

# TMCM-6210 AND TMCM-6211 HARDWARE MANUAL

TMCM-6210/TMCM-6211 Hardware Version 1.10 • 2015-OCT-26 | Document Rev. 1.00 • 2016-MAY-27

**TMCM-6210 and TMCM-6211 both are 6-axis controller/driver modules for 2-phase bipolar stepper motors with separate differential encoder and separate HOME/STOP switch inputs for each axis (6x). Dynamic current control, and quiet, smooth and efficient operation are combined with stealthChop™, dcStep™, stallGuard™ and coolStep™ features.**



Figure 1: TMCM-6211 Product Photo

## Features

- 6-Axis Controller/Driver Modules
- For 2-Phase Bipolar Stepper Motors
- Up-to 0.7 3A RMS / 24V DC
- Encoder/HOME/STOP
- 4x Analog/Digital Inputs
- 4x Digital Outputs
- Brake Chopper Support
- CAN, RS485, USB (TMCM-6210)
- EtherCAT®, USB (TMCM-6211)

## Applications

- Lab Automation
- Semiconductor
- Manufacturing
- Robotics
- Factory Automation
- CNC

## Block Diagram: TMCM-6210 Interfaces & Features

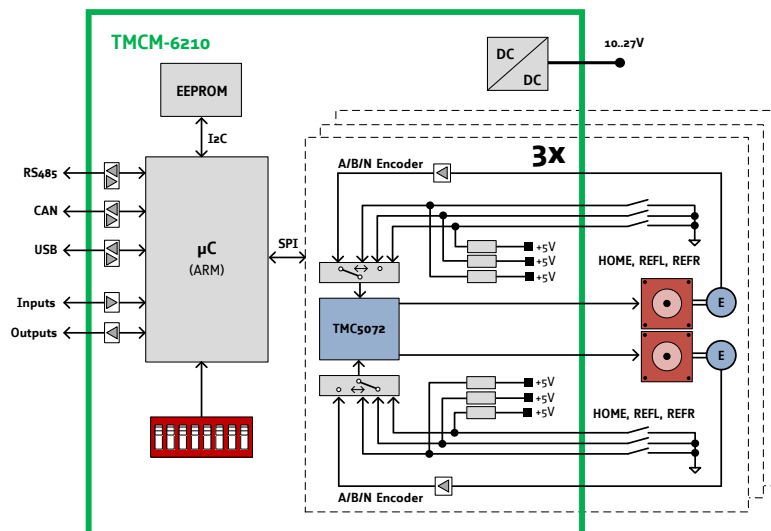


Figure 2: Block Diagram of TMCM-6210

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Read entire documentation; especially the Supplemental Directives on page 41.



## Functional Scope of TMCM-6210 and TMCM-6211

### Shared Features of TMCM-6210 and TMCM-6211

**TMCM-6210 and TMCM-6211 both offer a stepper motor controller and driver for six axes, along with other shared features, as briefly described below:**

#### Motion Controller

Motion profile is calculated in real time. On the fly alterations of motor parameters (e.g. position, velocity and acceleration) are possible. Dedicated HOME, STOP\_L, and <aSTOP\_R switch inputs (with internal pull-ups) are available via differential encoder input motor axis (6x). A high-performance microcontroller controls the overall system, and conducts communication protocol handling.

#### Bipolar Stepper Motor Driver

The bipolar stepper motor driver allows up to 256 microsteps per full step, with highly highly efficient operation and low power dissipation. The bipolar stepper motor driver offers dynamic current control and integrated protection. Quiet operation and smooth motion are ensured via stealthChop functionality; load-dependent speed control through dcStep features; stall detection through stallGuard2; reduction of power consumption and heat dissipation via coolStep.

#### Digital and analog In- and Outputs

In combination with a brake chopper unit, four general purpose analog inputs (0..10V) or digital inputs (+24V signals) and four general purpose digital outputs (open-drain, 500mA each) are provided.

#### Electrical Data

Supply voltage ranges from nom. +12V to +24V; with +10V ... +27V supply voltage operating range. The motor current is up to 0.7A RMS (programmable). The brake chopper unit supports an external brake resistor that limits supply voltage when energy is fed back into the supply rail.

#### Mechanical Data

Board size is 215 mm x 100 mm, overall height 21mm max. (including PCB - but excluding mating connectors and cables). Mounting holes (12x M3) are available for optional use.

### Specific Product Differences

**Both products differ concerning bus interface options and firmware options, as shown in the Table below:**

Product differences between TMCM-6210 and TMCM-6211		
Scope	TMCM-6210	TMCM-6211
<b>Bus Interfaces</b>	<ul style="list-style-type: none"> <li>CAN</li> <li>RS485</li> <li>USB full speed (12M/bits) device interface: Micro-USB</li> </ul>	<ul style="list-style-type: none"> <li>EtherCAT®</li> <li>USB full speed (12M/bits) device interface: Micro-USB</li> </ul>
<b>Firmware</b>	<ul style="list-style-type: none"> <li>TMCL™ remote (direct mode) and standalone operation with memory for up to 1024 TMCL commands.</li> <li>CANopen® (CoE) firmware available</li> </ul>	<ul style="list-style-type: none"> <li>CANopen® via EtherCAT® (CoE) firmware</li> </ul>

*Table 1: TMCM-6210 Interface Brick: Connectors and Mating Connectors*

**i** Please consult firmware documentation for TMCM-6210/TMCM-6211 for additional programming and communication protocol information.



## Order Codes: TMCM-6210

The TMCM-6210 unit is available with two different firmware options:

Order code	Description	Size
TMCM-6210-TMCL	6-axis controller/driver up-to 0.7A RMS / +24V, CAN + RS485 + USB with standard TMCL firmware	215mm x 100mm x 21mm
TMCM-6210-CANopen	6-axis controller/driver up-to 0.7A RMS / +24V, CAN + RS485 + USB with CANopen firmware	215mm x 100mm x 21mm

Table 2: Order Codes: TMC-6210

## Order Codes: TMCM-6211

The TMCM-6211 unit is available with one firmware:

Order code	Description	Size
TMCM-6211-CoE	6-axis controller/driver up-to 0.7A RMS / +24V, EtherCAT® + USB with CANopen over EtherCAT® firmware	215mm x 100mm x 21mm

Table 3: Order Code: TMCM-6211

## Order Codes: Cable Loom

A cable loom is available for a range of TMCM products, as specified in the Table below:

Order code	Description	Size
<b>TMCM-G4-CABLE</b>	Cable loom for <b>TMCM-6210/6211</b> , TMCM-6212/6213, TMCM-3212/3213, TMCM-3214/3215, TMCM-3312/3313 and TMCM-3314/3315.  1x cable loom for RS485 connector (6210) 1x standard CAT5 cable with 2x RJ45 for CAN / EtherCAT® (6210/6211) 1x RJ45-2-DSUB_G4_V10 adapter (for CAN RJ45 <-> D-SUB translation) (6210) 1x Micro-USB cable (6210/6211) 1x cable loom for INPUTs connector (6210/6211) 1x cable loom for OUTPUTs connector (6210/6211) 6x cable loom for MOTOR connector (small) (6210/6211) 3x cable loom for MOTOR connector (big) 6x cable loom for ENCODER connector (6210/6211) 6x cable loom for REF / HOME connector (6210/6211) 1 cable loom for POWER connector (small) (6210/6211) 1x cable loom for POWER connector (big) 1x cable loom for CONTROL connector (6210/6211) 1x cable loom for RESISTOR connector (6210/6211)	
<i>Contains:</i>		

Table 4: Order Code: TMCM-G4-CABLE

### NOTE:

→ The use of the above specified cables speeds up initial setup. The use of a cable is not required for all modules. The cables are assigned specifically to certain products with which they fit. **Only use as specified!**



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# MAIN MANUAL

## 1. TMC6210 Functional Description

TMC6210 is a highly integrated controller/driver module for six stepper motor axes, which can be controlled via several serial interfaces (CAN, RS485 and USB – depending on firmware).

### Additional Functional Details

Communication traffic is kept low since all-time critical operations (e.g. ramp calculations) are performed on board. The nominal supply voltage of the unit is 12V or 24V DC. The module is designed for both, standalone operation and direct mode. Full remote control of device with feedback is possible. The firmware of the module can be updated via one of the serial interfaces (depending on module and firmware type).

### Main Parts of TMC6210

In the Figure below, the main parts of the TMC6210 are shown:

- Microcontroller, responsible for overall control, executes the firmware (either TMCL or CANopen® incl. the communication stack)
- 3 Dual-axes motion controller and driver (based on the TMC5072) with calculation of ramps and speed profiles internally in hardware
- Interface for an external (e.g. optical) incremental A/B/N encoder (differential RS422 signals) for each axis
- Interface for HOME/REFL/REFR reference switches for each axis (either encoder interface or reference switches can be selected in software)
- 4 General purpose analog/digital inputs
- 4 General purpose digital (open-drain) outputs
- 3 Serial communication interfaces: CAN, RS485 and USB (Micro-USB-connector)

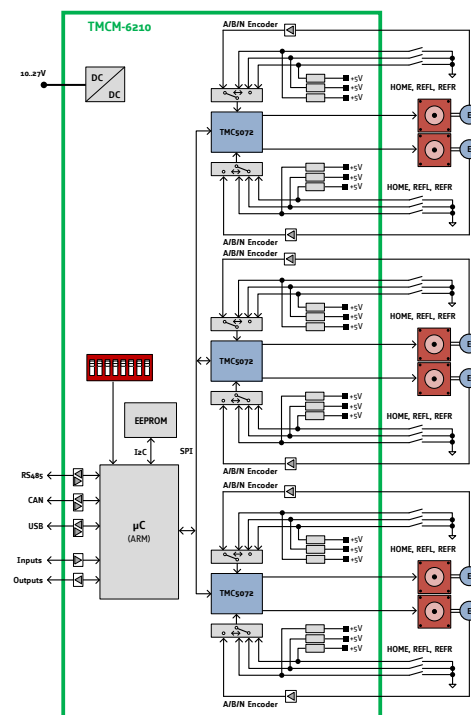


Figure 3: Main Parts of TMC6210



## 2. TMCM-6211 Functional Description

**TMCM-6211 is a highly integrated controller/driver module for 6-stepper motor axes, which offers an EtherCAT interface in addition to USB, for communication.**

### Interface Details

The unit offers an EtherCAT interface in addition to USB for communication. The nominal supply voltage of the unit is 12V or 24V DC. Full remote control of the device with feedback is possible using the CANopen over EtherCAT (CoE) firmware. The firmware of the module can be updated via one of the serial interfaces.

