# Operating Manual

# ehb SMARTmodul 04

**CANmodul**

Gauge-Modul
RPM-Modul
I/O-Modul
Sensor-Modul

(similar to original product)

# Information for service personnel

**Version 1.3**
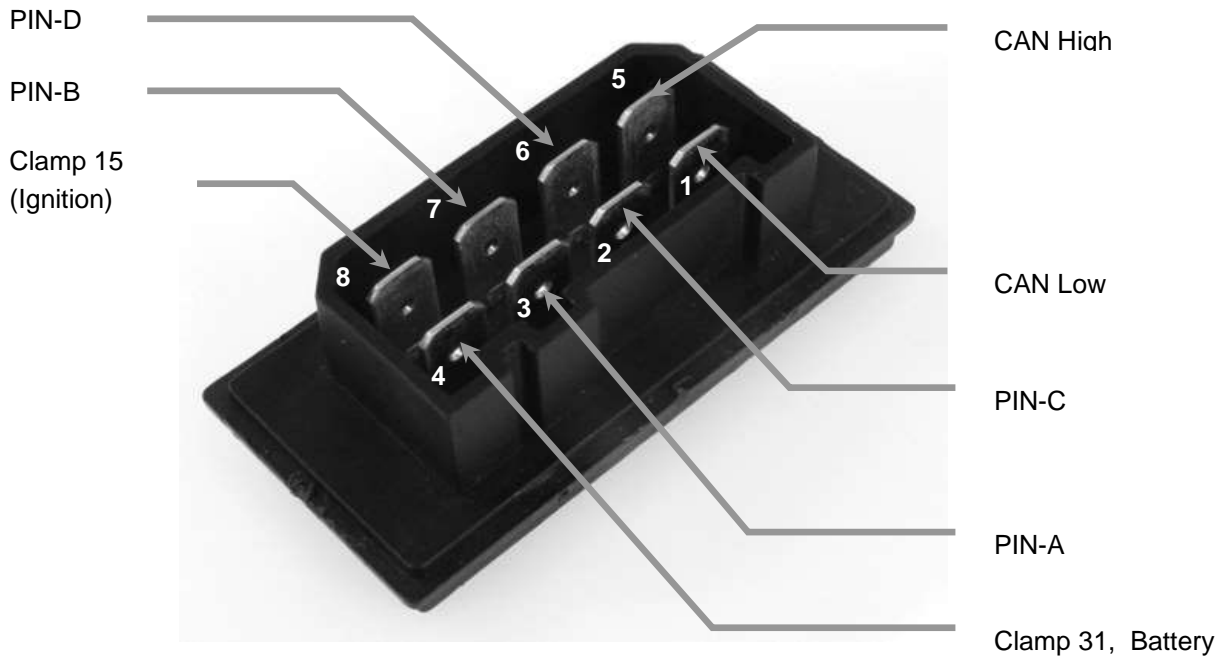
## Short manual

## Connector:



Abb. 1: SMARTmodul, detail front view

## Connector pin assignment several Moduls

| | connection | RPM-Modul | Gauge-Modul | I/O-Modul | Sensor-Modul |
|---|---|---|---|---|---|
| 3 | PIN-A | RPM + | Gauge 1 (oil pressure) | Input 1 or Output 1 | Fuel level sensor input |
| 7 | PIN-B | RPM - | Gauge 2 coolant temperature | Input 2 or Output 2 | Coolant level sensor input |
| 2 | PIN-C | Working speed | gauge 3 oil temperature | Input 3 or Output 3 | Hydraulic level sensor input |
| 6 | PIN-D | Frequency output tachometer | Frequency output tachometer Optional: gauge 4 fuel gauge | Input 4 or Output 4 | Hydraulic temperature sensor input |
| 5 | CAN-High | CAN-High | CAN-High | CAN-High | CAN-High |
| 1 | CAN-Low | CAN-Low | CAN-Low | CAN-Low | CAN-Low |
| 8 | KL.15 | Clamp 15 | Clamp 15 | Clamp 15 | Clamp 15 |
| 4 | KL.31 | Clamp 31 | Clamp 31 | Clamp 31 | Clamp 31 |

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# 1. General

## 1.1. Introduction

The SMARTmodul assisted the CAN protocol system (Controller Area Network) according to SAE J1939.

