FAULHABER

Technical Manual

Motion Controller

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

Version:
8th edition, 9-11-2018

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

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

Subject to change without notice.

The respective current version of this technical manual is available on FAULHABER's internet site:
www.faulhaber.com

Content

Content

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 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
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.

1.4 List of abbreviations

Abbreviation	Meaning
AnIn	Analogue Input
AGND	Analogue 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 Cable
Data	Data cable
DigIn	Digital input
DigOut	Digital output
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

1.5 Symbols and designations

CAUTION!
Hazards to persons. Disregard may lead to minor injuries.

- Measures for avoidance

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 Intended use

The FAULHABER Motion Controllers described here are designed for the activation and control of DC-micromotors (MCDC), linear DC servomotors (MCLM) and brushless DC motors (MCBL). They feature numerous functions and operating modes which facilitate flexible adaptation to the respective drive task.

Thanks to their compact design, the units can be used in a wide variety of applications and require only basic wiring. The flexible connection possibilities open a wide range of applications in all areas, such as in decentral systems in automation technology and in pick-and-place machines and machine tools.

The following points must be observed to ensure that the motors are used as intended:

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

2.2 Safety instructions

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 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)
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 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:

- Position control with analogue or digital setpoint specification
- Speed control with analogue 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 analogue 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
Analogue input	▪ Setpoint specification via analogue or PWM signal ▪ Digital input for reference marks and limit switches ▪ Pulse input ▪ Incremental encoder connection
Fault output	▪ 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 control

The set configuration can be stored permanently.

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.

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.

3.2 Product information

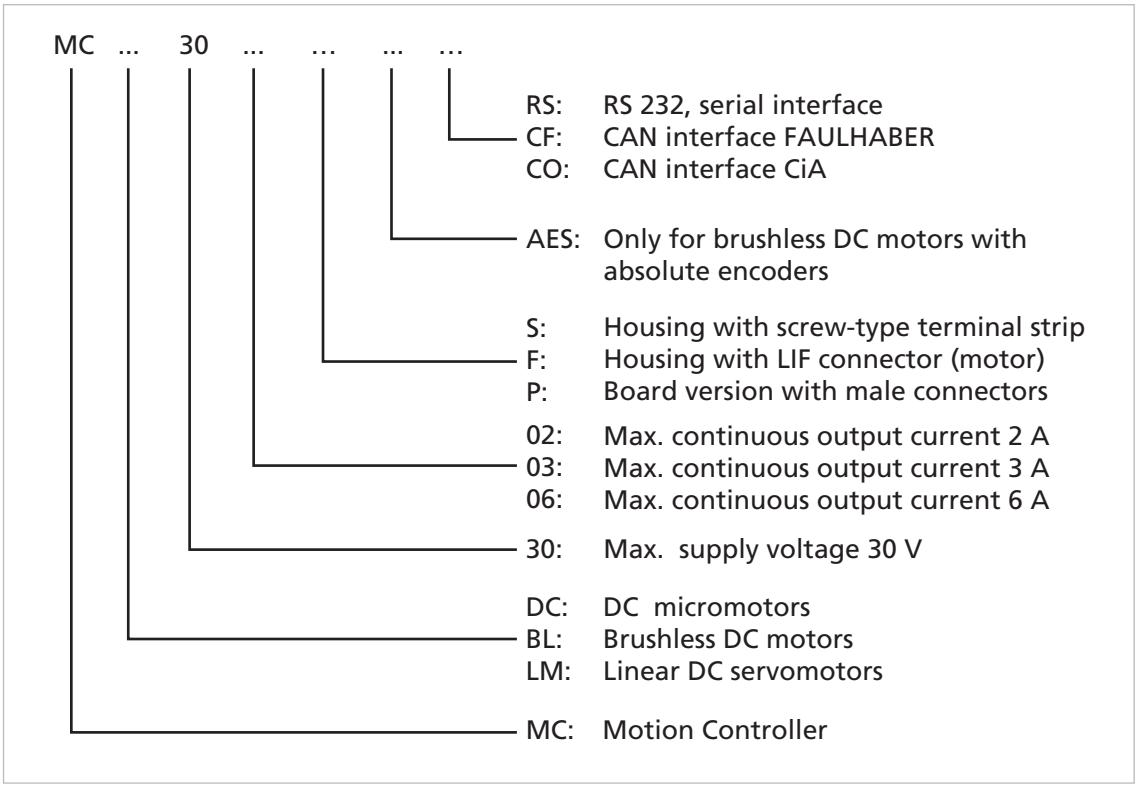


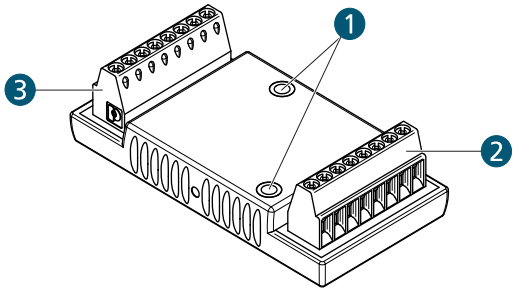
Fig. 1: Designation key

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

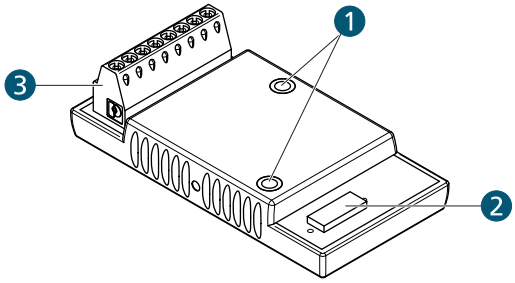
Motion Controller with hot-melt housing and screw terminals on the supply and motor side.



