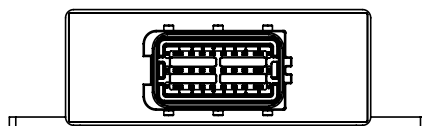


Top view



Plug view

## 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.

## 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 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)  8 Multifunctional inputs with analog inputs switchable 0...16.9 V / 0...32.8 V Digital inputs Current inputs Sensor inputs Frequency inputs
Outputs	2 I/Os (digital outputs, PWM-capable)  <b>Configurable:</b> 6 Motor half bridges or 3 Motor
Operating voltage range	8...32 V resp. 14.5...32 V with $V_{REF} = 10\text{ V}$ (Code B @ 12 V and Code E @ 24 V acc. to ISO 16750)
Overvoltage protection	$\geq 33\text{ V}$
Quiescent current	35 $\mu\text{A}$ at 12 V 75 $\mu\text{A}$ 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> Operating voltage Short circuit protection Reverse polarity Disconnection pin and connector Longterm overvoltage at $T_{Max}$ storage test at $T_{Max}$ and $T_{Min}$ Operation test at $T_{Max}$ and $T_{Min}$ Temperature steps Starting profile (form. Pulse 4 acc. to ISO 7637)
	<b>Acc. to ISO 7637 - 2:</b> Pulse 1, 2a, 2b, 3a, 3b  <b>Acc. to ISO 10605:</b> ESD up to $\pm 8\text{ kV}$ on pins, all others $\pm 15\text{ kV}$
chemical tests (@ room temperature, brushed)	Battery liquid (22 h) interior cleaner (2h) Glass cleaner (2h) Acetone (10 min) Ammoniumcontaining cleaner (22 h) Denatured alcohol (10 min) Transpiration (22 h) Cosmetic Products (Nivea Creme, 22 h) Refreshment containing coffein and sugar (Cola, 22 h) Cream, coffee whitener (22 h)

## SOFTWARE/PROGRAMMING

## Programming System

**MRS APPLICS STUDIO**

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	$\pm 1.5\%$ full scale			
Voltage input 0...16.9 V (see A) <sup>1</sup>	Input resistance	34 k $\Omega$	Voltage input 0...33.9 V	Input resistance	30 k $\Omega$
	Input frequency	$f_g^2 = 75$ Hz		Input frequency	$f_g^2 = 170$ Hz
	Conversion factor	1 Digit $\approx 4.13$ mV		Deviation	$\leq 3\%$
Voltage input 0...32.8 V (see B)	Input resistance	28 k $\Omega$	<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		
	Input frequency	$f_g^2 = 105$ Hz			
	Conversion factor	1 Digit $\approx 8.01$ mV			
Current input 0...25 mA (see C)	Input resistance	330 $\Omega$ gegen GND <sup>4</sup>			
	Conversion factor	1 mA $\approx 79$ digits			
Sensor input (see D)	Input resistance	1 k $\Omega$ gegen VREF / contact 30			
Digital input <sup>3</sup>	Input resistance	34 k $\Omega$			
	Turn-on threshold	6.1 V $\pm 0.3$ V			
	Turn-off threshold	4.0 V $\pm 0.3$ V			
Frequency input 0...35 kHz (see E) <sup>3</sup>	Input resistance	34 k $\Omega$			
	Turn-on threshold	3.8 V $\pm 0.3$ V			
	Turn-off threshold	1.3 V $\pm 0.3$ V			
	Min. pulse width	4 $\mu$ s			
	Meas. range PWM	15...98 %			
	Deviation	$\pm 3\%$			

## 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 $\approx 1$ mA for 800 mA...5 A $\pm 3\%$
	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

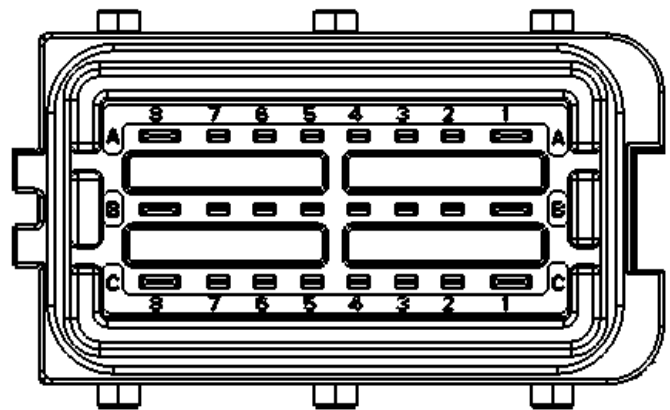
measured at +85°C, 28 V supply voltage, inductive load

