the connection to a node at CAN bus 1 failed.
DL	03	DL Node Lost EMU	EMU has detected that the connection to a node at CAN bus 1 failed.
DL	04	DL Node Lost DIS10	DIS10 has detected that the connection to a node at CAN bus 1 failed.
DL	05	DL Node Lost SAM	SAM has detected that the connection to a node at CAN bus 1 failed.

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10.5 System errors SE

Alarm		Alarm text	Meaning
SE	0105	Sensor Temperature Defect on SAM	Sensor faulty (internal temperature sensor on SAM)
SE	0205	High Temperature on SAM	Warning: SAM onboard temperature too high
SE	0305	Sensor Voltage Defect on SAM	Sensor faulty (supply voltage sensor on SAM)
SE	0405	High/Low Voltage on SAM	Warning: SAM supply voltage too high/to low
SE	0505	CAN Bus-1 Error/Bus Defect on SAM	SAM CAN1 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	0605	CAN Bus-1 Overrun on SAM	SAM CAN1 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	0705	CAN Bus-2 Error/Bus Defect on SAM	SAM CAN2 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	0805	CAN Bus-2 Overrun on SAM	SAM CAN2 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	0905	Temperature Compensation Error on SAM	Temperature Compensation on SAM faulty.
SE	1005	I/O-Module Slot 2 Defect on SAM	I/O-Module Slot 2 on SAM is faulty.
SE	1105	I/O-Module Slot 3 Defect on SAM	I/O-Module Slot 3 on SAM is faulty. Optional CCB-Card is missing or faulty.
SE	1405	CAN Bus-3 Error/Bus Defect on SAM	SAM CAN3 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	1505	CAN Bus-3 Overrun on SAM	SAM CAN3 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	2305	I/O-Module Slot 1 Defect on SAM	I/O-Module Slot 1 on SAM is faulty.
SE	2805	Download Server Collision on SAM	Download Server Collision detected by SAM
SE	2905	Not Projected Node on SAM	Warning:node number of SAM is no projected.
SE	10105	SAM Flash Card missing	Warning: Flash card in the SAM is missing.
SE	0103	Sensor temperature fault	Sensor faulty (internal temperature sensor on EMU)
SE	0203	High Temperature	Warning: EMU onboard temperature too high
SE	0303	Sensor Voltage Defect	Sensor faulty (supply voltage sensor on EMU)
SE	0403	High/Low Voltage	Warning: EMU supply voltage too high/too low
SE	0503	CAN Bus-1 Error/Bus Defect	EMU CAN1 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	0603	CAN Bus-1 Overrun	EMU CAN1 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	0703	CAN Bus-2 Error/Bus Defect	EMU CAN2 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	0803	CAN Bus-2 Overrun	EMU CAN2 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	0903	Temperature compensation error	Temperature Compensation on EMU faulty.
SE	1003	I/O-Module Slot 2 Defect	I/O-Module Slot 2 on EMU is faulty.
SE	1103	I/O-Module Slot 3 Defect	I/O-Module Slot 3 on EMU is faulty.

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Alarm		Alarm text	Meaning
SE	1203	I/O-Module Slot 4 Defect	I/O-Module Slot 4 on EMU is faulty.
SE	1403	CAN Bus-3 Error/Bus Defect	EMU CAN3 faulty: Either there is a short circuit at the bus or intense magnetic field are interfering the bus.
SE	1503	CAN Bus-3 Overrun	EMU CAN3 faulty: Interferences on the bus or a faulty node has cause a bus overrun.
SE	2303	I/O-Module Slot 1 Defect	I/O-Module Slot 1 on EMU is faulty.
SE	2403	I/O-Module Slot 5 Defect	I/O-Module Slot 5 on EMU is faulty.
SE	2503	I/O-Module Slot 6 Defect	I/O-Module Slot 6 on EMU is faulty.
SE	2603	I/O-Module Slot 7 Defect	I/O-Module Slot 7 on EMU is faulty.
SE	2703	I/O-Module Slot 8 Defect	I/O-Module Slot 8 on EMU is faulty.
SE	2803	Download Server Collision	Warning: Download Server Collision detected by EMU
SE	2903	Not Projected Node	Warning:node number of EMU is no projected.

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10.6 Sensor defect messages

Alarm			Alarm text	Meaning
SD	2	201	T-Exhaust A1	Sensor faulty (Exhaust Temperature Cylinder A1)
SD	2	202	T-Exhaust A2	Sensor faulty (Exhaust Temperature Cylinder A2)
SD	2	203	T-Exhaust A3	Sensor faulty (Exhaust Temperature Cylinder A3)
SD	2	204	T-Exhaust A4	Sensor faulty (Exhaust Temperature Cylinder A4)
SD	2	205	T-Exhaust A5	Sensor faulty (Exhaust Temperature Cylinder A5)
SD	2	206	T-Exhaust A6	Sensor faulty (Exhaust Temperature Cylinder A6)
SD	2	207	T-Exhaust A7	Sensor faulty (Exhaust Temperature Cylinder A7)
SD	2	208	T-Exhaust A8	Sensor faulty (Exhaust Temperature Cylinder A8)
SD	2	209	T-Exhaust A9	Sensor faulty (Exhaust Temperature Cylinder A9)
SD	2	210	T-Exhaust A10	Sensor faulty (Exhaust Temperature Cylinder A10)
SD	2	211	T-Exhaust B1	Sensor faulty (Exhaust Temperature Cylinder B1)
SD	2	212	T-Exhaust B2	Sensor faulty (Exhaust Temperature Cylinder B2)
SD	2	213	T-Exhaust B3	Sensor faulty (Exhaust Temperature Cylinder B3)
SD	2	214	T-Exhaust B4	Sensor faulty (Exhaust Temperature Cylinder B4)
SD	2	215	T-Exhaust B5	Sensor faulty (Exhaust Temperature Cylinder B5)
SD	2	216	T-Exhaust B6	Sensor faulty (Exhaust Temperature Cylinder B6)
SD	2	217	T-Exhaust B7	Sensor faulty (Exhaust Temperature Cylinder B7)
SD	2	218	T-Exhaust B8	Sensor faulty (Exhaust Temperature Cylinder B8)
SD	2	219	T-Exhaust B9	Sensor faulty (Exhaust Temperature Cylinder B9)
SD	2	220	T-Exhaust B10	Sensor faulty (Exhaust Temperature Cylinder B10)
SD	2	251	T-Bearing 1	Sensor faulty (Bearing Temperature Bearing 1)
SD	2	252	T-Bearing 2	Sensor faulty (Bearing Temperature Bearing 2)
SD	2	253	T-Bearing 3	Sensor faulty (Bearing Temperature Bearing 3)
SD	2	254	T-Bearing 4	Sensor faulty (Bearing Temperature Bearing 4)
SD	2	255	T-Bearing 5	Sensor faulty (Bearing Temperature Bearing 5)
SD	2	256	T-Bearing 6	Sensor faulty (Bearing Temperature Bearing 6)
SD	2	257	T-Bearing 7	Sensor faulty (Bearing Temperature Bearing 7)
SD	2	258	T-Bearing 8	Sensor faulty (Bearing Temperature Bearing 8)
SD	2	259	T-Bearing 9	Sensor faulty (Bearing Temperature Bearing 9)
SD	2	260	T-Bearing 10	Sensor faulty (Bearing Temperature Bearing 10)
SD	2	261	T-Bearing 11	Sensor faulty (Bearing Temperature Bearing 11)
SD	2	721	T-Splash Oil B1	Sensor faulty (Splash Oil Temperature B 1)
SD	2	722	T-Splash Oil B2	Sensor faulty (Splash Oil Temperature B 2)
SD	2	723	T-Splash Oil B3	Sensor faulty (Splash Oil Temperature B 3)
SD	2	724	T-Splash Oil B4	Sensor faulty (Splash Oil Temperature B 4)
SD	2	725	T-Splash Oil B5	Sensor faulty (Splash Oil Temperature B 5)
SD	2	726	T-Splash Oil B6	Sensor faulty (Splash Oil Temperature B 6)

Alarm			Alarm text	Meaning
SD	2	727	T-Splash Oil B7	Sensor faulty (Splash Oil Temperature B 7)
SD	2	728	T-Splash Oil B8	Sensor faulty (Splash Oil Temperature B 8)
SD	2	729	T-Splash Oil B9	Sensor faulty (Splash Oil Temperature B 9)
SD	2	730	T-Splash Oil B10	Sensor faulty (Splash Oil Temperature B 10)

10.7 Communication Protocols

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10.7.1.1 TRANSMIT

TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
1	0	1	194	PV500050 Binary Signal 1	PV500051 Binary Status 1
2	0	2	294	PV001140 T-Lube Oil	PV001126 T-Coolant
3	0	3	394	PV001002 Engine Speed	PV001057 Charger Speed ETC1
4	0	4	494	PV001115 ECU Operating Hours	SW identification
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
5	1	1	195	PV001026 P-Lube Oil	PV001049 P-Charge Air
6	1	2	295	PV001131 T-Charge Air	PV001152 T-Fuel
7	1	3	395	PV001046 P-Fuel	PV001205 Actual Droop
8	1	4	495	PV001137 T-Coolant Intercooler	PV001151 T-Intake Air
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
9	2	1	196	PV001021 Status Start Sequence	PV001075 Actual Failure Codes
10	2	2	296	PV001216 Act. Torque in Relation to DBR	PV001409 Requested Torque
11	2	3	396	PV001223 PWM Ratio Output Fan Control	PV001314 Optimum Load Signal (OLS)
12	2	4	496	dummy	PV001104 ECU Power Supply Voltage
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
13	3	1	197	PV001031 P-Crankcase	PV001036 P-Coolant after Pump
14	3	2	297	PV001041 P-Coolant Intercooler	PV001004 Injection Quantity
15	3	3	397	PV001119 Actual Fuel Consumption	PV001120 Trip Fuel Consumption
16	3	4	497	PV001121 Total Fuel Consumption	PV001198 Mean Trip Fuel Consumption
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
17	4	1	198	PV001255 Trip Operating Hours	PV001316 Common Trip By Empty Drive
18	4	2	298	PV001016 Selected Speed Demand	PV001017 Effective Engine Speed Demand
19	4	3	398	PV500010 Diagnostic Message 1	PV500011 Diagnostic Status 1
20	4	4	498	PV500020 Diagnostic Message 2	PV500021 Diagnostic Status 2
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
21	5	1	199	PV002201 T-Exhaust A1	PV002202 T-Exhaust A2
22	5	2	299	PV002203 T-Exhaust A3	PV002204 T-Exhaust A4
23	5	3	399	PV002205 T-Exhaust A5	PV002206 T-Exhaust A6
24	5	4	499	PV002207 T-Exhaust A7	PV002208 T-Exhaust A8
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
25	6	1	19A	PV002209 T-Exhaust A9	PV002210 T-Exhaust A10
26	6	2	29A	PV002211 T-Exhaust B1	PV002212 T-Exhaust B2
27	6	3	39A	PV002213 T-Exhaust B3	PV002214 T-Exhaust B4
28	6	4	49A	PV002215 T-Exhaust B5	PV002216 T-Exhaust B6
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
29	7	1	19B	PV002217 T-Exhaust B7	PV002218 T-Exhaust B8
30	7	2	29B	PV002219 T-Exhaust B9	PV002220 T-Exhaust B10
31	7	3	39B	PV009490 T-Exh. Failure 1	PV009491 T-Exh. Failure 2
32	7	4	49B	PV009492 T-Exh. Failure 3	PV009493 T-Exh. Failure 4
TPDO No.	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
33	8	1	19C	PV500030 Diagnostic Message 3	PV500031 Diagnostic Status 3
34	8	2	29C	PV500040 Diagnostic Message 4	PV500041 Diagnostic Status 4

10.7.1.2 RECEIVE

Node-ID Offset	Node-ID Offset	Transmit-PDO	COB-ID	PV-Name	PV-Name
1	0	1	214	PV500110 Binary Demand Signal 1	PV500111 Binary Demand Status 1
2	0	2	314	PV001801 CANOpen Speed Demand Analog	dummy

			Bit-No	Bit-No	Bit-No	PV-Name	System-Index	ECU PV-Index	Comment
Binary Status 1	PV500051	Byte 8	0	0	24	Speed Window 1	001	076	Status = "0" when valid
			1	1	25	Speed Window 2	001	077	
			2	2	26	Cylinder Cutout	001	074	
			3	3	27	Engine Stop Follow Up Active	005	052	
			4	4	28	Ready for Start	005	212	
			5	5	29	Prelube System On	005	271	
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	Torque Limitation Active	001	008	
			1	9	17	Power Reduction Active	001	009	
			2	10	18	Request Cold Engine Operation	001	317	
			3	11	19	Preheating HT ON	005	535	
			4	12	20	Preheating NT ON	005	536	
			5	13	21				
			6	14	22	Preheat Unit On	005	514	
			7	15	23				
		Byte 6	0	16	8				
			1	17	9	Preheat Temp. Not Reached	005	537	
			2	18	10	Automatic Shutdown	001	213	
			3	19	11	Feedback Override Activ	001	066	
			4	20	12				
			5	21	13				
			6	22	14				
			7	23	15				
		Byte 5	0	24	0	External Stop Activated	001	001	
			1	25	1	Speed Demand Fail Mode	001	013	
			2	26	2				
			3	27	3				
			4	28	4				
			5	29	5	Engine Running	001	068	
			6	30	6				
			7	31	7				
Binary Signal 1	PV500050	Byte 4	0	32	24	Speed Window 1	001	076	Measuring values
			1	33	25	Speed Window 2	001	077	
			2	34	26	Cylinder Cutout	001	074	
			3	35	27	Engine Stop Follow Up Active	005	52	
			4	36	28	Ready for Start	005	212	
			5	37	29	Prelube System On	005	271	
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	Torque Limitation Active	001	008	
			1	41	17	Power Reduction Active	001	009	
			2	42	18	Request Cold Engine Operation	001	317	
			3	43	19	Preheating HT ON	005	535	
			4	44	20	Preheating NT ON	005	536	
			5	45	21				
			6	46	22	Preheat Unit On	005	514	
			7	47	23				
		Byte 2	0	48	8				
			1	49	9	Preheat Temp. Not Reached	005	537	
			2	50	10	Automatic Shutdown	001	213	
			3	51	11	Feedback Override Activ	001	066	
			4	52	12				
			5	53	13				
			6	54	14				
			7	55	15				
		Byte 1	0	56	0	External Stop Activated	001	001	
			1	57	1	Speed Demand Fail Mode	001	013	
			2	58	2				
			3	59	3				
			4	60	4				
			5	61	5	Engine Running	001	068	
			6	62	6				