### Main Parts of TMCM-6211

In the Figure below, the main parts of TMCM-6211 are shown:

- Microcontroller, responsible for overall control, executes the firmware (CANopen over EtherCAT, CoE)
- 3 Dual-axes motion controller and driver (based on the TMC5072) with calculation of ramps and speed profiles internally in hardware
- Interface for an external (e.g. optical) incremental A/B/N encoder (differential RS422 signals) for each axis
- Interface for HOME/REFL/REFR reference switches for each axis (either encoder interface or reference switches can be selected in software)
- 4 General purpose analog/digital inputs
- 4 General purpose digital (open-drain) outputs
- EtherCAT and USB interfaces for communication

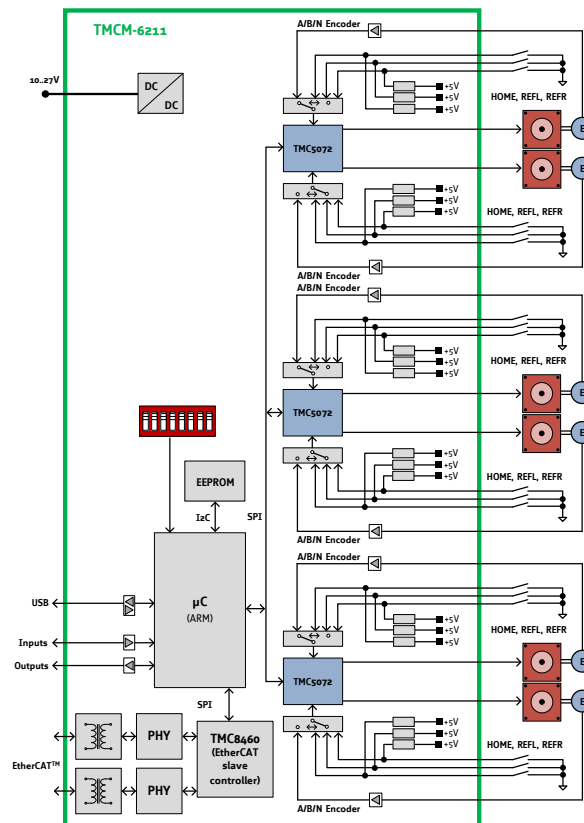


Figure 4: Main Parts of TMCM-6211



### 3. Mechanical and Electrical Interfacing

#### 3.1. Dimensions and Mounting Holes

The dimensions of the TMC6210 or TMC6211 driver boards are 215mm x 100mm x 21mm. Maximum component height - without mating connectors - is around 17mm above PCB level and 2mm below PCB level. Altogether, 12 mounting holes are available - for the specified M3 screws (3.2mm diameter) - for mounting the PCB.

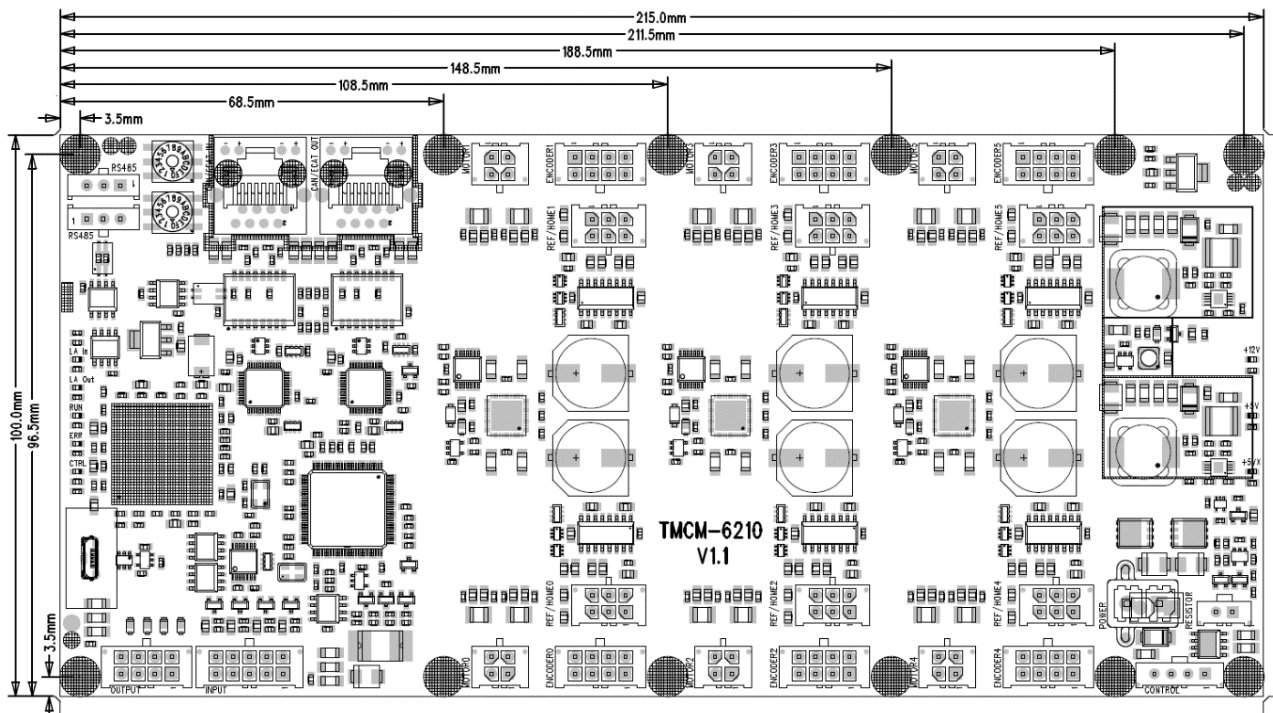


Figure 5: Dimension of TMC6210/TMC6211 and Position of Mounting Holes

**NOTE:**

→ TMC6210 and TMC6211 share the same PCB with different assembly options regarding the interface section. Dimensions, mounting holes and board mounting considerations (see chapter below) are the same for both boards.





### 3.2. Board Mounting Considerations

TMCM-6210/TMCM-6211 offer 12 metal-plated mounting holes.

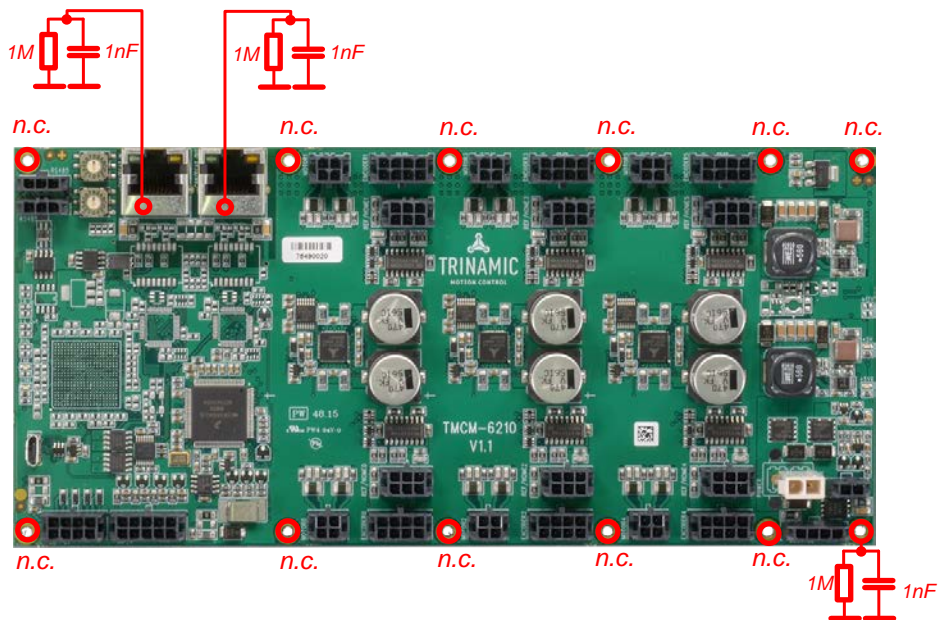


Figure 6: TMCM-6210/TMCM-6211 Mounting Hole Connections

#### Configuration Overview

One hole (lower right) is connected to on-board system ground (connected to power supply input ground) via 1M (500VDC) || 1nF (1kV). The same combination or resistor and capacitor is used for connecting the RJ45 shield ground (connector enclosure) to power supply input ground (see Figure above).

All other mounting holes are electrically isolated. Please take into consideration that not all holes must be used for mounting the PCB. It is recommended to use the mounting holes in all four corners and two in the middle (6 altogether), as a minimum. This will ensure adequate support of the PCB when inserting or removing connectors in order to avoid significant bending of the PCB.

#### NOTE:

→ Please always remove or attach mating connectors carefully by supporting the PCB, if necessary!



## 4. Connectors of TMCM-6210 and TMCM-6211

**TMCM-6210 and TMCM-6211 are two members of a new family of modules with a modular architecture, which are composed of so-called “bricks”.**

### Functional Details

TMCM-6210 and TMCM-6211 each consist of one interface brick, three dual-axes stepper motor controller/driver bricks and one supply brick. The TMCM-6210 interface brick offers CAN and RS485 interfaces while EtherCat is assembled on the TMCM-6211 instead. All other bricks are the same for both modules.