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

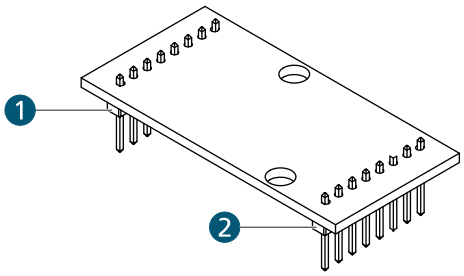
Motion Controller with hot-melt housing and screw terminals on the supply side and with flexboard connection on the motor side.



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

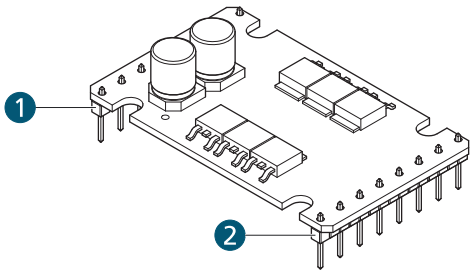
Motion Controller without housing (board version) with plug connectors on the supply and motor side.



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

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.

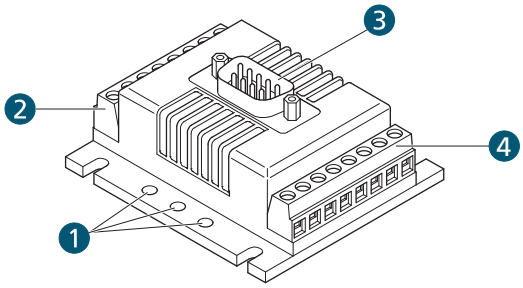


1 Plug connector on the supply side
2 Plug connector on the motor side

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

- This description must be carefully read and observed before commissioning.
- Observe the environmental conditions (see chap. 2.3, p. 9).

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

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

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.

NOTICE!
Improper installation or installation using unsuitable attachment materials can damage the Motion Controller.

- Comply with the installation instructions.

NOTICE!
Installation and connection of the Motion Controller when the power supply is applied can damage the device.

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

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.

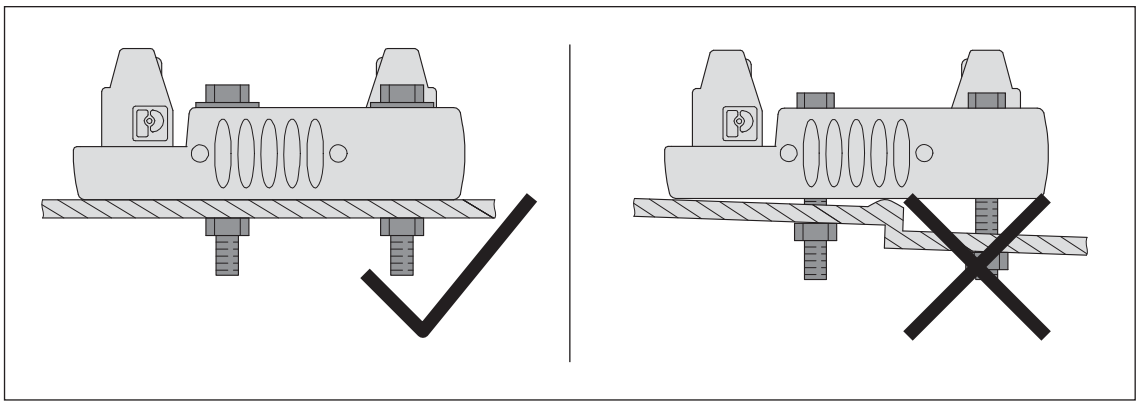


Fig. 2: Mounting (example)

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

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 Screening

The encoder and signal cables are susceptible to interference. Therefore, a maximum cable length cannot be specified.

Shielded wires must always be used with cable lengths > 300 mm.