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Coolant	PV001126	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 150 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 90°C = 9000 digit = 0x2328h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			23		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			28		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Lube Oil	PV001140	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 150 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: -20°C = -2000 digit = FFFFF830h	FF		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			FF		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			F8		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			30		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDU Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
Charger Speed ETC1	PV001057	Byte 8	0	0	24		Unit: rpm Resolution: 0.1 rpm Range: 0 rpm to + 80 000 rpm Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 600 rpm = 6000 digit = 0x1770h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			17		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			70		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Engine Speed	PV001002	Byte 4	0	32	24		Unit: rpm Resolution: 0.1 rpm Range: 0 rpm to + 3 000 rpm Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 600 rpm = 6000 digit = 0x1770h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			17		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			70		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
SW identification		**Byte 8**	0	0	24		**Byte order must be as follows for value calculation: Byte: 8 7 6 5 whereby: Byte 5 is the plant, Byte 6, 7 and 8 is the software Example: Plant 12 dec = 0C h software 40012 dez = 009C4C i.e. 009C4C0C**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**9C**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**4C**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**0C**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
ECU Operating Hours	**PV001115**	**Byte 4**	0	32	24		**Unit: h Resolution: 1 h Range: 0 h to + 200 000 h Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 10000h = 10000 digit = 0x2710**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**27**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
P-Charge Air	**PV001049**	**Byte 8**	0	0	24		**Unit: mbar** **Resolution: 0.01 mbar (signed)** **Range: 0 bar to + 4.5 bar** **Byte order must be as follows for value calculation:** **Byte: 8 7 6 5** **Example: 1.6 bar = 160000 digit = 0x21700**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**02**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**17**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**00**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
P-Lube Oil	**PV001026**	**Byte 4**	0	32	24		**Unit: mbar** **Resolution: 0.01 mbar (signed)** **Range: 0 bar to + 10 bar** **Byte order must be as follows for value calculation:** **Byte: 4 3 2 1** **Example: 4.0 bar = 400000 digit = 0x61A80**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**06**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**1A**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**80**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Fuel	PV001152	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to +150 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: - 5°C = - 500 digit = 0xFFFFFE0C	FF		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			FF		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			FE		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			0C		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Charge Air	PV001131	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to +150 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 60°C = 6000 digit = 0x1770	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			17		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			70		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Actual Droop	PV001205	Byte 8	0	0	24		Unit: % Resolution: 0.001 % Range: 0 % to + 15 % Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 2.5 % = 2500 digit = 0x09C4	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			09		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			C4		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
P-Fuel	PV001046	Byte 4	0	32	24		Unit: bar Resolution: 0.001 mbar Range: 0 bar to + 15 bar Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 2.5 bar = 2500 digit = 0x09C4	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			03		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			D0		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			90		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Intake Air	PV001151	Byte 8	0	0	24		Resolution: 0.01 °C Range: - 40 °C to + 150 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: - 5°C = - 500 digit = 0xFFFFFE0C	FF		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			FF		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			FE		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			0C		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Coolant Intercooler	PV001137	Byte 4	0	32	24		Resolution: 0.01 °C Range: - 40 °C to + 150 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 60°C = 6000 digit = 0x1770	0		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			0		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			17		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			70		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Actual Failure Codes	**PV001075**	**Byte 8**	0	0	24		**Unit: digits** **Range: 0 to 1 000** **Byte order must be as follows for value calculation:** **Byte: 8 7 6 5** **Example: 60 digit = 0x3C**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**00**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**3C**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Status Start Sequence	**PV001021**	**Byte 4**	0	32	24		**Unit: digits** **Range: 0 to 2 147 483 647** **Byte order must be as follows for value calculation:** **Byte: 4 3 2 1** **Example: 60 digit = 0x3C**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**3C**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Requested Torque*	**PV001409**	**Byte 8**	0	0	24		**Unit: Nm** **Resolution: 0.1 Nm** **Range: 0 Nm to + 10 000 Nm** **Byte order must be as follows for value calculation:** **Byte: 8 7 6 5** **Example: 2050 Nm = 20500 digit = 0x5014**	**0**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**0**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**50**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**14**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Actual Torque in Relation to DBR	**PV001216**	**Byte 4**	0	32	24		**Unit: %** **Resolution: 0.001 %** **Range: 0 % to + 100 %** **Byte order must be as follows for value calculation:** **Byte: 4 3 2 1** **Example: 75 % = 75000 digit = 0x3D090**	**0**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**3**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**D0**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**90**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Optimum Load Signal	**PV001314**	**Byte 8**	0	0	24		**Unit: % Resolution: 0.001 % Range: 0 % to + 100 % Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 75 % = 75000 digit = 0x124F8**	**0**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**01**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**24**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**F8**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
PWM Ratio Output Fan Control	**PV001223**	**Byte 4**	0	32	24		**Unit: % Resolution: 0.001 % Range: 0 % to + 100 % Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 75% = 75000 digit = 0x124F8**	**0**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**0**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**D0**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**90**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
ECU Power Supply Voltage	PV001104	Byte 8	0	0	24		Unit: V Resolution: 0.001V Range: 0 V to 50 V Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 20.5 V = 20500 digit = 0x5014	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			50		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			14		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
dummy		Byte 4	0	32	24			00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			00		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
P-Coolant after Pump	**PV001036**	**Byte 8**	0	0	24		**Unit: bar Resolution: 0.01 mbar Range: 0 bar to + 15 bar Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 2.5 bar = 250000 digit = 0x3D090**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**03**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**D0**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**90**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
P-Crankcase	**PV001031**	**Byte 4**	0	32	24		**Unit: mbar Resolution: 0.01 mbar Range: - 500 mbar to + 500 mbar Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: -50mbar = -5000 digit = FFFFEC78**	**FF**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**FF**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**EC**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**78**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No	ECU PV-Index	PV-Name	HEX	ECU Error Code	Comment
Injection Quantity	**PV001004**	**Byte 8**	0	0	24		**Unit: mm³/H** **Resolution: 0.01 mm³/H** **Range: 0 mm³/H to + 1000 mm³/H** **Byte order must be as follows for value calculation:** **Byte: 8 7 6 5** **Example: 25 mm³/H = 2500 digit = 0x9C4**	**0**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**0**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**0**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
P-Coolant Intercooler	**PV001041**	**Byte 4**	0	32	24		**Unit: bar** **Resolution: 0.01 mbar** **Range: 0 bar to + 10 bar** **Byte order must be as follows for value calculation:** **Byte: 4 3 2 1** **Example: 2.5 bar = 250000 digit = 0x3D090**	**0**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**3**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**D0**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**90**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Trip Fuel Consumption	**PV001120**	**Byte 8**	0	0	24		**Unit: l** **Resolution: 0.1 l** **Range: 0 l to + 10 000 000 l** **Byte order must be as follows for value calculation:** **Byte: 8 7 6 5** **Example: 900 l = 9000 digit = 0x2328**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**01**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**23**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**28**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Actual Fuel Consumption	**PV001119**	**Byte 4**	0	32	24		**Unit: l/h** **Resolution: 0.001 l/h** **Range: 0 l/h to + 1000 l/h** **Byte order must be as follows for value calculation:** **Byte: 4 3 2 1** **Example: 90 l/h = 90000 digit = 0x15F90**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**01**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**5F**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**90**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Mean Trip Fuel Consumption	PV001198	Byte 8	0	0	24		Unit: l/h Resolution: 0.001 l/h Range: 0 l/h to + 10 000 000 l/h Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 90 l/h = 90 000 digit = 0x15F90	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			01		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			5F		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			90		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Total Fuel Consumption	PV001121	Byte 4	0	32	24		Unit: l Resolution: 0.1 l Range: 0 l to + 10 000 000 l Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 900 l = 9000 digit = 0x2328	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			23		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			28		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDU Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
Common Trip By Empty Drive*	**PV 001316**	**Byte 8**	0	0	24		**Unit: sec Resolution: 1 sec Range: 0 sec to + 200 000 sec Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 1h = 3600 digit = 0xE10**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Trip Operating Hours	**PV001255**	**Byte 4**	0	32	24		**Unit: h Resolution: 1 h Range: 0 h to + 200 000 h Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 10h = 10 digit = 0x10**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDU Bit-No	Obj Bit-No	ECU PV-Index	PV-Name	HEX	ECU Error Code	Comment
Effective Engine Speed Demand	PV 001017	Byte 8	0	0	24		Unit: rpm Resolution: 0.1 rpm Range: 0 rpm to + 3 000 rpm Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 600 rpm = 6000 digit = 0x1770	0		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			0		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			17		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			70		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Selected Speed demand	PV001016	Byte 4	0	32	24		Unit: rpm Resolution: 0.1 rpm Range: 0 rpm to + 3 000 rpm Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 600 rpm = 6000 digit = 0x1770	0		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			0		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			0		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			6		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
CANOpen Diagnostic Status 1	**PV500011**	**Byte 8**	0	0	24	HI T-Coolant	001	129	**Status = "0" when valid**
			1	1	25	HI T-Charge Air	001	133	
			2	2	26	HI T-Coolant Intercooler	001	139	
			3	3	27	HI T-Lube Oil	001	143	
			4	4	28	Hi Fuel Leakage Level	001	56	
			5	5	29	SS Engine Speed Low	001	177	
			6	6	30	AL Prelubrication Fault	001	237	
			7	7	31	*Reserved*			
		Byte 7	0	8	16	AL Combined Alarm Yellow	001	10	
			1	9	17	LO P-Lube Oil	001	29	
			2	10	18	LO Coolant Level	001	55	
			3	11	19	Lo Coolant Level Intercooler	001	99	
			4	12	20	AL ECU Defect	001	116	
			5	13	21	AL Speed Demand Defect	001	118	
			6	14	22	LO Power Supply	001	122	
			7	15	23	HI Power Supply	001	123	
		Byte 6	0	16	8	HIHI Charger Speed ETC1	001	70	
			1	17	9	HIHI T-Fuel	001	200	
			2	18	10	LOLO P-Coolant after Pump	001	40	
			3	19	11	LOLO P-Coolant Intercooler	001	45	
			4	20	12	LOLO P-Fuel	001	48	
			5	21	13	LOLO T-Preheat	001	358	
			6	22	14	*Reserved*			
			7	23	15	*Reserved*			
		Byte 5	0	24	0	AL Combined Alarm Red	001	14	
			1	25	1	SS Overspeed	001	3	
			2	26	2	LOLO P-Lube Oil	001	30	
			3	27	3	HIHI T-Coolant	001	130	
			4	28	4	HIHI T-Lube Oil	001	144	
			5	29	5	HIHI T-Charge Air	001	168	
			6	30	6	HIHI ECU Power Supply Voltage	001	271	
			7	31	7	HIHI P-Crankcase	001	35	
CANOpen Diagnostic Message 1	**PV500010**	**Byte 4**	0	32	24	HI T-Coolant	001	129	**Measuring values**
			1	33	25	HI T-Charge Air	001	133	
			2	34	26	HI T-Coolant Intercooler	001	139	
			3	35	27	HI T-Lube Oil	001	143	
			4	36	28	Hi Fuel Leakage Level	001	56	
			5	37	29	SS Engine Speed Low	001	177	
			6	38	30	AL Prelubrication Fault	001	237	
			7	39	31	Reserved			
		Byte 3	0	40	16	AL Combined Alarm Yellow	001	10	
			1	41	17	LO P-Lube Oil	001	29	
			2	42	18	LO Coolant Level	001	55	
			3	43	19	Lo Coolant Level Intercooler	001	99	
			4	44	20	AL ECU Defect	001	116	
			5	45	21	AL Speed Demand Defect	001	118	
			6	46	22	LO Power Supply	001	122	
			7	47	23	HI Power Supply	001	123	
		Byte 2	0	48	8	HIHI Charger Speed ETC1	001	70	
			1	49	9	HIHI T-Fuel	001	200	
			2	50	10	LOLO P-Coolant after Pump	001	40	
			3	51	11	LOLO P-Coolant Intercooler	001	45	
			4	52	12	LOLO P-Fuel	001	48	
			5	53	13	LOLO T-Preheat	001	358	
			6	54	14	Reserved			
			7	55	15	Reserved			
		Byte 1	0	56	0	AL Combined Alarm Red	001	14	
			1	57	1	SS Overspeed	001	3	
			2	58	2	LOLO P-Lube Oil	001	30	
			3	59	3	HIHI T-Coolant	001	130	
			4	60	4	HIHI T-Lube Oil	001	144	
			5	61	5	HIHI T-Charge Air	001	168	
			6	62	6	HIHI ECU Power Supply Voltage	001	271	
			[illegible]	63	7	HIHI P-Crank[illegible]	001	35	

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
CANOpen Diagnostic Status 2	PV500021	Byte 8	0	0	24	HI P-Crankcase	001	34	Status = "0" when valid
			1	1	25	LO P-Coolant after Pump	001	39	
			2	2	26	LO P-Coolant Intercooler	001	44	
			3	3	27	LO P-Fuel	001	47	
			4	4	28	LO P-Charge Air	001	50	
			5	5	29	HI P-Lube Oil Differential	001	54	
			6	6	30	LO P-Fuel (Common Rail)	001	64	
			7	7	31	HI P-Fuel (Common Rail)	001	65	
		Byte 7	0	8	16	Combined AL SysFault	005	996	
			1	9	17	Combined AL SMCS-5 Failure	005	998	
			2	10	18				
			3	11	19				
			4	12	20				
			5	13	21				
			6	14	22				
			7	15	23				
		Byte 6	0	16	8	LOLO ECU Power Supply Voltage	001	270	
			1	17	9	HI T-Fuel	001	299	
			2	18	10	HIHI T-Coolant Intercooler	001	398	
			3	19	11	SD Air Filter Restr	006	170	
			4	20	12	SD Fuel Filter Restr.	006	180	
			5	21	13	SD Aux Engine Protection	006	190	
			6	22	14	AL Aux Engine Protection	009	930	
			7	23	15	AL Aux Engine Protection Switch	009	940	
		Byte 5	0	24	0	*Reserved*			
			1	25	1	AL Common Rail Leakage	001	185	
			2	26	2	LO T-Preheat	001	357	
			3	27	3	HI Air Filter Restr	009	910	
			4	28	4	HI Fuel Filter Restr.	009	920	
			5	29	5	AL Check ECU Error Code	001	178	
			6	30	6	HI Level Water Fuel Prefilter	001	225	
			7	31	7	HI Charger Speed ETC1	001	58	
CANOpen Diagnostic Message 2	PV500020	Byte 4	0	32	24	HI P-Crankcase	001	34	
			1	33	25	LO P-Coolant after Pump	001	39	
			2	34	26	LO P-Coolant Intercooler	001	44	
			3	35	27	LO P-Fuel	001	47	
			4	36	28	LO P-Charge Air	001	50	
			5	37	29	HI P-Lube Oil Differential	001	54	
			6	38	30	LO P-Fuel (Common Rail)	001	64	
			7	39	31	HI P-Fuel (Common Rail)	001	65	
		Byte 3	0	40	16	Combined AL SysFault	005	996	
			1	41	17	Combined AL SMCS-5 Failure	005	998	
			2	42	18				
			3	43	19				
			4	44	20				
			5	45	21				
			6	46	22				
			7	47	23				
		Byte 2	0	48	8	LOLO ECU Power Supply Voltage	001	270	
			1	49	9	HI T-Fuel	001	299	
			2	50	10	HIHI T-Coolant Intercooler	001	398	
			3	51	11	SD Air Filter Restr	006	170	
			4	52	12	SD Fuel Filter Restr.	006	180	
			5	53	13	SD Aux Engine Protection	006	190	
			6	54	14	AL Aux Engine Protection	009	930	
			7	55	15	AL Aux Engine Protection Switch	009	940	
		Byte 1	0	56	0	Reserved			
			1	57	1	AL Common Rail Leakage	001	185	
			2	58	2	LO T-Preheat	001	357	
			3	59	3	HI Air Filter Restr	009	910	
			4	60	4	HI Fuel Filter Restr.	009	920	
			5	61	5	AL Check ECU Error Code	001	178	
			6	62	6	HI Level Water Fuel Prefilter	001	225	

			Byte Bit-No	PDU Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature A2	PV 112202	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			0E		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			10		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature A1	PV 112201	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			10		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Byte Bit-No	PDU Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature A4	PV 112204	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			0E		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			10		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature A3	PV 112203	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			10		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature A6	PV 112206	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			0E		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			10		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature A5	PV 112205	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			10		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Byte Bit-No	PDO Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature A8	**PV 112208**	**Byte 8**	0	0	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature A7	**PV 112207**	**Byte 4**	0	32	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDO Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature A10	**PV 112210**	**Byte 8**	0	0	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature A9	**PV 112209**	**Byte 4**	0	32	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit- No	Bit- No	Bit- No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature B2	PV 112212	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			0E		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			10		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature B1	PV 112211	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			10		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature B4	PV 112214	Byte 8	0	0	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			0E		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			10		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature B3	PV 112213	Byte 4	0	32	24		Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			00		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			10		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature B6	**PV 112216**	**Byte 8**	0	0	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature B5	**PV 112215**	**Byte 4**	0	32	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature B8	**PV 112218**	**Byte 8**	0	0	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature B7	**PV 112217**	**Byte 4**	0	32	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
			7	63	7					

			Byte Bit-No	PDO Bit-No	Obj Bit-No		PV-Name	HEX	ECU Error Code	Comment
T-Exhaust Temperature B10	**PV 112220**	**Byte 8**	0	0	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			**00**		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			**0E**		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			**10**		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
T-Exhaust Temperature B9	**PV 112219**	**Byte 4**	0	32	24		**Unit: °C Resolution: 0.01 °C Range: - 40 °C to + 1 000 °C Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 450°C = 45000 digit = 0xAFC8h**	**00**		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			**00**		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			**00**		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			**10**		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					
				63	7					

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
T-Exh. Failure 2	PV009491	Byte 8	0	0	24				Status = "0" when valid
			1	1	25				
			2	2	26				
			3	3	27				
			4	4	28				
			5	5	29				
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	HI T-Exhaust B7	002	317	
			1	9	17	HI T-Exhaust B8	002	318	
			2	10	18	HI T-Exhaust B9	002	319	
			3	11	19	HI T-Exhaust B10	002	320	
			4	12	20				
			5	13	21				
			6	14	22				
			7	15	23				
		Byte 6	0	16	8	HI T-Exhaust A9	002	309	
			1	17	9	HI T-Exhaust A10	002	310	
			2	18	10	HI T-Exhaust B1	002	311	
			3	19	11	HI T-Exhaust B2	002	312	
			4	20	12	HI T-Exhaust B3	002	313	
			5	21	13	HI T-Exhaust B4	002	314	
			6	22	14	HI T-Exhaust B5	002	315	
			7	23	15	HI T-Exhaust B6	002	316	
		Byte 5	0	24	0	HI T-Exhaust A1	002	301	
			1	25	1	HI T-Exhaust A2	002	302	
			2	26	2	HI T-Exhaust A3	002	303	
			3	27	3	HI T-Exhaust A4	002	304	
			4	28	4	HI T-Exhaust A5	002	305	
			5	29	5	HI T-Exhaust A6	002	306	
			6	30	6	HI T-Exhaust A7	002	307	
			7	31	7	HI T-Exhaust A8	002	308	
T-Exh. Failure 1	PV009490	Byte 4	0	32	24				
			1	33	25				
			2	34	26				
			3	35	27				
			4	36	28				
			5	37	29				
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	HI T-Exhaust B7	002	317	
			1	41	17	HI T-Exhaust B8	002	318	
			2	42	18	HI T-Exhaust B9	002	319	
			3	43	19	HI T-Exhaust B10	002	320	
			4	44	20				
			5	45	21				
			6	46	22				
			7	47	23				
		Byte 2	0	48	8	HI T-Exhaust A9	002	309	
			1	49	9	HI T-Exhaust A10	002	310	
			2	50	10	HI T-Exhaust B1	002	311	
			3	51	11	HI T-Exhaust B2	002	312	
			4	52	12	HI T-Exhaust B3	002	313	
			5	53	13	HI T-Exhaust B4	002	314	
			6	54	14	HI T-Exhaust B5	002	315	
			7	55	15	HI T-Exhaust B6	002	316	
		Byte 1	0	56	0	HI T-Exhaust A1	002	301	
			1	57	1	HI T-Exhaust A2	002	302	
			2	58	2	HI T-Exhaust A3	002	303	
			3	59	3	HI T-Exhaust A4	002	304	
			4	60	4	HI T-Exhaust A5	002	305	
			5	61	5	HI T-Exhaust A6	002	306	
			6	62	6	HI T-Exhaust A7	002	307	

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
T-Exh. Failure 4	PV009493	Byte 8	0	0	24				Status = "0" when valid
			1	1	25				
			2	2	26				
			3	3	27				
			4	4	28				
			5	5	29				
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	LO T-Exhaust B7	002	417	
			1	9	17	LO T-Exhaust B8	002	418	
			2	10	18	LO T-Exhaust B9	002	419	
			3	11	19	LO T-Exhaust B10	002	420	
			4	12	20	AL T-Exhaust out of Range Limit2	002	620	
			5	13	21	AL Exhaust Monitoring Fail	002	512	
			6	14	22	AL EMU Voltage 11V	002	612	
			7	15	23	AL EMU Voltage -7V	002	613	
		Byte 6	0	16	8	LO T-Exhaust A9	002	409	
			1	17	9	LO T-Exhaust A10	002	410	
			2	18	10	LO T-Exhaust B1	002	411	
			3	19	11	LO T-Exhaust B2	002	412	
			4	20	12	LO T-Exhaust B3	002	413	
			5	21	13	LO T-Exhaust B4	002	414	
			6	22	14	LO T-Exhaust B5	002	415	
			7	23	15	LO T-Exhaust B6	002	416	
		Byte 5	0	24	0	LO T-Exhaust A1	002	401	
			1	25	1	LO T-Exhaust A2	002	402	
			2	26	2	LO T-Exhaust A3	002	403	
			3	27	3	LO T-Exhaust A4	002	404	
			4	28	4	LO T-Exhaust A5	002	405	
			5	29	5	LO T-Exhaust A6	002	406	
			6	30	6	LO T-Exhaust A7	002	407	
			7	31	7	LO T-Exhaust A8	002	408	
T-Exh. Failure 3	PV009492	Byte 4	0	32	24				
			1	33	25				
			2	34	26				
			3	35	27				
			4	36	28				
			5	37	29				
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	LO T-Exhaust B7	2	417	
			1	41	17	LO T-Exhaust B8	2	418	
			2	42	18	LO T-Exhaust B9	2	419	
			3	43	19	LO T-Exhaust B10	2	420	
			4	44	20	AL T-Exhaust out of Range Limit2	2	620	
			5	45	21	AL Exhaust Monitoring Fail	2	512	
			6	46	22	AL EMU Voltage 11V	2	612	
			7	47	23	AL EMU Voltage -7V	2	613	
		Byte 2	0	48	8	LO T-Exhaust A9	2	409	
			1	49	9	LO T-Exhaust A10	2	410	
			2	50	10	LO T-Exhaust B1	2	411	
			3	51	11	LO T-Exhaust B2	2	412	
			4	52	12	LO T-Exhaust B3	2	413	
			5	53	13	LO T-Exhaust B4	2	414	
			6	54	14	LO T-Exhaust B5	2	415	
			7	55	15	LO T-Exhaust B6	2	416	
		Byte 1	0	56	0	LO T-Exhaust A1	2	401	
			1	57	1	LO T-Exhaust A2	2	402	
			2	58	2	LO T-Exhaust A3	2	403	
			3	59	3	LO T-Exhaust A4	2	404	
			4	60	4	LO T-Exhaust A5	2	405	
			5	61	5	LO T-Exhaust A6	2	406	
			6	62	6	LO T-Exhaust A7	2	407	

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
Diagnostic Status 3	PV500031	Byte 8	0	0	24	Failure Preheat Unit	005	538	Status = "0" when valid
			1	1	25	WB SAM Fan Control 1	006	531	
			2	2	26	WB SAM Fan Control 1	006	541	
			3	3	27				
			4	4	28				
			5	5	29				
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	HI P-Fuel Prefilter	005	615	
			1	9	17	HIHI P-Fuel Prefilter	005	625	
			2	10	18	SD P-Fuel Prefilter	005	630	
			3	11	19				
			4	12	20				
			5	13	21				
			6	14	22				
			7	15	23				
		Byte 6	0	16	8	HI Pressure 1	006	31	
			1	17	9	LO Pressure 1	006	32	
			2	18	10	HIHI Pressure 1	006	33	
			3	19	11	LOLO Pressure 1	006	34	
			4	20	12	HI Pressure 2	006	51	
			5	21	13	LO Pressure 2	006	52	
			6	22	14	HIHI Pressure 2	006	53	
			7	23	15	LOLO Pressure 2	006	54	
		Byte 5	0	24	0	HI T-Exhaust A	006	12	
			1	25	1	HIHI T-Exhaust A	006	13	
			2	26	2	SD T-Exhaust A	006	19	
			3	27	3	HI T-Exhaust B	006	22	
			4	28	4	HIHI T-Exhaust B	006	23	
			5	29	5	SD T-Exhaust B	006	29	
			6	30	6	SD Pressure 1	006	45	
			7	31	7	SD Pressure 2	006	65	
Diagnostic Message 3	PV500030	Byte 4	0	32	24	Failure Preheat Unit	005	538	
			1	33	25	WB SAM Fan Control 1	006	531	
			2	34	26	WB SAM Fan Control 1	006	541	
			3	35	27				
			4	36	28				
			5	37	29				
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	HI P-Fuel Prefilter	005	615	
			1	41	17	HIHI P-Fuel Prefilter	005	625	
			2	42	18	SD P-Fuel Prefilter	005	630	
			3	43	19				
			4	44	20				
			5	45	21				
			6	46	22				
			7	47	23				
		Byte 2	0	48	8	HI Pressure 1	006	31	
			1	49	9	LO Pressure 1	006	32	
			2	50	10	HIHI Pressure 1	006	33	
			3	51	11	LOLO Pressure 1	006	34	
			4	52	12	HI Pressure 2	006	51	
			5	53	13	LO Pressure 2	006	52	
			6	54	14	HIHI Pressure 2	006	53	
			7	55	15	LOLO Pressure 2	006	54	
		Byte 1	0	56	0	HI T-Exhaust A	006	12	
			1	57	1	HIHI T-Exhaust A	006	13	
			2	58	2	SD T-Exhaust A	006	19	
			3	59	3	HI T-Exhaust B	006	22	
			4	60	4	HI Pressure 1	006	31	
			5	61	5	LO Pressure 1	006	32	
			6	62	6	HIHI Pressure 1	006	33	