The SMARTmodule have been developed to be responsible for supporting and expanding existing CANbus systems. The using of these modules can make the communication with the engine management system of an electronically controlled engine easier for the operator of a machine or an aggregate.

The engine management systems (ECU) of individual motor manufacturers have not only a engine control function, they also provide information of operating values, such as Oil pressure, temperature, speed, operating hours and more on the CAN bus. This information will be received and processed in the SMARTmodules.

# 2. Important information on use

| | |
|---|---|
| **Use** | This device is to be operated only in combination with the supplied accessories. |
| | Use only mild cleaning agents. |
| | Do not insert any objects into the device openings not intended for this purpose, since otherwise electronic faults can result. |
| | **When operating the device, comply with the general accident prevention regulations.** |
| **Safety** | Do not operate the ehb ehb product within range of strong electromagnetic fields. |
| | Note and comply with the temperature specifications given in the "Technical data" section. |
| **Storage** | An ehb SMARTmodul 04 device that is not in use may only be stored in compliance with the operation specifications. |
| **Installation** | During the installation of the device follow the directions of the manufacturers of plugs and wire harnesses. |
| **Shipping** | The unit is to be shipped either in its original packaging or in suitable sturdy alternative packaging. |
| | Improper packaging is regarded as negligence and results in any claims for repair under guarantee being forfeited. |
| **Maintenance** | The module requires no maintenance and no special upkeep over its entire service life. |
| **Opening the module** | The module does not contain components that can be serviced, replaced or repaired by the customer or third-party service personnel. |
| | The module has a protective seal to prevent it being opened without authorisation. Please note that any unauthorised opening of the device can lead to it being irreparably damaged. |
| | **ATTENTION!** |
| | **Cleaning the device with a high-pressure cleaner may destroy the device. It has to be clearly communicated to personnel that high-pressure cleaning can lead to damage and thereby result in the guarantee being rendered null and void.** |

## 3. Repairing of devices

Should the device require repair work, please return it to:

ehb electronics gmbh
Hans-Böckler-Str. 20
30851 Langenhagen
GERMANY

Please make sure that you include a written fault description. This will considerably facilitate the fault identification process for the service personnel and thus ensure a quicker turnaround time for the ehb product. Alternatively you can use our online service for the returning of devices: **www.ehbservice.de**

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**NOTE!**

ehb electronics GmbH assumes liability only for the proper execution of services and the correct characteristics of the materials used. Any further claims such as for loss of profit and for direct and indirect consequential damages such as loss of data are excluded.
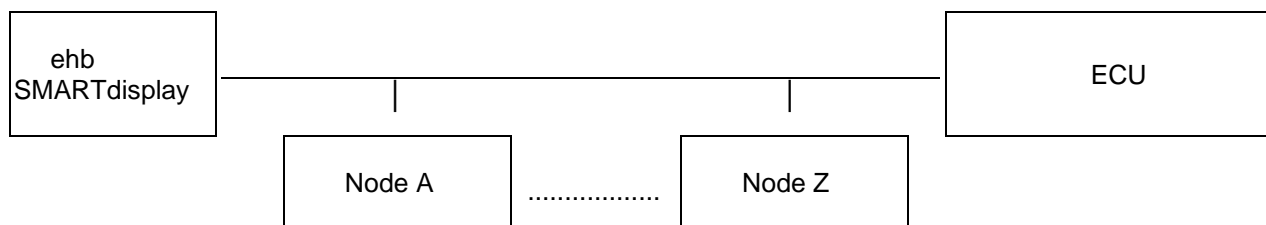
**ATTENTION!**

Damages arising from improper packaging of the device for shipping and/or unauthorised intervention will invalidate the guarantee.

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## 4. CAN-BUS wiring

The CANbus wiring have to be in lines as for example in a two-spot bonding between the ehb SMARTdisplay and the engine management system. If further nodes (CANmoduls) are to be connected, these must be attached in accordance with the following diagram:

```
+----------------+                                          +----------------+
|  ehb           |--------------+---------------+-----------|                |
|  SMARTdisplay  |              |               |           |      ECU       |
+----------------+         +---------+     +---------+      +----------------+
                           | Node A  |.....| Node Z  |
                           +---------+     +---------+
```

Only the two outside bus participants should be equipped with 120R terminating resistances.

