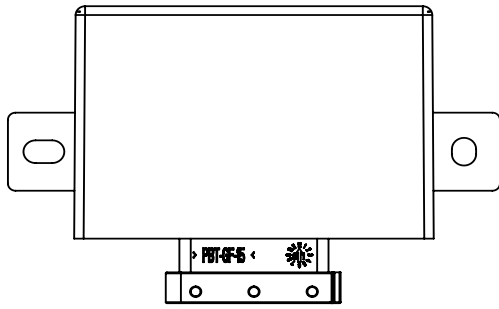
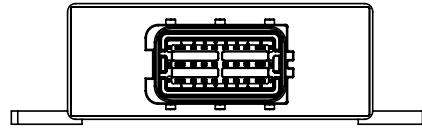


DESCRIPTION

With the 3CH 10 A motor controller, you can precisely control up to three DC motors via the full bridges. The integrated ramp functions allow you to start up the motors smoothly or slow them down. The module also has 8 configurable multifunction inputs and 2 current-controlled PWM outputs, e.g. for controlling two hydraulic proportional valves.



Top view



Plug view

TECHNICAL DATA

|  |  |
|--|--|
| Housing                                      | PA66GF30   |
| Connector                                    | Delphi / Aptiv - 211PC249S0033   |
| Weight                                       | 290 g  |
| Temperature range (acc. to ISO 16750-4)      | -40°C...+85°C  |
| Environmental protection (acc. to ISO 20653) | IP6K8 with correct mounting position (connector downwards)   |
| Current consumption                          | 50 mA at 12 V<br>33 mA at 24 V   |
| Fuse protection                              | max. load, see S. 3  |
| Total inputs and outputs                     | 16 (8 inputs, 2 I/Os, 6 motor half bridges)  |
| Inputs                                       | 2 I/Os (analog inputs 0...33.9 V)<br><br>8 Multifunctional inputs with analog inputs switchable 0...16.9 V / 0...32.8 V<br>Digital inputs<br>Current inputs<br>Sensor inputs<br>Frequency inputs |
| Outputs                                      | 2 I/Os (digital outputs, PWM-capable)<br><br><b>Configurable:</b><br>6 Motor half bridges or<br>3 Motor  |
| Operating voltage range                      | 8...32 V resp. 14.5...32 V with $V_{REF} = 10 V$ (Code B @ 12 V and Code E @ 24 V acc. to ISO 16750)   |
| Overvoltage protection                       | ≥ 33 V   |
| Quiescent current                            | 35 µA at 12 V<br>75 µA at 24 V   |
| Reverse voltage protection                   | yes  |
| CAN Interface                                | CAN Interface 2.0 A/B, ISO 11898-2, ISO 11898-5, CAN-FD capable  |
| LIN Interface                                | see assembly options   |

REGULATORY APPROVALS AND TESTING

|  |   |
|--|---|
| E1 Approval                                  | 06 10058  |
| Electrical tests                             | <b>Acc. to ISO 16750 – 2 bzw. -4:</b><br>Operating voltage<br>Short circuit protection<br>Reverse polarity<br>Disconnection pin and connector<br>Longterm overvoltage at $T_{Max-20K}$<br>storage test at $T_{Max}$ and $T_{Min}$<br>Operation test at $T_{Max}$ and $T_{Min}$<br>Temperature steps<br>Starting profile (form. Pulse 4 acc. to ISO 7637)<br><br><b>Acc. to ISO 7637 - 2:</b> Pulse 1, 2a, 2b, 3a, 3b<br><br><b>Acc. to ISO 10605:</b> ESD up to ± 8 kV on pins, all others ±15 kV |
| chemical tests (@ room temperature, brushed) | Battery liquid (22 h)<br>interior cleaner (2h)<br>Glass cleaner (2h)<br>Acetone (10 min)<br>Ammoniumcontaining cleaner (22 h)<br>Denatured alcohol (10 min)<br>Transpiration (22 h)<br>Cosmetic Products (Nivea Creme, 22 h)<br>Refreshment containing coffein and sugar (Cola, 22 h)<br>Cream, coffee whitener (22 h)  |

SOFTWARE/PROGRAMMING

|                    |  |
|--------------------|--|
| Programming System | <b>MRS APPLICS STUDIO</b><br>The Applics Studio is the new development and tool platform for our assemblies. Program your MRS controls quickly and easily with our stand-alone software. The focus is on your application. |
|--------------------|--|