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System Index	PV Index	Comment
Diagnostic Status 4	PV500041	Byte 8	0	0	24				Status = "0" when valid
			1	1	25				
			2	2	26				
			3	3	27				
			4	4	28				
			5	5	29				
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	MD Force Max Fan Speed	009	987	
			1	9	17	MD Disable Cyl. Cut Off	009	988	
			2	10	18	AL CCB J1939 Error	009	995	
			3	11	19	AL CCB CANOpen Error	009	996	
			4	12	20	AL CCB Error	009	997	
			5	13	21				
			6	14	22				
			7	15	23				
		Byte 6	0	16	8	MD CAN Lamptest	009	978	
			1	17	9	MD CAN Speed Setting Limit act	009	979	
			2	18	10	MD CAN Reset Trip Fuel counter	009	980	
			3	19	11	MD CAN Ext Power curve limit	009	981	
			4	20	12	MD CAN Park brake interlock	009	982	
			5	21	13	MD CAN Neutral	009	983	
			6	22	14	MD CAN Alternate Minimum	009	984	
			7	23	15	MD CAN Ext Preheating Disable	009	985	
		Byte 5	0	24	0	MD CAN Speed Demand	009	970	
			1	25	1	MD CAN Torque Limit 1	009	971	
			2	26	2	MD CAN Torque Limit 2	009	972	
			3	27	3	MD CAN Override	009	973	
			4	28	4	MD CAN Start interlock	009	974	
			5	29	5	MD CAN Engine Start	009	975	
			6	30	6	MD CAN Engine Stop	009	976	
			7	31	7	MD CAN Alarm Reset	009	977	
Diagnostic Message 4	PV500040	Byte 4	0	32	24				
			1	33	25				
			2	34	26				
			3	35	27				
			4	36	28				
			5	37	29				
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	MD Force Max Fan Speed	009	987	
			1	41	17	MD Disable Cyl. Cut Off	009	988	
			2	42	18	AL CCB J1939 Error	009	995	
			3	43	19	AL CCB CANOpen Error	009	996	
			4	44	20	AL CCB Error	009	997	
			5	45	21				
			6	46	22				
			7	47	23				
		Byte 2	0	48	8	MD CAN Lamptest	009	978	
			1	49	9	MD CAN Speed Setting Limit act	009	979	
			2	50	10	MD CAN Reset Trip Fuel counter	009	980	
			3	51	11	MD CAN Ext Power curve limit	009	981	
			4	52	12	MD CAN Park brake interlock	009	982	
			5	53	13	MD CAN Neutral	009	983	
			6	54	14	MD CAN Alternate Minimum	009	984	
			7	55	15	MD CAN Ext Preheating Disable	009	985	
		Byte 1	0	56	0	MD CAN Speed Demand	009	970	
			1	57	1	MD CAN Torque Limit 1	009	971	
			2	58	2	MD CAN Torque Limit 2	009	972	
			3	59	3	MD CAN Override	009	973	
			4	60	4	MD CAN Start interlock	009	974	
			5	61	5	MD CAN Engine Start	009	975	
			6	62	6	MD CAN Engine Stop	009	976	

			Byte Bit-No	PDO Bit-No	Obj-Bit-No	PV-Name	System No.	Index	Comment
Binary Demand Status 1	**PV500111**	**Byte 8**	0	0	24	External Preheating Disable	009	985	**Status = "0" when valid**
			1	1	25	Speed Setting Limit Active	009	979	
			2	2	26				
			3	3	27				
			4	4	28				
			5	5	29				
			6	6	30				
			7	7	31				
		Byte 7	0	8	16	Binary Output Test	009	978	
			1	9	17	Reset Trip Fuel Counter	009	980	
			2	10	18	External Power Curve Limitation	009	981	
			3	11	19	Force Max Fan Speed	009	987	
			4	12	20	Start Interlock	009	974	
			5	13	21	Park Brake Interlock	009	982	
			6	14	22	Neutral*	009	983	
			7	15	23	Alternate Minimum VSG/ Incr. Idle	009	984	
		Byte 6	0	16	8				
			1	17	9				
			2	18	10				
			3	19	11				
			4	20	12	Engine Start	009	975	
			5	21	13				
			6	22	14				
			7	23	15				
		Byte 5	0	24	0				
			1	25	1	Override	009	973	
			2	26	2	Disable Cylinder Cut Out	009	988	
			3	27	3				
			4	28	4				
			5	29	5	Engine Stop	009	976	
			6	30	6	Alarm Reset	009	977	
			7	31	7				
Binary Demand Signal 1	**PV500110**	**Byte 4**	0	32	24	External Preheating Disable	009	851	**Measuring value**
			1	33	25	Speed Setting Limit Active	009	821	
			2	34	26				
			3	35	27				
			4	36	28				
			5	37	29				
			6	38	30				
			7	39	31				
		Byte 3	0	40	16	Binary Output Test	009	817	
			1	41	17	Reset Trip Fuel Counter	009	841	
			2	42	18	External Power Curve Limitation	009	857	
			3	43	19	Force Max Fan Speed	009	869	
			4	44	20	Start Interlock	009	720	
			5	45	21	Park Brake Interlock	009	730	
			6	46	22	Neutral*	009	740	
			7	47	23	Alternate Minimum VSG/ Incr. Idle	009	780	
		Byte 2	0	48	8				
			1	49	9				
			2	50	10				
			3	51	11				
			4	52	12	Engine Start	009	813	
			5	53	13				
			6	54	14				
			7	55	15				
		Byte 1	0	56	0				
			1	57	1	Override	009	807	
			2	58	2	Disable Cylinder Cut Out	009	804	
			3	59	3				
			4	60	4				
			5	61	5	Engine Stop	009	814	
			6	62	6	Alarm Reset	009	816	

			Bit- No	Bit- No	Bit- No		PV-Name	HEX	ECU Error Code	Comment
dummy		Byte 8	0	0	24					
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16					
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8					
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0					
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
CANOpen Speed Demand Analog	PV009201	Byte 4	0	32	24		Unit: rpm Resolution: 0.1 rpm Range: 0 to 3000 rpm Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 600 rpm = 6000 digit = 0x1770	0		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			0		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			17		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			70		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Bit-No	Bit-No	Bit-No		PV-Name	HEX	ECU Error Code	Comment
Torque Limit 1	PV009288	Byte 8	0	0	24		Unit: Nm Resolution: 0.1 Nm Range: 0 Nm to + 20 000 Nm Byte order must be as follows for value calculation: Byte: 8 7 6 5 Example: 2050 Nm = 20500 digit = 0x5014	00		
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16			00		
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8			50		
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0			14		
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
Torque Limit 2	PV009289	Byte 4	0	32	24		Unit: Nm Resolution: 0.1 Nm Range: 0 Nm to + 20 000 Nm Byte order must be as follows for value calculation: Byte: 4 3 2 1 Example: 2050 Nm = 20500 digit = 0x5014	00		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			00		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			50		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			14		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

			Byte Bit-No	PDU Bit-No	Obj Bit-No	ECU PV-Index	PV-Name	HEX	ECU Error Code	Comment
dummy		Byte 8	0	0	24					
			1	1	25					
			2	2	26					
			3	3	27					
			4	4	28					
			5	5	29					
			6	6	30					
			7	7	31					
		Byte 7	0	8	16					
			1	9	17					
			2	10	18					
			3	11	19					
			4	12	20					
			5	13	21					
			6	14	22					
			7	15	23					
		Byte 6	0	16	8					
			1	17	9					
			2	18	10					
			3	19	11					
			4	20	12					
			5	21	13					
			6	22	14					
			7	23	15					
		Byte 5	0	24	0					
			1	25	1					
			2	26	2					
			3	27	3					
			4	28	4					
			5	29	5					
			6	30	6					
			7	31	7					
dummy	0	Byte 4	0	32	24			0		
			1	33	25					
			2	34	26					
			3	35	27					
			4	36	28					
			5	37	29					
			6	38	30					
			7	39	31					
		Byte 3	0	40	16			0		
			1	41	17					
			2	42	18					
			3	43	19					
			4	44	20					
			5	45	21					
			6	46	22					
			7	47	23					
		Byte 2	0	48	8			0		
			1	49	9					
			2	50	10					
			3	51	11					
			4	52	12					
			5	53	13					
			6	54	14					
			7	55	15					
		Byte 1	0	56	0			0		
			1	57	1					
			2	58	2					
			3	59	3					
			4	60	4					
			5	61	5					
			6	62	6					

*	One of the following fault codes:
	134,136,142,144,145,147,149,151,363,364,
**	Assumes value 0 or 1, in addition when SD => 0, when MD => 1
***	Prerequisite for this COB-ID is: NODE-ID = 20!!!
	See calculation below for other node-ID
****	ERR_MD indicated when PV110010 MD is => ERR_MD = 1
	Combination of ERR_MD = 1 and PV510037 Bit 0 = 1 => Communication error

Calculating COB-IDs:

Transmit PDOs:

COB-ID = 80 + [NODE-ID]+[Offset]+([PDO number]*100)

E.g.:
Node-ID: 20dec --> 14hex
Object: Node-Id+2,TPDO3

COB-ID = 80hex + 14hex + 2hex + (3*100)hex = 394hex

Receive PDOs:

COB-ID: = 100 + [NODE-ID]+[Offset]+([PDO number]*100)

E.g.:
Node-ID: 20dec --> 14hex
Object: Node-Id+0,RPDO2

COB-ID = 100hex + 14hex+ 0hex + (2*100)hex= 311

10.7.2 Interface Description J1939

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Overview J1939 - Transmit

J1939-Standard		J1939-Proprietär				Description
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**actual name**
		2	1	1	PGN 65296	External Stop Activated
SPN 190	**PGN 61444**					Engine Speed
		2	5	7	PGN 65281	SS Overspeed
		2	3	1	PGN 65296	Torque Limitation Active
		2	3	1	PGN 65280	Power Reduction Active
SPN 3040	**PGN 65226**					AL Combined Alarm Yellow
		2	5	1	PGN 65296	Speed Demand Fail Mode
SPN 3039	**PGN 65226**					AL Combined Alarm Red
		16	0	5	PGN 65310	Selected Speed Demand
		16	0	7	PGN 65310	Effective Engine Speed Demand
		32	0	3	PGN 65311	Status Start Sequence
SPN 100	**PGN 65263**					P-Lube Oil
		2	5	1	PGN 65280	LO P-Lube Oil
		2	7	1	PGN 65280	LOLO P-Lube Oil
SPN 101	**PGN 65263**					P-Crankcase
		2	1	1	PGN 65297	HI P-Crankcase
		2	3	1	PGN 65297	HIHI P-Crankcase
SPN 109	**PGN 65263**					P-Coolant after Pump
		2	5	1	PGN 65297	LO P-Coolant after Pump
		2	7	1	PGN 65297	LOLO P-Coolant after Pump
SPN 1203	**PGN 65172**					P-Coolant Intercooler
		2	1	2	PGN 65297	LO P-Coolant Intercooler
		2	3	2	PGN 65297	LOLO P-Coolant Intercooler
SPN 94	**PGN 65263**					P-Fuel
		2	1	2	PGN 65280	LO P-Fuel
		2	3	2	PGN 65280	LOLO P-Fuel
SPN 102	**PGN 65270**					P-Charge Air
		2	5	2	PGN 65280	LO P-Charge Air
		2	7	2	PGN 65280	HI P-Lube Oil Differencial
		2	1	3	PGN 65280	LO Coolant Level
SPN1239	**PGN 65169**					HI Fuel Leakage Level
SPN 103	**PGN 65245**					Charger Speed ETC1
		2	3	3	PGN 65280	HI Charger Speed ETC1
		2	5	3	PGN 65280	LO P-Fuel (Common Rail)
		2	7	3	PGN 65280	HI P-Fuel (Common Rail)
		2	5	2	PGN 65296	Engine Running
		2	1	4	PGN 65280	HIHI Charger Speed ETC1
		2	7	2	PGN 65296	Cylinder Cutout
		16	0	1	PGN 65284	Actual Failure Codes
		2	3	7	PGN 65296	Speed Window 1
		2	5	7	PGN 65296	Speed Window 2
		2	5	2	PGN 65297	LO Intercooler Coolant Level

J1939-Standard		J1939-Proprietär				Description
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**actual name**
SPN 158	**PGN 65271**					ECU Power Supply Voltage
SPN 247	**PGN 65253**					ECU Operating Hours
		2	3	4	PGN 65280	AL ECU Defect
		2	5	4	PGN 65280	AL Speed Demand Defect
SPN 183	**PGN 65266**					Actual Fuel Consumption
SPN 182	**PGN 65257**					Daily Fuel Consumption
SPN 250	**PGN 65257**					Total Fuel Consumption
		2	7	4	PGN 65280	LO Power Supply
		2	1	5	PGN 65280	HI Power Supply
SPN 110	**PGN 65262**					T-Coolant
		2	3	5	PGN 65280	HI T-Coolant
		2	5	5	PGN 65280	HIHI T-Coolant
SPN 2629	**PGN 64979**					T-Charge Air
		2	7	5	PGN 65280	HI T-Charge Air
SPN 52	**PGN 65262**					T-Coolant Intercooler
		2	7	2	PGN 65297	HI T-Coolant Intercooler
SPN 175	**PGN 65262**					T-Lube Oil
		2	1	6	PGN 65280	HI T-Lube Oil
		2	3	6	PGN 65280	HIHI T-Lube Oil
SPN 105	**PGN 65270**					T-Intake Air
SPN 174	**PGN 65262**					T-Fuel
		2	1	7	PGN 65280	HIHI T-Charge Air
		2	5	7	PGN 65280	SS Engine Speed Low
		2	7	7	PGN 65280	AL Check ECU Error Code
		2	1	8	PGN 65280	AL Common Rail Leakage
SPN 1029	**PGN 65203**					Mean Trip Fuel Consumption
		2	3	8	PGN 65280	HIHI T-Fuel
SPN1110	**PGN 65252**					Automatic Shutdown
SPN 92	**PGN 61443**					Act. Torque in Relation to DBR
SPN 975	**PGN 65213**					PWM Ratio Output Fan Control
SPN 97	**PGN 65279**					HI Level Water Fuel Prefilter
		2	1	3	PGN 65297	AL Prelubrication Fault
SPN 1036	**PGN 65200**					Trip Operating Hours
		2	5	8	PGN 65280	LOLO ECU Power Supply Voltage
		2	7	8	PGN 65280	HIHI ECU Power Supply Voltage
		2	7	1	PGN 65281	HI T-Fuel
		8	0	1	PGN 65318	Optimum Load Signal (OLS) PWM
		16	0	5	PGN 65323	Optimum Load Signal (OLS) PWM
SPN 1037	**PGN 65200**					Common Trip By Empty Drive
SPN 1081	**PGN 65252**					Request Cold Engine Operation
		2	1	4	PGN 65297	LO T-Preheat
		2	3	4	PGN 65297	LOLO T-Preheat
		2	1	1	PGN 65285	HIHI T-Coolant Intercooler
		16	0	3	PGN 65318	Requested Torque

J1939-Standard		**J1939-Proprietär**				**Description**
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**actual name**
		2	5	3	PGN 65296	Ready for Start
		2	7	3	PGN 65296	Prelube System ON
		2	1	4	PGN 65296	Preheating HT ON
		2	3	4	PGN 65296	Preheating NT ON
		2	1	3	PGN 65296	Preheat Temp Not Reached
		2	3	8	PGN 65296	Preheat System On
		2	7	4	PGN 65296	Alarm SAM SysFault
SPN 2434	**PGN 65031**					T-Exhaust A
		2	1	4	PGN 65287	HI T-Exhaust A
		2	3	4	PGN 65287	HIHI T-Exhaust A
		2	5	3	PGN 65287	SD T-Exhaust 1
SPN 2433	**PGN 65031**					T-Exhaust B
		2	5	4	PGN 65287	HI T-Exhaust B
		2	7	4	PGN 65287	HIHI T-Exhaust B
		2	7	3	PGN 65287	SD T-Exhaust B
		2	1	1	PGN 65287	HI Pressure 1
		2	5	1	PGN 65287	LO Pressure 1
		2	3	1	PGN 65287	HIHI Pressure 1
		2	7	1	PGN 65287	LOLO Pressure 1
		2	1	3	PGN 65287	SD Pressure 1
SPN 1387	**PGN 65164**					Pressure 1
		2	1	2	PGN 65287	HI Pressure 2
		2	5	2	PGN 65287	LO Pressure 2
		2	3	2	PGN 65287	HIHI Pressure 2
		2	7	2	PGN 65287	LOLO Pressure 2
		2	3	3	PGN 65287	SD Pressure 2
SPN 1388	**PGN 65164**					Pressure 2
		2	1	5	PGN 65297	HI Air Filter Restr
SPN107	**PGN 65270**					Air Filter Restriction
		2	1	5	PGN 65287	SD Air Filter Restr.
		2	3	5	PGN 65297	HI Fuel Filter Restr.
SPN 95	**PGN 65276**					Fuel Filter Restriction
		2	3	5	PGN 65287	SD Fuel Filter Restr.
		2	5	5	PGN 65297	HI Aux Engine Protection
		2	5	5	PGN 65287	SD Aux Engine Protection
		2	7	5	PGN 65297	AL Aux Protection Switch
		16	0	5	PGN 65318	Analog Fan Control 1 %
		16	0	7	PGN 65318	Analog Fan Control 2 %
		2	1	6	PGN 65297	WB Analog Fan Control Fan 1
		2	3	6	PGN 65297	WB Analog Fan Control Fan 2
		2	1	6	PGN 65287	HI P-Fuel Prefilter
		2	3	6	PGN 65287	HIHI P-Fuel Prefilter
		2	7	5	PGN 65287	SD AIN P-Fuel Prefilter
		2	1	8	PGN 65296	engine shutdown follow-up

J1939-Standard		J1939-Proprietär				Description
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**actual name**
		2	7	8	PGN 65296	AL MTU CAN-Bus (MCS-5) Failure
		2	1	1	PGN 65289	HI T-Exhaust A1
		2	3	1	PGN 65289	HI T-Exhaust A2
		2	5	1	PGN 65289	HI T-Exhaust A3
		2	7	1	PGN 65289	HI T-Exhaust A4
		2	1	2	PGN 65289	HI T-Exhaust A5
		2	3	2	PGN 65289	HI T-Exhaust A6
		2	5	2	PGN 65289	HI T-Exhaust A7
		2	7	2	PGN 65289	HI T-Exhaust A8
		2	1	3	PGN 65289	HI T-Exhaust A9
		2	3	3	PGN 65289	HI T-Exhaust A10
		2	5	3	PGN 65289	HI T-Exhaust B1
		2	7	3	PGN 65289	HI T-Exhaust B2
		2	1	4	PGN 65289	HI T-Exhaust B3
		2	3	4	PGN 65289	HI T-Exhaust B4
		2	5	4	PGN 65289	HI T-Exhaust B5
		2	7	4	PGN 65289	HI T-Exhaust B6
		2	1	5	PGN 65289	HI T-Exhaust B7
		2	3	5	PGN 65289	HI T-Exhaust B8
		2	5	5	PGN 65289	HI T-Exhaust B9
		2	7	5	PGN 65289	HI T-Exhaust B10
		2	1	6	PGN 65289	LO T-Exhaust A1
		2	3	6	PGN 65289	LO T-Exhaust A2
		2	5	6	PGN 65289	LO T-Exhaust A3
		2	7	6	PGN 65289	LO T-Exhaust A4
		2	1	7	PGN 65289	LO T-Exhaust A5
		2	3	7	PGN 65289	LO T-Exhaust A6
		2	5	7	PGN 65289	LO T-Exhaust A7
		2	7	7	PGN 65289	LO T-Exhaust A8
		2	1	8	PGN 65289	LO T-Exhaust A9
		2	3	8	PGN 65289	LO T-Exhaust A10
		2	5	8	PGN 65289	LO T-Exhaust B1
		2	7	8	PGN 65289	LO T-Exhaust B2
		2	1	1	PGN 65290	LO T-Exhaust B3
		2	3	1	PGN 65290	LO T-Exhaust B4
		2	5	1	PGN 65290	LO T-Exhaust B5
		2	7	1	PGN 65290	LO T-Exhaust B6
		2	1	2	PGN 65290	LO T-Exhaust B7
		2	3	2	PGN 65290	LO T-Exhaust B8
		2	5	2	PGN 65290	LO T-Exhaust B9
		2	7	2	PGN 65290	LO T-Exhaust B10
		2	1	3	PGN 65290	AL T-Exhaust out of Range Limit2
		2	3	3	PGN 65290	AL Exhaust Monitoring Fail
		2	5	3	PGN 65290	AL EMU Voltage 11V
		2	7	3	PGN 65290	AL EMU Voltage -7V

