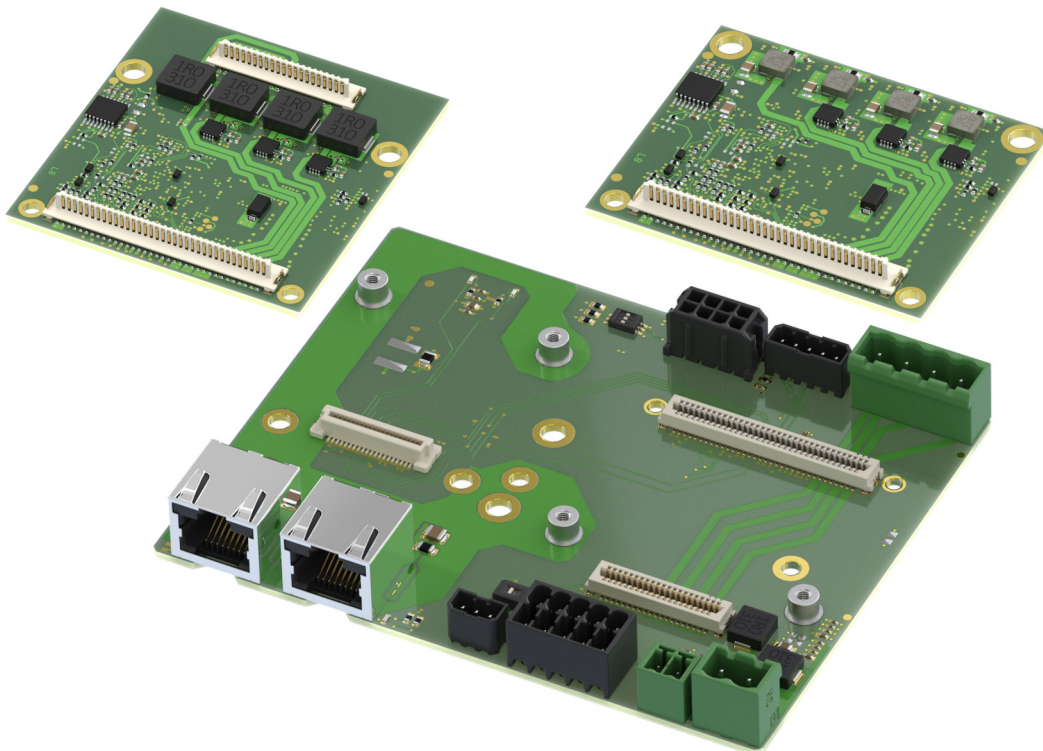


# Technical Manual

MC 3602 B

MC 3606 B



## Imprint

---

Version:  
1st edition, 16.10.2024

Copyright  
by Dr. Fritz Faulhaber GmbH & Co. KG  
Faulhaberstraße 1 · 71101 Schönaich

All rights reserved, including those to the translation.  
No part of this description may be duplicated, reproduced,  
stored in an information system or processed or  
transferred in any other form without prior express written  
permission of Dr. Fritz Faulhaber GmbH & Co. KG.

This document has been prepared with care.  
Dr. Fritz Faulhaber GmbH & Co. KG cannot accept any  
liability for any errors in this document or for the  
consequences of such errors. Equally, no liability can be  
accepted for direct or consequential damages resulting  
from improper use of the equipment.

The relevant regulations regarding safety engineering  
and interference suppression as well as the requirements  
specified in this document are to be noted and followed  
when using the software.

Subject to change without notice.

The respective current version of this technical manual is  
available on FAULHABER's internet site:  
[www.faulhaber.com](http://www.faulhaber.com)

# Content

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>About this document</b>                                    | <b>5</b>  |
| 1.1      | Validity of this document                                     | 5         |
| 1.2      | Associated documents  | 5         |
| 1.3      | Using this document   | 5         |
| 1.4      | List of abbreviations   | 6         |
| 1.5      | Symbols and designations                                      | 7         |
| <b>2</b> | <b>Safety</b>   | <b>8</b>  |
| 2.1      | Intended use  | 8         |
| 2.2      | Safety instructions   | 9         |
| 2.2.1    | Dangers in the event of damages and changes                   | 9         |
| 2.2.2    | Correct installation and commissioning                        | 9         |
| 2.2.3    | Heat development  | 10        |
| 2.3      | Environmental conditions                                      | 10        |
| 2.4      | EC directives on product safety                               | 11        |
| <b>3</b> | <b>Product description</b>                                    | <b>12</b> |
| 3.1      | General product description                                   | 12        |
| 3.2      | Product information   | 13        |
| 3.3      | Product variants  | 13        |
| 3.3.1    | Controller PCBs   | 14        |
| 3.3.1.1  | MC 3602 B   | 14        |
| 3.3.1.2  | MC 3606 B   | 16        |
| 3.3.2    | Evaluation board  | 18        |
| <b>4</b> | <b>Installation</b>   | <b>20</b> |
| 4.1      | Mounting  | 20        |
| 4.1.1    | Mounting instructions   | 20        |
| 4.1.2    | Installing the Motion Controller PCBs on the evaluation board | 21        |
| 4.2      | Electrical connection   | 22        |
| 4.2.1    | Notes on the electrical connection                            | 22        |
| 4.2.2    | Drive connections   | 23        |
| 4.2.3    | Connection of the power supply                                | 24        |
| 4.2.3.1  | Voltage supply  | 24        |
| 4.2.4    | Connector pin assignment                                      | 25        |
| 4.2.4.1  | Pin assignment of B2B connector (X100)                        | 25        |
| 4.2.4.2  | Pin assignment of B2B connector (X101)                        | 29        |
| 4.2.4.3  | Pin assignment of the evaluation board (motor side)           | 31        |
| 4.2.4.4  | Pin assignment of the evaluation board (supply side)          | 35        |
| 4.2.5    | Evaluation board: Connection at the motor side                | 38        |
| 4.2.6    | I/O circuit diagrams  | 42        |
| 4.2.7    | External circuit diagrams                                     | 44        |
| 4.3      | Electromagnetic compatibility (EMC)                           | 48        |
| 4.3.1    | Considered systems  | 48        |
| 4.3.2    | Functional earthing   | 50        |
| 4.3.3    | Cable routing   | 51        |
| 4.3.4    | Shielding   | 52        |
| 4.3.4.1  | Establishing the shield connection                            | 53        |
| 4.3.4.2  | Establishing shield connection with cable lug                 | 54        |

# Content

---

|          |   |           |
|----------|---|-----------|
| 4.3.5    | Sensor and encoder interfaces .....                                 | 55        |
| 4.3.5.1  | Analog sensors and analog Hall sensors .....                        | 56        |
| 4.3.5.2  | Incremental encoders / Digital Hall sensors / Digital sensors ..... | 56        |
| 4.3.5.3  | Encoders with absolute interface .....                              | 56        |
| 4.3.6    | Using filters .....   | 57        |
| 4.3.6.1  | PWM filter (motor-side) .....                                       | 57        |
| 4.3.6.2  | Emission-reducing, ferrite-based filters (motor side) .....         | 57        |
| 4.3.6.3  | Input-side filters.....   | 58        |
| 4.3.6.4  | Insulation resistance .....   | 58        |
| 4.3.6.5  | Coiling ferrite ring .....  | 58        |
| 4.3.7    | Error avoidance and troubleshooting .....                           | 59        |
| <b>5</b> | <b>Maintenance and diagnostics .....</b>                            | <b>61</b> |
| 5.1      | Maintenance tasks .....   | 61        |
| 5.2      | Diagnosis .....   | 61        |
| 5.3      | Troubleshooting .....   | 62        |
| <b>6</b> | <b>Accessories .....</b>  | <b>63</b> |
| <b>7</b> | <b>Warranty .....</b>   | <b>64</b> |
| <b>8</b> | <b>Additional documents .....</b>                                   | <b>65</b> |
| 8.1      | Declaration of Conformity .....                                     | 65        |
| 8.2      | Declaration of Incorporation .....                                  | 68        |

## About this document

# 1 About this document

## 1.1 Validity of this document

This document describes the installation and use of the MC 360x B series.

This document is intended for use by trained experts authorized to perform installation and electrical connection of the product.

All data in this document relate to the standard versions of the series listed above. Changes relating to customer-specific versions can be found in the corresponding data sheet.

## 1.2 Associated documents

For certain actions during commissioning and operation of FAULHABER products additional information from the following manuals is useful:

| Manual             | Description  |
|--------------------|--|
| Motion Manager 7   | Operating instructions for FAULHABER Motion Manager PC software                                |
| Quick start guide  | Description of the first steps for commissioning and operation of FAULHABER Motion Controllers |
| Drive functions    | Description of the operating modes and functions of the drive                                  |
| Accessories manual | Description of the accessories   |
| EtherCAT module    | Instructions for installation and use of the FAULHABER EtherCAT module.                        |

These manuals can be downloaded in pdf format from the web page [www.faulhaber.com](http://www.faulhaber.com).

## 1.3 Using this document

- ▶ Read the document carefully before undertaking configuration, in particular chapter "Safety".
- ▶ Retain the document throughout the entire working life of the product.
- ▶ Keep the document accessible to the operating and, if necessary, maintenance personnel at all times.
- ▶ Pass the document on to any subsequent owner or user of the product.

## About this document

### 1.4 List of abbreviations

| Abbreviation             | Meaning   |
|--------------------------|---|
| AC                       | Alternating Current                                   |
| AES                      | Absolute encoder                                      |
| AGND                     | Analog Ground   |
| AnIn                     | Analog input  |
| CAN                      | Controller Area Network                               |
| CAN_L                    | CAN-Low   |
| CAN_H                    | CAN-High  |
| CLK                      | Clock   |
| $\overline{\text{CLK}}$  | Clock with logically inverted signal                  |
| CS                       | Chip Select   |
| $\overline{\text{CS}}$   | Chip Select   |
| Data                     | Data cable  |
| $\overline{\text{Data}}$ | Data cable with logically inverted signal             |
| DigIn                    | Digital input   |
| DigOut                   | Digital output  |
| DIP                      | Dual In-Line Package                                  |
| EFC                      | Electronics Filter Conformity                         |
| EFM                      | Electronics Filter Motor                              |
| EFS                      | Electronics Filter Supply                             |
| EMC                      | Electromagnetic compatibility                         |
| ESD                      | Electrostatic discharge                               |
| ET                       | EtherCAT (Ethernet for Control Automation Technology) |
| GND                      | Ground  |
| I/O                      | Input/Output  |
| IRQ                      | Interrupt Request                                     |
| LA                       | Link LED EtherCAT                                     |
| MC                       | Motion Controller                                     |
| MISO                     | Master In Slave Out                                   |
| MOSI                     | Master Out Slave In                                   |
| Mot                      | Motor   |
| n.c.                     | not connected   |
| PWM                      | Pulse Width Modulation                                |
| RxD                      | Receive Data  |
| SGND                     | Signal ground   |
| SPI                      | Serial Peripheral Interface                           |
| TxD                      | Transmit data   |
| U <sub>DD</sub>          | Power supply  |

## About this document

---

### 1.5 Symbols and designations

 **DANGER!**

Danger with high level of risk: if not avoided, death or serious injury will result.

- ▶ Measures for avoidance

 **WARNING!**

Danger with medium level of risk: if not avoided, death or serious injury may result.

- ▶ Measures for avoidance

 **CAUTION!**


Danger with low level of risk: if not avoided, minor or moderate injury may result.

- ▶ Measures for avoidance

**NOTICE!**


Risk of damage.

- ▶ Measures for avoidance


 Instructions for understanding or optimizing the operational procedures

- ✓ Pre-requirement for a requested action

1. First step for a requested action

-  Result of a step

2. Second step of a requested action

-  Result of an action

- ▶ Request for a single-step action

## 2 Safety

### 2.1 Intended use

The Motion Controllers described here are designed to be devices controlled by a higher-level master and to be used for control and positioning tasks for the following motors:

- DC-Micromotors
- Linear DC-Servomotors
- Brushless DC-motors
- Stepper motors

The Motion Controller is suitable in particular for tasks in the following fields of application:

- Robotics
- Toolbuilding
- Automation technology
- Industrial equipment and special machine building
- Medical technology
- Laboratory technology

When using the Motion Controllers the following aspects should be observed:

- The Motion Controller contains electronic components and should be handled in accordance with the ESD regulations.
- Do **not** use the Motion Controller in environments where it will come into contact with water, chemicals and/or dust, **nor** in explosion hazard areas.
- The Motion Controller should be operated only within the limits specified in the data sheet.
- Please ask the manufacturer for information about use under individual special environmental conditions.



## 2.2 Safety instructions

In addition to the safety risks described in this technical manual, machine-specific dangers could arise that cannot be foreseen by the manufacturer of the Motion Controller (e.g., risk of injury from driven components). The manufacturer of the machine in which the Motion Controller is installed must perform a risk analysis in accordance with the regulations applicable to the machine and inform the end user of the residual risks.

### 2.2.1 Dangers in the event of damages and changes

Damage to the Motion Controller can impair its functions. A damaged Motion Controller can unexpectedly start, stop or jam. This can result in damage to other components and materials.

- ▶ Do **not** start up a drive system with a defective or damaged Motion Controller.
- ▶ Appropriately mark a defective or damaged Motion Controller.
- ▶ Do **not** replace defective or damaged components of the Motion Controller.
- ▶ Make no changes (modifications, repairs) to the Motion Controller.
- ▶ Have loose or defective connections immediately replaced by an electrician.
- ▶ After replacing a defective or damaged Motion Controller, test and document the correct function.

### 2.2.2 Correct installation and commissioning

Errors during the installation and commissioning of the Motion Controller could impair its function. An incorrectly installed Motion Controller can unexpectedly start, stop or jam. This can result in damage to other components and materials.

- ▶ Follow the instructions for installation and commissioning given in these installation instructions exactly.
- ▶ Only have work on electrical operating equipment performed by an electrician.
- ▶ During all work on the electrical equipment, observe the 5 safety rules:
  - a) Disconnect from power
  - b) Secure against being switched on again
  - c) Check that no voltage is present
  - d) Ground and short-circuit
  - e) Cover or block-off adjacent parts that are under voltage

**Electrostatic discharges can damage the electronics.**

- ▶ Store and transport the Motion Controller in suitable ESD packaging.
- ▶ Handle the Motion Controller in compliance with the ESD handling regulations (e.g. wear an ESD wristband, ground surrounding components).
- ▶ During installation, ensure that components in the surroundings cannot be electrostatically discharged.

**Soiling, foreign bodies, humidity and mechanical influences can damage the electronics.**

- ▶ Keep foreign objects away from the electronics.

## Safety

- ▶ Install the Motion Controller in a housing that protects it from mechanical influences and is adapted to the ambient conditions (protection class determination).

**Installation and connection work whilst supply voltage is applied at the device can damage the electronics.**

- ▶ Do **not** insert or withdraw connectors whilst supply voltage is applied at the Motion Controller.
- ▶ During all aspects of installation and connection work on the Motion Controller, switch off the power supply.

**Incorrect connection of the pins can damage the electronic components.**

- ▶ Connect the wires as shown in the connection assignment.

### 2.2.3 Heat development

Active components may cause the Motion Controller to heat up. If touched, there is a risk of burning.

- ▶ Protect the Motion Controller against being touched and cool sufficiently.
- ▶ If necessary, affix a suitable warning sign in the immediate vicinity of the controller.



Fig. 1: Suitable warning sign acc. to DIN EN ISO 7010

## 2.3 Environmental conditions

- ▶ Select the installation location so that clean dry air is available for cooling the Motion Controller.
- ▶ Select the installation location so that the air has unobstructed access to flow around the drive.
- ▶ When installed within housings and cabinets take particular care to ensure adequate cooling of the Motion Controller.
- ▶ Select a power supply that is within the defined tolerance range.
- ▶ Protect the Motion Controller against heavy deposits of dust, in particular metal dust and chemical pollutants.
- ▶ Protect the Motion Controller against humidity and wet.

### 2.4 EC directives on product safety

- ▶ The following EC directives on product safety must be observed.
- ▶ If the Motion Controller is being used outside the EU, international, national and regional directives must be also observed.

#### **Machinery Directive (2006/42/EC)**

The controllers with attached motor described in this technical manual may be drive systems according to the Machinery Directive. They are therefore to be considered incomplete machines according to the Machinery Directive. Compliance is documented by the Declaration of Incorporation for the product and by the EC Declaration of the Conformity.

#### **EMC Directive (2014/30/EU)**

The directive concerning electromagnetic compatibility (EMC) applies to all electrical and electronic devices, installations and systems sold to an end user. In addition, CE marking can be undertaken for built-in components according to the EMC Directive. Conformity with the directive is documented in the Declaration of Conformity.

#### **Applied standards**

Various harmonized standards were applied to the products described in this technical manual; these standards are documented in the EC Declaration of Conformity. You can find the Declaration of Incorporation for the product and the EC Declaration of Conformity in chap. 8, p. 65.

#### **WEEE Directive (2012/19/EU)**

The directive on the disposal of electrical and electronic devices prescribes the separate collection of old electrical and electronic devices. The products described in this technical manual fall within the scope of this directive.

### 3 Product description

#### 3.1 General product description

The MC 3602 B and MC 3606 B products are unboxed versions of the FAULHABER Motion Controllers and control either DC, LM, BL or stepper motors. The Motion Controllers are configured here via the FAULHABER Motion Manager software V7.


The drives can be operated in the network via the CANopen or EtherCAT fieldbus interface (EtherCAT in combination with EtherCAT module only). In smaller setups, networking can also be performed via the RS232 interface. The Motion Controller operates in the network in principle as a subordinate device; master functionality for actuating other axes is not provided. After basic commissioning via Motion Manager, the controllers can alternatively also be operated without communication interface.


The controllers can be mounted on a base board via B2B plug connectors. For this reason, FAULHABER offers an evaluation board for connecting an MC 3602 B or an MC 3606 B controller. However, for the customer's application, a customer base board must be created.

With the integrated output stage with optimized current measurement, DC, BL, LM and stepper motors from the FAULHABER product line from 08 to 32 mm can be controlled.

On the B2B plug connector, the following connections are available:

- Communications interfaces
- Common or separate power supplies between motor and controller
- Various inputs and outputs
- Motor phases
- Feedback components such as:
  - Digital/analog Hall sensors
  - Incremental encoders with or without line drivers.

 Not all options of the BiSS-C interface are supported by FAULHABER Motion Controllers of the V3.0 series. Before using encoders from other manufacturers, clarify the compatibility with FAULHABER Support.

 Motion Controllers with RS232, CANopen or EtherCAT interface can also be operated independently of the communications interface if a pre-programmed function or sequence program has been programmed without digital command controls.

## Product description

### 3.2 Product information

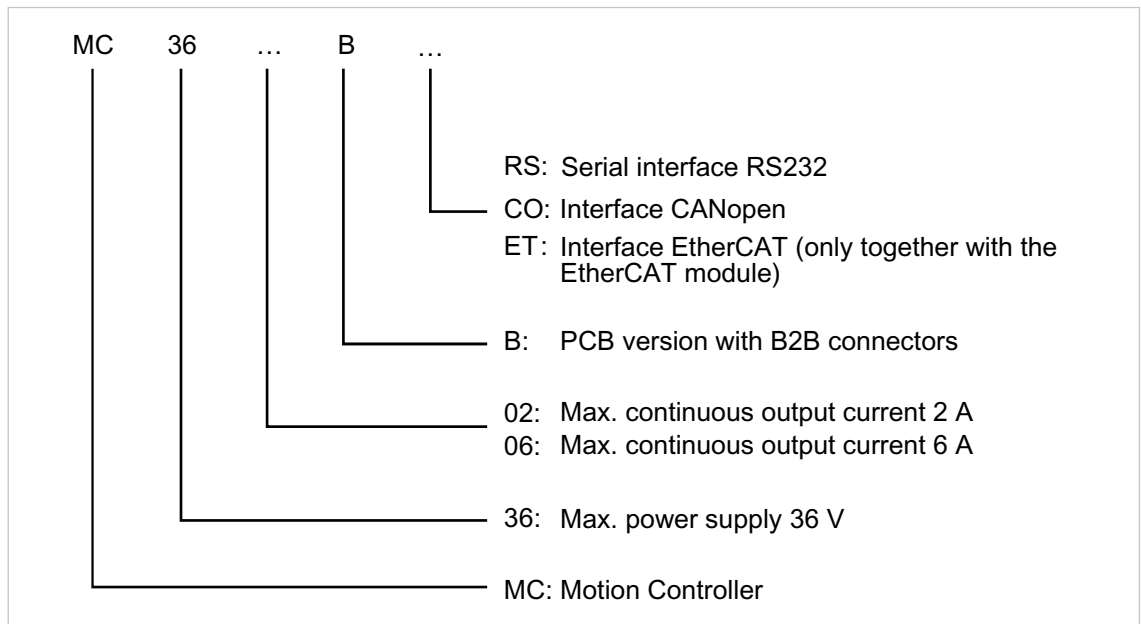


Fig. 2: Designation key

### 3.3 Product variants

The following product variants are possible:

- MC3602 B RS/CO
- MC3602 B ET
- MC3606 B RS/CO
- MC3606 B ET

The Motion Controller PCBs must be mounted on a base board. The FAULHABER evaluation board offers space for a Motion Controller PCB. For the customer's application, a customer base board must be created.

The EtherCAT variants (ET) can only be used with an additional EtherCAT module (see separate manual).

