

Technical Manual

MCBL 3002/03/06 RS/CF/CO

MCDC 3002/03/06 RS/CF/CO

MCLM 3002/03/06 RS/CF/CO

MCBL 3002/03/06 AES RS/CF/CO

Imprint

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

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About this document

1 About this document

1.1 Validity of this document

This document describes the installation and use of the following series:

- MCBL 3002/03/06 RS/CF/CO
- MCDC 3002/03/06 RS/CF/CO
- MCLM 3002/03/06 RS/CF/CO
- MCBL 3002/03/06 AES RS/CF/CO

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 |
|--------------------------------------|---|
| Communications and Functional Manual | Interface description – RS232 |
| Communications and Functional Manual | Interface description – CANopen with FAULHABER channel |
| Communications and Functional Manual | Interface description – CANopen CiA 402 |
| Software manual | Operating instructions for FAULHABER Motion Manager PC software |

These manuals can be downloaded in pdf format from the web page www.faulhaber.com/manuals.

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 |
|--------------|---|
| AnIn | Analog input |
| AGND | Analog Ground |
| CAN | Controller Area Network |
| CAN_L | CAN-Low |
| CAN_H | CAN-High |
| CF | Controller with CANopen interface (Faulhaber channel) |
| CLK | Clock |
| CO | Controller with CANopen interface acc. to CiA 402 |
| CS | Chip Select |
| Data | Data cable |
| DigIn | Digital input |
| DigOut | Digital output |
| EFC | Electronics Filter Conformity |
| EFM | Electronics Filter Motor |
| EFS | Electronics Filter Supply |
| EMC | Electromagnetic compatibility |
| ESD | Electrostatic discharge |
| FAULT | Fault output |
| GND | Ground |
| PLC | Programmable Logic Controller |
| PWM | Pulse Width Modulation |
| RS | Controller with serial RS232 interface |
| RxD | Receive Data |
| TTL | Transistor Transistor Logic |
| TxD | Transmit data |

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 for use for control and positioning tasks for the following motors:

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

Thanks to their compact design, the units can be used in a wide variety of applications and require only basic wiring:

- 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 is **not** suitable for use in combination with stepper motors.
- 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.

Safety

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

- ▶ Keep foreign objects away from the electronics.
- ▶ 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. 7, p. 47.

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.

Product description

3 Product description

3.1 General product description

The FAULHABER Motion Controllers are based on a high-performance digital signal processor (DSP) that enables high control accuracy, exact positioning and very low speeds.

The Motion Controllers are designed for various drive applications, which can be configured using the respective communication interface.

Depending on the version, the following tasks can be performed:

- Motion control with analogue or digital setpoint specification
- Speed control with analog or digital setpoint specification
- Detection of reference marks and limit switches
- Advanced operating modes such as stepper motor operation, electronic gearheads, voltage controller mode or current control with analog current setting
- Execution of sequence programs stored in the controller (only with version RS)

Various inputs and outputs are available for implementing these tasks:

| Input/output | Possible applications |
|----------------------------|--|
| Analog input | <ul style="list-style-type: none"> ■ Setpoint specification via analogue or PWM signal ■ Digital input for reference marks and limit switches ■ Pulse input ■ Incremental encoder connection |
| Fault output | <ul style="list-style-type: none"> ■ Digital output ■ Pulse output ■ Digital input for reference marks and limit switches ■ Rotation direction input |
| 1 additional digital input | Digital input for reference marks and limit switches |
| Communications interface | Depending on the version, as serial RS232 or CAN interface for coupling to PC or controller |

The set configuration can be stored permanently.

i Motion Controllers with RS232 interface can also be operated independently of the communication interface if a pre-programmed function or sequence program has been programmed without digital command control.

i As an option, the motor and control electronics can be supplied with power separately (important for safety-relevant applications). In this case, the 3rd input is no longer available.

Special preconfiguration of the modes and parameters is possible on request.

Product description

3.2 Product information

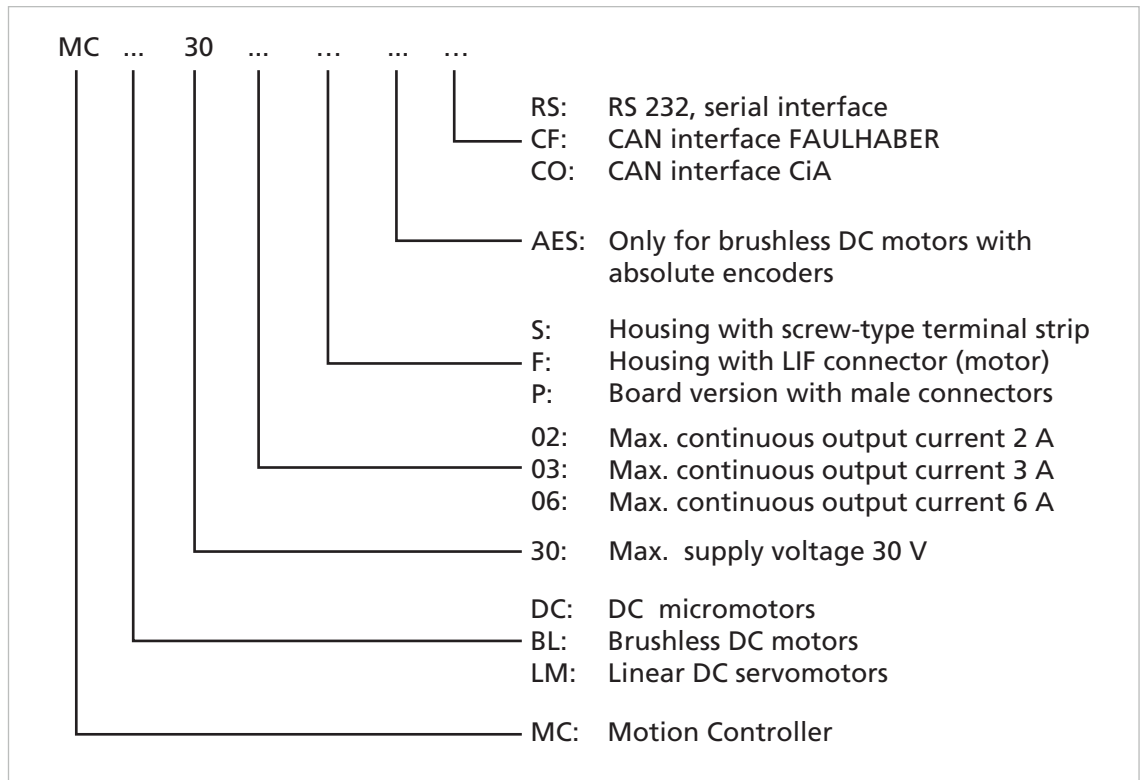


Fig. 2: Designation key

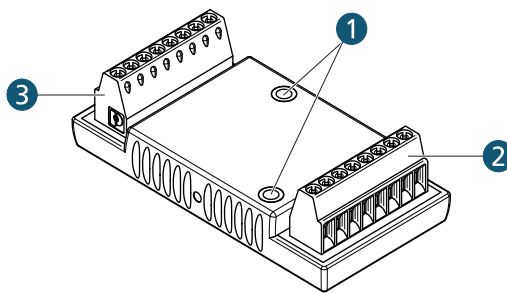
Product description

3.3 Product variants

3.3.1 Motion Controllers for motors in the lower power range

3.3.1.1 MCxx 3002 S RS/CF/CO

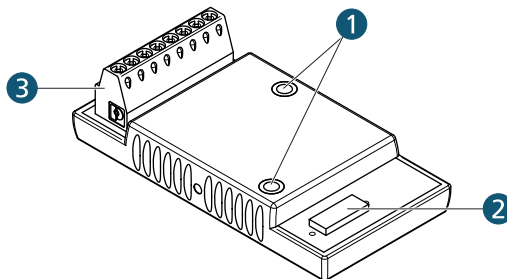
Motion Controller with hot-melt housing and screw terminals on the supply and motor side.



- 1 Assembly sleeves
- 2 Screw terminal block on the motor side
- 3 Screw terminal block on the supply side

3.3.1.2 MCxx 3002 F RS/CF/CO

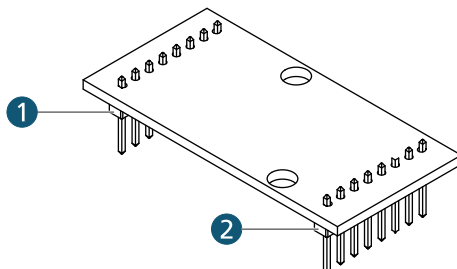
Motion Controller with hot-melt housing and screw terminals on the supply side and with flexboard connection on the motor side.



- 1 Assembly sleeves
- 2 LIF plug connector on the motor side for FFC and FPC, 8-pole
- 3 Screw terminal block on the supply side

3.3.1.3 MCxx 3002 P RS/CF/CO

Motion Controller without housing (board version) with plug connectors on the supply and motor side.

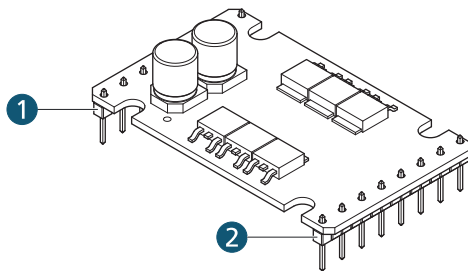


- 1 Plug connector on the supply side
- 2 Plug connector on the motor side

Product description

3.3.1.4 MCxx 3003 P RS/CF/CO

Motion Controller without housing (board version) with plug connectors on the supply and motor side.

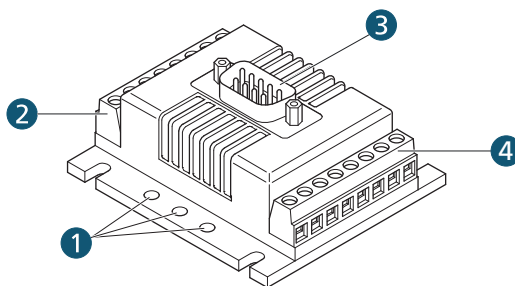


- 1 Plug connector on the supply side
- 2 Plug connector on the motor side

3.3.2 Motion Controller for motors in the higher power range

3.3.2.1 MCxx 3006 S RS/CF/CO

Motion Controller with metal housing and screw terminals on the supply and motor side.