## 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

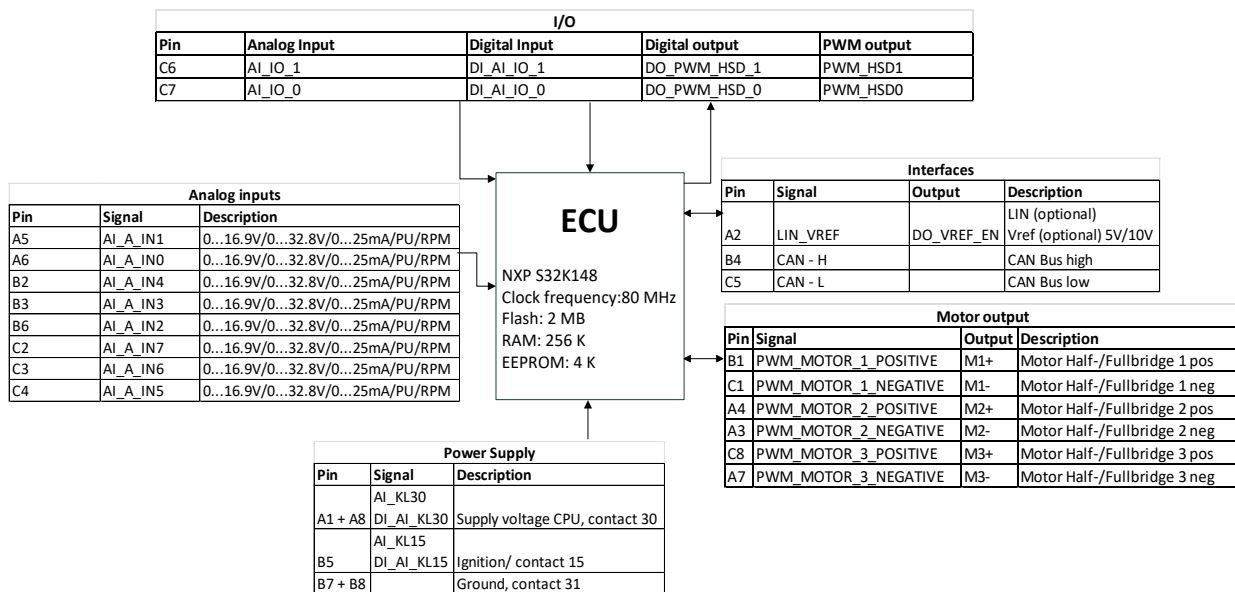
## PIN ASSIGNMENT INPUTS AND OUTPUTS

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
	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			
	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			
	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			
	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			
	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			