## Product description

### 3.3.1 Controller PCBs

#### 3.3.1.1 MC 3602 B

##### Connector and LED

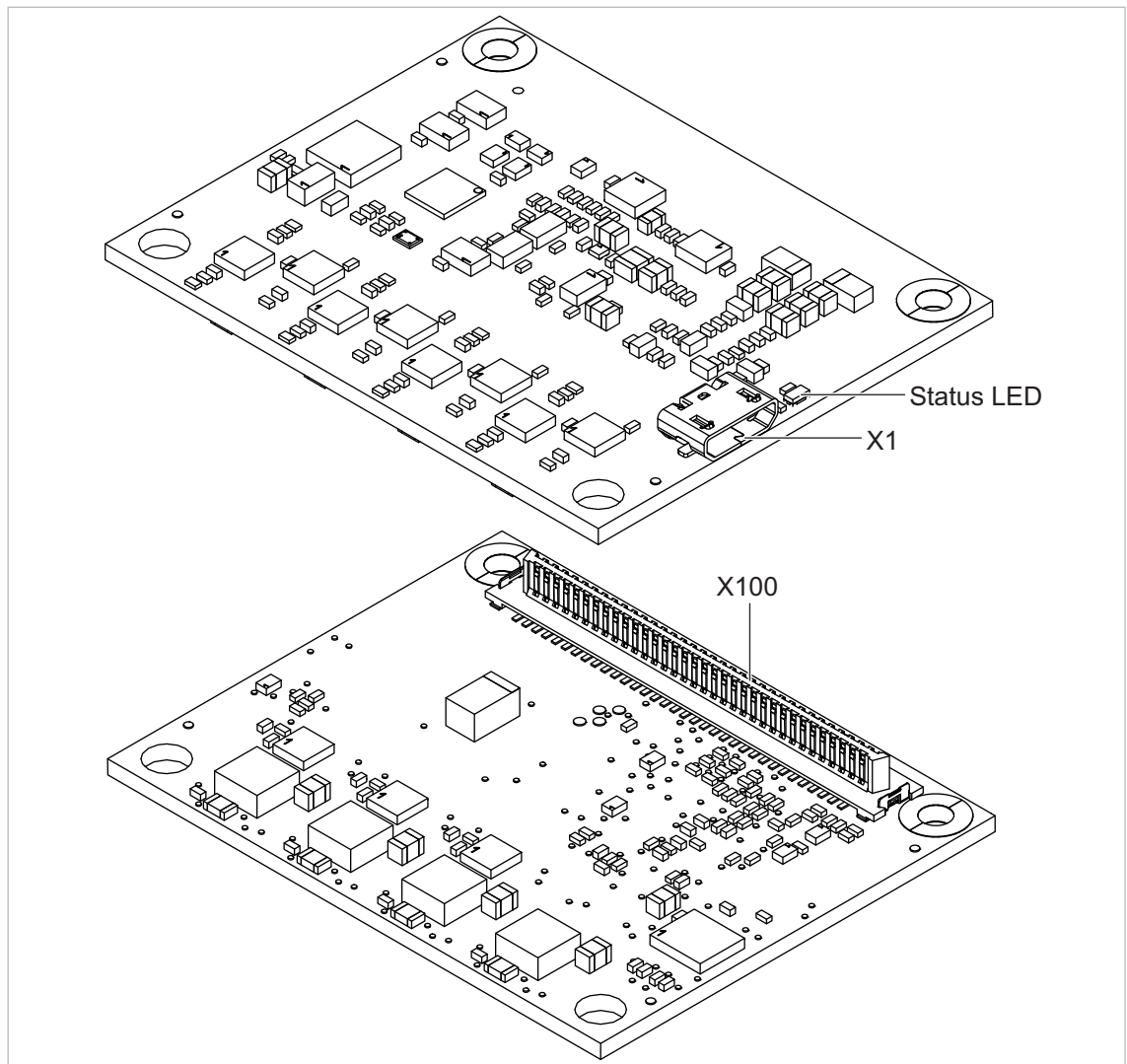


Fig. 3: Connector and LED overview for MC 3602 B

Tab. 1: Connector overview

| Designation | Function                             |
|-------------|--------------------------------------|
| USB (X1)    | Connection of the USB communication  |
| B2B (X100)  | Connection of all controller signals |

Tab. 2: LED functions

| Designation | Function   |
|-------------|--|
| State LED   | <ul style="list-style-type: none"> <li>Green (continuous light): Device active.</li> <li>Green (flashing): Device active. However the state machine has not yet reached the <i>Operation Enabled</i> state.</li> <li>Red (continuously flashing): The drive has switched to a fault state. The output stage will be switched off or has already been switched off.</li> <li>Red (error code): Booting has failed. Please contact FAULHABER Support.</li> </ul> |

# Product description

## Dimensions

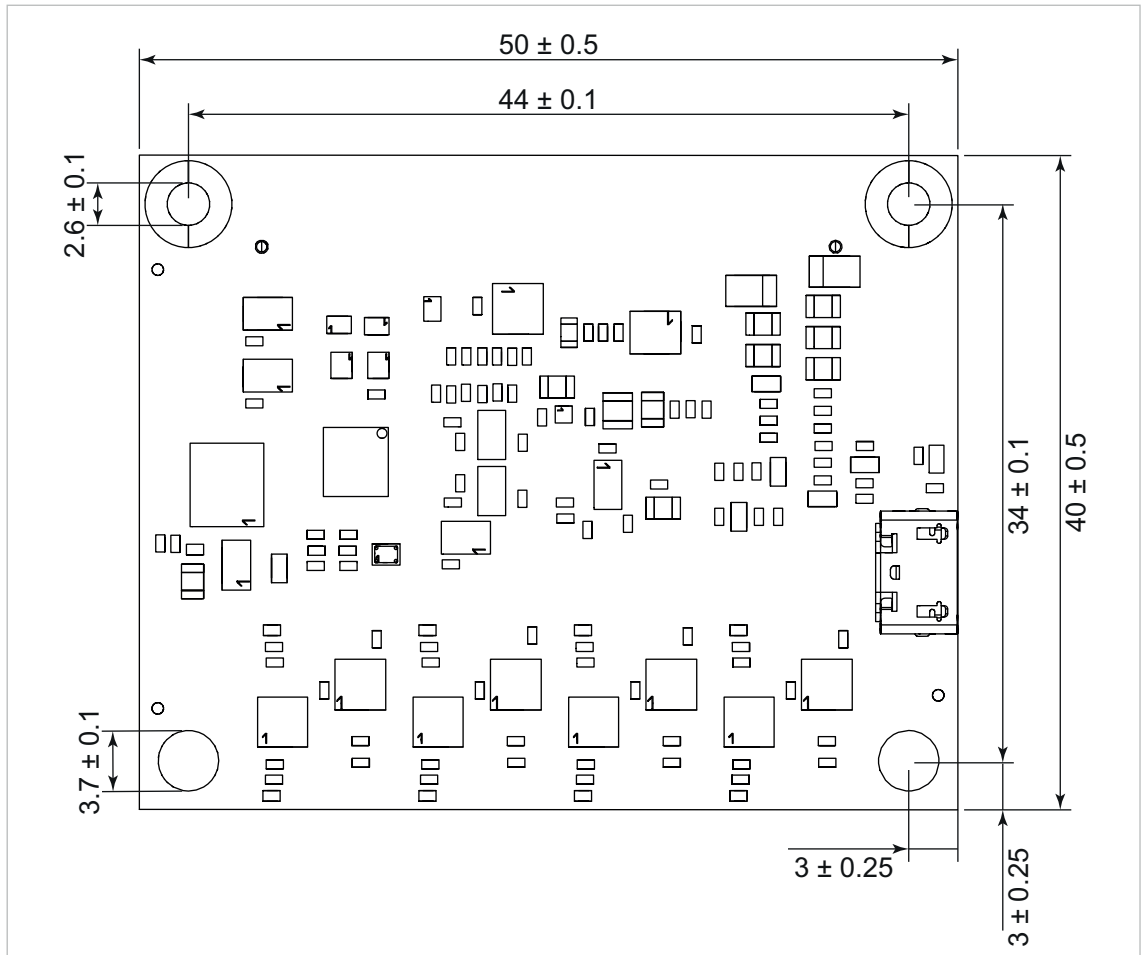


Fig. 4: Dimensions of MC 3602 B

## Product description

### 3.3.1.2 MC 3606 B Connector and LED

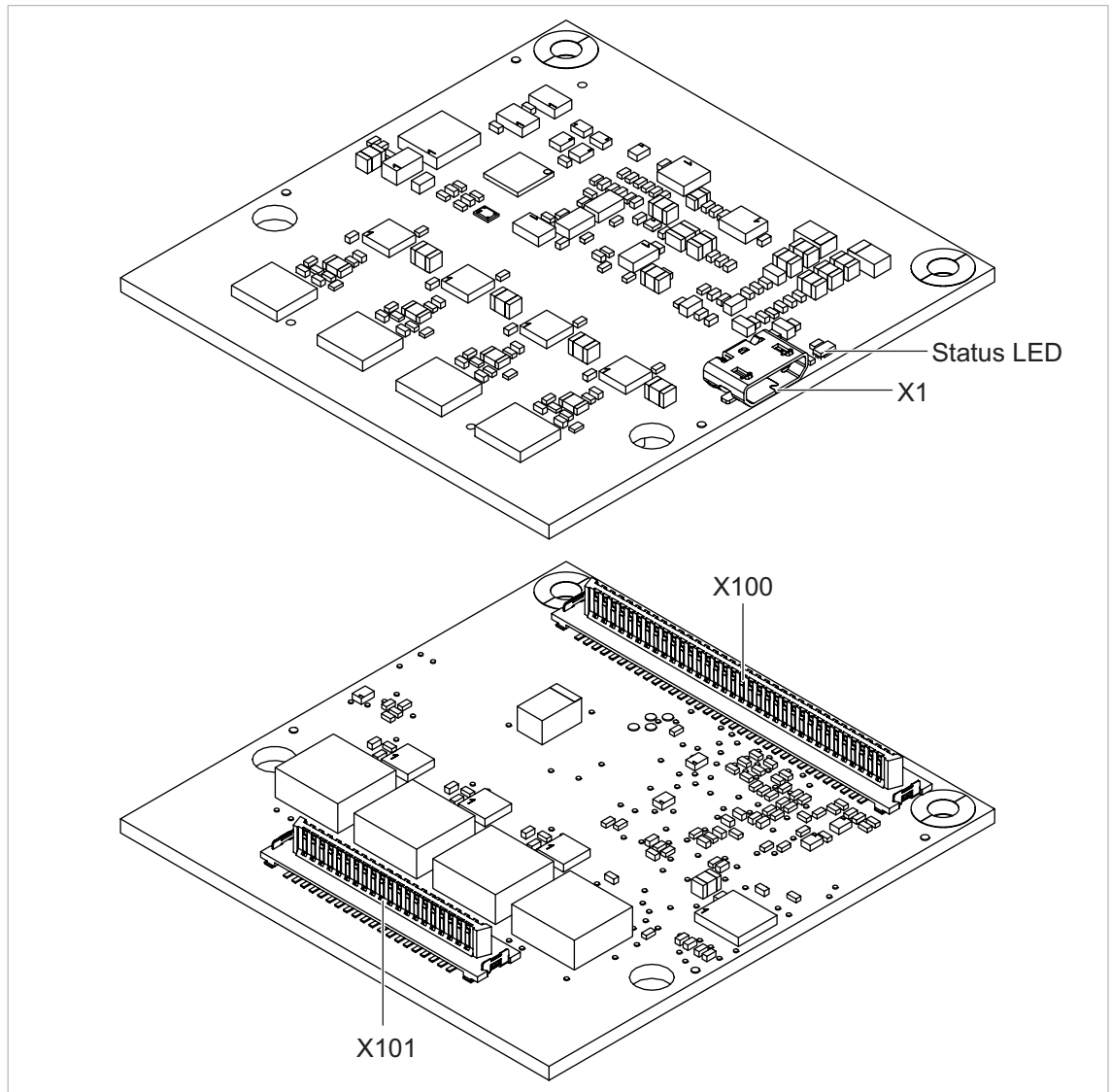


Fig. 5: Connector and LED overview for MC 3606 B

Tab. 3: Connector overview

| Designation | Function                             |
|-------------|--------------------------------------|
| USB (X1)    | Connection of the USB communication  |
| B2B (X100)  | Connection of all controller signals |
| B2B (X101)  | Additional power connection          |

Tab. 4: LED functions

| Designation | Function   |
|-------------|--|
| State LED   | <ul style="list-style-type: none"> <li>Green (continuous light): Device active.</li> <li>Green (flashing): Device active. However the state machine has not yet reached the <i>Operation Enabled</i> state.</li> <li>Red (continuously flashing): The drive has switched to a fault state. The output stage will be switched off or has already been switched off.</li> <li>Red (error code): Booting has failed. Please contact FAULHABER Support.</li> </ul> |



# Product description

## Dimensions

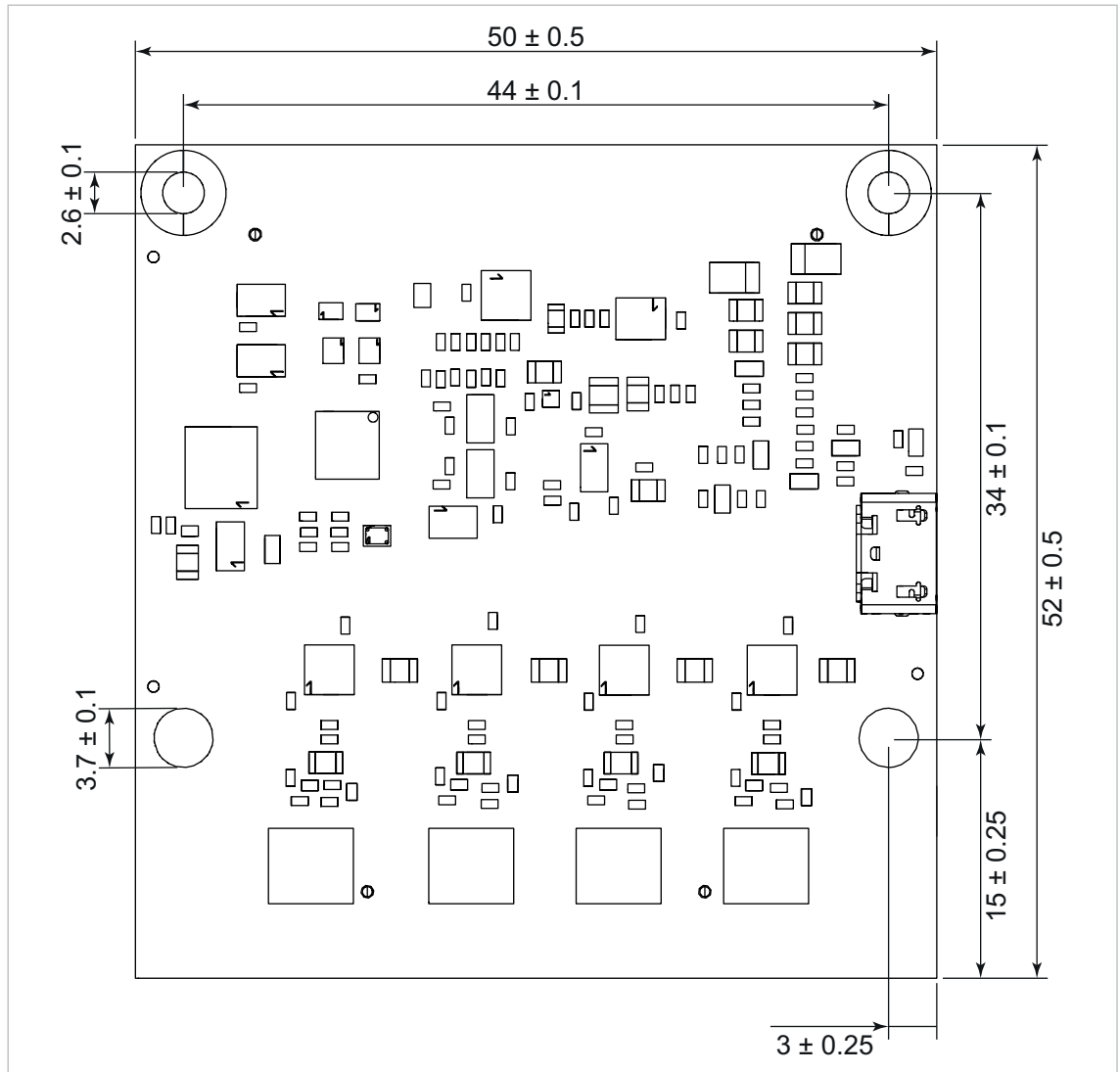


Fig. 6: Dimensions of MC 3606 B

## Product description

### 3.3.2 Evaluation board

#### Connectors

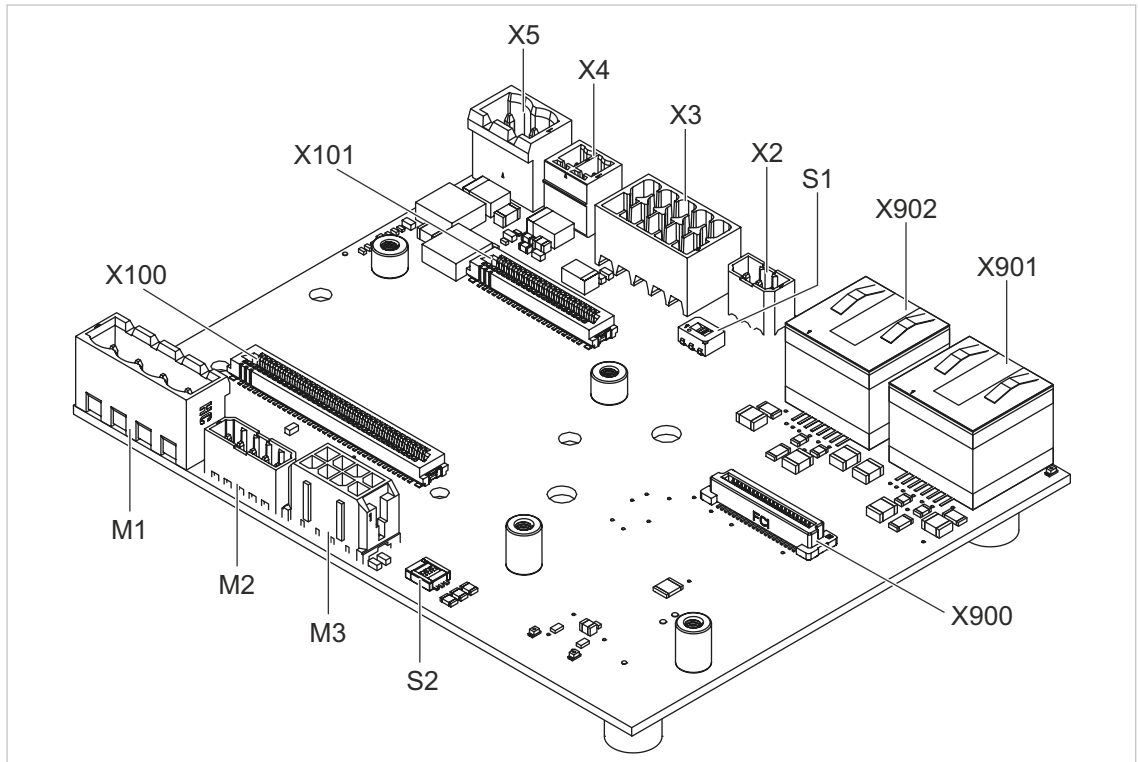


Fig. 7: Connector overview of the evaluation board

Tab. 5: Connector overview of the evaluation board

| Designation                               | Function   |
|---|--|
| M1 (motor)                                | Connection of the motor phases   |
| M2 (sensor)                               | Connection of the Hall sensors   |
| M3 (encoder)                              | Connection of an incremental encoder with or without line driver.<br>Alternatively an absolute encoder can be connected with or without line driver.                 |
| S2 (DIP switch encoder termination)       | Encoder termination resistor (On/Off): <ul style="list-style-type: none"> <li>On: Termination resistor active</li> <li>Off: Termination resistor inactive</li> </ul> |
| X900 (EB ET ADDON)                        | Connection of the EtherCAT module for an EtherCAT application  |
| X901 (EtherCAT OUT)<br>X902 (EtherCAT IN) | Connection of the EtherCAT communication   |
| S1 (DIP switch RS232/CAN)                 | RS232 or CAN communication active: <ul style="list-style-type: none"> <li>RS232: RS232 active</li> <li>CAN: CAN active</li> </ul>                                    |
| X2 (COM)                                  | RS232/CAN interface connection   |
| X3 (I/O)                                  | Inputs or outputs for external circuits  |
| X4 ( $U_p$ )                              | Voltage supply of the controller   |
| X5 ( $U_{mot}$ )                          | Voltage supply of the motor  |
| B2B (X101)                                | Additional power connection (MC 3606 B)  |
| B2B (X100)                                | Connection of all controller signals   |

# Product description

## Dimensions

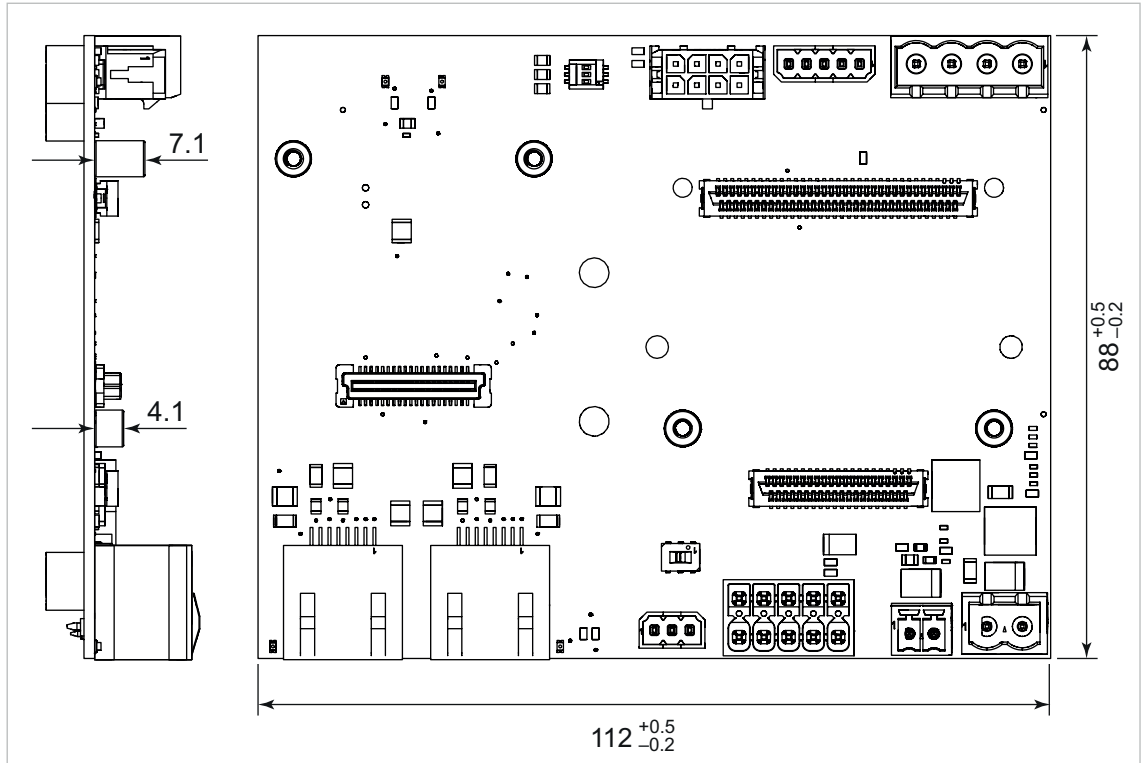


Fig. 8: Dimensions of the evaluation board

## 4 Installation

Only trained experts and instructed persons with knowledge of the following fields may install and commission the Motion Controller:

- Automation technology
- Standards and regulations (such as the EMC Directive)
- Low Voltage Directive
- Machinery Directive
- VDE regulations (DIN VDE 0100)
- Accident prevention regulations

This description must be carefully read and observed before commissioning.

