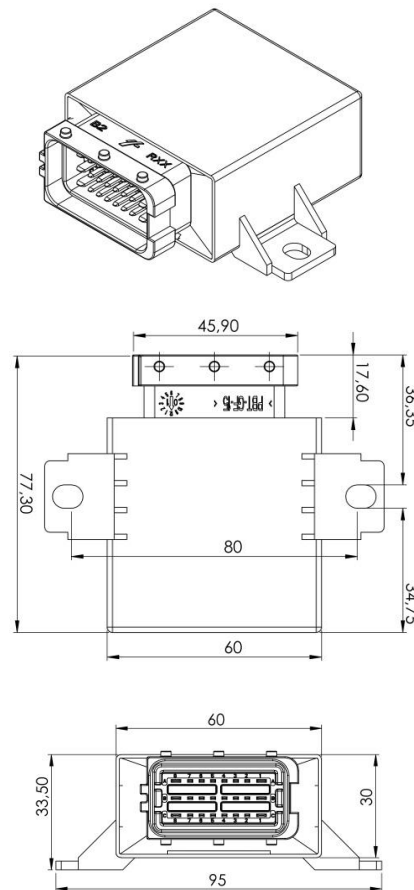




**TECHNICAL DATA**

|   |  |
|---|--|
| Housing                                   | Molded plastic, sealed   |
| Connector                                 | Sicma 211 PL249S0005   |
| Housing Dimensions                        | 60 x 60 x 30 mm (without tabs)<br>60 x 80 x 30 mm (incl. connector)  |
| Weight                                    | 170 g  |
| Temperature Range (ISO 16750-4 Compliant) | -40 to +85 °C (at +85 °C rated power see page 4)   |
| Environmental Protection                  | IP68   |
| Current Consumption                       | 30 mA  |
| Over-Current Protection                   | 20 A   |
| Total Inputs and Outputs                  | 14 (6 inputs, 8 I/O's)   |
| Inputs                                    | <u>Configurable as:</u><br>Digital, positive encoder signal<br>analog (0...11.4 / 33.68 V)<br><u>Depending on assembly:</u><br>Digital, low side switch encoder signal<br>Frequency input<br>Analog input (0...24.5 mA, PT1000 sensor) |
| Outputs                                   | <u>Configurable as:</u><br>Digital, positive switching (high side)<br><u>Depending on assembly:</u><br>PWM output (3 Hz...500 Hz)<br>Reference voltage source (5 V/8 V)  |
| Operating Voltage                         | 9–32 V<br>12 V (Code C) and 24 V (Code E)<br>ISO 16750–2 compliant   |
| Starting Voltage                          | 8 V  |
| Overvoltage Protection                    | ≥ 33 V   |
| Undervoltage Cut-Off                      | 8 V  |
| Quiescent Current                         | 97 µA (at 24 V); 8.5 µA (at 12 V)  |
| Reverse Polarity Protection               | Yes  |
| CAN Interfaces                            | CAN-bus interface 2.0 A/B, ISO 11898-2 compliant   |
| Baud Rate                                 | 60 kbps...1000 kbps<br>Default: 125 kbps   |

**TECHNICAL DRAWING (IN MM)**



**SOFTWARE/PROGRAMMING**

|                    |  |
|--------------------|--|
| Programming System | MRS Developers Studio  |
|                    | MRS Developers Studio with built-in functions library, similar to programming with FUP. Custom software blocks can be integrated into "C-code". Program memory is sufficient for about 300 basic logic components. |

**REGULATORY APPROVALS AND TESTING**

|                  |   |
|------------------|---|
| CE Conformity    | Compliant   |
| E1 Label         | UN/ECE-R10 04   |
| E1 Approval      | 04 7181   |
| Electrical Tests | According to ISO 16750 – 2/ 16750-4:<br>Short circuit protection<br>Pin/connector Interruption<br>Overvoltage at +65 °C<br>Operation/storage test at +85 °C<br>Superimposed alternating voltage<br>Slow decrease and increase of supply voltage<br>Momentary drop in supply voltage<br>Reset behavior at voltage drop<br>According to ISO 7637 - 2: Pulse 1, 2a, 2b, 3a, 3b |