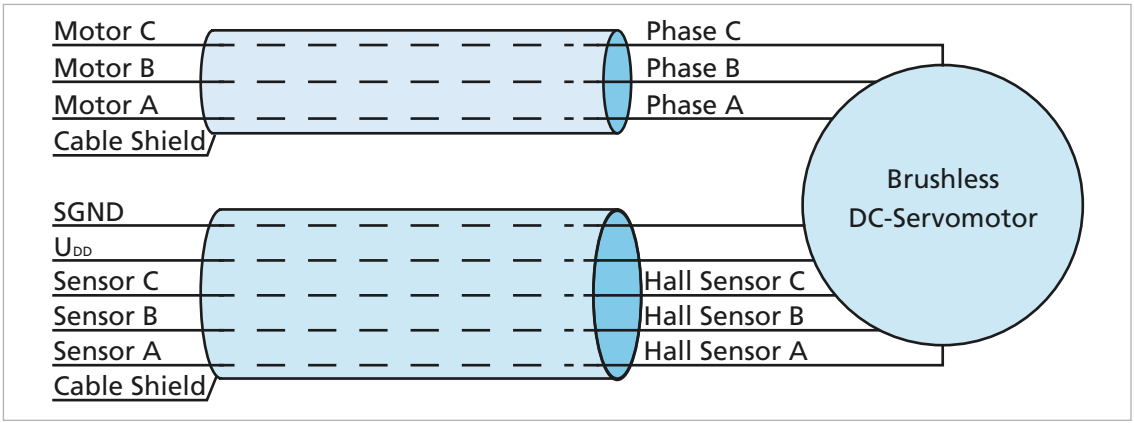


Fig. 3: MCBL motor wiring

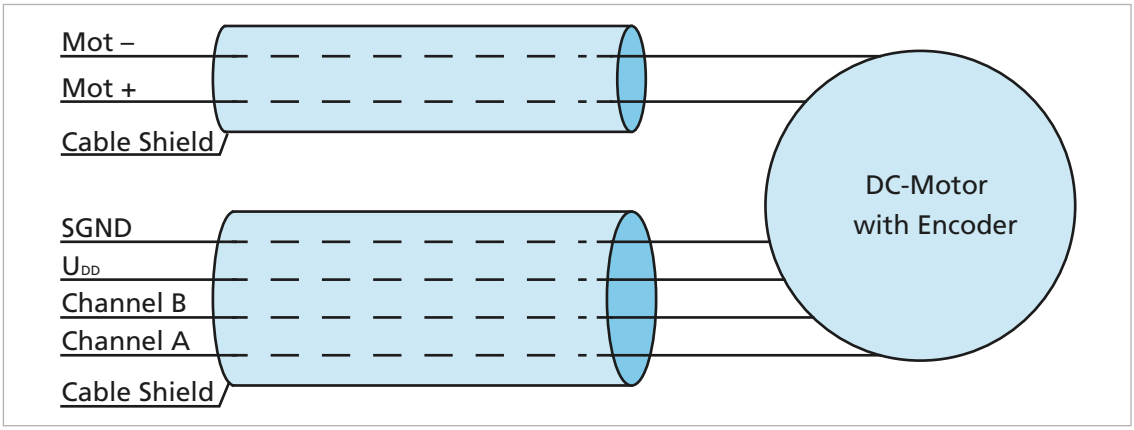


Fig. 4: MCDC motor wiring

- Connect screen connections for the sensor systems and the motor cables to the Motion Controller to the earthed mounting plate or the screen connection screw on the Motion Controller by the shortest available route.

The best screening effect is achieved if the braiding is laid flat for instance on a screen terminal.

If the installation ensures potential equalisation, the braid can also be attached to an earthed surface on the motor.

Alternatively equalisation currents can also be suppressed by connected the cable screen at the motor end via a capacitor (approx. 1µF … 2µF / 50 V).

4.2.3 Electrical connection of the Motion Controller

4.2.3.1 Connecting the supply

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.

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
Analogue 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.

✓ The connection cables are <3 m

1. Take the appropriate EMC protective measures (see chap. 4.2.3.2, p. 20).
2. Take the appropriate ESD protective measures.
3. Connect wires or flexboard according to pin assignment (see chap. 4.2.4, p. 21).
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.

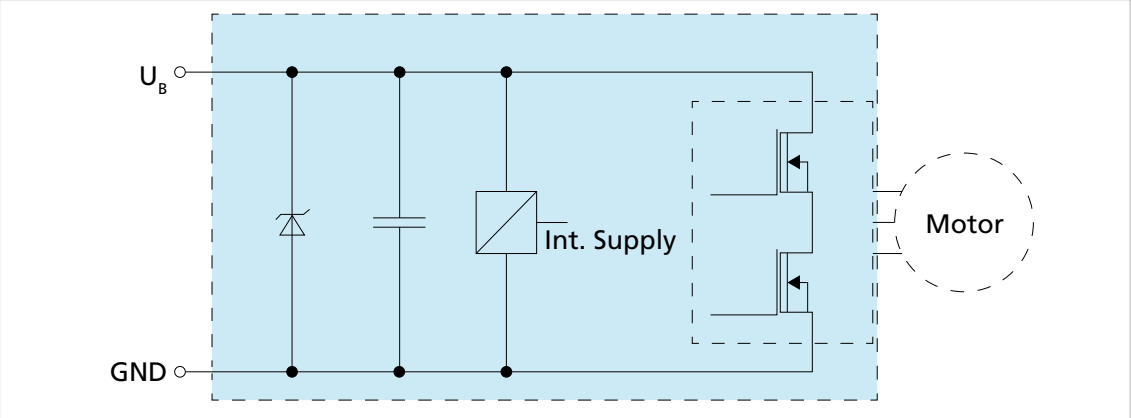


Fig. 5: Circuit diagram – common electronics supply

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.

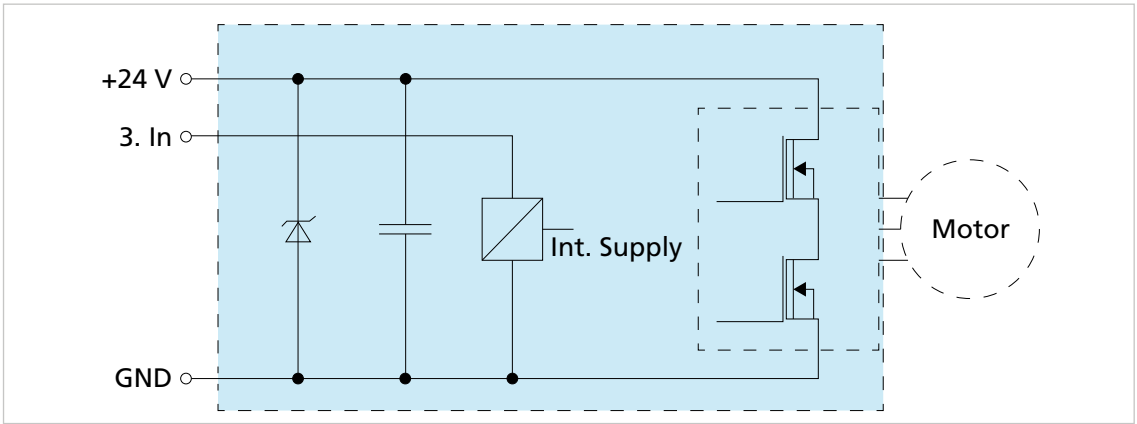


Fig. 6: Circuit diagram – separate electronics supply

4.2.3.2 EMC protective measures

To provide the required interference resistance in industrial applications, it may be necessary to use an EMC filter or a screen and an EMC suppressor circuit.

