System description
Electronic monitoring system

EMS 2

DEUTZ®

1 Foreword

This system description provides an overview of the design and the operation of the electronic monitoring system (EMS 2).

In addition, the functions which the EMS 2 contains, and the manner in which problems in the engine and in the EMS 2 can be detected, are explained.

2 Important notes

In the event of critical conditions, the EMS 2 may independently shut the engine off, either with or without prior warning depending on the configuration, or may merely provide a warning. The user must be informed of this and must be familiarised with limp-home mode.

- The following states can be recognised with the **diagnostic lamp**

Display	State	Indicates
Diagnostic lamp illuminates for 2 s from ignition on.	Lamp test	System is ready for operation.
Diagnostic lamp continuously illuminated.	**Warning** regarding exceeded limit values and system faults.	A **reduction in power** is only possible in combination with an engine governor, e.g. EMR and MVS. ⚠ The reduction in power can be temporarily bridged with the **limp-home mode button**. (Depression of the button is confirmed with slow flashing, see *). After the engine has been shut-off, fault code enquiry is possible (see **).
Diagnostic lamp flashes rapidly (approx. 1 Hz).	**Emergency engine shut-off** if shut-off limits are exceeded or not achieved.	**Attention:** In a few seconds, the engine will be **automatically** shut-off for the purpose of protection. ⚠ **T**he reduction in power can be temporarily bridged with the **limp-home mode button**. (Depression of the button is confirmed with slow flashing, see *). After the engine has been shut-off, fault code enquiry is possible (see **).
*** Diagnostic lamp flashes slowly (approx. 0.5 Hz).**	The **limp-home mode button** has been actuated in order to bridge the reduction in power or engine shut-off. Bridging is stored in the control unit.	**Attention**: Following actuation of the l**imp-home mode button**, the engine continues to run **without protection** for a short time, and may become **damaged**! For this reason, only actuate the button in the **event of an emergenc**y (**e.g. if life is otherwise placed at risk**)!
**** Fault code enquiry**	The diagnostic lamp serves to display a **fault code** (a sequence of short and long flashing impulses).	In the event of **engine standstill**, an enquiry regarding the fault code may be made with the limp-home mode button/ diagnostic button, see Chapter 8.4.

- The illumination of the **maintenance/service lamp** demands that the engine be maintained by the DEUTZ Service department.

3 System description

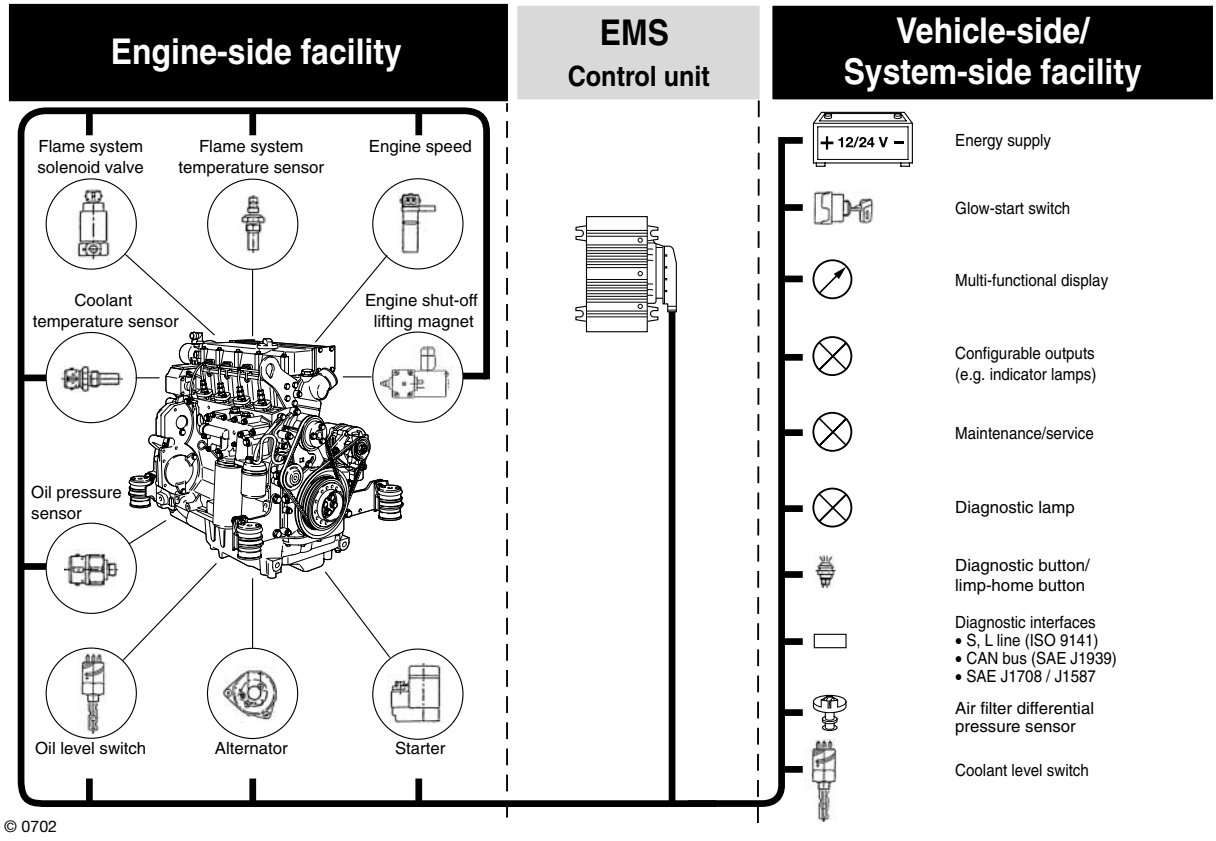
3.1 Use of the EMS 2

The EMS 2 is a monitoring system for the 1013, 1015 engine model series. It can be used on its own and also in combination with the MVS (solenoid valve system) or the EMR (electronic engine governor).