J1939-Standard		J1939-Proprietär				Description
SPN	PGN	Length	Bit-Pos	Byte-Pos	PGN	actual name
		2	1	4	PGN 65290	SD T-Exhaust A1
		2	3	4	PGN 65290	SD T-Exhaust A2
		2	5	4	PGN 65290	SD T-Exhaust A3
		2	7	4	PGN 65290	SD T-Exhaust A4
		2	1	5	PGN 65290	SD T-Exhaust A5
		2	3	5	PGN 65290	SD T-Exhaust A6
		2	5	5	PGN 65290	SD T-Exhaust A7
		2	7	5	PGN 65290	SD T-Exhaust A8
		2	1	6	PGN 65290	SD T-Exhaust A9
		2	3	6	PGN 65290	SD T-Exhaust A10
		2	5	6	PGN 65290	SD T-Exhaust B1
		2	7	6	PGN 65290	SD T-Exhaust B2
		2	1	7	PGN 65290	SD T-Exhaust B3
		2	3	7	PGN 65290	SD T-Exhaust B4
		2	5	7	PGN 65290	SD T-Exhaust B5
		2	7	7	PGN 65290	SD T-Exhaust B6
		2	1	8	PGN 65290	SD T-Exhaust B7
		2	3	8	PGN 65290	SD T-Exhaust B8
		2	5	8	PGN 65290	SD T-Exhaust B9
		2	7	8	PGN 65290	SD T-Exhaust B10
1137	PGN 65187					T-Exhaust A1
1138	PGN 65187					T-Exhaust A2
1139	PGN 65187					T-Exhaust A3
1140	PGN 65187					T-Exhaust A4
1141	PGN 65186					T-Exhaust A5
1142	PGN 65186					T-Exhaust A6
1143	PGN 65186					T-Exhaust A7
1144	PGN 65186					T-Exhaust A8
1145	PGN 65185					T-Exhaust A9
1146	PGN 65185					T-Exhaust A10
1147	PGN 65185					T-Exhaust B1
1148	PGN 65185					T-Exhaust B2
1149	PGN 65184					T-Exhaust B3
1150	PGN 65184					T-Exhaust B4
1151	PGN 65184					T-Exhaust B5
1152	PGN 65184					T-Exhaust B6
1153	PGN 65183					T-Exhaust B7
1154	PGN 65183					T-Exhaust B8
1155	PGN 65183					T-Exhaust B9
1156	PGN 65183					T-Exhaust B10
		2	1	1	PGN 65288	MD CAN Speed Demand
		2	3	1	PGN 65288	MD CAN Torque Limit 1
		2	5	1	PGN 65288	MD CAN Torque Limit 2
		2	7	1	PGN 65288	MD CAN Override
		2	1	2	PGN 65288	MD CAN Start interlock
		2	3	2	PGN 65288	MD CAN Engine Start
		2	5	2	PGN 65288	MD CAN Engine Stop
		2	7	2	PGN 65288	MD CAN Alarm Reset

J1939-Standard		J1939-Proprietär				Description
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**actual name**
		2	1	3	PGN 65288	MD CAN Lamptest
		2	3	3	PGN 65288	MD CAN Speed Setting Limit act
		2	5	3	PGN 65288	MD CAN Reset Trip Fuel counter
		2	7	3	PGN 65288	MD CAN Ext Power curve limit
		2	1	4	PGN 65288	MD CAN Park break interlock
		2	3	4	PGN 65288	MD CAN Neutral
		2	5	4	PGN 65288	MD CAN Alternate Minimum
		2	7	4	PGN 65288	MD CAN Ext Preheating Disable
		2	1	5	PGN 65288	MD Force Max Fan Speed
		2	3	5	PGN 65288	MD Disable Cyl. Cut Off
		2	1	8	PGN 65288	AL CCB J1939 Error
		2	3	8	PGN 65288	AL CCB CANopen Error
		2	5	8	PGN 65288	AL CCB Error
SPN 234	**PGN 65242**					Software Identification
SPN 965	**PGN 65242**					Number of Software Identification Fields

Overview J1939 - Receive

J1939 (Standard)		J1939 (Proprietary)				Description
SPN	**PGN**	**Length**	**Bit-Pos**	**Byte-Pos**	**PGN**	**Actual name**
SPN 898	**PGN 0**					Speed Demand Analog
		2	1	1	PGN 65325	Disable Cylinder Cut Out 2
SPN 1237	**PGN 65265**					Override
		2	1	2	PGN 65325	Engine Start
SPN 970	**PGN 61441**					Engine Stop
		2	3	2	PGN 65325	Alarm Reset
		2	5	2	PGN 65325	Lamptest
		2	7	2	PGN 65325	Speed Setting Limit Active
SPN 988	**PGN 56832**					Reset Trip Fuel Counter
SPN 2883	**PGN 64971**					Alternate Minimum VSG
		2	5	3	PGN 65325	External PowerCurve Limitation
		2	7	3	PGN 65325	Force Max. Fan Speed
		16	0	5	PGN 65326	Torque Limit 1
		16	0	3	PGN 65326	Torque Limit 2
		2	7	5	PGN 65325	Start Interlock
SPN 70	**PGN 65265**					Park Break Interlock
SPN 604	**PGN 65219**					Neutral
		2	3	6	PGN 65325	External Preheating Enable
SPN 695	**PGN 0**					Override Control Mode

10.7.2.2. Commands sent to Engine - Standard

NOTE - Retarder may be disabled by commanding a torque limit of 0%. Use of the limit mode allows the use of the retarder only up to the limit specified in the request. This can be used to permit retarding of up to 50%, for example, if that limit is required by some device such as an EBS, or it can disable the use of the retarder by others, as when an ABS controller detects wheel slip.

Transmission Repetition when active:	10 ms to engine - 50 ms to retarder		
Data Length:	8		
Data Page:	0		
PDU Format:	0		
PDU Specific:	DA	PGN Supporting Information:	
Default Priority:	3		
Parameter Group Number:	0 (0x0)		

byte	bit	name	SPN	description	available
1	**1-2**	**Engine Override Control Mode**	**695**	**00 Override disabled. 01 Speed control 10 Torque control 11 Speed/torque limit control**	***yes***
1	3-4	Engine Requested Speed Control Conditions	696		***no***
1	5-6	Override Control Mode Priority	897		***no***
2-3	**-**	**Engine Requested Speed/Speed Limit**	**898**	**Resolution: 0.125 rpm/bit, 0 offset Data Range: 0 to 8,031.875 rpm Operational Range: same as data range**	***yes***
4	**-**	**Engine Requested Torque/Torque Limit**	**518**		***no***

SPN 695: The override control mode defines which sort of command is used. In Case of Engine Requested Speed, 01 will be send. Using the Engine requested Speed Limit, 11 will be sent.

SPN 898: Parameter provided to the engine from external sources in the torque/speed control message. This is the engine speed which the engine is expected to operate at if the speed control mode is active or the engine speed which the engine is not expected to exceed if the speed limit mode is active.

PGN 56832 Reset - RESET

NOTE—This message requires an Acknowledgement response
(See J1939-21, PGN 59392) from the receiving node.
The use of individual proprietary protocols can still be used instead of the "trip reset" PGN to maintain security.

Transmission Repetition: When needed
Data Length: 8
Data Page: 0
PDU Format: 222
PDU Specific: DA PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 56832 (0xDE00)

byte	bit	name	SPN	description	available
1.1	**1-2**	**Trip Group**	**988**	**00 Take no action** **01 Reset** **11 Not applicable** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range:** **same as data range**	***yes***
1.3	3-4	Trip Group 2 - Proprietary	989		***no***
2		Service Component Identification	1584		***no***
3.1	1-2	Engine Build Hours Reset	1211		***no***

SPN 988: Command signal used to reset the PGNs and parameters as defined in Table SPN988_A.

PGN 61441 Electronic Brake Controller 1 - EBC1

Used for brake control information

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	240	
PDU Specific:	1	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	61441 (0xF001)	

byte	bit	name	SPN	description	available
1.1	1-2	ASR Engine Control Active	561		**no**
1.3	3-4	ASR Brake Control Active	562		**no**
1.5	5-6	Anti-Lock Braking (ABS) Active	563		**no**
1.7	7-8	EBS Brake Switch	1121		**no**
2		Brake Pedal Position	521		**no**
3.1	1-2	ABS Off-road Switch	575		**no**
3.3	3-4	ASR Off-road Switch	576		**no**
3.5	5-6	ASR "Hill Holder" Switch	577		**no**
3.7	7-8	Traction Control Override Switch	1238		**no**
4.1	1-2	Accelerator Interlock Switch	972		**no**
4.3	3-4	Engine Derate Switch	971		**no**
4.5	**5-6**	**Engine Auxiliary Engine Shutdown Switch** **Engine Stop**	**970**	**00 - Off** **01 - On** **10 - Error** **11 - Not available** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range:** **same as data range**	**yes**
4.7	7-8	Remote Accelerator Enable Switch	969		**no**
5		Engine Retarder Selection	973		**no**
6.1	1-2	ABS Fully Operational	1243		**no**
6.3	3-4	EBS Red Warning Signal	1439		**no**
6.5	5-6	ABS/EBS Amber Warning Signal (Powered Vehicle)	1438		**no**
6.7	7-8	ATC/ASR Information Signal	1793		**no**
7		Source Address of Controlling Device for Brake Control	1481		**no**
8.3	3-4	Halt brake switch	2911		**no**
8.5	5-6	Trailer ABS Status	1836		**no**
8.7	7-8	Tractor-Mounted Trailer ABS Warning Signal	1792		**no**

SPN 970: Switch signal which requests that all engine fueling stop.

PGN 64971 (R) Off-Highway Engine Control Selection - OHECS

Allows for the selection of off-highway engine control modes, as they apply to different modes of engine operation which may be used to aid particular working environments. By offering characteristics suitable for the work in hand, the operator may select the desired mode (e.g. economy fuel ratings, droop settings, alternate idle points, multiple engine synchronization, etc.) to maximize performance under given conditions. The operator selects these inputs via hardwire switch operation, whereby an overall system control communicates the information to the engine controller.

Transmission Repetition:	500 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	253	
PDU Specific:	203	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	64971 (0xFDCB)	

byte	bit	name	SPN	description	available
1.1	1-2	Engine Auxiliary Governor Switch	2884		***no***
1.3	3-4	Engine Synchronization Switch	1377		***no***
1.5	**5-6**	**Engine Alternate Low Idle Switch**	**2883**	**00 - Default low idle point is selected** **01 - Alternate low idle point is selected** **10 - Error** **11 - Not available or Unused** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range: same as data range**	***yes***
2		Engine Alternate Rating Select	2882		***no***
3.1	1-4	Engine Alternate Droop Accelerator 1 Select	2881		***no***
3.5	5-8	Engine Alternate Droop Accelerator 2 Select	2879		***no***
4.1	1-4	Engine Alternate Droop Remote Accelerator Select	2886		***no***
4.5	5-8	Engine Alternate Droop Auxiliary Input Select	2885		***no***

SPN 2883: Operator switch which selects between two low idle speeds, default and alternate. The normal programmed low idle is the default low idle, and when the Alternate Low Idle switch is activated, a alternate preprogrammed low idle speed is selected. The accelerator position control operates as normal but is now bound to a different low idle speed. This selection impacts Point 1 on the Engine Configuration.

PGN 65219 Electronic Transmission Controller 5 - ETC5

Transmission Repetition:	On request	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	195	PGN Supporting Information:
Default Priority:	7	
Parameter Group Number:	65219 (0xFEC3)	

byte	bit	name	SPN	description	available
1.1	1-2	Transmission High Range Sense Switch	778		***no***
1.3	3-4	Transmission Low Range Sense Switch	779		***no***
2.1	1-2	Transmission Reverse Direction Switch	767		***no***
2.3	**3-4**	**Transmission Neutral Switch**	**604**	**00 - Off** **01 - On** **Data Length: 2 bits** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range:** **same as data range**	***yes***
2.5	5-6	Transmission Forward Direction Switch	903		***no***

SPN 604: Identifies the status of the switch that indicates neutral.

PGN 65265 Cruise Control/Vehicle Speed - CCVS

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	241	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65265 (0xFEF1)	

byte	bit	name	SPN	description	available
1.1	1-2	Two Speed Axle Switch	69		***no***
1.3	**3-4**	**Parking Brake Switch**	**70**	**00 - Parking brake not set** **01 - Parking brake set** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range: same as data range**	***yes***
1.5	5-6	Cruise Control Pause Switch	1633		***no***
2-3		Wheel-Based Vehicle Speed	84		***no***
4.1	1-2	Cruise Control Active	595		***no***
4.3	3-4	Cruise Control Enable Switch	596		***no***
4.5	5-6	Brake Switch	597		***no***
4.7	7-8	Clutch Switch	598		***no***
5.1	1-2	Cruise Control Set Switch	599		***no***
5.3	3-4	Cruise Control Coast (Decelerate) Switch	600		***no***
5.5	5-6	Cruise Control Resume Switch	601		***no***
5.7	7-8	Cruise Control Accelerate Switch	602		***no***
6		Cruise Control Set Speed	86		***no***
7.1	1-5	PTO State	976		***no***
7.6	6-8	Cruise Control States	527		***no***
8.1	1-2	Engine Idle Increment Switch	968		***no***
8.3	3-4	Engine Idle Decrement Switch	967		***no***
8.5	5-6	Engine Test Mode Switch	966		***no***
8.7	**7-8**	**Engine Shutdown Override Switch**	**1237**	**00 - Off** **01 - On** **Data Length: 2 bits** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3 Operational Range: same as data range** **Type: Measured**	***yes***

SPN 70: Switch signal which indicates when the parking brake is set. In general the switch actuated by the operator's park brake control, whether a pedal, lever or other control mechanism (see also SPN 619).

SPN 1237; Switch signal which indicates the position of the engine shutdown override switch. This switch function allows the operator to override an impending engine shutdown.

10.7.2.2. Commands sent to Engine - Proprietary

PGN 65325 Engine Comands 1

Transmission Repetition:	1000 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	45	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65325 (0xFF2D)	

byte	bit	name	MTU-Ref.	description	available
1	1-2	*Disable Cylinder Cut Out*	PV009804	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	*Engine Start*	PV009813	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	*Alarm Reset*	PV009816	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	*Binary Output Test*	PV009817	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	*Speed Setting Limit Active*	PV009821	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	5-6	*External PowerCurve*	PV009857	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	7-8	*Force Max. Fan Speed*	PV009869	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	*Start Interlock-*	PV009720	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	3-4	*Disable External Preheating*	PV009851	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

Engine Start:	Starting procedure in progress.
Alarm Reset:	Stored alarms in ADEC will be reset
Lamptest:	Parameter provided to the engine control system for switch-on the alarm and status lamps (ADEC & SAM)
Speed Setting Limit Active:	Speed setting is limited to a certain value programmed in the ECU
External PowerCurve Limitation:	Max power output of the engine is limited to its value programmed in the ECU
Force Max. Fan Speed:	Maximum fan speed (programmable value) is set in ECU
Start Interlock:	Start prohibition if value = 1. **Attention:** if start is directly connected to ECU, no function of this Parameter, the engine will start!
Disable External Preheating:	External signal to disable the automatic preheating function of the SAM-module. (Also available as binary contact)

PGN 65326 Engine Comands 2

Transmission Repetition:	1000 ms		
Data Length:	8		
Data Page:	0		
PDU Format:	255		
PDU Specific:	46	PGN Supporting Information:	
Default Priority:	6		
Parameter Group Number:	65326 (0xFF2E)		

byte	bit	name	MTU-Ref.	description	available
…	…	…	…	…	…
3-4		*Torque Limit 1*	PV009888	Resolution: 1Nm/bit, 0 offset Data Range: -32000 to 32255 Nm	***yes***
5-6		*Torque Limit 2*	PV009889	Resolution: 1Nm/bit, 0 offset Data Range: -32000 to 32255 Nm	***yes***

Torque Limit 1: Fix value for maximum torque of the engine.

Torque Limit 2: Fix value for maximum torque of the engine.

! The lower value of these two will be used for Power Limitation of the engine. If the value is too low or 0 the engine will not be able to start or stall.

10.7.2.3. Command sent to Vehicle Control - Standard

PGN 61443 (R) Electronic Engine Controller 2 - EEC2 Transmit

Transmission Repetition:	50 ms
Data Length:	8
Data Page:	0
PDU Format:	240
PDU Specific:	3 PGN Supporting Information:
Default Priority:	3
Parameter Group Number:	61443 (0xF003)

byte	bit	name	SPN	description	available
1	1-2	Accelerator Pedal 1 Low Idle Switch	558		**no**
1	3-4	Accelerator Pedal Kickdown Switch	559		**no**
1	5-6	Road Speed Limit Status	1437		**no**
1	7-8	Accelerator Pedal 2 Low Idle Switch	2970		**no**
2	-	Accelerator Pedal Position	91		**no**
3	**-**	**Percent Load At Current Speed**	**92**	**Resolution: 1 %/bit, 0 offset** **Data Range: 0 to 250 %** **Operational Range: 0 to 125%**	**yes**
4	-	Remote Accelerator Pedal Position	974		**no**
5	-	Accelerator Pedal Position	29		**no**
6	1-2	Vehicle Acceleration Rate Limit Status	2979		**no**
7		Actual Maximum Available Engine - Percent Torque	3357		**no**

SPN 92: The ratio of actual engine percent torque (indicated) to maximum indicated torque available at the current engine speed,clipped to zero torque during engine braking.

PGN 61444 Electronic Engine Controller 1 - EEC1

Transmission Repetition	90ms	
Data Length:	8	
Data Page:	0	
PDU Format:	240	
PDU Specific:	4	PGN Supporting Information:
Default Priority:	3	
Parameter Group Number:	61444 (0xF004)	

byte	bit	name	SPN	description	available
1	1-4	Engine Torque Mode	899		***no***
2	-	Driver's Demand Engine - Percent Torque	512		***no***
3	-	Actual Engine - Percent Torque	513	Resolution: 1 %/bit, -125 % offset Data Range: -125 to 125 % Operational Range: 0 to 125%	***no***
4-5	**-**	**Engine Speed**	**190**	**Resolution: 0.125 rpm/bit, 0 offset** **Data Range: 0 to 8,031.875 rpm** **Operational Range: same as data range**	***yes***
6	-	Source Address of Controlling Device for Engine Control	1483		***no***
7	1-4	Engine Starter Mode	1675	0000 start not requested 0011 start finished (after 50ms mode goes to 0000) 0101 starter inhibited due to engine not ready for start (preheating) 1111 not available	***no***
8	-	Engine Demand – Percent Torque	2432		***no***

SPN 190: Actual engine speed which is calculated over a minimum crankshaft angle of 720 degrees

PGN 64979 Turbocharger Information 6 - TCI6

Transmission Repetition: 1 s
Data Length: 8
Data Page: 0
PDU Format: 253
PDU Specific: 211 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 64979 (0xFDD3)

byte	bit	name	SPN	description	available
1-2		**Engine Turbocharger 1 Compressor Outlet Temperature**	**2629**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	***yes***
3-4		Engine Turbocharger 2 Compressor Outlet Temperature	2799		***no***
5-6		Engine Turbocharger 3 Compressor Outlet Temperature	2800		***no***
7-8		Engine Turbocharger 4 Compressor Outlet Temperature	2801		***no***

SPN 2629: Temperature of the air exiting the turbocharger 1 compressor outlet

PGN 65031 Exhaust Temperature - ET

Transmission Repetition:	0.5 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	7	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65031 (0xFE07)	

byte	bit	name	SPN	description	available
1-2	-	Engine Exhaust Exhaust Gas Temperature - Right Manifold	2433	Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range	***yes***
3-4	-	Engine Exhaust Exhaust Gas Temperature - Left Manifold	2434	Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range	***yes***

SPN 2433: Temperature of combustion byproducts within the right engine exhaust manifold.

SPN 2434: Temperature of combustion byproducts within the left engine exhaust manifold.

PGN 65164 (R) Auxiliary Analog Information - AAI

Auxiliary Analog Information

Transmission Repetition:	On request	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	140	PGN Supporting Information:
Default Priority:	7	
Parameter Group Number:	65164 (0xFE8C)	

byte	bit	name	SPN	description	available
1		Auxiliary Temperature 1	441		***no***
2		Auxiliary Temperature 2	442		***no***
3		Auxiliary Pressure #1	1387	Resolution: 16 kPa/bit, 0 offset Data Range: 0 to 4000 kPa Operational Range: same as data range	***yes***
4		Auxiliary Pressure #2	1388	Resolution: 16 kPa/bit, 0 offset Data Range: 0 to 4000 kPa Operational Range: same as data range	***yes***
5-6		Auxiliary Level	3087		***no***

SPN 1387: Auxiliary Pressure #1
Pressure measured by auxiliary pressure sensor #1. Not to be used in place of existing SPNs.

SPN 1388: Auxiliary Pressure #2
Pressure measured by auxiliary pressure sensor #2. Not to be used in place of existing SPNs.