To reduce the effects on the DC power supply network, L1 ferrite sleeves (such as WE 742 700 790) can be used on the supply cables.

To protect against overvoltage on the supply side (surge), it is recommended to additionally connect an external diode D1 (e. g. NTE 4934, 1500 W).

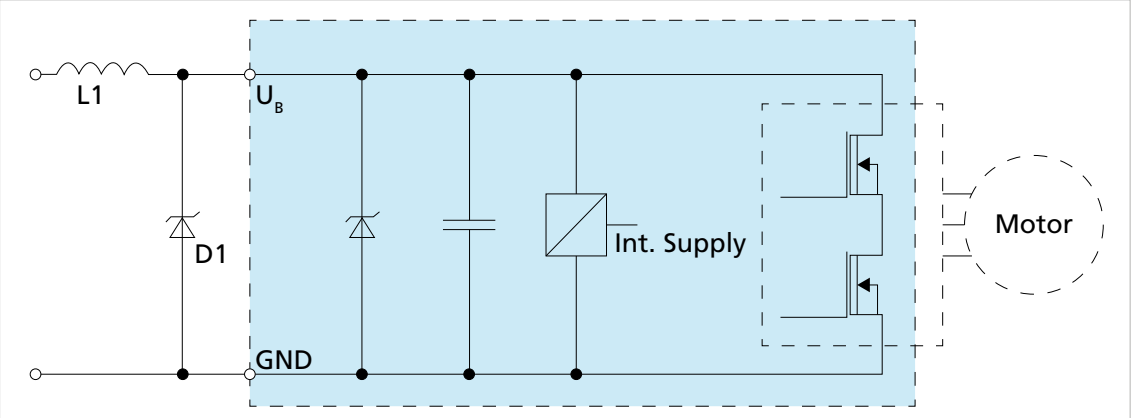


Fig. 7: EMC suppressor circuit

NOTICE!
Risk of damage caused by EMC interaction in the case of separate electronics supply

- In the case of a separate electronics supply, the suppressor circuit (see Fig. 7) must be such that it protects both supply connections.

Mcxx 3003/3006 protective measures
The devices are intended only for use in industrial applications. If the devices are used in the home, in business, in commerce or in a small business, appropriate measures must be taken to ensure that the emitted interference is below the permissible limit value.

Tab. 3 shows which additional EMC measures can be implemented to optimise the behaviour of the equipment in the intended environment with regard to transient emission and interference resistance.

Tab. 3: EMC measures

Motion Controller	Operational environment	Interference type	Action
MCDC 3006 S	Industrial area	Transient emission	EMC filter
MCBL 3006 S	Industrial area	Transient emission	EMC filter
MCBL 3006 S	Industrial area	Interference resistance	EMC suppressor circuit

- EMC filter (MCDC 3006 S and MCBL 3006 S only):

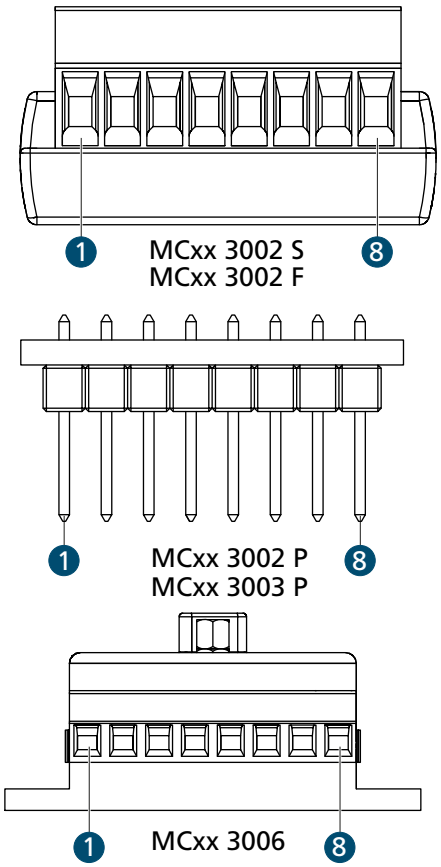
  The supply and motor supply cables must be installed directly at the device with two windings through a suitable ferrite sleeve (e.g. Würth Elektronik No.: 74270090).

- EMC suppressor circuit (MCBL 3006 S and MCLM 3006 S only):

  The signal cables of the MCBL 3006 S and MCLM 3006 S must be installed directly at the device with two windings through a star ring (e.g., Würth Elektronik No.: 7427153).