Also comply with the supplementary instructions for installation (see chap. 2.3, p. 10).

### 4.1 Mounting

#### 4.1.1 Mounting instructions

##### CAUTION!

The Motion Controller can become very hot during operation.

- ▶ Place a guard against contact and warning notice in the immediate proximity of the controller (see chap. 2.2.3, p. 10).

##### DANGER!

Incorrect handling and installation can cause the Motion Controller to perform uncontrolled movements.

A damaged Motion Controller can unexpectedly start, stop or jam. Depending on the use of the Motion Controller, this can lead to severe or fatal injury.

- ▶ Observe the safety information in the chap. 2.2.1, p. 9.
- ▶ Use suitable fastening material (see the following chapter).

##### Visual inspection

- ▶ After unpacking the Motion Controller, perform and document a visual inspection:
  - Motion Controller is undamaged?
  - Sticker with serial number is present?
  - Pin contacts in the connectors are OK (not oxidized, not bent)?

## Installation

**⚠ DANGER!**

The function of the Motion Controller is not ensured if the visual inspection criteria are not satisfied.

If the function is not ensured, the drive may start unexpectedly. Depending on the use of the Motion Controller, this can lead to severe or fatal injury.

- ▶ Do not start up the Motion Controller.

**⚠ DANGER!**

During operation, the drive system produces mechanical forces and movements.

- ▶ Protect the drive system and components driven by the drive system from being touched.

### 4.1.2 Installing the Motion Controller PCBs on the evaluation board

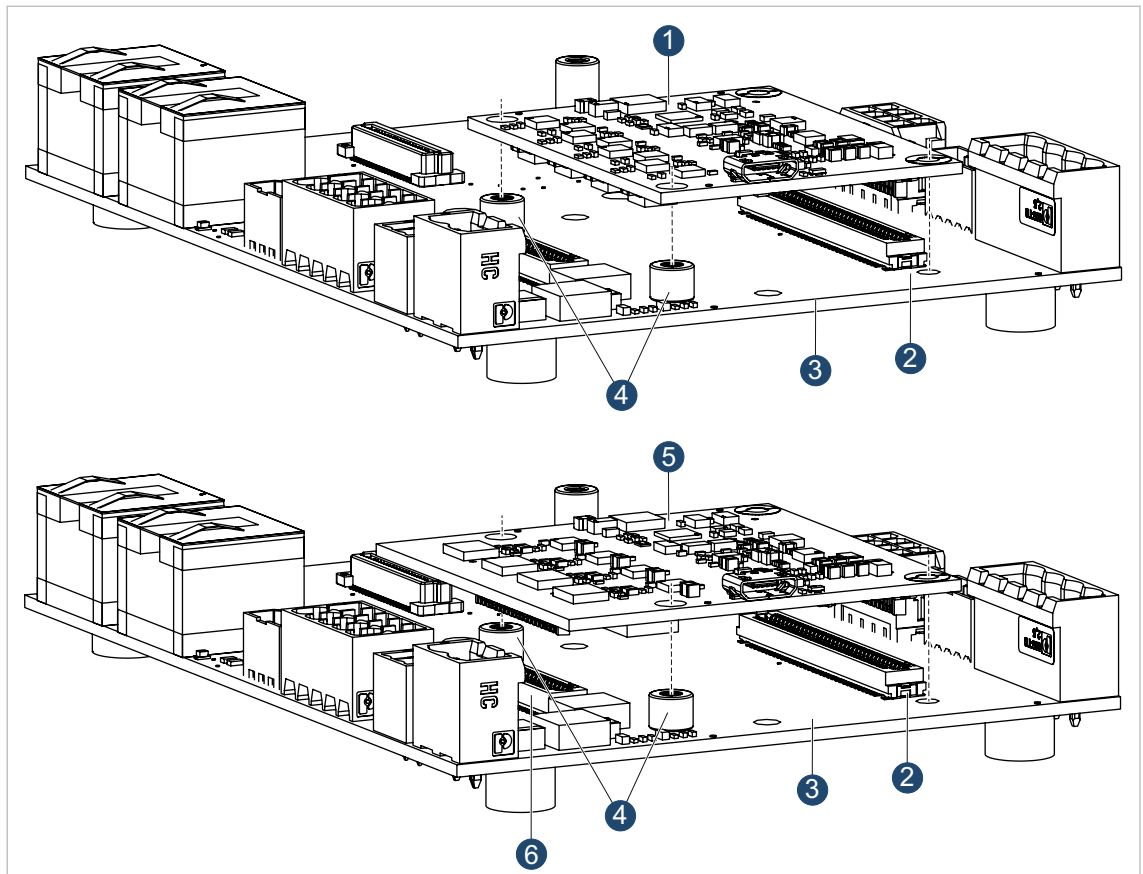


Fig. 9: Installing the Motion Controller PCBs on the evaluation board

- |                    |                        |
|--------------------|------------------------|
| 1 MC 3602 B        | 4 Threaded attachments |
| 2 B2B port (X100)  | 5 MC 3606 B            |
| 3 Evaluation board | 6 B2B port (X101)      |

## Installation

### NOTICE!

**Incorrect installation can damage the Motion Controller.**

- ▶ Note orientation of the Motion Controller PCB acc. to Fig. 9.
- ▶ Connect Motion Controller PCB MC 3602 B (1) to the evaluation board (3) via the B2B connection X100 (2).
- ▶ Connect Motion Controller PCB MC 3606 B (5) to the evaluation board (3) via the B2B connections X100 (2) and X101 (6).
- ▶ Fasten the Motion Controller PCB to the two threaded attachments (4) using screws (M2.5 x 6) and a suitable washer.

## 4.2 Electrical connection

### 4.2.1 Notes on the electrical connection

#### NOTICE!

**Electrostatic discharges to the Motion Controller connections can damage the electronic components.**

- ▶ Observe the ESD protective measures.

#### NOTICE!

**Incorrect connection of the wires can damage the electronic components.**

- ▶ Connect the wires as shown in the connection assignment.

#### NOTICE!

**A short-term voltage peak during braking can damage the power supply or other connected devices.**

- ▶ For applications with high load inertia, the FAULHABER Braking Chopper of the BC 5004 series can be used to limit overvoltages and thereby protect the power supply. For more detailed information see the data sheet for the Braking Chopper.

The Motion Controller contains a PWM output stage for controlling the motors. Power losses arising during operation and alternating electrical fields arising due to the pulsed control of the motors, must be dissipated and damped by appropriate installation.

- ▶ Connect the Motion Controller to a grounding system. This should be done preferably by mounting it on an grounded baseplate, or alternatively by connecting it to an grounded mounting rail.
- ▶ Make sure that potential equalization is present between all coupled parts of the system. This applies even if the Motion Controller and motor are mounted separately.
- ▶ If several electrical devices or controllers are networked by means of RS232 or CAN, make sure that the potential difference between the ground potentials of the various parts of the system is less than 2 V.

✚ The cross-section of the required potential equalization conductors between the various parts of the system is specified in VDE 100 and must satisfy the following conditions:

## Installation

- At least 6 mm<sup>2</sup>
- Larger than half the cross-section of the supply conductor

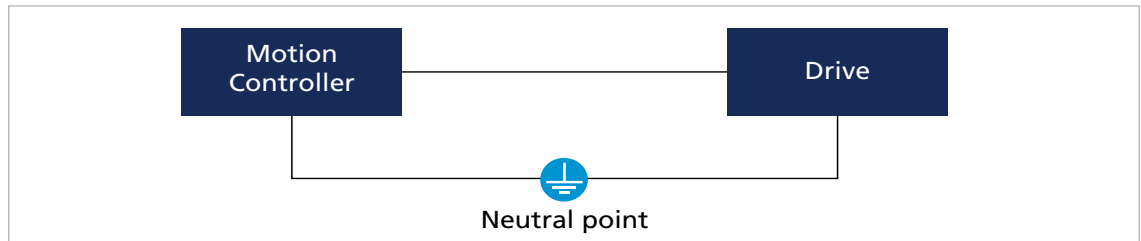


Fig. 10: Potential equalization between electrically connected parts of the system

### 4.2.2 Drive connections

The maximum length of the cable between the Motion Controller and motor depends on the sensor system used and the electrical and magnetic fields in the environment.

Tab. 6: Guide values for the cable length

| Encoder type                             | Unshielded length | Shielded length <sup>a)</sup> |
|--|-------------------|-------------------------------|
| Digital Hall sensors                     | 0.5 m             | 2–5 m                         |
| Analog Hall sensors                      | 0.5 m             | 2–5 m                         |
| Incremental encoders without line driver | 0.5 m             | 2–5 m                         |
| Incremental encoders with line driver    | 2 m               | 2–5 m <sup>b)</sup>           |
| Absolute encoders without line driver    | 0.3 m             | 0.5 m                         |
| Absolute encoders with line driver       | 2 m               | 5 m <sup>b)</sup>             |

a) applies to cables separately shielded from the motor phase power cables.

b) For position encoders with Line Driver interface, the cables must be shielded, twisted pairs

Longer connection cables are generally permissible, but must be validated for the target installation.

Optimization of the behavior in respect of transient emission and interference resistance may require additional EMC measures (see chap. 4.3, p. 48)

## Installation

### 4.2.3 Connection of the power supply

- Discrete inputs and outputs (for instance for discrete set-point specification or for connection of limit switches and reference switches)
- Communication connections
- ▶ Make sure that the connection cables on the connection side are not longer than 3 m.
- ▶ Keep the shield connections for connection cables short and flat.

**i** The USB port is a pure configuration connection. A cable length of < 3 m also applies for the USB connection.

To reduce the effects on the DC power supply network, ferrite sleeves (such as WE 742 700 790) can be used on the supply cables.

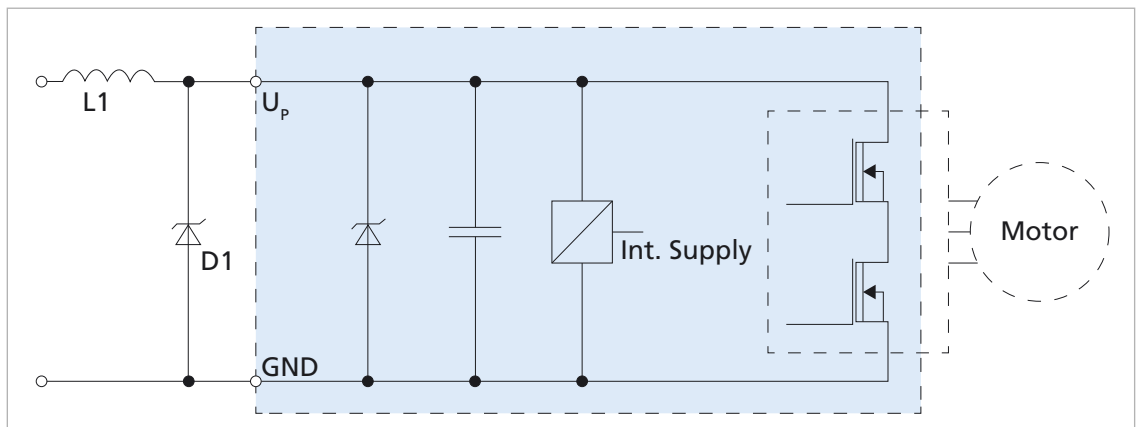


Fig. 11: EMC suppressor circuit

#### 4.2.3.1 Voltage supply

- ▶ Connect the Motion Controller to a sufficiently dimensioned power supply unit.
- ▶ During acceleration procedures, current peaks with values up to the peak current limit setting of the motor can occur for multiples of 10 ms.
- ▶ During braking procedures, energy can be regenerated and fed back into the DC power supply network. If this energy cannot be taken up by other drives, the voltage in the DC power supply network will rise. A limit value for the voltage that can be fed back during regenerative braking can be set in the Motion Controller. Alternatively the overvoltage can be dissipated by an additional external brake chopper, see the data sheet for the brake chopper.



## Installation

### 4.2.4 Connector pin assignment

#### 4.2.4.1 Pin assignment of B2B connector (X100)

The Motion Controller is connected to the evaluation board or customer base board via a B2B connector, through which all controller signals are transmitted.

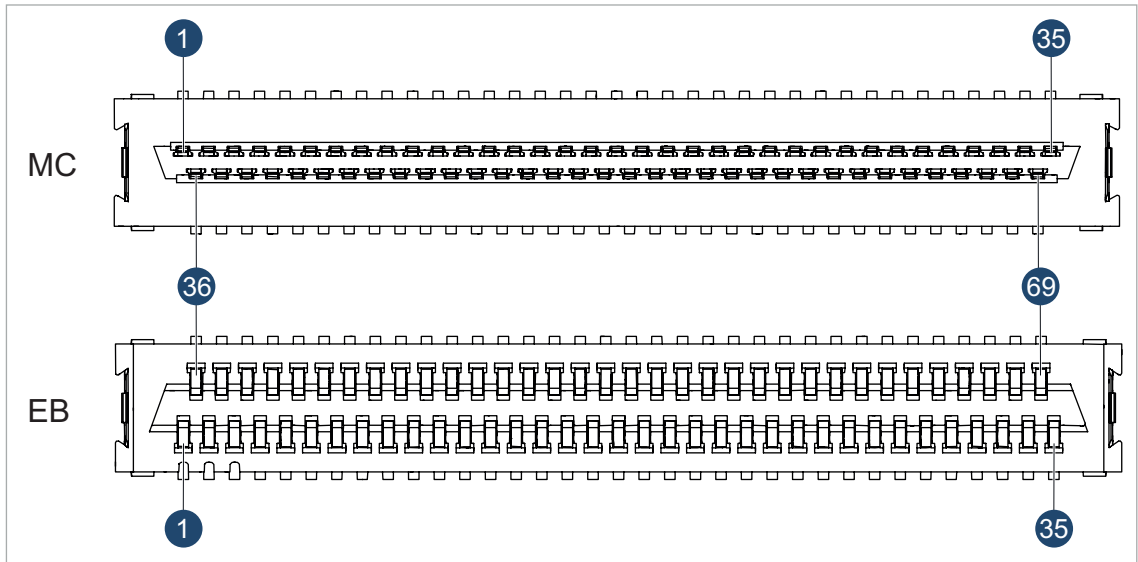


Fig. 12: Pin overview of the B2B connector (X100) on the Motion Controller (MC) and on the evaluation board (EB)

Tab. 7: Pin assignment of B2B connector

| Pin | Designation | Meaning                          |
|-----|-------------|----------------------------------|
| 1   | Phase A     | Motor phase A                    |
| 2   | Phase A     | Motor phase A                    |
| 3   | Phase B     | Motor phase B                    |
| 4   | Phase B     | Motor phase B                    |
| 5   | Phase C     | Motor phase C                    |
| 6   | Phase C     | Motor phase C                    |
| 7   | Phase D     | Motor Phase D                    |
| 8   | Phase D     | Motor Phase D                    |
| 9   | $U_{mot}$   | Power supply of the motor        |
| 10  | $U_{mot}$   | Power supply of the motor        |
| 11  | $U_{mot}$   | Power supply of the motor        |
| 12  | GND         | Ground connection                |
| 13  | GND         | Ground connection                |
| 14  | $U_p$       | Power supply of the electronics  |
| 15  | $U_p$       | Power supply of the electronics  |
| 16  | CAN-H       | CAN-High interface               |
| 17  | $U_{DD}$    | 5V supply connection for sensors |
| 18  | Sens B      | Hall sensor B                    |
| 19  | SPI-SCLK    | ECAT SPI CLK                     |

## Installation

| Pin | Designation      | Meaning  |
|-----|------------------|--|
| 20  | SPI-MOSI         | ECAT SPI MOSI                                  |
| 21  | U <sub>DD</sub>  | 5V supply connection for sensors               |
| 22  | +3.3V Out        | 3.3V supply connection for external components |
| 23  | SPI-IRQ1         | ECAT IRQ1                                      |
| 24  | SPI-IRQ2         | ECAT IRQ2                                      |
| 25  | AUX-DIGIO3       | ECAT error signal                              |
| 26  | DigIn 1          | Digital input                                  |
| 27  | DigOut 2         | Digital output                                 |
| 28  | DigOut 1         | Digital output                                 |
| 29  | AnIn 1           | Analog input                                   |
| 30  | TxD              | RS232 interface transmit direction             |
| 31  | Channel A        | Encoder channel A                              |
| 32  | Channel B        | Encoder channel B                              |
| 33  | Index            | Index channel                                  |
| 34  | EGND             | Earth connection                               |
| 35  | EGND             | Earth connection                               |
| 36  | Phase A          | Motor phase A                                  |
| 37  | Phase A          | Motor phase A                                  |
| 38  | Phase B          | Motor phase B                                  |
| 39  | Phase B          | Motor phase B                                  |
| 40  | Phase C          | Motor phase C                                  |
| 41  | Phase C          | Motor phase C                                  |
| 42  | Phase D          | Motor Phase D                                  |
| 43  | Phase D          | Motor Phase D                                  |
| 44  | U <sub>mot</sub> | Power supply of the motor                      |
| 45  | U <sub>mot</sub> | Power supply of the motor                      |
| 46  | GND              | Ground connection                              |
| 47  | GND              | Ground connection                              |
| 48  | GND              | Ground connection                              |
| 49  | GND              | Ground connection                              |
| 50  | CAN-L            | CAN-Low interface                              |
| 51  | GND              | Ground connection                              |
| 52  | Sens A           | Hall sensor A                                  |
| 53  | Sens C           | Hall sensor C                                  |
| 54  | SPI-SEL1         | ECAT CS  |
| 55  | SPI-MISO         | ECAT SPI MISO                                  |
| 56  | GND              | Ground connection                              |
| 57  | GND              | Ground connection                              |
| 58  | AUX-DIGIO4       | Reserve  |
| 59  | GND              | Ground connection                              |

## Installation

| Pin | Designation                   | Meaning                                       |
|-----|-------------------------------|---|
| 60  | GND                           | Ground connection                             |
| 61  | DigIn 2                       | Digital input                                 |
| 62  | DigIn 3                       | Digital input                                 |
| 63  | AGND                          | Analog ground connection                      |
| 64  | AnIn 2                        | Analog input                                  |
| 65  | RxD                           | RS232 interface receive direction             |
| 66  | $\overline{\text{Channel A}}$ | Encoder channel A (logically inverted signal) |
| 67  | $\overline{\text{Channel B}}$ | Encoder channel B (logically inverted signal) |
| 68  | $\overline{\text{Index}}$     | Index channel (logically inverted signal)     |
| 69  | EGND                          | Earth connection                              |

### Connections to the customer base board

Connections for the Motion Control System must be implemented on the customer base board. The following figure shows the corresponding connections of the X100 connector.