- 1 Mounting holes
- 2 Screw terminal block on the supply side
- 3 D-sub connector for serial connection (RS) or CAN connection (CF/CO)
- 4 Screw terminal block on the motor side

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)?

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.

Installation

⚠ 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 Install Motion Controller with housing

NOTICE!

Pressing out of the assembly sleeves.

On a soft or uneven surface, the assembly sleeves can be pushed out while screwing on the Motion Controller.

- ▶ Select a smooth and hard surface that supports the assembly sleeves against the screwing forces.

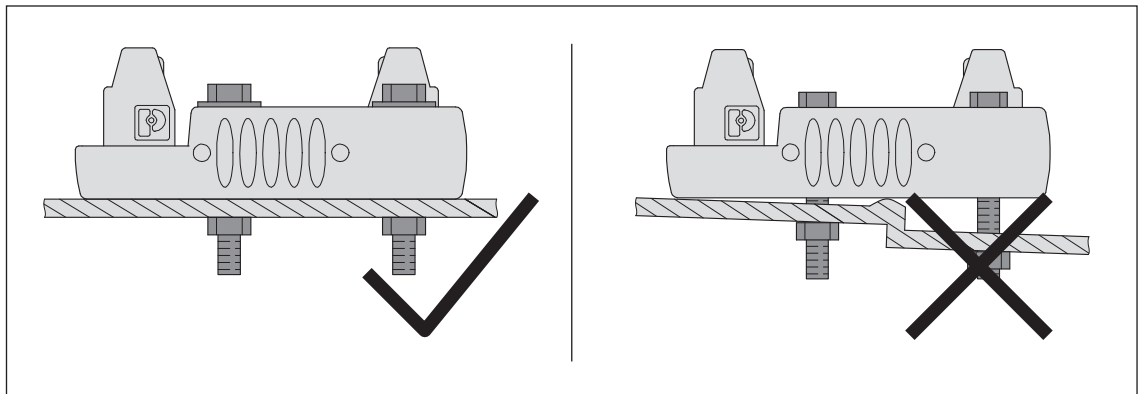


Fig. 3: Mounting (example)

1. Secure the Motion Controller at the assembly sleeves or mounting holes with fastening screws on a flat and hard surface (for screw size and torque, see Tab. 1).
2. Protect the fastening screws to prevent displacement due to the effect of heat.

Tab. 1: Attachment specifications

| Motion Controller | Min. tightening torque (Ncm) | Max. tightening torque (Ncm) |
|----------------------|------------------------------|------------------------------|
| MCxx 3002 S RS/CF/CO | 12 | 15 |
| MCxx 3002 F RS/CF/CO | 12 | 15 |
| MCxx 3006 S RS/CF/CO | 50 | 60 |

Installation

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!

Excessive force can damage the flexboard.

- ▶ Do not press in the plug connectors by force.
- ▶ Use a suitable tool (tweezers, flat-nose pliers) if necessary.
- ▶ Do not pinch the flexboard.

4.2.2 Electrical connection of the Motion Controller

NOTICE!

Risk of damage caused by inadequately dimensioned power supply unit.

Using an inadequately dimensioned power supply unit can result in malfunctions.

- ▶ Make sure that the power supply unit is adequately dimensioned.

i With the exception of the power supply, all connection cables on the supply side must not exceed a length of 3 m. The maximum permissible length of the motor connection cable is dependent on the used encoder type (see Tab. 2). Whether or not a longer motor connection cable may be used must be checked on a case-by-case basis.

Tab. 2: Recommended values for the lengths of the motor connection cable

| Encoder type | Length of the motor connection cable, unshielded | Length of the motor connection cable, shielded |
|--------------|---|--|
| Analog Hall | 0.3 m | 2.0 m |
| IE2/IE3 | 0.5 m | On request |
| IE3L | Several meters, dependent on speed and resolution | On request |
| AES | 0.3 m | On request |

To ensure the allowable emissions or necessary immunity in industrial use, it may be necessary to use an EMC filter and / or shielding or an EMC suppressor circuit.

Installation

- ✓ The connection cables are <3 m
- 1. Take the appropriate EMC protective measures (see chap. 4.3, p. 32).
- 2. Take the appropriate ESD protective measures.
- 3. Connect wires or flexboard according to pin assignment (see chap. 4.2.3, p. 20).
- 4. Connect the power supply as described in the explanation below.

There are 2 options for supplying power to the motor and the FAULHABER Motion Controller:

Power supply with common electronics supply

In the case of power supply with common electronics supply, the controller and motor are switched off simultaneously if a fault occurs. After interruption of the power supply, the reference run must be performed again.

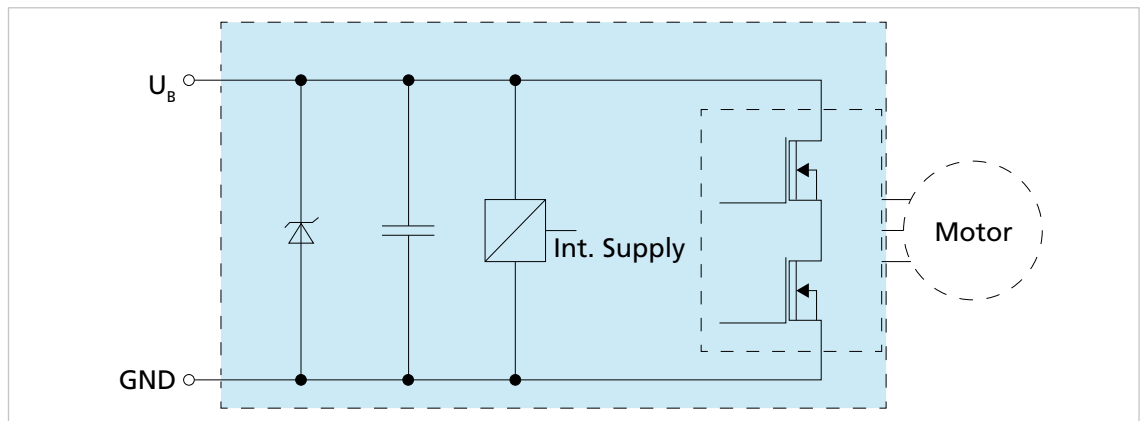


Fig. 4: Circuit diagram – common electronics supply

Power supply with separate electronics supply (option 3085)

In the case of power supply with separate electronics supply, the motor supply can be switched off (e.g. by means of a safety relay) in the event of a fault while the controller continues to be supplied. As a result, the reference run does not need to be performed again after a fault because the sensor supply of the motor was maintained during the fault. In the case of a separate electronics supply, power is supplied using the connection 3.In / U_{EL} in addition to the connection U_B . Motion Controllers with a separate electronics supply do not therefore have a third digital input.

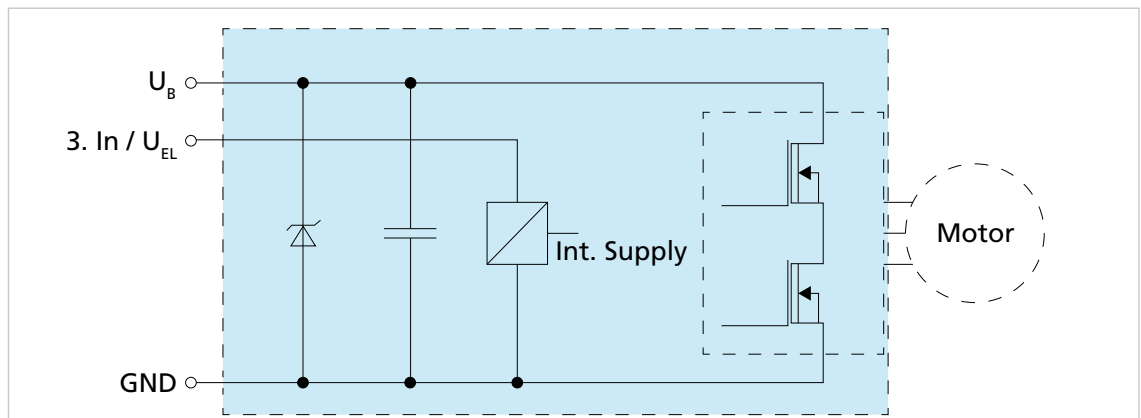
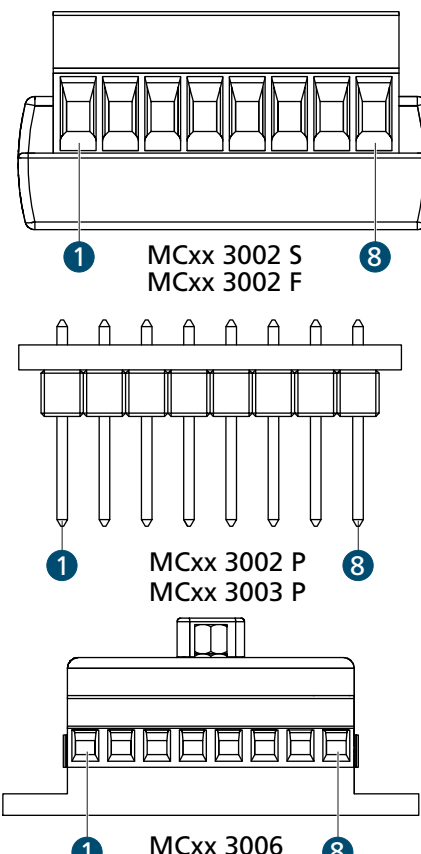


Fig. 5: Circuit diagram – separate electronics supply

Installation

4.2.3 Connections

4.2.3.1 Connections on the supply side (MCxx 3002/3003/3006)

| | Pin | Designation | Meaning |
|--|-----|-------------|--|
|  | 1 | TxD/CAN_H | RS232/CAN interface |
| | 2 | RxD/CAN_L | RS232/CAN interface |
| | 3 | AGND | Analog Ground |
| | 4 | Fault | Fault output |
| | 5 | AnIn | Analog input |
| | 6 | U_B | Power supply for controllers |
| | 7 | GND | Ground connection for controllers |
| | 8 | 3. In | 3. Input / opt. separated power supply |

Tab. 3: Electrical data - connections of the Motion Controllers on the supply side