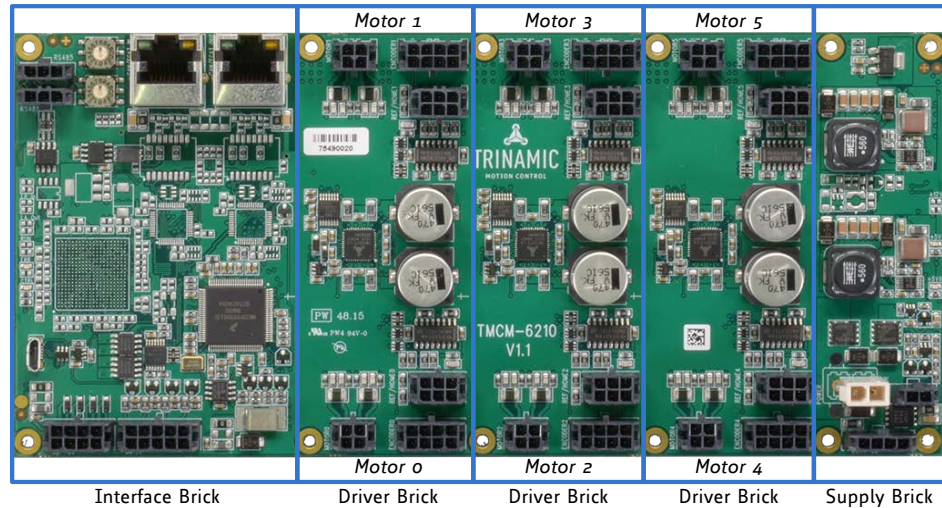


Figure 7: Different bricks used for the TMCM-6210/TMCM-6211



### 4.1. TMCM-6210 Interface Brick Connector Overview

The interface brick of the TMCM-6210 offers RS485, CAN and USB interfaces for communication, four general purpose analog inputs - which can be used as digital inputs as well - and four open- drain outputs.

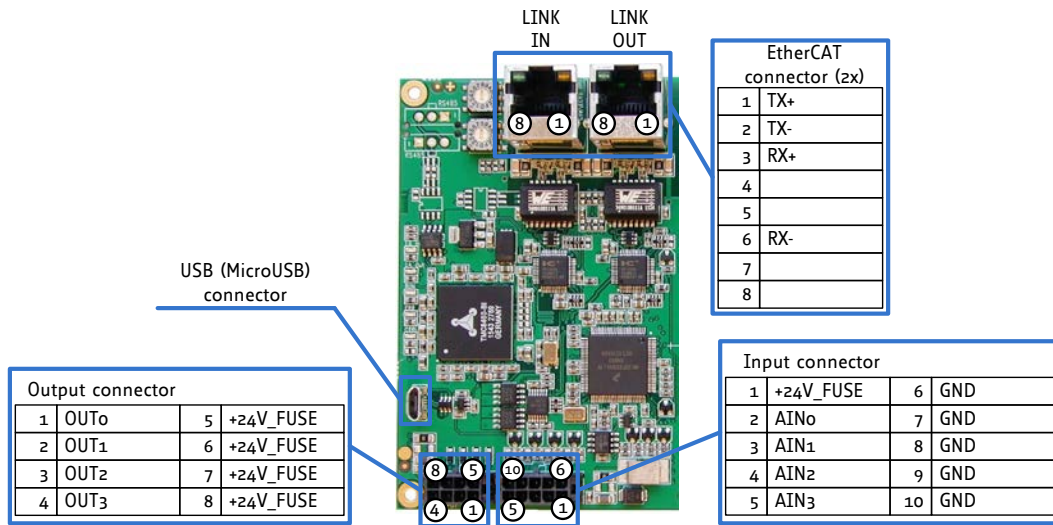


Figure 8: TMCM-6210 Interface Brick

Connector and Mating Connector Overview		
Label	Connector Type	Mating Connector Type
RS485	Molex MicroFit™, 436500315 1x4 pin header, 3mm pitch	Molex MicroFit Housing: 43645-0300 Contacts: 43030-0007
CAN	RJ45 plug connector	E.g. standard CAT 5/CAT 5e cables can be used
USB	Micro-USB connector, type B (USB device interface)	Standard Micro-USB
Inputs	Molex MicroFit, 430451012 2x5 pin header, 3mm pitch	Molex MicroFit Housing: 43025-1000 Contacts: 43030-0007
Outputs	Molex MicroFit, 430450812 2x4 pin header, 3mm pitch	Molex MicroFit, Housing: 43025-0800 Contacts: 43030-0007

Table 5: TMCM-6210 Interface Brick: Connectors and Mating Connectors



### 4.1.1. RS485 Connector

Two RS485 connectors with the same pin assignment are on the board; with direct pin connection between pins.

#### Functional Details

The second connector can be used for attaching a bus termination resistor to the RS485 bus (there is no on-board termination resistor); or for further distribution of the RS485 bus signals to other RS485 communication nodes while maintaining a proper bus structure.

A 3-pin Molex MicroFit™ connector (Molex part no. 436500315) is used for RS485 connection. Mating connector housing: e.g. Molex 43645-0300. Contacts: Molex 43030-0007.

**i** Alternative Molex options are available, both for housing and contacts.

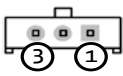
Interface Brick: RS485 Connector				
	Pin	Label	Direction	Description
	1	GND	Power	Supply and signal ground.
	2	RS485+	Bi-directional	RS485 interface, diff. signal (non-inverting).
	3	RS485-	Bi-directional	RS485 interface, diff signal (inverting).

Table 6: Interface Brick: RS485 Connector



### 4.1.2. TMCM-6210 CAN Connector

Two CAN connectors with the same pin assignment are on the board, with direct pin connection between pins.

**CAN Connection Details**

The second one can be used for connecting a bus termination resistor to the RS485 bus (there is no termination resistor on-board); or for further distribution of the CAN bus signals to other CAN nodes while maintaining a proper bus structure.

**Use of RJ45 Plug Connector**

A standard RJ45 plug connector is used for CAN communication. Connection is made via standard CAT cables (e.g. CAT 5, non-crossing). Pin assignment of the RJ45 is based on the CiA 303-1 recommendation.


Interface Brick: CAN Connector				
	Pin	Label	Direction	Description
	1	CAN_H	Bi-Directional	CAN interface, diff signal (non-inverting)
	2	CAN_L	Bi-directional	CAN interface, diff signal (inverting)
	3	GND	Power	Supply and signal ground
	4	n.c.		
	5	n.c.		
	6	n.c.		
	7	n.c.		
	8	n.c.		

Table 7: Interface Brick: CAN Connector

### 4.1.3. USB Connector

TMCM-6210/TMCM-6211 each offer a Micro USB connector (Type B, device interface) for communication.

**USB high speed Support**

The USB interface supports USB high speed communication (12Mbit/s).

**USB-powered Mode**

When USB-connected, the digital logic part of the TMCM-62102/TMCM-6213 is supplied via USB (USB powered mode), if no main supply is available. This mode can also be used for firmware-updates, TMCL-program download or parameter settings, etc. (requires USB connection, only).

**USB standalone Mode**

Depending on the variation of the voltage levels of USB +5V and on-board generated +5V, the board will draw current from the USB supply.



### 4.1.4. Input Connector

**TMCM-6210/TMCM-6211 each offer four analog inputs (nom. 0..10V range), which can be used as digital inputs, which are also +24V-tolerant.**

#### Molex Connector Housings

Four inputs are available via one 10-pin Molex MicroFit connector (Molex part no. 430451012).

Mating connector housing: e.g. Molex 43025-1000. Contacts Molex: 43030-0007.

- i** Alternative Molex options are available, both for mating housing and contacts.

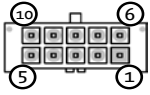
Interface Brick: Input Connector				
	Pin	Label	Direction	Description
	1	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +48V_FUSE supply outputs on output connector: 500mA / polyfuse-protected).
	2	AIN0	Input	Analog input channel 0 (nom. 0..10V).
	3	AIN1	Input	Analog input channel 1 (nom. 0..10V).
	4	AIN2	Input	Analog input channel 2 (nom. 0..10V).
	5	AIN3	Input	Analog input channel 3 (nom. 0..10V).
	6	GND	Power	Supply and signal ground.
	7	GND	Power	Supply and signal ground.
	8	GND	Power	Supply and signal ground.
	9	GND	Power	Supply and signal ground.
	10	GND	Power	Supply and signal ground.

Table 8: Interface Brick: Input Connector



### 4.1.5. Output Connector

The TMCM-6210/TMCM-6211 offer four digital outputs (open-drain).

**Molex Connector Housings**

Four outputs are available via one 8-pin Molex MicroFit connector (Molex part no. 43045-0812).

Mating connector housing: e.g. Molex 43025-0800. Contacts Molex 43030-0007.

**i** Alternative Molex options are available, both for mating housing and contacts.

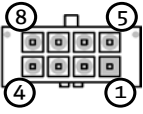
Interface Brick: Output Connector				
	Pin	Label	Direction	Description
	1	AOUT0	Output	Open-drain output.
	2	AOUT1	Output	Open-drain output.
	3	AOUT2	Output	Open-drain output.
	4	AOUT3	Output	Open-drain output.
	5	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA / polyfuse-protected).
	6	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA / polyfuse-protected).
	7	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA / polyfuse-protected).
	8	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA / polyfuse-protected).

Table 9: Interface Brick: Output Connector

**i** The TMCM-6210 and TMCM-6111 each offer 4 open-drain (N-channel MOSFET) general purpose outputs, which are available at the output connector of the interface brick part. Go to page 33 for information about [Connecting General Purpose Outputs OUT 0...3](#).