# Installation

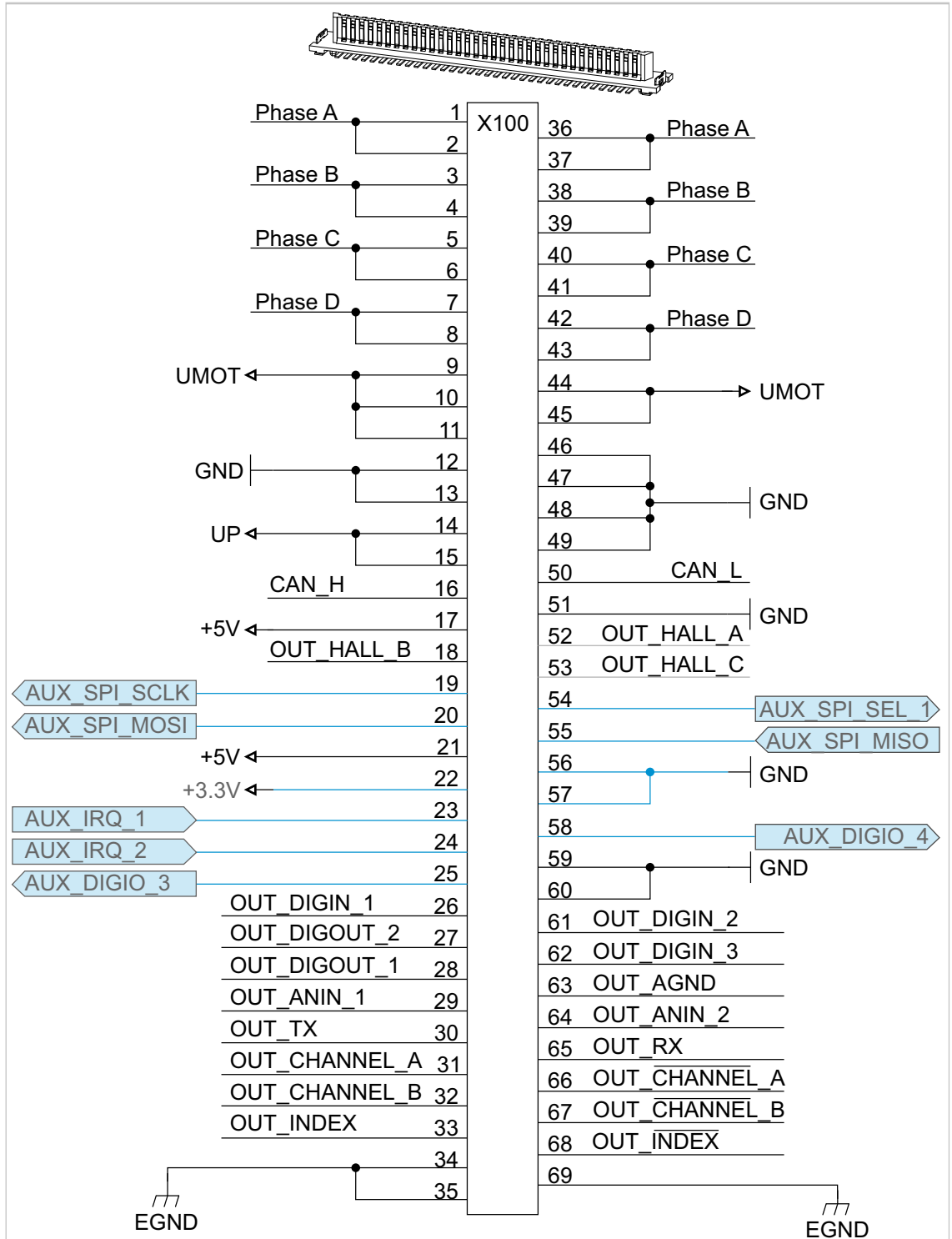


Fig. 13: Connections of the X100 connector on the customer base board

The signals that are essential for the optional EtherCAT functionality are shown in blue. The EtherCAT functionality can only be used together with the EtherCAT module. See the separate technical manual for the EtherCAT module.

## Installation

### 4.2.4.2 Pin assignment of B2B connector (X101)

The Motion Controller MC 3606 B is connected to the evaluation board or customer base board via an additional B2B connector, through which additional power connections are established.

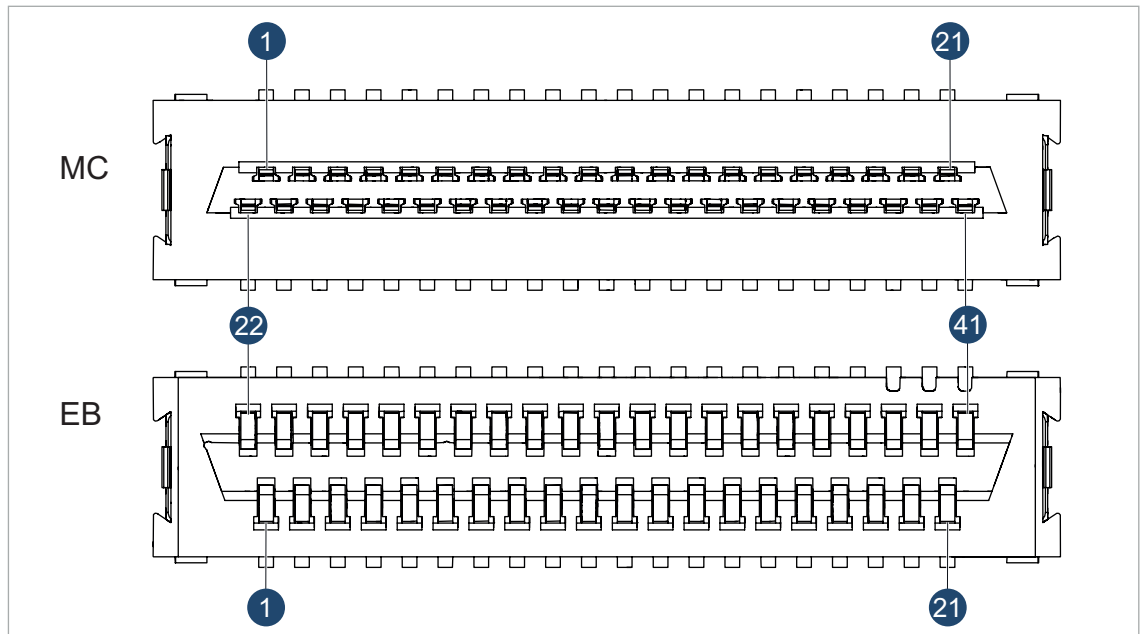


Fig. 14: Pin overview of the B2B connector (X101) on the MC 3606 B (MC) and on the evaluation board (EB)

Tab. 8: Pin assignment of the connector strip

| Pin | Designation      | Meaning                   |
|-----|------------------|---------------------------|
| 1   | EGND             | Earth connection          |
| 2   | Phase A          | Motor phase A             |
| 3   | Phase A          | Motor phase A             |
| 4   | Phase A          | Motor phase A             |
| 5   | Phase B          | Motor phase B             |
| 6   | Phase B          | Motor phase B             |
| 7   | Phase B          | Motor phase B             |
| 8   | Phase C          | Motor phase C             |
| 9   | Phase C          | Motor phase C             |
| 10  | Phase C          | Motor phase C             |
| 11  | Phase D          | Motor Phase D             |
| 12  | Phase D          | Motor Phase D             |
| 13  | Phase D          | Motor Phase D             |
| 14  | $U_{\text{mot}}$ | Power supply of the motor |
| 15  | $U_{\text{mot}}$ | Power supply of the motor |
| 16  | $U_{\text{mot}}$ | Power supply of the motor |
| 17  | GND              | Ground connection         |
| 18  | GND              | Ground connection         |

## Installation

| Pin | Designation      | Meaning                   |
|-----|------------------|---------------------------|
| 19  | GND              | Ground connection         |
| 20  | GND              | Ground connection         |
| 21  | EGND             | Earth connection          |
| 22  | Phase A          | Motor phase A             |
| 23  | Phase A          | Motor phase A             |
| 24  | Phase A          | Motor phase A             |
| 25  | Phase B          | Motor phase B             |
| 26  | Phase B          | Motor phase B             |
| 27  | Phase B          | Motor phase B             |
| 28  | Phase C          | Motor phase C             |
| 29  | Phase C          | Motor phase C             |
| 30  | Phase C          | Motor phase C             |
| 31  | Phase D          | Motor Phase D             |
| 32  | Phase D          | Motor Phase D             |
| 33  | Phase D          | Motor Phase D             |
| 34  | U <sub>mot</sub> | Power supply of the motor |
| 35  | U <sub>mot</sub> | Power supply of the motor |
| 36  | U <sub>mot</sub> | Power supply of the motor |
| 37  | U <sub>mot</sub> | Power supply of the motor |
| 38  | GND              | Ground connection         |
| 39  | GND              | Ground connection         |
| 40  | GND              | Ground connection         |
| 41  | EGND             | Earth connection          |

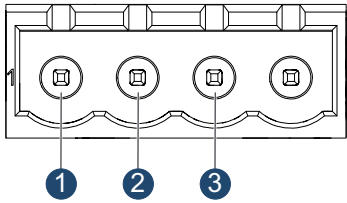
## Installation

### 4.2.4.3 Pin assignment of the evaluation board (motor side)

#### Motor connection (M1)

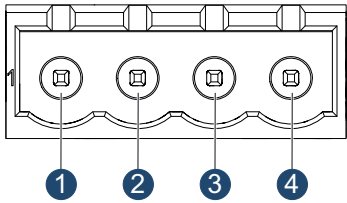
Tab. 9: Pin assignment of the BL motor connection (M1)

| Pin | Designation | Meaning                      |
|-----|-------------|------------------------------|
| 1   | Motor A     | Connection of motor, phase A |
| 2   | Motor B     | Connection of motor, phase B |
| 3   | Motor C     | Connection of motor, phase C |



Tab. 10: Pin assignment of the stepper motor connection (M1)

| Pin | Designation | Meaning                       |
|-----|-------------|-------------------------------|
| 1   | Motor A     | Connection of motor, phase A+ |
| 2   | Motor B     | Connection of motor, phase A- |
| 3   | Motor C     | Connection of motor, phase B+ |
| 4   | Motor D     | Connection of motor, phase B- |

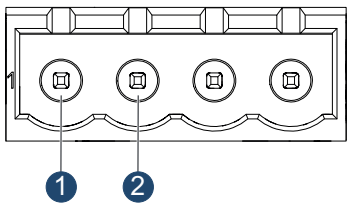


Tab. 11: Electrical data of the motor connection (M1)

| Designation        | Value                                      |
|--------------------|--|
| Motor power supply | 0... $U_{mot}$<br>Max. 18 A<br>100 kHz PWM |

Tab. 12: Pin assignment of the DC motor connection (M1)

| Pin | Designation | Meaning                                |
|-----|-------------|--|
| 1   | Motor +     | Connection of motor, positive pole     |
| 2   | Motor -     | Connection of the motor, negative pole |



Tab. 13: Electrical data of the DC motor connection (M1)

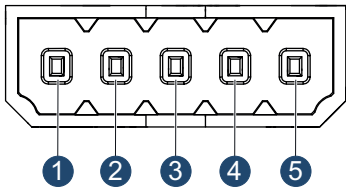
| Designation        | Value                                      |
|--------------------|--|
| Motor power supply | 0... $U_{mot}$<br>Max. 18 A<br>100 kHz PWM |

## Installation

### Sensor connection (M2)

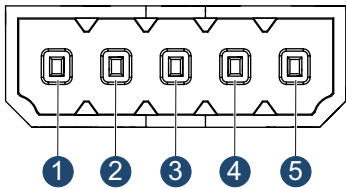
Tab. 14: Pin assignment of the sensor connection (M2)

| Pin | Designation | Meaning                  |
|-----|-------------|--------------------------|
| 1   | $U_{DD}$    | Power supply for sensors |
| 2   | GND         | Ground connection        |
| 3   | Sens A      | Hall sensor A            |
| 4   | Sens B      | Hall sensor B            |
| 5   | Sens C      | Hall sensor C            |



Tab. 15: Pin assignment at sensor connection (M2) for sin/cos sensor

| Pin | Designation | Meaning                  |
|-----|-------------|--------------------------|
| 1   | $U_{DD}$    | Power supply for sensors |
| 2   | GND         | Ground connection        |
| 3   | COS(+)      | Cosine signal            |
| 4   | SIN(+)      | Sine signal              |
| 5   | n.c.        | –                        |



Only in combination with sin/cos sensors on FAULHABER LM motors or BX4 motors in sin/cos special version.

Tab. 16: Electrical data of the sensor connection (M2)

| Designation         | Value          |
|---------------------|----------------|
| Sensor power supply | 5 V<br><100 mA |
| Sensor connection   | <5 V           |

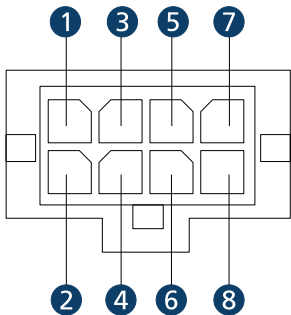
### Encoder connection (M3)

The pin assignment of the encoder connector varies depending on the encoder type.

- Incremental encoder with or without line driver
- Absolute encoder with or without line driver.

Tab. 17: Pin assignment for incremental encoder with line driver (M3)

| Pin | Designation                   | Meaning                                       |
|-----|-------------------------------|---|
| 1   | $U_{DD}$                      | Power supply for incremental encoder          |
| 2   | GND                           | Ground connection                             |
| 3   | $\overline{\text{Channel A}}$ | Encoder channel A (logically inverted signal) |
| 4   | Channel A                     | Encoder channel A                             |
| 5   | $\overline{\text{Channel B}}$ | Encoder channel B (logically inverted signal) |
| 6   | Channel B                     | Encoder channel B                             |
| 7   | $\overline{\text{Index}}$     | Encoder index (logically inverted signal)     |
| 8   | Index                         | Encoder index                                 |





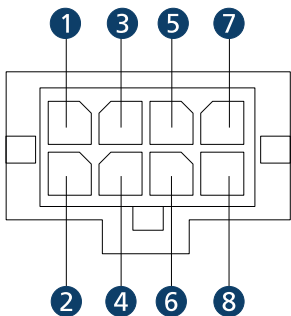
# Installation

Tab. 18: Electrical data for incremental encoder with line driver (M3)

| Designation                           | Value                  |
|---------------------------------------|------------------------|
| Power supply for incremental encoder  | 5 V<br><100 mA         |
| Connection of the incremental encoder | <5 V<br><2 MHz<br>5 kΩ |

Tab. 19: Pin assignment for incremental encoder without line driver (M3)

| Pin | Designation                   | Meaning                              |
|-----|-------------------------------|--------------------------------------|
| 1   | $U_{DD}$                      | Power supply for incremental encoder |
| 2   | GND                           | Ground connection                    |
| 3   | $\overline{\text{Channel A}}$ | n.c.                                 |
| 4   | Channel A                     | Encoder channel A                    |
| 5   | $\overline{\text{Channel B}}$ | n.c.                                 |
| 6   | Channel B                     | Encoder channel B                    |
| 7   | $\overline{\text{Index}}$     | n.c.                                 |
| 8   | Index                         | Encoder index                        |

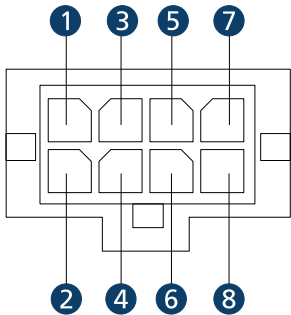


Tab. 20: Electrical data for incremental encoder without line driver (M3)

| Designation                           | Value                  |
|---------------------------------------|------------------------|
| Power supply for incremental encoder  | 5 V<br><100 mA         |
| Connection of the incremental encoder | <5 V<br><2 MHz<br>5 kΩ |

Tab. 21: Pin assignment for absolute encoder with line driver (M3)

| Pin | Designation              | Meaning  |
|-----|--------------------------|--|
| 1   | $U_{DD}$                 | Power supply for absolute encoder                            |
| 2   | GND                      | Ground connection  |
| 3   | $\overline{\text{CS}}$   | Chip Select for absolute encoder (logically inverted signal) |
| 4   | CS                       | Chip Select for absolute encoder                             |
| 5   | $\overline{\text{Data}}$ | Data for absolute encoder (logically inverted signal)        |
| 6   | Data                     | Data for absolute encoder                                    |
| 7   | $\overline{\text{CLK}}$  | Clock for absolute encoder (logically inverted signal)       |
| 8   | CLK                      | Clock for absolute encoder                                   |



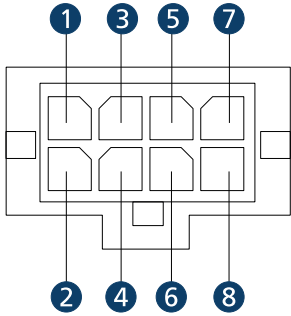
## Installation

Tab. 22: Electrical data for absolute encoder with line driver (M3)

| Designation                   | Value          |
|-------------------------------|----------------|
| Absolute encoder power supply | 5 V<br><100 mA |
| Connection Chip Select        | 5 V            |
| Connection data               | <5 V<br>5 kΩ   |
| Connection clock              | 5 V<br>1 MHz   |

Tab. 23: Pin assignment for absolute encoder without line driver (M3)

| Pin | Designation       | Meaning                           |
|-----|-------------------|-----------------------------------|
| 1   | $U_{DD}$          | Power supply for absolute encoder |
| 2   | GND               | Ground connection                 |
| 3   | $\overline{CS}$   | n.c.                              |
| 4   | CS                | Chip Select for AES               |
| 5   | $\overline{Data}$ | n.c.                              |
| 6   | Data              | Data for AES                      |
| 7   | $\overline{CLK}$  | n.c.                              |
| 8   | CLK               | Clock for AES                     |



Tab. 24: Electrical data for absolute encoder without line driver (M3)

| Designation                   | Value          |
|-------------------------------|----------------|
| Absolute encoder power supply | 5 V<br><100 mA |
| Connection Chip Select        | 5 V            |
| Connection data               | <5 V<br>5 kΩ   |
| Connection clock              | 5 V<br>1 MHz   |

## Installation

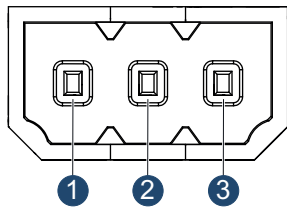
### COM connection (X2)

The pin assignment of the COM connection differs according to the type of communication. The distinction is made between the following types of communication:

- RS232
- CANopen

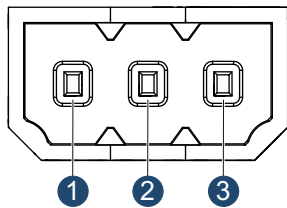
Tab. 25: Pin assignment of the COM port (X2) for RS232

| Pin | Designation | Meaning                            |
|-----|-------------|------------------------------------|
| 1   | TxD         | RS232 interface transmit direction |
| 2   | RxD         | RS232 interface receive direction  |
| 3   | GND         | Ground connection                  |



Tab. 26: Pin assignment of the COM port (X2) for CANopen

| Pin | Designation | Meaning            |
|-----|-------------|--------------------|
| 1   | CAN-H       | CAN-High interface |
| 2   | CAN-L       | CAN-Low interface  |
| 3   | GND         | Ground connection  |

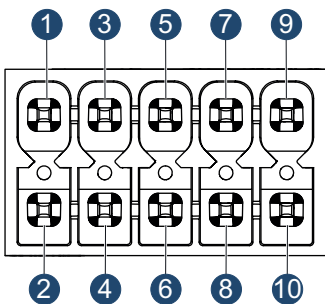


#### 4.2.4.4 Pin assignment of the evaluation board (supply side)

##### I/O connection (X3)

Tab. 27: Pin assignment of the I/O connection (X3)

| Pin | Designation     | Meaning                                  |
|-----|-----------------|--|
| 1   | U <sub>DD</sub> | Power supply for external consumer loads |
| 2   | GND             | Ground connection                        |
| 3   | DigOut 1        | Digital output (open collector)          |
| 4   | DigOut 2        | Digital output (open collector)          |
| 5   | DigIn 1         | Digital input                            |
| 6   | DigIn 2         | Digital input                            |
| 7   | DigIn 3         | Digital input                            |
| 8   | AnIn 1          | Analog input                             |
| 9   | AnIn 2          | Analog input                             |
| 10  | AGND            | Ground connection for analog inputs      |



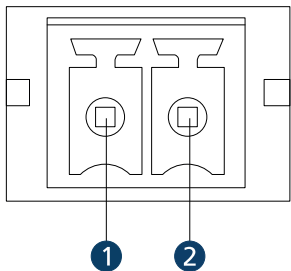
# Installation

Tab. 28: Electrical data for the I/O connection (X3)

| Designation                         | Value   |
|-------------------------------------|---|
| Power supply for external consumers | 5 V<br><100 mA  |
| DigOut                              | low = GND<br>high = high resistance<br>47 kΩ<br>Max. 0.7 A  |
| DigIn                               | <50 V<br>47 kΩ<br><1 MHz<br>TTL level: low < 0.5 V, high > 3.5 V<br>PLC level: low < 7 V, high > 11.5 V |
| AnIn                                | ±10 V<br>AGND   |

## Voltage supply of the controller (X4)

Tab. 29: Pin assignment for the power supply of the controller (X4)

|   | Pin | Designation    | Meaning                      |
|---|-----|----------------|------------------------------|
|  | 1   | GND            | Ground connection            |
|   | 2   | U <sub>p</sub> | Power supply for controllers |

Tab. 30: Electrical data for the voltage supply (X4)

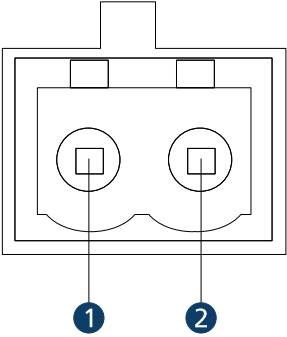
| Designation                 | Value   |
|-----------------------------|---|
| Power supply for controller | 7–36 V<br>≤100 mA (without external consumer) |

# Installation

## Voltage supply of the motor (X5)

Tab. 31: Pin assignment for the power supply of the motor (X5)

| Pin | Designation      | Meaning                   |
|-----|------------------|---------------------------|
| 1   | GND              | Ground connection         |
| 2   | U <sub>mot</sub> | Power supply of the motor |



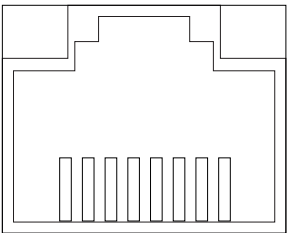
Tab. 32: Electrical data for the voltage supply (X5)

| Designation        | Value |
|--------------------|-------|
| Motor power supply | <36 V |