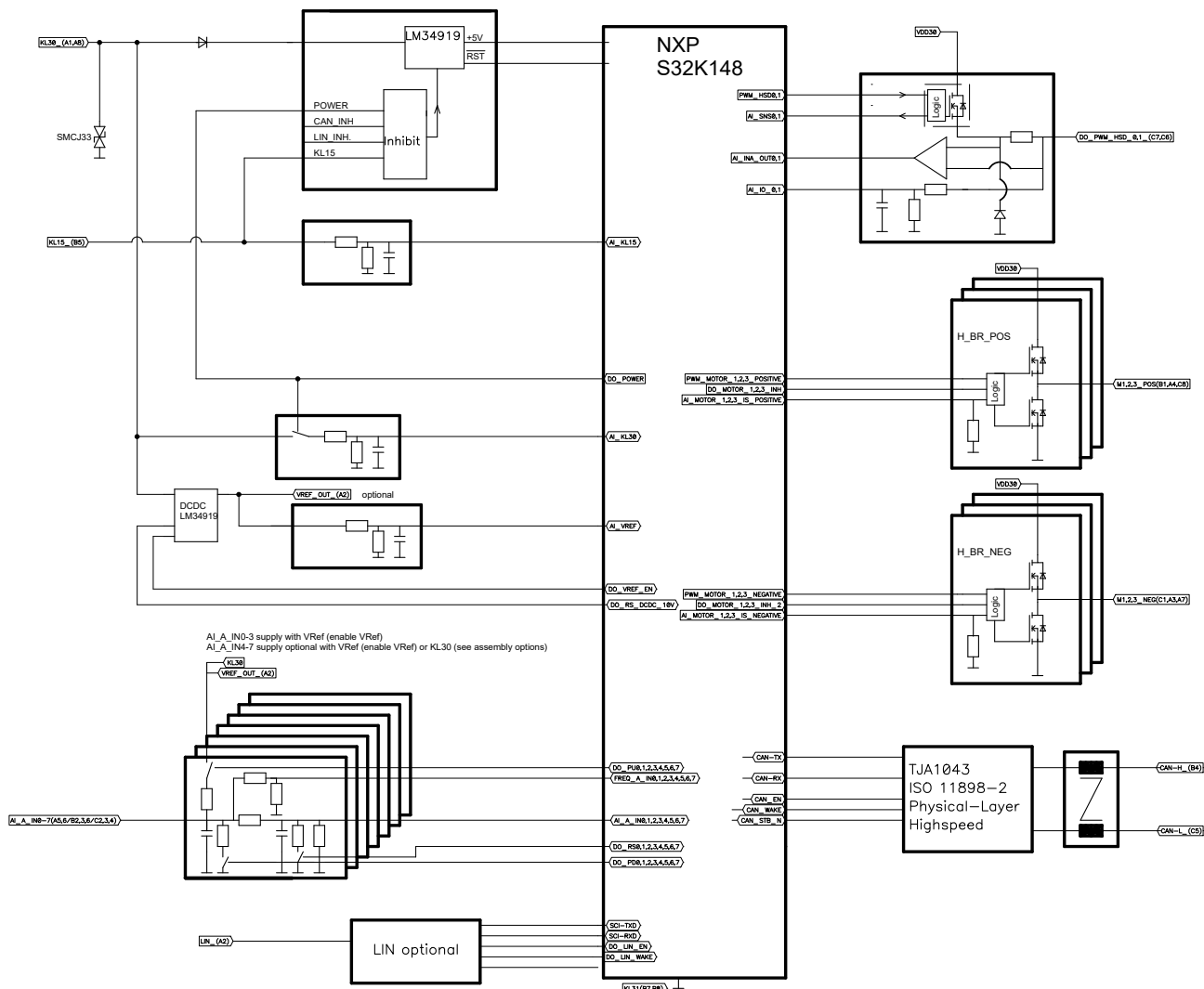


Pin assignment

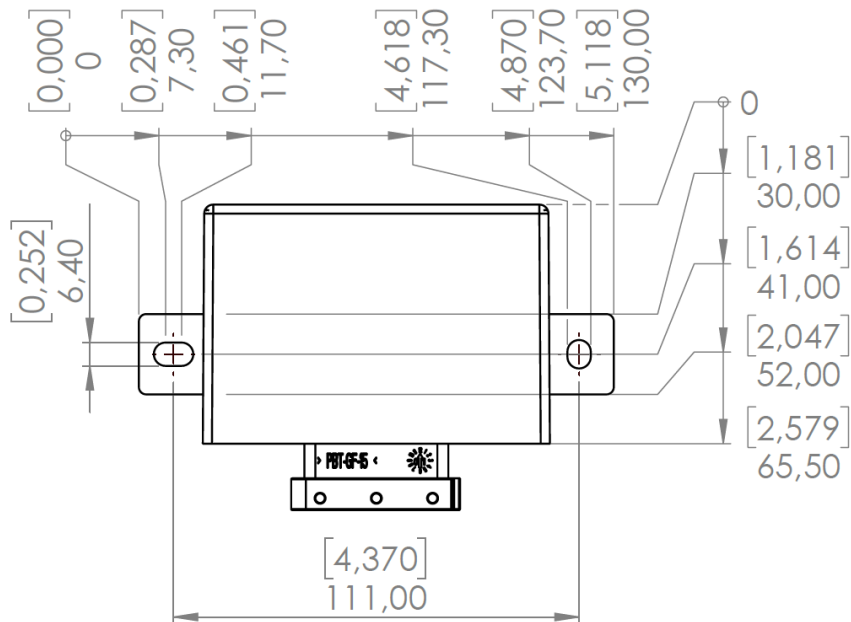
## PIN FEATURE MAP



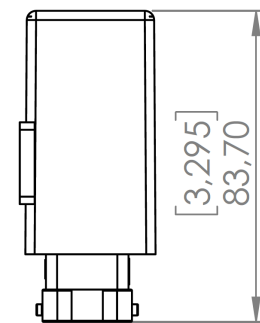
## BLOCK FUNCTION DIAGRAM



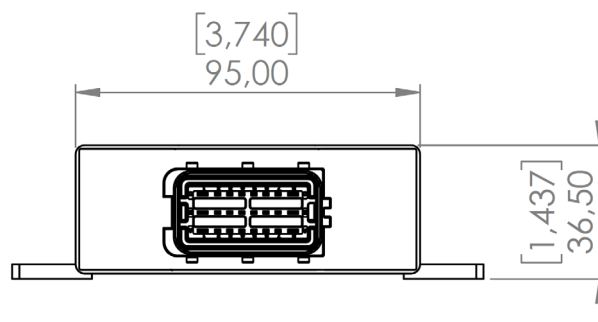
## TECHNICAL DRAWING IN MM [INCH]



