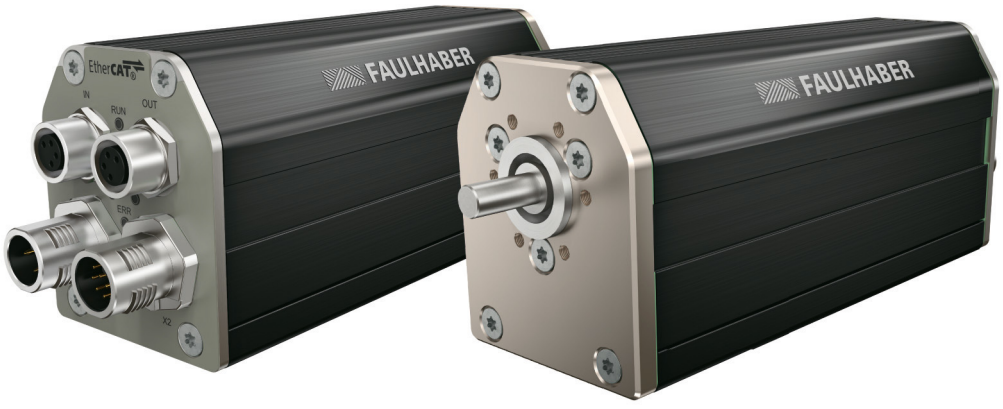
FAULHABER

Technical Manual

MCS 3242 BX4

MCS 3268 BX4

MCS 3274 BP4



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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

Content

1 About this document

1.1 Validity of this document

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

- MCS 3242 BX4
- MCS 3268 BX4
- MCS 3274 BP4

This document is intended for use by trained experts authorised 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 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 6	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

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.

1.4 List of abbreviations

Abbreviation	Meaning
AC	Alternating Current
AnIn	Analogue Input
AGND	Analogue Ground
CAN	Controller Area Network
CAN_L	CAN-Low
CAN_H	CAN-High
CS	Command Specifier
DC	Direct Current
DigIn	Digital input
DigOut	Digital output
EGND	Enclosure ground
EMC	Electromagnetic compatibility
ESD	Electrostatic discharge
ET	EtherCAT (Ethernet for Control Automation Technology)
GND	Ground
I/O	Input/Output
PLC	Programmable Logic Controller
PWM	Pulse Width Modulation
RxD	Receive data
TTL	Transistor Transistor Logic
TxD	Transmit data

1.5 Symbols and markers

CAUTION!
Hazards due to hot surfaces. Disregard may lead to burns.

- Measures for avoidance

NOTICE!
Risk of damage.

- Measures for avoidance

Instructions for understanding or optimising 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 Use for the intended purpose

The Motion Control systems described here consist of a combination of a basic motor and an integral Motion Controller within a common housing with standard protection class IP 54.

The Motion Control systems are intended for use as slaves, and are particularly suitable for positioning tasks in the following application fields:

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

When using the Motion Control systems the following aspects should be recognised:

- Motion Control systems contain electronic components and should be handled in accordance with the ESD regulations.
- Do **not** install Motion Control systems in environments where they will come into contact with chemicals, **nor** in explosion hazard areas.
- Motion Control systems 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

NOTICE!
Electrostatic discharges can damage the electronics.

- Wear conductive work clothes.
- Wear an earthed wristband.

NOTICE!
Penetration of foreign objects can damage the electronics.

- Do not open the housing.

NOTICE!
Inserting and withdrawing connectors 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 device.

2.3 Environmental conditions

- Select the installation location so that clean dry air is available for cooling the Motion Control system.
- When installed within an enclosure, take particular care to ensure adequate cooling of the Motion Control system.
- Select a power supply that is within the defined tolerance range.
- Protect the Motion Control system against chemical pollutants.
- Motion Control systems satisfy protection class IP54 to DIN EN 60259.

Depending on the application, additional shaft seals may optionally be installed in the base drive, which have to be maintained at regular intervals.

When combined with attachments (e.g. gearboxes) or for enhanced motor protection an additional seal (O-ring) to enhance the protection class is optionally available (see chap. 3.4.3, p. 13, chap. 4.1.2, p. 16 and chap. 5.2, p. 29).

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)
Because of their small size, no serious threats to life or physical condition can normally be expected from electric miniature drives. Therefore the Machinery Directive does not apply to our products. The products described here are not "incomplete machines". Therefore installation instructions are not normally issued by FAULHABER.

Low Voltage Directive (2014/35/EU)
The Low Voltage Directive applies for all electrical equipment with a nominal voltage of 75 to 1500 V DC and 50 to 1000 V AC. The products described in this technical manual do not fall within the scope of this directive, since they are intended for lower voltages.

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.

3 Product description

3.1 General product description

The FAULHABER Motion Control systems described here are intended for controlled operation of various basic motors incorporated as sub-systems. The offer various different functions and operating modes, allowing complex drive duties to be performed. Thanks to their compact design and flexible connection options, the units can be used in a wide variety of applications and require only basic wiring.

The Motion Control system can offer the following communications interfaces:

- RS232
- CANopen
- RS232 and EtherCAT

Connections are also available for common or separate power supplies between motor and controller, and also for a wide variety of inputs and outputs. Configuration of the Motion Control system is performed using the FAULHABER Motion Manager V6.

The drives can be incorporated into the network by means of the CANopen or EtherCAT field bus interfaces. In smaller installations networking can be performed using the RS232 interface. Within the network the Motion Control system operates principally as a slave. Master functionality for controlling other axes is not provided. Alternatively after initial commissioning by the Motion Manager the Motion Control system can also be operated without any communications interface.

Motion Control systems are normally secured using the tapped holes in the faceplate. Where cabling is connected axially, optionally the drive can be secured from below on a flat baseplate (see chap. 4.1, p. 15).

Analogue Hall sensors are used as feedback components.

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

3.2 Product information

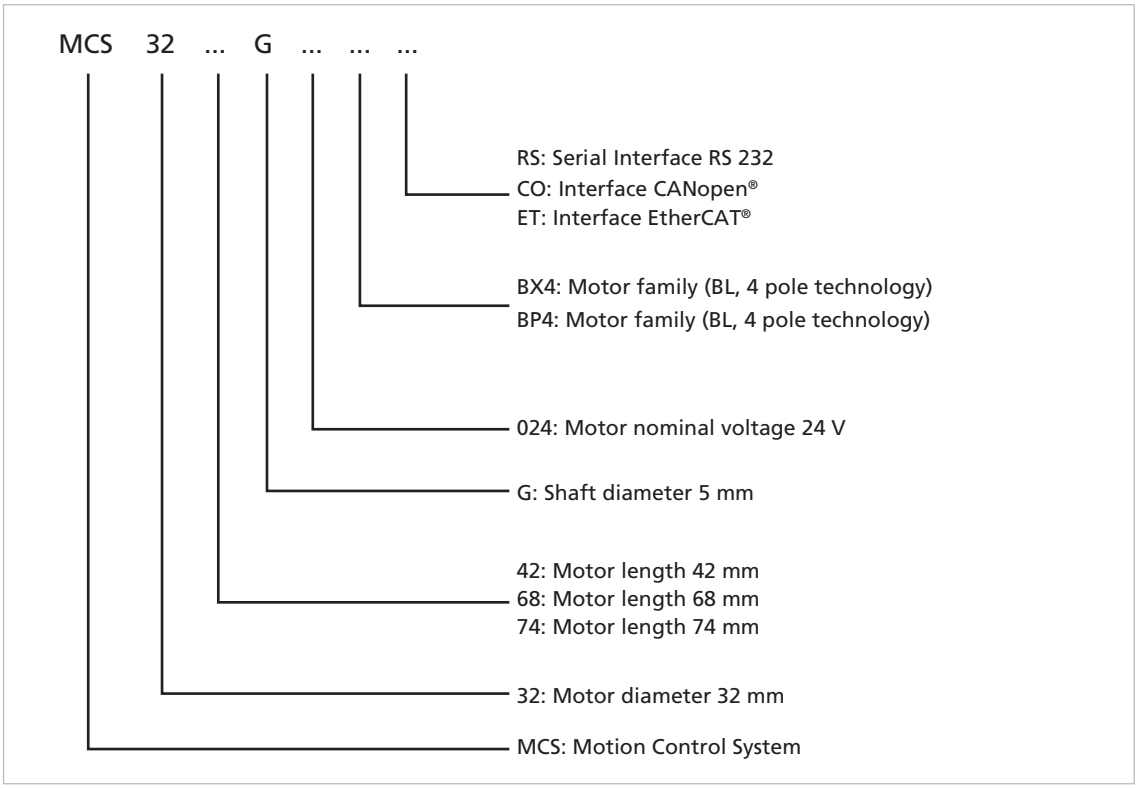


Fig. 1: Designation key

3.3 Product variants

The following product variants are available:

- Motion Control system with axial cable exit
- Motion Control System with radial cable exit

As well as the cable exit, the following communications interfaces can be selected:

- RS232
- CANopen
- RS232 and EtherCAT

The following motors are available for selection for each product variant:

- 3242 BX4
- 3268 BX4
- 3274 BP4

Depending on the motor, interface and cable exit selection, the installed length and/or height of the MCS will vary. Details can be found on the respective product datasheet or the relevant dimensional drawing.