## EtherCAT connection (IN/OUT)

Tab. 33: Pin assignment EtherCAT (IN/OUT), connector: RJ45

| Designation | Meaning  |
|-------------|--|
| IN/OUT      | EtherCAT communication<br>Pin 1: TxD+ Transmission Data +<br>Pin 2: TxD- Transmission Data -<br>Pin 3: RxD+ Receiver Data +<br>Pin 6: RxD- Receiver Data - |



# Installation

## 4.2.5 Evaluation board: Connection at the motor side

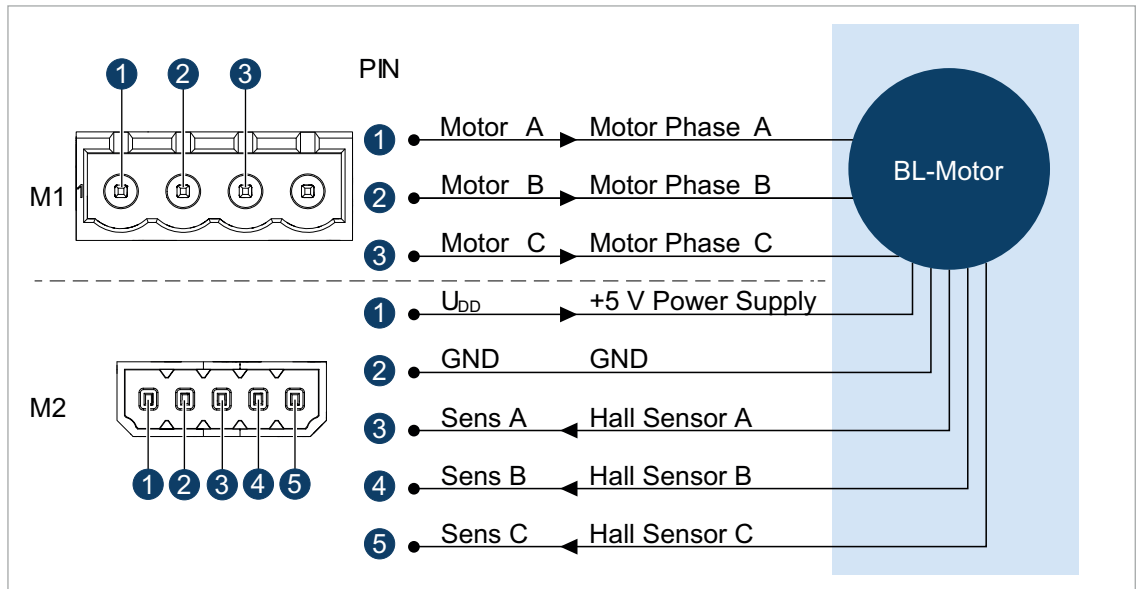


Fig. 15: BL/LM motor with Hall sensors

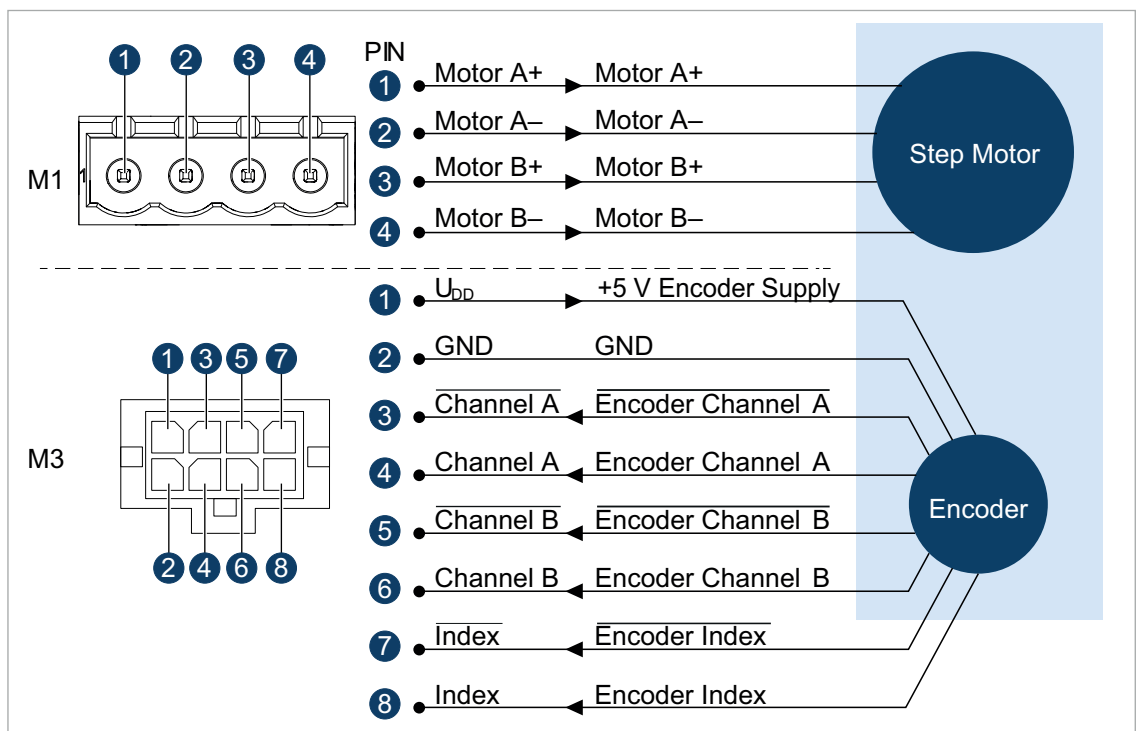


Fig. 16: Stepper motor with incremental encoders

# Installation

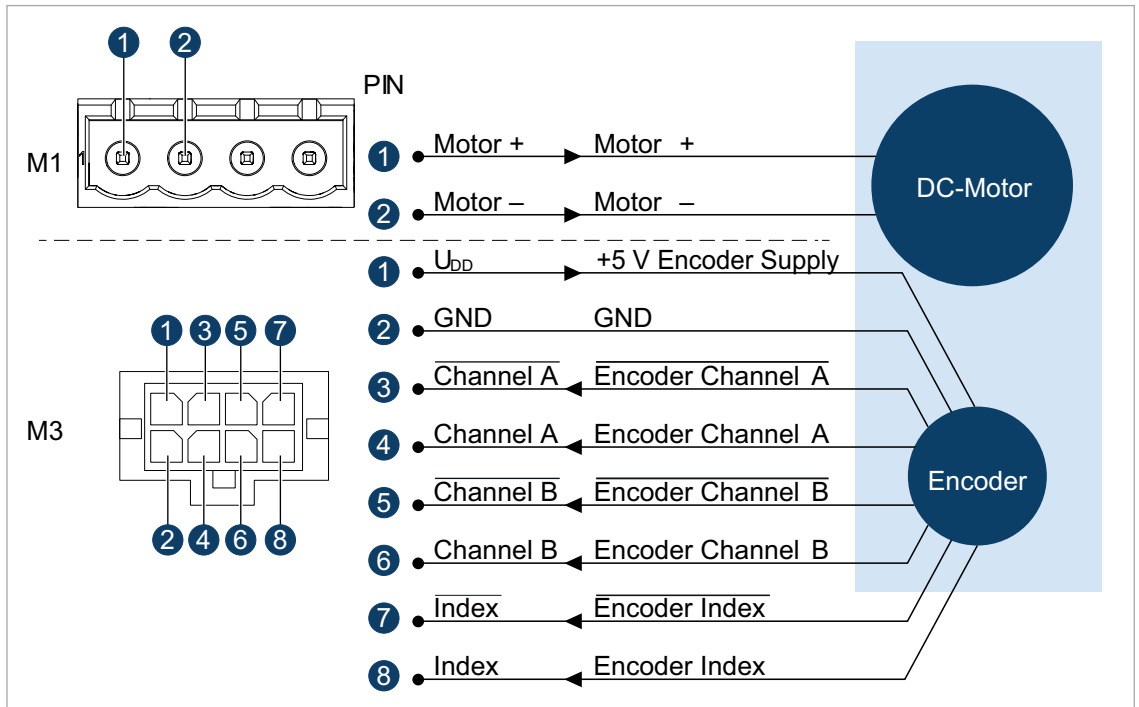


Fig. 17: DC-motor with incremental encoders

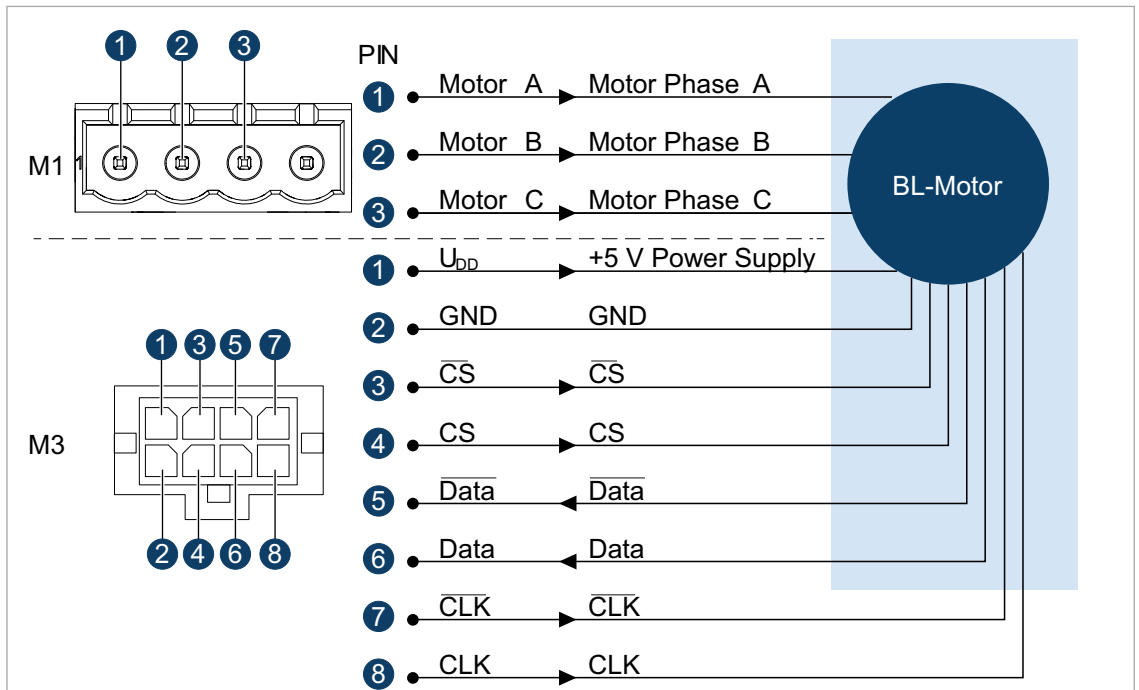


Fig. 18: BL motor with absolute encoders

# Installation

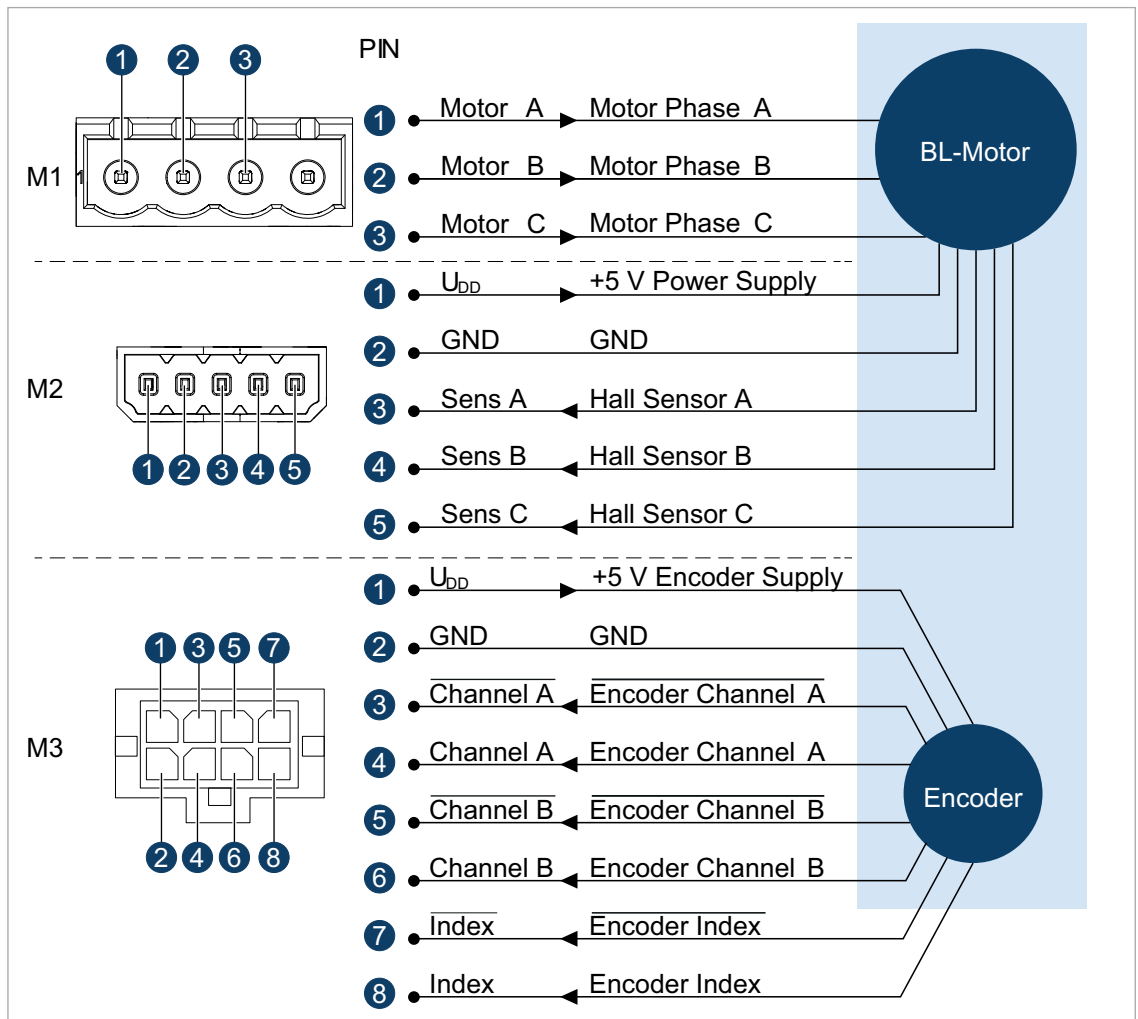


Fig. 19: BL motor with Hall sensors and incremental encoders



# Installation

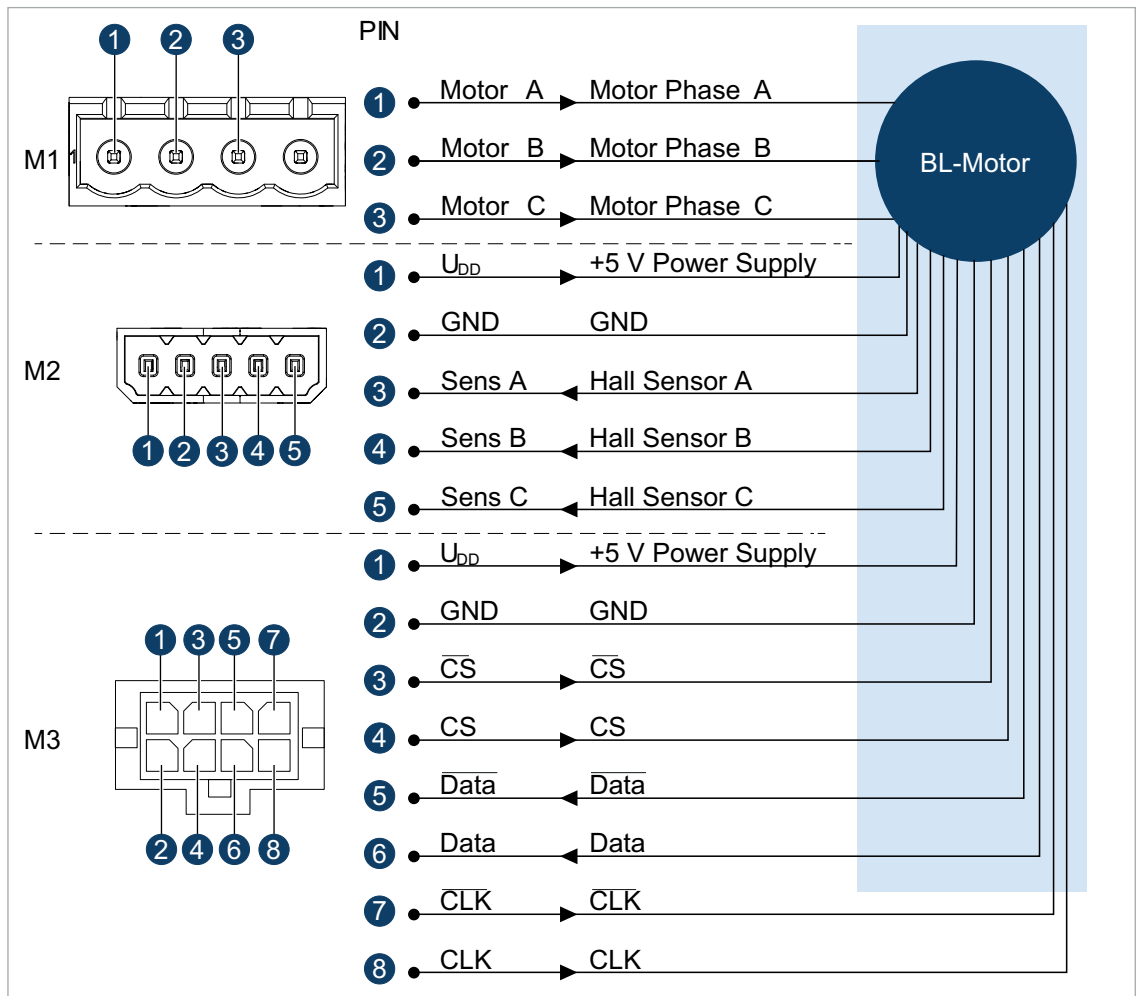


Fig. 20: BL motor with Hall sensors and absolute encoders

## Installation

### 4.2.6 I/O circuit diagrams

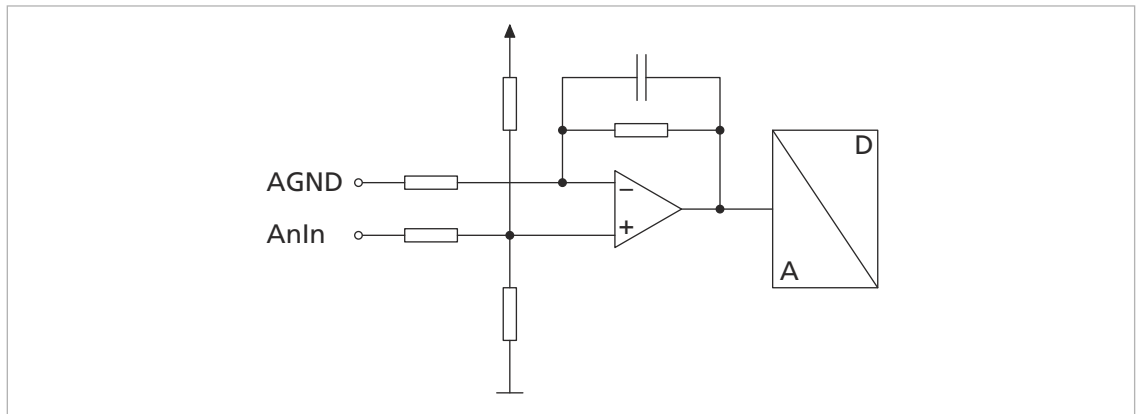


Fig. 21: Analog input circuit diagram (internal)

**i** So that the voltage drop on the supply side does not affect the speed specification value, connect the analog input ground (AGND) to the power supply ground (GND).

The analog inputs are executed as differential inputs. Both inputs use the same reference input.

The analog inputs can be used flexibly:

- Specification of set-points for current, speed or position
- Connection of actual value encoders for speed or position
- Use as a free measurement input (queried via the interface)

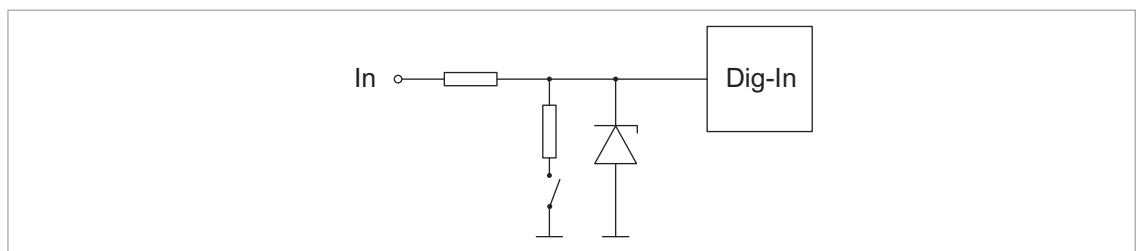


Fig. 22: Digital input circuit diagram (internal)

The digital inputs are switchable from the input level (PLC/TTL). The input resistance is approx. 30 kΩ. The digital inputs can be configured for the following purposes (see the Drive Functions):

- Digital input for reference and limit switches
- Connection of an external encoder
- PWM (Pulse Width Modulation) set-point specification for current, speed and position

## Installation

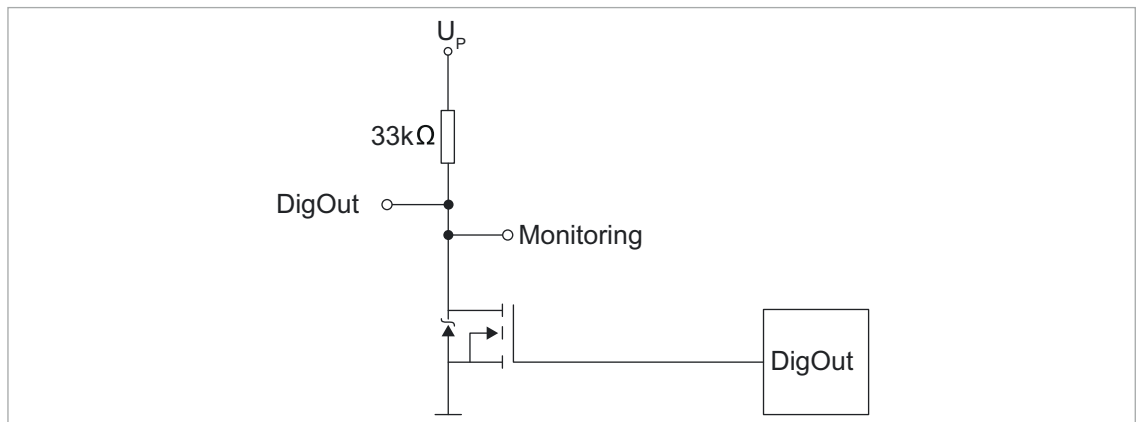


Fig. 23: Digital output circuit diagram (internal)

The digital output has the following properties:

- Open collector switch to ground
- Monitored output current (switch opens in the event of an error)

A digital output can be assigned to an error output. It can be freely programmed.