For the wiring we recommend a protected twisted 2 core cable, with a cross section of at least 0,5mm² (mechanical stability). Thus data transmission rates of 250 kBit/s can be realized on a distance up to 100m without any problems.

☞ In order to obtain an optimal effect of the screen, this may be attached only at one side to ground (see connection diagram).

## 5. Handling of SMARTmoduls

### 5.1. Start and stop of SMARTmoduls

The SMARTmodul will be switch on and off like the ECU with clamp 15 of the ignition start switch.

# 6. Function of the Gauge-Modul

The most engine manufacturer are produce engines with ECU with SAE J1939 CAN-BUS protocol. The SMARTmodule can receive all information which is send by the ECU, if the information base on SAE J1939 protocol. Much of this information is not necessary for the everyday operation.

The gauge module with the standard software supports the following gauges.


- Engine oil-pressure, VDO 350 030 025
- Coolant temperature, VDO 310 030 023
- Engine oil-temperature, VDO 310 030 003
- RPM VDO 333 035 029 (or optional Fuel level gauge VDO 301 030 001)
.

For the connection of conventional gauges can be used 12V and 24V gauges (depending on battery voltage). The gauges have to be compatible with VDO temperature and oil-pressure sensors. If you use other sensors, the characteristic must be factory-adjusted.


The following standard sensors are reproduced or simulated:


1. Connection PIN-A: Oil-pressure sensor: 0...10bar, 10-184 Ohm

| Pressure in Bar | 0 | 2 | 6 | 10 |
|---|---|---|---|---|
| Resistance in Ohm | 10 | 52 | 124 | 184 |


2. Connection PIN-B: Temperature sensor VDO 92-027-004 (coolant temperature )

| Temperature in °C | -40 | 25 | 90 | 150 |
|---|---|---|---|---|
| Resistance in Ohm | 17162 | 543,54 | 51,21 | 10,96 |


3. Connection PIN-C: Temperature sensor VDO 92-027-006 (Oil temperature)

| Temperature in °C | -40 | 25 | 120 | 180 |
|---|---|---|---|---|
| Resistance in Ohm | 36563 | 926,71 | 36,51 | 10,24 |


4. Connection PIN-D: Tachometer VDO 333 035 029 with  8 pulses per revolution

| Speed in UPM | 0 | 800 | 1000 | 2000 | 3000 | 4000 |
|---|---|---|---|---|---|---|
| Frequency in Hz | 0 | 106,7 | 133,3 | 266,7 | 400 | 533,3 |

**Note:** The frequency is independent of the number of cylinders of the engine. So even at 4 or 6 cylinder engines 8 pulses per revolution!


4b. **Optional:** connection PIN-D: Float operated sensor for fuel level  VDO 226 801 015 001

| Füllstand in % | empty   0% | full   100% |
|---|---|---|
| Resistance in Ohm | 3 | 180 |

## 7. Function oft he RPM Modul

In addition to the receiving operation values sends the CAN module speed requirements on the CAN bus to the ECU.

**Note:** Some EMR need for change in the speed over the CAN-bus a special release from the service of the engine manufacturer. Please see also hints in the handbook of ECU / engine.

**Speed adjustment:**

With the help of inputs UPM + (PIN-A) and UPM-(PIN-B) the engine speed can change within the limits of the min and max speed manually. In inching mode, the speed change gradually by 40 RPM. (inching mode = Unique inching UPM+ or UPM-)