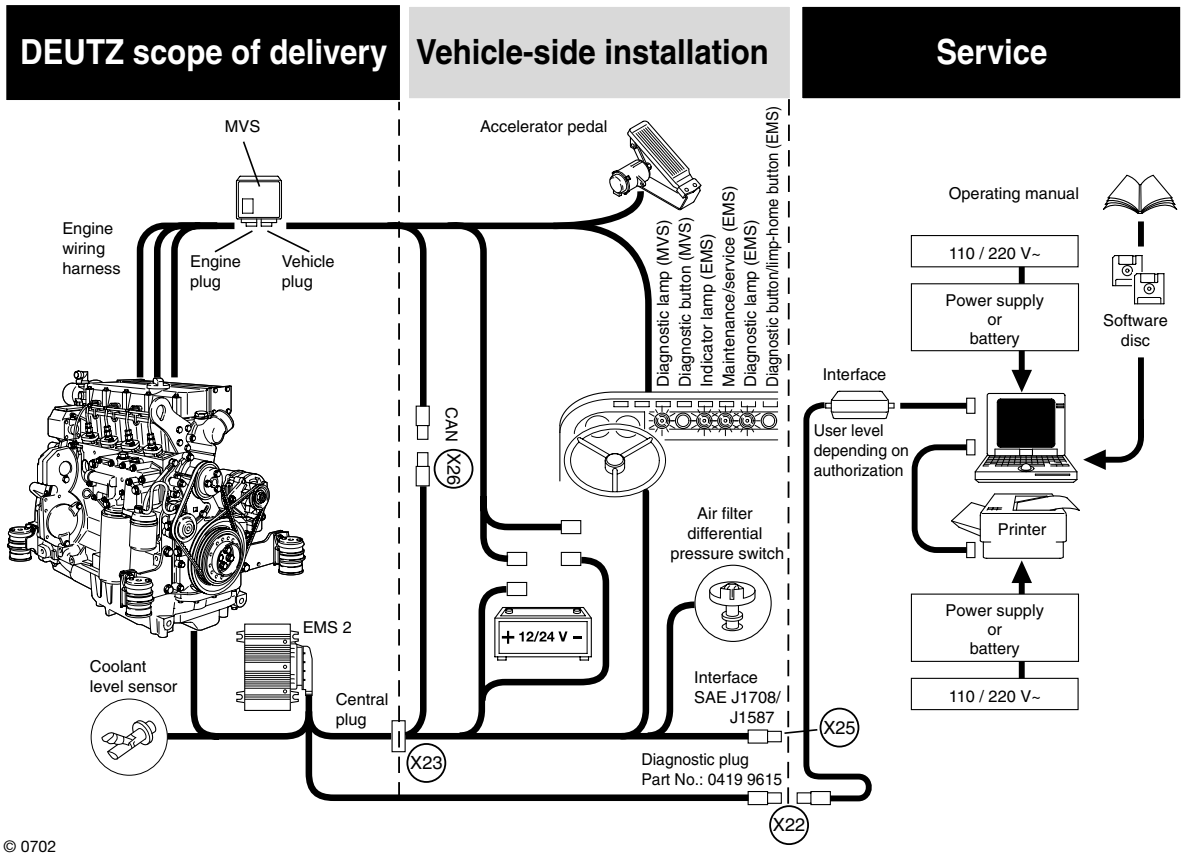
The EMS 2 provides functions for engine protection, for indicating maintenance requirements and for diagnostic purposes. With the aid of the data recorder function, an overview of the manner of operation, capacity utilisation and possible causes of engine failure may be obtained. In addition, data exchange with other electronic control units (e.g. EMR, MVS) is possible via the CAN interface.

3.2 System overview

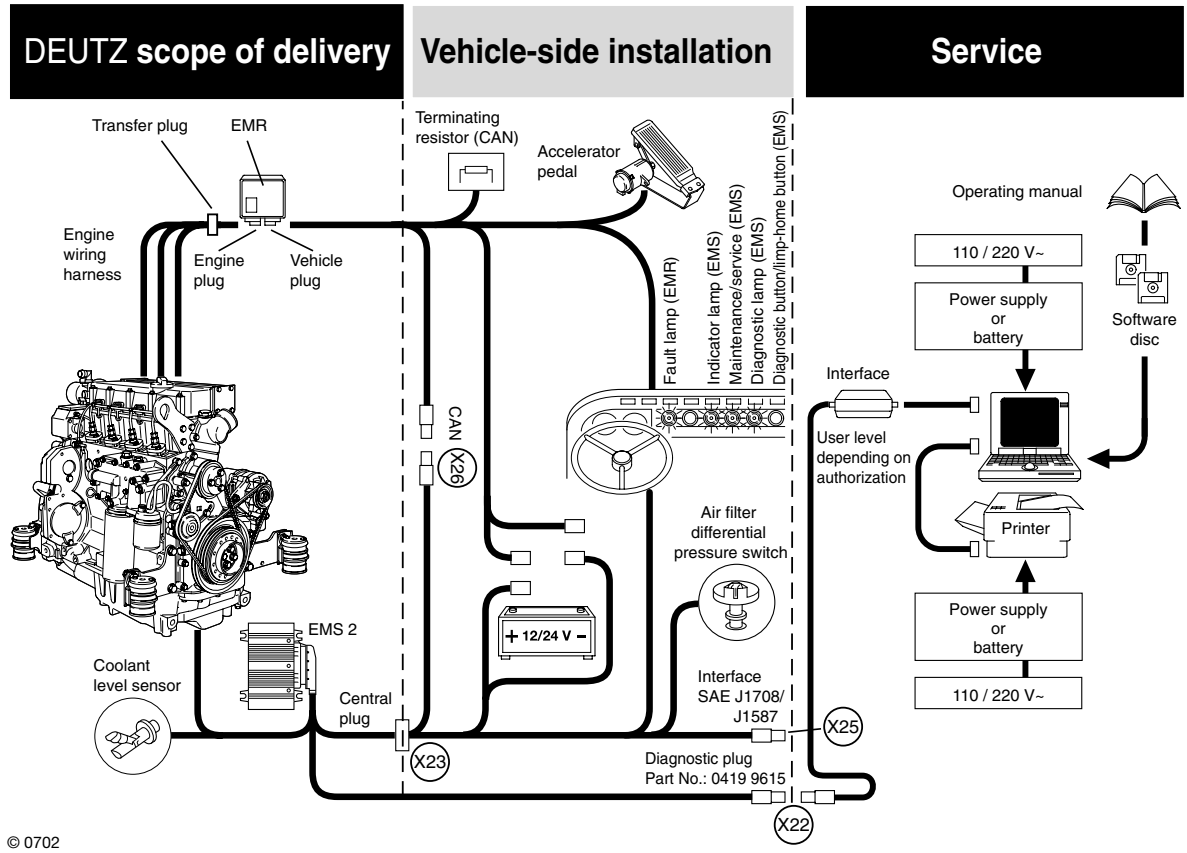
3.2.1 EMS 2 alone



3.2.2 EMS 2 in combination with MVS



3.2.3 EMS 2 in combination with EMR



4 System functions[1]

4.1 Introduction

The EMS 2 serves to electronically monitor the engine. Its functions include:

Engine protection functions

- Warning the operator if limit values are exceeded or not achieved.
- Reduction in engine power.
- Emergency engine shut-off if operating data exceed or do not achieve the shut-off limits.

Indication of maintenance requirements

in order to remind the operator and to reduce the consumption of operating media. The maintenance intervals can be obtained from the DEUTZ engine operating instructions, Chapter 5.1.

- in the event of excessive air filter differential pressure.
- if the number of operating hours leads to the achievement of the next maintenance requirements.
- if the load population reaches a maintenance limit.
- if calculation of the engine operating statuses (temperatures, speed, etc.) results in the oil change limit's being exceeded.

Data exchange

with other systems via the CAN interface, e.g. with the solenoid valve system (MVS):

- Transmission of the output reduction signal if limit values are exceeded.
- Engine shut-off via the CAN interface sets, e.g. the fuel injection quantity to zero.
- The integration of measurement data and fault messages via the CAN interface extends the input signals of the EMS 2 for executing engine protection functions and system diagnosis (see above).
- Transfer of the EMS 2 measurement data to other systems.