# Installation

## 4.2.7 External circuit diagrams

### Bipolar analog set-point specification via potentiometer

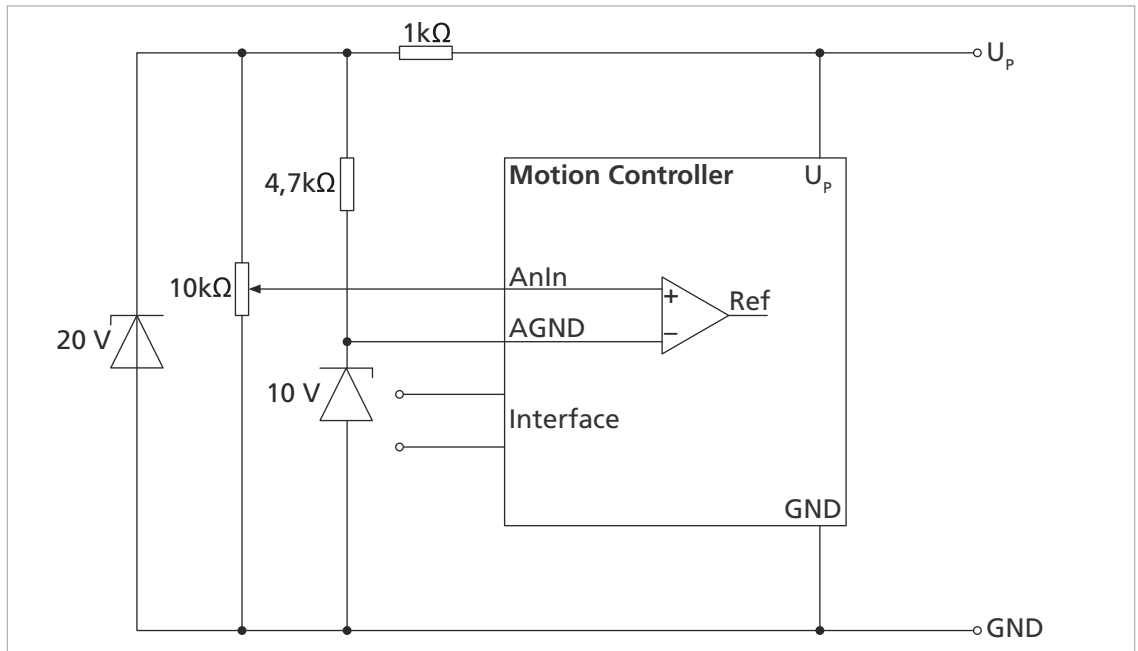


Fig. 24: Bipolar analog set-point specification via potentiometer

### Analog set-point specification via potentiometer with internally set offset and scaling

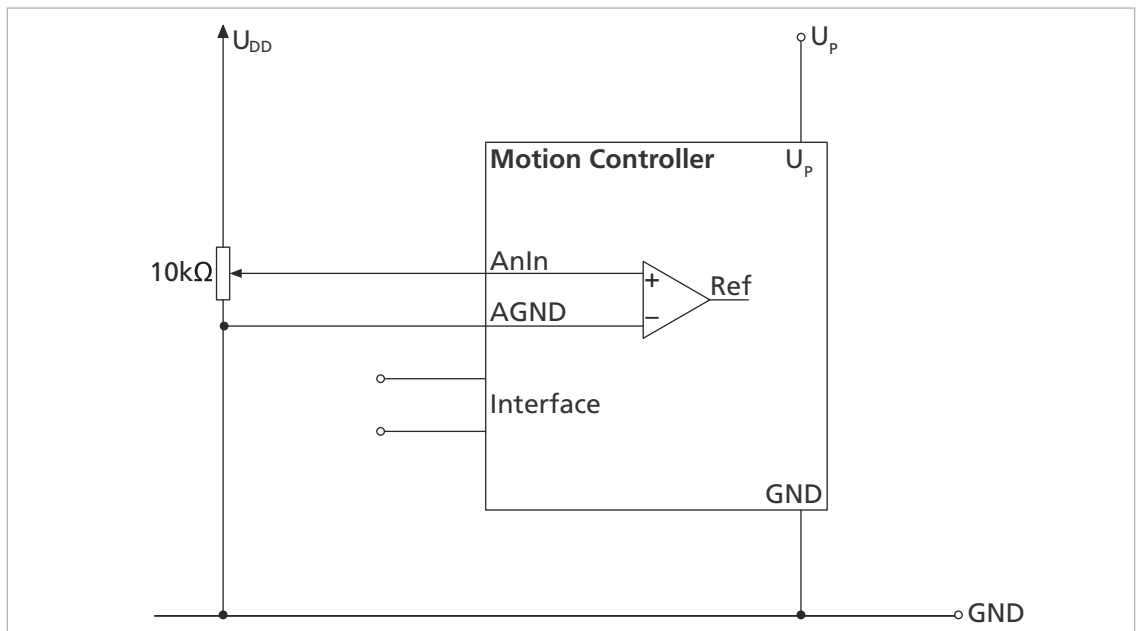


Fig. 25: Analog set-point specification via potentiometer with internally set offset and scaling

# Installation

## Connection of reference and limit switches

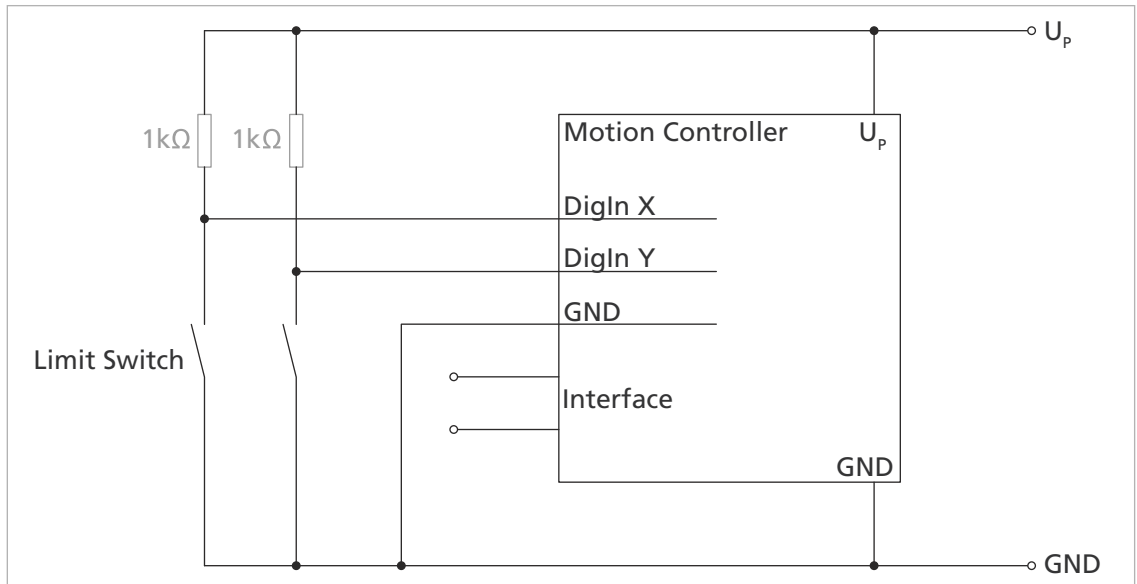


Fig. 26: Connection of reference and limit switches

**i** Depending on the type of switch it may be necessary to use additional pull-up resistors. No internal pull-up resistors are incorporated in the Motion Controller.

## Connection for external consumers (warning lamp, brake, solenoid)

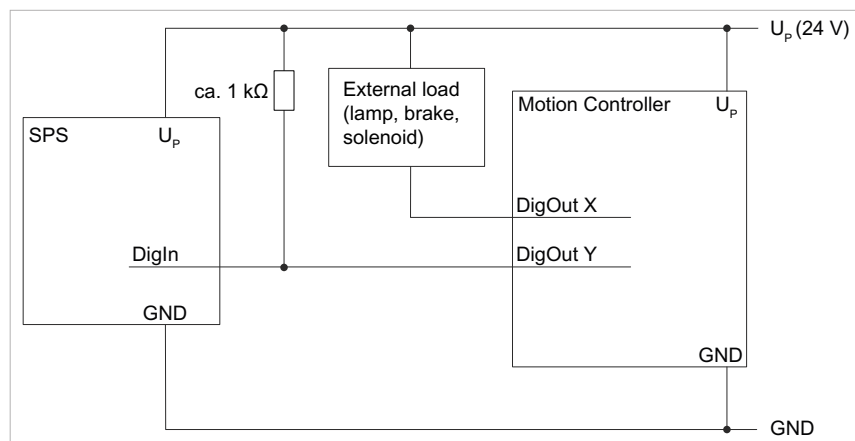


Fig. 27: Connection for external consumers

# Installation

## Connection of an external incremental encoder

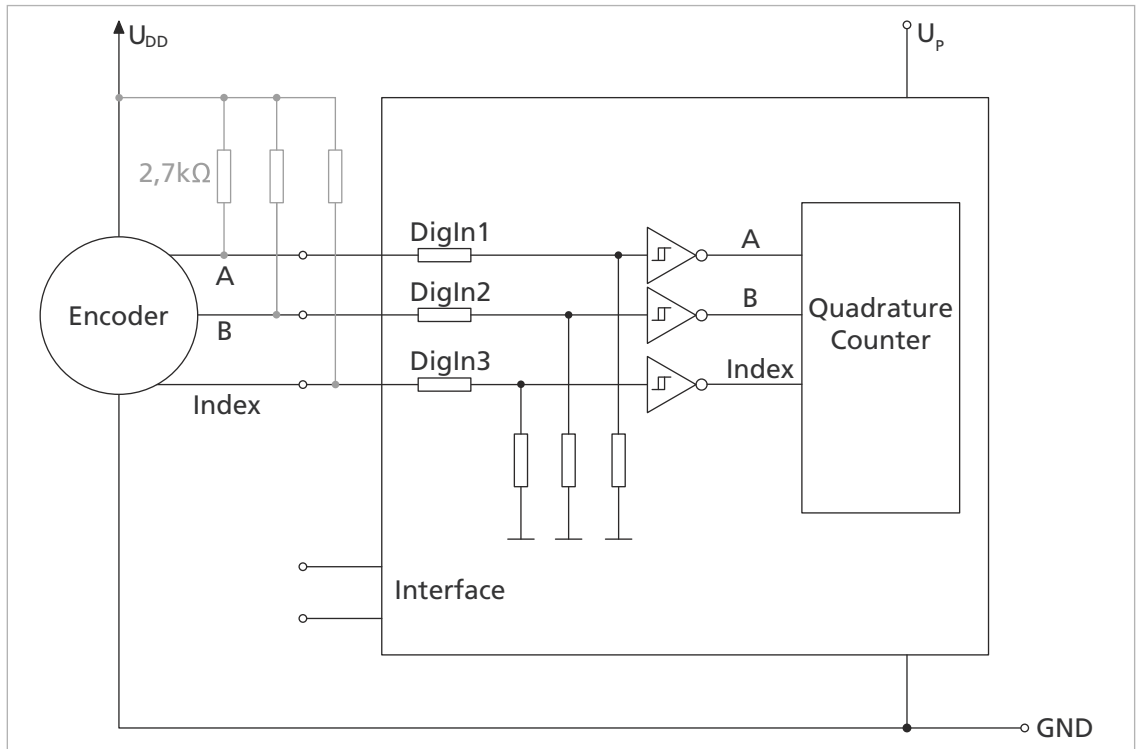


Fig. 28: Connection of an external incremental encoder

**i** Depending on the type of encoder it may be necessary to use additional pull-up resistors. No internal pull-up resistors are incorporated in the Motion Controller.

## Wiring between PC/controller and a drive

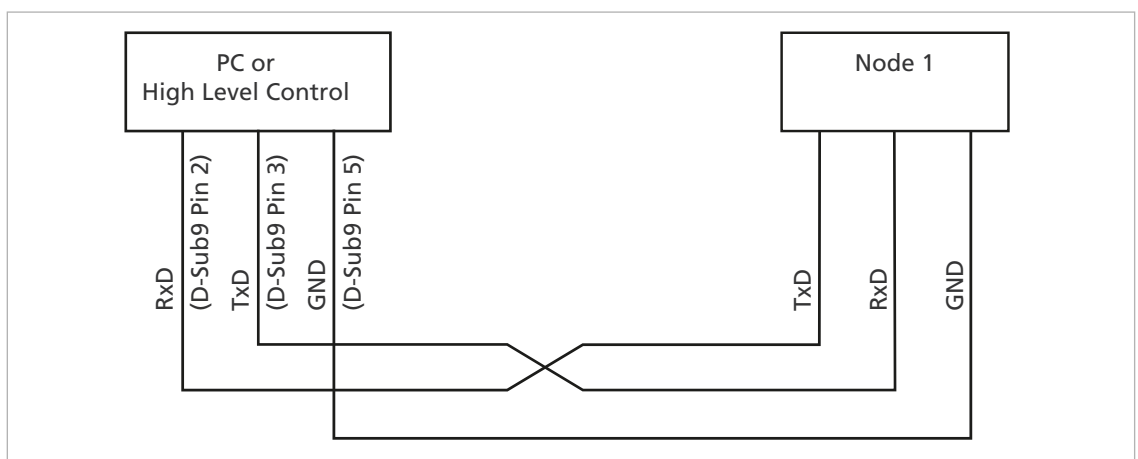


Fig. 29: Wiring between PC/controller and a drive

# Installation

## Wiring with several Motion Control Systems in RS232 network operation

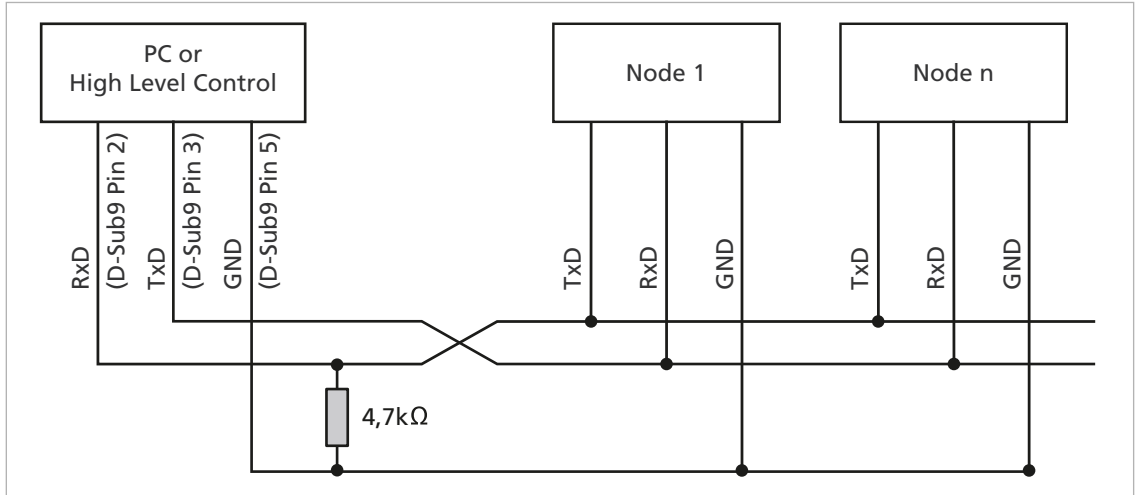


Fig. 30: Wiring with several Motion Control Systems in RS232 network operation

**i** Depending on the number of networked Motion Control Systems, a smaller value may be necessary for the pull-down resistor.

## Connection to the CANopen network

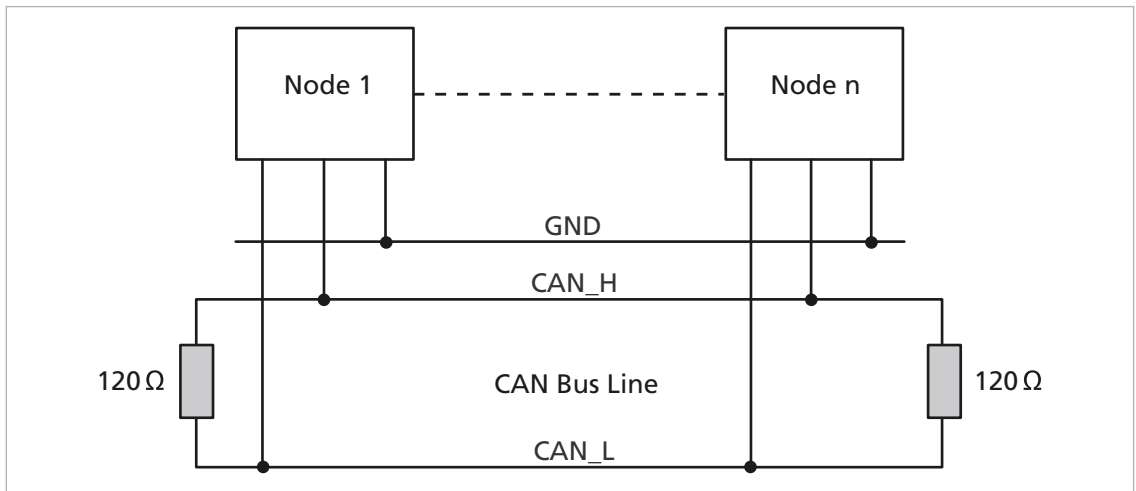


Fig. 31: Connection to the CANopen network

**i** If the CAN wiring is not laid in a straight line it may be necessary to individually optimize the amount and location of the terminating resistors. For instance in a star network a central 60 Ohm terminating resistor may be more suitable. When the optimum arrangement of terminating resistors is fitted, no accumulation of error frames should be evident.

# Installation

## 4.3 Electromagnetic compatibility (EMC)

- ▶ Follow the instructions in the following chapters to perform an EMC-compliant installation.

**WARNING!**

The Motion Controller can cause high-frequency interference which can affect the function of electronic implants and other electronic devices.

- ▶ Take appropriate interference suppression measures, particularly during use in residential environments.
- ▶ Observe the notices for EMC-compliant setup.

**NOTICE!**

Drive electronics with qualified limit values in accordance with EN-61800-3: Category C2 can cause radio interference in residential areas.

- ▶ For these drive electronics, take additional measures to limit the spread of radio interference.

### 4.3.1 Considered systems

The following considerations assume installations that can be described with the following circuit diagrams.

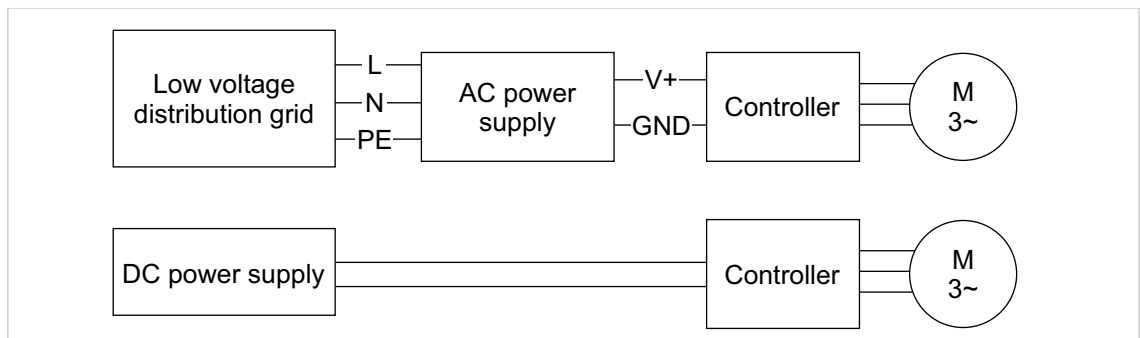


Fig. 32: Circuit diagrams of the considered systems



# Installation

## AC-mains system

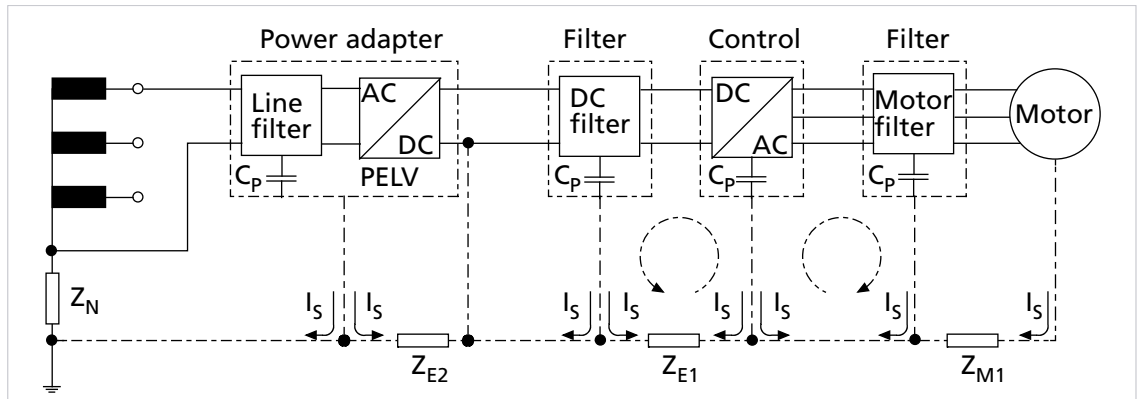


Fig. 33: Interference sources in an AC-mains system

- $Z_N$  Mains impedance of mains transformer – power supply connection
- $Z_{E1}$  Common-mode impedance of electronics on DC side
- $Z_{E2}$  Common-mode impedance of electronics on AC side – power supply connection
- $Z_{M1}$  Impedance of motor housing – controller
- $I_s$  Parasitic current
- $C_p$  Parasitic capacitance/filter capacitance


Parasitic current usually arises from the following components:

- Semiconductors
- Capacitive portion of the motor supply line
- Parasitic elements in the motor

Operating the motors with PWM is the cause here.