4.2.4 Connections

4.2.4.1 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	Analogue Ground
4	Fault	Fault output
5	AnIn	Analogue Input
6	U_B	Power supply for controllers
7	GND	Ground connection for controllers
8	3. In	3. Input / opt. separated power supply

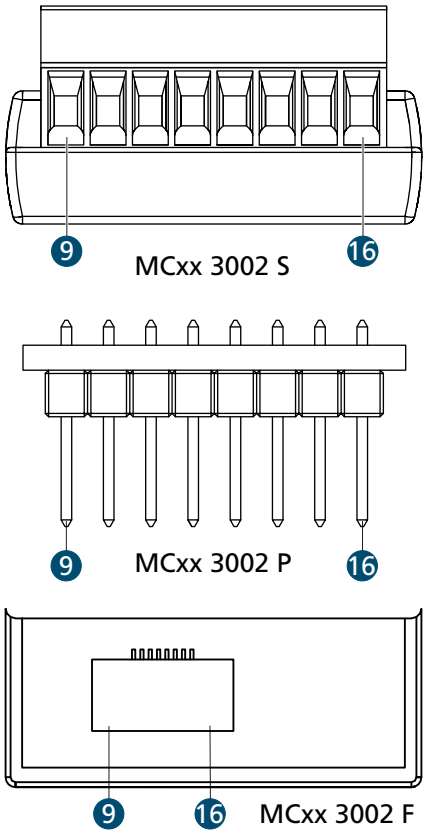
Tab. 4: Electrical data - connections of the Motion Controllers on the supply side

Pin	Use	Designation	Value
1 (TxD/CAN_H) 2 (RxD/CAN_L)	–	Connection of the communication	–
3 (AGND)	Analogue Ground	Analogue ground reference	–
	Digital input (external encoder)	Input resistance	Channel B R_{in} = 10 kΩ
		Frequency	f ≤ 400 kHz
4 (fault)	Digital input	Input resistance	R_{in} = 100 kΩ
	Digital output (open collector)	Voltage limit	$U_{max} = U_B$
		Current limitation	I_{max} = 30 mA
		Switch states (digital output)	▪ clear: switched through to GND ▪ set: high resistance
		Switch states (fault output)	▪ No fault: switched through to GND ▪ Fault: high resistance
		Pulsed output (MCBL and MCLM only)	f ≤ 2 kHz Resolution: 1…255 increments/revolution

Pin	Use	Designation	Value
5 (AnIn)			AGND as ground reference
	Analogue Input	Speed set value/position set value	U_{in} = ±10 V
	Digital input	Speed set value via PWM signal (not MCLM)	f = 100…2 000 Hz T = 50% ≙0 rpm
		External encoders	Channel A f ≤ 400 kHz
		Step frequency input	f ≤ 400 kHz R_{in} = 5 kΩ
6 (U_B)	–	Power supply	U_B = 8…30 V DC (MCxx 3002) U_B = 12…30 V DC (MCxx 3003 and MCxx 3006)
7 (GND)	–	Ground	–
8 (3. In)	Digital input	Input resistance	R_{in} = 22 kΩ
	Power supply of the electronics	Power supply	U_{EL} = 8…30 V DC (MCxx 3002) U_{EL} = 12…30 V DC (MCxx 3003 and MCxx 3006)

4.2.4.2 MCDC 3002 connections on the motor side

Tab. 5: Pin assignment of the screw terminal block/plug connector on the motor side



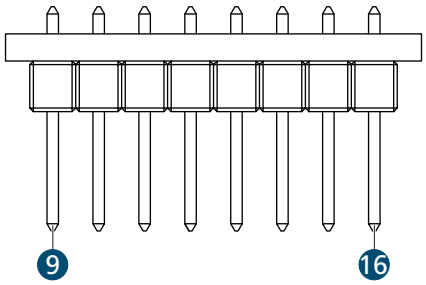
Pin	Designation	Meaning
9	4. In	4. Input
10	Ch A	Encoder channel A
11	Ch B	Encoder channel B
12	U_{CC}	Power supply for external consumer loads
13	SGND	Ground connection of the signal
14	Mot +	Power supply of the motor +
15	Mot –	Power supply of the motor –
16	5. In	5. Input

Tab. 6: 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 kΩ
	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 kΩ f ≤ 400 kHz
12 (U_{CC})	Output voltage for external use (e.g., encoders)	U_{out} = 5 V
	Load current	I_{out} ≤ 60 mA
13 (SGND)	Signal ground	–
14 (Mot +) 15 (Mot –)	Motor connection	▪ 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 kHz
16 (5. In) Digital input	Input resistance	R_{in} = 22 kΩ
	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

4.2.4.3 MCDC 3003 connections on the motor side

Tab. 7: Pin assignment of the plug connector on the motor side



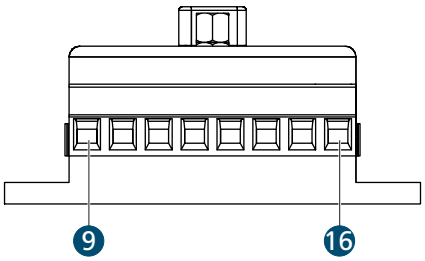
Pin	Designation	Meaning
9	5. In	5. Input
10	4. In	4. Input
11	Ch A	Encoder channel A
12	Ch B	Encoder channel B
13	U_{CC}	Power supply for external consumer loads
14	SGND	Ground connection of the signal
15	Mot +	Power supply of the motor +
16	Mot –	Power supply of the motor –