## INPUT FEATURES - SUMMARY (DEPENDING ON ASSEMBLY)

|  |   |                              |  |   |                  |
|--|---|------------------------------|--|---|------------------|
| <b>Pin A5, A6, B2, B3, B6, C2, C3, C4 (MULTI_IN)</b> | Programmable as analog or digital input |                              | <b>Pin C6, C7 (IO_1, IO_0) (see E)</b> | Programmable as analog or digital input |                  |
|  | Resolution                              | 12 Bit                       |  | Resolution                              | 12 Bit           |
|  | Accuracy                                | ± 1.5 % full scale           |  |   |                  |
| Voltage input 0...16.9 V (see A) <sup>1</sup>        | Input resistance                        | 34 kΩ                        | Voltage input 0...33.9 V               | Input resistance                        | 30 kΩ            |
|  | Input frequency                         | $f_g^2 = 75$ Hz              |  | Input frequency                         | $f_g^2 = 170$ Hz |
|  | Conversion factor                       | 1 Digit ≈ 4.13 mV            |  | Deviation                               | ≤ 3 %            |
| Voltage input 0...32.8 V (see B)                     | Input resistance                        | 28 kΩ                        |  |   |                  |
|  | Input frequency                         | $f_g^2 = 105$ Hz             |  |   |                  |
|  | Conversion factor                       | 1 Digit ≈ 8.01 mV            |  |   |                  |
| Current input 0...25 mA (see C)                      | Input resistance                        | 330 Ω gegen GND <sup>4</sup> |  |   |                  |
|  | Conversion factor                       | 1 mA ≈ 79 digits             |  |   |                  |
| Sensor input (see D)                                 | Input resistance                        | 1 kΩ gegen VREF / contact 30 |  |   |                  |
|  |   |                              |  |   |                  |
| Digital input <sup>3</sup>                           | Input resistance                        | 34 kΩ                        |  |   |                  |
|  | Turn-on threshold                       | 6.1 V ±0.3 V                 |  |   |                  |
|  | Turn-off threshold                      | 4.0 V ±0.3 V                 |  |   |                  |
| Frequency input 0...35 kHz (see E) <sup>3</sup>      | Input resistance                        | 34 kΩ                        |  |   |                  |
|  | Turn-on threshold                       | 3.8 V ±0.3 V                 |  |   |                  |
|  | Turn-off threshold                      | 1.3 V ±0.3 V                 |  |   |                  |
|  | Min. pulse width                        | 4 μs                         |  |   |                  |
|  | Meas. range PWM                         | 15...98 %                    |  |   |                  |
|  | Deviation                               | ± 3 %                        |  |   |                  |

<sup>1</sup> Standard configuration<sup>2</sup> Cutoff frequency (-3 dB)<sup>3</sup> When using the standard configuration, see<sup>1</sup><sup>4</sup> When using the pull down no voltage higher than 8.5 V may be present, otherwise the pulldown is automatically deactivated for safety reasons

## OUTPUT FEATURES - SUMMARY

|   |   |                               |  |   |                                       |
|---|---|-------------------------------|--|---|---------------------------------------|
| <b>Pin A3, A4, A7, B1, C1, C8 Motor outputs BTN9970LV</b> | Protective circuit for inductive loads                                  | Integrated                    | <b>Pin C6, C7 IOs with BTS</b>   | Protective circuit for inductive loads                                      | Integrated                            |
|   | Wire fault diagnostics  | Possible via current sense    |  | Wire fault diagnostics  | Possible via current sense            |
|   | Short circuit diagnostics   | Possible via current sense    |  | Short circuit diagnostics   | Possible via current sense            |
| Motor output (see G)                                      | Switching voltage max. load current                                     | 8...32 V see load test (S. 3) | Digital, positive switching (High-Side; see E) inclusive INA-current sense | Switching voltage max. load current   | 8...32 V DC see load test (S. 3)      |
|   | duty cycle  | 0...100%                      |  | Conversion factor   | 1 Digit ≈ 1 mA for 800 mA...5 A ± 3 % |
|   | PWM-Frequenz  | up to 30 kHz                  |  | Deviation current sense INA293  |                                       |
| Short circuit resistance against GND and V <sub>s</sub>   | Switching-off is controlled motor driver for <b>each</b> output channel |                               | PWM output (see E)   | Output frequency  | 1 Hz bis 1 kHz                        |
| Protection circuit overload                               | Overtemperature shutdown integrated                                     |                               |  | Resolution  | 1 ‰                                   |
|   |   |                               |  | Switching current   | see load test (S. 3)                  |
|   |   |                               | Short circuit resistance against GND and V <sub>s</sub>                    | Switching-off is controlled high side driver for <b>each</b> output channel |                                       |
|   |   |                               | Protection circuit overload  | Overtemperature shutdown integrated   |                                       |

LOAD TESTS AT  $T_{+85^{\circ}\text{C}}$  HSD- AND MOTOR OUTPUTS

| Test without PWM | load   | duration  | Test with PWM | PWM / DC      | load   | duration  |
|------------------|--|-----------|---------------|---------------|--|-----------|
| @ 28 V $V_s$     | 2 x BTS (C6, C7) each 6.7 A                                | Permanent | @ 28 V $V_s$  | 20 kHz / 96 % | 1 x BTN as full bridge (A3, A4 or B1, C1 or A7, C8) 10 A   | Permanent |
| @ 28 V $V_s$     | 3 x BTN as full bridge (A3, A4, A7, B1, C1, C8) each 6.6 A | Permanent | @ 28 V $V_s$  | 20 kHz / 96 % | 3 x BTN as Full bridge (A3, A4, A7, B1, C1, C8) each 6.1 A | Permanent |
| @ 28 V $V_s$     | 1 x BTN as fullbridge (A3, A4 or B1, C1 or A7, C8) 12 A    | Permanent | @ 28 V $V_s$  | 100 Hz / 90 % | 2 x BTS (C6, C7) each 4.2 A                                | Permanent |

measured at +85°C, 28 V supply voltage, resistive load

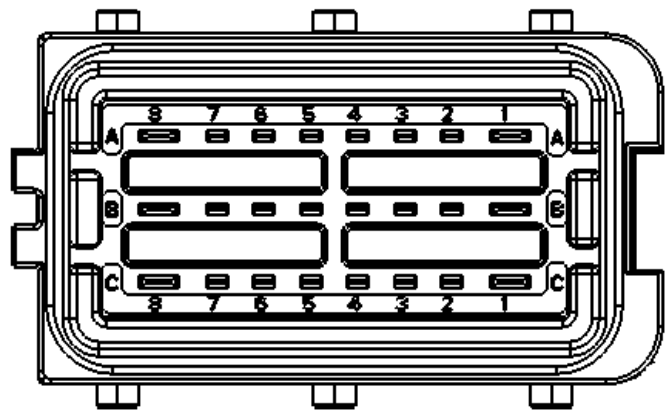
measured at +85°C, 28 V supply voltage, inductive load