PGN 65169 Fuel Leakage - FL

Transmission Repetition: 1 s
Data Length: 8
Data Page: 0
PDU Format: 254
PDU Specific: 145 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65169 (0xFE91)

byte	bit	name	SPN	description	available
1	**1-2**	**Engine Fuel Leakage 1**	**1239**	**00 - no leakage detected** **01 – leakage detected** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range: same as data range**	***yes***
1	3-4	Engine Fuel Leakage 2	1240		***no***

SPN 1239: Status signal which indicates fuel leakage in the fuel rail of the engine. The location can be either before or after the fuel pump.

PGN 65172 Engine Auxiliary Coolant - EAC

Transmission Repetition:	0.5 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	148	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65172 (0xFE94)	

byte	bit	name	SPN	description	available
1		**Engine Auxiliary Coolant Pressure**	**1203**	**Resolution: 4 kPa/bit, 0 offset Data Range: 0 to 1000 kPa Operational Range: same as data range**	***yes***
2		Engine Auxiliary Coolant Temperature	1212		***no***
3		Sea Water Pump Outlet Pressure	2435		***no***

SPN 1203: Gage pressure of coolant found in the intercooler which is located after the turbocharger.

PGN 65183 Exhaust Port Temperature 5 - EPT5

Transmission Repetition: 1 s
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 159 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65183 (0xFE9F)

byte	bit	name	SPN	description	available
1-2		**Engine Exhaust Gas Port 17 Temperature**	**1153**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
3-4		**Engine Exhaust Gas Port 18 Temperature**	**1154**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
5-6		**Engine Exhaust Gas Port 19 Temperature**	**1155**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
7-8		**Engine Exhaust Gas Port 20 Temperature**	**1156**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**

SPN 1153: Temperature at the cylinder exhaust port of the engine.

SPN 1154: Temperature at the cylinder exhaust port of the engine.

SPN 1155: Temperature at the cylinder exhaust port of the engine.

SPN 1156: Temperature at the cylinder exhaust port of the engine.

PGN 65184 Exhaust Port Temperature 4 - EPT4

Transmission Repetition: 1 s
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 160 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65184 (0xFEA0)

byte	bit	name	SPN	description	available
1-2		**Engine Exhaust Gas Port 13 Temperature**	**1149**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
3-4		**Engine Exhaust Gas Port 14 Temperature**	**1150**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
5-6		**Engine Exhaust Gas Port 15 Temperature**	**1151**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
7-8		**Engine Exhaust Gas Port 16 Temperature**	**1152**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**

SPN 1149: Temperature at the cylinder exhaust port of the engine.

SPN 1150: Temperature at the cylinder exhaust port of the engine.

SPN 1151: Temperature at the cylinder exhaust port of the engine.

SPN 1152: Temperature at the cylinder exhaust port of the engine.

PGN 65185 Exhaust Port Temperature 3 - EPT3

Transmission Repetition: 1 s
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 161 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65185 (0xFEA1)

byte	bit	name	SPN	description	available
1-2		**Engine Exhaust Gas Port 9 Temperature**	**1145**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
3-4		**Engine Exhaust Gas Port 10 Temperature**	**1146**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
5-6		**Engine Exhaust Gas Port 11 Temperature**	**1147**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
7-8		**Engine Exhaust Gas Port 12 Temperature**	**1148**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**

SPN 1145: Temperature at the cylinder exhaust port of the engine.

SPN 1146: Temperature at the cylinder exhaust port of the engine.

SPN 1147: Temperature at the cylinder exhaust port of the engine.

SPN 1148: Temperature at the cylinder exhaust port of the engine.

PGN 65186 Exhaust Port Temperature 2 - EPT2

Transmission Repetition: 1 s
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 162 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65186 (0xFEA2)

byte	bit	name	SPN	description	available
1-2		**Engine Exhaust Gas Port 5 Temperature**	**1141**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
3-4		**Engine Exhaust Gas Port 6 Temperature**	**1142**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
5-6		**Engine Exhaust Gas Port 7 Temperature**	**1143**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
7-8		**Engine Exhaust Gas Port 8 Temperature**	**1144**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**

SPN 1141: Temperature at the cylinder exhaust port of the engine.

SPN 1142: Temperature at the cylinder exhaust port of the engine.

SPN 1143: Temperature at the cylinder exhaust port of the engine.

SPN 1144: Temperature at the cylinder exhaust port of the engine.

PGN 65187 Exhaust Port Temperature 1 - EPT1

Transmission Repetition: 1 s
Data Length: 8
Extended Data Page: 0
Data Page: 0
PDU Format: 254
PDU Specific: 163 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65187 (0xFEA3)

byte	bit	name	SPN	description	available
1-2		**Engine Exhaust Gas Port 1 Temperature**	**1137**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
3-4		**Engine Exhaust Gas Port 2 Temperature**	**1138**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
5-6		**Engine Exhaust Gas Port 3 Temperature**	**1139**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**
7-8		**Engine Exhaust Gas Port 4 Temperature**	**1140**	**Resolution: 0.03125 deg C/bit, -273 deg C offset Data Range: -273 to 1735 deg C Operational Range: same as data range**	**yes**

SPN 1137: Temperature at the cylinder exhaust port of the engine.

SPN 1138: Temperature at the cylinder exhaust port of the engine.

SPN 1139: Temperature at the cylinder exhaust port of the engine.

SPN 1140: Temperature at the cylinder exhaust port of the engine.

PGN 65200 Trip Time Information 2 - TTI2

Transmission Repetition	On request	
Data Length:	20	
Data Page:	0	
PDU Format:	254	
PDU Specific:	176	PGN Supporting Information:
Default Priority:	7	
Parameter Group Number:	65200 (0xFEB0)	

byte	bit	name	SPN	description	available
1-4		Trip Cruise Time	1034		***no***
5-8		Trip PTO Time	1035		***no***
9-12		**Trip Engine Running Time**	**1036**	**Resolution: 0.05 hr/bit, 0 offset Data Range: 0 to 210,554,060.75 hr Operational Range: same as data range**	***yes***
13-16		**Trip Idle Time**	**1037**	**Resolution: 0.05 hr/bit, 0 offset Data Range: 0 to 210,554,060.75 hr Operational Range: same as data range**	***yes***
17-20		Trip Air Compressor On Time	1038		***no***

SPN 1036: Total time accumulated while the engine speed is greater than zero since the last trip reset. Note that time with the ignition switch on but engine speed at zero is not included.

SPN 1037: Total time accumulated while the engine speed is greater than zero, both the PTO and remote PTO is inactive, and the vehicle speed is less than 2 km/h, since the last trip reset. In marine applications, this parameter is defined as the total time accumulated while the engine speed is greater than zero, and less than or equal to 50 RPM greater than low idle, since the last trip reset.

PGN 65203 Fuel Information (Liquid) - LFI

Transmission Repetition: On request
Data Length: 8
Data Page: 0
PDU Format: 254
PDU Specific: 179 PGN Supporting Information:
Default Priority: 7
Parameter Group Number: 65203 (0xFEB3)

byte	bit	name	SPN	description	available
1-4		Total Engine PTO Fuel Used	1028		***no***
5-6		**Trip Average Fuel Rate**	**1029**	**Resolution: 0.05 L/h per bit, 0 offset** **Data Range: 0 to 3,212.75 L/h** **Operational Range: same as data range**	***yes***

SPN 1029: Average fuel rate, equal to trip fuel divided by trip time while the engine speed is above zero, since the last trip reset. This includes idle, PTO (both moving and non-moving) and drive operation but excludes ignition-on time while the engine speed is at zero rpm.

NOTE—This parameter is intended for liquid fueled engines. See SPN 1031 for alternate resolution.

PGN 65213 Fan Drive - FD

Transmission Repetition:	1 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	189	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65213 (0xFEBD)	

byte	bit	name	SPN	description	available
1		**Estimated Percent Fan Speed**	**975**	**Resolution: 0.4 %/bit, 0 offset** **Data Range: 0 to 100 %** **Operational Range: same as data range**	***yes***
2.1	1-4	Fan Drive State	977	0000 Fan off 0111 Default Operation 1001 Manual control Resolution: 16 states/4 bit, 0 offset Data Range: 0 to 15 Operational Range: same as data range	***no***
3-4		Fan Speed	1639		***no***

SPN 975: Estimated fan speed as a ratio of the fan drive (current speed) to the fully engaged fan drive (maximum fan speed). A two state fan (off/on) will use 0% and 100% respectively. A three state fan (off/intermediate/on) will use 0%, 50% and 100% respectively. A variable speed fan will use 0% to 100%. Multiple fan systems will use 0 to 100% to indicate the percent cooling capacity being provided.
Note that the intermediate fan speed of a three state fan will vary with different fan drives, therefore 50% is being used to indicate that the intermediate speed is required from the fan drive.

<u>Note:</u> In case of the Rockford Fan Clutch the signal will show 5% = ON (means full Fan Speed) and 95% = OFF (means Fan Speed is nearly stopped).

PGN 65226 ACTIVE DIAGNOSTIC TROUBLE CODES (DM1)

Transmission Rate:	10ms
Data Length:	Variable
Data page:	0
PDU Format:	254
PDU Specific:	202
Default Priority:	6
Parameter Group Number:	65226 (0xFECA)

byte	bit	name	SPN	description	available
1	1-2	Protect Lamp Status			***no***
1	**3-4**	**Amber Warning Lamp Status**	**3040**	**00 Lamp Off 01 Lamp On**	***yes***
1	**5-6**	**Red Stop Lamp Status**	**3039**	**00 Lamp Off 01 Lamp On**	***yes***
1	7-8	Malfunction Indicator Lamp Status			***no***
2	1-2	Reserved for SAE assignment Lamp Status			***no***
2	3-4	Reserved for SAE assignment Lamp Status			***no***
2	5-6	Reserved for SAE assignment Lamp Status			***no***
2	7-8	Reserved for SAE assignment Lamp Status			***no***
3		SPN, 8 least significant bits of SPN			***no***
4		SPN, second byte of SPN			***no***
5	6-8	SPN, 3 most significant bits			***no***
5	1-5	FMI			***no***
6	1-7	Occurrence Count			***no***
6	8	SPN Conversion Method			***no***

3040: This lamp is used to relay trouble code information that is reporting a problem with the vehicle system but the vehicle need not be immediately stopped.

3039: This lamp is used to relay trouble code information that is of a severe enough condition that it warrants stopping the vehicle.

PGN 65242 Software Identification

Standard setting for SW identification is 40012A20.
Each byte transmits only one ASCII character. So the identification must be transmitted in hex code (does not need more than 6 characters):

40012_{dec} = $9C4C_{hex}$

A 20_{dec} = 14_{hex}

The transmitted value is 9C4C14 $_{hex}$ (ASCII coded 6 byte string).

	No. SW. Fields	Plante		Software				End Delimiter
PV	PV900926	PV900920	PV900921	PV900922	PV900923	PV900924	PV900925	PV900927
J1939 (Pos.Byte in PG)	1	2	3	4	5	6	7	8
SW_{dec}	1	20		40012				42
SW hex	1	14		9C4C				2A
Content PG J1939	1 (dez) 01_{hex}	‚4‘ (ASCII) 34h$_{ex}$	‚1‘(ASCII) 31$_{he}$x	‚C‘(ASCII) 43_{hex}	‚4‘(ASCII) 34_{hex}	‚C‘(ASCII) 43_{hex}	‚9‘(ASCII) 39_{hex}	‚*‘ (ASCII) $2A_{hex}$

Transmission Repetition: On request
Data Length: Variable
Extended Data Page 0
Data Page: 0
PDU Format: 254
PDU Specific: 218 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65242 (0xFEDA)

byte	bit	name	SPN	description	available
1	**-**	**Number of software identifiaction fields**	**965**	**Data Length: 1 byte, Resolution: 1 step/bit 0 offset, Data range: 0 to 250 steps, Optional Range: 0 to 125 Type: measured; Supporting information: PGN reference:65242**	***yes***
2-N	**-**	Software identification.	**234**	**Data Length: Variable – up to 200 characters (“*” delimited) Resolution: ASCII, 0 offset Data range: 0 to 255 per byte, Optional Range: same as data rang,eType: measured Supporting information: PGN reference: 65242**	***yes***

SPN 234: Software identification.
Software identification of an electronic module. As an example, this parameter may be represented with ASCII characters MMDDYYaa where MM ist the month, DD ist the day, YY is the year und aa is the revision number.
Note: The ASCII character “*” is reserved as a delimiter.

SPN 965: Number of software identifiaction fields
Number of software identification designators represented in the software identification group.

PGN 65245 Turbocharger - TC

Transmission Repetition:	1s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	221	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65245 (0xFEDD)	

byte	bit	name	SPN	description	available
1	-	Engine Turbocharger Lube Oil Pressure	104		***no***
2-3	**-**	**Engine Turbocharger 1 Speed Engine**	**103**	**Resolution: 4 rpm/bit, 0 offset** **Data Range: 0 to 257,020 rpm** **Operational Range: same as data range**	***yes***
4	7-8	Engine Turbocharger Oil Level Switch	1665		***no***

SPN 103: Rotational velocity of rotor in the turbocharger.

PGN 65252 Shutdown - SHUTDOWN

Transmission Repetition:	1 s
Data Length:	8
Data Page:	0
PDU Format:	254
PDU Specific:	228 PGN Supporting Information:
Default Priority:	6
Parameter Group Number:	65252 (0xFEE4)

byte	bit	name	SPN	description	available
1.1	1-2	Engine Idle Shutdown has Shutdown Engine	593		***no***
1.3	3-4	Engine Idle Shutdown Driver Alert Mode	594		***no***
1.5	5-6	Engine Idle Shutdown Timer Override	592		***no***
1.7	7-8	Engine Idle Shutdown Timer State	590		***no***
2.7	7-8	Engine Idle Shutdown Timer Function	591		***no***
3.1	1-2	A/C High Pressure Fan Switch	985		***no***
3.3	3-4	Refrigerant Low Pressure Switch	875		***no***
3.5	5-6	Refrigerant High Pressure Switch	605		***no***
4.1	**1-2**	**Engine Wait to Start Lamp**	**1081**	**00 - Off** **01 - On** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range: same as data range**	***yes***
5.1	**1-2**	**Engine Protection System has Shutdown Engine**	**1110**	**Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range:same as data range**	***yes***
5.3	3-4	Engine Protection System Approaching Shutdown	1109		***no***
5.5	5-6	Engine Protection System Timer Override	1108		***no***
5.7	7-8	Engine Protection System Timer State	1107		***no***
6.7	7-8	Engine Protection System Configuration	1111		***no***
7.1	1-2	Engine Alarm Acknowledge	2815		***no***
7.3	3-4	Engine Alarm Output Command Status	2814		***no***
7.5	5-6	Engine Air Shutoff Command Status	2813		***no***
7.7	7-8	Engine Overspeed Test	2812		***no***

SPN 1081: Lamp signal which indicates that the engine is too cold to start and the operator should wait until the signal becomes inactive (turns off).

SPN 1110: Status signal which indicates whether or not the engine protection system has shutdown the engine. See Figure

PGN 65253 Engine Hours, Revolutions - HOURS

Transmission Repetition:	On request	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	229	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65253 (0xFEE5)	

byte	bit	name	SPN	description	available
1-4	**-**	**Engine Total Hours of Operation**	**247**	**Resolution: 0.05 hr/bit, 0 offset** **Data Range: 0 to 210,554,060.75 hr** **Operational Range: same as data range**	***yes***
5-8	-	Engine Total Revolutions	249		***no***

SPN 247: Accumulated time of operation of engine.

PGN 65257 Fuel Consumption (Liquid) - LFC

Transmission Repetition:	On request	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	233	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65257 (0xFEE9)	

byte	bit	name	SPN	description	available
1-4	**-**	**Engine Trip Fuel**	**182**	**Resolution: 0.5 L/bit, 0 offset Data Range: 0 to 2,105,540,607.5 L Operational Range: same as data range**	***yes***
5-8	**-**	**Engine Total Fuel Used**	**250**	**Resolution: 0.5 L/bit, 0 offset Data Range: 0 to 2,105,540,607.5 L Operational Range: same as data range**	***yes***

SPN 182: Fuel consumed during all or part of a journey.

SPN 250: Accumulated amount of fuel used during vehicle operation.

PGN 65262 Engine Temperature 1 - ET1

Transmission Repetition: 1 s
Data Length: 8
Data Page: 0
PDU Format: 254
PDU Specific: 238 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65262 (0xFEEE)

byte	bit	name	SPN	description	available
1		**Engine Coolant Temperature**	**110**	**Resolution: 1 deg C/bit, -40 deg C offset** **Data Range: -40 to 210 deg C** **Operational Range: same as data r ange**	***yes***
2		**Engine Fuel Temperature**	**174**	**Resolution: 1 deg C/bit, -40 deg C offset** **Data Range: -40 to 210 deg C** **Operational Range: same as data range**	***yes***
3-4		**Engine Oil Temperature 1**	**175**	**Resolution: 0.03125 deg C/bit, -273 deg C offset** **Data Range: -273 to 1735 deg C** **Operational Range: same as data range**	***yes***
5-6		Engine Turbocharger Oil Temperature	176		***no***
7		**Engine Intercooler Temperature**	**52**	**Resolution: 1 deg C/bit, - 40 deg C offset** **Data Range: -40 to 210 deg C** **Operational Range: same as data range**	***yes***
8		Engine Intercooler Thermostat Opening	1134		***no***

SPN 110: Temperature of liquid found in engine cooling system.

SPN 174: Temperature of fuel entering injectors.

SPN 175: Temperature of the engine lubricant.

SPN 52: Temperature of liquid found in the intercooler located after the turbocharger.

PGN 65263 Engine Fluid Level/Pressure 1 - EFL/P1

Transmission Repetition: 0.5 s
Data Length: 8
Data Page: 0
PDU Format: 254
PDU Specific: 239 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65263 (0xFEEF)

byte	bit	name	SPN	description	available
1	**-**	**Engine Fuel Delivery Pressure**	**94**	**Resolution: 4 kPa/bit, 0 offset Data Range: 0 to 1000 kPa Operational Range: same as data range**	***yes***
2	-	Engine Extended Crankcase Blow-by Pressure	22		***no***
3	-	Engine Oil Level	98		***no***
4	**-**	**Engine Oil Pressure**	**100**	**Resolution: 4 kPa/bit, 0 offset Data Range: 0 to 1000 kPa Operational Range: same as data range**	***yes***
5-6	**-**	**Engine Crankcase Pressure**	**101**	**Resolution: 1/128 kPa/bit, -250 kPa offset Data Range: -250 kPa to 251.99 kPa Operational Range: same as data range**	***yes***
7	**-**	**Engine Coolant Pressure**	**109**	**Resolution: 2 kPa/bit, 0 offset Data Range: 0 to 500 kPa**	***yes***
8	-	Engine Coolant Level	111	Resolution: 0.4 %/bit, 0 offset Data Range: 0 to 100 % Operational Range: same as data range	***no***

SPN 94: Gage pressure of fuel in system as delivered from supply pump to the injection pump.

SPN 100: Gage pressure of oil in engine lubrication system as provided by oil pump.

SPN 101: Gage pressure inside engine crankcase.

SPN 109: Gage pressure of liquid found in engine cooling system.

SPN 111: Ratio of volume of liquid found in engine cooling system to total cooling system volume. Typical monitoring location is in the coolant expansion tank

PGN 65266 Fuel Economy (Liquid) - LFE

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	242	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65266 (0xFEF2)	

byte	bit	name	SPN	description	available
1-2	**-**	**Engine Fuel Rate**	**183**	**Resolution: 0.05 L/h per bit, 0 offset** **Data Range: 0 to 3,212.75 L/h** **Operational Range: same as data range**	***yes***
3-4	-	Engine Instantaneous Fuel Economy	184		***no***
5-6	-	Engine Average Fuel Economy	185		***no***
7	-	Engine Throttle Position	51		***no***

SPN 183: Amount of fuel consumed by engine per unit of time.

PGN 65270 Inlet/Exhaust Conditions 1 - IC1

Transmission Repetition:	0.5 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	246	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65270 (0xFEF6)	

byte	bit	name	SPN	description	available
1	-	Engine Particulate Trap Inlet Pressure	81		***no***
2	**-**	**Engine Turbocharger Boost Pressure**	**102**	**Resolution: 2 kPa/bit, 0 offset** **Data Range: 0 to 500 kPa** **Operational Range: same as data range**	***yes***
3	**-**	**Engine Intake Manifold 1 Temperature**	**105**	**Resolution: 1 deg C/bit, -40 deg C offset** **Data Range: -40 to 210 deg C** **Operational Range: same as data range**	***yes***
4	-	Engine Air Inlet Pressure	106		***no***
5	**-**	**Engine Air Filter 1 Differential Pressure**	**107**	**Resolution: 0.05 kPa/bit, 0 offset** **Data Range: 0 to 12.5 kPa** **Operational Range: same as data range**	***yes***
6-7	-	Engine Exhaust Gas Temperature	173		***no***
8	-	Engine Coolant Filter Differential Pressure	112		***no***

SPN 102: Gage pressure of air measured downstream on the compressor discharge side of the turbocharger

SPN 105: Temperature of pre-combustion air found in intake manifold of engine air supply system.