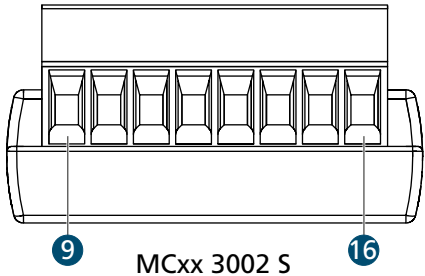
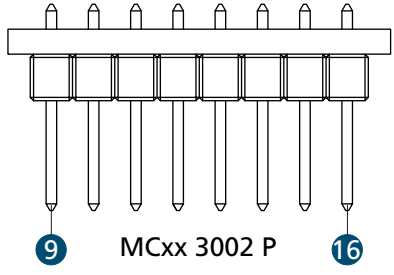
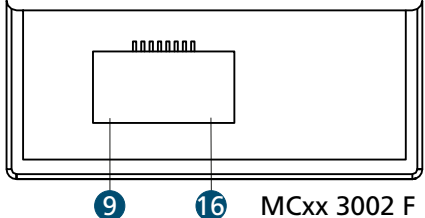
| Pin | Use | Designation | Value |
|--------------------------------|----------------------------------|---------------------------------|---|
| 1 (TxD/CAN_H) 2 (RxD/CAN_L) | – | Connection of the communication | – |
| 3 (AGND) | Analog Ground | Analog ground reference | – |
| | Digital input (external encoder) | Input resistance | Channel B $R_{in} = 10 \text{ k}\Omega$ |
| | | Frequency | $f \leq 400 \text{ kHz}$ |
| 4 (fault) | Digital input | Input resistance | $R_{in} = 100 \text{ k}\Omega$ |
| | Digital output (open collector) | Voltage limit | $U_{max} = U_B$ |
| | | Current limitation | $I_{max} = 30 \text{ mA}$ |
| | | Switch states (digital output) | <ul style="list-style-type: none"> clear: switched through to GND set: high resistance |
| | | Switch states (fault output) | <ul style="list-style-type: none"> No fault: switched through to GND Fault: high resistance |

Installation

| Pin | Use | Designation | Value |
|-------------|---------------------------------|---|---|
| | | Pulsed output (MCBL and MCLM only) | $f \leq 2 \text{ kHz}$ Resolution: 1...255 increments/revolution |
| 5 (AnIn) | | | AGND as ground reference |
| | Analog input | Speed set value/position set value | $U_{in} = \pm 10 \text{ V}$ |
| | Digital input | Speed set value via PWM signal (not MCLM) | $f = 100...2\,000 \text{ Hz}$ $T = 50\% \pm 0 \text{ min}^{-1}$ |
| | | External encoders | Channel A $f \leq 400 \text{ kHz}$ |
| | | Step frequency input | $f \leq 400 \text{ kHz}$ $R_{in} = 5 \text{ k}\Omega$ |
| 6 (U_B) | – | Power supply | $U_B = 8...30 \text{ V DC}$ (MCxx 3002) $U_B = 12...30 \text{ V DC}$ (MCxx 3003 and MCxx 3006) |
| 7 (GND) | – | Ground | – |
| 8 (3. In) | Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | Power supply of the electronics | Power supply | $U_{EL} = 8...30 \text{ V DC}$ (MCxx 3002) $U_{EL} = 12...30 \text{ V DC}$ (MCxx 3003 and MCxx 3006) |

4.2.3.2 MCDC 3002 connections on the motor side

Tab. 4: Pin assignment of the screw terminal block/plug connector on the motor side

| | Pin | Designation | Meaning |
|--|-----|-------------|--|
|  <p>MCxx 3002 S</p> | 9 | 4. In | 4. Input |
| | 10 | Ch A | Encoder channel A |
| | 11 | Ch B | Encoder channel B |
| | 12 | U_{CC} | Power supply for external consumer loads |
| | 13 | SGND | Ground connection of the signal |
| | 14 | Mot + | Power supply of the motor + |
| | 15 | Mot – | Power supply of the motor – |
| | 16 | 5. In | 5. Input |
|  <p>MCxx 3002 P</p> | | | |
|  <p>MCxx 3002 F</p> | | | |

Installation

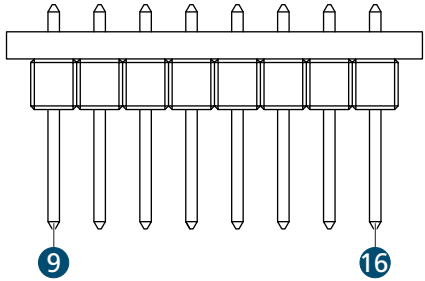
Tab. 5: Electrical data - connections of the MCDC 3002 Motion Controllers on the motor side

| Pin | Designation | Value |
|-----------------------------|--|---|
| 9 (4. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...4.5 V, High: 12.5 V... U_B |
| | TTL level | Low: 0...0.5 V, High: 2.5 V... U_B |
| 10 (Ch A) 11 (Ch B) | Encoder input | Integrated pull-up resistor after +5 V: $R = 2.2 \text{ k}\Omega$ $f \leq 400 \text{ kHz}$ |
| 12 (U_{CC}) | Output voltage for external use (e.g., encoders) | $U_{out} = 5 \text{ V}$ |
| | Load current | $I_{out} \leq 60 \text{ mA}$ |
| 13 (SGND) | Signal ground | – |
| 14 (Mot +) 15 (Mot –) | Motor connection | <ul style="list-style-type: none"> ▪ Clockwise rotation with homopolar connection ▪ Anticlockwise rotation with oppositely poled connection |
| | Output voltage | $U_{out} = 0...U_B$ |
| | PWM switching frequency | $f_{PWM} = 78.12 \text{ kHz}$ |
| 16 (5. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...4.5 V, High: 12.5 V... U_B |
| | TTL level | Low: 0...0.5 V, High: 2.5 V... U_B |

Installation

4.2.3.3 MCDC 3003 connections on the motor side

Tab. 6: Pin assignment of the plug connector on the motor side

| | Pin | Designation | Meaning |
|---|-----|-----------------|--|
|  | 9 | 5. In | 5. Input |
| | 10 | 4. In | 4. Input |
| | 11 | Ch A | Encoder channel A |
| | 12 | Ch B | Encoder channel B |
| | 13 | U _{CC} | Power supply for external consumer loads |
| | 14 | SGND | Ground connection of the signal |
| | 15 | Mot + | Power supply of the motor + |
| | 16 | Mot - | Power supply of the motor - |

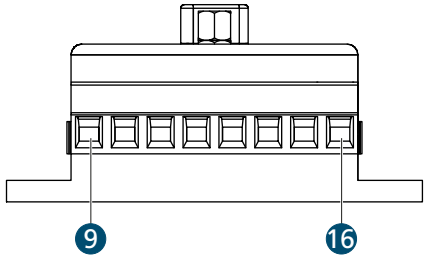
Tab. 7: Electrical data - connections of the MCDC 3003 Motion Controllers on the motor side

| Pin | Designation | Value |
|-----------------------------|--|---|
| 9 (5. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...7 V, High: 12.5 V...U _B |
| | TTL level | Low: 0...0.5 V, High: 3.5 V...U _B |
| 10 (4. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...7 V, High: 12.5 V...U _B |
| | TTL level | Low: 0...0.5 V, High: 3.5 V...U _B |
| 11 (Ch A) 12 (Ch B) | Encoder input | Integrated pull-up resistor after +5 V: $R=2.2 \text{ k}\Omega$ $f \leq 400 \text{ kHz}$ |
| 13 (U _{CC}) | Output voltage for external use (e.g., encoders) | $U_{out} = 5 \text{ V}$ |
| | Load current | $I_{out} \leq 60 \text{ mA}$ |
| 14 (SGND) | Signal ground | - |
| 15 (Mot +) 16 (Mot -) | Motor connection | <ul style="list-style-type: none"> ▪ Clockwise rotation with homopolar connection ▪ Anticlockwise rotation with oppositely poled connection |
| | Output voltage | $U_{out} = 0...U_B$ |
| | PWM switching frequency | $f_{PWM} = 78.12 \text{ kHz}$ |

Installation

4.2.3.4 MCDC 3006 connections on the motor side

Tab. 8: Pin assignment of the screw terminal block on the motor side

| | Pin | Designation | Meaning |
|---|-----|-----------------|--|
|  | 9 | 5. In | 5. Input |
| | 10 | 4. In | 4. Input |
| | 11 | Ch A | Encoder channel A |
| | 12 | Ch B | Encoder channel B |
| | 13 | U _{CC} | Power supply for external consumer loads |
| | 14 | SGND | Ground connection of the signal |
| | 15 | Mot + | Power supply of the motor + |
| | 16 | Mot - | Power supply of the motor - |

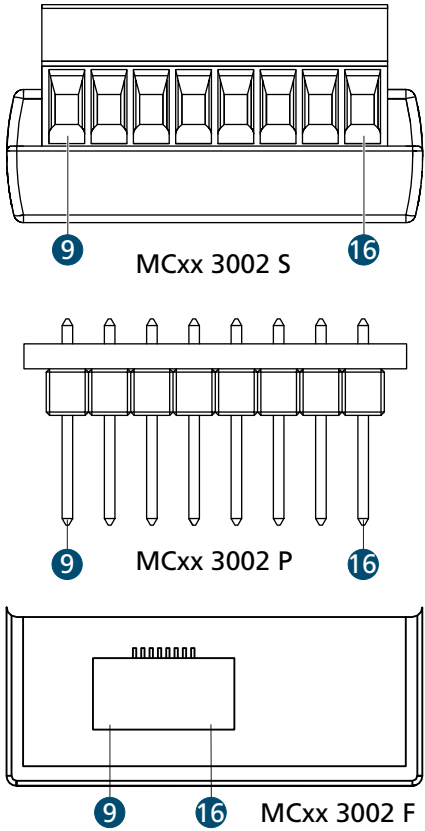
Tab. 9: Electrical data - connections of the MCDC 3006 Motion Controllers on the motor side

| Pin | Designation | Value |
|-----------------------------|--|---|
| 9 (5. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...7 V, High: 12.5 V...U _B |
| | TTL level | Low: 0...0.5 V, High: 3.5 V...U _B |
| 10 (4. In) Digital input | Input resistance | $R_{in} = 22 \text{ k}\Omega$ |
| | PLC level | Low: 0...7 V, High: 12.5 V...U _B |
| | TTL level | Low: 0...0.5 V, High: 3.5 V...U _B |
| 11 (Ch A) 12 (Ch B) | Encoder input | Integrated pull-up resistor after +5 V: $R=2.2 \text{ k}\Omega$ $f \leq 400 \text{ kHz}$ |
| 13 (U _{CC}) | Output voltage for external use (e.g., encoders) | $U_{out} = 5 \text{ V}$ |
| | Load current | $I_{out} \leq 60 \text{ mA}$ |
| 14 (SGND) | Signal ground | – |
| 15 (Mot +) 16 (Mot -) | Motor connection | <ul style="list-style-type: none"> ▪ Clockwise rotation with homopolar connection ▪ Anticlockwise rotation with oppositely poled connection |
| | Output voltage | $U_{out} = 0...U_B$ |
| | PWM switching frequency | $f_{PWM} = 78.12 \text{ kHz}$ |

