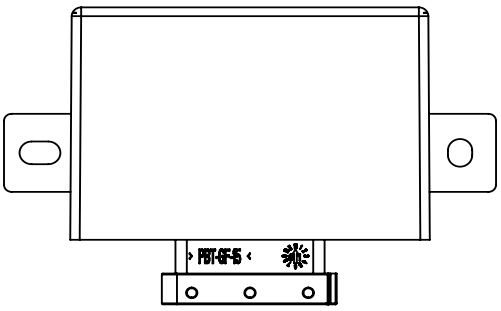
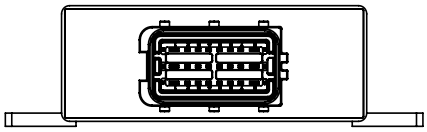


Top view



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) and when using the protection cap and corrugated tube acc. to the accessories list **CAUTION! Follow the mechanical instructions!**
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 [PWM capable, integrated current measurement INA]; 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) **Configurable:** 6 Motor half bridges or 3 Motor
Supply voltage range	8...32 V resp. 14.5...32 V with V_{REF} = 10 V (Code B for 12 V, Code E for 24 V, acc. to ISO 16750-2)
Overvoltage protection	≥ 33 V
Quiescent current	35 µA at 12 V 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 APPROVAS AND TESTING

E1 Approval	06 10058
Electrical tests	**Acc. to ISO 16750-2 or -4:** Supply voltage Short circuit protection Reverse polarity Disconnection pin and connector Longterm overvoltage at T_{max}-20 °C 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) **Acc. to ISO 7637 - 2:** Pulse 1, 2a, 2b, 3a, 3b **Acc. to ISO 10605:** ESD up to ± 8 kV on pins, all others ±15 kV
chemical tests (at room temperature, brushed)	Battery liquid (22 h) interior cleaner (2h) Glass cleaner (2h) Acetone (10 min) Ammonuimcontaining 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)

Pin A5, A6, B2, B3, B6, C2, C3, C4 (MULTI_IN)	Programmable as analog or digital input	
	Resolution	12 Bit
	Accuracy	± 1.5 % full scale
Voltage input 0...16.9 V (see A)[1]	Input resistance	34 kΩ
	Input frequency	f_g[2]= 75 Hz
	Conversion factor	1 Digit ≈ 4.13 mV
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[4]
	Conversion factor	1 mA ≈ 79 digits
Sensor input (see D)	Input resistance	1 kΩ gegen VREF / contact 30
Digital input[3]	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)[3]	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 %

Pin C6, C7 (IO_1, IO_0) (see F)	Programmable as analog or digital input	
	Resolution	12 Bit
Voltage input 0...33.9 V	Input resistance	30 kΩ
	Input frequency	f_g[2]= 170 Hz
	Deviation	≤ 3 %

[1] Standard configuration
[2] Cutoff frequency (-3 dB)
[3] When using the standard configuration, see[1]
[4] 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

Pin A3, A4, A7, B1, C1, C8 Motor outputs BTN9970LV	Protective circuit for inductive loads	Integrated
	Wire fault diagnostics	Possible via current sense
	Short circuit diagnostics	Possible via current sense
Motor output (see G)	Switching voltage	8...32 V
	max. load current	see load test (S. 3)
	duty cycle	0...100%
	PWM-Frequenz	up to 30 kHz
Short circuit resistance against GND and V_S	Switching-off is controlled motor driver for **each** output channel	
Protection circuit overload	Overtemperature shutdown integrated	

Pin C6, C7 IOs with BTS	Protective circuit for inductive loads	Integrated
	Wire fault diagnostics	Possible via current sense
	Short circuit diagnostics	Possible via current sense
Digital, positive switching (High-Side; see F) inclusive INA-current sense	Switching voltage	8...32 V DC
	max. load current	see load test (S. 3)
	Conversion factor	1 Digit ≈ 1 mA
	Deviation current sense INA293	for 800 mA...5 A ± 3 %
PWM output (see F)	Output frequency	1 Hz bis 1 kHz
	Resolution	1 ‰
	Switching current	see load test (S. 3)
Short circuit resistance against GND and V_S	Switching-off is controlled high side driver for **each** output channel	
Protection circuit overload	Overtemperature shutdown integrated	