Diagnosis of the entire system

- System self-diagnosis, i.e. of the control unit, the sensors and the actuators.
- Display of engine operating data and self-diagnosis data on a PC (ISO9141 / RS232).
- Forwarding of the engine operating data to the SAE-J1708/1587 interface for diagnostic and display systems.
- Actuation of a telltale and output of a flashing code for fault identification.

Data recorder

Determination of the manner of operation, capacity utilisation and causes of engine failure.

- Recording the most important measurement variable signals.
- Determination of the load population.
- Storage of exceeded maintenance intervals.
- Documentation of hours of engine operation.

Engine operation display

- Output of a signal (telltale or relay) as soon as the speed exceeds 400 rpm.

[1] Not all functions are available in all applications.

4.2 Engine protection functions

4.2.1 General

The following table contains an overview of the measurement variables which can be monitored, together with the relevant, possible engine protection functions.

Monitorable measurement variable	Possible engine protection function[1]		
	Warning	Power reduction	Emergency engine shut-off
Speed	x		x
Oil temperature	x	x	x
Coolant temperature	x	x	x
Cylinder temperature 1	x	x	x
Cylinder temperature 2	x	x	x
Oil pressure	x	x	x
Coolant leveld	x	x	x
Oil level	x	x	x
Reserve signal T1	x	x	x

[1]The configuration is programmed in the factory.

- If the measurement variable lies within the **warning range**, the diagnostic lamp is **continuously** illuminated. As a result of a command via the CAN interface to the EMR or MVS, the **power is reduced**. If the measurement variable exceeds/does not achieve the recovery threshold, the lamp is extinguished again.
- A reduction in power is only possible in combination with EMR and MVS.
- If the measurement lies within the **shut-off range**, emergency **engine shut-off** is carried out following the expiry of a waiting period. The diagnostic lamp **flashes rapidly** (frequency approx. 1 Hz). Shut-off is effected either
  - via a **shut-off solenoid** or
  - via the **CAN interface** on other electronic control units (EMR, MVS)
- Limit values which are exceeded or not achieved are documented in the **fault memory**.
- The fault message is output if the diagnostic button is actuated during engine standstill
  - as a flashing code via the diagnostic lamp.
  - with a notebook connected via the ISO9141 interface with the SERDIA diagnostic programme.
  - via the ISO J1708/1587 interface according to standard.
- **Starting prevention** can be recognised via the rapid flashing of the diagnostic lamp (1Hz) in the event of engine standstill. If the EMS 2 has shut the engine off on the basis of the engine monitoring functions, restarting is prevented. The same applies if monitoring is carried out during standstill, and engine starting is blocked due e.g. a low coolant level.
- The engine can be restarted by switching the ignition off/on (terminal 15).
- Outputs may also be used to initialise lamps or relays if limit values are exceeded or not achieved, see Chapter entitled Outputs 5.2.

4.2.2 Override-Funktion

- In **safety-critical cases**, emergency engine shut-off or output reduction can be **suppressed** with the **limp-home button**/diagnostic button (override signal). The EMS 2 is programmed in such a manner that the overwriting of these engine protection functions applies only for a specific period of time (limp-home time) or until the engine is shut-off.
- Depression of the button is confirmed via **slow slashing** (frequency approx. 0.5 Hz). The limp-home time (override time) begins again each time the button is depressed. Excessively frequent actuation of the button may damage the engine and lead to the expiry of the warranty (responsibility of the user).
- Override procedures are stored in the control unit.
- Following the expiry of the override time, the warning, reduction in power or the shut-off function are reactivated insofar as the relevant conditions for this are still present.

4.2.3 Speed monitoring

Speed monitoring prevents engine damage as a result of excessive speed, and is defined prior to delivery depending on the combination (e.g. EMS with MVS) and model series. The speed signal can be supplied to the EMS 2 control unit in three ways:

- With a pick-up (magnetic speed sensor).
- Via the W terminal of the alternator.
- With data exchange via the CAN interface.

4.2.4 Temperature monitoring

Depending on the engine model series, temperature sensors are available for engine oil, coolant, cylinder head 1 and 2, and reserve temperatures. Connection to the EMS 2 is carried out in two ways:

- Either via the inputs (see Chapter 5.1).
- Or via the CAN interface from other systems (MVS, EMR).

In addition, each time the temperature is exceeded, an output for initialising a lamp or a relay may be allocated, see Chapter entitled Outputs 5.2.

If the temperature falls below the recovery threshold, the diagnostic lamp is shut-off, and the power reduction or emergency shut-off engine protection functions are reset.

4.2.5 Engine oil pressure and reserve pressure monitoring

Oil pressure monitoring is activated following the expiry of a fixed period of time after the engine has been started.

Depending on the application, the connection to the EMS 2 can be carried out in two ways:

- Via the inputs (see Chapter 5.1).
- Or via the CAN interface from other systems (MVS, EMR).

In addition, each time the temperature is exceeded, an output for initialising a lamp or a relay may be allocated, see Chapter entitled Outputs 5.2.

The warning limit is speed-dependent. In order to take pressure fluctuations into consideration, the oil pressure may fall below the warning limit for a speed-dependent period of time before the engine protection functions respond.

Following the **expiry of the waiting period**, the diagnostic lamp is **continuously** illuminated, insofar as the signal still lies in the warning range.

If the oil pressure exceeds the recovery threshold, the diagnostic lamp is shut-off, and the power reduction or emergency shut-off engine protection functions are reset.

Other pressures may be monitored depending on the application and the input assignment of the control unit.

4.2.6 Filling level monitoring

Depending on the engine model series, sensors are available for engine oil, coolant or reserve fluid filling levels. Connection to the EMS 2 is carried out in two ways:

- Via the inputs (see Chapter 5.1).
- Or via the CAN interface from other systems (MVS, EMR).

If the **warning threshold is not achieved**, the diagnostic lamp is **continuously** illuminated. If the level rises above the recovery threshold due to the fluid's being topped up, the diagnostic lamp is shut-off.

Whilst engine is stationary

Fluid levels are monitored whilst the engine is stationary and the ignition is switched on (terminal 15). If the level falls below the shut-off limit, starting is prevented following a period of time which is specified in the factory. During this enquiry time, engine starting is released until starting is prevented.

During engine operation

The engine oil level is not monitored during engine operation. For the other fluid levels, monitoring during engine operation may also be programmed in the factory.

4.3 Indication of maintenance requirements

Maintenance requirements may be indicated in the following manner:

- Via the maintenance/service lamp.
- Via the ISO 9141 interface with SERDIA.

After maintenance has been carried out, the maintenance messages can be reset with SERDIA or by connecting the L lead of the ISO9141 interface to ground for a minimum of 5 to a maximum of 10 seconds. The functions described in the following may report maintenance requirements, whereby each may initialise the maintenance lamp. An enquiry regarding the functions which are reporting the maintenance requirements can be made with the flashing code.

4.3.1 With operating time counter

When the operating time counter reaches the next maintenance interval, the maintenance/service lamp is switched on, and the operator is reminded that maintenance is due.

4.3.2 With load population

This function is only possible if the EMS 2 receives a load signal, e.g. from another electronic control unit via the CAN interface.