Tab. 8: 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 kΩ
	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 kΩ
	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 kΩ f ≤ 400 kHz
13 (U_{CC})	Output voltage for external use (e.g., encoders)	U_{out} = 5 V
	Load current	I_{out} ≤ 60 mA
14 (SGND)	Signal ground	–
15 (Mot +) 16 (Mot –)	Motor connection	▪ 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 kHz

4.2.4.4 MCDC 3006 connections on the motor side

Tab. 9: Pin assignment of the screw terminal block on the motor side



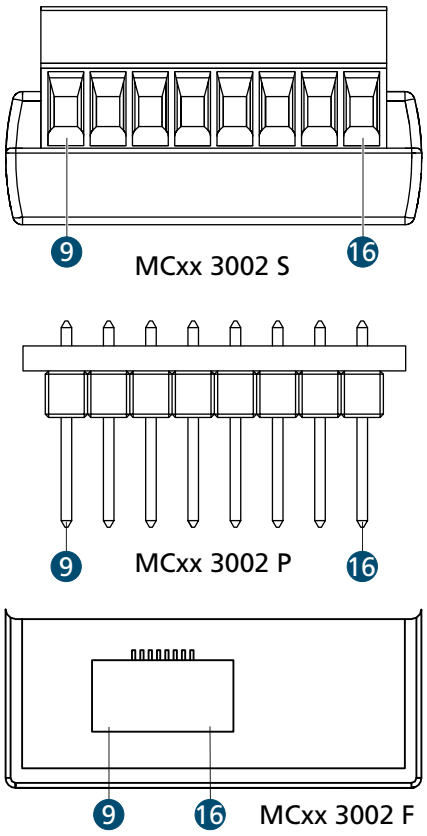
Pin	Designation	Meaning
9	5. In	5. Input
10	4. In	4. Input
11	Ch A	Encoder channel A
12	Ch B	Encoder channel B
13	U_{CC}	Power supply for external consumer loads
14	SGND	Ground connection of the signal
15	Mot +	Power supply of the motor +
16	Mot –	Power supply of the motor –

Tab. 10: 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 kΩ
	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 kΩ
	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 kΩ f ≤ 400 kHz
13 (U_{CC})	Output voltage for external use (e.g., encoders)	U_{out} = 5 V
	Load current	I_{out} ≤ 60 mA
14 (SGND)	Signal ground	–
15 (Mot +) 16 (Mot –)	Motor connection	▪ 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 kHz

4.2.4.5 MCBL/MCLM 3002 connections on the motor side

Tab. 11: Pin assignment of the plug connector/screw terminal block on the motor side



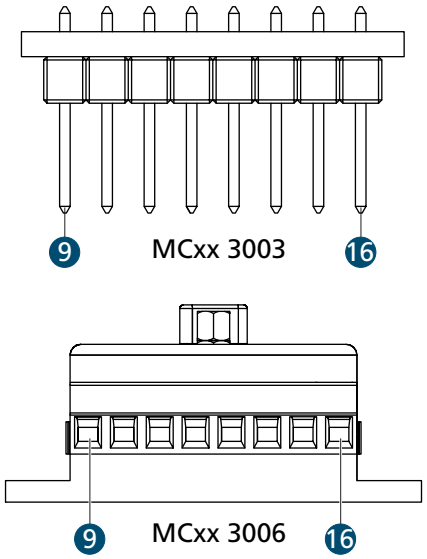
Pin	Designation	Meaning
9	Sensor A	Hall sensor A / DATA for absolute encoders
10	Sensor B	Hall sensor B / CS for absolute encoders
11	Sensor C	Hall sensor C / CLK for absolute encoders
12	U_{CC}	Power supply for external consumer loads
13	SGND	Ground connection of the signal
14	Motor A	Motor phase A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

Tab. 12: Electrical data - connections of the MCBL/MCLM 3002 Motion Controllers on the motor side

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

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

Tab. 13: 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

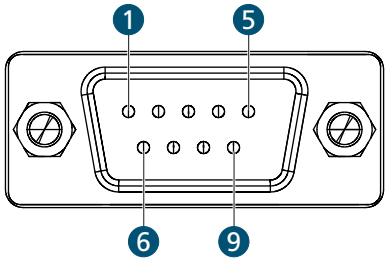
The pin assignment on the motor side is not compatible with previous controller versions.

Tab. 14: Electrical data - connections of the MCBL/MCLM 3002 Motion Controllers on the motor side

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

4.2.4.7 MCxx 3006 D-sub connector

Tab. 15: Pin assignment of the D-sub connector



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

4.2.5 I/O circuit diagrams

4.2.5.1 Analogue input

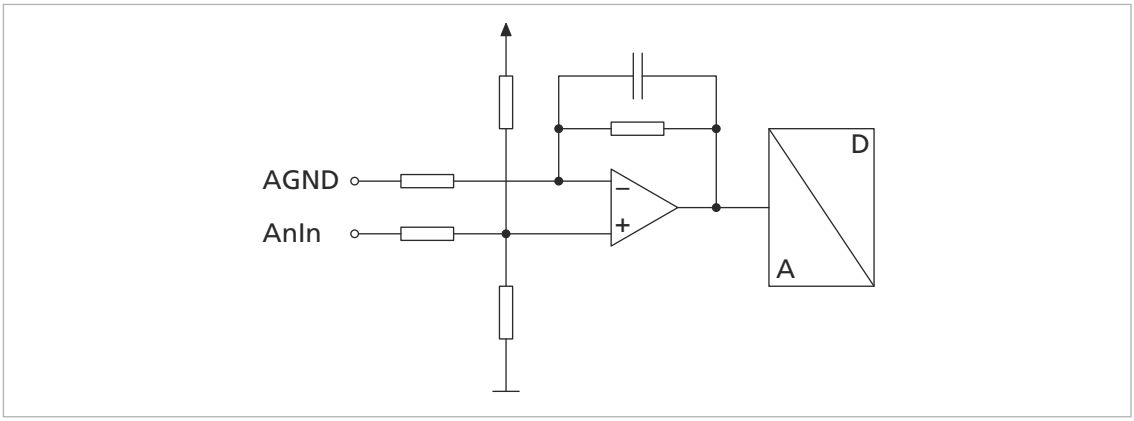


Fig. 8: Analogue input circuit diagram (internal)