## 4.2. TMCM-6211 Interface Brick Connector Overview

The interface brick of the TMCM-6211 offers EtherCAT and USB interfaces for communication, four general purpose analog inputs (which can be used as digital inputs as well) and four open-drain outputs.

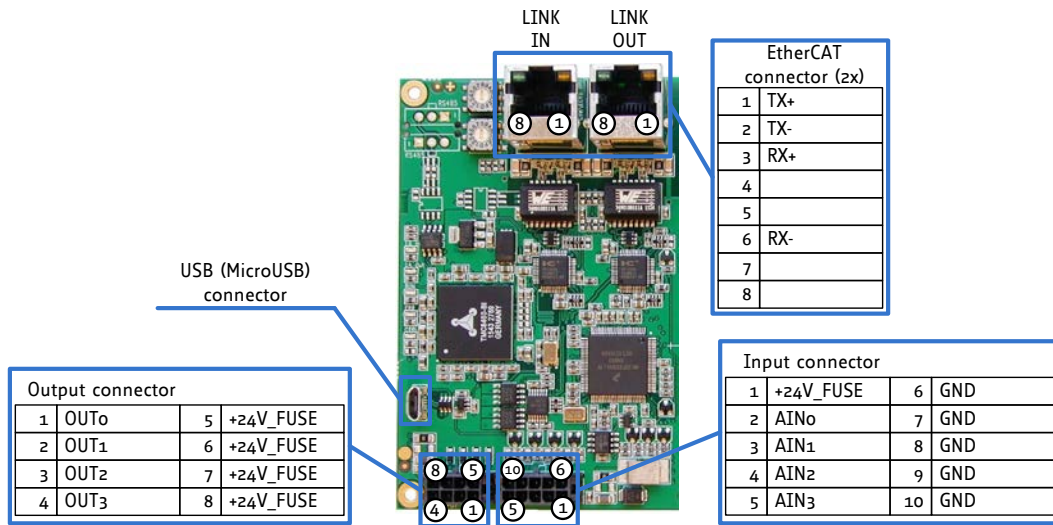


Figure 9: TMCM-6211 Interface Brick

TMCM-6211 Connector and Mating Connector Overview		
Label	Connector type	Mating connector type
EtherCAT	RJ45 plug connector	E.g. standard CAT 5 / CAT 5e cables suitable for 100Mbit/s Ethernet
USB	Micro-USB connector, type B (USB device interface)	Standard Micro-USB
Inputs	Molex MicroFit, 43045-1012 2x5 pin header, 3mm pitch	Molex MicroFit Housing: 43025-1000 Contacts: 43030-0007
Outputs	Molex MicroFit, 43045-0812 2x4 pin header, 3mm pitch	Molex MicroFit Housing: 43025-0800 Contacts: 43030-0007

Table 10: TMCM-6211 Interface Brick: Connectors and Mating Connectors





### 4.2.1. TMCM-6211 EtherCAT Connector

Two EtherCAT connectors are on the board: one for LINK IN (towards/coming from EtherCAT master) and one for LINK OUT (for connecting further slaves) connection.

**Connection Options**

A standard RJ45 plug connector (as used for 10/100Mbit/s Ethernet) is used for EtherCAT communication. Connections are made via standard cables suitable for 100Mbit/s Ethernet (e.g. CAT 5/5e etc.).

The PHYs that are used on the TMCM-6211 support auto MDI-X. Therefore, TX and RX signals on the connector can be exchanged. Thus, the use of cables with straight-through pin assignment is possible, for example.


TMCM-6211 Interface Brick: EtherCAT Connector				
	Pin	Label	Direction	Description
	1	TX+	Output	Transmit data output, differential, non-inverting
	2	TX-	Output	Transmit data output, differential, inverting
	3	RX+	Input	Receive data input, differential, non-inverting
	4			
	5			
	6	RX-	Input	Receive data input, differential, inverting
	7			
	8			

Table 11: TMCM-6211 Interface Brick: EtherCAT Connector

### 4.2.2. USB Connector

The TMCM-6210/TMCM-6211 offers a Micro USB connector (Type B, device interface) for communication.

**Functional Details**

The USB interface supports USB high speed communication (12Mbit/s).

**USB-powered Mode**

When USB-attached, the digital logic part of the TMCM-3312/TMCM-3313 is supplied via USB (USB powered mode), if there is no main supply available. This mode can be used for firmware-updates, TMCL-program download or parameter settings etc. (requires USB connection, only).

**USB standalone Mode**

In USB standalone mode (main board supply available) the board can still draw current from the USB supply – depending on the voltage level of the USB +5V and the on-board generated +5V.



### 4.2.3. Input Connector

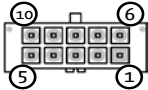
The TMC6210/TMC6211 each offer four analog inputs (nom. 0..10V range), which can be used as digital inputs also (+24V tolerant).

#### Molex Connector Details

Four inputs are available via one 10-pin Molex MicroFit connector (Molex part no. 430451012).

Mating connector housing: e.g. Molex 43025-1000. Contacts Molex 43030-0007.

**i** Alternative Molex options are available, both for mating housing and contacts.

Interface Brick: Input Connector				
	Pin	Label	Direction	Description
	1	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA / polyfuse protected).
	2	AIN0	Input	Analog input channel 0 (nom. 0..10V).
	3	AIN1	Input	Analog input channel 1 (nom. 0..10V).
	4	AIN2	Input	Analog input channel 2 (nom. 0..10V).
	5	AIN3	Input	Analog input channel 3 (nom. 0..10V).
	6	GND	Power	Supply and signal ground.
	7	GND	Power	Supply and signal ground.
	8	GND	Power	Supply and signal ground.
	9	GND	Power	Supply and signal ground.
	10	GND	Power	Supply and signal ground.

*Interface Brick: Input Connector*



### 4.2.4. Output Connector

TMCM-6210/TMCM-6211 each offer four digital outputs (open-drain).

**Molex Connector Details**

Four outputs are available via one 8-pin Molex MicroFit connector (Molex part no. 43045-0812).

Mating connector housing: e.g. Molex 43025-0800. Contacts Molex 43030-0007.

**i** Alternative Molex options are available, both for mating housing and contacts.

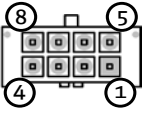
Interface Brick: Output Connector				
	Pin	Label	Direction	Description
	1	OUT0	Output	Open-drain output channel 0.
	2	OUT1	Output	Open-drain output channel 1.
	3	OUT2	Output	Open-drain output channel 2.
	4	OUT3	Output	Open-drain output channel 3.
	5	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA/polyfuse-protected).
	6	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA/polyfuse-protected).
	7	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA/polyfuse-protected).
	8	+24V_FUSE	Power output	Connected via fuse (polyfuse) to power supply input (+24V_LOGIC supply input on power control connector). Max. output current (together with all +24V_FUSE supply outputs on output connector: 500mA/polyfuse-protected).

Table 12: Interface Brick: Output Connector

**i** The TMCM-6210 and TMCM-6111 each offer 4 open-drain (N-channel MOSFET) general purpose outputs, which are available at the output connector of the interface brick part. Go to page 33 for information about [Connecting General Purpose Outputs OUT 0...3](#).



### 4.3. TMCM-6210 and TMCM-6211 Driver Brick

Each driver of both the TMCM-6210 and TMCM-6211 offers two outputs for bipolar stepper motors with up to 0.7A RMS/ 1.0A peak motor current (programmable).

#### Functional Details

Separate HOME + REFL and REFR inputs and encoder inputs (for incremental ABN encoders with differential signals) are available for each motor axes. The TMCM-6210 and TMCM-6211 each offer three such driver bricks, supporting 3 stepper motors altogether.

**NOTE:**

→ Due to sharing of hardware resources, either REFL and REFR inputs or encoder inputs are available at a given point in time.

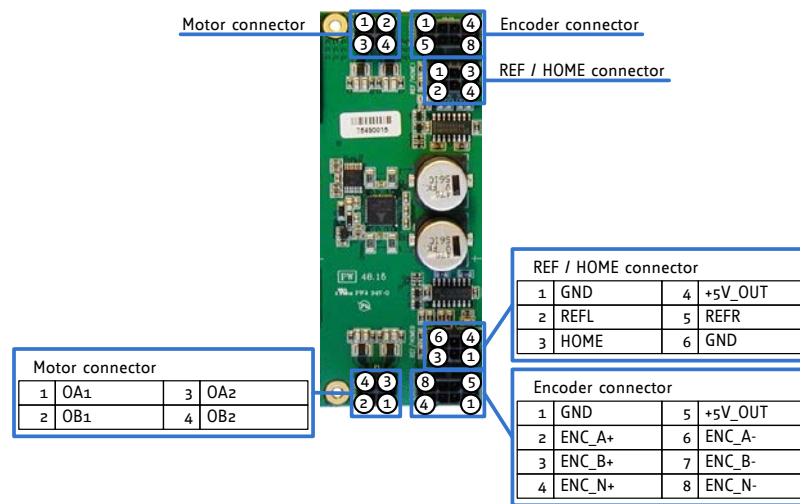


Figure 10: TMCM-6210+ TMCM-6211 Driver Brick

TMCM-6210 and TMCM-6211 Driver Brick: Connectors and Mating Connectors		
Label	Connector type	Mating Connector Type
Motor	Molex MicroFit Jr. 43045-0412 2x2 pin header, 3mm pitch	Molex MicroFit Jr. Housing: 43025-0400 Contacts: 43030-0007
REF / HOME	Molex MicroFit 43045-0612 2x3 pin header, 3mm pitch	Molex MicroFit Housing: 43025-0600 Contacts: 43030-0007
Encoder	Molex MicroFit 43045-0812 2x4 pin header, 3mm pitch	Molex MicroFit Housing: 43025-0800 Contacts: 43030-0007

Table 13: TMCM-6210 versus TMCM-6211 Driver Brick: Connectors and Mating Connectors



### 4.3.1. Motor Connector

#### Available Molex Connector Housings

Each motor (with two coils A + B and four connecting wires) can be connected via one 4 pin Molex MicroFit connector (Molex part No. 43045-0412).  
Mating connector housing: e.g. Molex 43025-0400. Contacts: Molex 43030-0007.