**Working RPM (Ramp function):**

If the input working RPM (PIN-C) is active, the current RPM will increased in the period T = 10s until the programmed value of "working RPM" is reached. This speed is kept as long as until the working RPM input (PIN-C) is disabled. Then the RPM drops down until the minimum RPM is reached during the period of T = 10s.
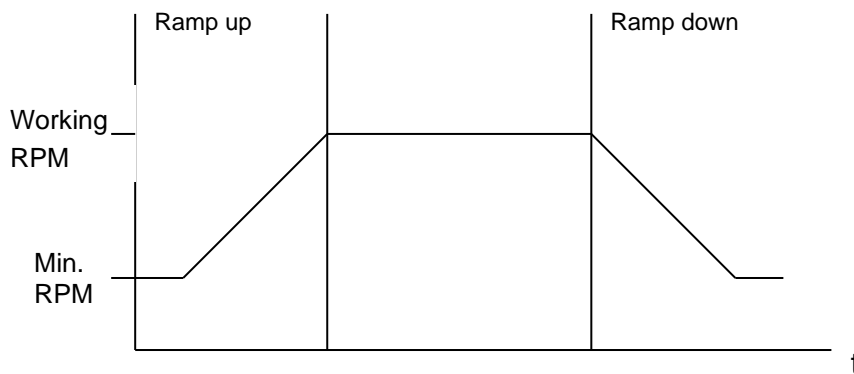


This ramp function is especially relevant for water pumps, as a sudden speed changes can lead to a setback in the water cycle.

**Set working RPM:**

By pressing the buttons RPM+ and RPM- for min. 3 sec, the current speed is stored as new working RPM, and is also saved after turning off. (Teach in method)

**Tachometer:**

For the visualization of the current speed a tachometer VDO 333 035 029 can be connected at PIN D.

| Speed in RPM | 0 | 800 | 1000 | 2000 | 3000 | 4000 |
|---|---|---|---|---|---|---|
| Frequency in Hz | 0 | 106,7 | 133,3 | 266,7 | 400 | 533,3 |

**Note:** The frequency is independent of the number of cylinders of the engine. So even at 4 or 6 cylinder engines 8 pulses per revolution!

# 8. Function of I/O-Modul

The number of inputs and outputs is limited to four.

**Inputs:**

With the help of the digital inputs (PIN A, PIN B, PIN and PIN-C-D) measured values can be transferred via the CANbus and for example evaluated and displayed by the CANmonitor with CANmd. (end-, level-, temperature and pressure switch)

**Outputs:**

About the CANbus received parameters are evaluated and issued on the outputs. The outputs are dimensioned with per 2A (BTS721).

**Example1:**

With the help of an I / O module, the switching states of the connections PIN A, PIN B, PIN and PIN-C-D are queried by a CANmonitor over greater distances.

As required, the same connections through a CANbus CANmonitors are switched with the command + UB.

**Example2:**

Conceivable also a misalignment of intelligence (software) would be into the CAN module. Simple example would be a level monitoring with two level switches, and an exit for a pump control. Over the CAN bus a status message is then only sent.

# 9. Function of Sensor-Modul

**Sensor inputs:**

With the help of the analog inputs (PIN A, PIN B, PIN and PIN-C-D) actual measured values are transfer on the bus and for example evaluated and displayed by a CANmonitor with CANmd.

The following characteristic are supported:

- Float operated sensor for fuel level  VDO 226 801 015 001

| Level in % | empty  0% | full   100% |
|---|---|---|
| Resistance in Ohm | 3 | 180 |

- Coolant level sensor VDO 226 801 015 001  → 0-100%

| Level in % | empty   0% | full   100% |
|---|---|---|
| Resistance in Ohm | 3 | 180 |

- Hydraulic oil-pressure,  active 4-20mA sensor

| Pressure in Bar | 0 | | | 1285 |
|---|---|---|---|---|
| Current in mA | 4 | | | 20 |

- Hydraulic oil-temperature,  temperature sensor VDO 92-027-006 (oil-temperature)

| Temperature in °C | -40 | 25 | 120 | 180 |
|---|---|---|---|---|
| Resistance in Ohm | 36563 | 926,71 | 36,51 | 10,24 |

**Example:**

Most industrial engines are delivered with a MMS, which does not support the connections of an external tank sensor.

With the help of the sensor module and a conventional tank sensor can be supplied the level into the CAN bus and indicated and evaluated with the CANmonitor and display.

Since the CAN module CAN-protocol after SAE J1939 supported these sensor messages can be used also in connection with third party supplier and their CAN visualization systems.