Depending on the application, additional shaft seals may optionally be installed in the base drive, which have to be maintained at regular intervals.

When combined with attachments (e.g. gearboxes) or for enhanced motor protection an additional seal (O-ring) to enhance the protection class is optionally available (see chap. 3.4.3, p. 13, chap. 4.1.2, p. 16 and chap. 5.2, p. 29).

3.4 Cable exits for the Motion Control system

3.4.1 Axial cable exit (standard)

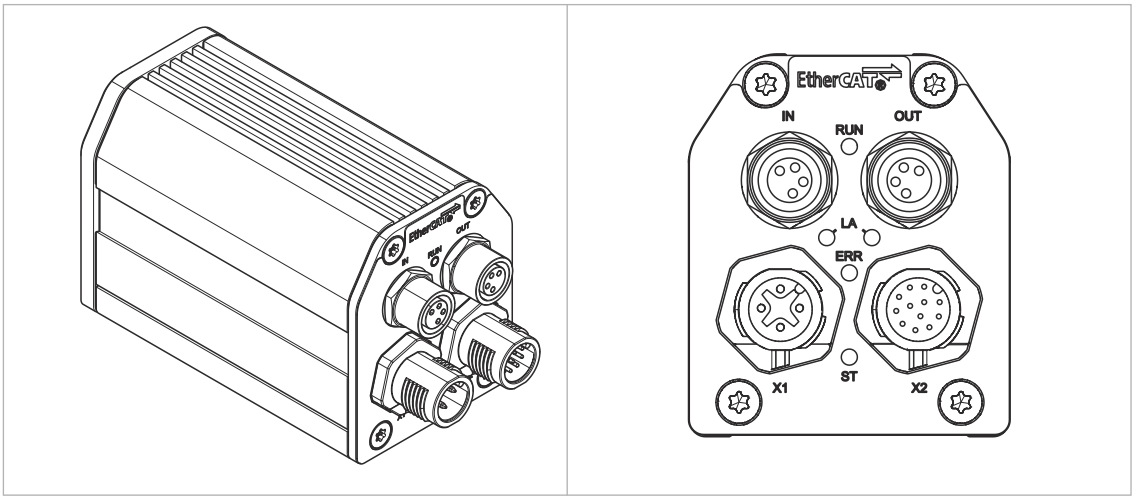


Fig. 2: Isometric view (left) and connector view (right) for axial cable exit

3.4.2 Radial cable exit (option 5451)

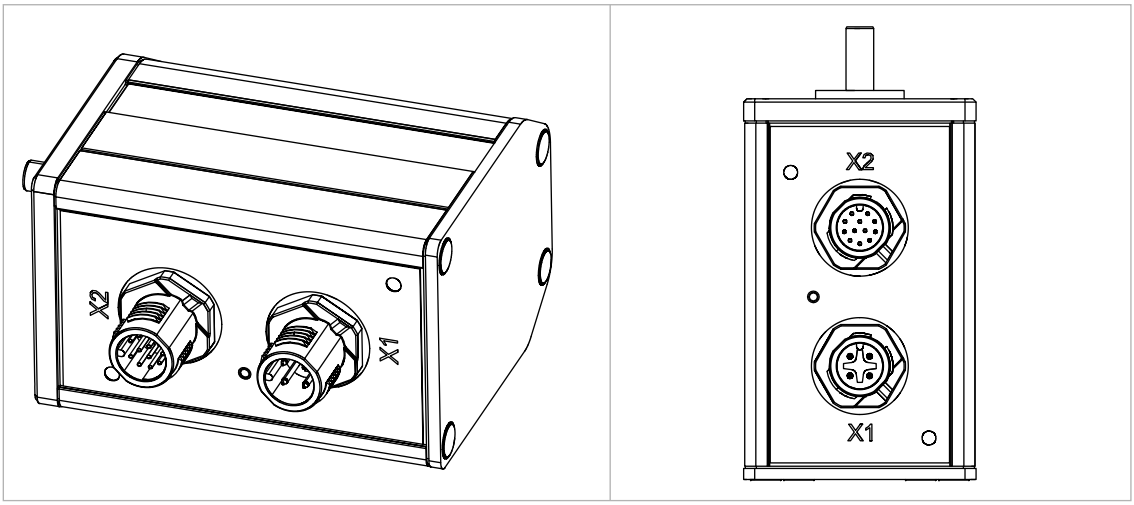


Fig. 3: Isometric view (left) and connector view (right) for radial cable exit

3.4.3 Gearbox combination

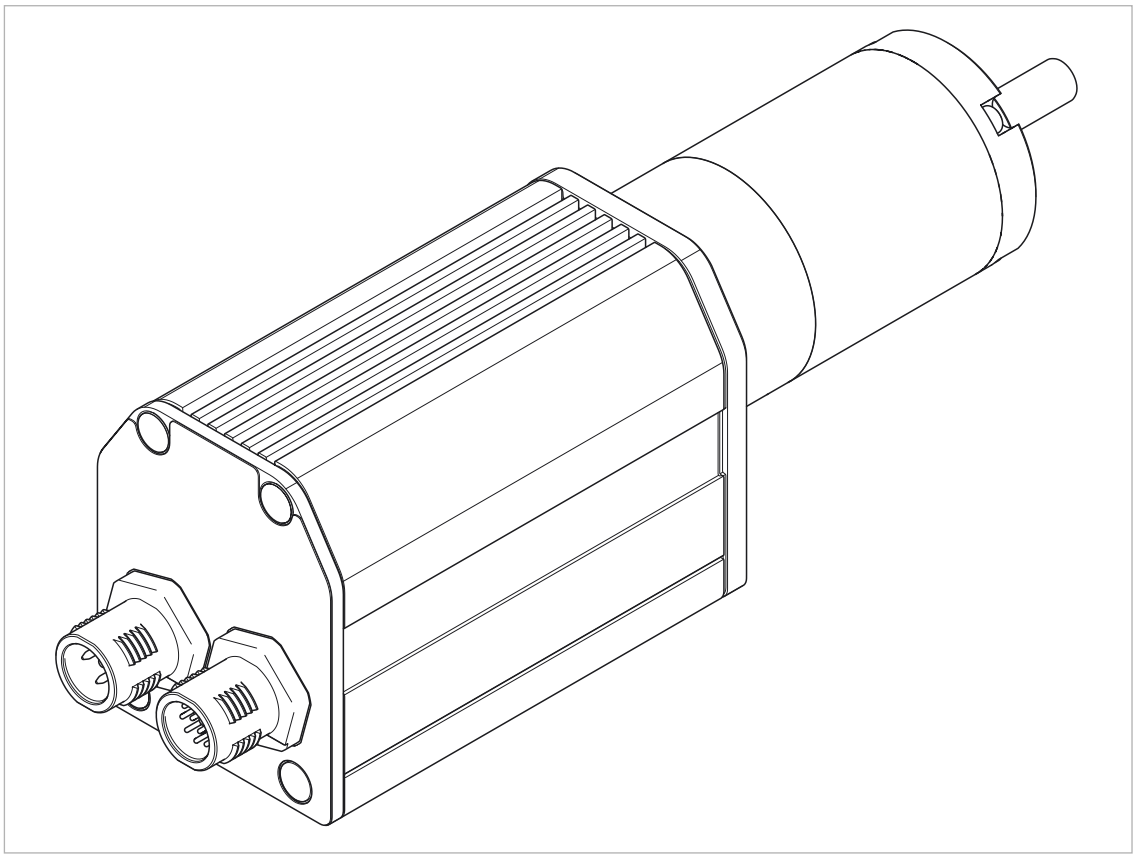


Fig. 4: Combination example with gearbox 32A

Using option 5657 and when the base drive is directly flange-mounted or in combination with attachments (e.g. gearboxes), an additional seal (O-ring), to enhance the protection class of the complete system, may be installed between the drive and the attachment (see chap. 4.1.2, p. 16 and chap. 5.2, p. 29).