PIN ASSIGNMENT POWER SUPPLY AND INTERFACES (DEPENDING ON ASSEMBLY)

| Pin     | Pin Description             | Pin | Pin Description                                 |
|---------|-----------------------------|-----|---|
| A1 + A8 | Supply voltage / contact 30 | A2  | LIN / VREF (Depending on assembly, max. 500 mA) |
| B5      | Ignition / contact 15       | B4  | CAN - H   |
| B7 + B8 | Ground / contact 31         | C5  | CAN - L   |

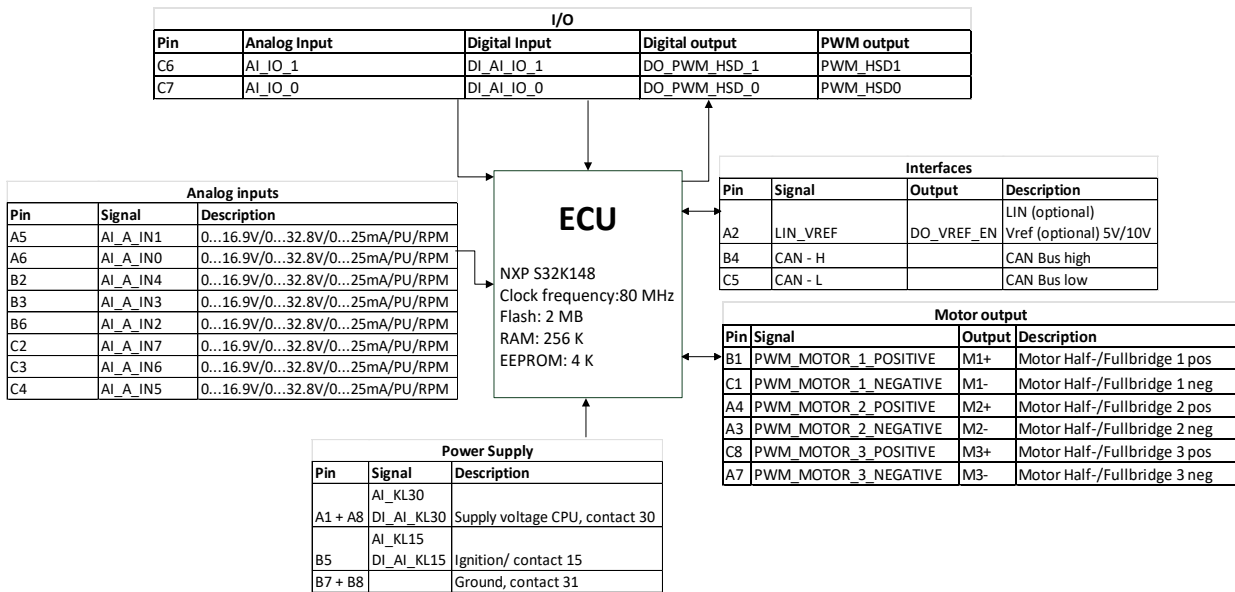
PIN ASSIGNMENT INPUTS AND OUTPUTS

| Pin | Signal        | Pin Description                   | Pin | Signal                 | Pin Description        |
|-----|---------------|-----------------------------------|-----|------------------------|------------------------|
| A5  | AI_A_IN1      | Analog input 1                    | C1  | PWM_MOTOR_1_NEGATIVE   | Motor output 1 neg.    |
|     | DI_AI_A_IN1   | Digital input 1                   |     | AI_MOTOR_1_IS_NEGATIVE | Current sense 1 neg.   |
|     | FREQ_A_IN1    | Frequency input 1                 | B1  | PWM_MOTOR_1_POSITIVE   | Motor output 1 pos.    |
|     | DO_PD1        | Activation Current Input          |     | AI_MOTOR_1_IS_POSITIVE | Current sense 1 pos.   |
|     | DO_PU1        | Activation Pull-up                | A3  | PWM_MOTOR_2_NEGATIVE   | Motor output 2 neg.    |
|     | DO_RS1        | Range selection 0...16.9 / 32.8 V |     | AI_MOTOR_2_IS_NEGATIVE | Current sense 2 neg.   |
| A6  | AI_A_IN0      | Analog input 0                    | A4  | PWM_MOTOR_2_POSITIVE   | Motor output 2 pos.    |
|     | DI_AI_A_IN0   | Digital input 0                   |     | AI_MOTOR_2_IS_POSITIVE | Current sense 2 pos.   |
|     | FREQ_A_IN0    | Frequency input 0                 | A7  | PWM_MOTOR_3_NEGATIVE   | Motor output 3 neg.    |
|     | DO_PD0        | Activation Current Input          |     | AI_MOTOR_3_IS_NEGATIVE | Current sense 3 neg.   |
|     | DO_PU0        | Activation Pull-up                | C8  | PWM_MOTOR_3_POSITIVE   | Motor output 3 pos.    |
|     | DO_RS0        | Range selection 0...16.9 / 32.8 V |     | AI_MOTOR_3_IS_POSITIVE | Current sense 3 pos.   |
| B2  | AI_A_IN4      | Analog input 4                    | C6  | AI_IO_1                | Analog input IO1       |
|     | DI_AI_A_IN4   | Digital input 4                   |     | AI_SNS1                | Current sense IO1      |
|     | FREQ_A_IN4    | Frequency input 4                 |     | AI_INA_OUT1            | INA Current sense IO1  |
|     | DO_PD4        | Activation Current Input          |     | DI_AI_IO_1             | Digital input IO1      |
|     | DO_PU4        | Activation Pull-up                |     | DO_PWM_HSD1            | Digital output IO1 PWM |
|     | DO_RS4        | Range selection 0...16.9 / 32.8 V |     | PWM_HSD1               | output IO1             |
| B3  | AI_A_IN3      | Analog input 3                    | C7  | AI_IO_0                | Analog input IO0       |
|     | DI_AI_A_IN3   | Digital input 3                   |     | AI_SNS0                | Current sense IO0      |
|     | DI_FREQ_A_IN3 | Frequency input 3                 |     | AI_INA_OUT0            | INA Current sense IO0  |
|     | DO_PD3        | Activation Current Input          |     | DI_AI_IO_0             | Digital input IO0      |
|     | DO_PU3        | Activation Pull-up                |     | DO_PWM_HSD0            | Digital output IO1     |
|     | DO_RS3        | Range selection 0...16.9 / 32.8 V |     | PWM_HSD0               | PWM output IO0         |
| B6  | AI_A_IN2      | Analog input 2                    | A2  | DO_LIN_EN              | Activation LIN         |
|     | DI_AI_A_IN2   | Digital input 2                   |     |                        |                        |
|     | DI_FREQ_A_IN2 | Frequency input 2                 |     |                        |                        |
|     | DO_PD2        | Activation Current Input          |     |                        |                        |
|     | DO_PU2        | Activation Pull-up                |     |                        |                        |
|     | DO_RS2        | Range selection 0...16.9 / 32.8 V |     |                        |                        |
| C2  | AI_A_IN7      | Analog input 7                    |     |                        |                        |
|     | DI_AI_A_IN7   | Digital input 7                   |     |                        |                        |
|     | DI_FREQ_A_IN7 | Frequency input 7                 |     |                        |                        |
|     | DO_PD7        | Activation Current Input          |     |                        |                        |
|     | DO_PU7        | Activation Pull-up                |     |                        |                        |
|     | DO_RS7        | Range selection 0...16.9 / 32.8 V |     |                        |                        |
| C3  | AI_A_IN6      | Analog input 6                    |     |                        |                        |
|     | DI_AI_A_IN6   | Digital input 6                   |     |                        |                        |
|     | DI_FREQ_A_IN6 | Frequency input 6                 |     |                        |                        |
|     | DO_PD6        | Activation Current Input          |     |                        |                        |
|     | DO_PU6        | Activation Pull-up                |     |                        |                        |
|     | DO_RS6        | Range selection 0...16.9 / 32.8 V |     |                        |                        |
| C4  | AI_A_IN5      | Analog input 5                    |     |                        |                        |
|     | DI_AI_A_IN5   | Digital input 5                   |     |                        |                        |
|     | DI_FREQ_A_IN5 | Frequency input 5                 |     |                        |                        |
|     | DO_PD5        | Activation Current Input          |     |                        |                        |
|     | DO_PU5        | Activation Pull-up                |     |                        |                        |
|     | DO_RS5        | Range selection 0...16.9 / 32.8 V |     |                        |                        |