SPN 107: Change in engine air system pressure, measured across the filter, due to the filter and any accumulation of solid foreign matter on or in the filter.

PGN 65271 Vehicle Electrical Power - VEP

Transmission Repetition:	1 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	247	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65271 (0xFEF7)	

byte	bit	name	SPN	description	available
1		Net Battery Current	114		***no***
2		Alternator Current	115		***no***
3-4		Alternator Potential (Voltage)	167		***no***
5-6		Electrical Potential (Voltage)	168		***no***
7-8		**Battery Potential (Voltage), Switched**	**158**	**Resolution: 0.05 V/bit, 0 offset Data Range: 0 to 3212.75 V Operational Range: same as data range**	***yes***

SPN 158: Electrical potential measured at the input of the electronic control unit supplied through a switching device.

PGN 65276 Dash Display - DD

Transmission Repetition: 1s
Data Length: 8
Data Page: 0
PDU Format: 254
PDU Specific: 252 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65276 (0xFEFC)

byte	bit	name	SPN	description	available
1		Washer Fluid Level	80		***no***
2		Fuel Level	96		***no***
3		**Engine Fuel Filter Differential Pressure**	**95**	**Resolution: 2 kPa/bit, 0 offset Data Range: 0 to 500 kPa Operational Range: same as data range**	***yes***
4		Engine Oil Filter Differential Pressure	99	Resolution: 0.5 kPa/bit, 0 offset Data Range: 0 to 125 kPa Operational Range: same as data range	***no***
5-6		Cargo Ambient Temperature	169		***no***

SPN 95: Change in fuel delivery pressure, measured across the filter, due to accumulation of solid or semisolid matter on the filterelement.

PGN 65279 Water in Fuel Indicator - WFI

Transmission Repetition:	10 s	
Data Length:	8	
Data Page:	0	
PDU Format:	254	
PDU Specific:	255	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65279 (0xFEFF)	

byte	bit	name	SPN	description	available
1.1	**1-2**	**Water In Fuel Indicator**	**97**	**00 - No** **01 - Yes** **Resolution: 4 states/2 bit, 0 offset** **Data Range: 0 to 3** **Operational Range:** **same as data range**	***yes***

SPN 97: Signal which indicates the presence of water in the fuel.

10.7.2.4. Command sent to Vehicle Control - Proprietary

PGN65280 Engine Alarms 1

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	0	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65280 (0xFF00)	

byte	bit	name	MTU-Ref.	description	avail-able
1	3-4	Power Reduction Active	PV001009	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	LO P-Lube Oil	PV001029	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	LOLO P-Lube Oil	PV001030	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	LO P-Fuel	PV001047	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	LOLO P-Fuel	PV001048	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	LO P-Charge Air	PV001050	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	HI P-Lube Oil Differential	PV001054	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	LO Coolant Level	PV001055	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	3-4	HI Charger Speed ETC1	PV001058	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
3	5-6	LO P-Fuel (Common Rail)	PV001064	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	7-8	HI P-Fuel (Common Rail)	PV001065	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	HIHI Charger Speed ETC1	PV001070	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	AL ECU Defect	PV001116	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	5-6	AL Speed Demand Defect	PV001118	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	LO Power Supply	PV001122	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	1-2	HI Power Supply	PV001123	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	HI T-Coolant	PV001129	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	5-6	HIHI T-Coolant	PV001130	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	HI T-Charge Air	PV001133	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	1-2	HI T-Lube Oil	PV001143	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	3-4	HIHI T-Lube Oil	PV001144	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	1-2	HIHI T-Charge Air	PV001168	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	5-6	SS Engine Speed Low	PV001177	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
7	7-8	AL Check ECU Error Code	PV001178	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	1-2	AL Common Rail Leakage	PV001185	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	3-4	HIHI T-Fuel	PV1200	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	5-6	LOLO ECU Power Supply Voltage	PV1270	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	7-8	HIHI ECU Power Supply Voltage	PV1271	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

Power Reduction Active: Alarm Power Reduction active due to malfunction of one of the engine functions.

LO P-Lube Oil: Lub Oil Pressure too low, check engine (Sensor B5.1)

LOLO P-Lube Oil: Lub Oil Pressure below critical limit: engine stop or power reduction (Sensor B5.1)

LO P-Fuel: Fuel Pressure too low (Sensor B34.1)

LOLO P-Fuel: Fuel Pressure below critical limit (Sensor B34.1)

LO P-Charge Air: Charge air pressure too low (Sensor B10)

HI P-Lube Oil Differential: Measuring points before and after oil filter deliver too high difference. Eventually oil filter clogged. (Sensor F25)

LO Coolant Level: Water Level too low - refill water (Sensor F33)

HI Charger Speed ETC1: Exhaust turbo charger speed too high (Sensor B44.1)

LO P-Fuel (Common Rail): High fuel pressure too low (Sensor B48)

HI P-Fuel (Common Rail): High fuel pressure too high (Sensor B48)

HIHI Charger Speed ETC1: Exhaust turbo charger speed exceeded a critical limit. Power reduction (Sensor B44.1)

AL ECU Defect: Internal malfunction of the ADEC-Governor e.g. Integrated Circuit defect.

AL Speed Demand Defect: Engine Speed demand signal not available.

LO Power Supply: 24VDC Power supply to governor too low (<18VDC)

HI Power Supply: 24VDC Power supply to governor too high (>32VDC)

HI T-Coolant: Coolant Water Temperature too high (Sensor B6)

HIHI T-Coolant: Coolant Water Temperature exceeded critical value (Sensor B6)

HI T-Charge Air: Charge Air Temperature too high (Sensor B9)

HI T-Lube Oil: Lube Oil Temperature too high (Sensor B7)

HIHI T-Lube Oil: Lube Oil Temperature exceeds critical value (Sensor B7)

HIHI T-Charge Air: Charge Air Temperature exceeds critical value (Sensor B9)

SS Engine Speed Low: Engine speed dropped below critical value ➔ engine stop by governor

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AL Check ECU Error Code: An ADEC internal alarm occurred which cannot be seen in the SAM and on the J1939 interface. Therefore the operator or service personnel has to check the alarm code (PV1075 Actual Failure Codes) and find the appropriate alarm in a reference list.

AL Common Rail Leakage Common Rail System is leaking.

HIHI T-Fuel: Fuel temperature exceeded a critical value (Sensor B33)

LOLO ECU Power Supply Voltage: 24VDC Power supply to ADEC dropped below critical value (U_{Bat} < 14VDC)

HIHI ECU Power Supply Voltage: 24VDC Power supply to ADEC exceeds critical value (U_{Bat} >36VDC)

PGN65281 Engine Alarms 2

Transmission Repetition: 100 ms or on change
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 1 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65281 (0xFF01)

byte	bit	name	MTU-Ref.	description	avail-able
1	7-8	HI T-Fuel	PV001299	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	5-6	SS Overspeed	PV001003	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

SS Overspeed: Engine speed exceeded critical value (standard: nominal speed +15%) Engine emergency stop, the power transistors are switched off immediately. Sensor Camshaft B1 Sensor Crankshaft B13

HI T-Fuel: Fuel temperature is too high (Sensor B33).

PGN65284 Actual Failure Codes

Transmission Repetition: 1000 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 4 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65284 (0xFF04)

byte	bit	name	MTU-Ref.	description	avail-able
1-2	0	Actual Failure Codes	PV001075	Resolution: 1 digit / Bit Data Range: 0 to 64255digit	***yes***

Actual Failure Codes: valid value: 0 to 999. If there is no alarm, „0" is transmit on the interface, an existing alarm is transmit with its number, are there more alarms they will be transmit in sequence at a rate of 1sec.

PGN65285 Engine Alarms 3

Transmission Repetition: 200 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 5 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65285 (0xFF05)

byte	bit	name	MTU-Ref.	description	avail-able
1	1-2	HIHI T-Coolant Intercooler	PV001398	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

HIHI T-Coolant Intercooler: Coolant Intercooler Temperature exceeds critical value

PGN65287 SAM Alarms 1

Transmission Repetition: 100 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 7 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65287 (0xFF07)

byte	bit	name	MTU-Ref.	Description	available
1	1-2	HI Pressure 1	PV006031	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	3-4	HIHI Pressure 1	PV006033	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	LO Pressure 1	PV006032	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	LOLO Pressure 1	PV006034	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	HI Pressure 2	PV006051	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	HIHI Pressure 2	PV006053	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	LO Pressure 2	PV006052	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	LOLO Pressure 2	PV006054	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	SD Pressure 1	PV006045	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	3-4	SD Pressure 2	PV006065	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	Description	available
3	5-6	SD T-Exhaust 1	PV006019	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	7-8	SD T-Exhaust B	PV006029	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	HI T-Exhaust A	PV006012	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	HIHI T-Exhaust A	PV006013	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	5-6	HI T-Exhaust B	PV006022	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	HIHI T-Exhaust B	PV006023	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	1-2	SD Air Filter Restr.	PV006170	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	SD Fuel Filter Restr.	PV009930	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	5-6	SD Aux Engine Protection	PV009940	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	SD AIN P-Fuel Prefilter	PV005052	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	1-2	HI P-Fuel Prefilter	PV005625	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	3-4	HIHI P-Fuel Prefilter	PV005630	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

HI Pressure 1	Auxiliary pressure 1 too high (1st limit value)
HIHI Pressure 1	Auxiliary pressure 1 too high (2nd limit value)
LO Pressure 1	Auxiliary pressure 1 too low (1st limit value)
LOLO Pressure 1	Auxiliary pressure 1 too low (2nd limit value)
HI Pressure 2	Auxiliary pressure 2 too high (1st limit value)
HIHI Pressure 2	Auxiliary pressure 2 too high (2nd limit value)
LO Pressure 2	Auxiliary pressure 2 too low (1st limit value)
LOLO Pressure 2	Auxiliary pressure 2 too low (2nd limit value)
SD Pressure 1	Sensor defect (auxiliary pressure 1)
SD Pressure 2	Sensor defect (auxiliary pressure 2)
SD T-Exhaust 1	Sensor defect (T-exhaust temperature on A-side)
SD T-Exhaust B	Sensor defect (T-exhaust temperature on B-side)
HI T-Exhaust A	T-exhaust temperature on A-side too high (1st limit value)
HIHI T-Exhaust A	T-exhaust temperature on A-side too high (2nd limit value)
HI T-Exhaust B	T-exhaust temperature on B-side too high (1st limit value)
HIHI T-Exhaust B	T-exhaust temperature on B-side too high (2nd limit value)
SD Air Filter Restr.	Sensor defect (air filter restriction)
SD Fuel Filter Restr.	Sensor defect (fuel filter restriction)
SD Aux Engine Protection	Sensor defect (aux Engine Protection)
SD AIN P-Fuel Prefilter	Sensor defect (fuel prefilter differential pressure)
HI P-Fuel Prefilter	Fuel prefilter differential pressure too high (1st limit value)

PGN65288 CCB Alarms

Transmission Repetition: 100 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 8 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65288 (0xFF08)

byte	bit	name	MTU-Ref.	description	avail-able
1	1-2	MD CAN Speed Demand	PV0099 70	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	3-4	MD CAN Torque Limit 1	PV0099 71	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	MD CAN Torque Limit 2	PV0099 72	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	MD CAN Override	PV0099 73	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	MD CAN Start interlock	PV0099 74	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	MD CAN Engine Start	PV0099 75	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	MD CAN Engine Stop	PV0099 76	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	MD CAN Alarm Reset	PV0099 77	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	MD CAN Lamptest	PV0099 78	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	3-4	MD CAN Speed Setting Limit act	PV0099 79	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	5-6	MD CAN Reset Trip Fuel counter	PV0099 80	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
3	7-8	MD CAN Ext Power curve limit	PV009981	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	MD CAN Park break interlock	PV009982	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	MD CAN Neutral	PV009983	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	5-6	MD CAN Alternate Minimum	PV009984	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	MD CAN Ext Preheating Disable	PV009985	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	1-2	MD Force Max Fan Speed	PV009987	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	MD Disable Cyl. Cut Off	PV009988	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	1-2	AL CCB J1939 Error	PV009995	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	3-4	AL CCB CANopen Error	PV009996	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	5-6	AL CCB Error	PV009997	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

MD CAN Speed Demand	Warning: Speed demand signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Torque Limit 1	Warning: Torque limit 1 signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Torque Limit 2	Warning: Torque limit 2 Signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Override	Warning: Override signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Start interlock	Warning: Start interlock signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Engine Start	Warning: Engine start signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Engine Stop	Warning: Engine stop signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Alarm Reset	Warning: Alarm reset signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Lamptest	Warning: Lamptest signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Speed Setting Limit act	Warning: Speed setting limit active signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Reset Trip Fuel counter	Warning: Reset trip fuel counter signal on the external CAN-bus is missing (J1939/CANopen**)**
MD CAN Ext Power curve limit	Warning: Ext. power curve limit signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Park break interlock	Warning: Park break interlock signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Neutral	Warning: Neutral signal on the external CAN-bus is missing (J1939/CANopen)
MD CAN Alternate Minimum	Warning: Alternate minimum signal on the external CAN-bus is missing (J1939/CANopen**)**
MD CAN Ext Preheating Disable	Warning: Ext. preheating disable signal on the external CAN-bus is missing (J1939/CANopen)
MD Force Max Fan Speed	Warning: Force max. fan speed signal on the external CAN-bus is missing (J1939/CANopen)
MD Disable Cylinder Cut Out	Warning: Disable cylinder cut out signal on the external CAN-bus is missing (J1939/CANopen)

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MD J1939 Override Ctrl. Mode	Warning: J1939 override ctrl. mode signal on the external CAN-bus is missing (J1939/CANopen)
AL CCB J1939 Error	Warning: Internal failure mode on the external CAN-bus converter detected (J1939)
AL CCB CANopen Error	Warning: Internal failure mode on the external CAN-bus converter detected (CANopen)
AL CCB Error	Warning: Internal Failure Mode on the external CAN-bus converter detected (Common Failure).

PGN65289 EMU Alarms 1

Transmission Repetition: 1000 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 9 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65289 (0xFF09)

byte	bit	name	MTU-Ref.	description	avail-able
1	1-2	HI T-Exhaust A1	PV002302	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	3-4	HI T-Exhaust A2	PV002303	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	HI T-Exhaust A3	PV002304	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	HI T-Exhaust A4	PV002305	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	HI T-Exhaust A5	PV002306	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	HI T-Exhaust A6	PV002307	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	HI T-Exhaust A7	PV002308	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	HI T-Exhaust A8	PV002309	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	HI T-Exhaust A9	PV002310	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	3-4	HI T-Exhaust A10	PV002311	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	5-6	HI T-Exhaust B1	PV002312	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
3	7-8	HI T-Exhaust B2	PV002313	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	HI T-Exhaust B3	PV002314	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	HI T-Exhaust B4	PV002315	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	5-6	HI T-Exhaust B5	PV002316	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	HI T-Exhaust B6	PV002317	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	1-2	HI T-Exhaust B7	PV002318	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	HI T-Exhaust B8	PV002319	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	5-6	HI T-Exhaust B9	PV002320	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	HI T-Exhaust B10	PV002401	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	1-2	LO T-Exhaust A1	PV002402	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	3-4	LO T-Exhaust A2	PV002403	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	5-6	LO T-Exhaust A3	PV002404	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	7-8	LO T-Exhaust A4	PV002405	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	1-2	LO T-Exhaust A5	PV002406	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
7	3-4	LO T-Exhaust A6	PV002407	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	5-6	LO T-Exhaust A7	PV002408	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	7-8	LO T-Exhaust A8	PV002409	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	1-2	LO T-Exhaust A9	PV002410	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	3-4	LO T-Exhaust A10	PV002411	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	5-6	LO T-Exhaust B1	PV002412	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	7-8	LO T-Exhaust B2	PV002413	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

HI T-Exhaust A1	Exhaust temperature of cylinder A1 too high (EMU)
HI T-Exhaust A2	Exhaust temperature of cylinder A2 too high (EMU)
HI T-Exhaust A3	Exhaust temperature of cylinder A3 too high (EMU)
HI T-Exhaust A4	Exhaust temperature of cylinder A4 too high (EMU)
HI T-Exhaust A5	Exhaust temperature of cylinder A5 too high (EMU)
HI T-Exhaust A6	Exhaust temperature of cylinder A6 too high (EMU)
HI T-Exhaust A7	Exhaust temperature of cylinder A7 too high (EMU)
HI T-Exhaust A8	Exhaust temperature of cylinder A8 too high (EMU)
HI T-Exhaust A9	Exhaust temperature of cylinder A9 too high (EMU)
HI T-Exhaust A10	Exhaust temperature of cylinder A10 too high (EMU)
HI T-Exhaust B1	Exhaust temperature of cylinder B1 too high (EMU)
HI T-Exhaust B2	Exhaust temperature of cylinder B2 too high (EMU)
HI T-Exhaust B3	Exhaust temperature of cylinder B3 too high (EMU)
HI T-Exhaust B4	Exhaust temperature of cylinder B4 too high (EMU)
HI T-Exhaust B5	Exhaust temperature of cylinder B5 too high (EMU)
HI T-Exhaust B6	Exhaust temperature of cylinder B6 too high (EMU)
HI T-Exhaust B7	Exhaust temperature of cylinder B7 too high (EMU)
HI T-Exhaust B8	Exhaust temperature of cylinder B8 too high (EMU)
HI T-Exhaust B9	Exhaust temperature of cylinder B9 too high (EMU)
HI T-Exhaust B10	Exhaust temperature of cylinder B10 too high (EMU)
LO T-Exhaust A1	Exhaust temperature of cylinder A1 too low (EMU)
LO T-Exhaust A2	Exhaust temperature of cylinder A2 too low (EMU)
LO T-Exhaust A3	Exhaust temperature of cylinder A3 too low (EMU)
LO T-Exhaust A4	Exhaust temperature of cylinder A4 too low (EMU)
LO T-Exhaust A5	Exhaust temperature of cylinder A5 too low (EMU)
LO T-Exhaust A6	Exhaust temperature of cylinder A6 too low (EMU)
LO T-Exhaust A7	Exhaust temperature of cylinder A7 too low (EMU)

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LO T-Exhaust A8 Exhaust temperature of cylinder A8 too low (EMU)

LO T-Exhaust A9 Exhaust temperature of cylinder A9 too low (EMU)

LO T-Exhaust A10 Exhaust temperature of cylinder A10 too low (EMU)

LO T-Exhaust B1 Exhaust temperature of cylinder B1 too low (EMU)

LO T-Exhaust B2 Exhaust temperature of cylinder B2 too low (EMU)

PGN65290 EMU Alarms 2

Transmission Repetition: 1000 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 10 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65290 (0xFF0A)

byte	bit	name	MTU-Ref.	description	avail-able
1	3-4	LO T-Exhaust B4	PV002415	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	LO T-Exhaust B5	PV002416	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	LO T-Exhaust B6	PV002417	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	LO T-Exhaust B7	PV002418	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	1-2	LO T-Exhaust B3	PV002414	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	LO T-Exhaust B8	PV002419	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	LO T-Exhaust B9	PV002420	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	LO T-Exhaust B10	PV002620	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	AL T-Exhaust out of Range Limit2	PV002512	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	3-4	AL Exhaust Monitoring Fail	PV002612	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	5-6	AL EMU Voltage 11V	PV002613	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
3	7-8	AL EMU Voltage -7V	PV002451	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	SD T-Exhaust A1	PV002452	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	SD T-Exhaust A2	PV002453	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	5-6	SD T-Exhaust A3	PV002454	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	SD T-Exhaust A4	PV002455	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	1-2	SD T-Exhaust A5	PV002456	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	SD T-Exhaust A6	PV002457	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	5-6	SD T-Exhaust A7	PV002458	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	SD T-Exhaust A8	PV002459	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	1-2	SD T-Exhaust A9	PV002460	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	3-4	SD T-Exhaust A10	PV002461	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	5-6	SD T-Exhaust B1	PV002462	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	7-8	SD T-Exhaust B2	PV002463	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	1-2	SD T-Exhaust B3	PV002464	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

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byte	bit	name	MTU-Ref.	description	avail-able
7	3-4	SD T-Exhaust B4	PV002465	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	5-6	SD T-Exhaust B5	PV002466	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	7-8	SD T-Exhaust B6	PV002467	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	1-2	SD T-Exhaust B7	PV002468	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	3-4	SD T-Exhaust B8	PV002469	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	5-6	SD T-Exhaust B9	PV002470	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	7-8	SD T-Exhaust B10	PV002201	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