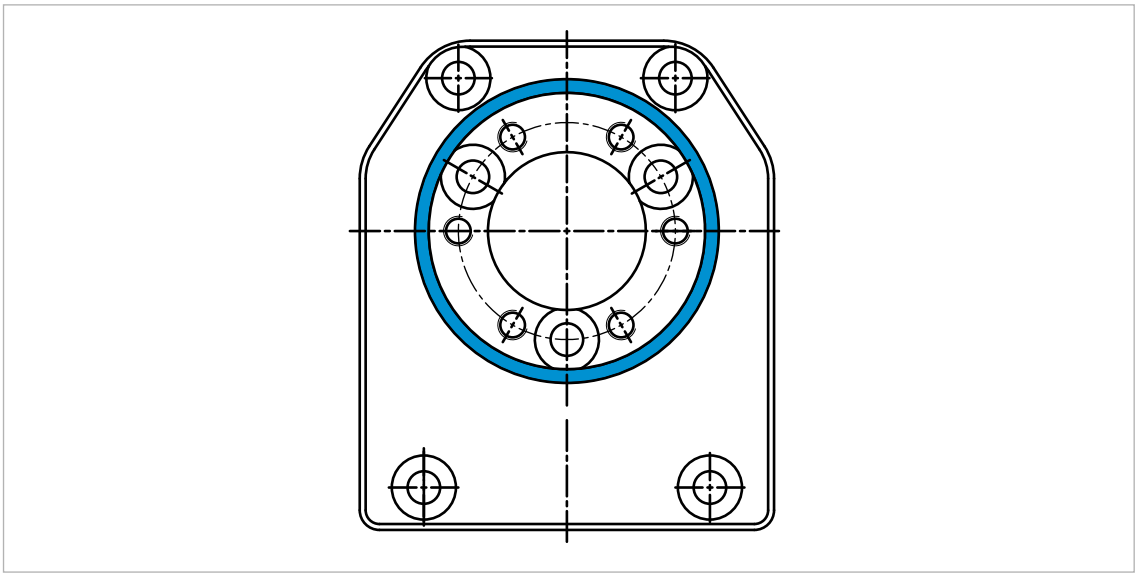


Fig. 5: Front elevation of the motor flange A-side with radial groove (blue)

3.5 Connector overview

Tab. 1: Connector overview of the Motion Control system

Designation	Function
IN/OUT	Connection of the EtherCAT communication
X1 (supply)	Power supply of the Motion Control system
X2 (I/O)	Interface connection RS232/CAN and inputs or outputs for external circuits

Tab. 2: LED overview

Designation	Interface	Function
Status LED	all	▪ Green (continuous): Device active. ▪ Green (flashing): Device active. However the state machine has not yet reached the *Operation Enabled* state. ▪ Red (continuously flashing): The drive has switched to a fault state. The output stage will be switched off or has already been switched off. ▪ Red (Error code): Boot procedure failed. Please contact FAULHABER Support.
RUN LED	EtherCAT	▪ Green (continuous): Connection available. Device is ready for operation. ▪ Green (flashing): Device is in the *Pre-Operational* state. ▪ Green (single flash): Device is in the *Safe-Operational* state. ▪ Off: Device is in the *Initialisation* state.
ERR LED	EtherCAT	▪ Red (flashing): Defective configuration. ▪ Red (single flash): Local error. ▪ Red (double flash): Watchdog timeout. ▪ Off: No connection error
LA LED	EtherCAT	▪ Green (continuous): No data transfer. Connection to another participant has been established. ▪ Green (flashing): Data transfer active. ▪ Off: No data transfer. No connection to another participant.

4 Installation

4.1 Mounting

Only trained specialists and instructed persons with knowledge of the following fields may install and operate the Motion Control system:

- 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. 8).

4.1.1 Mounting instructions

CAUTION!
When in operation the Motion Control system can become very hot.

- Place a guard against contact and warning notice in the immediate proximity to the Motion Control system.

NOTICE!
Improper installation or installation using unsuitable attachment materials can lead to the Motion Control system becoming damaged.

- Comply with the installation instructions.

NOTICE!
Installation and connection of the Motion Control system when the power supply is live can lead to the device becoming damaged.

- During all aspects of installation and connection work on the Motion Control system, switch off the power supply.

NOTICE!
Installation of the Motion Control system on a surface that is not flat and connection on it can lead to the Motion Control system becoming damaged.

- Install the Motion Control system on a flat surface.

4.1.2 Installation at the faceplate

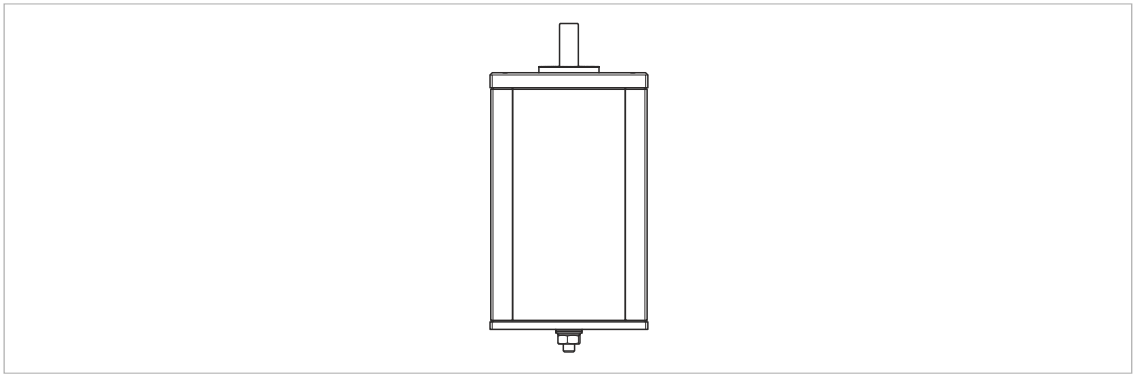


Fig. 6: V3 installation

NOTICE!
If the Motion Control system is installed with the shaft end facing upwards, liquids can accumulate on the upward-facing surface and damage the unit.

- If the system is installed to V3 format (see Fig. 6), make sure that no liquids can penetrate into the bearings.
- Optionally: Use a Motion Control system with an additional shaft seal. Fitting an additional shaft seal will lead to a reduction in motor performance (see chap. 4.1, p. 15)
- Secure the Motion Control system (1) with screws (2) using the tapped holes on the cover plate as shown in Fig. 7.
  - The tightening torque of the screws is 130 Ncm.
  - The maximum screw-in depth is 4 mm.

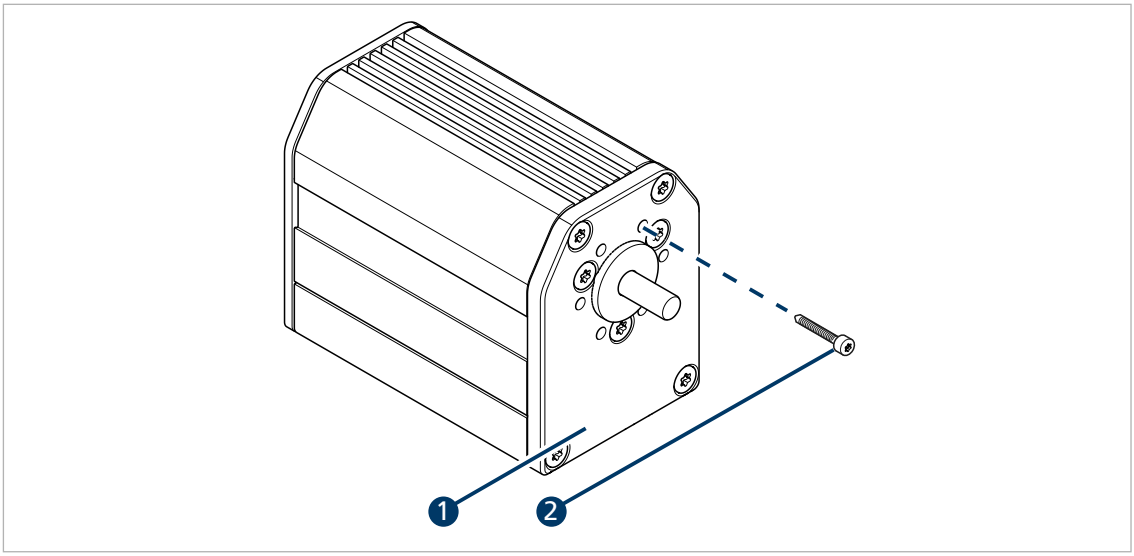


Fig. 7: Installation at the faceplate

Using option 5657 and when the base drive is directly flange-mounted or in combination with attachments (e.g. gearboxes), an additional seal (O-ring), to enhance the protection class of the complete system, may be installed between the drive and the attachment (see chap. 4.1.2, p. 16 and chap. 5.2, p. 29).