Maintenance is signalised with the aid of the maintenance/service lamp in accordance with the capacity utilisation of the engine throughout the engine operation period.

4.3.3 With air filter differential pressure sensor

Depending on the engine model series, the engine is equipped with air filter differential pressure sensors. If the air filter differential pressure exceeds the specified limit during engine operation, i.e. at engine speeds in excess of 400 rpm, the maintenance/service lamp is switched on. The maintenance message is only reset if the air filter differential pressure returns to normal.

4.3.4 Oil change interval calculation

This procedure is not applied in the case of all engine model series. The oil change interval depends on the manner in which the engine is operated. Calculation of the time of the next oil change is carried out with characteristic engine variables such as temperatures, speed, etc. When the calculation reached the oil change limit, the maintenance/service lamp is initialised.

4.4 Data recording

4.4.1 Data channels

The EMS 2 contains a maximum of 32 memory domains, in which a maximum of 32 measurement and calculation values (speed, temperatures, pressures, fluid levels, output signals, etc.) can be recorded. Some of these signals, e.g. charge air pressure and charge air temperature, can also be read in from engine governor systems via the CAN interface. In the relevant memory domains, identical measurement signals with different sampling rates can be recorded (most rapid sampling rate 5 Hz).

Depending on the spacing of the measurement points, measurement value recording of up to several thousand is possible. Either the current, maximum, minimum or the mean measurement values are recorded.

Depending on the engine model series and system expansion, values from the following table may be recorded:

Possible measurement signals
Charge air pressure
Charge air temperature
Operating time counter
Speed
Oil temperature
Coolant temperature
Cylinder head temperature 1
Cylinder head temperature 2
Reserve temperature 1
Reserve temperature 2
Engine oil pressure
Reserve oil pressure 1
Reserve oil pressure 2
Coolant level
Engine oil leve
Fluid level 1
Fluid level 2
Fluid level 3
Load signal
Fuel injection quantity (via CAN)
Output switching statuses
Power reduction signal
Override signal
Shut-off limit exceeded
Test operation mode

The EMS 2 is programmed with a sensible data recording configuration in the factory. Changes must be coordinated with head office, and are only possible with SERDIA.

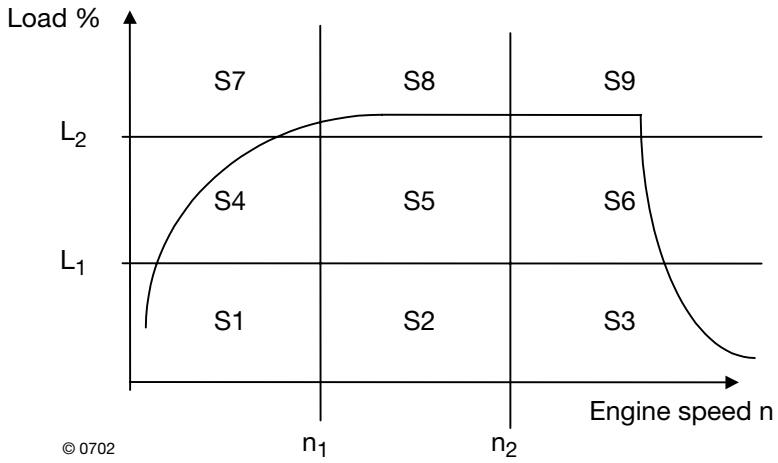
Data recording is only carried out whilst the engine is running.

The data are read out with SERDIA, and are available in a standard format for commercially available graphics and evaluation programmes, e.g. Excel.

4.4.2 Load population determination

If a load signal is transmitted from an electronic control unit via the CAN interface, the EMS 2 is able to determine the capacity utilisation of the engine. In order to achieve this, the hours of engine operation are allocated to the relevant load and speed ranges. Optimally-designed engines may therefore be made available to the customer for special usages.

Load population:
S1 to S9 are operating time counters for the relevant range.
For maintenance information, the range counters are weighted with factors.



The load population can be displayed and printed out with SERDIA.

4.4.3 Override memory

If limit values are exceeded, the operator can, as in the case of the engine protection functions, see 4.2, prevent the reduction in power or emergency engine shut-off via a button for a brief period of time or until the engine is next stationary (depending on the EMS 2 programme).

The interruption of the protective functions is stored in the control unit of the EMS 2, and cannot be deleted.

4.4.4 Maintenance overdue memory

The EMS 2 stores the point in time at which maintenance was required and the reset time, i.e. when maintenance was acknowledged.
These values may also be read with SERDIA.

4.5 Engine operation display

The EMS 2 may also be used for the purpose of engine operation display. As soon as the engine speed exceeds a speed threshold of 400 rpm, a lamp is initialised. This function is not in use in all engine model series.

5 Inputs/Outputs

5.1 Inputs

The following table provides an overview of the possible outputs at the EMS 2.

No.	Pin	GND	Designation	can be connected	measured	Especially suitable for
1A	1		Speed input[1]	W terminal	Frequency	For speed measurement only.
1B	10, 27			Pick-up		
2	25	29	Limp-home and diagnosis	Sensor to ground	Voltages 0 and 5 V (digital)	For error code enquiry and limp-home only.
3	8		PWM input	PWM signal switch	Pulse-duty factor (digital)	Integration of a physical variable from another control unit (e.g. oil pressure).
4	15	13	Pressure measurement input	Voltage sensor	Voltages 0 to 5 V (analogue)	Oil pressure measurement
5	14	31	NTC input	NTC (temperature-dependent resistor)	Resistors (analogue)	Coolant temperature Oil temperature
6	32	30	PT100-1	PT100 (temperature-dependent resistor)	Resistors (analogue)	Cylinder head temperature
7	17		PT100-2			
8	16		Analogue 1	Voltage sensor	Voltages 0 to U_{Batt} (analogue)	Suitable for many signals, e.g. air filter differential pressure, fluid levels, etc.
9	34		Analogue 2			
10	33	12	Analogue 3	Voltage sensor	Voltages 0 to 5 V (analogue)	Suitable for many signals, e.g. pressures, temperatures, fluid levels, etc.

[1]Speed input available as an option only.

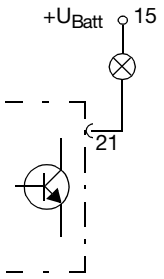
An example of pin assignment (engine 1015, EMS and MVS) is shown in Chapter 11.8.

The EMS 2 control unit can be configured in the factory in such a manner that further input signals can be read via the CAN bus.

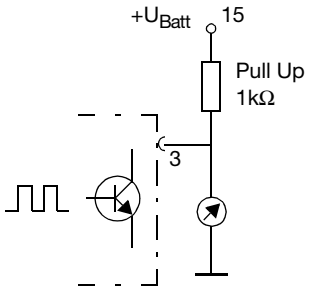
5.2 Outputs

5.2.1 General

On configuration of outputs 1 to 6 as **digital outputs**, these function as switches to ground.



Digital output



PWM output

Via configuration, a digital value (e.g. "Speed in the shut-off range") may be allocated as a parameter to each digital output (with the exception of the diagnostic lamp output).