Top view



Side view



Plug view

## ASSEMBLY OPTIONS AND ORDER INFORMATION

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

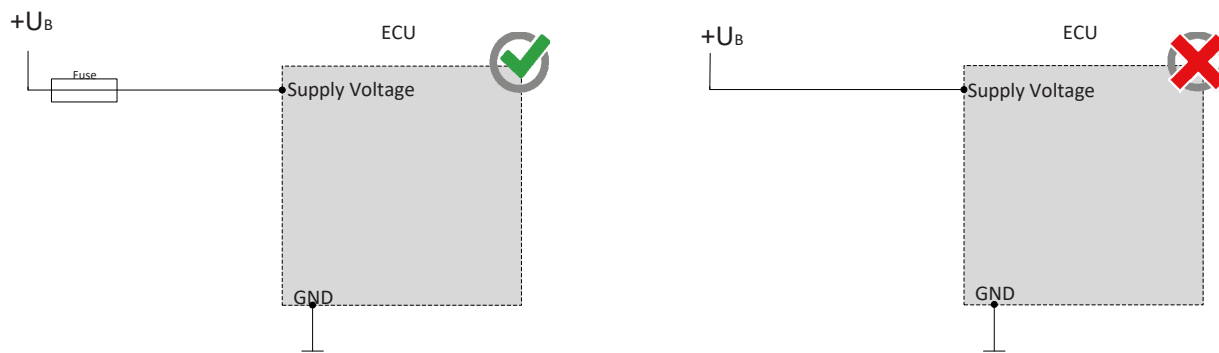
## MANUFACTURER

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

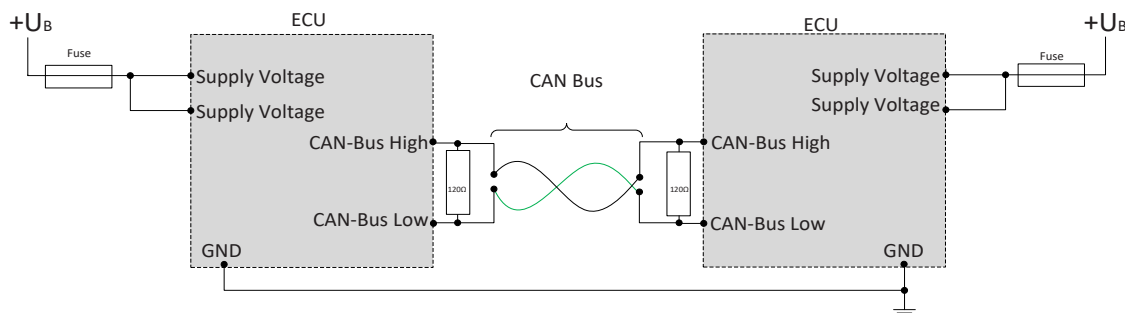


## NOTES ON WIRING AND CABLE ROUTING

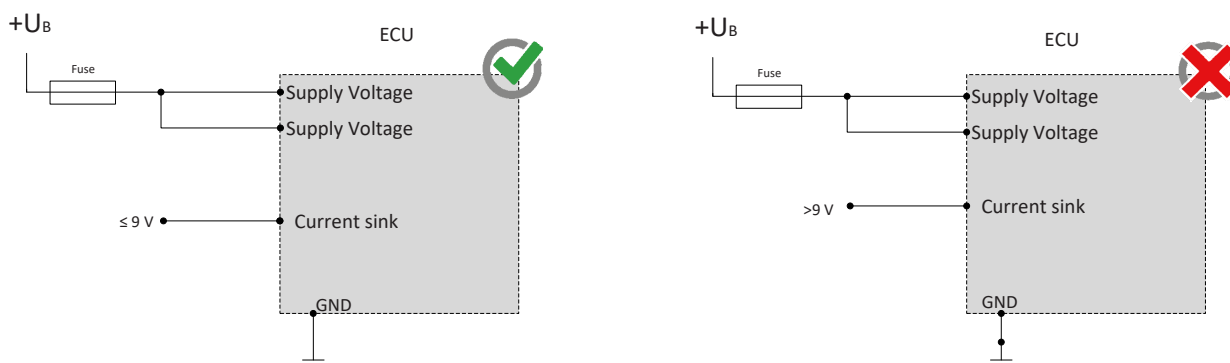
The control must be protected against overload (see performance data)



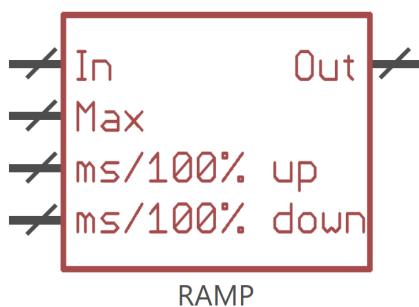
CAN bus communication is the main communication between the control unit and the vehicle. Therefore, connect the CAN bus with special care and check the correct communication with the vehicle to avoid undesired behavior.



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.

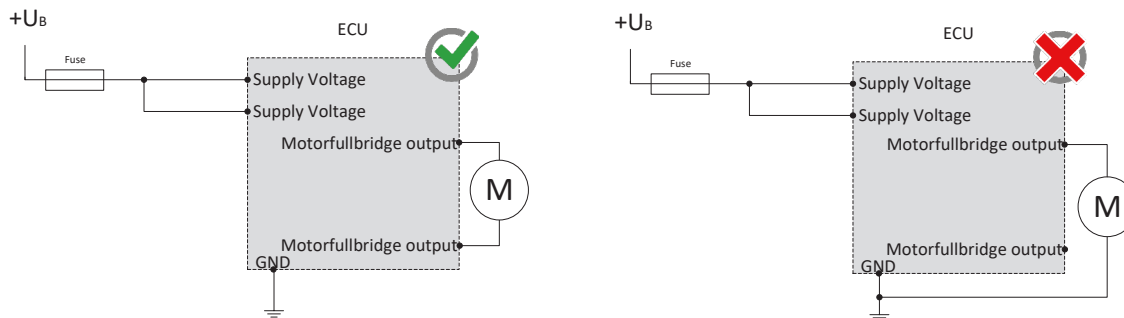


To prevent damage to the hardware, a ramp function, e.g. via the graphic programming block "Ramp", must be used. The description for this is stored in the Applica Studio.