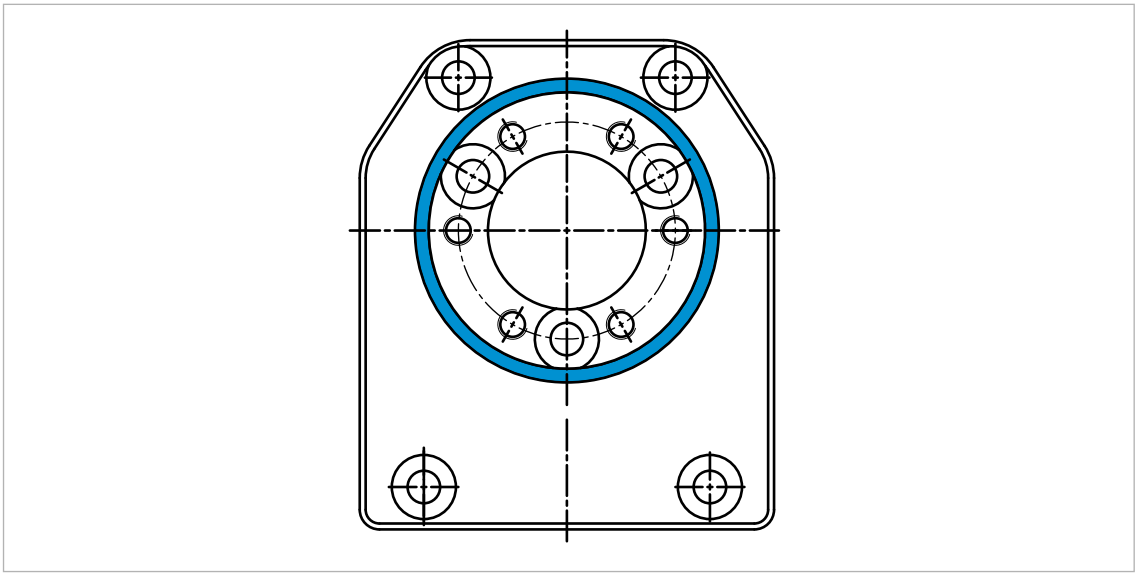


Fig. 8: Front elevation of the motor flange A-side with radial groove (blue)

4.1.3 Installation with a baseplate

Screws and baseplate are not part of the FAULHABER product portfolio, they must be provided by the user.

1. Secure the Motion Control system (1) with screws (3) to the baseplate (2).
   - Screw type ST 2.2
   - The tightening torque of the countersunk screws is 50 Ncm.
   - The maximum screw-in depth of the countersunk screws is 5 mm

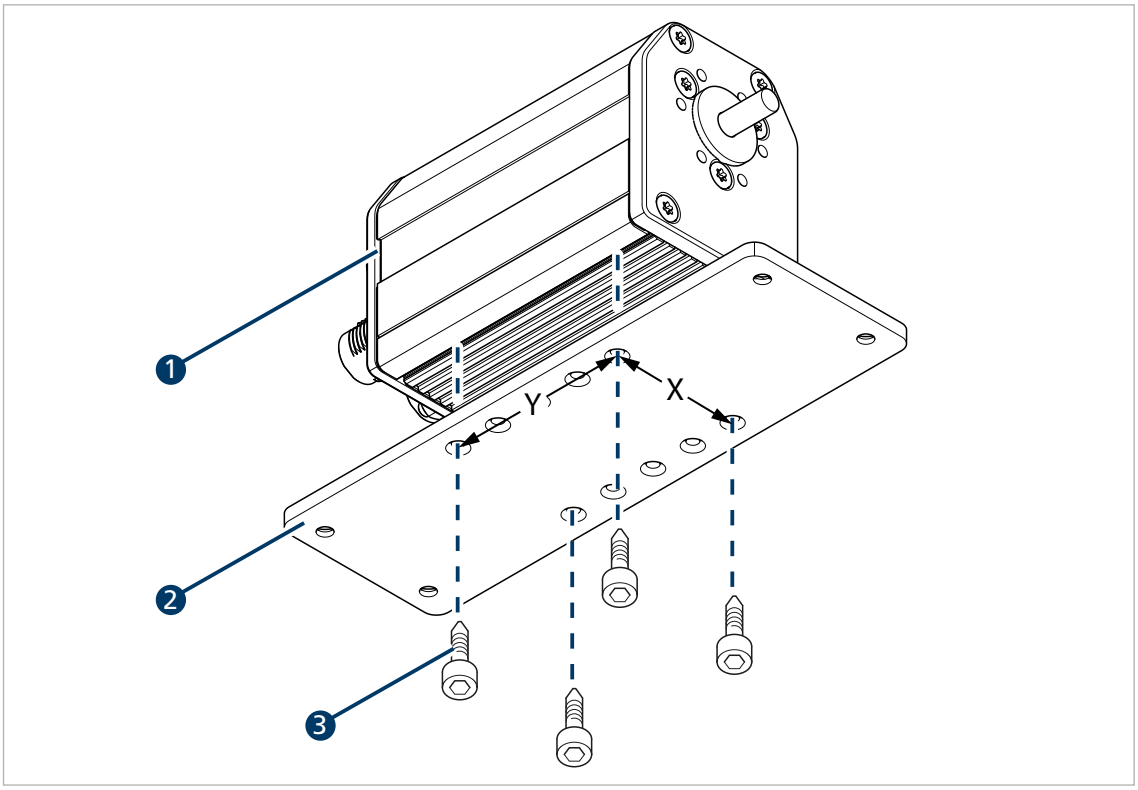


Fig. 9: Installation with a baseplate

Screw distances	3274 BP4 RS/CO/ET	3268 BX4 RS/CO/ET	3242 BX4 RS/CO/ET
X	29 mm	29 mm	29 mm
Y	103 mm	94 mm	68 mm

4.2 Electrical connection

4.2.1 Instructions for the electrical connection

NOTICE!
Electrostatic discharges to the Motion Control system connections can damage the electronic components.

- Comply with 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 Control system 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 Control system to an earthing system. This should be done preferably by mounting on an earthed baseplate, or by mounting on an earthed flange. Alternatively the earthing can be achieved by connecting the screen of the connecting cables to the connection sockets.
- Make sure that potential equalisation is present between all coupled parts of the system.
- If several electrical devices or controllers are networked by means of RS232 or CAN, make sure that the potential difference between the earth potentials of the various parts of the system is less than 2 V.
- The EGND connection, and if necessary the screen around the power supply connection cable, are available for potential equalisation.