- i** Alternative Molex options are available, both for mating housing and contacts.

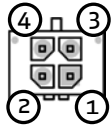
Driver Brick: Motor Connector				
	Pin	Label	Direction	Description
	1	OA1	Output	Motor coil A.
	2	OB1	Output	Motor coil B.
	3	OA2	Output	Motor coil A.
	4	OB2	Output	Motor coil B.

Table 14: Driver Brick: Motor Connector

#### In case you need to connect or disconnect the motor:

#### NOTICE

**Do not connect or disconnect motor during operation!**

**Always switch off or disconnect power supply before connecting or disconnecting the motor.**

**This will prevent excessive voltage spikes - caused by motor cable and motor inductivity - that can permanently damage driver MOSFETs.**



### 4.3.2. REF/HOME Connector

One REF/HOME connector per motor axis is available.

#### Molex Connector Details

HOME, REFL and / or REFR switches can be connected via one 6-pin Molex MicroFit connector (Molex part no. 43045-0612).

Mating connector housing: e.g. Molex 43025-0600. Contacts Molex 43030-0007.

**i** Alternative Molex options are available, both for mating housing and contacts.

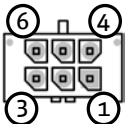
Driver Brick: REF/HOME Connector				
	Pin	Label	Direction	Description
	1	GND	Power	Supply and signal ground
	2	REFL	Input	REF left / Left stop switch input. Internal pull-up (5k6) to +5V. External switch to ground may be connected or up-to +5V push-pull signal.
	3	HOME	Input	Home switch input. Internal pull-up (5k6) to +5V. External switch to ground may be connected or up-to +5V push-pull signal.
	4	+5V_OUT	Power output	Connected to the on-board +5V auxiliary DC/DC converter. All +5V_OUT power supply outputs together on the 3 REF / HOME, 3 Encoder connectors and the Output connector may draw up-to 1A (e.g. 100mA per encoder and up-to 20mA per REF / HOME switch).
	5	REFR	Input	REF right / Right stop switch input. Internal pull-up (5k6) to +5V. External switch to ground may be connected or up-to +5V push-pull signal.
	6	GND	Power	Supply and signal ground

Table 15: Driver Brick: REF/HOME Connector



### 4.3.3. Encoder Connector

**One encoder connector per motor axis is available. Incremental A/B/N encoders with differential encoder signals are supported.**

**Available Configuration Options**

The TMCM6210/TMCM-6211 each offer on-board differential line receivers (AM26LV32 or equivalent) with 120R termination resistor per differential signal pair. Differential encoder signals can be connected via one 8-pin Molex MicroFit connector (Molex part no. 43045-0812).  
Mating connector housing: e.g. Molex 43025-0800. Contacts Molex 43030-0007.

**i** Alternative Molex options are available both for mating housing and contacts.

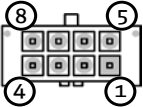
Driver Brick: Encoder Connector				
	Pin	Label	Direction	Description
	1	GND	Power	Supply and signal ground.
	2	ENC_A+	Input	Differential input of encoder channel A, non-inverting input.
	3	ENC_B+	Input	Differential input of encoder channel B, non-inverting input.
	4	ENC_N+	Input	Differential input of encoder null/zero channel, non-inverting input.
	5	+5V_OUT	Power output	Connected to the on-board +5V auxiliary DC/DC converter. All +5V_OUT power supply outputs together on the 3 REF/HOME, 3 encoder connectors and the Output connector may draw up-to 1A (e.g. 100mA per encoder and up-to 20mA per REF/HOME switch).
	6	ENC_A-	Input	Differential input of encoder channel A, inverting input
	7	ENC_B-	Input	Differential input of encoder channel B, inverting input
	8	ENC_N-	Input	Differential input of encoder null/zero channel, inverting input.

Table 16: Driver Brick: Encoder Connector



### 4.4. TMCM-6210 and TMCM-6211 Power Supply Brick

The power supply brick of the TMCM-6210 and TMCM-6211 offers one main supply input via the power connector.

**Connection Details**

Optionally, a separate logic supply input is made available.

Also available: hardware driver stage enable input on the Control connector and connection for an external brake connector with the on-board brake chopper circuit.

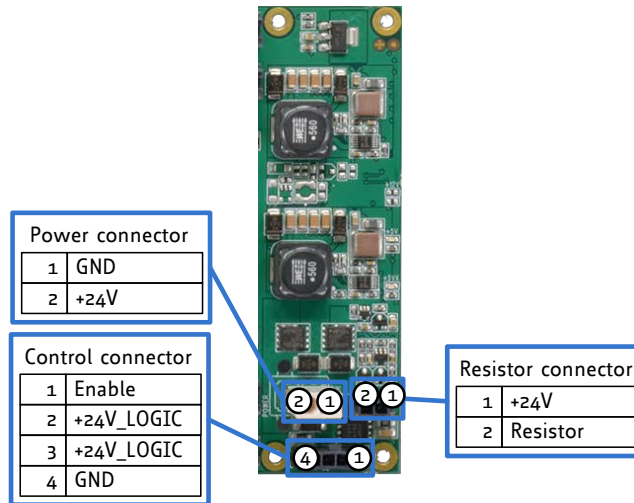


Figure 11: TMCM-6210 and TMCM-6211 Power Supply Brick

Connector and Mating Connector Overview		
Label	Connector Type	Mating Connector Type
Power	Molex MiniFit Jr. 39-28-1023 1x2 pin header, 4.2mm pitch	Molex MiniFit Jr. Housing: 39-01-2020 Contacts: 39-00-0039
Control	Molex MicroFit 43650-0415 1x4 pin header, 3mm pitch	Molex MicroFit Housing: 43645-0400 Contacts: 43030-0007
Resistor	Molex MicroFit 43650-0215 2x4 pin header, 3mm pitch	Molex MicroFit Housing: 43645-0200 Contacts: 43030-0007

Table 17: TMCM-6210 versus TMCM-6211 Power Supply Brick: Connectors and Mating Connectors





#### 4.4.1. Power Connector

A 2-pin Molex MiniFit Jr. connector (Molex part no. 39-28-1023) is available for power supply connection. Mating connector housing: e.g. Molex 39-01-2020. Contacts Molex 39-00-0039.

- i Alternative Molex options are available both for mating housing and contacts.

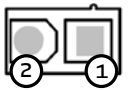
Power Supply Brick: Power Connector				
	Pin	Label	Direction	Description
	1	GND	Power	Supply and signal ground.
2	+24V	Power supply input	Power supply input. +12V ... +24V +/- 10% regulated power supply input. Supply input for all six motor driver stages and logic supply.	

Table 18: Power Supply Brick: Power Connector

#### For proper module operation:

### NOTICE

Keep power supply voltage (+24V) below upper limit of 27V!  
Make use of regulated power supply.

This will prevent serious damage of driver electronics.

#### For proper logic power and main power supply:

### NOTICE

Keep logic power supply voltage (+24V\_LOGIC) above or equal to main power supply.  
Make use of regulated power supply.

This will prevent serious damage to on-board electronics (diode connection between +24V main power supply input and +248V logic supply input).



### 4.4.2. Control Connector

A 4-pin Molex MicroFit connector (Molex part no. 436500415) is used for the driver stage enable signal and optional separate logic supply input.

Mating connector housing: e.g. Molex 43645-0400. Contacts Molex 43030-0007.

- i Alternative Molex options are available both for mating housing and contacts.

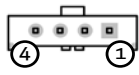
	Pin	Label	Direction	Description
	1	GND	Power	Supply and signal ground.
	2	+24V_LOGIC	Power supply input	Separate logic supply input. Can be used in order to keep digital / logic part alive while driver stage is not supplied (Power supply input via Power connector either switched off or disconnected).
	3	+24V_LOGIC	Power supply input	Same as Pin 2.
	4	ENABLE	Input	Driver stage enable input (logic high). Maybe connected to pin 3 / +24V_LOGIC in order to enable driver.

Table 19: Power Supply Brick: Control Connector

#### For proper module operation:

#### NOTICE

Keep digital logic power supply voltage (+24V\_LOGIC) below upper limit of 27V!

Make use of regulated power supply.

This will prevent serious damage of driver electronics.

#### For proper logic power and main power supply:

#### NOTICE

Keep logic power supply voltage (+24V\_LOGIC) above or equal to main power supply!

Make use of regulated power supply.

This will prevent serious damage to on-board electronics (diode connection between +24V main power supply input and +24V logic supply input).



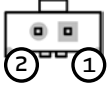
### 4.4.3. Brake Resistor Connector

**TMCM-6210 and TMCM-6211 both offer a brake chopper in hardware for limiting supply voltage in case energy is fed back from motor / driver stage into the supply rail.**

**Molex Connector Details**

A 2-pin Molex MicroFit connector (Molex part No. 43650-0215) is used for connecting an external brake resistor.  
 Mating connector housing: e.g. Molex 43645-0200. Contacts Molex 43030-0007.

**i** Alternative Molex options are available, both for housing and contacts.

Power Supply Brick: Resistor Connector				
	Pin	Label	Direction	Description
	1	+24V	Power supply input	Connected to power supply input of Power connector.
	2	Resistor	Output	Brake chopper output. An external power resistor should be connected between Pin 1 and Pin 2 of this connector.

*Table 20: Power Supply Brick: Resistor Connector*



## 4.5. Power Supply Considerations

To protect the module from over-voltage the following considerations need to be taken into account.

### Power Supply and Over-Voltage Protection

TMC6210/TMC6211 includes approx. 2800µF/35V of supply filter capacitors. In addition, the module includes a 24V suppressor diode for over-voltage protection.