Compare in addition the SPN and PGN parameter numbers supported listed in the user manual of the foreign manufacturer.

| connection | Sensor | value | SPN | PGN |
|------------|--------|-------|-----|-----|
| PIN-A | Fuel level | 0-100% | SPN96 | PGN65276 |
| PIN-B | coolant level | 0-100% | SPN111 | PGN65263 |
| PIN-C | Hydraulic oil-pressure | 0 – 128,510 kPa | SPN1762 | PGN61448 |
| PIN-D | Hydraulic oil-temperature | -273 –  +1735°C | SPN1638 | PGN65128 |

## 10. Technical specifications

| Parameter | condition | limits | | | remarks |
|---|---|---|---|---|---|
| | | Min. | Typ | Max. | |
| Voltage UB | | 8V | 12...24V | 32V | |
| Interference voltage UB | 6Vss, 50Hz | 14V | | 28V | |
| Voltage peak UB | 2ms | | 200V | | |
| Current consumption at UB 8-24V terminal 30 (battery +) | ignition on/off | < 5mA | | 200 mA | Current consumption can accelerate with different switched Outputs |
| **Analog outputs** PIN-A gauge 1 PIN-B gauge 2 PIN-C gauge 3 PIN-D gauge 4 | input max. 14V max. 100 mA | 10 Ω | | 10 MΩ | Sensor emulation against GND |
| **Digital outputs aktiv High** PIN-A output 1 PIN-B output 2 PIN-C output 3 PIN-D output 4 | TA 25°C | 2A 2A 2A 2A | | | Short-circuit-proof |
| PIN-D Frequency | | | 100mA | | Square wave signal for tachometer IPU 8 short-circuit-proof |
| **Digitalinputs aktiv Low** PIN-A input 1 (RPM+) PIN-B input 2 (RPM-) PIN-C input 3 (G/S) | UB > 5V UB = 5V UB = 12V UB = 24V | 19% 0,95 V 2,28 V 4,56 V | 21% 1,05 V 2,52 V 5,04 V | 23% 1,15 V 2,76 V 5,52 V | Level Detection depending on the Battery voltage |
| CAN-Bus-Interface | | | 250kBit/s | | CAN 2.0B, SAE J1939 |
| Operating temperature Temperature at stock | | -40°C -55°C | | +105°C +105°C | |
| Humidity (not condense) | 48h | | 95% | | SAE J1378 |
| Vibration | 6h, 10-80Hz | | 20g | | SAE J1378 |
| Shock | 72x, 9-13ms | 44g | | 55g | SAE J1378 |
| Size | LxBxH | 75mm x 95mm x 35mm | | | |
| Protection | | IP53 | | | contacts are not protect |
| Mounting | | 8 x Amp Positiv Lock | | | |

Reference to test standards

The product has been tested according to the following norms:

Emission. Measurement of radio radiation according to DIN EN 61000-6-4, DIN EN 61000-4-20
Robustness against electric static discharge (ESD) according to nach DIN EN 61000-4-2