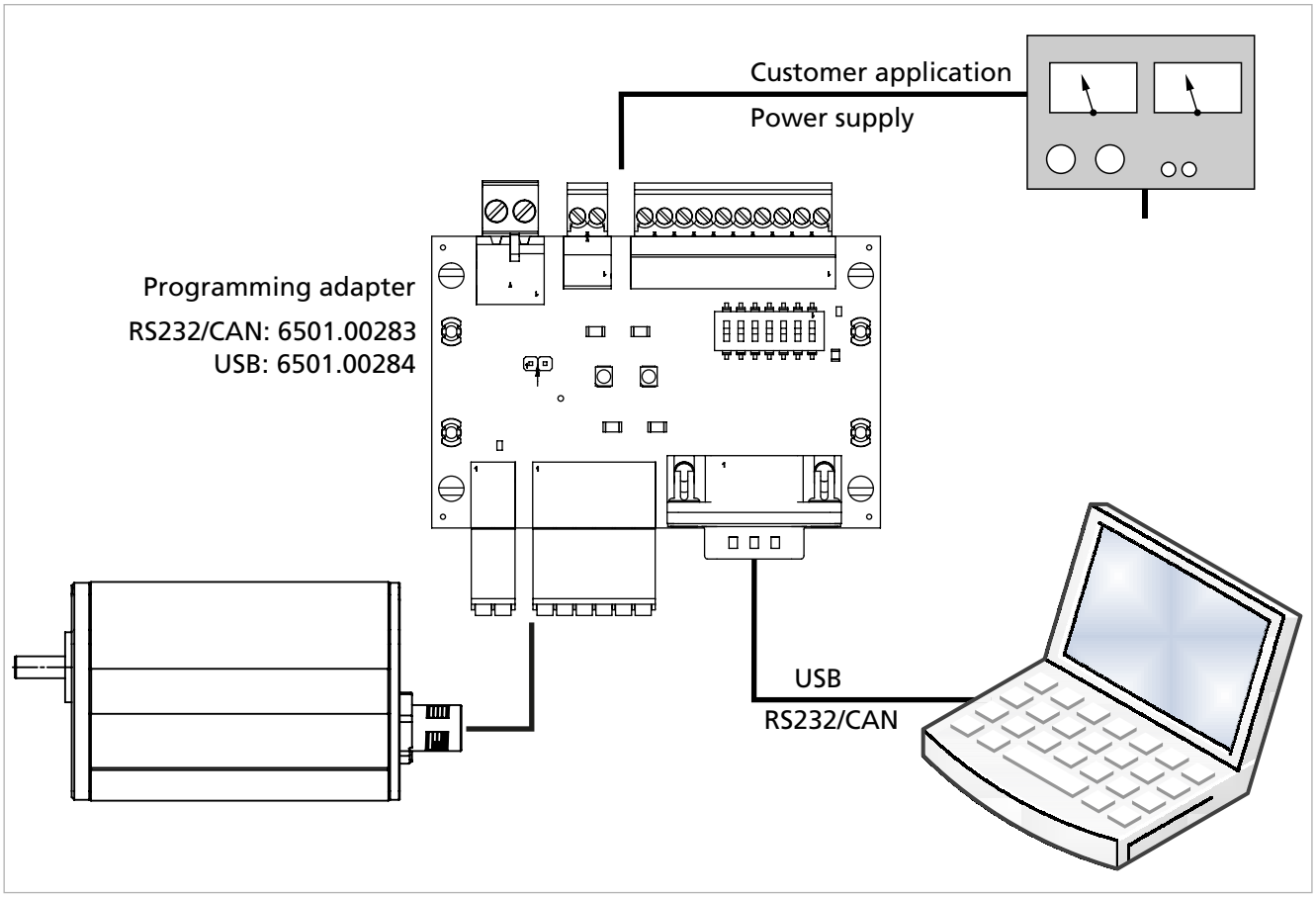


Fig. 10: Commissioning via programming adapter

For details on pin assignment and jumper settings of the programming adapter refer to the appropriate data sheets.

4.2.2 Connecting the Motion Control system

Connections of the Motion Control system:

- Discrete inputs and outputs (for instance for discrete target values preselection or for connection of limit switches / reference switches)
- Communication connections

▸ Make sure that the connection cables are not longer than 3 m.

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

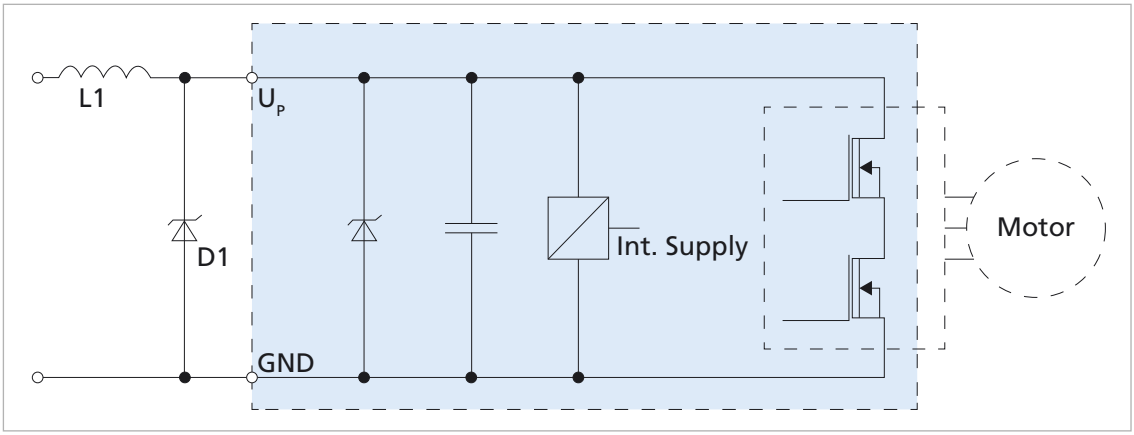


Fig. 11: EMC protective circuit

4.2.2.1 Power supply

▸ Connect the Motion Control system to a sufficiently well 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 Control system.Alternatively the over-voltage can be dissipated by an additional external Brake Chopper, see the datasheet for the Brake Chopper.

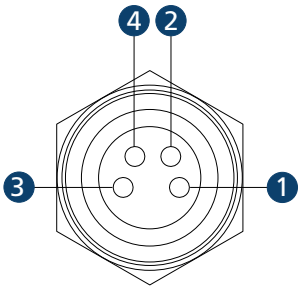
4.2.3 Connector pin assignment

NOTICE!
Incorrect connection of the pins can damage the electronic components.

▸ Check the view orientation of the pins in the diagram.

EtherCAT interface connection (IN/OUT)

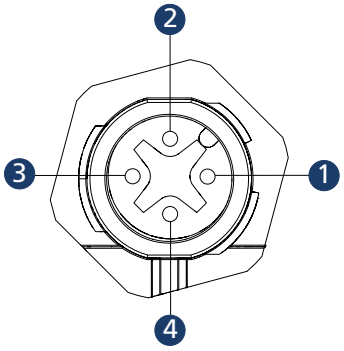
Tab. 3: Pin assignment for the EtherCAT M8 connector, 4–pin, A-coded, socket side view



Pin	Designation	Meaning
1	Rx/Tx +	Rx/Tx positive connection port
2	Tx/Rx +	Tx/Rx positive connection port
3	Tx/Rx –	Tx/Rx negative connection port
4	Rx/Tx –	Rx/Tx negative connection port

Supply connection (X1)

Tab. 4: Pin assignment for the M12 connector, 4-pin, A-coded, viewed from the pin side



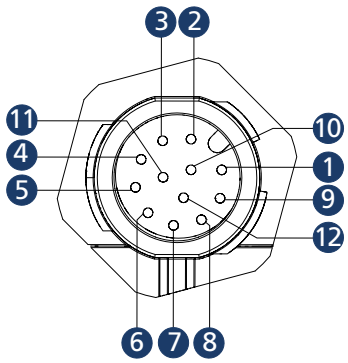
Pin	Designation	Meaning
1	GND	Ground
2	U_p	Supply connection to the electronics
3	U_{mot}	Supply connection to the motor
4	EGND	Enclosure ground connection

Tab. 5: Electrical data for the supply connection (X1)

Designation	Value
Power supply for the electronics	12–50 V Reference potential to GND < 100 mA (without external consumer load)
Power supply for motor	<50 V Reference potential to GND

I/O port (X2)

Tab. 6: Pin assignment for the M12 connector, 12-pin, A-coded, viewed from the pin side



Pin	Designation	Meaning
1	GND	Ground
2	CAN_L /RxD	CAN-Low interface
3	CAN_H /TxD	CAN-High interface
4	U_{DD}	Supply voltage for external consumer load
5	DigOut 1	Digital output
6	DigOut 2	Digital output
7	DigIn 1	Digital input
8	DigIn 2	Digital input
9	DigIn 3	Digital input
10	AnIn 1	Analogue input
11	AGND	Analogue ground
12	AnIn 2	Analogue input
Screen	EGND	Enclosure ground connection

Tab. 7: Electrical data for the I/O port (X2)

Pin	Value
External power supply	5 V Current Source < 100 mA
DigOut	Low = GND High = high resistance Integrated pull-up resistor = 33 kΩ Current sink < 0.7 A TTL level: low < 0.5 V, high > 3.5 V PLC level: low < 7 V, high > 11.5 V
DigIn	<50 V Input resistance > 10 kΩ Frequency < 1 MHz Reference potential = GND
AnIn	Input voltage = ±10 V Input resistance > 27 kΩ AGND