INPUT FEATURES - SUMMARY

|  |                                   |                            |
|--|-----------------------------------|----------------------------|
| <b>Pin C3, C4, C5, C6, C7</b>                            | Usable as analog or digital input |                            |
|  | Resolution                        | 12-bit                     |
|  | Accuracy                          | ± 1 % full scale           |
| Voltage Input<br>0...11.4 V (see <a href="#">A</a> )     | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *= 60 Hz    |
|  | Accuracy                          | ± 3 %                      |
| Current Input<br>0...24.5 mA<br>(see <a href="#">C</a> ) | Input resistance                  | 500 Ω                      |
|  | Input frequency                   | 40 Hz                      |
|  | Conversation factor               | 1 mA ± 462 digits          |
| Frequency Input (see <a href="#">D</a> )                 | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | ± 3% accuracy at ≤ 2.2 kHz |
|  | Turn-on threshold                 | 6.5 V                      |
|  | Turn-off threshold                | 5 V                        |
| Digital Input Positive (see <a href="#">A</a> )          | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *= 60 Hz    |
|  | Turn-on threshold                 | 7 V                        |
|  | Turn-off threshold                | 4.5 V                      |
| <b>Pin C2</b>  | Usable as analog or digital input |                            |
|  | Resolution                        | 12-bit                     |
|  | Accuracy                          | ± 1 % full scale           |
| Voltage Input<br>0...33.68 V<br>(see <a href="#">B</a> ) | Input resistance                  | 66.6 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *=40 Hz     |
|  | Accuracy                          | ± 3 %                      |
| Current Input<br>0...24.5 mA<br>(see <a href="#">C</a> ) | Input resistance                  | 470 Ω                      |
|  | Input frequency                   | f <sub>c</sub> *= 40 Hz    |
|  | Conversion factor                 | 1 mA ± 462 digits          |

\* f<sub>c</sub>= cutoff frequency (-3 dB)

|  |                                   |                            |
|--|-----------------------------------|----------------------------|
| Frequency Input (see <a href="#">D</a> )             | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | ± 3% accuracy at ≤ 2.2 kHz |
|  | Turn-on threshold                 | 7 V                        |
|  | Turn-off threshold                | 4.5 V                      |
| Digital Input Positive (see <a href="#">B</a> )      | Input resistance                  | 66.6 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *=40 Hz     |
|  | Turn-on threshold                 | 19 V                       |
|  | Turn-off threshold                | 14.5 V                     |
| <b>Pin A1, A2, A3, A4, A5, A6</b>                    | Usable as analog or digital input |                            |
|  | Resolution                        | 12-bit                     |
|  | Accuracy                          | ± 1 % full scale           |
| Voltage Input<br>0...11.4 V (see <a href="#">E</a> ) | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *=60 Hz     |
|  | Accuracy                          | ± 5 %                      |
| Digital Input Positive (see <a href="#">E</a> )      | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *= 60 Hz    |
|  | Turn-on threshold                 | 6.5 V                      |
|  | Turn-off threshold                | 5 V                        |
| <b>Pin A7, A8</b>                                    | Usable as digital input           |                            |
|  | Resolution                        | 12 Bit                     |
|  | Accuracy                          | ± 1 % full scale           |
| Digital Input Positive (see <a href="#">E</a> )      | Input resistance                  | 22.7 kΩ                    |
|  | Input frequency                   | f <sub>c</sub> *=60 Hz     |
|  | Turn-on threshold                 | 6.5 V                      |
|  | Turn-off threshold                | 5 V                        |

OUTPUT FEATURES - SUMMARY

|   |   |                            |
|---|---|----------------------------|
| <b>Pin A1, A2</b>   | Protective circuit for inductive loads  | Optional integrated        |
|   | Wire fault diagnostics  | Possible via current sense |
|   | Short circuit diagnostics   | Possible via current sense |
| Digital, Positive Switching (high side, see <a href="#">E</a> ) | Switching voltage   | 9-32 V DC                  |
|   | Switching current   | 0.02-2.5 A                 |
|   | Conversation factor current sense   | 1 Digit ± 2.3 mA           |
| Short Circuit Resistance Against GND and V <sub>B</sub>         | The switching-off is controlled by high-side driver (separate for each channel) |                            |

|   |  |                            |
|---|--|----------------------------|
| <b>Pin A3, A4, A5, A6, A7, A8</b>                               | Protective circuit for inductive loads                                       | Optional integrated        |
|   | Wire fault diagnostics   | Possible via current sense |
|   | Short circuit diagnostics  | Possible via current sense |
| Digital, Positive Switching (high side, see <a href="#">E</a> ) | Switching voltage  | 9-32 V DC                  |
|   | Switching current  | 0.02-2.5 A                 |
|   | Conversation factor current sense  | 1 Digit ± 2.5 mA           |
| PWM-Output (see <a href="#">F</a> )                             | Output frequency   | 500 Hz                     |
|   | Duty cycle   | 0...1000 ‰                 |
|   | Resolution   | 1 ‰                        |
|   | Switching current  | ≤ 2.5 A (see page 4)       |
| Short Circuit Protection Against Ground and V <sub>B</sub>      | Switching-off is controlled via high side driver (separate for each channel) |                            |