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

Test without PWM	load	duration
at 28 V V_S	2 x BTS (C6, C7) each 6.7 A	Permanent
at 28 V V_S	3 x BTN as full bridge (A3, A4, A7, B1, C1, C8) each 6.6 A	Permanent
at 28 V V_S	1 x BTN as fullbridge (A3, A4 or B1, C1 or A7, C8) 12 A	Permanent

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

Test with PWM	PWM / DC	load	duration
at 28 V V_S	20 kHz / 96 %	1 x BTN as full bridge (A3, A4 or B1, C1 or A7, C8) 10 A	Permanent
at 28 V V_S	20 kHz / 96 %	3 x BTN as Full bridge (A3, A4, A7, B1, C1, C8) each 6.1 A	Permanent
at 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, inductive load

PIN ASSIGNMENT POWER SUPPLY AND INTERFACES (DEPENDING ON ASSEMBLY)

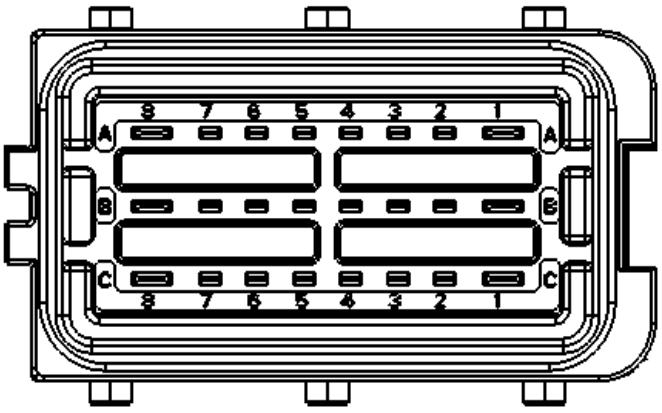
Pin	Pin Description
A1 + A8	Supply voltage / contact 30
B5	Ignition / contact 15
B7 + B8	Ground / contact 31

Pin	Pin Description
A2	LIN / VREF (Depending on assembly, max. 500 mA)
B4	CAN-H
C5	CAN-L

PIN ASSIGNMENT INPUTS AND OUTPUTS

Pin	Signal	Pin Description
A5	AI_A_IN1 DI_AI_A_IN1 FREQ_A_IN1 DO_PD1 DO_PU1 DO_RS1	Analog input 1 Digital input 1 Frequency input 1 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
A6	AI_A_IN0 DI_AI_A_IN0 FREQ_A_IN0 DO_PD0 DO_PU0 DO_RS0	Analog input 0 Digital input 0 Frequency input 0 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
B2	AI_A_IN4 DI_AI_A_IN4 FREQ_A_IN4 DO_PD4 DO_PU4 DO_RS4	Analog input 4 Digital input 4 Frequency input 4 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
B3	AI_A_IN3 DI_AI_A_IN3 FREQ_A_IN3 DO_PD3 DO_PU3 DO_RS3	Analog input 3 Digital input 3 Frequency input 3 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
B6	AI_A_IN2 DI_AI_A_IN2 FREQ_A_IN2 DO_PD2 DO_PU2 DO_RS2	Analog input 2 Digital input 2 Frequency input 2 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
C2	AI_A_IN7 DI_AI_A_IN7 FREQ_A_IN7 DO_PD7 DO_PU7 DO_RS7	Analog input 7 Digital input 7 Frequency input 7 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
C3	AI_A_IN6 DI_AI_A_IN6 FREQ_A_IN6 DO_PD6 DO_PU6 DO_RS6	Analog input 6 Digital input 6 Frequency input 6 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V
C4	AI_A_IN5 DI_AI_A_IN5 FREQ_A_IN5 DO_PD5 DO_PU5 DO_RS5	Analog input 5 Digital input 5 Frequency input 5 Activation Current Input Activation Pull-up Range selection 0...16.9 / 32.8 V