4.2.4 I/O circuit diagrams

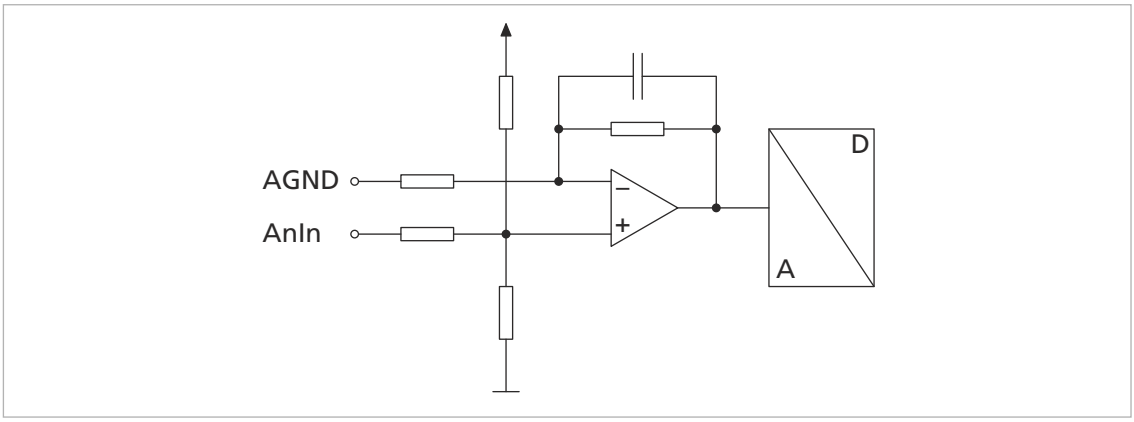


Fig. 12: Analogue input circuit diagram (internal)

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

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

The analogue inputs can be used flexibly:

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

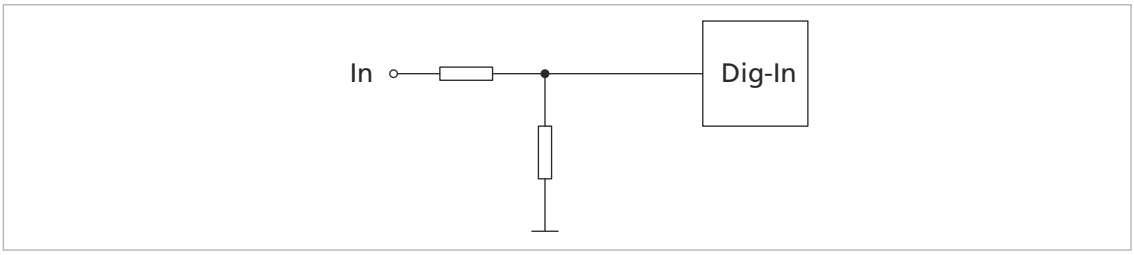


Fig. 13: Digital input circuit diagram (internal)

The digital inputs are switchable from the input level (PLC/TTL). 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 value specification for current, speed and position

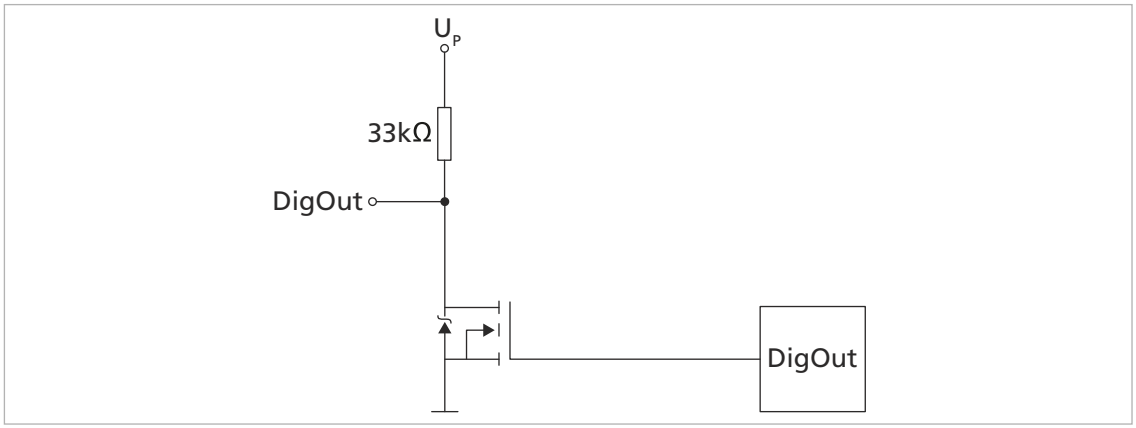


Fig. 14: Digital output circuit diagram (internal)

The digital output has the following properties:

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

The digital output can be configured for the following purposes:

- Fault output
- Actuation of an externally installed brake
- Digital output (freely programmable)

4.2.5 External circuit diagrams

Bipolar analogue set value specification via potentiometer

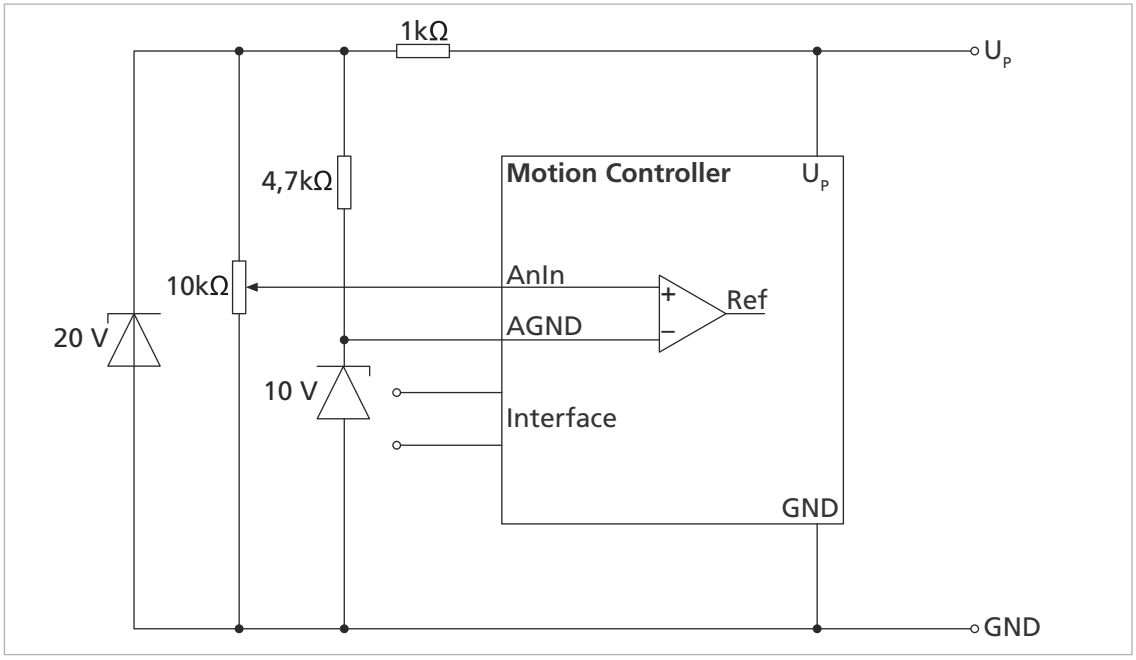


Fig. 15: Bipolar analogue set value specification via potentiometer

Analogue set value specification via potentiometer with internally set offset and scaling