The analogue input is a differential input. The analogue 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):

4.2.5.2 Digital output

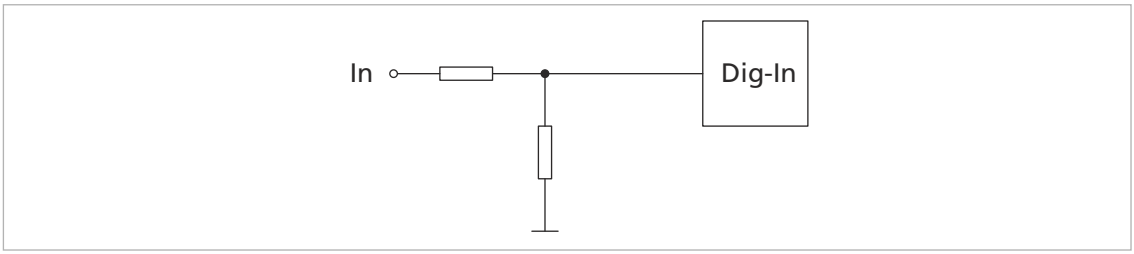


Fig. 9: Internal circuit – 3rd input

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.

4.2.5.3 Error 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 supply voltage of the sensors must not be greater than the power supply of the Motion Controller.

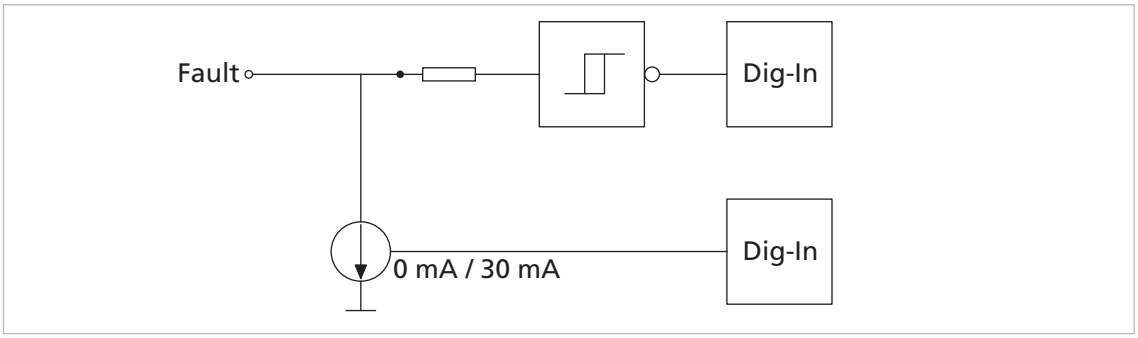


Fig. 10: Internal circuit – fault (Dig I/O)

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.