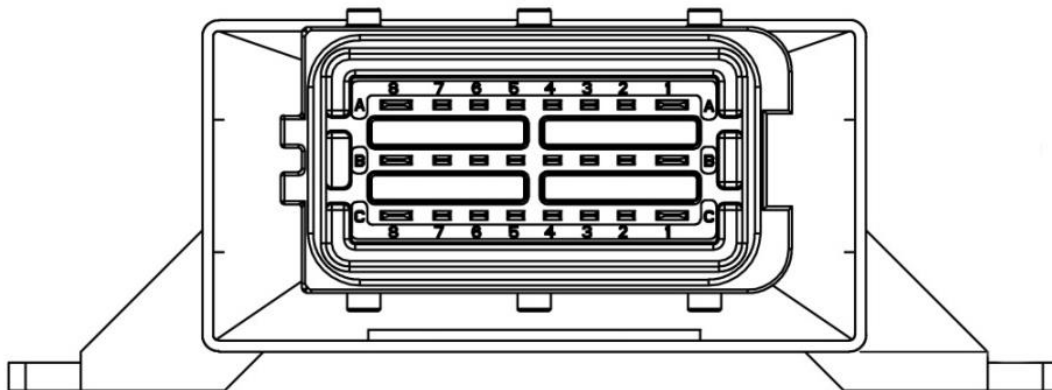
**PIN ASSIGNMENT POWER SUPPLY AND INTERFACES**

| Pin | Description   | Pin | Description   |
|-----|---|-----|---|
| B1  | Supply voltage for output pins A1 through A4, operating voltage for CPU | B6  | Ground/contact 31 according to DIN 72552 CAN-bus high                   |
| B2  | CAN-bus 1 high  | B7  | VREF (assembly option see page 5, otherwise not connected)              |
| B3  | CAN-bus 1 low   | B8  | Supply voltage for output pins A5 through A8, operating voltage for CPU |
| B4  | CAN-bus 1 high/RS 485 – A/RS 232 Tx (optional, see page 5)              | C1  | Ground/contact 31 according to DIN 72552 CAN bus high                   |