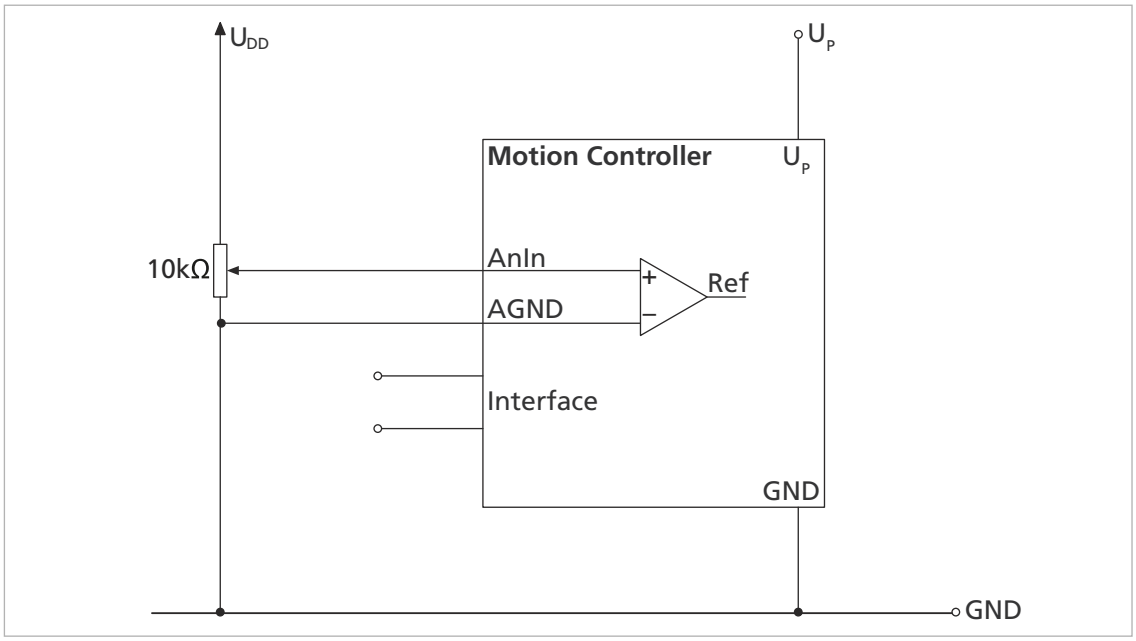


Fig. 16: Analogue set value specification via potentiometer with internally set offset and scaling

Connection of reference and limit switches

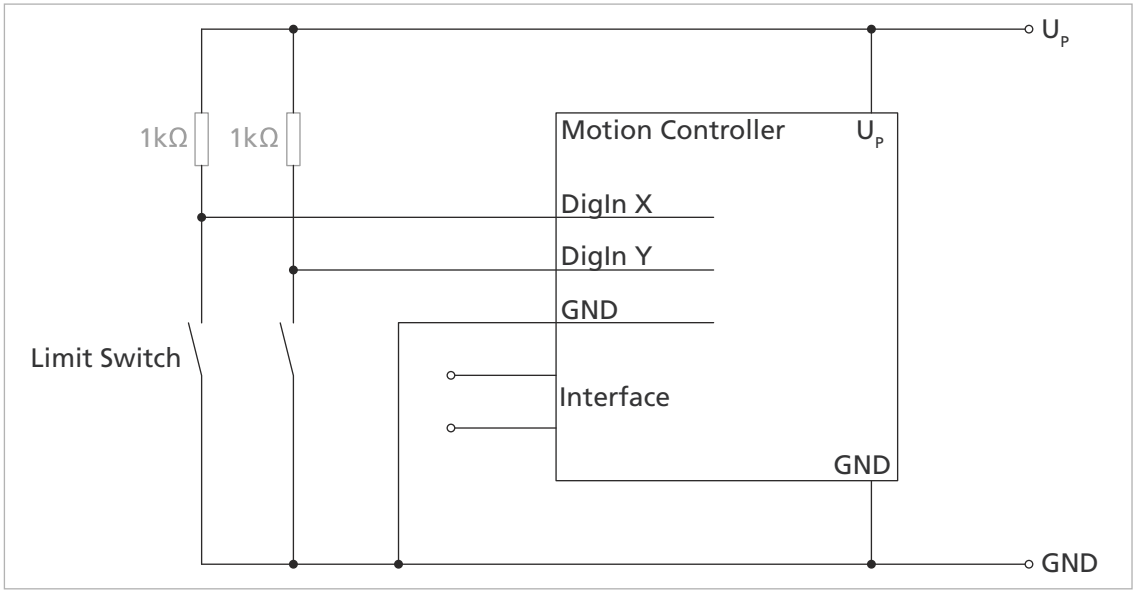


Fig. 17: Connection of reference and limit switches

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 of an external incremental encoder