Pin	Signal	Pin Description
C1	PWM_MOTOR_1_NEGATIVE AI_MOTOR_1_IS_NEGATIVE	Motor output 1 neg. Current sense 1 neg.
B1	PWM_MOTOR_1_POSITIVE AI_MOTOR_1_IS_POSITIVE	Motor output 1 pos. Current sense 1 pos.
A3	PWM_MOTOR_2_NEGATIVE AI_MOTOR_2_IS_NEGATIVE	Motor output 2 neg. Current sense 2 neg.
A4	PWM_MOTOR_2_POSITIVE AI_MOTOR_2_IS_POSITIVE	Motor output 2 pos. Current sense 2 pos.
A7	PWM_MOTOR_3_NEGATIVE AI_MOTOR_3_IS_NEGATIVE	Motor output 3 neg. Current sense 3 neg.
C8	PWM_MOTOR_3_POSITIVE AI_MOTOR_3_IS_POSITIVE	Motor output 3 pos. Current sense 3 pos.
C6	AI_IO_1 AI_SNS1 AI_INA_OUT1 DI_AI_IO_1 DO_PWM_HSD1 PWM_HSD1	Analog input IO1 Current sense IO1 INA Current sense IO1 Digital input IO1 Digital output IO1 PWM output IO1
C7	AI_IO_0 AI_SNS0 AI_INA_OUT0 DI_AI_IO_0 DO_PWM_HSD0 PWM_HSD0	Analog input IO0 Current sense IO0 INA Current sense IO0 Digital input IO0 Digital output IO1 PWM output IO0
A2	DO_LIN_EN	Activation LIN



Pin assignment

PIN FEATURE MAP

I/O				
Pin	**Analog Input**	**Digital Input**	**Digital output**	**PWM output**
C6	AI_IO_1	DI_AI_IO_1	DO_PWM_HSD_1	PWM_HSD1
C7	AI_IO_0	DI_AI_IO_0	DO_PWM_HSD_0	PWM_HSD0