Installation

4.2.3.5 MCBL/MCLM 3002 connections on the motor side

Tab. 10: Pin assignment of the plug connector/screw terminal block on the motor side

| | Pin | Designation | Meaning | |
|--|-----|-----------------|--|--|
|  | 9 | Sensor A | Hall sensor A / DATA for absolute encoders | |
| | 10 | Sensor B | Hall sensor B / CS for absolute encoders | |
| | 11 | Sensor C | Hall sensor C / CLK for absolute encoders | |
| | 12 | U _{CC} | Power supply for external consumer loads | |
| | 13 | SGND | Ground connection of the signal | |
| | 14 | Motor A | Motor phase A | |
| | 15 | Motor B | Motor phase B | |
| | 16 | Motor C | Motor phase C | |
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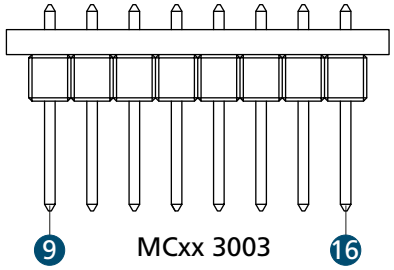
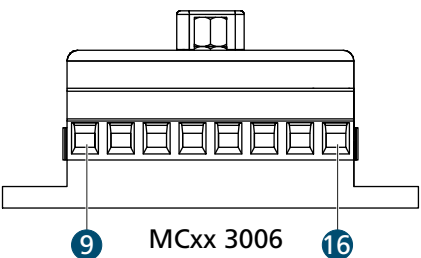
Tab. 11: Electrical data - connections of the MCBL/MCLM 3002 Motion Controllers on the motor side

| Pin | Designation | Value |
|-----------------------|--|-------------------------------|
| 9 (Sensor A) | Hall sensor input voltage | $U_{in} \leq 5 \text{ V}$ |
| 10 (Sensor B) | | |
| 11 (Sensor C) | | |
| 12 (U _{CC}) | Output voltage for external use (e.g., Hall sensors) | $U_{out} = 5 \text{ V}$ |
| | Load current | $I_{out} \leq 60 \text{ mA}$ |
| 13 (SGND) | Signal ground | – |
| 14 (Motor A) | Motor connection | Phase A |
| 15 (Motor B) | | Phase B |
| 16 (Motor C) | | Phase C |
| | Output voltage | $U_{out} = 0 \dots U_B$ |
| | PWM switching frequency | $f_{PWM} = 78.12 \text{ kHz}$ |

Installation

4.2.3.6 MCBL/MCLM 3003/3006 connections on the motor side

Tab. 12: Pin assignment of the plug connector/screw terminal block on the motor side

| | Pin | Designation | Meaning |
|--|-----|-----------------|--|
|  | 9 | Sensor A | Hall sensor A / DATA for absolute encoders |
| | 10 | Sensor B | Hall sensor B / CS for absolute encoders |
|  | 11 | Sensor C | Hall sensor C / CLK for absolute encoders |
| | 12 | U _{CC} | Power supply for external consumer loads |
| | 13 | SGND | Ground connection of the signal |
| | 14 | Motor A | Motor phase A |
| | 15 | Motor B | Motor phase B |
| | 16 | Motor C | Motor phase C |

i The pin assignment on the motor side is not compatible with previous controller versions.

Tab. 13: Electrical data - connections of the MCBL/MCLM 3002 Motion Controllers on the motor side

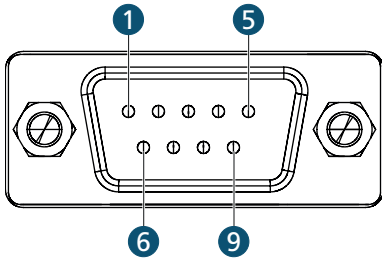
| Pin | Designation | Value |
|-----------------------|--|-------------------------------|
| 9 (Sensor A) | Hall sensor input voltage | $U_{in} \leq 5 \text{ V}$ |
| 10 (Sensor B) | | |
| 11 (Sensor C) | | |
| 12 (U _{CC}) | Output voltage for external use (e.g., Hall sensors) | $U_{out} = 5 \text{ V}$ |
| | Load current | $I_{out} \leq 60 \text{ mA}$ |
| 13 (SGND) | Signal ground | – |
| 14 (Motor A) | Motor connection | Phase A |
| 15 (Motor B) | | Phase B |
| 16 (Motor C) | | Phase C |
| | Output voltage | $U_{out} = 0 \dots U_B$ |
| | PWM switching frequency | $f_{PWM} = 78.12 \text{ kHz}$ |

Installation

4.2.3.7 MCxx 3006 D-sub connector

Tab. 14: Pin assignment of the D-sub connector

| Pin | RS232 | CAN |
|-----|-------|-------|
| 2 | RxD | CAN-L |
| 3 | TxD | GND |
| 5 | GND | - |
| 7 | - | CAN-H |



4.2.4 I/O circuit diagrams

4.2.4.1 Analog input

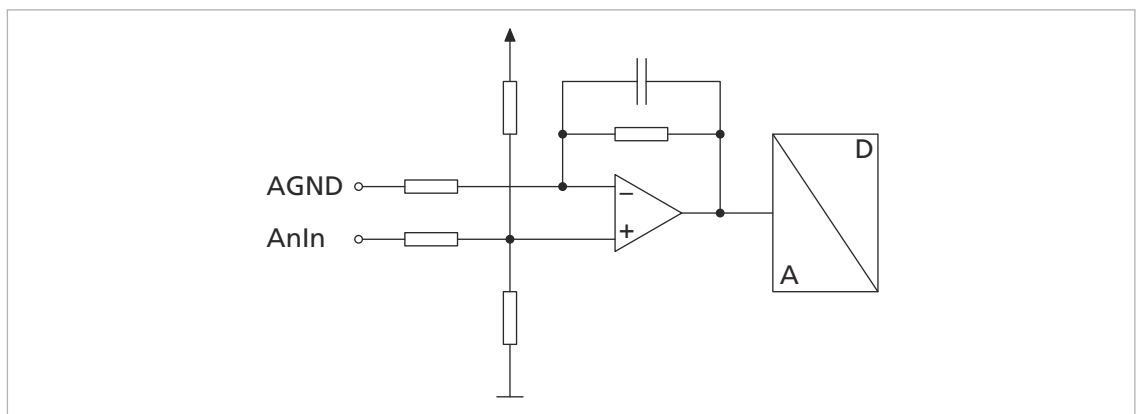


Fig. 6: Analog input circuit diagram (internal)

The analog input is a differential input. The analog GND should be connected to the power supply GND. This prevents the voltage drop in the supply conductor from affecting the speed specification value. Depending on options and configuration, the analogue input serves different purposes (see Communications and Functional Manual).

4.2.4.2 Digital input

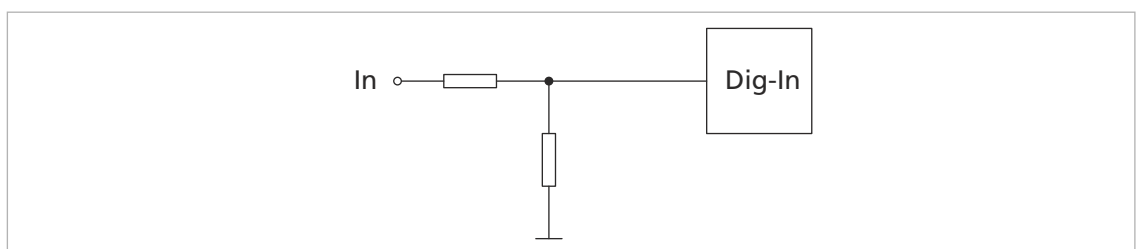


Fig. 7: Internal circuit – 3rd input

This connection can be used as a reference or digital input. The drives are optionally available ex works with separate electronics supply at this connection. This allows the motor voltage to be switched off independent of the electronics supply.

Installation

4.2.4.3 Fault output

The fault output is factory-configured as an output. Before being wired as an input, the FAULT pin must be configured accordingly (see Communications Manual).

NOTICE!

Damage to electronics

The electronics of the fault connection can be damaged in the following cases:

Fault output is not configured as an input and a voltage is being applied to the fault output. Voltage applied at the fault output is greater than the power supply of the Motion Controller.

Voltage supply of the sensors is active while the power supply of the Motion Controller is inactive.

- ▶ Check the settings of the fault output before applying a voltage.
- ▶ Match the power supply of the sensors and of the Motion Controller to each other. The power supply of the sensors must not be greater than the power supply of the Motion Controller.

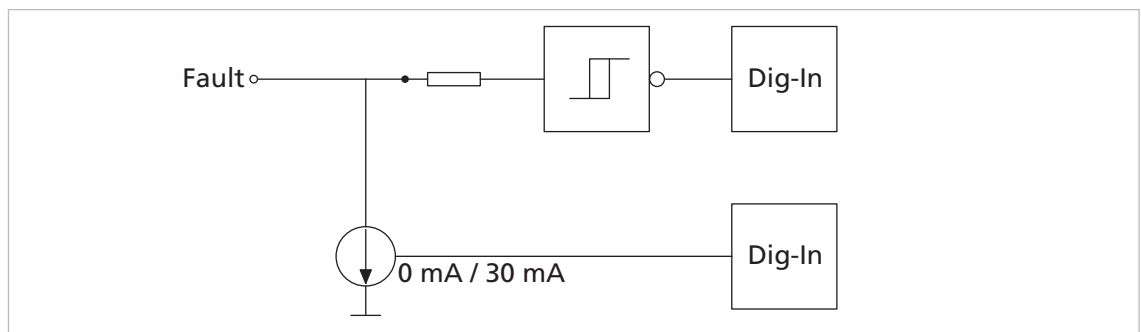


Fig. 8: Internal circuit – fault (Dig I/O)

| Pin | Designation | Meaning |
|-----|-------------|--------------|
| 1 | Fault | Fault output |

The fault output has the following features:

- Open collector switch to ground
- Output resistance in open state (high level): 100 kΩ
- Switch opens in the event of a fault (high level)
- Output current limited to approx. 30 mA. The voltage in the open state must not exceed the power supply (maximum U_B).
- Short-circuit-proof

The fault output can be configured for the following functions:

- Pulse output
- Digital output (freely programmable)
- Reference input or digital input
- Rotation direction input



Recommendation: If the fault output is used as an input, connect an external resistor (1 kΩ/0.25 W) in series.