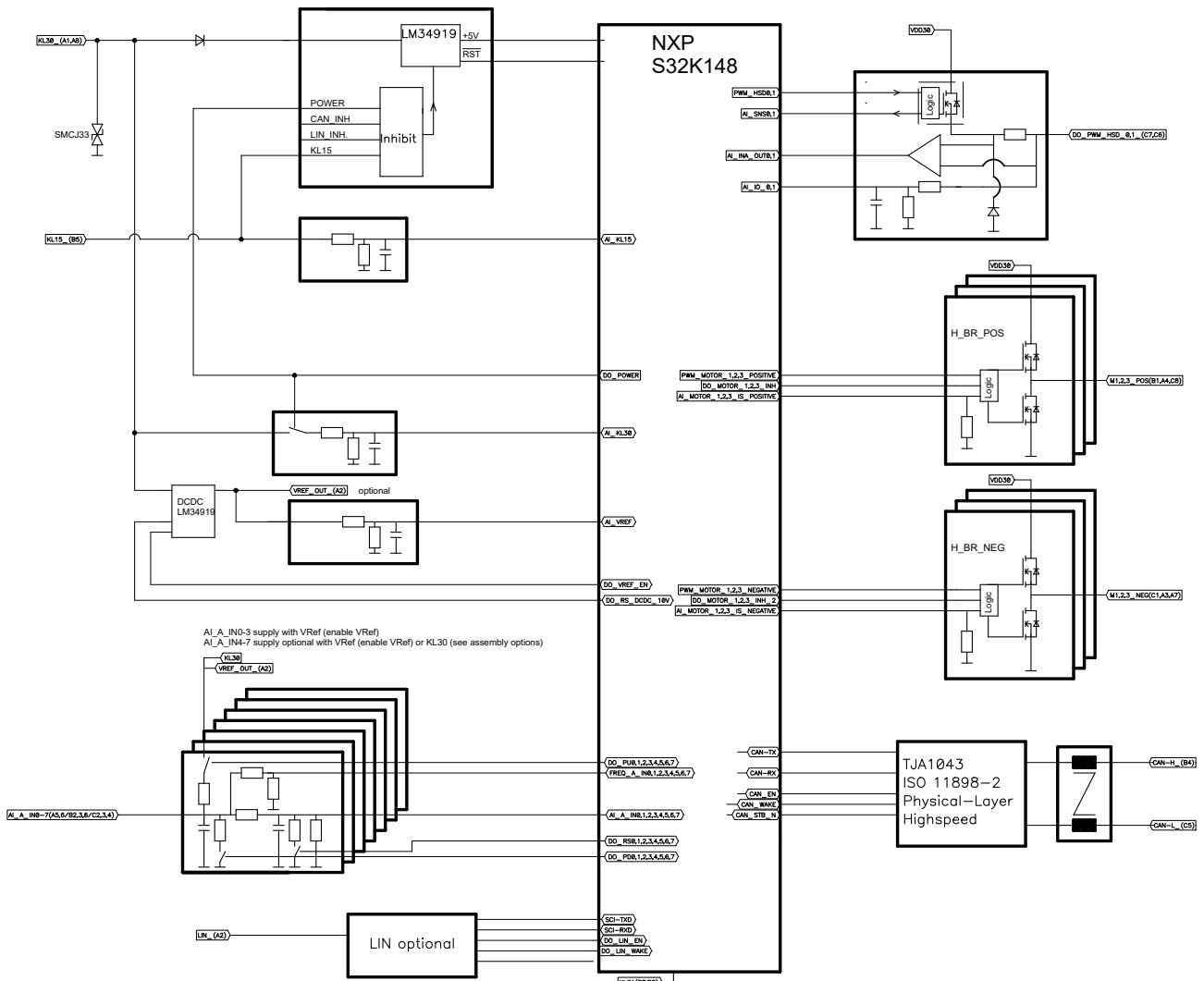


Pin assignment

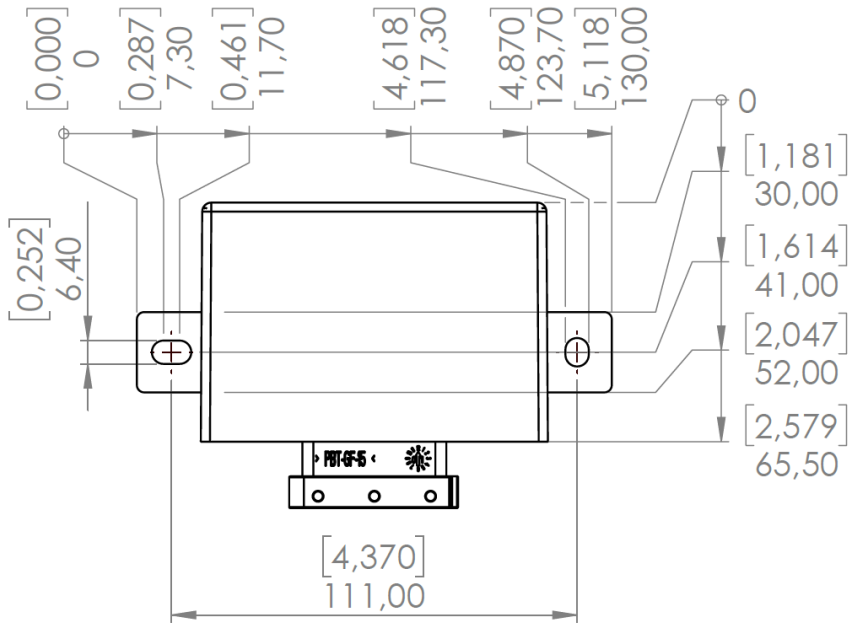
PIN FEATURE MAP



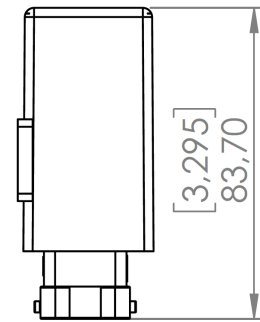
BLOCK FUNCTION DIAGRAM



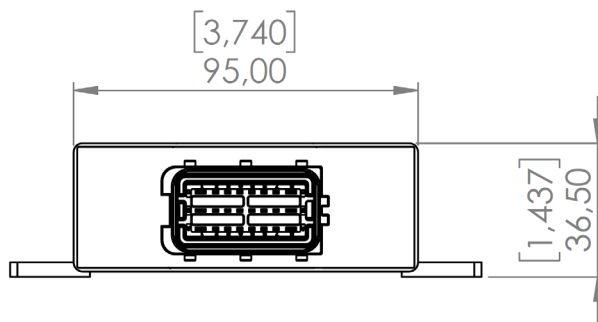
TECHNICAL DRAWING IN MM [INCH]



Top view



Side view



Plug view

ASSEMBLY OPTIONS AND ORDER INFORMATION

| Drawing number        | Pin enumeration inputs               |                                      |                                      |  |                                      | Outputs | Interfaces   |                         | Remarks                |                              |
|-----------------------|--------------------------------------|--------------------------------------|--------------------------------------|--|--------------------------------------|---------|--|-------------------------|------------------------|------------------------------|
|                       | A<br>Voltage<br>0...16.9 V           | B<br>Voltage<br>0...32.8 V           | C<br>Current<br>0...25 mA            | D<br>Sensor Inputs<br>1 kΩ pull-up                         | E<br>Frequency<br>inputs             |         | F<br>I/Os (optional as<br>Analog input<br>or Digital output<br>with PWM) | G<br>Motor out-<br>puts |                        | CAN<br>(FD-<br>ca-<br>pable) |
| <b>1.162.300.0000</b> | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2, B3, B6,<br>C2, C3, C4 on VREF                  | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | C6, C7  | A3, A4, A7,<br>B1, C1, C8  | B4,<br>C5               | A2<br>(Master)         |                              |
| <b>1.162.304.1000</b> | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B3, B6 on<br>VREF; B2, C2, C3, C4<br>on contact 30 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | C6, C7  | A3, A4, A7,<br>B1, C1, C8  | B4,<br>C5               | -                      | A2 = V <sub>REF</sub>        |
| <b>1.162.202.1000</b> | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | A5, A6, B3, B6 on<br>VREF; B2, C2, C3, C4<br>on contact 30 | A5, A6, B2,<br>B3, B6, C2,<br>C3, C4 | C6, C7  | A3, A4, A7,<br>B1, C1, C8  | B4,<br>C5               | A2 (Mas-<br>ter, 12 V) |                              |