LO T-Exhaust B3 Exhaust temperature of cylinder B3 too low (EMU)

LO T-Exhaust B4 Exhaust temperature of cylinder B4 too low (EMU)

LO T-Exhaust B5 Exhaust temperature of cylinder B5 too low (EMU)

LO T-Exhaust B6 Exhaust temperature of cylinder B6 too low (EMU)

LO T-Exhaust B7 Exhaust temperature of cylinder B7 too low (EMU)

LO T-Exhaust B8 Exhaust temperature of cylinder B8 too low (EMU)

LO T-Exhaust B9 Exhaust temperature of cylinder B9 too low (EMU)

LO T-Exhaust B10 Exhaust temperature of cylinder B10 too low (EMU)

AL Exhaust Monitoring Fail Warning: Exhaust Temperature Monitoring fail (EMU)

AL Press Monitoring Fail (EMU) Warning: pressure monitoing fail (EMU)

AL EMU 11V Warning: Sensor Voltage for Temperature Measuring out of range (EMU)

AL EMU -7V Warning: Sensor Voltage for Temperature Measuring out of range (EMU)

SD T-Exhaust A1 Sensor defective (Exhaust Temperature Cylinder A1)

SD T-Exhaust A2 Sensor defective (Exhaust Temperature Cylinder A2)

SD T-Exhaust A3 Sensor defective (Exhaust Temperature Cylinder A3)

SD T-Exhaust A4 Sensor defective (Exhaust Temperature Cylinder A4)

SD T-Exhaust A5 Sensor defective (Exhaust Temperature Cylinder A5)

SD T-Exhaust A6 Sensor defective (Exhaust Temperature Cylinder A6)

SD T-Exhaust A7 Sensor defective (Exhaust Temperature Cylinder A7)

SD T-Exhaust A8 Sensor defective (Exhaust Temperature Cylinder A8)

SD T-Exhaust A9 Sensor defective (Exhaust Temperature Cylinder A9)

SD T-Exhaust A10 Sensor defective (Exhaust Temperature Cylinder A10)

SD T-Exhaust B1 Sensor defective (Exhaust Temperature Cylinder B1)

SD T-Exhaust B2 Sensor defective (Exhaust Temperature Cylinder B2)

SD T-Exhaust B3 Sensor defective (Exhaust Temperature Cylinder B3)

SD T-Exhaust B4 Sensor defective (Exhaust Temperature Cylinder B4)

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SD T-Exhaust B5	Sensor defective (Exhaust Temperature Cylinder B5)
SD T-Exhaust B6	Sensor defective (Exhaust Temperature Cylinder B6)
SD T-Exhaust B7	Sensor defective (Exhaust Temperature Cylinder B7)
SD T-Exhaust B8	Sensor defective (Exhaust Temperature Cylinder B8)
SD T-Exhaust B9	Sensor defective (Exhaust Temperature Cylinder B9)
SD T-Exhaust B10	Sensor defective (Exhaust Temperature Cylinder B10)

PGN65296 Status Information 1

Transmission Repetition:	200 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	16	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65296(0xFF10)	

byte	bit	name	MTU-Ref.	description	avail-able
1	1-2	External Stop Activated	PV001001	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	3-4	Torque Limitation Active	PV001009	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	Speed Demand Fail Mode	PV001013	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	Engine Running	PV001068	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	Cylinder Cutout	PV001074	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	Preaheat Temp. Not Reached	PV001089	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	5-6	Ready for Start	PV005211	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	7-8	Prelube System On	PV005271	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	Preheating HT ON	PV005520	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	Preheating NT ON	PV005530	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	7-8	Alarm SAM System Fault	PV005996	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

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byte	bit	name	MTU-Ref.	description	avail-able
7	3-4	Speed Window 1	PV001076	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	5-6	Speed Window 2	PV001077	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	1-2	Engine Shutdown follow-up	PV005055	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	3-4	Preheat System ON	PV005514	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
8	7-8	MTU MCS-5 Bus Failure	PV005998	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

External Stop Activated: Engine is stopped from external. 0 = no Stop; 1 = Stop

Torque Limitation Active: Power limitation is active if set = 1

Speed Demand Fail Mode: Reaction of engine if speed demand fails. 0 = Actual speed will be maintained; 1 = Replacement value will be used.

Engine Running: Engine operates.

Cylinder Coutout: Cylinder cut out Active: Engine is running in half engine mode.

Ready for Start: Indicates if an engine start or the oil prelube procedure can be initialized.

Prelube System ON: Indicates if prelube procedure is active.

Preheat Temp. Not Reached: Alarm if coolant is below preheat temperature.

Preheating HT ON: Preheating high temperature is switched on.

Preheating NT ON: Preheating low temperature is switched on.

Alarm SAM System Fault: Indicates if SAM detects an internal system fault.

Speed Window 1: Indicated if engine speed is within a defined speed window.

Speed Window 2: Indicated if engine speed is within a defined speed window.

Engine Shutdown follow-up: Indicates that the engine stop has been activated, and that the engine will be stopped after the follow-up procedure has been expired.

Preheating HT ON: Preheating system is running.

MTU MCS-5 Bus Failure: Indicates if CAN connection between SAM and ADEC is lost.

PGN65297 Engine Alarms 4

Transmission Repetition:	200 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	17	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65297(0xFF11)	

byte	bit	name	MTU-Ref.	description	avail-able
1	1-2	HI P-Crankcase	PV001034	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	3-4	HIHI P-Crankcase	PV001035	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	5-6	LO P-Coolant after Pump	PV001039	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
1	7-8	LOLO P-Coolant after Pump	PV001040	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	1-2	LO P-Coolant Intercooler	PV001044	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	3-4	LOLO P-Coolant Intercooler	PV001045	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	5-6	LO Intercoolant Level	PV001099	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
2	7-8	HI T-Coolant Intercooler	PV001139	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
3	1-2	AL Prelubrication Fault	PV001237	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	1-2	LO T-Preheat	PV001357	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
4	3-4	LOLO T-Preheat	PV001358	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

byte	bit	name	MTU-Ref.	description	avail-able
5	1-2	HI Air Filter Restr	PV009910	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	3-4	HI Fuel Filter Restr.	PV009920	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	5-6	Hi Aux Engine Protection	PV009930	6 5 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
5	7-8	AL Aux Protection Switch	PV009940	8 7 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
6	1-2	Wire Brake SAM Fan Control 1	PV006531	2 1 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***
7	3-4	Wire Brake SAM Fan Control 1	PV006541	4 3 0 0 False 0 1 True 1 0 Sensor Defekt 1 1 Missing Data	***yes***

HI P-Crankcase (ECU): Crankcase pressure too high

HIHI P-Crankcase (ECU): Crankcase pressure exceeded critical limit

LO P-Coolant after Pump (ECU): Coolant pressure after pump too low.

LOLO P-Coolant after Pump (ECU): Coolant pressure after pump has fallen below critical limit

LO P-Coolant Intercooler (ECU): P-Coolant intercooler pressure too low

LOLO P-Coolant Intercooler (ECU): P-Coolant intercooler pressure has fallen below critical limit

LO Intercoolant Level Water Level for intercoolant circuit too low - refill water

HI T-Coolant Intercooler (ECU): Coolant Intercooler temperature too high.

AL Prelubrication Fault (ECU): If function is used: Lube oil pressure must exceed a programmable value within a certain time, else Alarm.

LO T-Preheat (ECU): Preheat temperature below programmed value

LOLO T-Preheat (ECU): Preheat temperature below critical value

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HI Air Filter Restr (SAM): Selection via PR341:
0 = no monitoring;
1 = Message;
2 = Yellow Alarm;
3 = Red Alarm;
4 = SS - Alarm

HI Fuel Filter Restr.: Fuel filter differential pressure too high

Hi Aux Engine Protection: Aux engine protection exceeded alarm limit

AL Aux Protection Switch: Aux engine protection has been activated

Wire Brake SAM Fan Control 1: Monitoring of fan control circuit has detect an broken wire

Wire Brake SAM Fan Control 1: Monitoring of fan control circuit has detect an broken wire

PGN65310 Engine Speed Demand

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	30	Supporting Information:
Default Priority:	6	
Parameter Group Number:	65310 (0xFF1E)	

byte	bit	name	MTU-Ref.	description	avail-able
5-6	0	Selected Speed Demand	PV001016	Resolution: 0.125 rpm/bit Data Range: 0 to 8,031.875	***yes***
7-8	0	Effective Engine Speed Demand	PV001017	Resolution: 0.125 rpm/bit Data Range: 0 to 8,031.875	***yes***

Selected Speed Demand: Speed demand of the governor

Effective Engine Speed Demand: Engine speed demand after calculation of droop.

PGN65311 Status Start Sequence

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	31	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65311 (0xFF1F)	

byte	bit	name	MTU-Ref.	description	avail-able
5-8	0	Status Start Sequence	PV0010 21	Resolution: 1digit / bit Data Range: 0 to 4,294,967,295 digit	***yes***

Status Start Sequence			**ptPV_EngineStartingStates**
Bit	**Bezeichnung Status-Bit**	**z.k.p.-Nr.**	**Beschreibung**
0	Startfreigabe- Start Release	2.1090.010	Freigabe zum Starten des Motors
1	Rückmeldung Local feedback local		Rückmeldung, dass Steuerkommandos lokal zum Motor geschaltet sind
2	Start aktiviert Start activated	2.1090.012	Startablauf im Gange (auch bei Notstart)
3	Anlasser Starter motor on	2.1090.013	Anlasser einschalten: über CAN, als auch über Binärausgang (PV) möglich.
4	Vorschmierpumpe Pre Lub oil pump	2.1090.014	Vorschmierpumpe einschalten: über CAN, als auch über Binärausgang (PV) möglich.
5	Lampe Vorschmierpumpe lamp	2.1090.015	Anzeige, dass Vorschmierpumpe aktiv ist.
6	Vorglühen preglow		Vorglühen über CAN aktivieren.
7	n > 80	2.1090.017	Info-Bit Anlasserdrehzahl erreicht
8	n > 300	2.1090.018	Info-Bit Ausrückdrehzahl erreicht
9	Leerlaufdrehzahl erreicht idle speed	2.1090.019	Info-Bit Leerlaufdrehzahl erreicht
10	Startabbruch CAN start termination	2.1090.020	Info-Bit, dass Startabbruch erfolgt ist
11	Start wiederholen start repeat	2.1090.021	
12	Anlassen start engine		Motor starten
13	Raildruck nicht erreicht		Raildruck prüfen High Pressure not reached
14	Rückmeldung Starttaste	2.1090.024	Motor-Startanweisung feedback start pushbutton
15	Rückmeldung Entwässern		
16	Startabbruch T-Kühlmittel	2.1090.026	Startabbruch aufgrund zu niedriger Kühlmitteltemperatur start termination due to low coolant temperature
17	Startabbruch P-Schmieröl		start termination due to no lub oil pressure
18	Abbruch Turnen	2.1090.028	Manuelles Drehen beendet oder abgebrochen.
19	Turnen	2.1090.029	Entwässern oder Sicherheitsturnen (entspricht Ventil)
20	Notstart		
21	Startfreigabe Override aktiv		
22	Betriebsklar-Taste Rückmeldung		
23	Startfreigabe Kupplung NEUTRAL		
24	Startfreigabe SSK Closed		
25	Startsperre manuelles Turnen		STARTBLO
26	Starttastenleuchte	2.1090.036	Bit in MDEC nicht benutzt Pushbutton lamp Start
27	Startsperre ext. Startverriegelung		
28	Startsperre automatischer Stop		Security Shutdown-Signal von MCS
29	Flammstart ausführen		
30	Reserviert		immer 0 aus Gründen der Abwärtskompatibilität
31	Reserviert		immer 0 aus Gründen der Abwärtskompatibilität

PGN65318 Optimum Load signal / Requested Torque

Transmission Repetition: 10 ms
Data Length: 8
Data Page: 0
PDU Format: 255
PDU Specific: 38 PGN Supporting Information:
Default Priority: 6
Parameter Group Number: 65318 (0xFF26)

byte	bit	name	MTU-Ref.	description	avail-able
1		Optimum Load Signal (OLS) PWM	PV1314	Resolution: 1 %/bit Data Range: -125% to +125 %	***yes***
3-4		Requested Torque	PV1409	Resolution: 1 Nm/bit Data Range: 0 to 64,255 Nm	***yes***
5-6		SAM Fan Control Fan 1	PV006532	Resolution: 0,0025 %/bit Data Range: 0 to 160,6375 %	***yes***
7-8		SAM Fan Control Fan 2	PV006542	Resolution: 0,0025 %/bit Data Range: 0 to 160,6375 %	***yes***

Optimum Load Signal (OLS) PWM: The OLS is implemented in Rail and C&I applications and is used for governing the generator in Diesel-electric plants. It is the deviation of requested torque to a programmed power control curve. The curve is engine speed related to torque. The signal serves the generator for its load control. A signal smaller than the mean value (normally 50%) means the actual load is higher than the Power curve and thus overloading the engine. The generator has to decrease its load. A signal higher than the mean value means the actual load is lower than the Power curve and the generator can increase its load.

The following values have an influence onto the OLS:
- Power reduction due to monitored values like T-Coolant, T-Lube Oil, P-Coolant…..
- Power reduction due to Charge Air Pressure.
- Increase of Speed Demand

Requested Torque: The actual required Torque. The powe output can be calculated by:

$$P = \omega M = 2\pi f M = \frac{2\pi}{60} n M = \frac{\pi}{30} n M \Rightarrow M = \frac{30P}{\pi n}$$

P = Power in W
M = Torque in Nm
n = Engine speed

SAM Fan Control Fan 1: Conrol signal for temperatur dependant fan speed of the high temperature coolant circuit.

SAM Fan Control Fan 1: Conrol signal for temperatur dependant fan speed of the low temperature coolant circuit.

PGN65323 Actual Droop

Transmission Repetition:	100 ms	
Data Length:	8	
Data Page:	0	
PDU Format:	255	
PDU Specific:	43	PGN Supporting Information:
Default Priority:	6	
Parameter Group Number:	65323 (0xFF2B)	

byte	bit	name	MTU-Ref.	description	avail-able
1-2	0	Actual Droop	PV001205	Resolution: 0,0025 %/bit Data Range: 0 to 160,6375 %	***yes***

Actual Droop: allowed speed difference between speed demand and actual engine speed depending on the engine load.

10.7.2.5. Example reading J1939 using PGN 65213

PGN 65213 Fan Drive - FD

The PGN Data Length and PGN data content for PGN 65213 are shown below.

The 'Data Length' attribute for this PGN indicates the PGN has a message data field length of 8 bytes. Only 28 bits of the message data field have data assignments – byte 1, bits 4-1 of byte 2, byte 3 and byte 4. There are 36 unspecified bits in the message – bits 8-5 of byte 2 and bytes 5-8.
When transmitted, the message data field for this PGN must be 8 bytes in length. The 36 unspecified bits must be filled each with a one (1) and the assigned 28 bits must be filled appropriately.

PGN 65213 Fan Drive – FD

Data Length: 8

Start Position	Length	Parameter Name	SPN
1	1 byte	Estimated Percent Fan Speed	975
2.1	4 bits	Fan Drive State	977
3-4	2 bytes	Fan Speed	1639

For analog values with more than 1Byte the following order has to be noticed: first Low-Byte, then High-Byte as the example shows.

Table – Example PGN 65213

<table>
<tr><td colspan="8">Byte 1</td><td colspan="8">Byte 2</td><td colspan="8">Byte 3</td><td colspan="8">Byte 4</td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td colspan="8">SPN 975</td><td colspan="4"></td><td colspan="4">SPN 977</td><td colspan="16">SPN 1639</td></tr>
<tr><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>1</td><td>1</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="16" rowspan="3"></td><td colspan="4">A</td><td colspan="4">5</td><td colspan="4">C</td><td colspan="4">3</td></tr>
<tr><td colspan="8">Low-Byte</td><td colspan="8">High-Byte</td></tr>
<tr><td colspan="16">C3 A5hex = 50.085dez</td></tr>
<tr><td colspan="8">Byte 5</td><td colspan="8">Byte 6</td><td colspan="8">Byte 7</td><td colspan="8">Byte 8</td></tr>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

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11 Appendix C

TIM ID: 0000037532 - 002

PRECONF Function

DPARAMS.DAT [1]

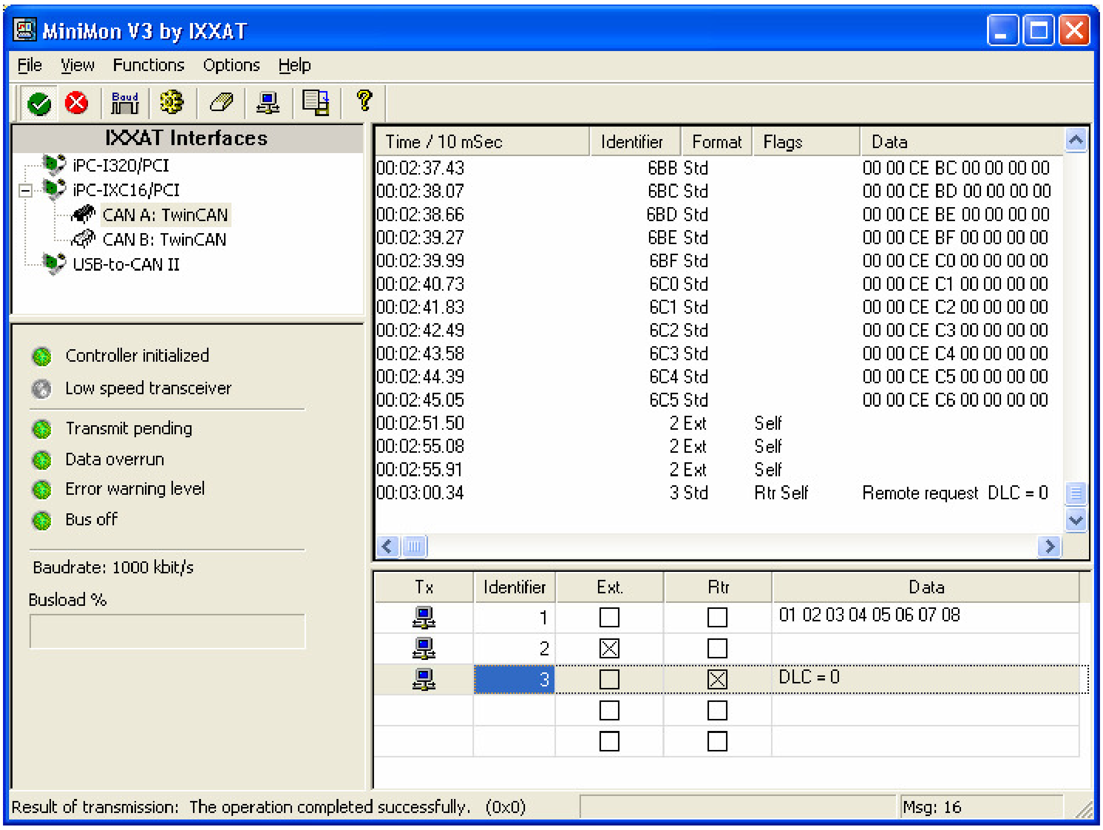
CF-Card root
- PRECONF
  - DPARAMS.DAT [3]
- DPARAMS.DAT [2]

If 1 = 2 then no download of DPARAMS.DAT
else 1 ≠ 2 then …
  If 2 = 3 then 2 will download and overwrite 1 (without dialog)
  else 2 ≠ 3 then Dialog „Load CF-Data (D)?“
    If [Yes] 2 will download and overwrite 1
    else [No] 2 will not be downloaded

miniMon

CAN Monitoring Tool for Windows

Software Version 3



IXXAT

Headquarter
IXXAT Automation GmbH
Leibnizstr. 15
D-88250 Weingarten

Tel.: +49 (0)7 51 / 5 61 46-0
Fax: +49 (0)7 51 / 5 61 46-29
Internet: www.ixxat.de
e-Mail: info@ixxat.de

US Sales Office
IXXAT Inc.
120 Bedford Center Road
USA-Bedford, NH 03110

Phone: +1-603-471-0800
Fax: +1-603-471-0880
Internet: www.ixxat.com
e-Mail: sales@ixxat.com

Support

In case of unsolvable problems with this product or other IXXAT products please contact IXXAT in written form by:

Fax: +49 (0)7 51 / 5 61 46-29
e-Mail: support@ixxat.de

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1 Overview

The miniMon V3 is a CAN monitor program which enables online monitoring of bus traffic on the CAN bus and the transmission of individual CAN objects. The miniMon is contained in the VCI V3 and therefore available under Windows 2000/XP.