Robustness against high frequency electro magnetic fields according to DIN EN 61000-4-3, DIN EN 61000-4-20, ISO 11451-1
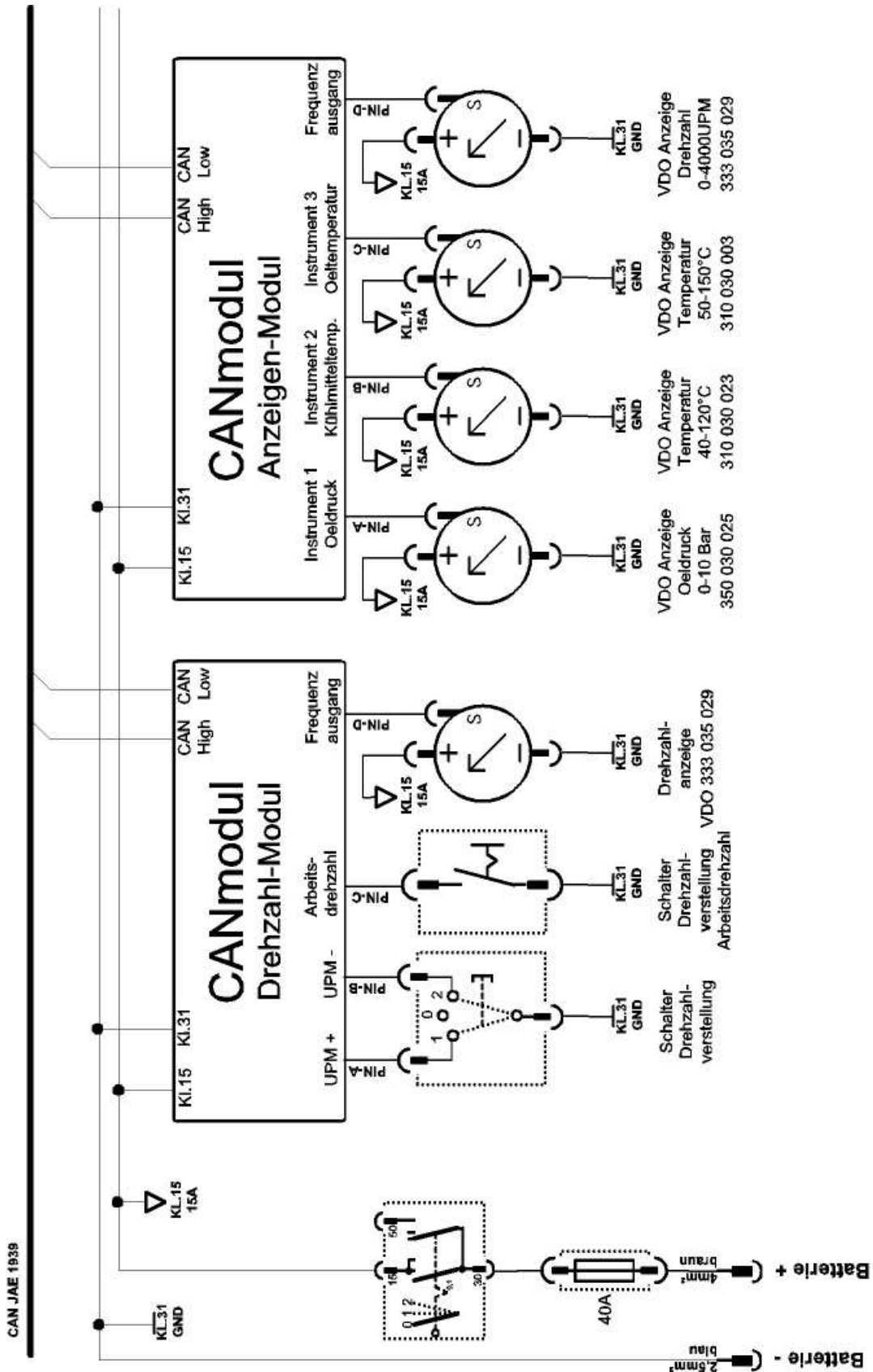
Robustness against quick transient disturbance (burst) according to DIN EN 61000-4-4

Robustness against peak current (surge) according to DIN EN 61000-4-5

Robustness against wire transmitted disturbance induced by high frequency fields according to DIN EN 61000-4-6

Vibration according to DIN EN 60068-2-6

## 11. Wiring diagram

## 12. Document information, history

| | |
|---|---|
| **Project:** | SMARTmodul |
| **Type of document:** | Technical documentation |
| **Version:** | 1.0 |
| **Created on:** | ehb electronics gmbh, Langenhagen |
| **Author:** | von Appen |

**Revisions:**

| Version: | Handling: | on: | by: |
|---|---|---|---|
| 0.0 | Translate the German version 0.1 | 31.07.2009 | H. Appen |
| 1.0 | Adaptation of the technical data | 29.08.2011 | Sch |
| 1.0 | Layout | 05.11.2015 | Hag |
| 1.1. | Adaption Information to use and Reverence to test standards, copyedit | 16.01.2019 | hk/hag |
| 1.2 | Version number only Adjustment | 16.01.2019 | hag |
| 1.3 | Change SMARTmodul to SMARTmodul | 11.09.2023 | lut |
| 1.3 | 13.Impressum ehbservice deleted | 11.09.2023 | lut |
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## 13. Impressum

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