ACCESSORIES

| Description  | Ordering number |
|--|-----------------|
| Programming tool MRS Applies Studio / Developers Studio Bundle | 1.100.200.00    |
| Cable set for programming                                      | 110490          |
| Connector package  | 110421          |
| PCAN FD USB Adapter  | 503750          |



Image similar

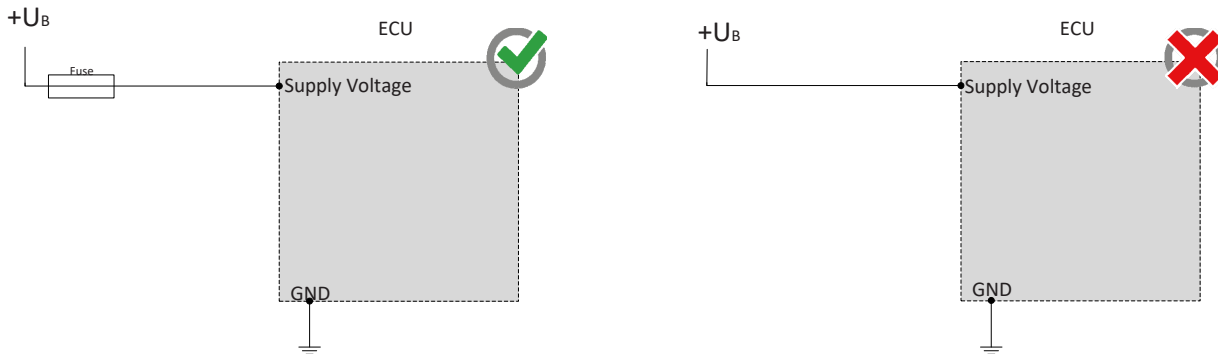
MANUFACTURER

MRS Electronic GmbH & Co. KG  
 Klaus-Gutsch-Str. 7  
 78628 Rottweil  
 Germany

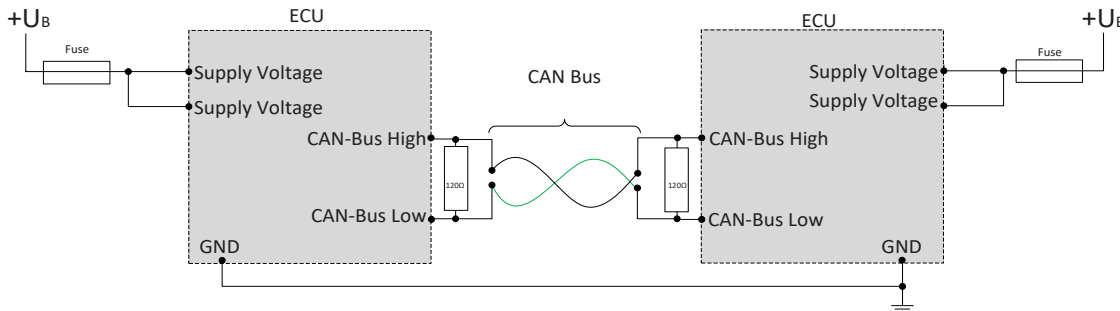


NOTES ON WIRING AND CABLE ROUTING

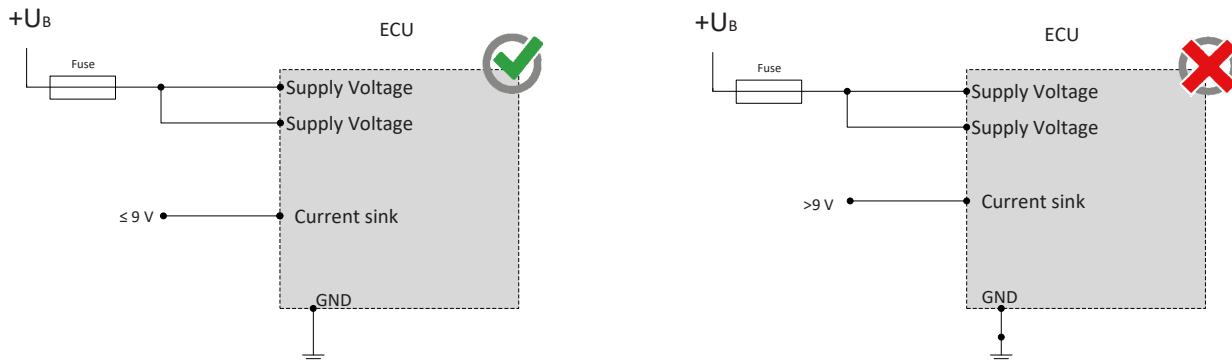
The control must be protected against overload (see performance data)



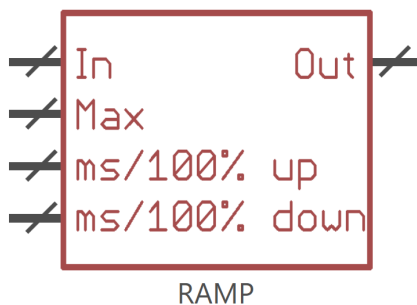
CAN bus communication is the main communication between the control unit and the vehicle. Therefore, connect the CAN bus with special care and check the correct communication with the vehicle to avoid undesired behavior.