Parameters can be used to set whether the output is switched on or off on the occurrence of the condition.

If outputs 3 and 4 are configured as **PWM outputs** (PWM = pulse-width modulation), analogue measurement values, which enter the control unit via CAN or the inputs, and internal EMS 2 variables, can be output.

A measurement value (e.g. "Speed") may be allocated to each PWM output via configuration.

The output frequency of the PWM signal can be parameterised in the range from 85 Hz to 500 Hz, whilst the pulse-width, i.e. the high or low time, changes in the same manner as the variable which is adjusted via a characteristic curve.

In the event of a fault, a cable break or a short-circuit can be diagnosed for all outputs.

The following Table provides an overview of the possible outputs at the EMS 2.

Nr.	Pin	Designation	Can e.g. be used for
1	21	Digital 3	Oil pressure telltale
2	22	Digital 4	Shut-off solenoid relay initialisation
3	3	Digital / PWM1	Coolant temperature telltale
4	4	Digital / PWM2	Air filter differential pressure telltale
5	5	Maintenance/service lamp	Maintenance/service lamp
6	23	Diagnostic lamp	Diagnostic lamp only

5.2.2 Diagnostic lamp output

This output actuates a diagnostic lamp for displaying fault codes, e.g. continuous illumination, slow flashing or rapid flashing to ground.

When the ignition is switched on, the lamp illuminates for approx. **2 s** for a **lamp test**.

Continuous illumination indicates a **warning**, i.e. either a measurement variable is in the warning range or a system component reports faulty behaviour such as, e.g. sensor cable break or short-circuit (see Fault messages).

Rapid flashing indicates imminent or current **engine protection shut-off**.

If the operator interrupts one of the engine protection functions, such as a reduction in power or imminent engine shut-off, by **pressing** the limp-home button whilst the engine is running, this is acknowledged with **slow flashing**.

If the limp-home button/diagnostic button is actuated whilst the **engine is stationary**, **flashing codes** are output for the **fault messages**.

6 Data interfaces

6.1 ISO interface

The ISO interface is a serial data interface which is standardised according to ISO 9141, and which enables the exchange of data with the control unit. The ISO interface has the following functions:

- Diagnosis with SERDIA.
- Exchange of diagnostic data.
- Control unit end-of-tape programming (reading and programming of parameters).
- Execution of engine test functions.
- Reading of measured and calculated variables.
- Reading the data recorder out.

6.2 CAN interface

The CAN interface is a rapid serial data bus which is standardised according to SAE J1939, and which enables the exchange of data between several control units (e.g. EMR, MVS, transmission electronics, traction control). The CAN interface has the following functions:

- Exchange of diagnostic data (error messages, deletion of error memory).
- Reading of measured and calculated variables.
- Suppression of fuel injection.
- Reduction of output.

6.3 SAE-J1708/1587 interface

- Output of all data received via the inputs or via the CAN interfaces.
- Output of the fault memory.
- Deletion of all fault messages.

Note:

☞ In the event of communication via the ISO9141 interface, the SAE-J1587 interface is shut-off!

7 Diagnosis

7.1 Self-diagnosis

Self-diagnosis becomes active when a minimum supply voltage (> 9 V) is exceeded.

In this case, both internal control unit faults are determined and the inputs and outputs and the sensors and output loads are checked for cable break and short-circuit. The fault must be present for a minimum period of time before it is stored. Continuous diagnostic lamp illumination indicates that a fault is currently present. A maximum of 15 faults are stored simultaneously. The individual faults which this involves can be seen from the fault message Table.

The fault messages are displayed as flashing codes as described in Section 7.2, and via the interfaces to PCs and diagnostic units as described in Chapter 8.2.

7.2 Diagnosis with flashing codes

The diagnostic lamp informs the operator of the presence of a fault or exceeded limit values, as described in the case of the engine protection functions in Chapter 4.2, with continuous illumination.
When the engine is stationary, each depression of the diagnostic/override button leads to the output of a flashing code which indicates which fault or signal has exceeded the limit value.
Each time the button is pressed, the next fault is displayed. Following the last fault, the first fault message is output again.
The flashing code is comprised of long and short flashing pulses which the operator counts.
The appropriate fault can be seen in the fault message Table (Chapter 8.4).

7.3 Diagnosis with SERDIA software

Together with the interface and notebook (or PC), SERDIA (Service Diagnosis software) forms a combined special service tool. With the aid of the SERDIA diagnostic software, information regarding the following can be displayed:

- Fault memory
- Configuration (authorisation is determined via the interface level)
- Measurement values
- Maintenance data
- Load population.

Fault messages for passive or eradicated faults can be deleted with SERDIA.

SERDIA (Service Diagnosis) is a software programme which the operator can use, via the PC, to monitor measurement values and detect faulty operating behaviour whilst the diesel engine is running.

In order to achieve this, the PC is connected to the diagnostic interface via an interface. Communication with the control unit is carried out via a special EMS 2 protocol.

With regard to handling SERDIA, see separate manual. The acquisition of SERDIA is explained via a DEUTZ service memorandum.

8 Fault messages

8.1 Integration of the fault messages via CAN

The EMS 2 is able to communicate with other electronic engine regulation systems via the CAN interface. Such an application includes the MVS (solenoid valve system). This transmits the fault messages to the EMS 2, and the diagnostic lamp is continuously illuminated. The messages can then be output via only one lamp as a flashing code. The nature of the flashing code indicates the system in which a fault is present (see code Table, Chapter 8.4). The operator is only required to heed one lamp, wiring expenditure is reduced. The faults and measurement values from other control units (e.g. MVS), which are read by EMS 2 via the CAN bus, are also output via the ISO9141 interface to a notebook with the SERDIA diagnostic programme.

8.2 Output of messages on a notebook or diagnostic systems

The EMS 2 stores the fault messages and transits these as a fault code via the ISO9141 interface. The codes are listed in the fault message Table (Chapter 8.4).
The fault messages can be read with the SERDIA diagnostic software and a notebook. In addition, measurement values which existed at the point in time at which the fault occurred are displayed on the screen for each fault.
Instead of using the ISO9141 interface for fault messages, the user may also use the SAE-J1708/1587 interface of the EMS 2 for outputting the faults on diagnostic systems.

8.3 Deletion of fault messages

Insofar as the faults no longer occur, the fault messages are automatically deleted after the ignition key has been actuated a number of times. If the fault messages are to be deleted directly following a repair operation, the ignition is actuated a corresponding number of times in succession, whereby waiting must be carried out each time during the lamp test time (approx. 3 seconds).
The fault messages can also be deleted with the SERDIA diagnostic programme and a notebook via the ISO9141 interface or also with also diagnostic systems according to the SAE-J1708/1587 standard.

8.4 Fault messages and fault codes

The following table contains an overview of the possible fault messages and codes.

Notes in the event of diagnosis with telltale:

Depending on the flashing code, the telltale provides a sequence of short and long flashing impulses.

Example: Flashing code S1 L1 S2: one short flash, one long, two short

Note in the event of diagnosis with SERDIA:

The programme displays the location of the fault, the type of fault and the frequency of the fault on the screen.