ECU

NXP S32K148
Clock frequency:80 MHz
Flash: 2 MB
RAM: 256 K
EEPROM: 4 K

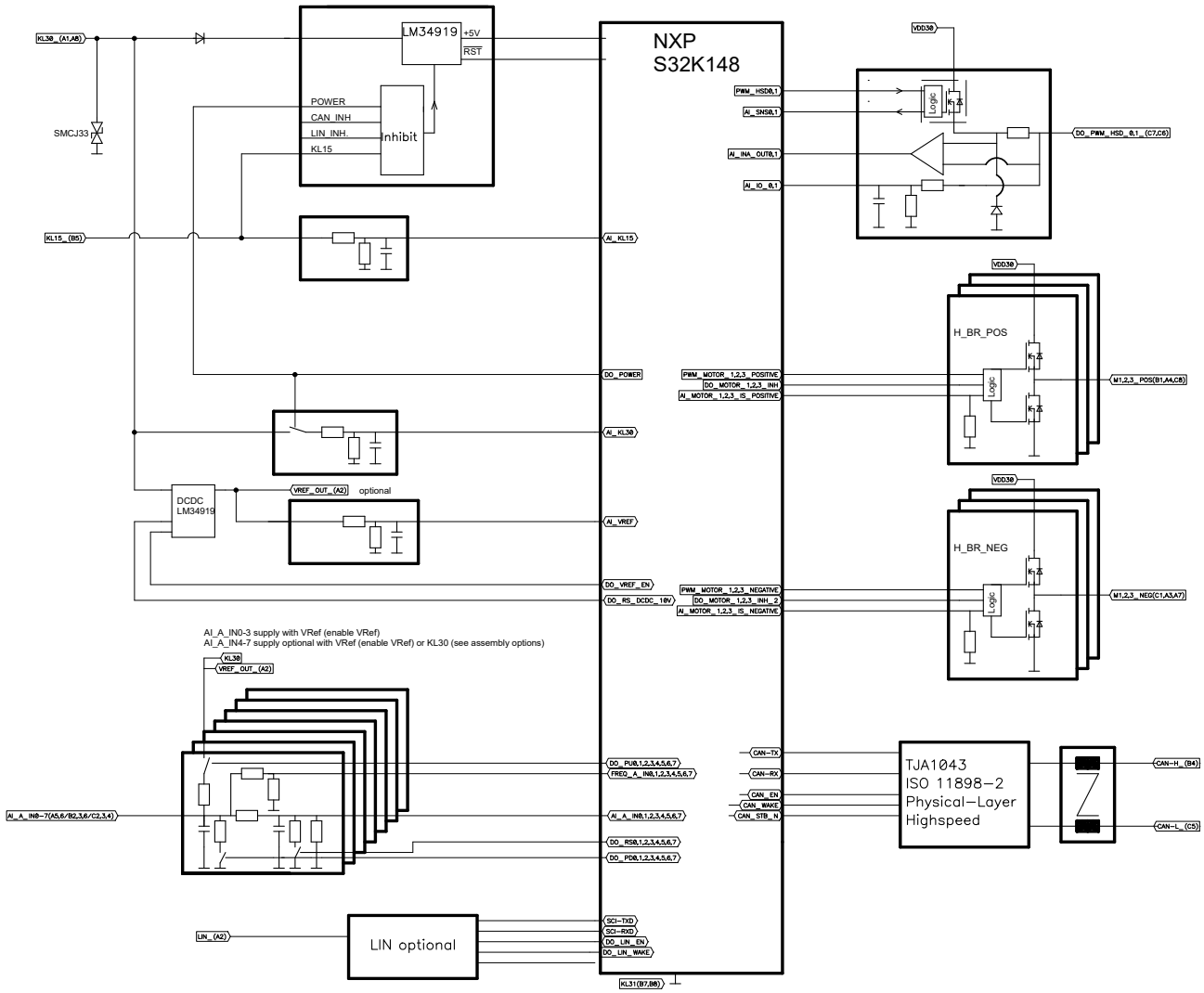
Analog inputs		
Pin	**Signal**	**Description**
A5	AI_A_IN1	0...16.9V/0...32.8V/0...25mA/PU/RPM
A6	AI_A_IN0	0...16.9V/0...32.8V/0...25mA/PU/RPM
B2	AI_A_IN4	0...16.9V/0...32.8V/0...25mA/PU/RPM
B3	AI_A_IN3	0...16.9V/0...32.8V/0...25mA/PU/RPM
B6	AI_A_IN2	0...16.9V/0...32.8V/0...25mA/PU/RPM
C2	AI_A_IN7	0...16.9V/0...32.8V/0...25mA/PU/RPM
C3	AI_A_IN6	0...16.9V/0...32.8V/0...25mA/PU/RPM
C4	AI_A_IN5	0...16.9V/0...32.8V/0...25mA/PU/RPM

Interfaces			
Pin	**Signal**	**Output**	**Description**
A2	LIN_VREF	DO_VREF_EN	LIN (optional) Vref (optional) 5V/10V
B4	CAN - H		CAN Bus high
C5	CAN - L		CAN Bus low