When using the input with pull-down resistance (Activation DO\_PD0...DO\_PD7), you must not connect a greater voltage than 9 V to the input.

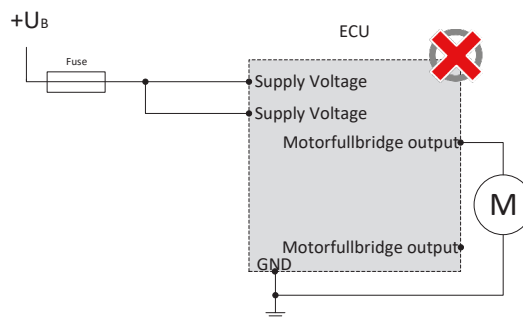
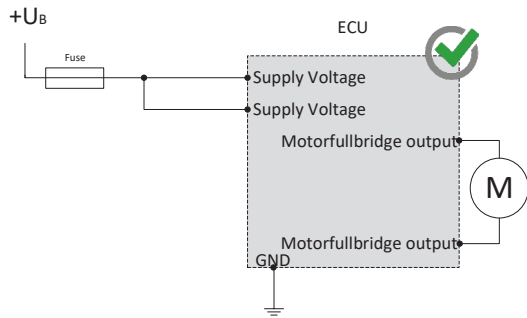


To prevent damage to the hardware, a ramp function, e.g. via the graphic programming block "Ramp", must be used. The description for this is stored in the Applics Studio.

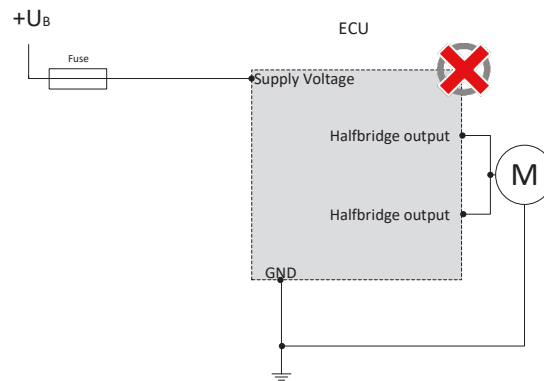
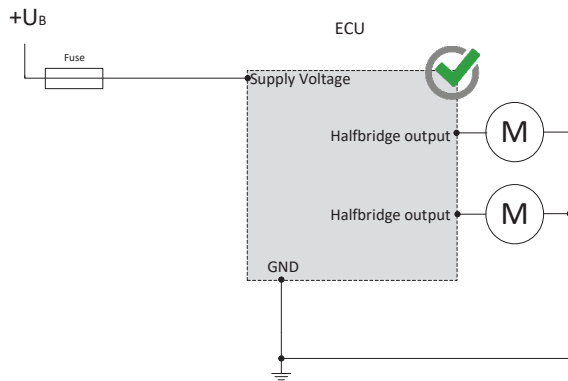


NOTES ON WIRING AND CABLE ROUTING

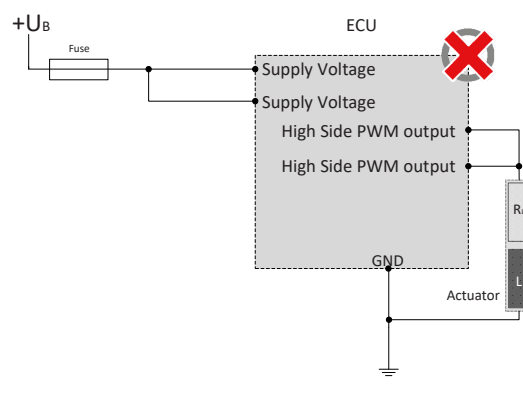
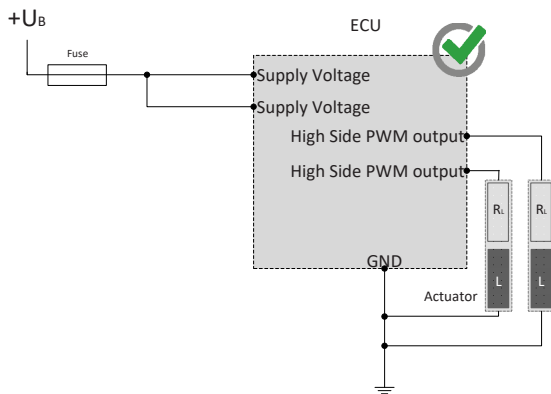
The full bridge motor outputs may only be interconnected against each other.



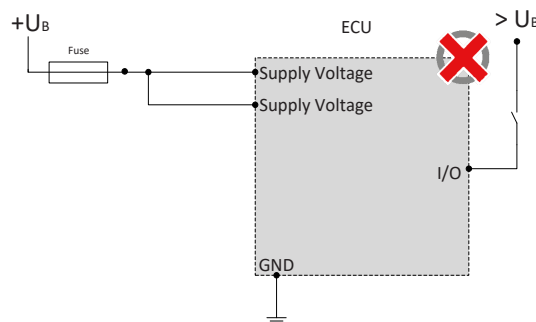
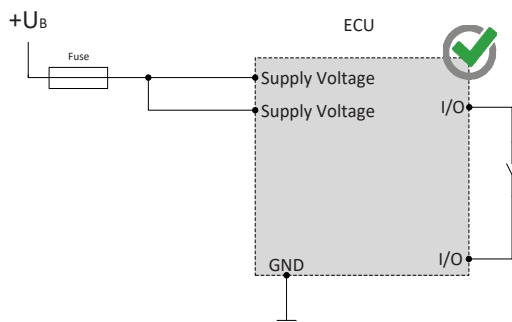
Halfbridge outputs must not be connected in parallel



PWM outputs may not be connected with each other or bypassed.