The display window of the miniMon V3 provides the following areas:

- Overview of the available CAN interfaces
- Current state of the selected CAN controller
- Display of the messages received
- Display of transmit messages

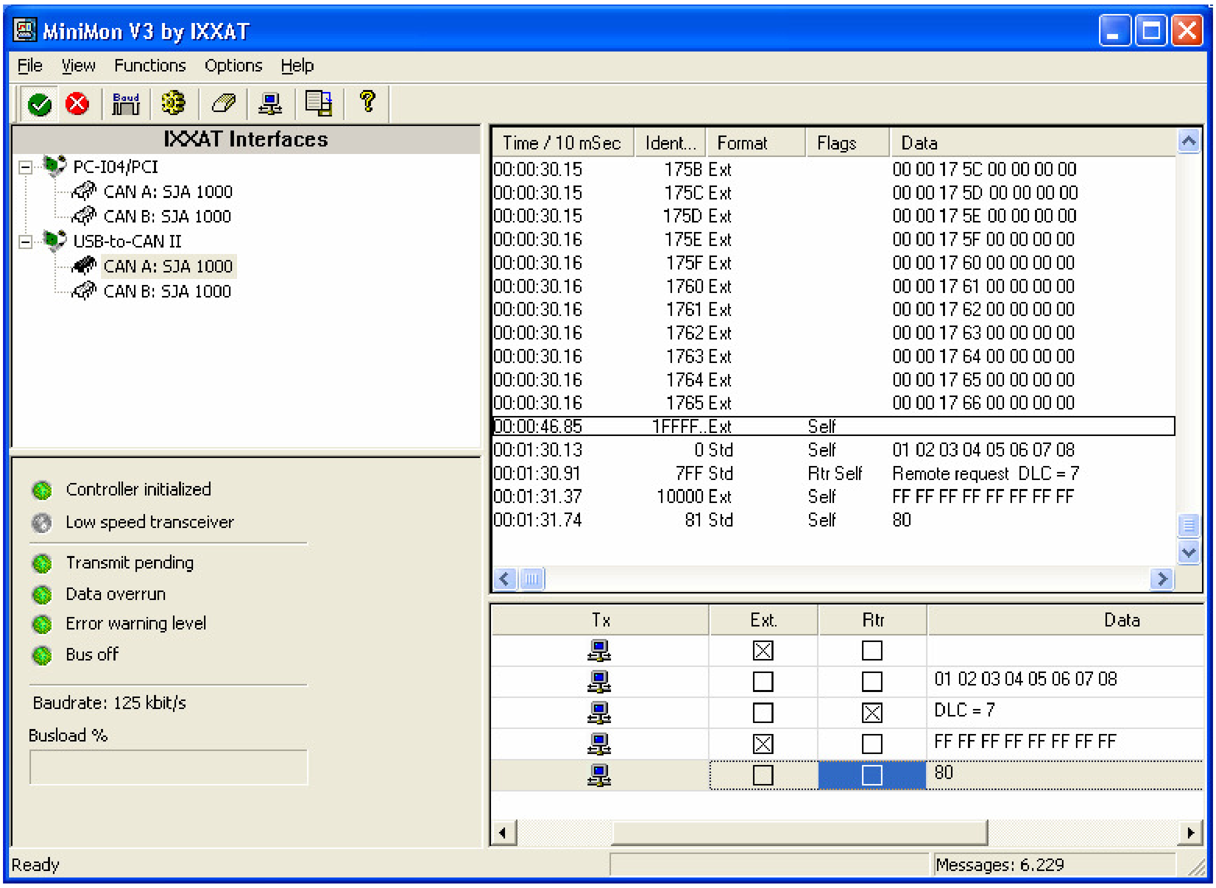


Fig. 1-1: Display window of the miniMon

2 Functions and operation

2.1 Starting the program

Start the miniMon from the Start menu of the VCI or by manually running the file miniMonV3.exe.

If only one CAN controller is available, the controller configuration dialogue is displayed directly, otherwise a controller has to be selected by hand in the controller selection window.

2.2 Configuration of the CAN controller

2.2.1 Selection of the CAN interface

The available CAN interfaces are listed in the top left-hand corner of the program window.

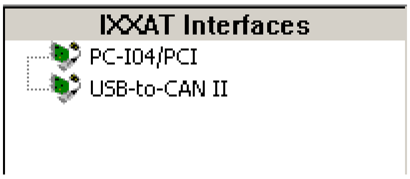


Fig. 2-1: Available CAN interfaces

By clicking once with the left-hand mouse button, additional data are displayed in the bottom left-hand corner.

Fig. 2-2: Information on the selected CAN interface

A "+" symbol now appears in front of the selected CAN interface The available CAN controllers are displayed by clicking on the "+" symbol.

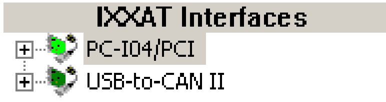


Fig. 2-3: Available controllers on the CAN interface board

2.2.2 Selection and configuration of the CAN controller

Now, a CAN controller can be selected with the mouse button.

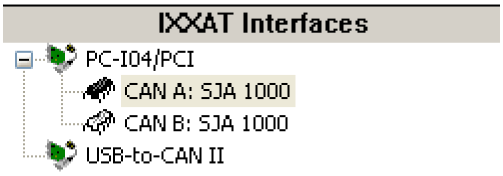


Fig. 2-4: Selected and marked CAN controller

If the selected CAN controller is already used by another program, the icon of the CAN Controller ( ) is blue.

The bit rate to be used can be set via the menu item Options/Configurations. Here you set a specified standard baud rate (according to CiA) or enter the appropriate baud rate for your CAN network via the bit timing register.

If your hardware contains a low speed bus interface, the controller can be switched to the low speed mode.

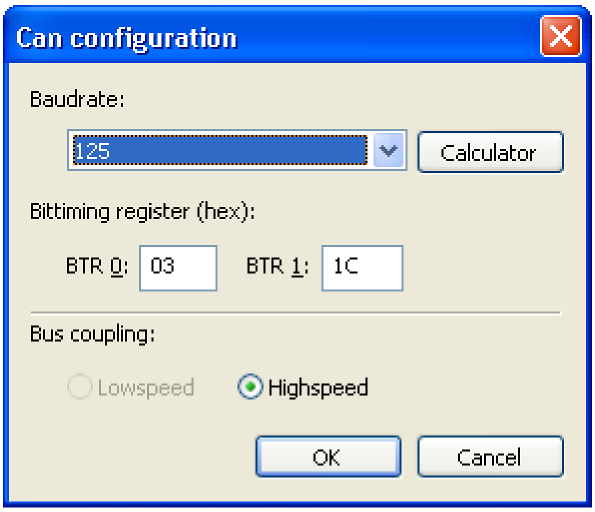


Fig. 2-5: Configuration dialog of the CAN controller

Via the calculator button, a dialogue for calculation of the bit timing parameters can be opened. The relevant bit timing values can be calculated by entering a bit rate.

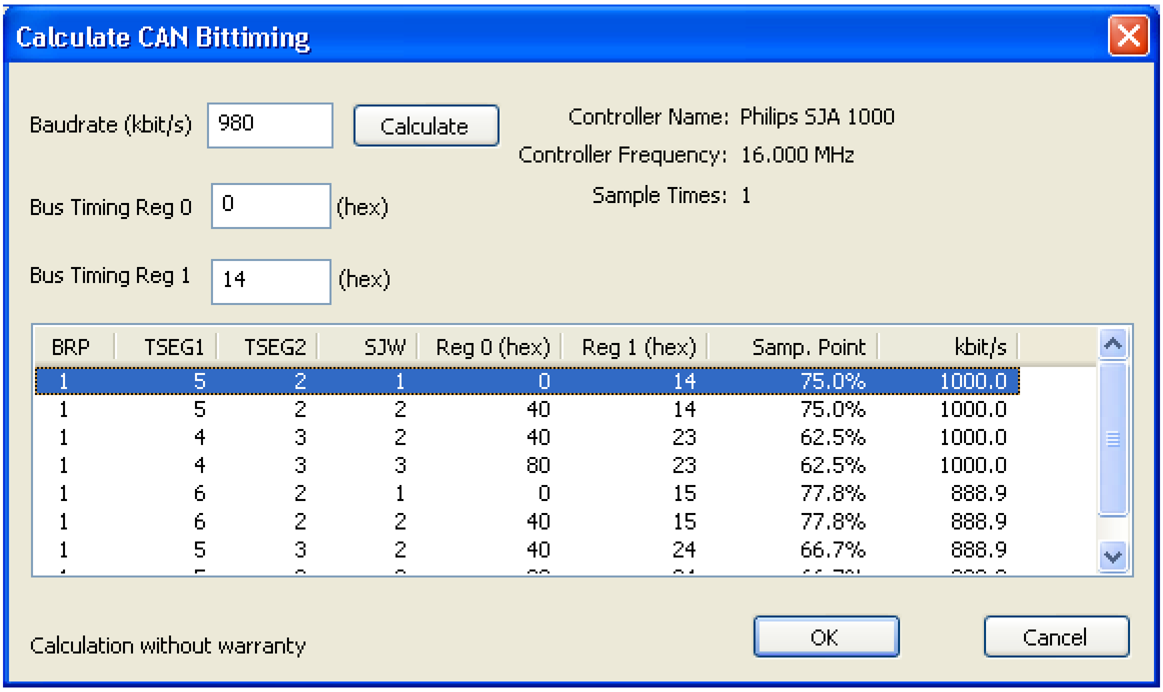


Fig. 2-6: Bit rate configuration

2.2.3 Description of the input boxes

- Baud rate (kBit/s) – Baud rate to be calculated in kBit per second
- Bus Timing Reg 0 – Value of the Bus Timing Register 0
- Bus Timing Reg 1 – Value of the Bus Timing Register 1

2.2.4 Description of the columns in the Calculator window

- BRP – Baud Rate Prescaler
- TSEG1 – Timing Segment 1
- TSEG2 – Timing Segment 2
- SJW – Synchronization Jump Width
- Reg 0 (hex) – Bit timing register 0 (hexadecimal format)
- Reg 1 (hex) – Bit timing register 1 (hexadecimal format)
- Samp. Point – Sample Location
- kbit/s – Calculated baud rate with the values of the marked line

2.2.5 Starting the CAN controller

The CAN controller now can be started via the menu item Functions/Start and is then ready to transmit and receive.

2.3 State of the CAN controller

The current controller state is displayed in the state window in the bottom left-hand corner.

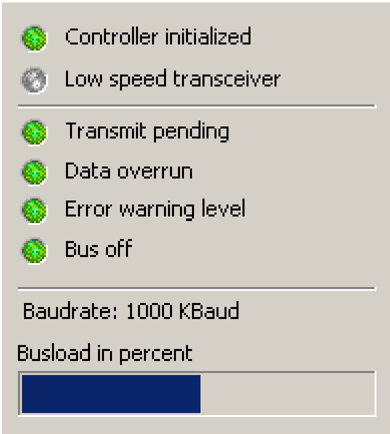


Fig. 2-7: Controller state

2.3.1 Meaning of the state LEDs

Name	Meaning	
Controller initialized	green =	CAN controller is started
Low speed transceiver	green =	Low speed transceiver is enabled
Transmit Pending	red =	There are messages not yet transmitted in the transmit queue
Data overrun	red =	CAN controller data overrun, messages may have been lost
Error warning level	red =	CAN controller in Error warning level
Bus off	red =	CAN controller in Bus off

Below this LEDs, the currently set bit rate is displayed. If the bit rate is not a CiA compliant standard rate, the bit timing values are displayed as hexadecimal figures.

With some CAN interfaces, the current bus load of the CAN bus is displayed as a graphic bar in percent.

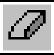
2.4 Menu and toolbar

2.4.1 Menu reference and toolbar buttons

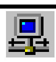
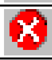
2.4.1.1 File menu

Menu item	Toolbar	Function
Exit		Ends the miniMon

2.4.1.2 View menu

Menu item	Toolbar	Function
Clear		Clears the display of the received data
Toolbar		Shows/hides the toolbar
Statusbar		Shows/hides the statusbar

2.4.1.3 Functions menu

Menu item	Toolbar	Function
Transmit Message		Transmits the currently marked message from the transmit table
Start		Starts the CAN controller
Stop		Stops the CAN controller
Automatic Baud detection		Listens on the CAN bus and attempts to detect the current bit rate
Logging to file		Writes the received data in a CSV file

2.4.1.4 Options menu

Menu item	Toolbar	Function
Configuration		Opens the configuration dialogue

2.4.1.5 Help menu

Menu item	Toolbar	Function
Open Manual		Opens the PDF manual
About		Displays a dialogue with the version information

2.5 Receiving messages

Received CAN objects are displayed in the receive window with timestamp, state, identifier and data.

Time / 10 mSec	Identifier	Format	Flags	Data
00:02:45.05	6C5	Std		00 00 CE C6 00 00 00 00
00:02:51.50	2	Ext	Self	
00:02:55.08	2	Ext	Self	
00:02:55.91	2	Ext	Self	
00:03:00.34	3	Std	Rtr Self	Remote request DLC = 0

Fig. 2-8: Example of received messages

2.5.1 Description of the columns in the Receive window

- **Time** The time of reception of the message is displayed here in increments of 0.01 seconds
- **Identifier** The message identifier is displayed in hexadecimal format
- **Format**
  Std standard CAN format (11 bit identifier)
  Ext extended CAN format (29 bit identifier)
- **Flags** Possible additional information concerning the message
  Ovr Messages were lost after this message
  Rtr A remote request message
  Self Self-reception message, sent by miniMon
- **Data** The data of the CAN message are displayed byte-wise in hexadecimal format

2.5.2 Message filtering

With the aid of the filter, certain messages become visible or invisible (Fig. 2.8.2.). This is selected via the identifier.
The filter dialog contains the following elements:

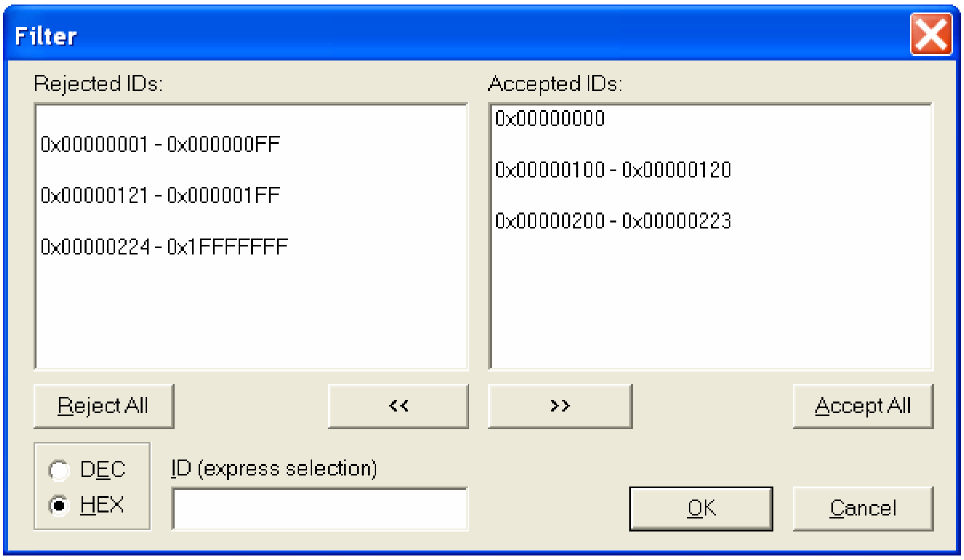


Fig 2.8.2: Id Range Filter configuration

Element	Meaning
Rejected IDs	List of the identifiers whose assigned messages do not pass the filter.
Accepted IDs	List of the identifiers which pass the filter
>>	Assignment of the identifier group selected in the list Rejected IDs to the list Accepted IDs
<<	Deletion of the entry selected in the list Accepted IDs
Accept all	When this button is pressed, all messages are received (all identifiers are entered in the list Accepted IDs)
Reject all	When this button is pressed, all messages are blocked (all identifiers are deleted from the list Accepted IDs and entered in the list Rejected IDs)
ID (express selection)	A filter function can be entered alphanumerically via this command line. This enables quick selection of identifiers. Individual identifiers or complete identifier arrays can be blocked or released. Individual filter commands are separated by a space. The command line facilitates selection of identifiers.
DEZ/HEX	This checkbox is used to select whether the identifiers are displayed in this dialog window in hexadecimal or decimal form.

Syntax of the command line:

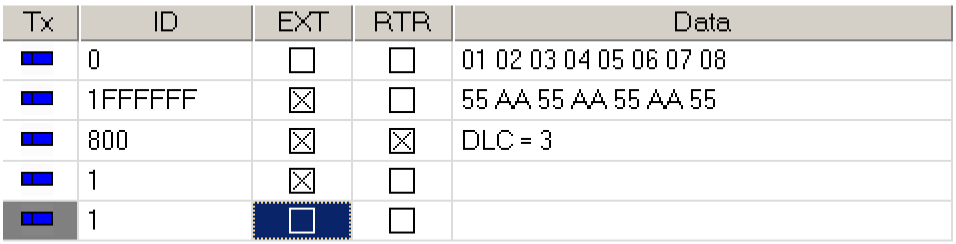
Command	Meaning
-ID	Move identifier ID into the list of rejected IDs
-ID1,ID2	Move identifier array ID1 to ID2 into the list of rejected IDs
+ID	Move identifier ID into the list of accepted IDs
+ID1,ID2	Move identifier array ID1 to ID2 into the list of accepted IDs
e.g.: -3,8	Moves the identifiers 3 to 8 into the list of rejected IDs, i.e. the identifiers 3 to 8 are filtered out

2.6 Transmitting messages

2.6.1 Overview

Individual messages can be sent. This is done by clicking on the symbol in the TX column, or by marking the message and then pressing the "F5" key, or via the menu items Functions/Transmit Message.

Up to 5 transmit messages can be set up.



Tx	ID	EXT	RTR	Data
	0	☐	☐	01 02 03 04 05 06 07 08
	1FFFFFF	☒	☐	55 AA 55 AA 55 AA 55
	800	☒	☒	DLC = 3
	1	☒	☐	
	1	☐	☐	

Fig. 2-9: Example of transmit data

2.6.2 Description of the columns in the transmit window

- **ID** The identifier of the message is displayed here in hexadecimal format.
  In standard format (11 bit), the value can be between 0 and 7FFh.
  In extended format (29 bit), the value can be between 0 and 1FFFFFFFh.
- **EXT** The message is transmitted in extended format (29 bit), even if the identifier is less than 7FFh.
  With an identifier of more than 7FFh, the column is automatically marked with a cross.
- **RTR** If marked, the message is a data request telegram (remote frame).

- **Data** Up to 8 databytes in hexadecimal format can be entered here.
  In the case of two-digit data, the next databyte is automatically jumped to, with single digit data it is possible to move on with the spacebar.
  In the case of data request telegrams, the data length code can be defined here.

2.7 Logging messages

The received CAN messages can be stored in a file as ASCII text.

The format of the text corresponds to the CSV format (comma separated value file) and can be read with Excel.

Here is an example:

ASCII Trace IXXAT miniMon V3 Version: 1.0.0.5				
Date: 31.03.2006				
Start time: 13:22:07				
Stop time: 13:23:34				
Baud rate: 1000 kbit/s				
Time	Identifier (hex)	Format	Flags	Data (hex)
00:03:27.72	770	hrs		00 0C 87 71 00 00 00
00:03:27.72	771	hrs		00 0C 87 72 00 00 00 00
------------- Logging Overrun ---------------------				
00:03:27.73	7DE	hrs		
00:03:27.73	7DF	hrs		00
00:03:27.73	7E0	hrs		00 0C
00:03:27.73	7E1	hrs		00 0C 87
00:03:27.73	7E2	hrs		00 0C 87 E3
00:03:27.73	7E3	hrs	**Ovr**	00 0C 87 E4 00
00:03:27.73	7EF	hrs		00 0C 87 F0 00 00 00 00
00:03:27.73	7F0	hrs		
00:03:27.73	7F1	hrs		00

The marked overruns have the following meaning:

- Logging Overrun = Data were lost when writing to the hard drive. The hard drive may be too slow.
- Ovr in the Flags column = Messages were lost after this message

3 Support

For more information on our products, FAQ lists and installation tips, please refer to the support section of our website (http://www.ixxat.de), which also contains information on current product versions and available updates.

If you have any further questions after studying the information on our website and the manuals, please contact our support department. The support section on our website contains the relevant forms for your support request. In order to facilitate our support work and enable a fast response, please provide precise information on the individual points and describe your question or problem in detail.

If you would prefer to contact our support department by phone, please also send a support request via our website first, so that our support department has the relevant information available.