**PIN ASSIGNMENT IN- AND OUTPUTS**

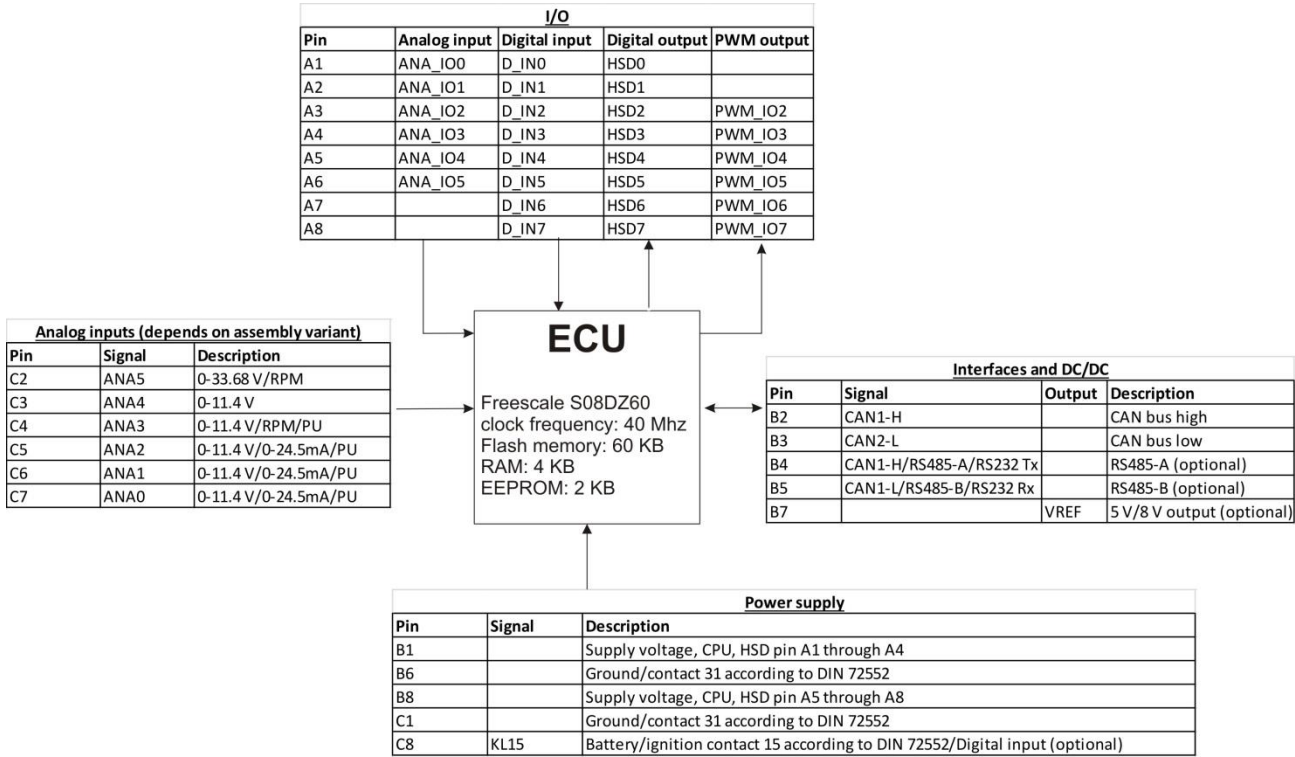
The alternative functions like frequency/current/pull-up or PT1000-inputs depends on the assembly variants (see table on page 5).

| Pin | Signal                      | Description   | Pin | Signal            | Description  |
|-----|-----------------------------|---|-----|-------------------|--|
| A1  | ANA_IO0 / D_IN0<br>OUT_HSD0 | Analog/digital input IO0; 0-11.4 V<br>Or digital output DO0                     | A8  | D_IN7<br>OUT_HSD7 | Digital input IO7; 0-11.4 V<br>Or digital output DO7 with PWM capability |
| A2  | ANA_IO1 / D_IN1<br>OUT_HSD1 | Analog/digital input IO1; 0-11.4 V<br>or digital output DO1                     | C2  | ANA5/ D_ANA5      | Analog input 5; 0-33.68 V<br>Can also be used as digital input           |
| A3  | ANA_IO2 / D_IN2<br>OUT_HSD2 | Analog/digital input IO2; 0-11.4 V<br>Or digital output DO2 with PWM capability | C3  | ANA4/ D_ANA4      | Analog input 4; 0-11.4 V<br>Can also be used as digital input            |
| A4  | ANA_IO3 / D_IN3<br>OUT_HSD3 | Analog/digital input IO3; 0-11.4 V<br>Or digital output DO3 with PWM capability | C4  | ANA3/ D_ANA3      | Analog input 3; 0-11.4 V<br>Can also be used as digital input            |
| A5  | ANA_IO4 / D_IN4<br>OUT_HSD4 | Analog/digital input IO4; 0-11.4 V<br>Or digital output DO4 with PWM capability | C5  | ANA2/ D_ANA2      | Analog input 2; 0-11.4 V<br>Can also be used as digital input            |
| A6  | ANA_IO5 / D_IN5<br>OUT_HSD5 | Analog/digital input IO5; 0-11.4 V<br>Or digital output DO5 with PWM capability | C6  | ANA1/ D_ANA1      | Analog input 1; 0-11.4 V<br>Can also be used as digital input            |
| A7  | D_IN6<br>OUT_HSD6           | Digital input IO6; 0-11.4 V<br>Or digital output DO6 with PWM capability        | C7  | ANA0/ D_ANA0      | Analog input 0; 0-11.4 V<br>Can also be used as digital input            |





PIN FEATURE MAP



PERFORMANCE TESTS HIGH-SIDE DRIVER VNQ5050AK

**Test without PWM**

|  | Test. No. | Load       | Endurance  |
|--|-----------|------------|------------|
| Endurance tests at +85 °C for digital outputs (max. 2 channels per high side driver) | 1         | 4 x 2.5 A  | Continuous |
|  | 2         | 3 x 2.5 A  | 30 minutes |
|  | 3         | 2 x 2.5 A  | 15 minutes |
|  |           | 2 x 3.5 A  |            |
| 4  | 1 x 2.5 A | 10 minutes |            |
|  | 3 x 3.5 A |            |            |