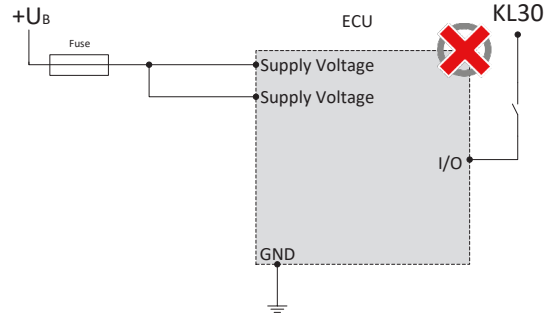
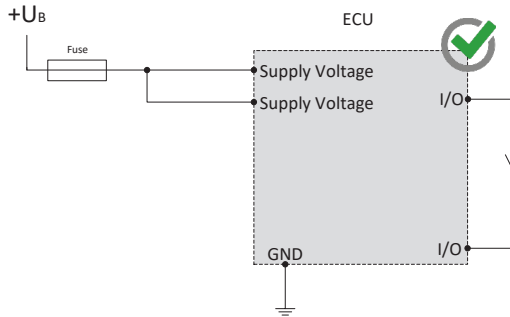


The pins (I/Os) can be used in combination and may not be switched externally against a higher voltage level than supply voltage.



NOTES ON WIRING AND CABLE ROUTING

The I/Os must not be connected against KL30, otherwise the reverse polarity protection can no longer be guaranteed.



## SAFETY AND INSTALLATION INFORMATION

It is essential to read the instructions in full thoroughly before working with the device.

Please note and comply with the instructions in the operating instructions and the information in the device data sheet, see [www.mrs-electronic.de](http://www.mrs-electronic.de)

**Staff qualification:** Only staff with the appropriate qualifications may work on this device or in its proximity.

### SAFETY

- 
- ⚠ WARNING! Danger as a result of a malfunction of the entire system.**  
Unforeseen reactions or malfunctions of the entire system may jeopardise the safety of people or the machine.
- Ensure that the device is equipped with the correct software and that the wiring and settings on the hardware are appropriate.
- 
- ⚠ WARNING! Danger as a result of unprotected moving components.**  
Unforeseen dangers may occur from the entire system when putting the device into operation and maintaining it.
- Switch the entire system off before carrying out any work and prevent it from unintentionally switching back on.
  - Before putting the device into operation, ensure that the entire system and parts of the system are safe.
  - The device should never be connected or separated under load or voltage.
- 
- ⚠ CAUTION! Risk of burns from the housing.**  
The temperature of the device housing may be elevated.
- Do not touch the housing and let all system components cool before working on the system.
- 

### PROPER USE

The device is used to control or switch one or more electrical systems or sub-systems in motor vehicles and machines and may only be used for this purpose. The device may only be used in an industrial setting.

- 
- ⚠ WARNING! Danger caused by incorrect use.**  
The device is only intended for use in motor vehicles and machines.
- Use in safety-related system parts for personal protection is not permitted.
  - Do not use the device in areas where there is a risk of explosion.
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#### Correct use:

- operating the device within the operating areas specified and approved in the associated data sheet.
- strict compliance with these instructions and no other actions which may jeopardise the safety of individuals or the functionality of the device.

#### Obligations of the manufacturer of entire systems

It is necessary to ensure that only functional devices are used. If devices fail or malfunction, they must be replaced immediately.

System developments, installation and the putting into operation of electrical systems may only be carried out by trained and experienced staff who are sufficiently familiar with the handling of the components used and the entire system.

It is necessary to ensure that the wiring and programming of the device does not lead to safety-related malfunctions of the entire system in the event of a failure or a malfunction. System behaviour of this type can lead to a danger to life or high levels of material damage.

The manufacturer of the entire system is responsible for the correct connection of the entire periphery (e.g. cable cross sections, correct selection/connection of sensors/actuators).

Opening the device, making changes to the device and carrying out repairs are all prohibited. Changes or repairs made to the cabling can lead to dangerous malfunctions. Repairs may only be carried out by MRS.

#### Installation

The installation location must be selected so the device is exposed to as low a mechanical and thermal load as possible. The device may not be exposed to any chemical loads.

Install the device in such a manner that the plugs point downwards. This means condensation can flow off the device. Single seals on the cables/leads must be used to ensure that no water gets into the device.

#### Putting into operation

The device may only be put into operation by qualified staff. This may only occur when the status of the entire system corresponds to the applicable guidelines and regulations.

## FAULT CORRECTION AND MAINTENANCE

- i NOTE The device is maintenance-free and may not be opened.**
- If the device has damage to the housing, latches, seals or flat plugs, it must be taken out of operation.
- Fault correction and cleaning work may only be carried out with the power turned off. Remove the device to correct faults and to clean it. Check the integrity of the housing and all flat plugs, connections and pins for mechanical damage, damage caused by overheating, insulation damage and corrosion. In the event of faulty switching, check the software, switches and settings.
- Do not clean the device with high pressure cleaners or steam jets. Do not use aggressive solvents or abrasive substances.