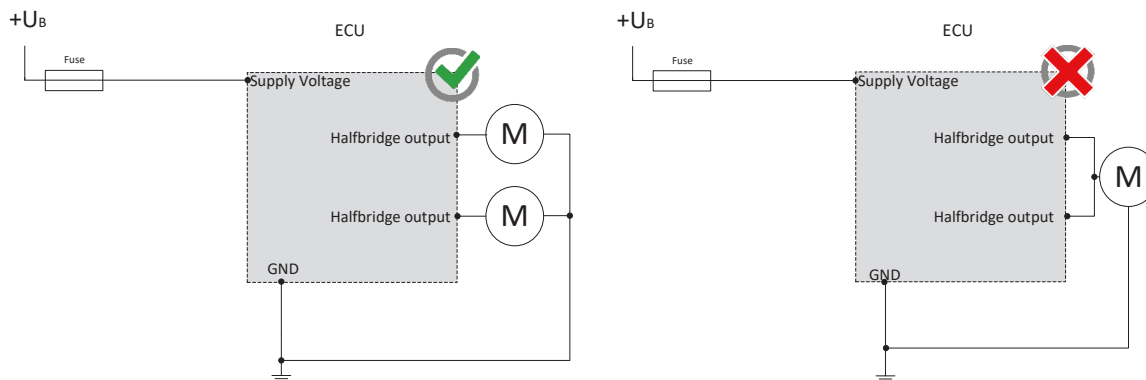


## NOTES ON WIRING AND CABLE ROUTING

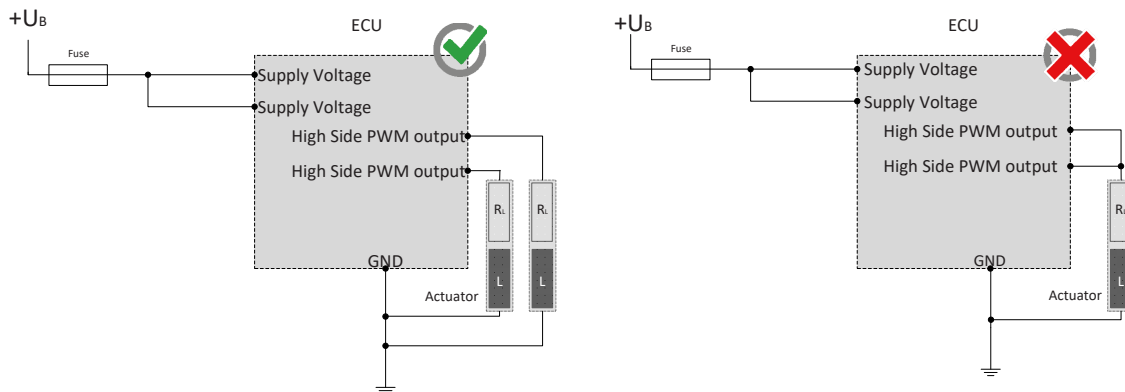
The full bridge motor outputs may only be interconnected against each other.



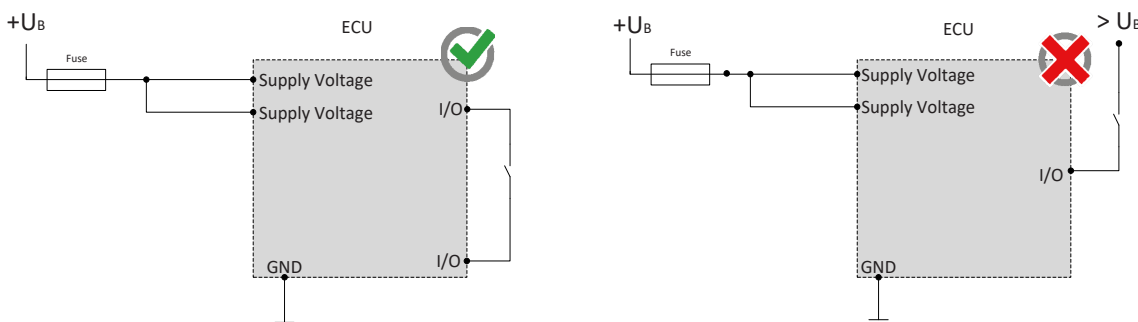
Halfbridge outputs must not be connected in parallel



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

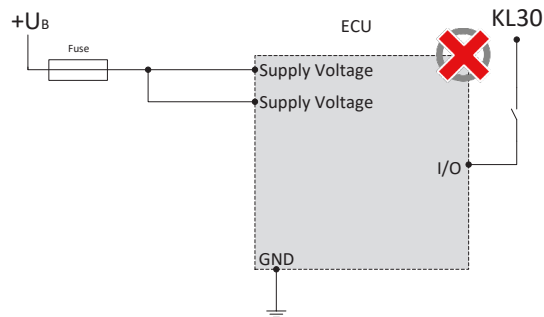
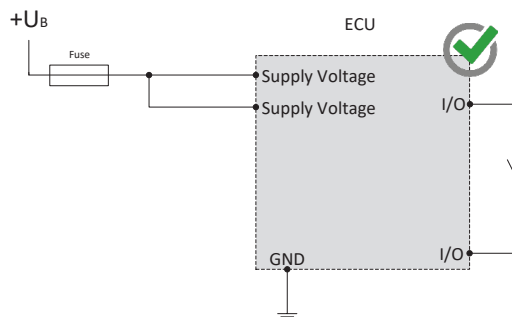


The pins (I/Os) can be used in combination and may not be switched externally against a higher voltage level than supply voltage.



## 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.

**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



**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.