**Test with PWM**

|  | Test No.  | Load      | Endurance  |
|--|-----------|-----------|------------|
| Endurance tests at +85 °C for PWM outputs with frequency=200 Hz and 90 % duty cycle (max. 2 channels per high side driver) | 1         | 4 x 2.0 A | Continuous |
|  | 2         | 4 x 2.5 A | 10 minutes |
|  | 3         | 1 x 3.5 A | 2 minutes  |
|  |           | 3 x 2.5 A |            |
| 4  | 2 x 3.5 A | 2 minutes |            |



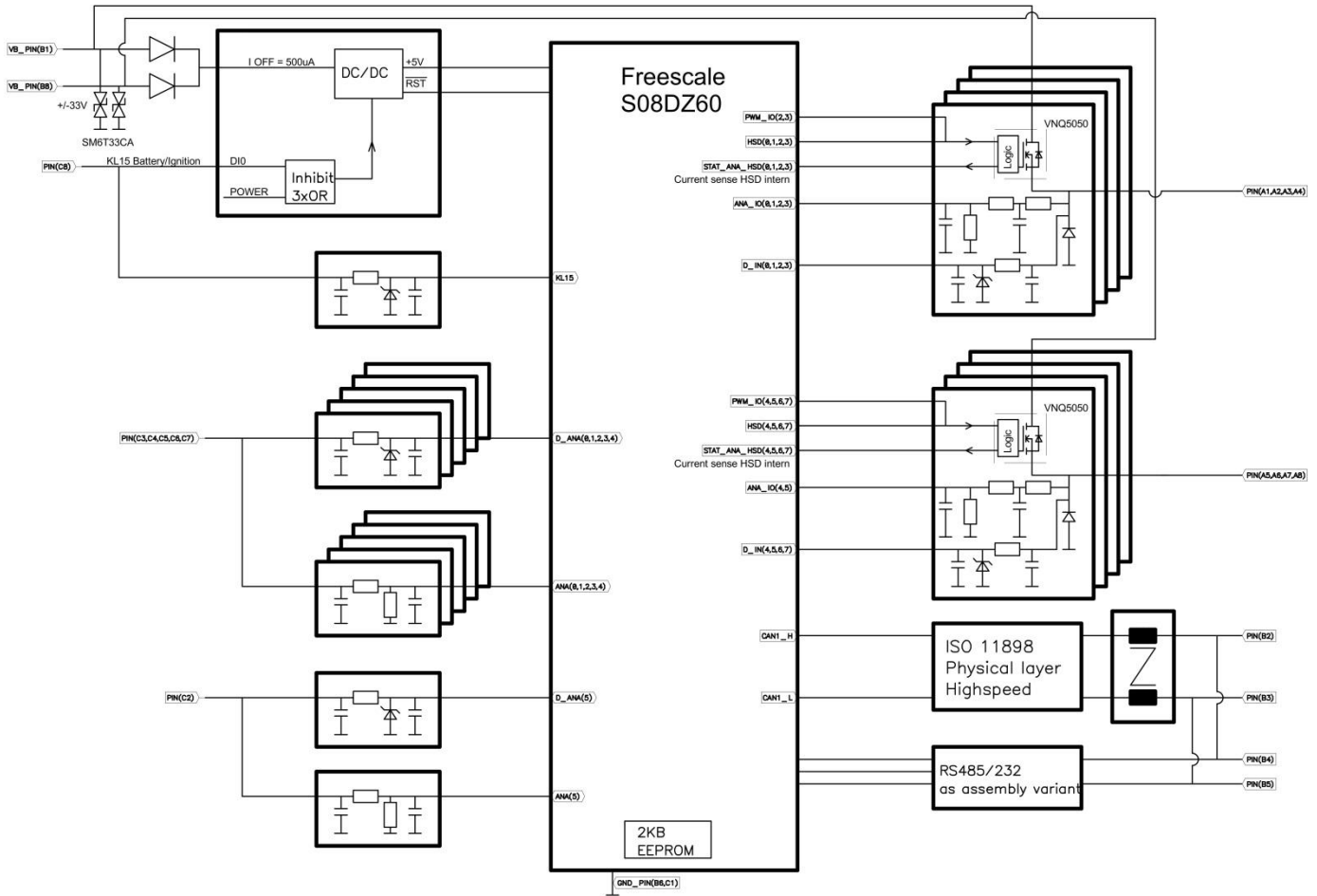
ASSEMBLY OPTIONS AND ORDER INFORMATION

|                        | Inputs                     |                            |                           |                |  | Outputs                 | CAN Bus High Speed | Serial Interface | DC/DC                          |
|------------------------|----------------------------|----------------------------|---------------------------|----------------|--|-------------------------|--------------------|------------------|--------------------------------|
|                        | A<br>Voltage<br>0 - 11,4 V | B<br>Voltage<br>0 – 33,7 V | C<br>Current<br>0 - 24 mA | D<br>Frequency | E<br>Sensor Inputs<br>10 kΩ Pull-up<br>I/O's (can be used as analog or digital inputs or as digital outputs) | F<br>PWM ≤ 500 Hz       |                    |                  | 5 V Reference<br>8 V Reference |
| <b>1.053.300.0000</b>  | C3,C4,C5,C6,C7             | C2                         |                           |                |  | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  |                                |
| <b>1.053.302.0000</b>  | C3,C5,C6,C7                |                            |                           | C2,C4          |  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  |                  | B7 (5 V)                       |
| <b>1.053.302.1200</b>  | C3,C5,C6,C7                |                            |                           | C2,C4          |  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  |                  | B7 (5 V)                       |
| <b>1.053.302.1300</b>  | C3,C5,C6,C7                |                            |                           | C2,C4          |  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  |                  | B7 (5 V)                       |