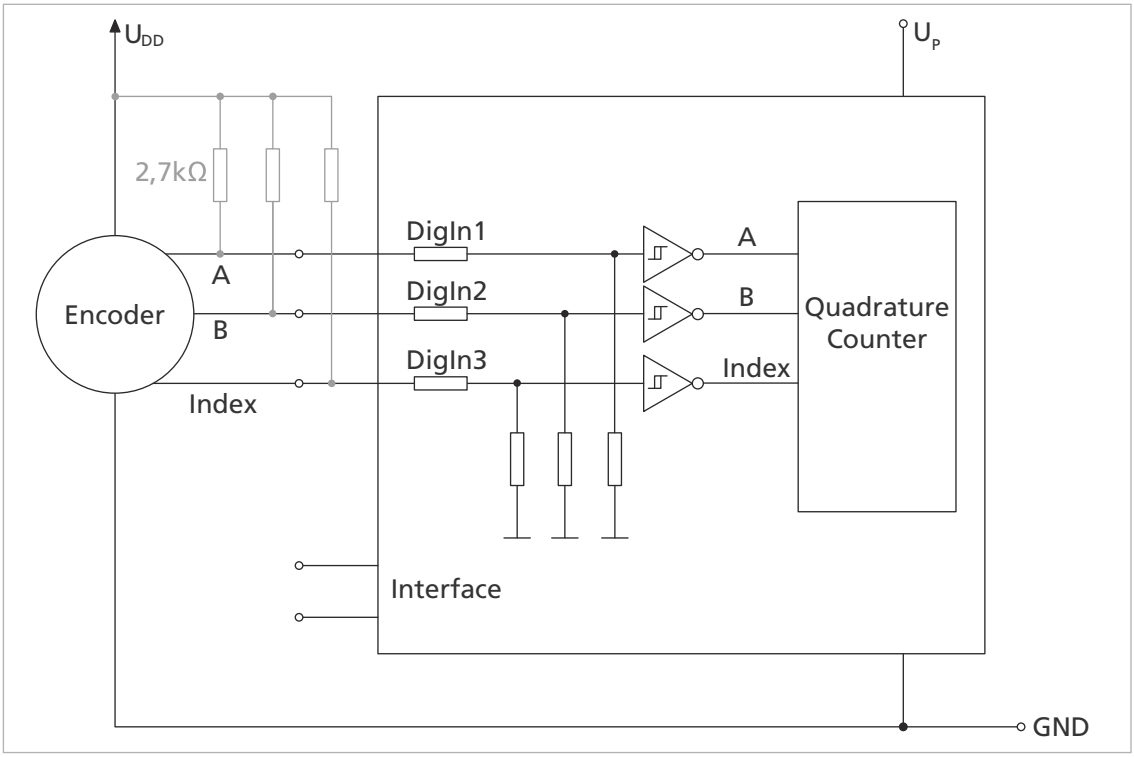


Fig. 18: Connection of an external incremental encoder

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

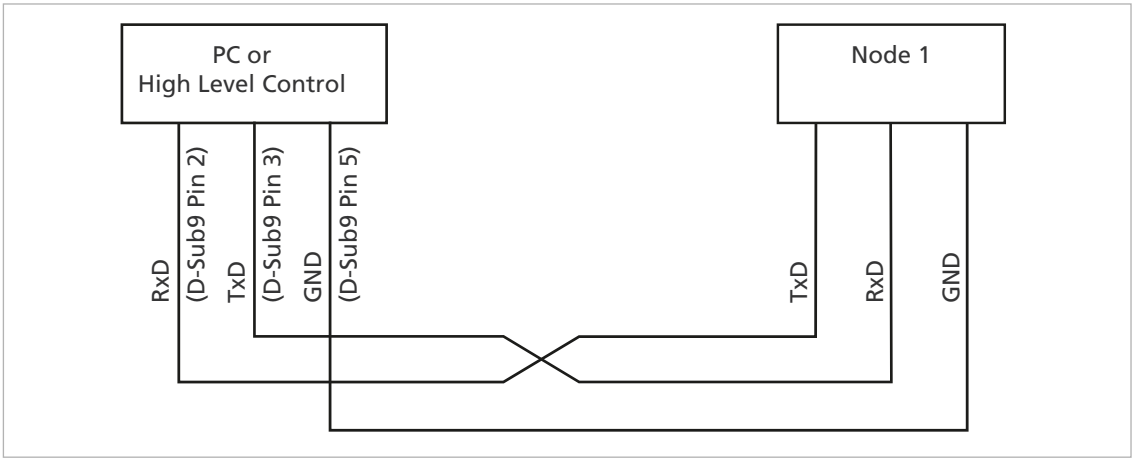


Fig. 19: Wiring between PC/controller and a drive

Wiring with several Motion Control Systems in RS232 network operation

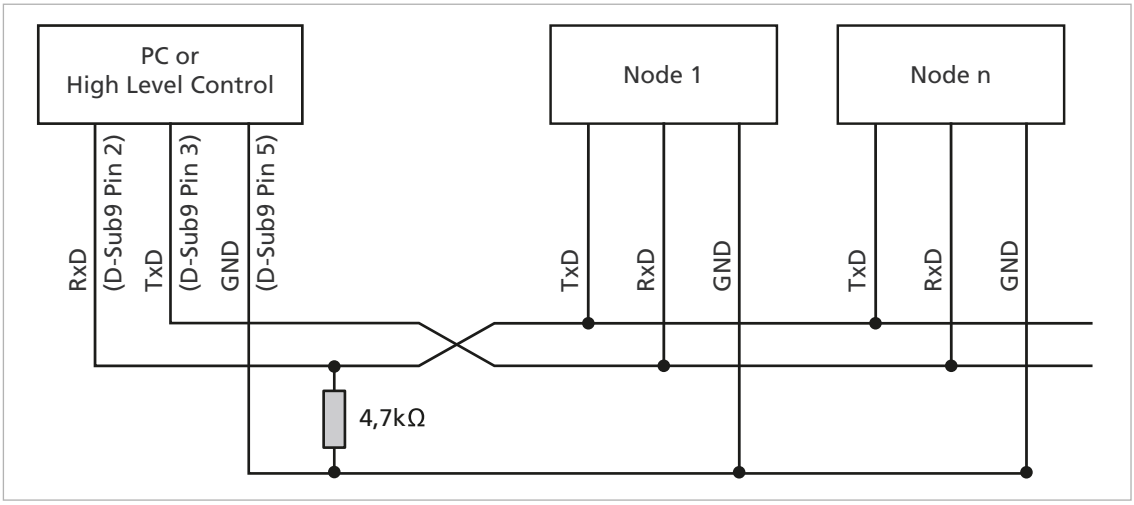


Fig. 20: Wiring with several Motion Control Systems in RS232 network operation

Depending on the number of networked controllers a smaller value may be necessary for the pull-down resistor.

Connection to the CANopen network

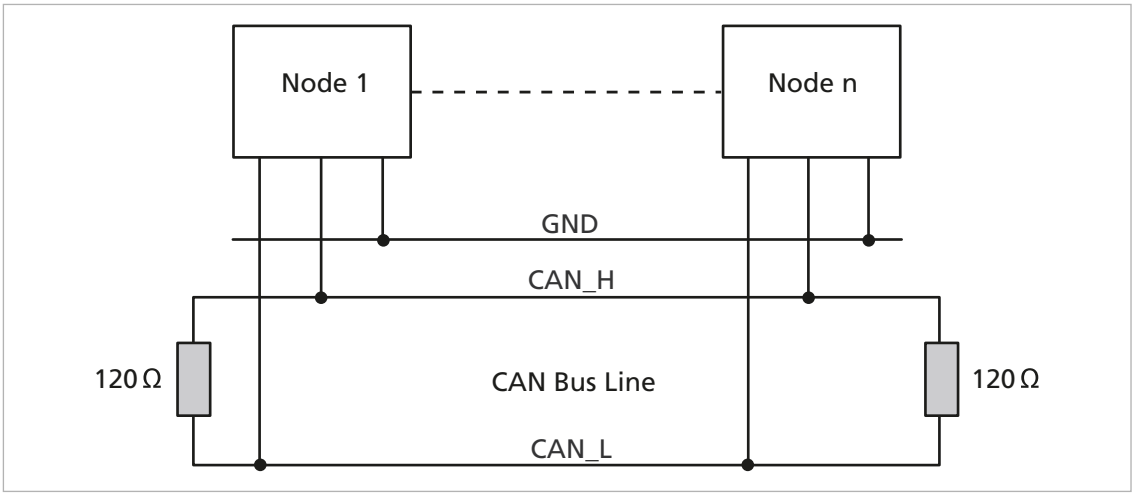


Fig. 21: Connection to the CANopen network

If the CAN wiring is not laid in a straight line it may be necessary to individually optimise 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.

5 Maintenance and diagnostics

5.1 Maintenance instructions

NOTICE!
The housing of the Motion Control system is not resistant to solvents such as alcohols or acetone.

- During operation and maintenance protect the housing against contact with solvents or substances containing solvents.

5.2 Maintenance activities

In principle the drives are 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 as necessary.

When using additional seals:

Option	Seal
5657	O-ring for sealing the motor flange in protection class IP54. After dismounting the drive from the flange or when replacing the attachment (e.g. gearbox) the O-ring has to be replaced.
5452	Rotary shaft seal for utilisation in direct contact with oily substances. Material: Nitrile rubber N7LM Lubrication: Self-lubrication depending on the ambient medium
5453	Shaft seal for sealing the motor shaft in protection class IP54. Material: Nitrile rubber N7LM Lubrication: Isoflex NB52 Lubrication interval: 500 operating hours Replacement: After 1000 operating hours

Using option 5452 or 5453 may reduce the motor performance. The lifetime generally depends on the installation and ambient conditions as well as on the given loading conditions.

5.3 Diagnostics

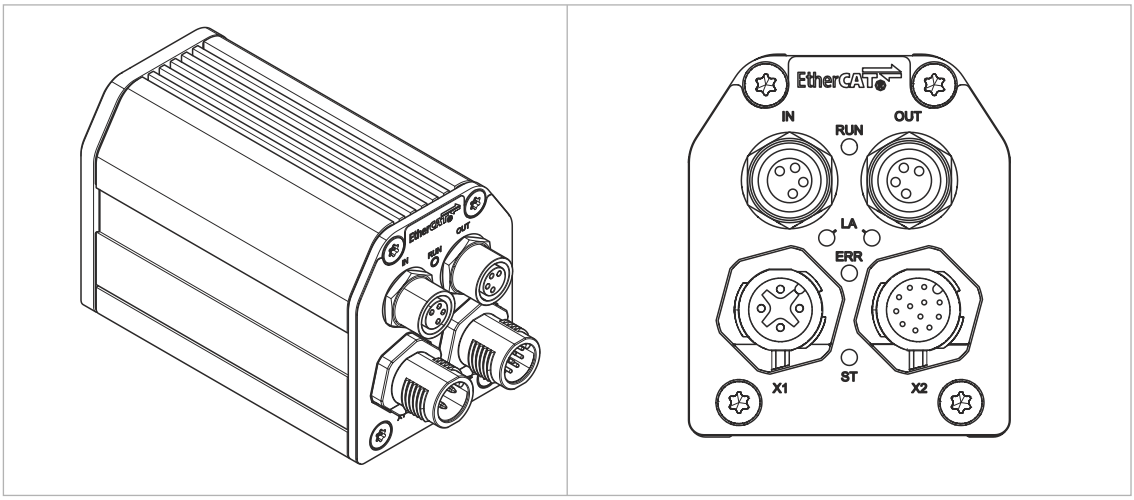


Fig. 22: Isometric view (left) and connector view (right) for axial cable exit

Tab. 8: LED overview

Designation	Interface	Function
Status LED	all	▪ Green (continuous): Device active. ▪ Green (flashing): Device active. However the state machine has not yet reached the *Operation Enabled* state. ▪ Red (continuously flashing): The drive has switched to a fault state. The output stage will be switched off or has already been switched off. ▪ Red (Error code): Boot procedure failed. Please contact FAULHABER Support.
RUN LED	EtherCAT	▪ Green (continuous): Connection available. Device is ready for operation. ▪ Green (flashing): Device is in the *Pre-Operational* state. ▪ Green (single flash): Device is in the *Safe-Operational* state. ▪ Off: Device is in the *Initialisation* state.
ERR LED	EtherCAT	▪ Red (flashing): Defective configuration. ▪ Red (single flash): Local error. ▪ Red (double flash): Watchdog timeout. ▪ Off: No connection error
LA LED	EtherCAT	▪ Green (continuous): No data transfer. Connection to another participant has been established. ▪ Green (flashing): Data transfer active. ▪ Off: No data transfer. No connection to another participant.

5.4 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
- Installation materials
- Additional equipment
- Programming adapter

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/gtc and downloaded from it.

FAULHABER

DR. FRITZ FAULHABER
GMBH & CO. KG
Antriebssysteme

Daimlerstraße 23 / 25
71101 Schönaich • Germany
Tel. +49(0)7031/638-0
Fax +49(0)7031/638-100
info@faulhaber.de
www.faulhaber.com

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