Installation

4.2.5 External circuit diagrams (Examples)

Bipolar analog set-point specification via potentiometer

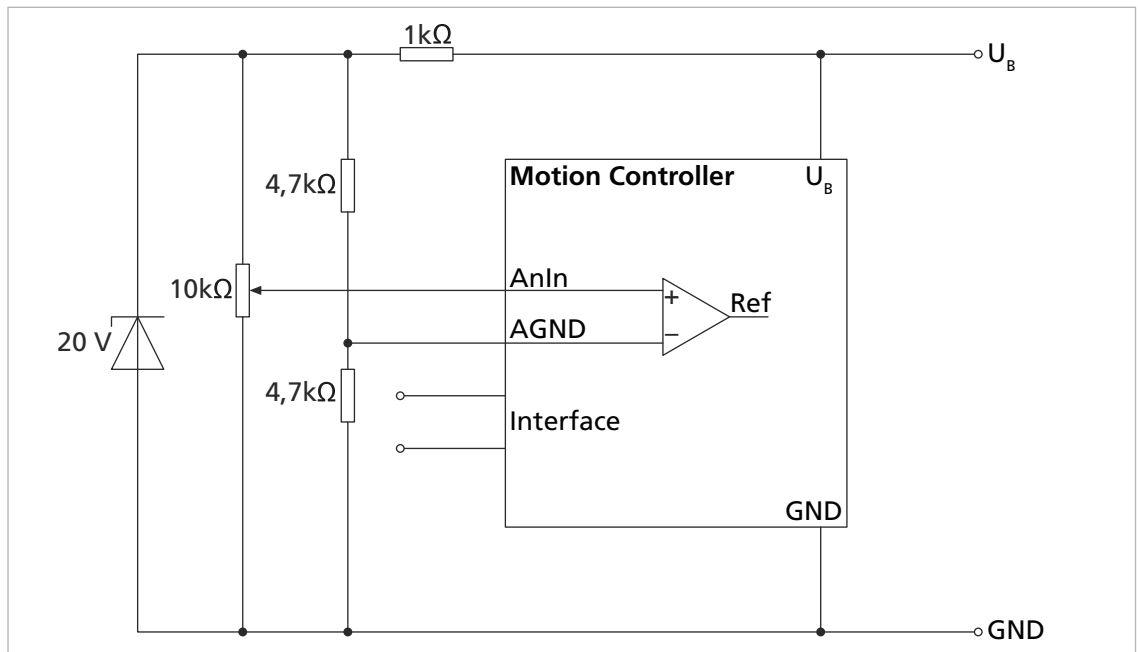


Fig. 9: Bipolar analog set-point specification via potentiometer

Connection of reference and limit switches

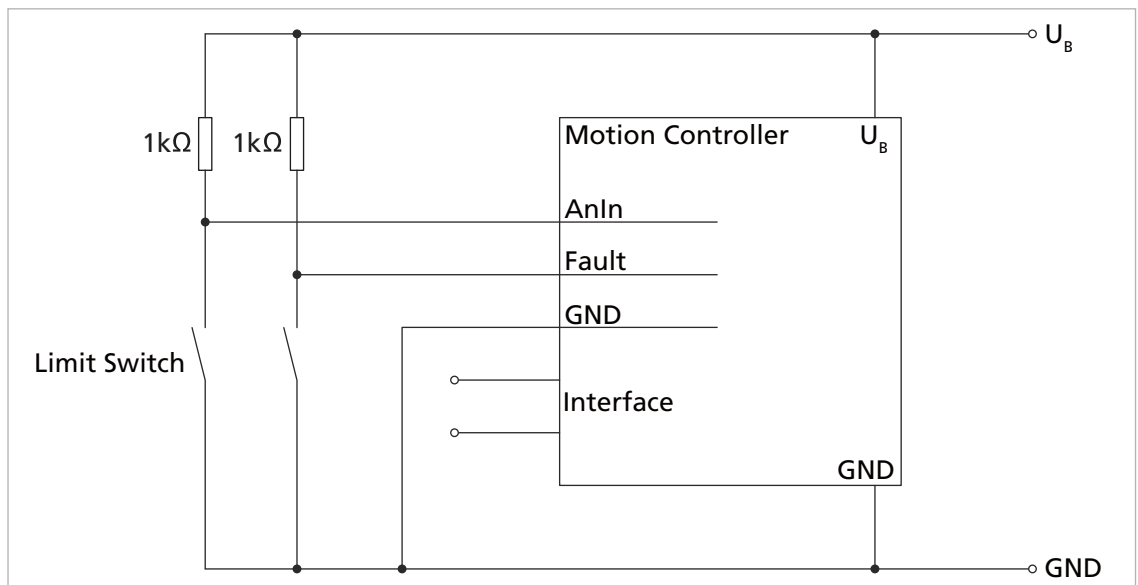


Fig. 10: Connection of reference and limit switches

Installation

Connection of an external incremental encoder

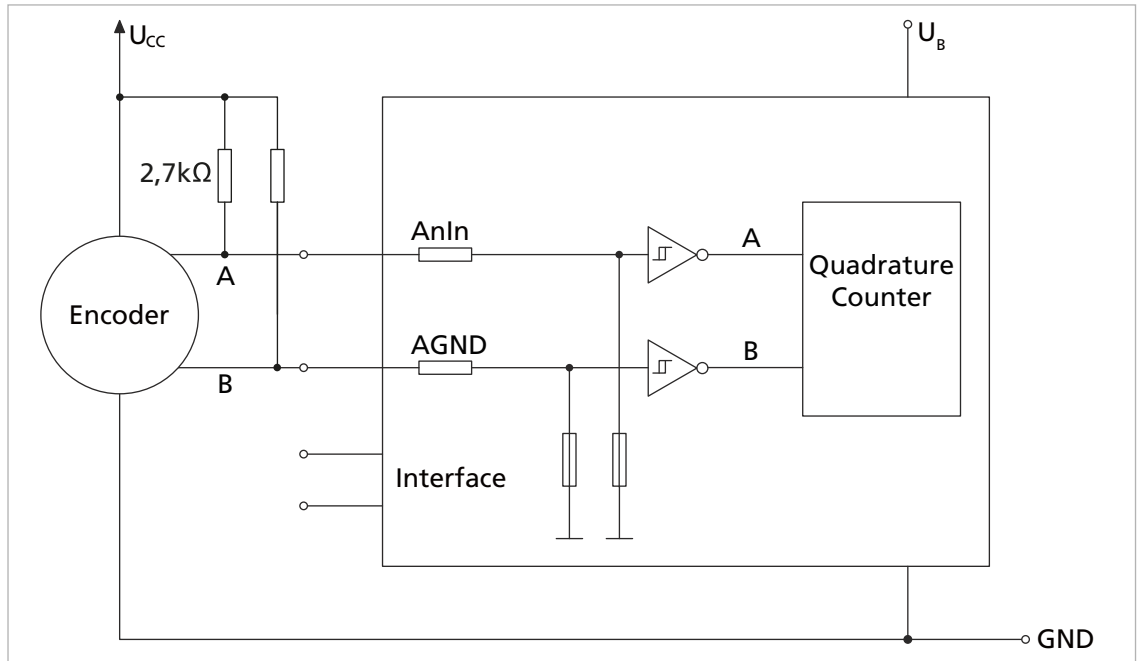


Fig. 11: Connection of an external incremental encoder

4.2.6 Communication connection

i The setting of the baud rate and node number necessary for the communication connection is made via the Motion Manager or as a direct command input (see Communications and Functional Manual and Software Manual).

Wiring with several Motion Control Systems in RS232 network operation

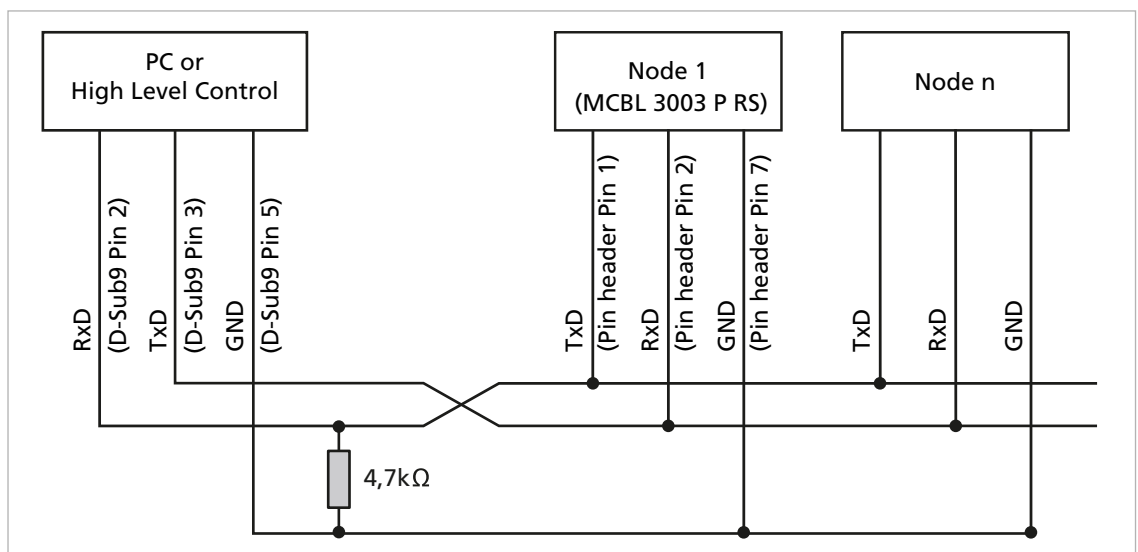


Fig. 12: Wiring with several Motion Control Systems in RS232 network operation (example: MCBL 3003 P RS)