| <b>1.053.303.0000</b>  | C3,C4                      | C2                         | C5,C6,C7                  |                |  | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  |                                |
| <b>1.053.304.1200</b>  | C3,C5,C6,C7                |                            |                           | C2,C4          | C2,C4  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  |                  | B7 (5 V)                       |
| <b>1.053.305.0000</b>  | C3,C5,C6,C7                |                            |                           | C2,C4          |  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  |                  | B7 (8 V)                       |
| <b>1.053.306.0000</b>  | C3,C4                      | C2                         |                           |                | C5,C6,C7   | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  |                                |
| <b>1.053.307.0000</b>  | C3                         | C2                         |                           |                | C4,C5,C6,C7  | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  |                                |
| <b>1.053.310.0000</b>  | C3,C4,C5,C6,C7             | C2                         |                           |                |  | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  | B4/B5 (RS485)                  |
| <b>1.053.320.1000</b>  | C3,C4,C5,C6,C7             | C2                         |                           |                |  | A1,A2,A3,A4,A5,A6,A7,A8 |                    |                  | B4/B5 (RS232)                  |
| <b>1.053P.300.0000</b> | C3,C4,C5,C6,C7             | C2                         |                           |                |  | A1,A2,A3,A4,A5,A6,A7,A8 |                    | CANopen          |                                |
| <b>1.053P.305.0000</b> | C3,C5,C6,C7                |                            |                           | C2,C4          |  | A1,A2,A3,A4,A5,A6,A7,A8 | A3,A4,A5,A6,A7,A8  | CANopen          | B7 (8 V)                       |

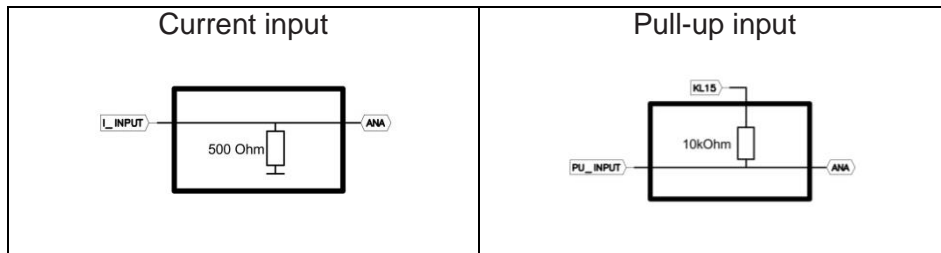
Order number with the last 4 digits 1000 or 1200 indicate that the device is active after the supply voltage is connected to pins B1 and B8 (operating voltage contact 30); pin C8 (ignition contact 15) can be used as digital input in this case.