#### **NOTE:**

- *It is important to make sure that supply voltage never rises above the upper limit of +27V!*
- *During motor deceleration the driver stage can feedback energy from the motor into the supply rail. Thus, supply voltage can increase. In order to limit the supply voltage a brake chopper circuit is included on the board. When activated in software and in combination with an external power resistor, this circuit then limits the supply voltage.*

### For proper module operation:

#### **NOTICE**

**Keep power supply voltage (+24V) below upper limit of 27V!**

**Make use of regulated power supply.**

**This will prevent serious damage of driver electronics.**

### For proper logic power and main power supply:

#### **NOTICE**

**Keep logic power supply voltage (+24V\_LOGIC) above or equal to main power supply.**

**Make use of regulated power supply.**

**This will prevent serious damage to on-board electronics (diode connection between +24V main power supply input and +24V logic supply input).**

### For proper digital logic power supply voltage:

#### **NOTICE**

**Keep digital logic power supply voltage (+24V\_LOGIC) below the upper limit of +27V!**

**Make use of regulated power supply.**

**This will prevent serious damage to on-board electronics (diode connection between +24V main power supply input and +24V logic supply input).**

### AREAS OF SPECIAL CONCERN



**There is limited reverse protection only!**

**The module will short-circuit any reversed supply voltage.**



## 4.6. TMCM-6210: RS485

TMCM-6210 provides a two-wire RS485 bus interface For remote control and communication with a host system.

### Proper Operation of RS485 Network

#### Bus Structure

For proper RS485 setup and operation, the following aspects must be taken into account:

The network topology must follow a bus structure as closely as possible. This means that the connection between each node and the bus itself should be as short as possible. Basically, it should be short compared to the length of the bus. The TMCM-6210 offers two connectors, which are connected directly with each other and with the on-board RS485 transceiver. Using both connectors for passing through the bus will help maintain a proper bus topology.

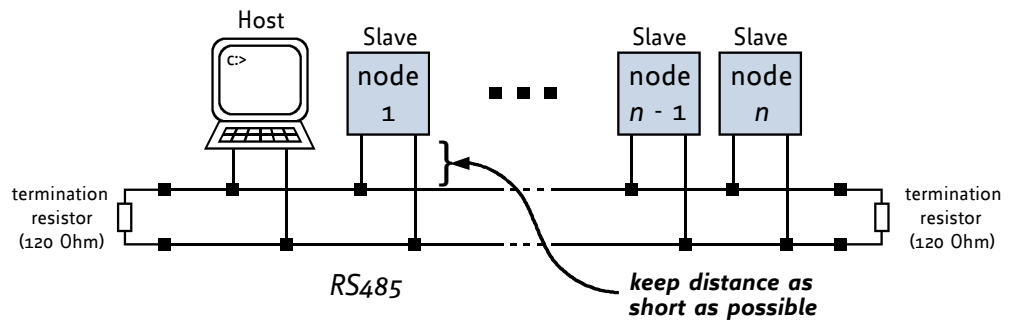


Figure 12: Bus Structure

#### Bus Termination

Especially for longer busses and/or multiple nodes connected to the bus and/or high communication speeds, the bus must be properly terminated at both ends. The TMCM-6210 does not integrate any termination resistor. Therefore, 120 Ohm termination resistors at both ends of the bus have to be added externally.

#### Number of Nodes

The RS485 electrical interface standard (EIA-485) allows up to 32 nodes to be connected to a single bus. The bus transceivers used on the TMCM-36210 units (SN65HVD1781D) have a significantly reduced bus load and allow a maximum connection of 255 units to a single RS485 bus; using TMCL firmware.

#### NOTE:

→ *Reliable communication cannot be established by making use of the maximum number of nodes connected to one bus and at the same time making use of maximum supported communication speed. Instead, a compromise has to be found between bus cable length, communication speed and number of nodes.*

#### Communication Speed

The maximum RS485 communication speed supported by the TMCM-6210 hardware is 1Mbit/s. Factory default is 9600 bit/s. Please see separate firmware manuals for information regarding other possible communication speeds below the upper limit in hardware.



**AREAS OF SPECIAL CONCERN**



**Always avoid floating bus lines when the host/master - or one of the slaves along the bus line - is transmitting data (all bus nodes are switched to receive mode).**

**No Floating BUS Lines**

**Floating bus lines may lead to communication errors. In order to ensure valid signals on the bus it is recommended to use a resistor network connecting both bus lines to well-defined logic levels.**

Two options are recommended:

**Make us of one Side of the Bus only**

**OPTION 1**

Add resistor (Bias) network on **one** side of the bus, only (120R termination resistor still at **both** ends):

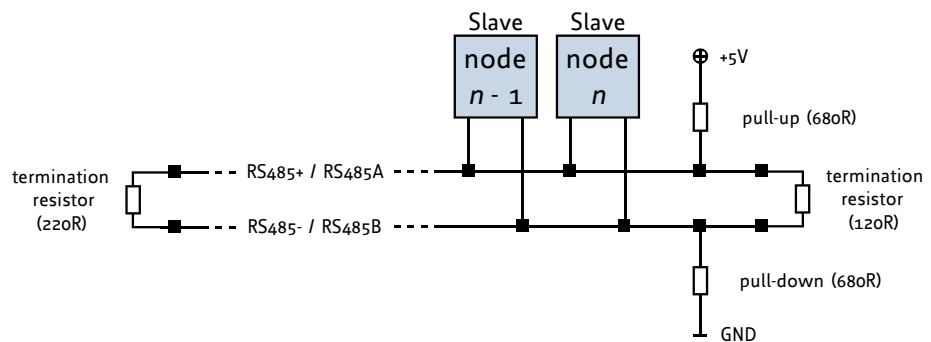


Figure 13: Bus Lines with Resistor (Bias) Network on one Side only

**Make use of two Sides of the BUS**

**OPTION 2**

Add resistor (Bias) network at **both** sides of the bus (like Profibus termination):

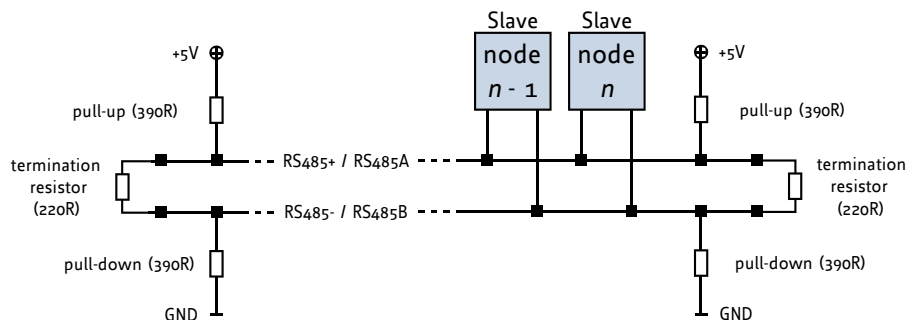


Figure 14: Bus Lines with Resistor (Bias) Network at both Sides

**i** Certain RS485 interface converters available for PCs already include these additional resistors (e.g. USB-2-485 with bias network at one end of the bus).



## 4.7. TMCM-6210: CAN Bus Interface

For remote control and communication with a host system, the TMCM-6210 provides a CAN bus interface.

### Proper CAN Operation

For proper CAN network operation the following items must be taken into account:

#### Bus Structure

The network topology must follow a bus structure as closely as possible. This means that the connection between each node and the bus itself must be as short as possible; in relation to the length of the bus. The TMCM-6210 offers two connectors (RJ45), which are connected directly with each other, and with the on-board CAN transceiver. Using both connectors for passing through the bus will help maintain a proper bus topology.

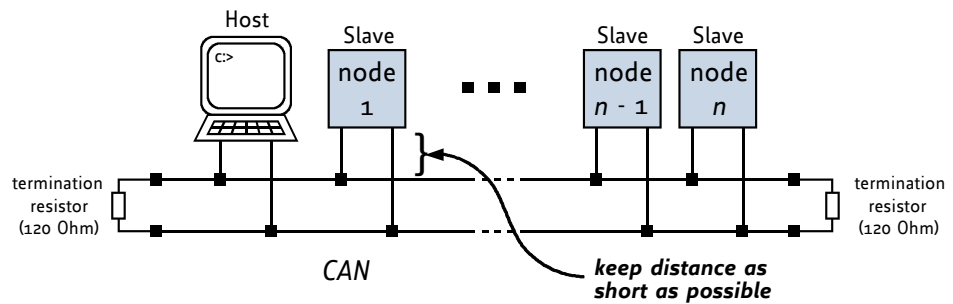


Figure 15: CAN Bus Structure

#### BUS Termination

Especially for longer busses and/or multiple nodes connected to the bus and/or high communication speeds, the bus must be properly terminated at both ends. The TMCM-6210 does not integrate any termination resistor. Therefore, 120 Ohm termination resistors at both ends of the bus must to be added externally.



### 4.7.1. TMCM-6210: CAN Adapter

As part of the cable loom for the TMCM-6210 (TMCM-G4-CABLE), an adapter PCB is available (RJ45-2-DSUB\_G4\_V10) for CAN bus connection via standard D-SUB connectors; instead of the RJ45 available on the TMCM-6210.

#### Other helpful Cables

A standard, ethernet cable, e.g. CAT5, can be used to connect the RJ45 connector on the TMCM-6210 with the RJ45 connector on the adapter PCB. The D-SUB connector on the adapter PCB can then be used to connect further slaves, or to connect the master with CAN D-SUB connectors.

**NOTE:**

→ Maintain a proper bus structure while using the adapter PCB!