Example:

- Location of the fault: Oil pressure input
- Type of fault: Cable break or short-circuit to U_{Batt}

Location of the fault	Type of fault	Flashing code S-short L-long	SAE J1587 FMI	PID/SID SAE-J1587
Zero fault information		S1	dispen-sed with	xxx[1]
Speed pick-up input	Cable break	S1 L1 S1	5	xxx
Oil pressure input	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S2	4 3	xxx
NTC input	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S3	4 3	xxx
PT100-1 input	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S4	4 3	xxx
PT100-2 input	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S5	4 3	xxx
Analogue input 1	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S6	4 3	xxx
Analogue input 2	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S7	4 3	xxx
Analogue input 3	Short-circuit to GND Cable break or short-circuit to U_{Batt}	S1 L1 S8	4 3	xxx
CAN connection		S1 L2 S1	12	SID 231
Override/diagnostic button fault		S1 L2 S2	-	-
Digital output 3	Cable break or short-circuit to GND Short-circuit to U_{Batt}	S1 L2 S3	4 3	SID 26
Digital output 4	Cable break or short-circuit to GND Short-circuit to U_{Batt}	S1 L2 S4	4 3	SID 40
Digital / PWM output 1	Cable break or short-circuit to GND Short-circuit to U_{Batt}	S1 L2 S5	4 3	SID 57

Location of the fault	Type of fault	Flashing code S-short L-long	SAE J1587 FMI	PID/SID SAE-J1587
Digital / PWM output 2	Cable break or short-circuit to GND Short-circuit to U_{Batt}	S1 L2 S6	4 3	SID 58
Maintenance lamp output	Cable break or short-circuit to GND Short-circuit to U_{Batt}	S1 L2 S7	4 3	SID 51
Diagnostic lamp output	Cable break or short-circuit to GND Short-circuit to U_{Batt}	no flashing code	4 3	SID 238
Speed exceeded	in warning range in shut-off range reduction in power	S1 L3 S1	0	PID 190
Engine oil temperature exceeded	in warning range in shut-off range reduction in power	S1 L3 S2	0	PID 175
Coolant temperature exceeded	in warning range in shut-off range reduction in power	S1 L3 S3	0	PID 110
Cylinder head temperature 1	in warning range in shut-off range reduction in power	S1 L3 S4	0	Parameter
Cylinder head temperature 2	in warning range in shut-off range reduction in power	S1 L3 S5	0	Parameter
Reserve temperature 1	in warning range in shut-off range reduction in power	S1 L3 S6	0	Parameter
Reserve temperature 2	in warning range in shut-off range reduction in power	S1 L3 S7	0	Parameter
Engine oil pressure	in warning range in shut-off range reduction in power	S1 L3 S8	1	PID 100
Reserve pressure 1	in warning range in shut-off range reduction in power	S1 L4 S1	1	Parameter
Reserve pressure 2	in warning range in shut-off range reduction in power	S1 L4 S2	1	Parameter
Coolant level	in warning range in shut-off range reduction in power	S1 L4 S3	1	PID 111
Engine oil level	in warning range in shut-off range reduction in power	S1 L4 S4	1	PID 98
Fluid level 1	in warning range in shut-off range reduction in power	S1 L4 S5	1	Parameter
Fluid level 2	in warning range in shut-off range reduction in power	S1 L4 S6	1	Parameter
Fluid level 3	in warning range in shut-off range reduction in power	S1 L4 S7	1	Parameter

Location of the fault	Type of fault	Flashing code S-short L-long	SAE J1587 FMI	PID/SID SAE-J1587
Engine protection shut-off executed		S1 L5 S1	-	-
Start prevention executed		S1 L5 S2	-	-
Reduction in power override executed		S1 L5 S3	-	-
Engine shut-off override executed		S1 L5 S4	-	-
Control unit EEPROM memory fault		S1 L5 S5	12	SID 253
Control unit RAM or RAM buffering defective		S1 L5 S6	-	-
Bosch control unit CAN fault codes		Bosch flashing code	-	-
Maintenance interval reached (operating hours)		S1 L6 S1	dispen-sed with	-
Maintenance interval reached (Load population)		S1 L6 S2	dispen-sed with	-
Oil change limit reached		S1 L6 S3	dispen-sed with	-
Maintenance signal 1 exceeds limit value		S1 L6 S4	dispen-sed with	-
Maintenance signal 2 exceeds limit value		S1 L6 S5	dispen-sed with	-
Air filter differential pressure exceeded		S1L6S6	dispen-sed with	-

[1]xxx = PID of the signal read via this input.

9 Repair

All components can only be replaced (repair is not possible) and are available individually. As the control unit has to be programmed with an engine-specific data record, the following specifications are necessary:

- Engine number.
- Complete part number.

Please contact your DEUTZ service partner.

Attention:

In order to avoid damaging the control units, the plug connections on the control unit must be disconnected prior to electric welding operations!

10 Installation

- Depending on the design of the configuration, the wiring to be carried out by the customer can be seen in the engine-specific **wiring diagram**, which is delivered together with the engine.
- With regard to the mechanical installation of the control unit, reference is made to the **installation guidelines** regarding the installation of electronic systems in DEUTZ diesel engines, order No. 0399 1990/1. Further information can be obtained from

  DEUTZ AG

  Installation Consultancy Department

  Tel.: (0221) 822 3140

  Fax.: (0221) 822 3198

Sensors and actuators must not, either for checking or test purposes, be individually connected to or between external voltage sources, but only in combination with the EMS 2, as the risk of destruction otherwise exists!

Despite polarity reversal protection in the control units, polarity reversal must be avoided. Polarity reversal may lead to damage to the control units!

The control unit plug connections are only dust and water-tight when the counter-plugs are connected! Until the counter-plugs are connected, the control units must be protected against spray water and electrical discharge at the contacts due to touching!

⚠ **Attention:**

Sensors and actuators must not, either for checking or test purposes, be individually connected to or between external voltage sources, but only in combination with the EMS 2, as the risk of destruction otherwise exists!

Despite polarity reversal protection in the control units, polarity reversal must be avoided. Polarity reversal may lead to damage to the control units!

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11 Technical data

11.1 Inputs/Outputs

The following tables contain an overview of the technical data of the EMS 2.