Installation

Wiring between PC/controller and a drive

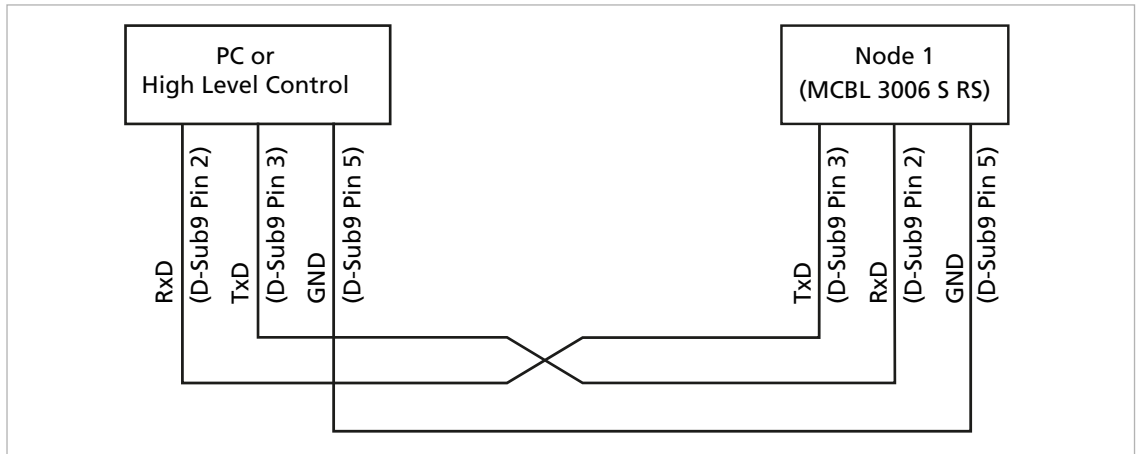


Fig. 13: Wiring between PC/controller and a drive (example: MCBL 3006 S RS)

Connection to the CANopen network

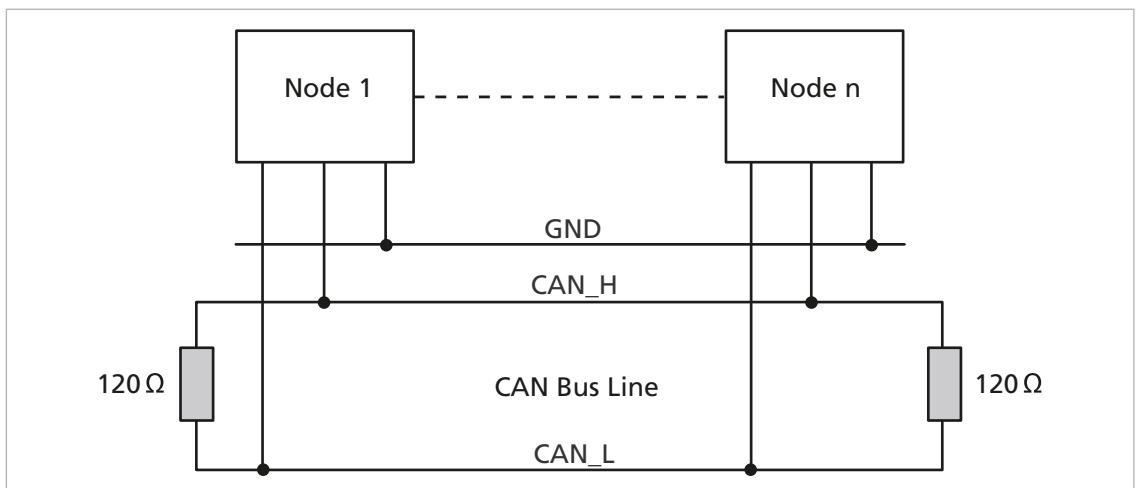


Fig. 14: Connection to the CANopen network

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.

The maximum cable length is limited by the transfer rate and the signal propagation times:

| Baud rate | Maximum cable length (including stub cable) |
|--------------|---|
| 1 000 kBit/s | 25 m |
| 500 kBit/s | 100 m |
| 250 kBit/s | 250 m |
| 125 kBit/s | 500 m |
| 50 kBit/s | 1000 m |
| 20 kBit/s | 2500 m |
| 10 kBit/s | 5000 m |

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.

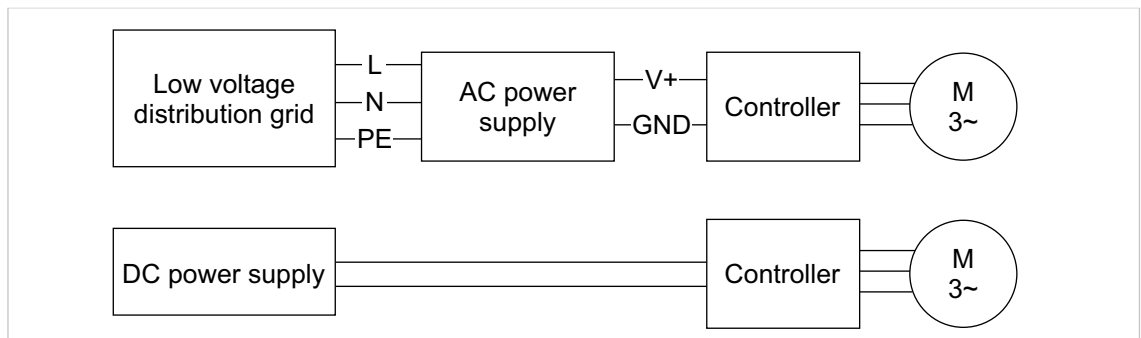


Fig. 15: Circuit diagrams of the considered systems

Installation

AC-mains system

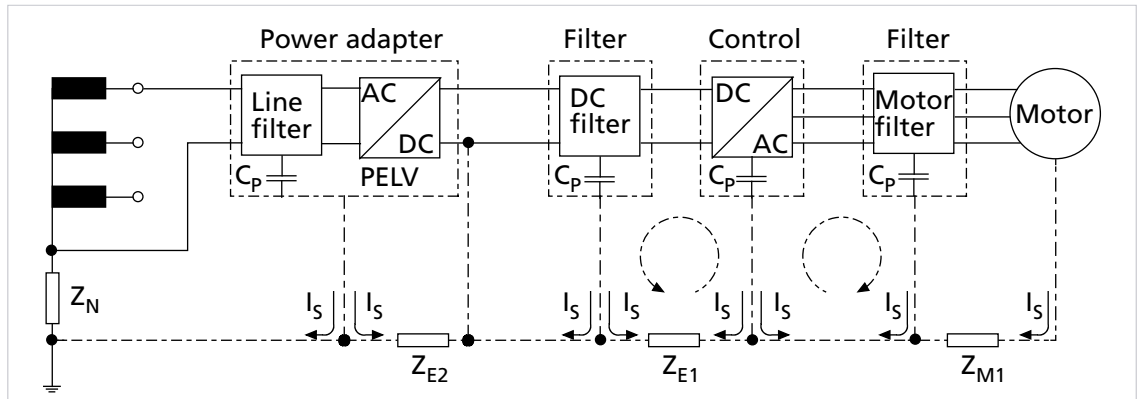


Fig. 16: Interference sources in an AC-mains system

- 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.

i 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"> Removes RF common-mode interference Fast testing possible | <ul style="list-style-type: none"> Does not remove all interference Fabrication necessary |
| 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"> Often only effective for power supply Does not remove all interference |

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 ≥ 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).

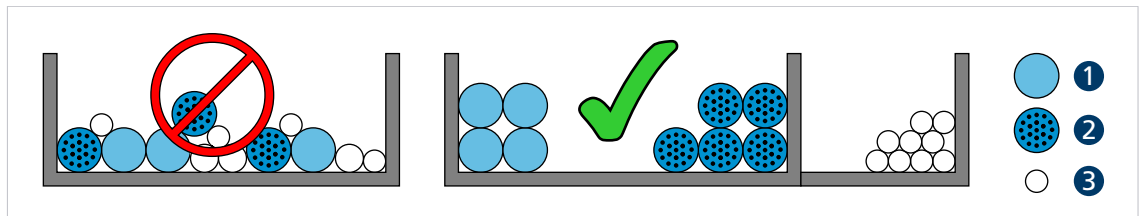


Fig. 17: Laying in the cable duct

- 1 High-current cable
- 2 Digital cable

- 3 Sensor cable

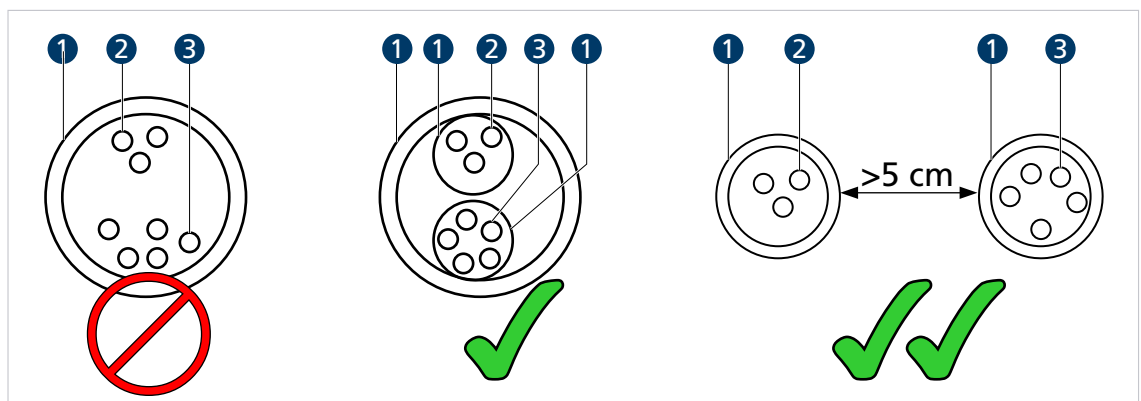


Fig. 18: Grouping and shielding of the cables

- 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 Ω) grounding bar or grounding plate. A connection to the controller housing should only be made if no grounding bar is available.
- ▶ Establish a star-point ground connection.
- ▶ 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. 19).