The DC-DC converter in the device and the used switching power supply also produce interference that could affect the mains. The created interference of the DC-DC converter in the device is, however, normally of little relevance due to the switched power (<5 W).

In contrast to this are the switching power supply, which supplies the controller with motor voltage or electronics voltage, and the PWM drive. Depending on the design, quality and effectiveness of the integrated filters (where present), the power supply can also cause interference.

 The qualitative assessment of a power supply can be performed with an interference voltage test and a resistive load (e.g., fanless heater / hot plate).

## DC-mains system

Prerequisite for connecting to the DC mains is that the switching interference of the power supply be negligible. A linear power supply can be used to reduce this interference.

## Installation

### Problem solutions

The interference may vary depending on load and installation.

| Solution  | Mode of action  | Benefits   | Disadvantages   |
|---|---|--|---|
| 3-phase common-mode choke / ferrite ring around all motor phases    | Removes common-mode interference of the motor   | <ul style="list-style-type: none"> <li>Removes RF common-mode interference</li> <li>Fast testing possible</li> </ul> | <ul style="list-style-type: none"> <li>Does not remove all interference</li> <li>Fabrication necessary</li> </ul>                 |
| PWM motor filter (e.g., EFM 5003 6501.00357)                        | Removes switching noise on the motor cable through DC averaging                                   | Interference limited to input side   | Does not remove all RF interference   |
| Motor filters and ferrites (e.g., EFC 5008 6501.00351)              | Removes RF interference on the motor cable  | Optimum for radio emissions  | Does not remove all low-frequency interference  |
| Input filter upstream of the controller (e.g., EFS 5004 6501.00350) | Removes interference of the switching regulator and part of the motor interference on DC networks | Pass an interference voltage measurement with correct wiring   | Does not remove interference on the motor side  |
| Mains filter upstream of the switching power supply                 | Removes common-mode interference of the power supply  | Very cost-effective solution   | <ul style="list-style-type: none"> <li>Often only effective for power supply</li> <li>Does not remove all interference</li> </ul> |

The mentioned variants are effective only if the following chapters are followed correctly.

### 4.3.2 Functional earthing

#### **DANGER!**

**Danger to life through ground leakage currents  $\geq 3.5$  mA**

- ▶ Check the grounding of the devices for proper installation.

The grounding system is essential for discharging parasitic current and for a potential distribution in the system that is as uniform as possible. The most efficient systems have a star or mesh shape. A star-shaped connection is easier to implement.

- ▶ Ensure an adequate cross section and a very good electrical ground connection so that the contact resistances are low not only for the low-frequency currents.

The ground connection can be improved, e.g., by removing the oxide layers from the ends of conductors with fine sandpaper.

#### **For electrical safety:**

- ▶ Ground in accordance with current standards and guidelines.
- ▶ Use separate protective conductors (PE) for all necessary parts (e.g., mains supply, motor, controller).
- ▶ Keep grounding cable as short as possible.

#### **For functional earthing:**

- ▶ Use a braided shield that is meshed as tightly as possible.
- ▶ Direct contact with the grounding plate is to be preferred.  
Therefore, avoid contact with the controller and then with the grounding plate.
- ▶ Connections made over a large surface area are to be preferred.

## Installation

### 4.3.3 Cable routing

**⚠ WARNING!**

**Voltages >25VAC are generated and transmitted in the drive system.**

- ▶ Set up the wiring of the drive system in a touch-proof manner.
- ▶ Only operate the drive system on an SELV or PELV power supply network.

The cable routing depends on various factors, such as:

- Is the cable shielded, twisted?
- Were interference-reducing measures taken?
- What material and what cable routing are used in the cable duct?
- Over what surface is the cable routed?

**Observe the following when laying the cables:**

- ▶ Use a full-surface, u-shaped and, if possible, metal cable duct.
- ▶ Lay the cables near the corners of the cable duct.
- ▶ Separate the cables by function where possible.
- ▶ Maintain distances when laying the cables.

The distances may vary depending on the zone in the switching cabinet.

- ▶ If possible, all cables should be twisted pairs or twisted and shielded in function groups (e.g., motor phases together, Hall sensors and supply together).

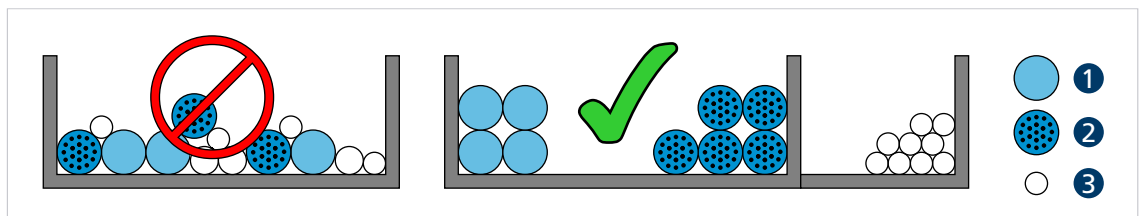


Fig. 34: Laying in the cable duct

- 1 High-current cable  
2 Digital cable

- 3 Sensor cable

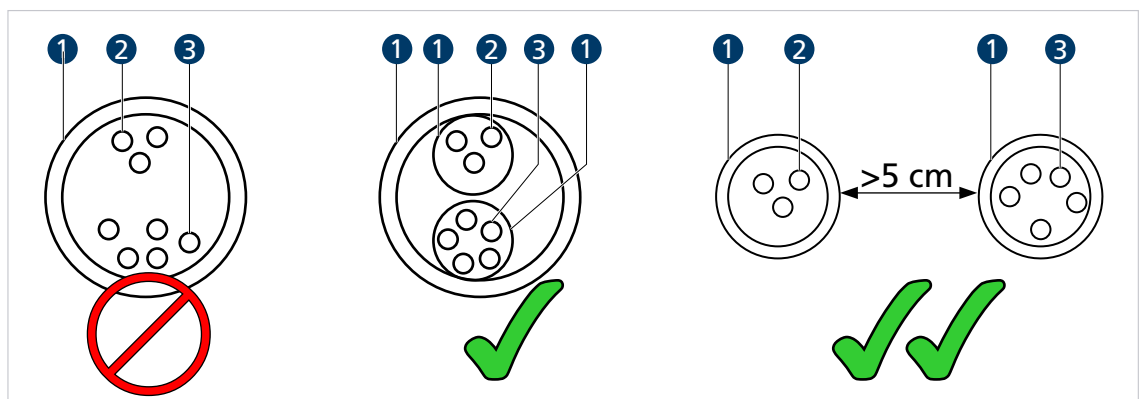


Fig. 35: Grouping and shielding of the cables

- 1 Shielding  
2 Motor phase

- 3 Hall sensor

## Installation

### 4.3.4 Shielding

- ▶ Shield cables in all cases.

Shield cables that are longer than 3 m with tightly meshed copper braiding.

- ▶ Shield all supply lines according to current guidelines/standards (e.g., IPC-A-620B) and connect using (round) shield clamp.

In special cases (e.g., with pigtail) or after qualification, the shield can be omitted for the following cables:

- Cables with length <50 cm
  - Cables with low power supplies (e.g., <20 V)
  - Sensor cables
- ▶ Connect shield clamps to a low-impedance (<0.3  $\Omega$ ) grounding bar or grounding plate.
  - ▶ Establish a star-point earth connection (see chap. 4.3.2, p. 50).
  - ▶ Lay the motor phases in a shield, separate from the sensor or encoder signals, and connect on at least the motor side (see 1 or 2 in Fig. 36).

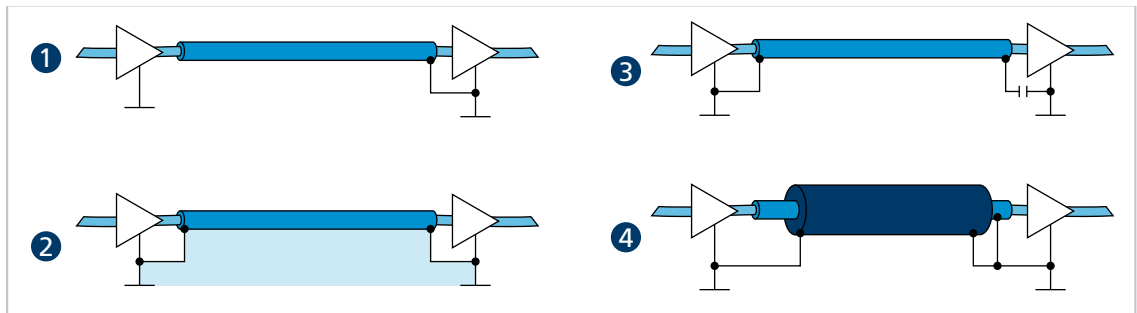


Fig. 36: Various possibilities for the shield connection

- 1 *Suppressing electrical fields*
- 2 *Alternating magnetic field*
- 3 *Interruption of the ground loop for direct currents or low-frequency currents*
- 4 *Discharging parasitic currents to the reference potential*

The sensor signals can optionally be laid with the motor phases in a shared cable/insulation hose using another outer braided shield. This outer braided shield must be connected at both ends (e.g., 4 in Fig. 36). A solution such as 2 in Fig. 36 is not functional in every case for this configuration. If this is not possible by means of a ground offset, establish the RF connection via specially suited capacitors (e.g., safety capacitors such as Y1/Y2/X1/X2, see 3 in Fig. 36). In this case, do not connect the shield multiple times except at the motor connection and controller side.

## Installation

### 4.3.4.1 Establishing the shield connection

The best results when establishing a shield connection on the cable are achieved in the following way:

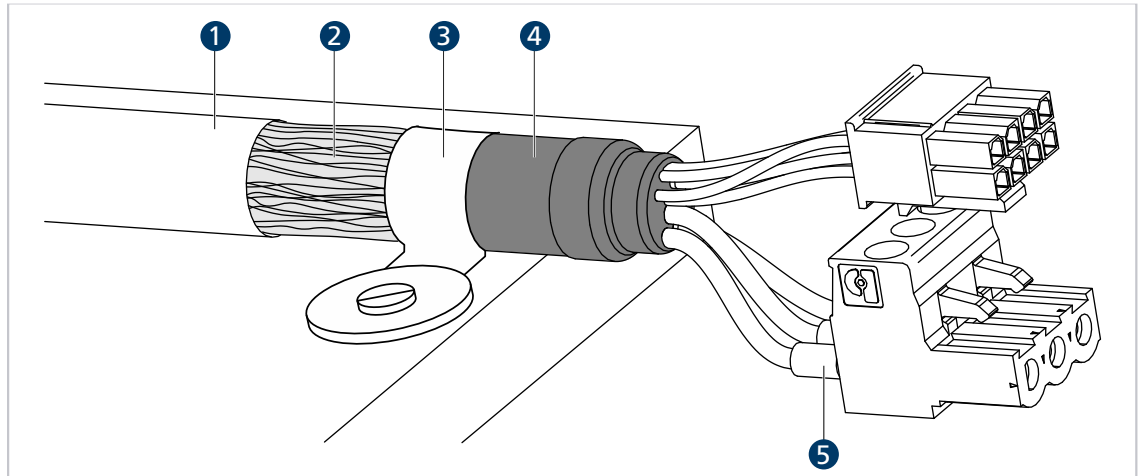


Fig. 37: Motor cable shield connection

- |   |                    |   |                    |
|---|--------------------|---|--------------------|
| 1 | Outer cable shield | 4 | Heat-shrink tubing |
| 2 | Braided shield     | 5 | Crimp-sleeve       |
| 3 | Shield clamp       |   |                    |

1. Remove approx. 50-100 mm from the outer cable shield (1). Make certain that none of the fibers of the braided shield (2) are destroyed.
2. Either push back the shield or roll it up and fasten with heat-shrink tubing (4).
3. Optionally fit crimp-sleeves on the cable ends (5) and attach to the plug connectors.
4. Fasten the shield and the fixed end of the heat-shrink tubing with a cable tie (3).

## Installation

### 4.3.4.2 Establishing shield connection with cable lug

A shield connection with cable lug should be avoided whenever possible. If it is necessary, however, the connection should be established as follows.

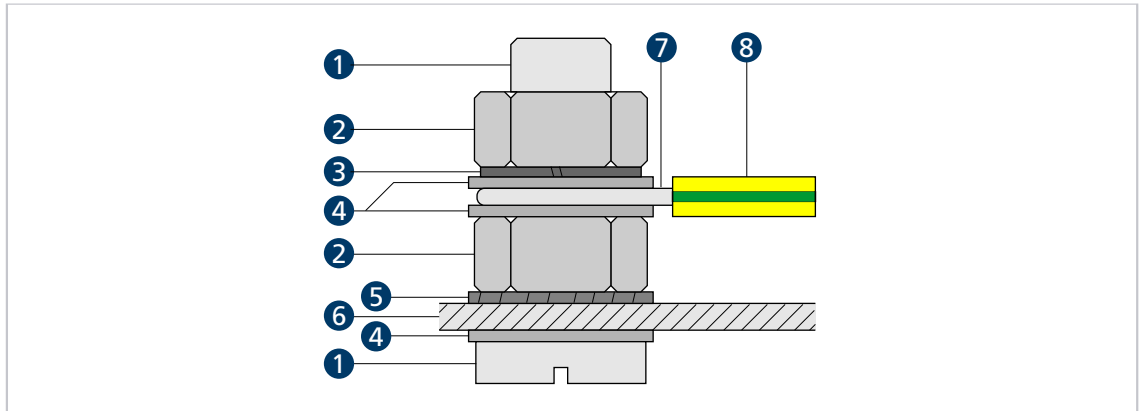


Fig. 38: Shield connection with cable lug

- |                 |                        |
|-----------------|------------------------|
| 1 Screw         | 5 Lock washer          |
| 2 Nut           | 6 Wall                 |
| 3 Spring washer | 7 Wire eyelet          |
| 4 Washer        | 8 Protective conductor |

1. Scrape the surface around the hole to remove as much of the oxide layer as possible.
2. Guide screw with washers through the cable lug.
3. Place lock washer on the screw.

Depending on the screw length, also position the lock washer against the roughened surface.

4. Fix screw with nut on the bottom side or screw into the thread.

## Installation

### 4.3.5 Sensor and encoder interfaces

Various solutions for different cable lengths are described in chap. 4.2.2, p. 23. The objective here should be to increase the signal quality to a reliably usable minimum.

The sensor systems used at FAULHABER for angle determination should be divided according to their useful frequency range. Depending on the frequency range, various filter measures are suitable.

- Analog Hall sensors (very low frequency)
- Digital Hall sensors and quadrature interfaces
- Absolute encoder

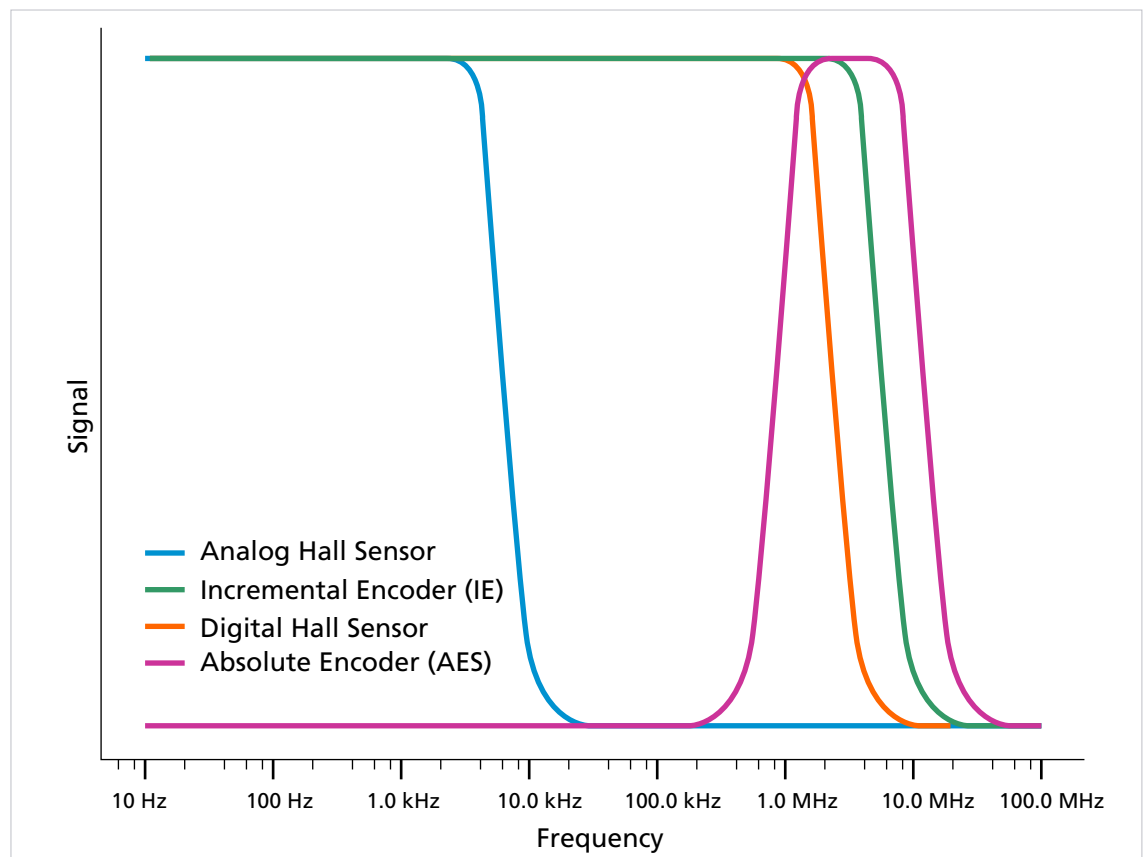


Fig. 39: Useful frequency ranges of the encoders

- ▶ To evaluate the interference on the signal (transmission quality), measure the signals.
- ▶ Make certain that no parasitic effects are measured. Select the reference potential correctly and measure directly on the controller if possible.

The following statement applies to all mentioned sensor systems: Differential signal transmission with line driver is an effective measure for increasing the interference immunity for longer cable lengths.


Additional measures for the various sensor systems can be found in the following sections.

## Installation


---


### 4.3.5.1 Analog sensors and analog Hall sensors

- ▶ Where possible, shield analog sensor cables and lay them apart from (shielded) motor cables.
- ▶ Connect the shield on one end, ideally on the motor side.

 The signal quality can be improved with a capacitor (470 nF, dielectric strength > 100 V) between device shield and sensor supply (+5 V).

### 4.3.5.2 Incremental encoders / Digital Hall sensors / Digital sensors

 Due to the increased signal hysteresis, digital Hall sensors are more robust than analog Hall sensors.


 Incremental encoders are robust due to a four-edge evaluation in the controller.

### 4.3.5.3 Encoders with absolute interface

- ▶ Connect the shield of the encoder lines on both ends.

On the controller side near the encoder plug connector, a terminating resistor of 120  $\Omega$  is highly recommended between Data+ and Data-. If necessary, this resistor must be integrated on the base board.

Alternatively, a so-called split termination can be used instead of the 120  $\Omega$  to increase the interference resistance. See also technical manual AEMTL (manual no. 7000.0x070).

 In the case of an absolute encoder interface, signal interference immediately results in invalid position values during the interference. A more interference-immune, differential data transmission is therefore advantageous.



## Installation

### 4.3.6 Using filters

The filters are divided into various function and current ranges.