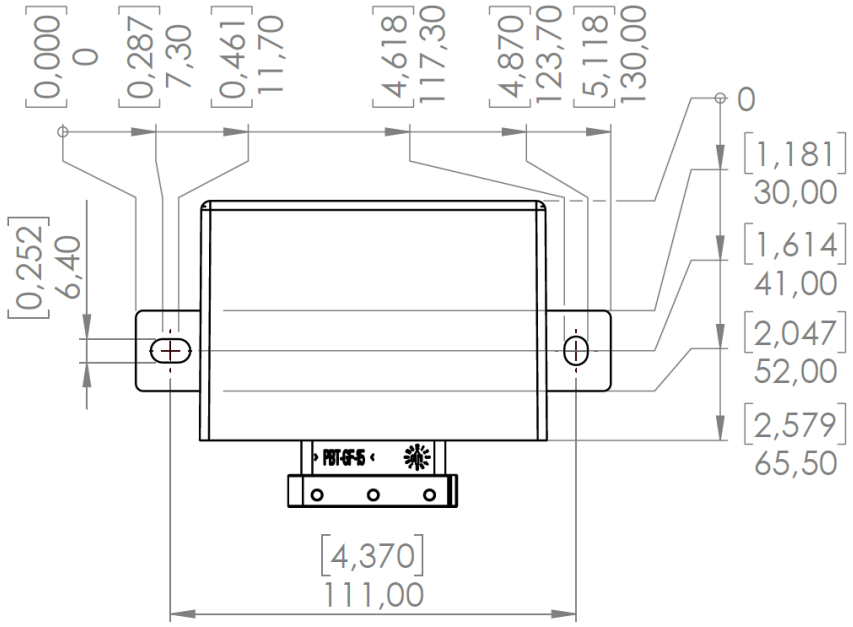
Motor output			
Pin	**Signal**	**Output**	**Description**
B1	PWM_MOTOR_1_POSITIVE	M1+	Motor Half-/Fullbridge 1 pos
C1	PWM_MOTOR_1_NEGATIVE	M1-	Motor Half-/Fullbridge 1 neg
A4	PWM_MOTOR_2_POSITIVE	M2+	Motor Half-/Fullbridge 2 pos
A3	PWM_MOTOR_2_NEGATIVE	M2-	Motor Half-/Fullbridge 2 neg
C8	PWM_MOTOR_3_POSITIVE	M3+	Motor Half-/Fullbridge 3 pos
A7	PWM_MOTOR_3_NEGATIVE	M3-	Motor Half-/Fullbridge 3 neg

Power Supply		
Pin	**Signal**	**Description**
A1 + A8	AI_KL30 DI_AI_KL30	Supply voltage CPU, contact 30
B5	AI_KL15 DI_AI_KL15	Ignition/ contact 15
B7 + B8		Ground, contact 31

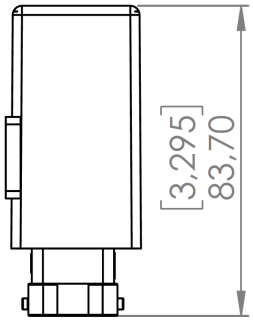
BLOCK FUNCTION DIAGRAM



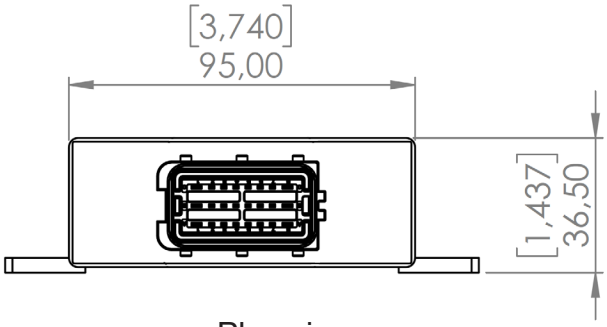
TECHNICAL DRAWING IN MM [INCH]



Top view



Side view



Plug view

ASSEMBLY OPTIONS AND ORDER INFORMATION

Drawing number	Pin enumberation 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)	G Motor outputs	CAN (FD-capable)	LIN	
1.162.300.0000	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)	
1.162.304.1000	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 = V_{REF}
1.162.202.1000	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 (Master, 12 V)	