BLOCK FUNCTION DIAGRAM



BLOCK FUNCTION DIAGRAM FOR ASSEMBLY OPTIONS



## ACCESSORIES

| Description                                | Order Number |
|--|--------------|
| Programming Tool MRS Developers Studio     | 1.100.100.09 |
| Cable Set CAN I/O WP                       | 112342       |
| Connector Package CAN I/O WP               | 110421       |
| Rubber Boot for Cable Set                  | 102892       |
| Crimp Contact 2,8 mm/1-2.5 mm <sup>2</sup> | 109947       |
| Crimp Contact 1.5 mm/1.3-2 mm <sup>2</sup> | 109949       |
| Dummy FCI Filler Plug                      | 110268       |
| PCAN-USB Interface                         | 105358       |

### Contact Information

MRS Electronic, Inc.  
2149 Winners Circle  
Dayton, OH 45404  
Email: [info@mrs-electronic.com](mailto:info@mrs-electronic.com)  
Phone: +1 937.259.4300  
Visit @ [www.mrs-electronic.com](http://www.mrs-electronic.com)





### GENERAL PROVISIONS

- Safe operation of series production equipment may not be guaranteed if samples or prototypes are used.
- Wiring examples provided by MRS Electronic, Inc.® do not imply any endorsement, responsibility, or liability for the overall system performance.
- Incorrect wiring may result in unexpected or inconsistent signals at the outputs of the control device.
- Potential hazards during operation of equipment cannot be excluded when using incorrect software programs or parameter settings in the control device.
- To avoid a loss of manufacturer's warranty, installation, modification, or exchange of product firmware or software has to be performed by MRS Electronic, Inc.® personnel or a qualified professional contractor.
- It is prohibited to open, modify or repair the control device. Modifications or repairs may result in hazardous malfunctions of the device.  
**Maintenance and repair should be performed by MRS Electronic, Inc.® personnel only.**
- It is not permitted to apply voltage to device terminals other than the power terminals if the power supply of the control device is shut down or disconnected. If the power supply is shut down, it is important that power to the control device, power amplifiers, and external sensors is shut down simultaneously.
- In case of failure or malfunction of the control device, please ensure that this condition of the device does not result in a hazardous malfunction of the overall system. Such unintended system behavior may lead to personnel injuries or serious property damage.
- System design, installation, and commissioning of electrical systems must only be performed by a qualified professional who is familiar with the components used and the overall system.
- Unforeseeable hazards may be caused by the machinery during commissioning and maintenance of the control device. To prevent such events, please ensure that the machinery is always in a safe state.
- Faulty components or components with malfunction must not be used. If components fail or show signs of malfunction they have to be replaced or repaired immediately.
- Control devices that are used for software development and have been flashed more than 500 times with software updates must not be used in commercial machinery.

### INSTALLATION RECOMMENDATIONS

- Do not install the control device close to components which emit considerable amounts of heat.
- Ensure that water cannot get inside the control device by properly sealing all cables and wires.
- Always install the control device with the connector(s) pointing downwards allowing for condensation water to drain off.

### WIRING AND CABLE ROUTING RECOMMENDATIONS

- Electrical and power terminals of the control device have to be sourced by the same electric circuit.
  - Connect the product only when wires/cables are de-energized.
  - Mechanically secure the cable harness in close range of the installation location of the control device. Fix and adjust the cable harness for in-phase mechanical motion with the control device.
  - It is not allowed to bridge PWM outputs together.
  - Power levels of the sensor inputs may be amplified as a result of external wiring, because they are designed as power supply and not as power sink. Amplified power levels may lead to unforeseeable malfunction and in case of permanent operation to damage of the control device.
  - The high-side outputs cannot be connected externally with battery.
- Special information for proportional magnets and solenoid switches or other switched inductive loads:
- The electronic circuitry must only be validated with the proportional valve connected.

### INTENDED USE

- If there are no restrictions for specific applications in this datasheet, the control device is designed for applications in mobile working machines.
- Use the control device only within the technical limits stated in this datasheet, especially with respect to voltages, currents, temperature, vibration, shock or any other specified environmental conditions.

### NOT INTENDED USE

- If the control unit is used in any other way than described in the paragraph "INTENDED USE", it is not an intended use.
- Any use or application of the control device in explosive environments is prohibited.
- The manufacturer's warranty is void for any damages resulting from unintended use and/or arbitrary modifications which are not expressly indicated in this datasheet.