Filter types:

- Input-side filters: filters on the power supply side
- Motor-side filters: filters that are connected between controller and motor in the motor phases

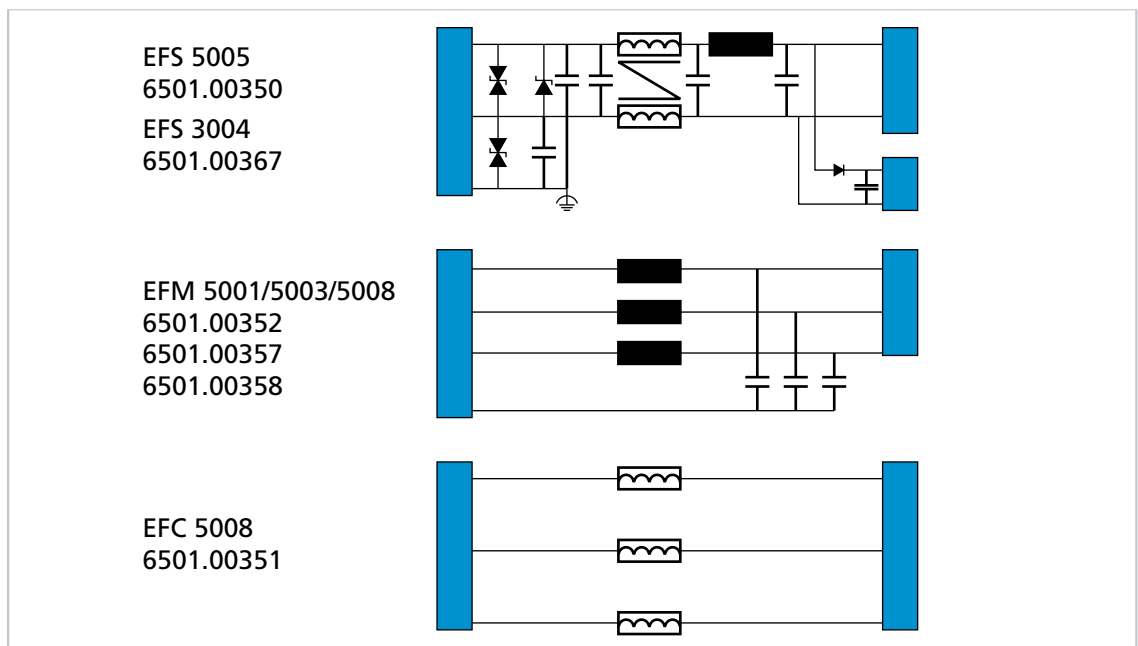


Fig. 40: Filter categories from FAULHABER

#### 4.3.6.1 PWM filter (motor-side)

The PWM filters are designed for the maximum motor supply voltage with a nominal value of 50 V (+10%) and allow a nominal motor current of 1, 3 or 8 ampere. With DC-motors, the supply line RMS value can be used. A peak current of 3 s can be assumed.

**i** The motor filters are only suitable for the PWM frequency of 100 kHz. Lower PWM frequencies must be explicitly tested, as the power losses increase at lower PWM frequency.

For the proper filter effect, all PWM filters require a 0 V connection, which should be connected as short as possible to the 0 V voltage (GND) of the motor supply (connection X5 of the supply side).

#### 4.3.6.2 Emission-reducing, ferrite-based filters (motor side)

These filters only require three phase connections. The 0 V return line (see chap. 4.3.6.1, p. 57) is not required. All PWM frequencies can be used. The filters reduce the rise time of the motor voltage/current and thereby reduce the high-frequency coupling currents on the shield.

## Installation

### 4.3.6.3 Input-side filters

The evaluation board is already equipped with measures that have an interference-reducing effect. Additional input-side filters (FAULHABER 6501.00367) are usually only needed in ambient conditions that place particular requirements on the interference resistance or if the emissions are noticeable. These filters are for applications that either cannot use the motor filter (e.g., integrated controllers) or in which the filtering by the motor filters is not sufficient.

In this case, two filtering measures are used:

- Measure comparable to large capacitors (approx.  $>100 \mu\text{F}$ ) as close as possible to the controller and, where possible, low-ESR capacitances
- Discharge of common-mode interference with a common-mode choke, a low-pass filter and capacitors between functional earth and DC power supply

### 4.3.6.4 Insulation resistance

The filters from FAULHABER are not intended for an insulation resistance test. Discharging of the common-mode interference with capacitors prevents a meaningful result from an insulation resistance test.

### 4.3.6.5 Coiling ferrite ring

Ideally, ferrites made of manganese-zinc material are used that are active in the 1...10 MHz range. Typical diameters are between 25 and 35 mm onto which two to three windings with all 3 motor phases are wound simultaneously.

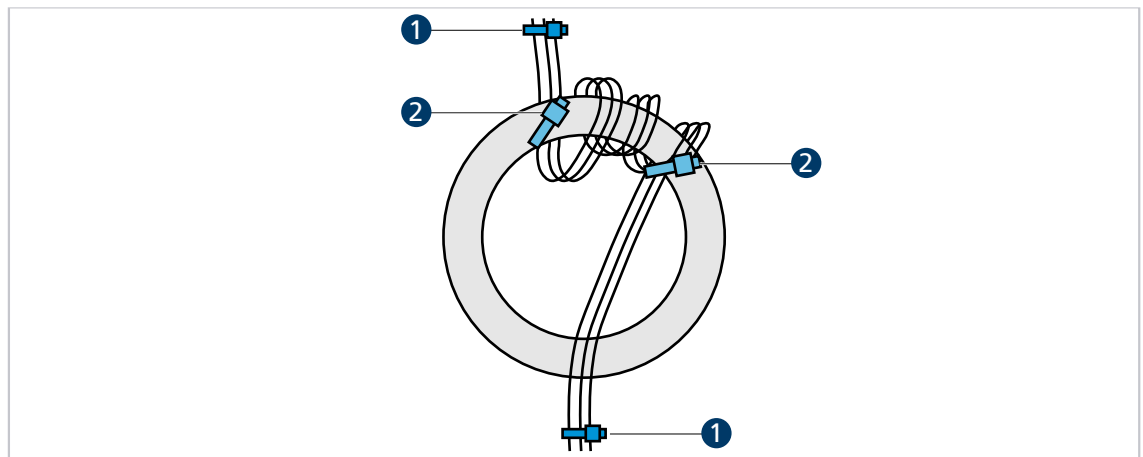


Fig. 41: Coiling ferrite ring

- 1 *Fastening the motor phase cables*      2 *Fastening on the ferrite ring (optional)*
1. Fasten motor phase cables, e.g., with cable ties (1), so that the motor side end of the cable points away from the user and the plug end of the cable points toward the user.
  2. Simultaneously guide all three phases through the ferrite ring from below.
  3. Guide the wound stranded wires back through the ring clockwise next to the first stranded wires so that a winding is created.
  4. Wrap 2 further windings directly next to the existing windings in the same way.
    - ↪ There are 9 stranded wires in the ferrite ring.
  5. Again secure the motor phase cables, e.g., with cable ties (2), on the ferrite ring.

## Installation

### 4.3.7 Error avoidance and troubleshooting

1. Can the problem clearly be traced back to the FAULHABER drive system?
  - a) Switch the output stage off and on.  
The voltage controller mode is suitable here.
  - b) Unplug controller supply voltages or operate controller via a separate external power supply used solely for this purpose.
  - c) If present, switch off unnecessary system components.
2. Have the measures shown in chap. 4.3.2, p. 50 been performed and tested?
  - a) Can a uniform ground potential be ensured, e.g., by using large cable cross sections?
  - b) Is the RF quality of the connections ensured?
    - Establish connection through metal-to-metal connection elements.
    - Remove paints or other insulating materials. Check that the shield connection is correct.
3. Were the recommended cables used?
  - a) Select motor cables in the accessory catalog.
  - b) Motor cables must be shielded as they otherwise act as an antenna.  
Unshielded cables could cause interference in the surrounding area. If uncertain, the shield can be doubled; for further information, see FAULHABER accessories catalog and chap. 4.3.4, p. 52.
4. Are the contacts correctly screwed down or properly plugged in?
5. Are the cables laid in accordance with the standards/directives (e.g., IPC-A-620B-2013)?
  - a) Sensor cables and encoders are to be laid at least 10 cm from the motor phases.
  - b) Lay sensor cables at least 10 cm from all other signal cables that are not also sensor cables. Alternatively, use absolute encoders and/or line drivers.
  - c) Keep cables away from high-voltage current and mains cables.
  - d) Only cross cables at an angle of 90°.
6. Is it necessary to use filters?
  - a) Use filters in the case of poor signal quality or if interference occurs/is to be expected.
  - b) Note the product listing in chap. 4.3.5, p. 55.

## Installation

### Conformity measurements

The following points must be observed during the conformity measurement:

| Conducted interference voltage measurement   | Radiated interference voltage measurement  |
|--|--|
| <ul style="list-style-type: none"> <li>When laying cables, remove all loops.</li> <li>Lay the cables with a meandering shape.</li> </ul>   | <ul style="list-style-type: none"> <li>Where possible, lay cables over a grounding plate.</li> </ul>   |
| <ul style="list-style-type: none"> <li>Connect the shield of the motor cable on the motor side and as close as possible on the controller side.</li> <li>The shield is to be connected over a large area, ideally with a round connection.</li> </ul>                | <ul style="list-style-type: none"> <li>The connection of the motor cable shield is to be as short as possible</li> <li>Keep the motor cable as short as possible.</li> </ul> |
| <ul style="list-style-type: none"> <li>Use an input filter. When selecting, pay attention to the difference of filter attenuation between 50 <math>\Omega</math> and realistic values 1/100 <math>\Omega</math> or 100/1 <math>\Omega</math> measurement.</li> </ul> | <ul style="list-style-type: none"> <li>Use a motor filter and keep the connection as short as possible.</li> </ul>   |
| <ul style="list-style-type: none"> <li>If possible, secure cable with shield clamps or with adhesive tape.</li> </ul>  |  |

## Maintenance and diagnostics

### 5 Maintenance and diagnostics

#### 5.1 Maintenance tasks

The drive is generally maintenance-free. Where the device is mounted in a cabinet, depending on the deposition of dust the air filter should be regularly checked and cleaned if necessary.

#### 5.2 Diagnosis

##### Motion Controller

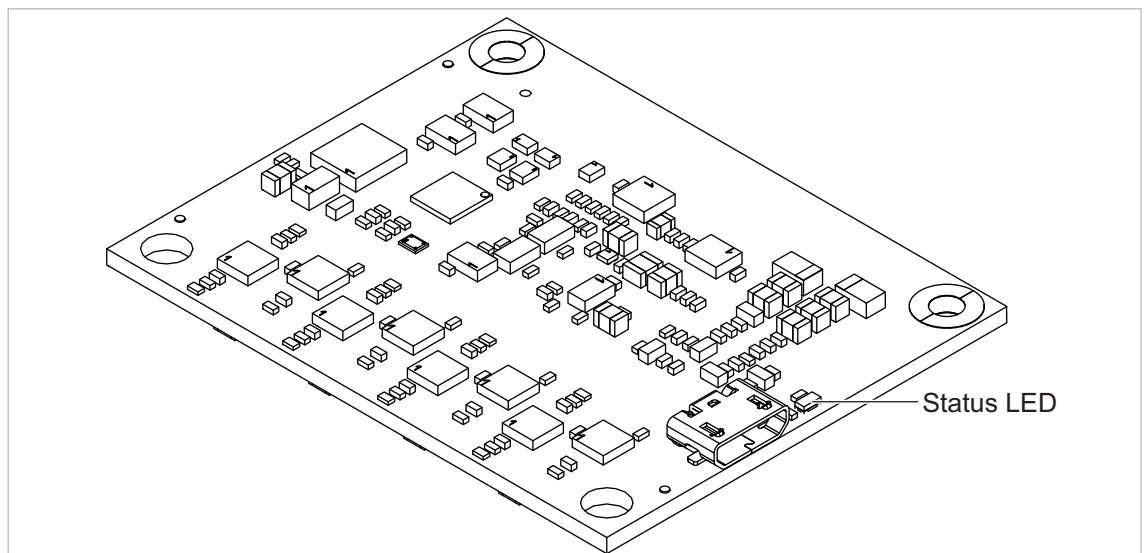


Fig. 42: MC 3602 B state LED

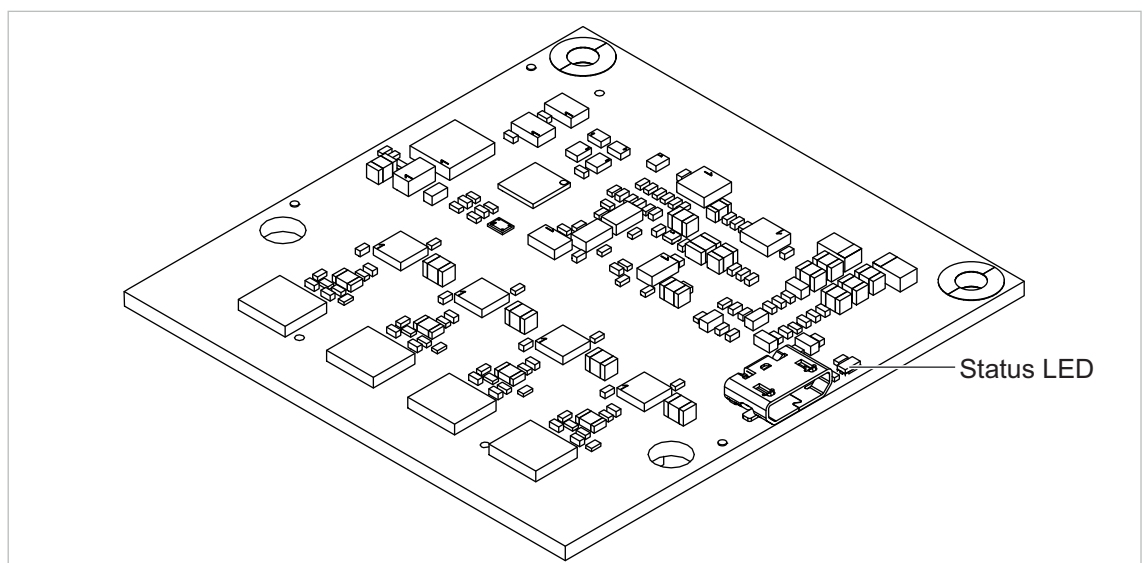



Fig. 43: MC 3606 B state LED

## Maintenance and diagnostics

Tab. 34: LED functions

| Designation | Function  |
|-------------|---|
| State LED   | <ul style="list-style-type: none"><li>Green (continuous light): Device active.</li><li>Green (flashing): Device active. However the state machine has not yet reached the <i>Operation Enabled</i> state.</li><li>Red (continuously flashing): The drive has switched to a fault state. The output stage will be switched off or has already been switched off.</li><li>Red (error code): Booting has failed. Please contact FAULHABER Support.</li></ul> |

### EtherCAT module

 You can find a description of the LED functions of the EtherCAT module in the separate manual (see chap. 1.2, p. 5).

## 5.3 Troubleshooting

If unexpected malfunctions occur during operation according to the intended use, please contact your support partner.

### 6 Accessories

Details of the following accessory parts can be found in the Accessories Manual:

- Connection cables
- Connectors
- Connector sets
- Installation aids
- Additional equipment

### 7 Warranty

Products of the company Dr. Fritz Faulhaber GmbH & Co. KG are produced using the most modern production methods and are subject to strict quality inspections. All sales and deliveries are performed exclusively on the basis of our General Conditions of Sale and Delivery which can be viewed on the FAULHABER home page [www.faulhaber.com/agb](http://www.faulhaber.com/agb) and downloaded from it.



## Additional documents

### 8 Additional documents

#### 8.1 Declaration of Conformity

##### EG–Konformitätserklärung EC Declaration of Conformity

mit gefordertem Inhalt gemäß ISO/IEC 17050-1  
with required content in accordance with ISO / IEC 17050-1

Dokument-Nr. / Monat, Jahr:  
Document-no. / month, year:

EG-00054-001 / 09.2024

Der Hersteller:  
The manufacturer:

**Dr. Fritz Faulhaber GmbH & Co. KG**  
Faulhaberstraße 1  
D-71101 Schönaich  
Germany

erklärt hiermit, dass das folgende Produkt  
declares that the following product

Produktbezeichnung:  
Product designation:

**MC3602 B RS/CO**  
**MC3602 B ET**  
**MC3606 B RS/CO**  
**MC3606 B ET**

Produkttyp:  
Product type:

**Motion Controller**  
**Motion Controller**

den grundlegenden Anforderungen entspricht, die in den nachfolgend bezeichneten  
Harmonisierungsrechtsvorschriften festgelegt sind:

*complies with the essential requirements of the following harmonization legislations:*

- Richtlinie 2011/65/EU des Europäischen Parlaments und des Rates vom 8.Juni 2011 zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten – **kurz: RoHS-Richtlinie**  
*Directive 2011/65 / EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment – short: RoHS directive*
- Richtlinie 2014/30/EU des Europäischen Parlaments und des Rates vom 26.Februar 2014 zur Angleichung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit – **kurz: EMV Richtlinie**  
*Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility – short: EMC directive*

Die Einhaltung dieser Richtlinie(n) setzt die Umsetzung aller in der technischen Dokumentation genannten Maßnahmen voraus.

*The measures indicated in all technical documents must be fulfilled in order to meet the requirements of this directive.*

DFF/FO\_0408 – 01 – 17.04.2018

## Additional documents

Die Konformität wird in Bezug auf folgende angewandte harmonisierte Normen erklärt:  
*The declared conformity relates to the following harmonized standards:*

Die Übereinstimmung mit den genannten EG-Richtlinien wurde durch Überprüfung gemäß folgender Fachgrundnormen nachgewiesen:  
*The conformity with the EC guidelines was proven according to the following references to the relevant harmonized standards used:*

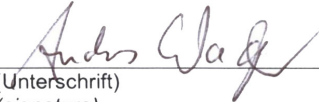
| Richtlinienbezug<br><i>Related to directive</i> | Fundstelle<br><i>Document</i> | Titel<br><i>Title</i>   |
|---|-------------------------------|---|
| RoHS-Richtlinie<br>RoHS Directive               | EN 50581:2012                 | Technische Dokumentation zur Beurteilung von Elektro- und Elektronikgeräten hinsichtlich der Beschränkung gefährlicher Stoffe |
| EMV Richtlinie<br>EMC directive                 | EN 61800-3:2018-09            | Drehzahlveränderbare elektrische Antriebe — Teil 3: EMV-Anforderungen einschließlich spezieller Prüfverfahren                 |
|   |                               |   |
|   |                               |   |
|   |                               |   |
|   |                               |   |
|   |                               |   |
|   |                               |   |
|   |                               |   |

Bevollmächtigter im Sinne des Anhangs II Nr. 1.A Nr. 2, 2006/42/EG für die Zusammenstellung der technischen Unterlagen:  
*Entitled person within the meaning of Annex II, point 1.A, No 2, 2006/42 / EC, for the compilation of technical documentation:*

Schönaich,

02.10.2024  
 (Datum)  
 (date)

Dr. Andreas Wagener  
 Head of Systems  
 Engineering  
 (Name, position)

  
 (Unterschrift)  
 (signature)

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung in Bezug auf die Erfüllung der grundlegenden Anforderung und die Anfertigung der technischen Unterlagen trägt der Hersteller / diese Erklärung wird verantwortlich für den Hersteller

*Only the producer is responsible for providing this declaration of conformity, regarding essential requirements and providing technical documentation / this declaration is, responsible for the manufacturer*

**Dr. Fritz Faulhaber GmbH & Co. KG**

Faulhaberstr. 1  
 D-71101 Schönaich  
 Germany

abgegeben durch  
*issued by*

Schönaich,

02.10.24  
 (Datum)  
 (date)

Dr. Udo Haberland  
 Geschäftsführung  
 (Name, Management)

  
 (Unterschrift)  
 (signature)

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Harmonisierungsrechtsvorschriften, beinhaltet jedoch keine Zusicherung von Eigenschaften.

*This declaration assures conformity with the standards and directives cited, but does not represent any guarantee of specific features.*

## Additional documents

---

Zusatzangaben:

*Additional information*

Diese Erklärung gilt für alle Exemplare, die in verschiedenen Leistungsdaten in dieser Serie hergestellt werden.

*This statement should be valid for all derivate produced according to the related construction drawings and electrical drawings, which are part of the technical documentation.*

DFF/FO\_0408 – 01- 17.04.2018

## Additional documents

### 8.2 Declaration of Incorporation

**Einbauerklärung nach Anhang II B,  
EG-Maschinenrichtlinie 2006/42/EG**  
*Installation Declaration according to Appendix II B,  
EC Machinery Directive 2006/42/EC*

Dokument-Nr./Monat.Jahr: EG-00055-001 / 09.2024  
*Document No./Month.Year:*

Der Hersteller: **Dr. Fritz Faulhaber GmbH & Co. KG**  
*The manufacturer:* Faulhaberstraße 1  
D-71101 Schönaich  
Germany

erklärt hiermit, dass es sich beim nachfolgend bezeichneten Produkt um eine Einbaukomponente (siehe unten) handelt und diese zum Einbau in eine Maschine bestimmt ist. Die Inbetriebnahme dieser unvollständigen Maschine ist solange untersagt, bis festgestellt wurde, dass die Gesamtmaschine, in die diese Komponente eingebaut werden soll, den grundlegenden Schutzanforderungen der hier genannten EG-Maschinenrichtlinie 2006/42/EG entspricht.

*herewith declares that the product designated below is an installable component (see below), and that it is intended for installation in a machine. It is prohibited to bring this incomplete machine into service until it has been proven that the machine as a whole in which this component is to be installed meets the basic safety requirements of the here mentioned EC Machinery Directive 2006/42/EC.*

Einbaukomponente: **MC3602 B RS/CO**  
*Installable component::* **MC3602 B ET**  
**MC3606 B RS/CO**  
**MC3606 B ET**

Produkttyp: **Motion Controller**  
*Product type:* **Motion Controller**

Gemäß Anhang VII Teil B der EG-Maschinenrichtlinie 2006/42/EG wurden spezielle technische Unterlagen für diese unvollständige Maschine erstellt. Durch begründetes Verlangen einzelstaatlicher Stellen können diese in elektronischer Form übermittelt werden.

*Pursuant to Appendix VII, Part B of the EC Machinery Directive 2006/42/EC, specific technical documents have been created for this incomplete machine. On reasoned request by national authorities these documents may be transmitted in machine-readable format.*

Der Bevollmächtigte für die Zusammenstellung und Übermittlung der relevanten technischen Unterlagen ist:  
*The person responsible for the compilation and transmission of the relevant technical documents is:*

Dr. Andreas Wagener, Dr. Fritz Faulhaber GmbH & Co. KG, Faulhaberstraße 1, 71101 Schönaich, Germany.

Schönaich, 02.10.24  
(Datum)  
(Date)

Dr. Udo Haberland,  
Geschäftsführung  
(Name, Chairman)

  
(Unterschrift)  
(Signature)