ACCESSORIES

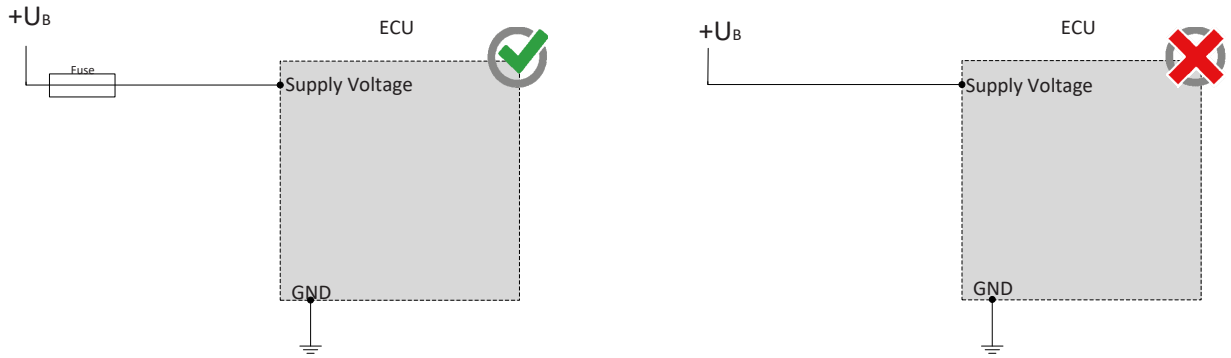
Description	Ordering number
Programming tool MRS Applics Studio / Developers Studio Bundle	1.100.200.00
Cable set for programming	110490
Connector package	110421
PCAN FD USB Adapter	503750
Protection cap	111441
Corrugated tube (outer diameter: 21.2 mm; inner diameter: 16.5 mm)	Available from independent retailers

MANUFACTURER

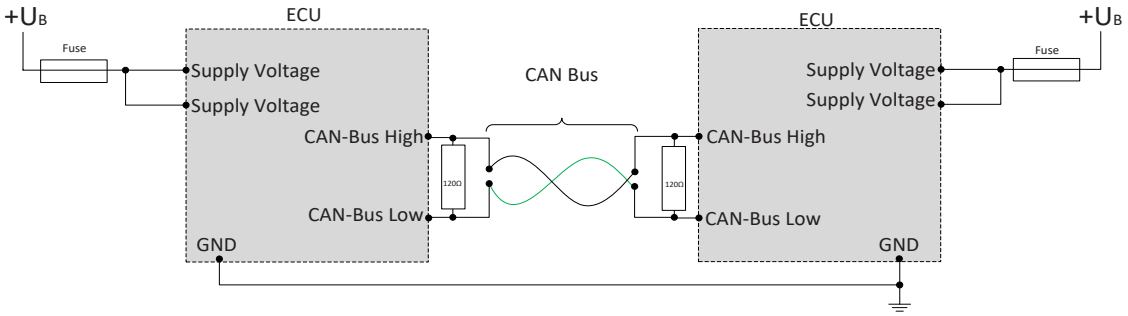
MRS Electronic GmbH & Co. KG
Klaus-Gutsch-Str. 7
78628 Rottweil
Germany

NOTES ON WIRING AND CABLE ROUTING

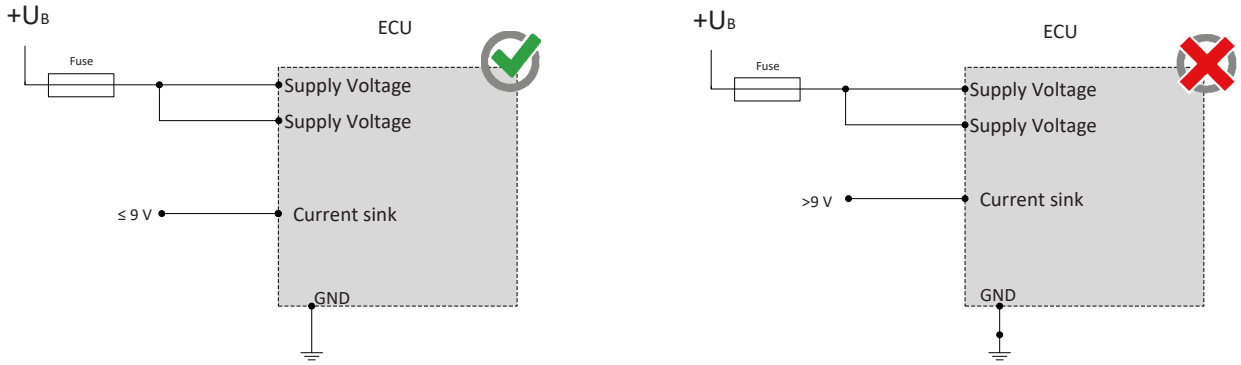
The control must be protected against overload (see performance data)