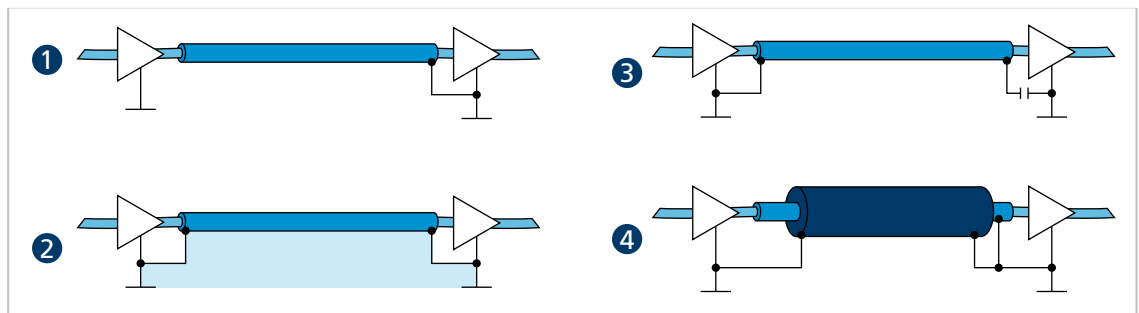


Fig. 19: Various possibilities for the shield connection

- 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. 19). A solution such as 2 in Fig. 19 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. 19). 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:

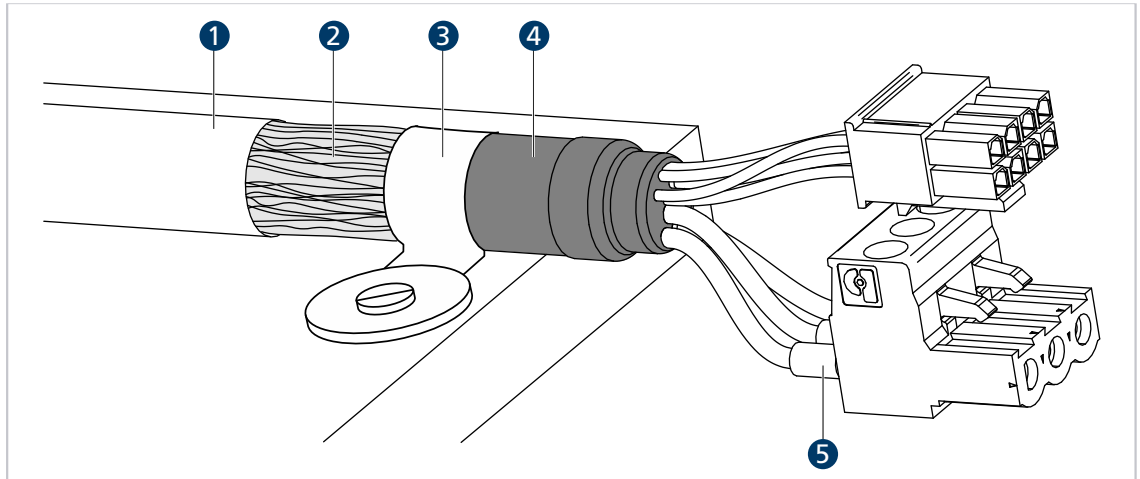


Fig. 20:

- | | | | |
|---|--------------------|---|--------------------|
| 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.

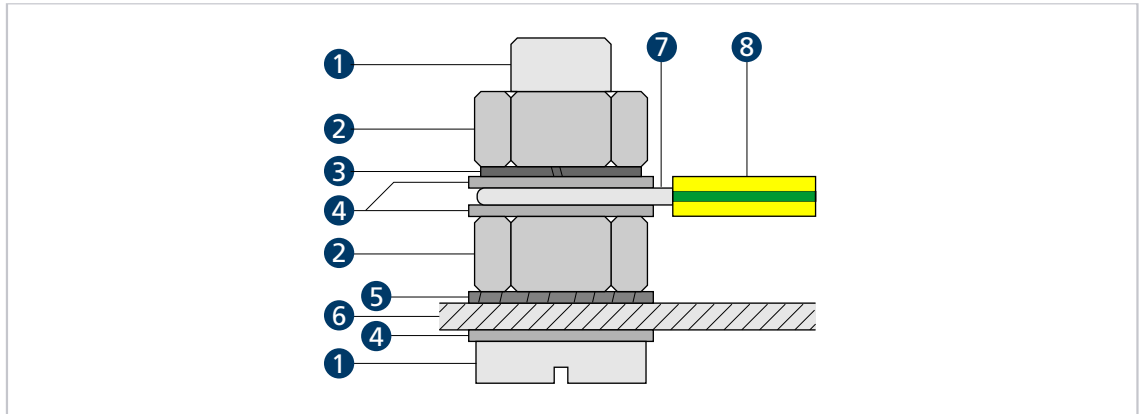


Fig. 21:

- | | |
|-----------------|------------------------|
| 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. 18. 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

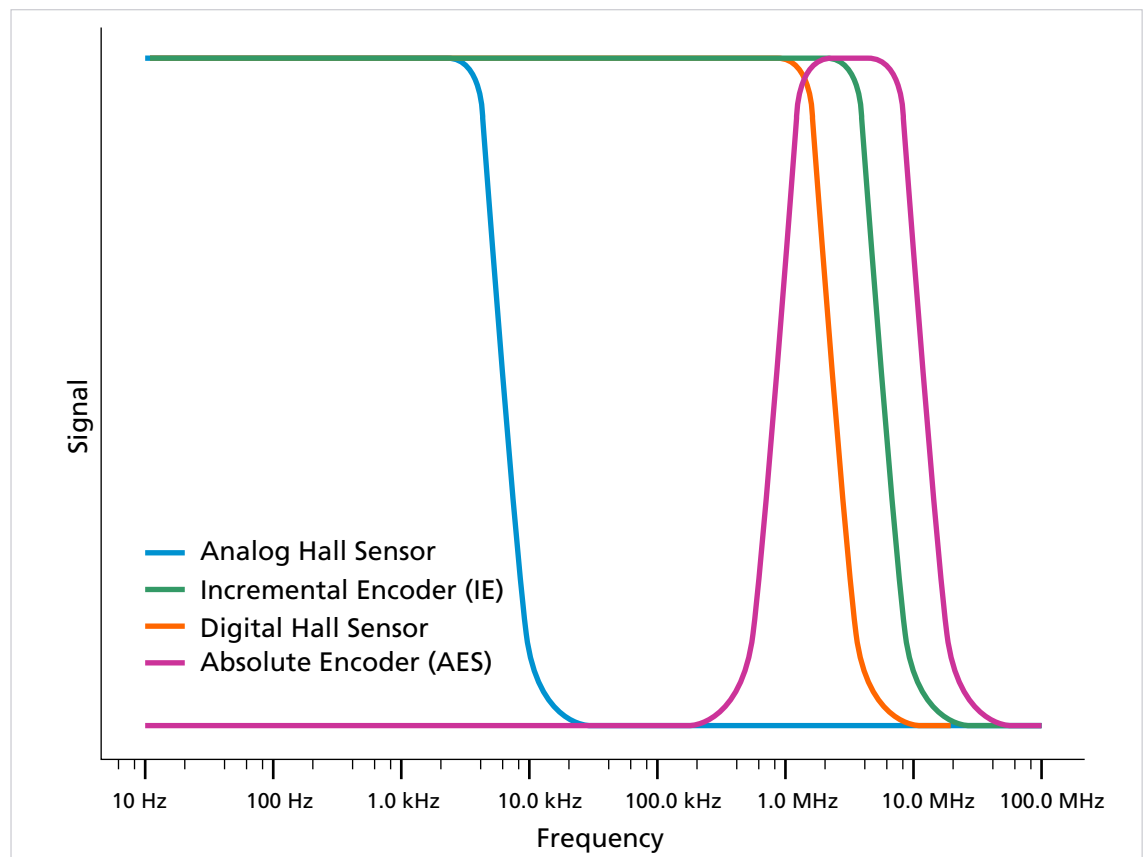


Fig. 22:

- ▶ 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.

4.3.5.2 Incremental encoders / Digital Hall sensors / Digital sensors

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

i 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 terminal resistance of 120 Ω is highly recommended between Data+ and Data-. This is already integrated in one of the special numbers (SN 6419) of the controller.

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

i 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.

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

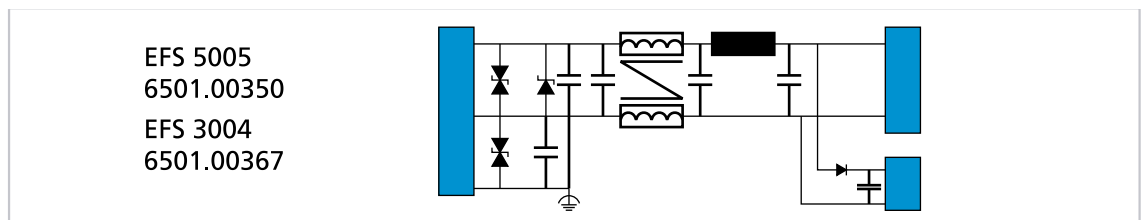


Fig. 23:

Installation

4.3.6.1 Mounting arrangement (example: top-hat rail/DIN rail)

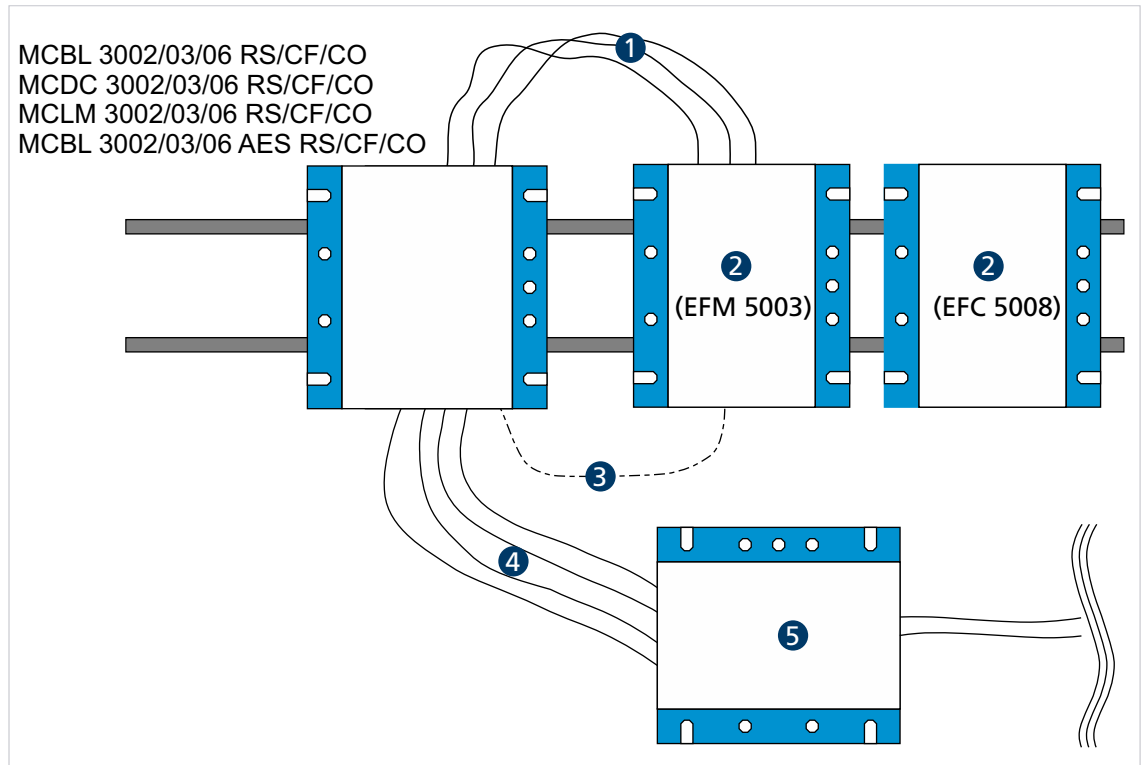


Fig. 24:

- | | |
|-------------------------------|-----------------|
| 1 Motor phases | 4 Supply cables |
| 2 Motor filter | 5 Input filter |
| 3 0V, no ground, no PE, no FE | |

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. 1, p. 1) 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.

4.3.6.3 Input-side filters

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 μF) 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.

Installation

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.

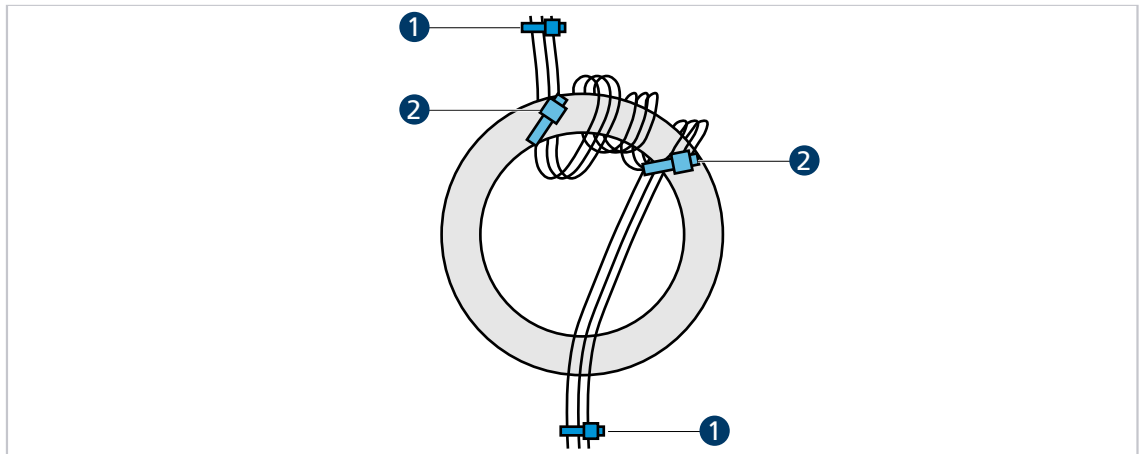


Fig. 25:

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. 34 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. 36.
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. 39.

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

5 Maintenance

5.1 Maintenance instructions

NOTICE!

The housing of the Motion Controller is not resistant to solvents such as alcohols or acetone.

- ▶ During operation and maintenance the housing must be protected against contact with solvents or substances containing solvents.

5.2 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.

5.3 Troubleshooting

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

6 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/gtc and downloaded from it.

Additional documents

7 Additional documents

7.1 Declaration of Conformity MCBL/DC/LM 3002

EG-Konformitätserklärung **EC Declaration of Conformity**

Dokument-Nr./Monat.Jahr:
Document-No./Month.Year:

EG-00028-001 / 06.2021

Der Hersteller:
The manufacturer:

Dr. Fritz Faulhaber GmbH & Co. KG
Daimlerstr. 23/25
D-71101 Schönaich
Germany

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

Produktbezeichnung:
Product designation:

MCBL 3002 F, MCBL 3002 P, MCBL 3002 S
MCDC 3002 P, MCDC 3002 S

Produkttyp:
Product type:

Motorcontroller
Motor controller

den wesentlichen Schutzanforderungen entspricht, die in der/den nachfolgenden Richtlinie(n) festgelegt sind:
fulfills the essential protection requirements defined within the following directive:

EMV-Richtlinie 2014/30/EU **EMC-Directive 2014/30/EU**

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.

Diese Erklärung gilt für alle Exemplare, die in verschiedenen Leistungsdaten in dieser Serie hergestellt werden.
This statement should be valid for all derivatives produced according to the related construction drawings and electrical drawings, which are part of the technical documentation.

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

- Anhang A / „Dokumentidentifikation“
- Annex A / Document identification

Die Anlage ist Bestandteil dieser Erklärung.
The annex is a component of this declaration.

Schönaich, 01.07.21
(Datum)
(date)

Dr. Thomas Bertolini,
Geschäftsführung
(Name, Chairman)


(Unterschrift)
(signature)

Additional documents

Anhang A zur Konformitätserklärung *Annex A to Declaration of Conformity*

Dokument-Nr./Monat.Jahr:
Document-No./Month.Year:

EG-00028-001 / 06.2021

Die Übereinstimmung mit den genannten EG-Richtlinien wurde durch Überprüfung gemäß nach folgender Fachgrundnorm nachgewiesen:

The conformity with the EC guidelines was proven according to the following standards:

| Fundstelle <i>Document</i> | Ausgabedatum <i>Date of issue</i> | Richtlinienbezug <i>Related to directive</i> |
|-------------------------------|--------------------------------------|---|
| EN 61800-3 | 2018 | EMV Richtlinie EMC directive |
| | | |
| | | |
| | | |

Additional documents

7.2 Declaration of Incorporation MCBL/DC/LM 3002

**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:
Document No./Month.Year:

EG-00029-001 / 06.2021

Der Hersteller:
The manufacturer:

Dr. Fritz Faulhaber GmbH & Co. KG
Daimlerstr. 23/25
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:
Installable component::

MCBL 3002 F, MCBL 3002 P, MCBL 3002 S
MCDC 3002 P, MCDC 3002 S

Produkttyp:
Product type:

Motion Controller (mit angeschlossenem Antrieb)
Motion Controller (with attached electrical drive)

Gemäß Anhang VII Teil B der EG-Maschinenrichtlinie 2006/42/EG wurden spezielle technischen 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, Daimlerstr. 23/25, 71101 Schönaich, Germany.

Schönaich,

01.07.21
(Datum)
(Date)

Dr. Thomas Bertolini,
Geschäftsführung
(Name, Chairman)


(Unterschrift)
(Signature)

Additional documents

7.3 Declaration of Conformity MCBL/DC/LM 3003/3006

EG-Konformitätserklärung EC Declaration of Conformity

Dokument-Nr./Monat.Jahr:
Document-No./Month. Year:

EG-00032-001 / 07.2021

Der Hersteller:
The manufacturer:

Dr. Fritz Faulhaber GmbH & Co. KG
Daimlerstr. 23/25
D-71101 Schönaich
Germany

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

Produktbezeichnung:
Product designation:

**MCBL 3003 P, MCBL 3006 S,
MCDC 3003 P, MCDC 3006 S,
MCLM 3003 P, MCLM 3006 S,**

Produkttyp:
Product type:

**Motorcontroller
Motor controller**

den wesentlichen Schutzanforderungen entspricht, die in der/den nachfolgenden Richtlinie(n) festgelegt sind:
fulfills the essential protection requirements defined within the following directive:

**EMV-Richtlinie 2014/30/EU
EMC-Directive 2014/30/EU**

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.

Diese Erklärung gilt für alle Exemplare, die in verschiedenen Leistungsdaten in dieser Serie hergestellt werden.
This statement should be valid for all derivatives produced according to the related construction drawings and electrical drawings, which are part of the technical documentation.


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

- Anhang A / „Dokumentidentifikation“
- Annex A / Document identification

Die Anlage ist Bestandteil dieser Erklärung.
The annex is a component of this declaration.

Schönaich, 12.07.21
(Datum)
(date)

Dr. Thomas Bertolini,
Geschäftsführung
(Name, Chairman)


(Unterschrift)
(signature)

Additional documents

Anhang A zur Konformitätserklärung ***Annex A to Declaration of Conformity***

Dokument-Nr./Monat.Jahr:
Document-No./Month.Year:

EG-00032-001 / 07.2021

Die Übereinstimmung mit den genannten EG-Richtlinien wurde durch Überprüfung gemäß nach folgender Fachgrundnorm nachgewiesen:

The conformity with the EC guidelines was proven according to the following standards:

| <i>Fundstelle</i> <i>Document</i> | <i>Ausgabedatum</i> <i>Date of issue</i> | <i>Richtlinienbezug</i> <i>Related to directive</i> |
|--------------------------------------|---|--|
| EN 61800-3 | 2018 | EMV Richtlinie EMC directive |
| | | |
| | | |
| | | |

Additional documents

7.4 Declaration of Incorporation MCBL/DC/LM 3003/3006

**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:
Document No./Month.Year:

EG-00033-001 / 07.2021

Der Hersteller:
The manufacturer:

Dr. Fritz Faulhaber GmbH & Co. KG
Daimlerstr. 23/25
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:
Installable component::

**MCBL 3003 P, MCBL 3006 S,
MCDC 3003 P, MCDC 3006 S,
MCLM 3003 P, MCLM 3006 S,**

Produkttyp:
Product type:

Motion Controller (mit angeschlossenem Antrieb)
Motion Controller (with attached electrical drive)

Gemäß Anhang VII Teil B der EG-Maschinenrichtlinie 2006/42/EG wurden spezielle technischen 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, Daimlerstr. 23/25, 71101 Schönaich, Germany.

Schönaich,

12.07.21
(Datum)
(Date)

Dr. Thomas Bertolini,
Geschäftsführung
(Name, Chairman)


(Unterschrift)
(Signature)