11.1.1 Input table

No.	Pin	GND	Designation	Range
1A	1		Speed input	0/U_{Batt}
1B	10, 27			
2	25	29	Limp-home and diagnosis	Button only (0/U_{Batt})
3	8		PWM input	0 to U_{Batt} (digital)
4	15	13	Pressure measurement input	0 to 5 V (analog)
5	14	31	NTC input	0° C to 130° C
6	32	30	PT100-1	0° C to 300° C
7	17		PT100-2	0° C to 300° C
8	16		Analogue 1	0 to U_{Batt} (analogue)
9	34		Analogue 2	0 to U_{Batt} (analogue)
10	33	12	Analogue 3	0 to 5 V (analogue)

11.1.2 Outputs table[1]

No.	Pin	Designation	max. current load
1	21	Digital 3	3 A
2	22	Digital 4	3 A
3	3	Digital / PWM1	0.5 A
4	4	Digital / PWM2	0.5 A
5	5	Maintenance/Service lamp	0.5 A
6	23	Diagnostic lamp	0.5 A

11.2 Electrical specifications

Nominal voltages:	12 V and 24 V, each unit functions with both nominal voltages
Operating voltage range:	U_{Batt} from 9 V to 32 V
Polarity reversal protection:	The unit is protected against battery voltage polarity reversal.
Overvoltage protection:	The unit is equipped with load-dump protection against 65 V for 300 ms.
Short-circuit strength:	All of the unit's connections are short-circuit-proof in the case of conducting connections with +U_{Batt}, -U_{Batt} and the connections against each other.
Off-ground nature:	The housing is off-ground.
Stray power emission:	Via air convection.
Terminal 30 load:	< 10 mA with terminal 15 shut-off

[1] Open collector

11.3 EMV/ESD protection

according to guidelines:	EU 95/54 EG		
	EN 61000-4-4		
	EN 61000-4-2		
	ISO 7637-2		
	ISO 7637-3		
	ISO 11452-2	100 kHz - 1 GHz	100 V/m
		57 MHz - 61 MHz	50 V/m Class B, else Class A
	ISO TR 10605		

11.4 Climatic conditions

Operating temperature:	-40 °C to 80 °C
Storage temperature:	-55 °C to 80 °C not temporally restricted
Temperature change:	IEC 68-2-14
Humidity: relative humidity: maximum temperature:	 up to 95% +55 °C
Salt spray resistance:	The system is resistant to salt spray in accordance with IEC 68-2-52.
Salt content (NaCl):	max. (5±1) % percentage per mass
Low air pressure:	The unit is resistant to vacuum.
Transportation and storage:	max. 150 mbar ±1%
Operation:	max. 533 mbar ±5%
Industrial climate:	according to DIN 50018, 6 cycles

11.5 Contamination

The unit is resistant to being coated with the following media:

- Engine oils and additives.
- Transmission fluids.
- Lubricating oils.
- Paints.
- Hydraulic fluids.
- Coolants.
- Greases.
- Fuels.
- Cold cleaners.

11.6 Mechanical conditions

Free fall:	The unit must survive a free fall from a height of 1 m onto concrete or steel in each of the three main axes without damage. Falling onto the plug side is not taken into consideration

Vibration:
For any of the main axes, the following maximum values apply:

Amplitude:	0,35 mm
Frequency:	10 Hz to 60 Hz.
Acceleration amplitude:	50 m/s^2
Frequency:	60 Hz to 500 Hz.
Shock resistance:	According to IEC-68-2-27
Peak acceleration:	294 m/s^2, semi-sinoidal form in each main axis

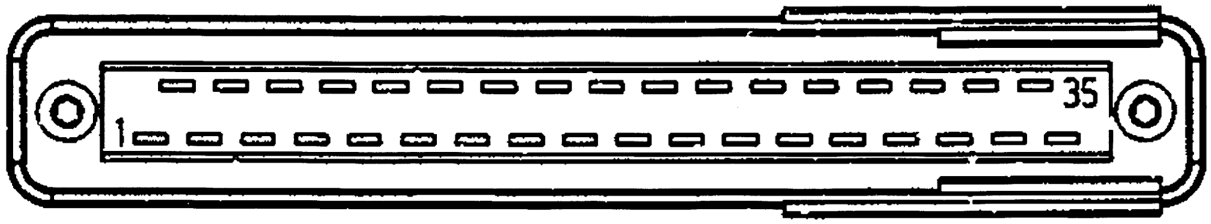
11.7 Protection class

Protection class:	IP66K according to DIN 40050.

11.8 Pin assignment

Pin		Designation	Application example in engine, e.g. 1015
1		W terminal (input 1A)	Free
	19	Ground for outputs	to the insulated ground node (GND)
2		Ground for outputs	to the insulated ground node
	20	Ground for outputs	Oil level switch ground (if available)
3		PWM1 (output 3) 0,5 A	Coolant temperature lamp
	21	Digital 3 (output 1) 3 A	Oil pressure lamp
4		PWM2 (output 4) 0,5 A	Air filter differential pressure lamp
	22	Digital 4 (output 2) 3 A	Engine shutt-off lifting magnet
5		Maintenance lamp (output 5) 0,5 A	Maintenance lamp
	23	Diagnostic lamp (output 6) 0,5 A	Diagnostic lamp
6		5V sensor supply	Oil pressure sensor supply voltage
	24	SAE-J1939 CAN high	SAE-J1939 CAN high
7		SAE-J1939 CAN low	SAE-J1939 CAN low
	25	Diagnostic request sampling element (input 2)	Diagnostic and limp-home button
8		PWM input (input 3) U_{Batt}	Free
	26	ISO 9141 S lead	ISO 9141 S lead
9		ISO 9141 L lead	ISO 9141 L lead
	27	Inductive speed sensor - (input 1B)	Pickup - input
10		Inductive speed sensor + (input 1B)	Pickup + input
	28	SAE J1708 +	SAE J1708 +
11		SAE J1708 -	SAE J1708 -
	29	Measurement ground	Diagnosis and limp-home button ground
12		Measurement ground	Charge air pressure sensor ground (if available)
	30	Measurement ground	Charge air temperature sensor ground (if available)
13		Measurement ground	Oil pressure ground
	31	Measurement ground	Coolant temperature ground
14		NTC input (input 5)	Coolant temperature input
	32	PT100-1 (input 6)	Charge air temperature input
15		Oil pressure (input 4) 5 V	Oil pressure sensor input
	33	Analogue 3 (input 10) 5 V/switch	Charge air pressure (if available)
16		Analogue 1 (input 8) U_{Batt} /switch	Coolant level input (if available)
	34	Analogue 2 (input 9) U_{Batt} /switch	Air filter differential pressure switch input
17		PT100-2 (input 7) switch	Oil level switch input (if available)
	35	Terminal 30, battery positive	Terminal 30
18		Terminal 15, ignition lock	Terminal 15

Coolant level ground and air filter differential pressure switch ground to ground node.