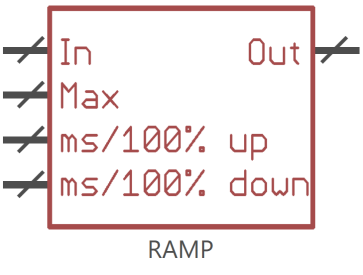
CAN bus communication is the main communication between the control unit and the vehicle. Therefore, connect the CAN bus with special care and check the correct communication with the vehicle to avoid undesired behavior.



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.

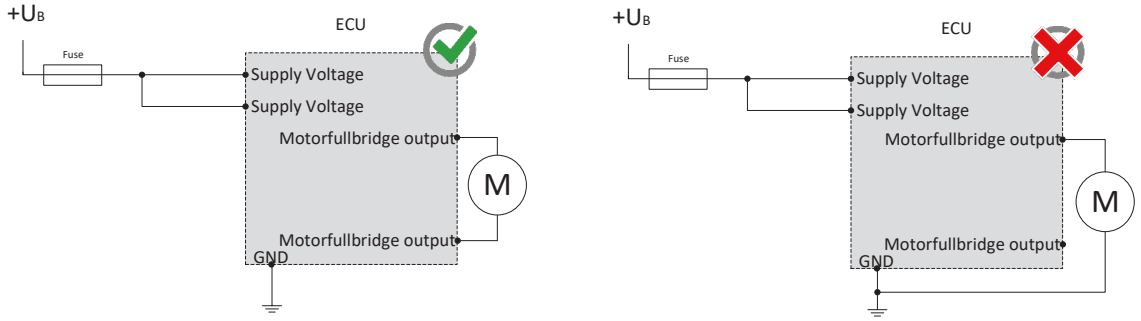


To prevent damage to the hardware, a ramp function, e.g. via the graphic programming block "Ramp", must be used. The description for this is stored in the Applics Studio.