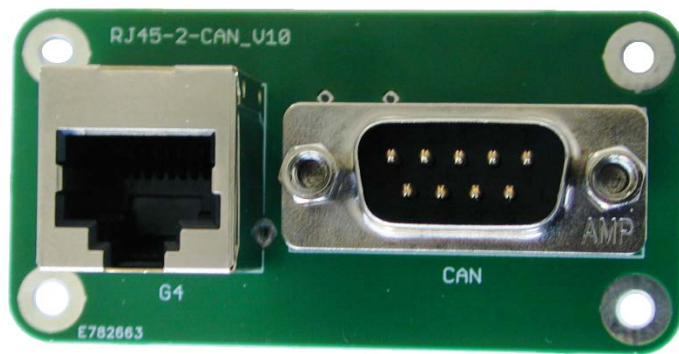


Figure 16: RJ45-2-DSUB PCB Top View

### 4.7.2. RJ45-2-DSUB SCHEMATIC and Connector Pin Assignment

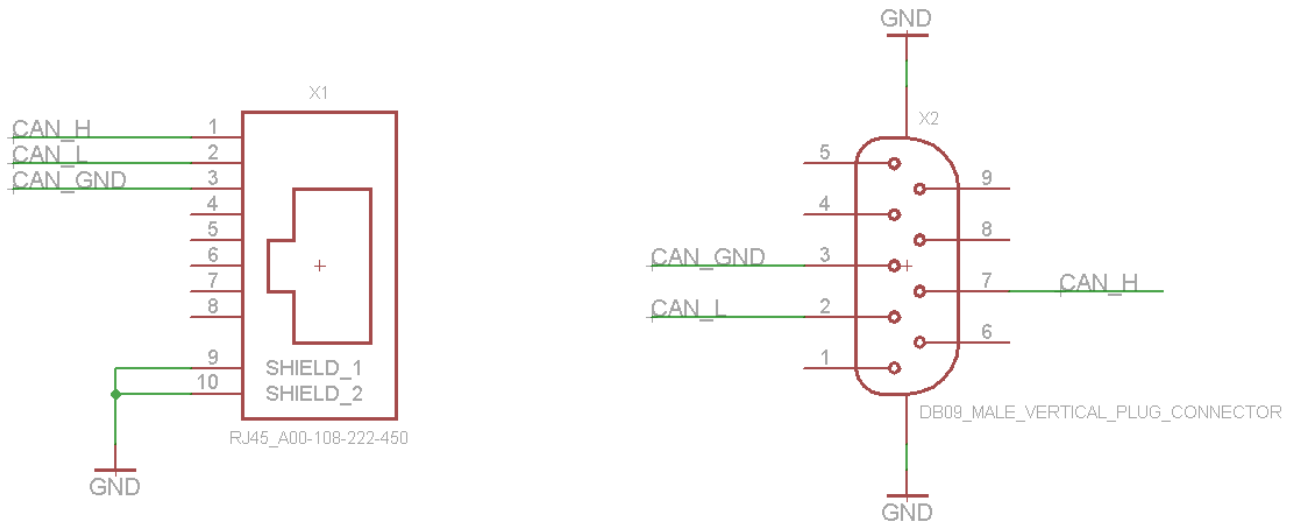


Figure 17: RJ45-2-DSUB schematic and Connector Pin Assignment





### 4.7.3. Connecting General Purpose Outputs OUT 0...3

**TMCM-6210 and TMCM-6111 each offer 4 open-drain (N-channel MOSFET) general purpose outputs, which are available at the output connector of the interface brick part.**

#### Output with internal Circuit

The internal connection of the N-channel MOSFETs together with a flyback / freewheeling diode can be seen in the Figure below. When the MOSFET is activated, the related output is pulled low (sometimes called npn-style switch).

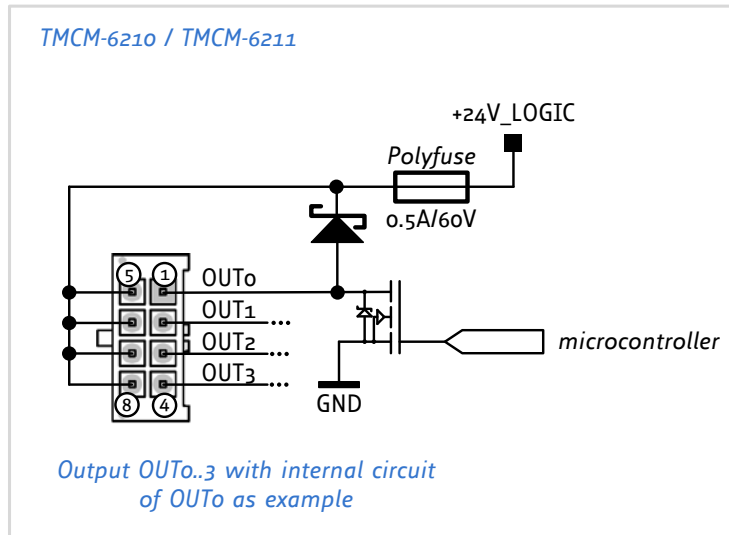


Figure 18: General Purpose Output. Internal Circuit (simplified illustration)

#### Circuit Connection Examples

Examples for connecting external circuits to the outputs:  
From left to right:

1. Simple digital output: high (+5V) / low.
2. LED connected to output.
3. Relay connected to output.

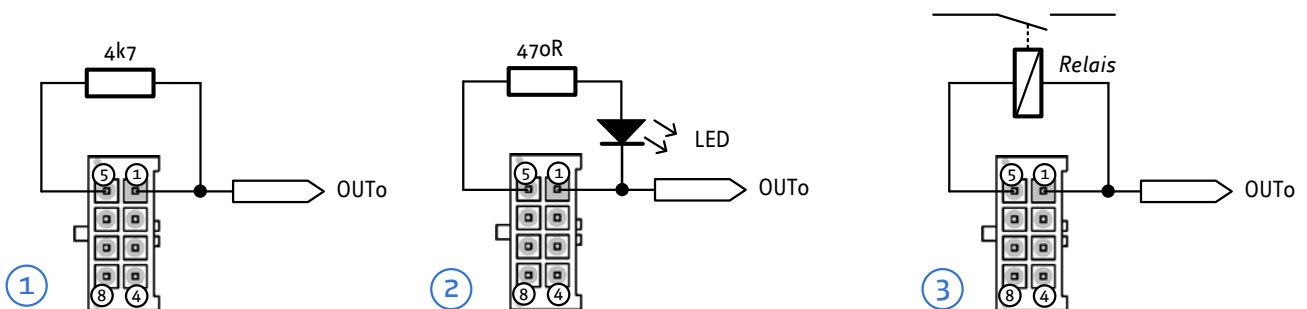


Figure 19: Circuit Connection Examples for connecting to general purpose Outputs



## 5. Motor Driver Current

The stepper motor driver section of TMCM-6210/TMCM-6211 operates current-controlled.

### Driver Current Programming

The driver current is programmed in software with 256 effective scaling steps in hardware up-to 7A RMS / 1A peak max. motor coil current.

#### **NOTE:**

- Motor current measured for one phase with max. current settings (100% e.g. "SAP 179, 0, 0" and "SAP 6, 0, 255") and 256 microsteps:
- CH1 (yellow): motor current [100mV / A]

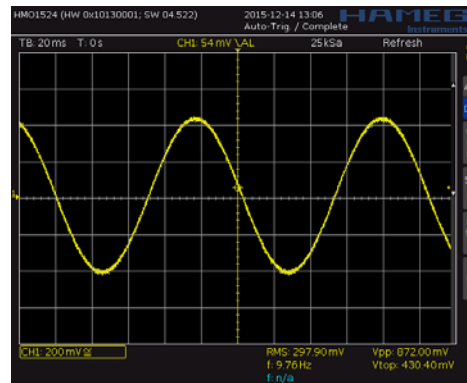


Figure 20: Motor Current Illustration as in Software Application

### Motor Current Settings in Software (TMC)

In TMCL axis parameter 6 (motor run current) and 7 (motor standby current) can be used for motor current settings:

```
SAP 6, 0, <value> // set run current
```

```
SAP 7, 0, <value> // set standby current
```

For <value> numbers between 0 (minimum) and 255 (maximum) are supported. Motor current is scaled linearly up-to 7A RMS / 1A peak.

Read-out value with GAP instead of SAP.

- i **Please see separate TMCM-6210 / TMCM-6211 firmware / software manual for further information)**



## 6. On Board LEDs

LEDs provide status information.

### 6.1. Power Supply Brick

**Two available LEDs** TMCM-6210 and TMCM-6211 both have two LEDs on the power supply brick part.  
**LEDs**

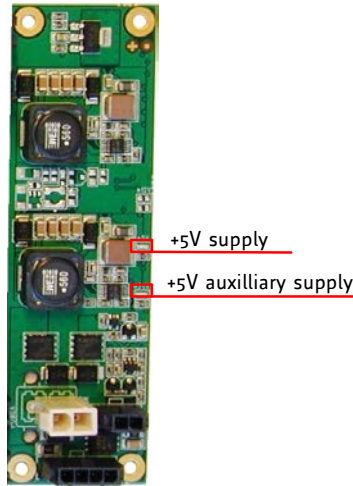


Figure 21: LEDs on Power Supply Brick

Available LEDs	
LED	Description
+5V supply	+5V available from on-board DC/DC converter for supply of on-board digital circuit.
+5V auxiliary supply	+5V auxiliary supply available (can be switched on/off in software). +5V_OUT on REF/HOME and ENCODER connector.

Table 21: Available LEDs



## 6.2. TMCM-6210 CAN Interface Brick

Two LEDs are available for TMCM-6210 (one green and one red).