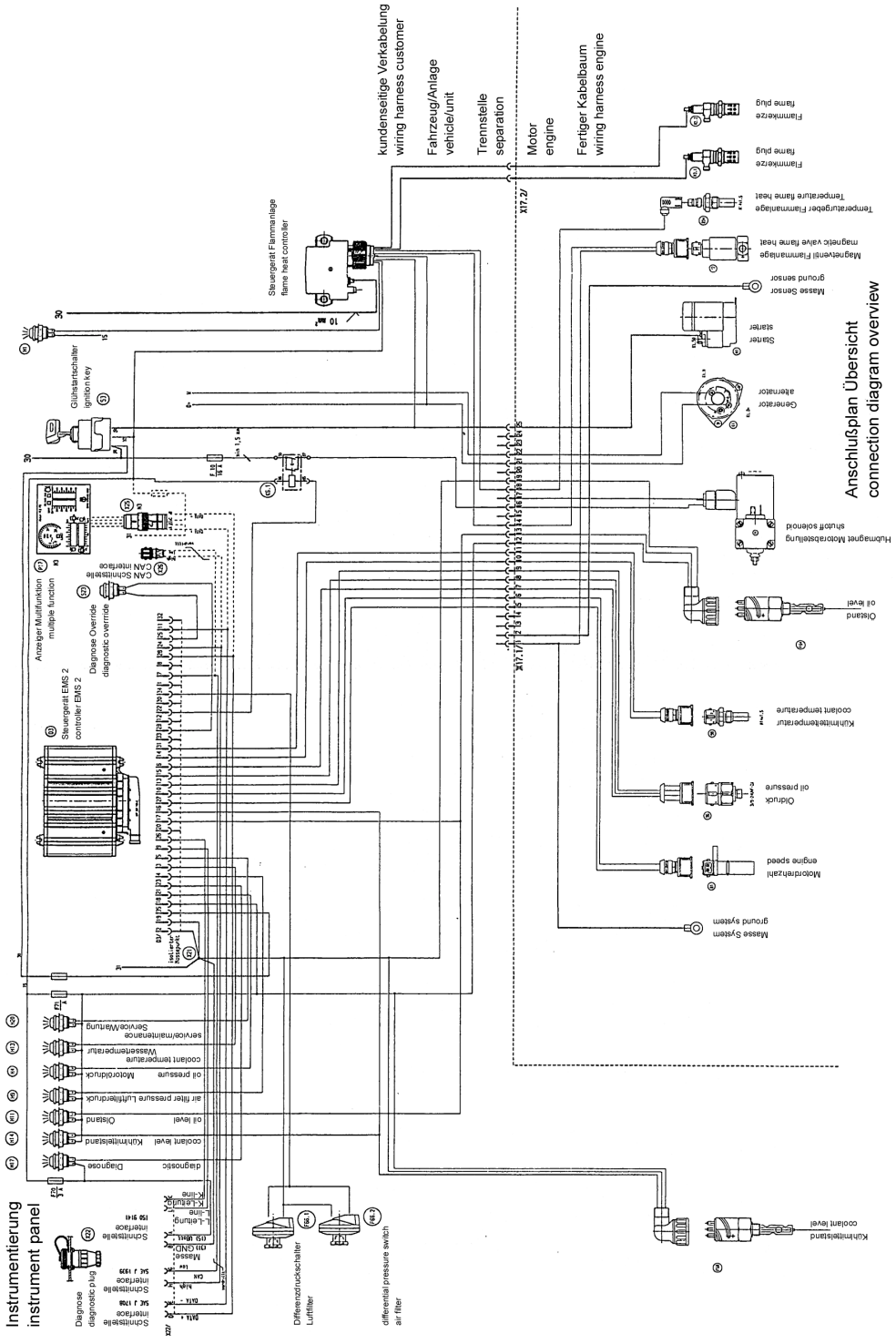
12 Appendix

12.1 Drawings (examples)

- Connection diagram, EMS 2 alone (example)
- Communication lead EMS with EMR (example)
- Communication lead EMS with MVS (example)

12.2 Connection diagram, EMS 2 alone (example)

Note: Only the engine-specific wiring plan is valid!



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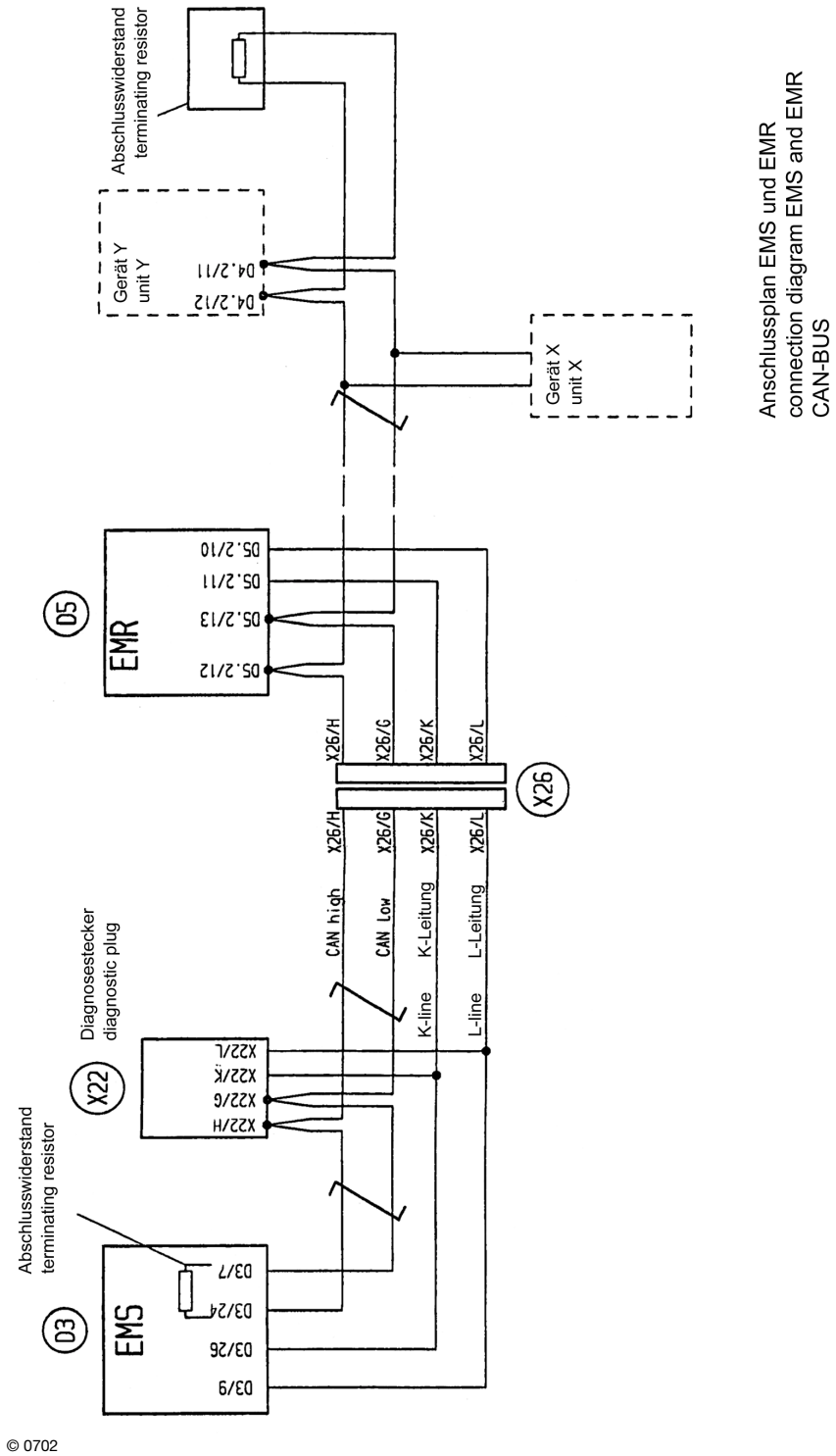
12.3 Communication lead EMS with EMR (example)

Note: Only the engine-specific wiring plan is valid!



12.4 Communication lead EMS with MVS (example)

Note: Only the engine-specific wiring plan is valid!