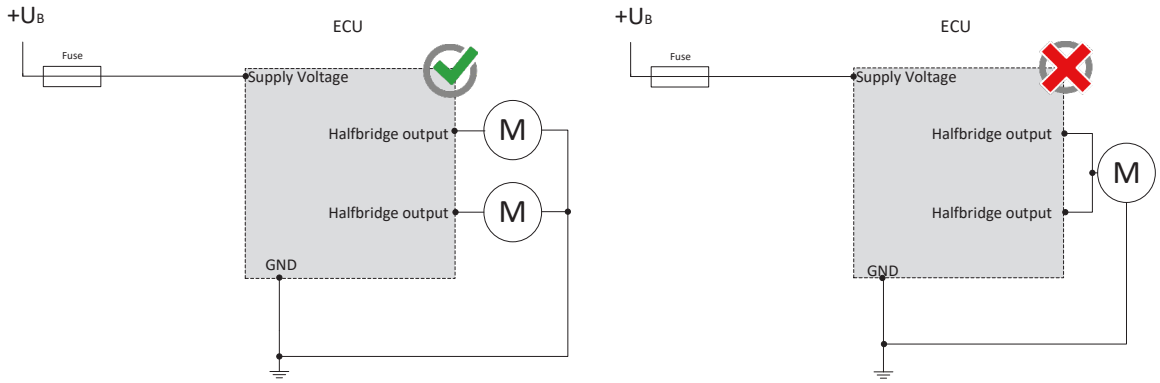


NOTES ON WIRING AND CABLE ROUTING

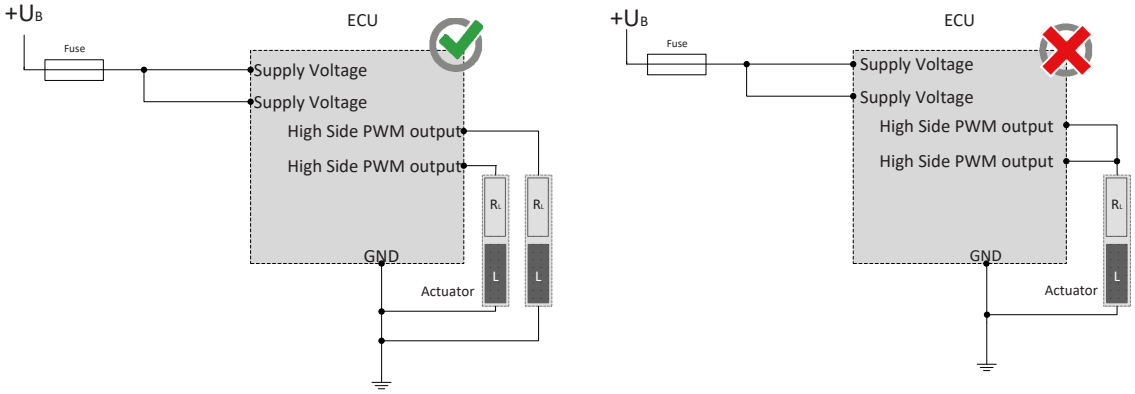
The full bridge motor outputs may only be interconnected against each other.



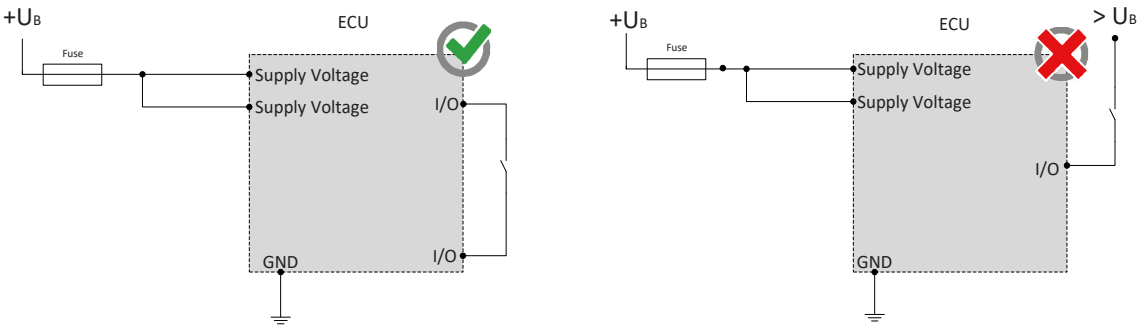
Halfbridge outputs must not be connected in parallel



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

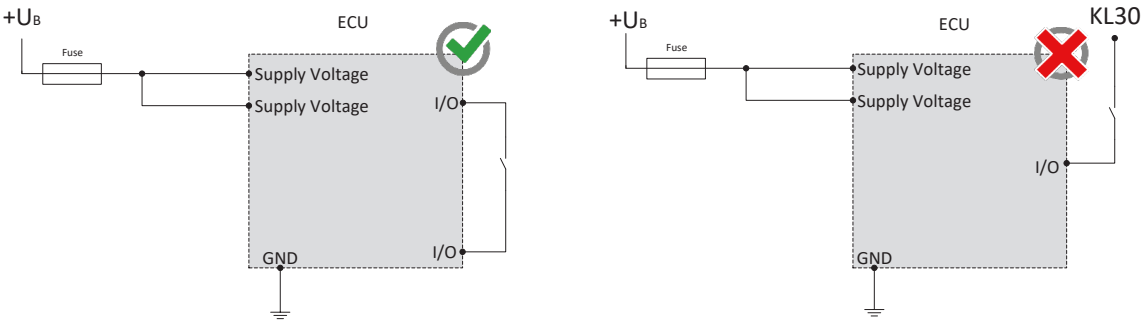


The pins (I/Os) can be used in combination and may not be switched externally against a higher voltage level than supply voltage.



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.



To comply with the IP protection class, the wiring harness attached to the mating connector must be routed through the corrugated tube and the mating connector must be connected to the control unit. The protection cap is then closed over the mating connector and the corrugated tube.

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

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.