### Connection Details

For the CAN and RS485 interface brick of the TMCM-3312 two LEDs provide information on connectivity and system status, as highlighted in the Figure below:

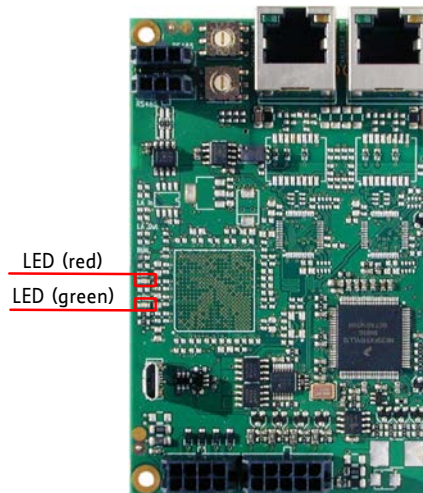


Figure 22: LEDs on TMCM-6210 Interface Brick



### 6.3. TMCM-6211 EtherCAT Interface Brick

Five LEDs are available for TMCM-6211.

**Connection Details**

For the TMCM-3313 EtherCat interface brick five LEDs provide information on connectivity and system status, has highlighted in the Figure below:

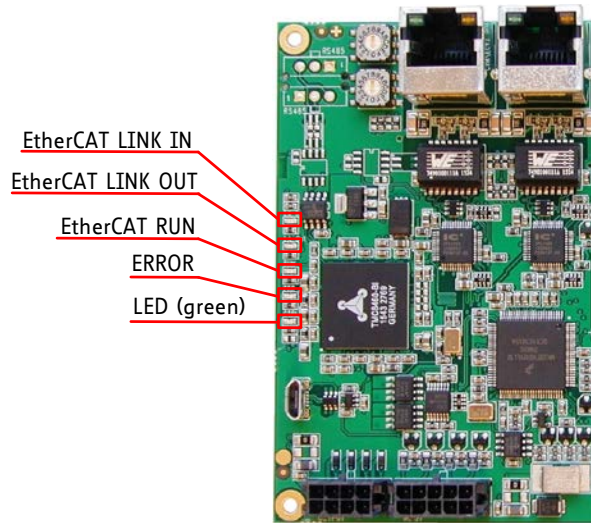


Figure 23: LEDs on TMCM-6211 Interface Brick

TMCM-6211: Interface Brick LEDs	
LED	Description
EtherCAT LINK IN	Signal LINK IN, connected to ESC
EtherCA LINK OUT	Signal LINK OUT, connected to ESC
EtherCAT RUN	Indicating status of EtherCAT state machine, connected to ESC
ERROR	Connected to microcontroller and ESC – indicating Error
LED (green)	Connected to microcontroller – flashing slowly during normal operation

Table 22: TMCM-6211 Interface Brick LEDs



## 7. Reset to Factory Default

Sometimes it is necessary to reset factory default settings, which is explained below.

### Reset Configuration

**In order to reset configuration to factory default, do as follows:**

**Action:**

- 1. Switch OFF power supply.
- 2. Short two pads of programming connector pad-array that are marked in red in the Figure below.
- 3. Switch ON power supply  
(On-board LED should be flashing fast / faster than during normal operation).
- 4. Switch OFF power supply.
- 5. Remove short circuit.

**Result:**

Now, the factory default setting is reset.

### Bottom View of PCB Interface Brick End

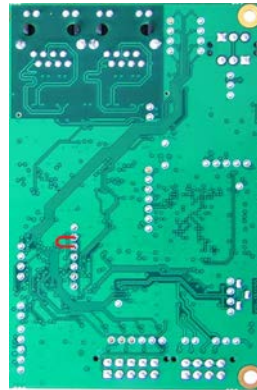


Figure 24: Reset to Factory Defaults



## 8. Operational Ratings

The operational ratings show the intended or the characteristic ranges and should be used as design values.

**NOTE:**

→ Maximum values must NOT be exceeded. In no case!

General Operational Ratings of Module					
Symbol	Parameter	Min	Type	Max	Unit
+24V	Power supply voltage input	10	24	27	V
+24V_LOGIC	Power supply voltage for on-board digital / logic (if supplied separately)	Same as +24V supply input			V
I <sub>PEAK</sub>	Motor coil current for sine wave <b>peak</b> (chopper regulated, adjustable via software)			1	A
I <sub>RMS</sub>	Continuous motor current ( <b>RMS</b> )			0.7	A
I <sub>+24V</sub>	Power supply current for driver		<< 6 x I <sub>RMS</sub>		A
T <sub>ENV</sub>	Environmental temperature at 6x 0.7A RMS motor current (no forced cooling)	-30 <sup>*)</sup>		+40 <sup>**)</sup>	°C

Table 23: General Operational Ratings of Module

\*) Limited by test equipment. Operation down to -40°C can be expected. Test included "cold" start at this temperature.

\*\*\*) Test setup/Test procedure: module is placed inside climate chamber (Binder MK53) with approx. 53l volume. Motor is placed outside chamber moving slowly with motor current set to maximum; supported by module (6x 0.A RMS). Test duration: 24h. Communication tested at beginning and end of test.



Operational Ratings of I/Os					
Symbol	Parameter	Min	Type	Max	Unit
V <sub>REFL/R_HOME</sub>	Input voltage for stop / home switch inputs REFL / REFR and HOME	0		5.5	V
V <sub>REFL/R_HOME_L</sub>	Low level voltage for stop / home switch inputs REFL / REFR and HOME	0		1.1	V
V <sub>REFL/R_HOME_H</sub>	High level voltage for stop / home switch inputs REFL / REFR and HOME	3.3			V
V <sub>OUT0...3</sub>	Voltage at open collector output OUT0...OUT3	0		Same as +24V supply input	V
I <sub>OUT0...3</sub>	Output sink current for OUT0...OUT3			1*)	A
V <sub>AIN0...3</sub>	Full scale input voltage range for analog inputs AIN0...AIN3	0		10**)	V

Table 24: Operational Ratings of I/Os

\*) Please note: when using the +24V available at the output connector max. current is limited to 500mA for all outputs together due to on-board fuse (polyfuse)

\*\*\*) Nominal upper input voltage which can be measured without saturation of the ADC. Max. voltage at max. ADC value will be around 10.56V.

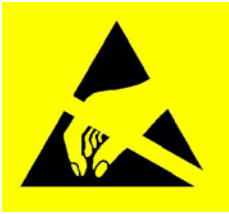




## APPENDICES

### 9. SUPPLEMENTAL DIRECTIVES

#### ESD-DEVICE INSTRUCTIONS



**This product is an ESD-sensitive CMOS device. It is sensitive to electrostatic discharge.**

- **Provide effective grounding to protect personnel and machines.**
- **Ensure work is performed in a non-static environment.**
- **Use personal ESD control footwear and ESD wrist straps, if necessary.**

**Failure to do so can result in defects, damages and decreased reliability.**

#### Producer Information

The producer of the products TMCM-6210 and TMCM-6211 is TRINAMIC GmbH & Co. KG in Hamburg, Germany; hereafter referred to as TRINAMIC. TRINAMIC is the supplier; and in this function provides the product and the production documentation to its customers.

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The documentation provided here, is for programmers and engineers only, who are equipped with the necessary skills and have been trained to work with this type of product.

The **Target User** knows how to responsibly make use of this product without causing harm to himself or others, and without causing damage to systems or devices, in which the user incorporates the product.



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## Product Documentation Details

This **Hardware User Manual** contains the **User Information** for the **Target User**.

The **Short Spec** forms the preface of the document and is aimed at providing a general product overview. The **Main Manual** provides detailed instructions.

## Collateral Documents & Tools

This product documentation is related and/or associated with additional tool kits, firmware and other items, as provided on the product page at: [www.trinamic.com](http://www.trinamic.com).



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## 10. REVISION HISTORY

### 10.1. Document Revision

Document Revision			
Version	Date	Author	Description
0.90	2015-DEC-17	GE	Initial version.
0.91	2016-MAR-14	GE	<ul style="list-style-type: none"> <li>• Cable loom added.</li> <li>• Order Codes Connector corrected + updated.</li> <li>• Block diagram added.</li> <li>• Remarks regarding RS485 and CAN added.</li> </ul>
0.92	2016-MAR-16	GE	<ul style="list-style-type: none"> <li>• Description for on-board LEDs added.</li> <li>• Description for factory default reset added.</li> <li>• RJ45-2-D-SUB adapter description added.</li> <li>• Minor corrections.</li> </ul>
0.93	2016-APR-20	GE	Supply output on Output and Input connectors renamed (+24V_FUSE)
0.94	2016-MAY-17	GE	<ul style="list-style-type: none"> <li>• Chapter <a href="#">4.7.3</a> – General Purpose Outputs OUT0..3 added</li> <li>• Pin assignment of Control connector in Table <a href="#">9</a> corrected.</li> </ul>
1.00	2016-MAY-27	GE/SV	<ul style="list-style-type: none"> <li>• Major layout adaptations.</li> <li>• Integration of ANSI-compliant safety notices.</li> </ul>

Table 25: Revision History: Document Revision

### 10.2. Hardware Revision

Hardware Revision		
Version	Date	Description
TMCM-6210_V09	2015-JAN-22	Initial version.
TMCM-6210_V10	2015-APR-27	Major redesign (incl. processor change).
TMCM-6210_V11	2015-OCT-26	<ul style="list-style-type: none"> <li>• Diff. encoder line-receiver will be disabled when REF switch inputs are enabled (circuit corrected).</li> <li>• 100nF input filter capacitors for HOME + REF switch inputs.</li> </ul>
TMCM-6211_V11	2015-OCT-26	Version with EtherCAT derived from TMCM-6210_V11.

Table 26: Revision History: Hardware Revision

### 10.3. References

[MOLEX]	MOLEX connector <a href="http://www.molex.com">http://www.molex.com</a>
[TMC262]	TMC262 datasheet Manual available on <a href="http://www.trinamic.com">http://www.trinamic.com</a> .
[TMC4361]	TMC4361 datasheet Manual available on <a href="http://www.trinamic.com">http://www.trinamic.com</a> .
[TMCL-IDE]	TMCL-IDE User Manual Manual available on <a href="http://www.trinamic.com">http://www.trinamic.com</a>