4.2.6 External circuit diagrams (Examples)

Bipolar analogue set value specification via potentiometer

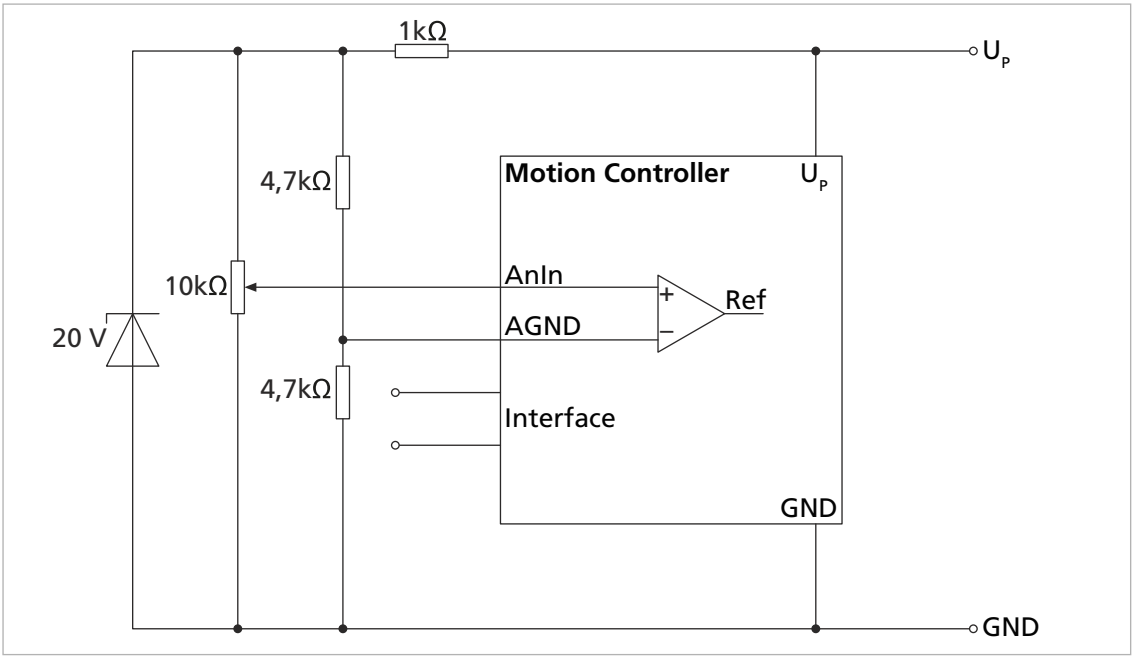


Fig. 11: Bipolar analogue set value specification via potentiometer

Connection of reference and limit switches

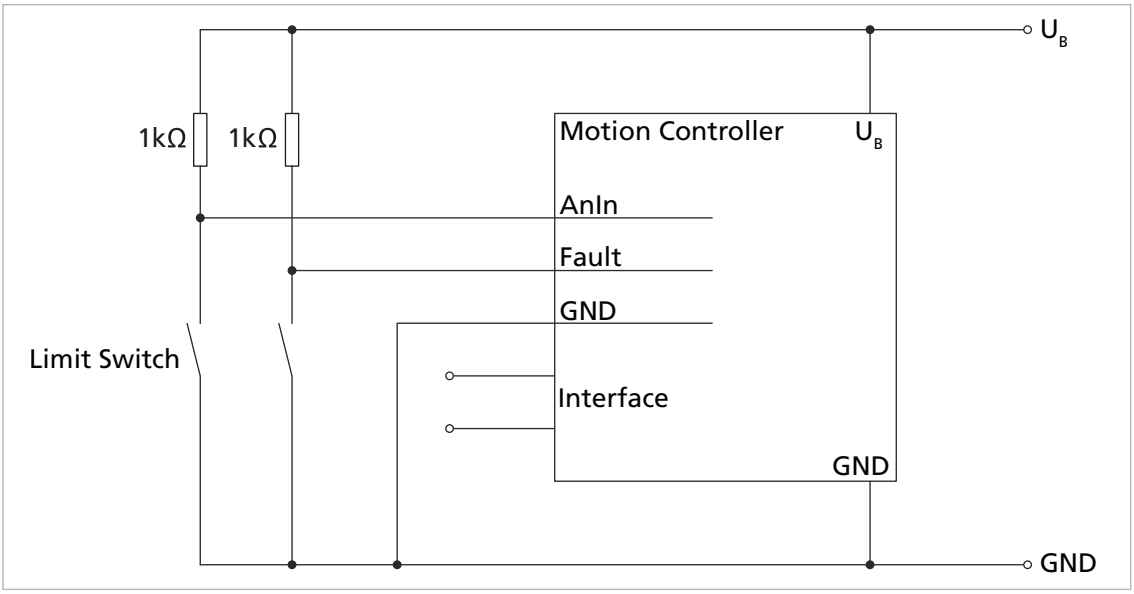


Fig. 12: Connection of reference and limit switches

Connection of an external incremental encoder

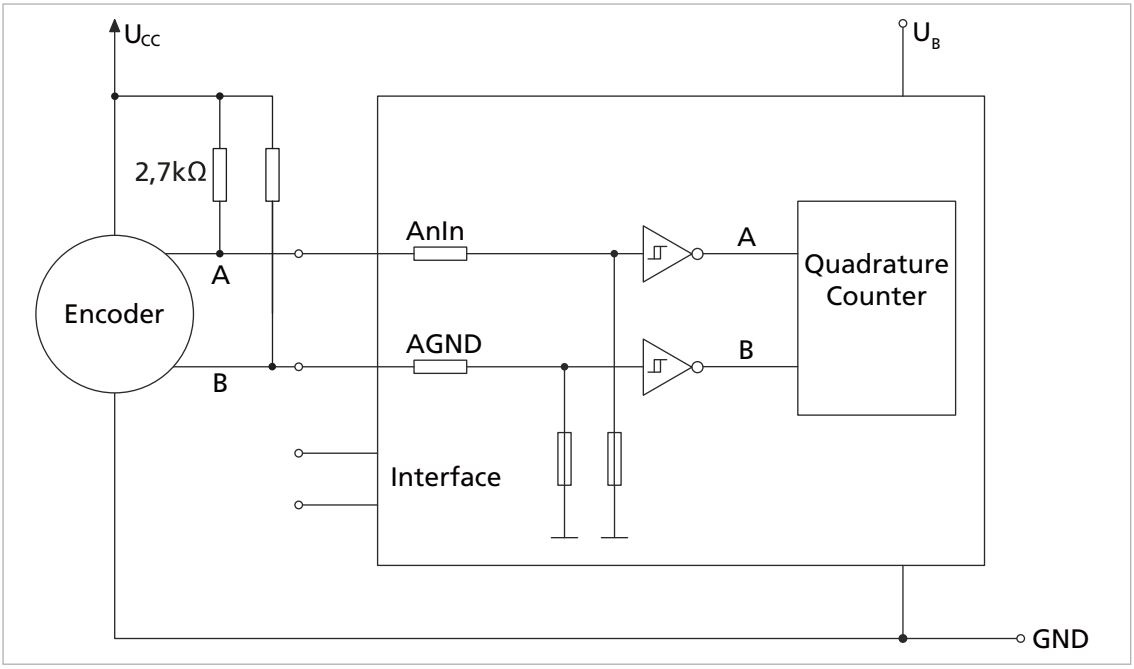


Fig. 13: Connection of an external incremental encoder

4.2.7 Communication port

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

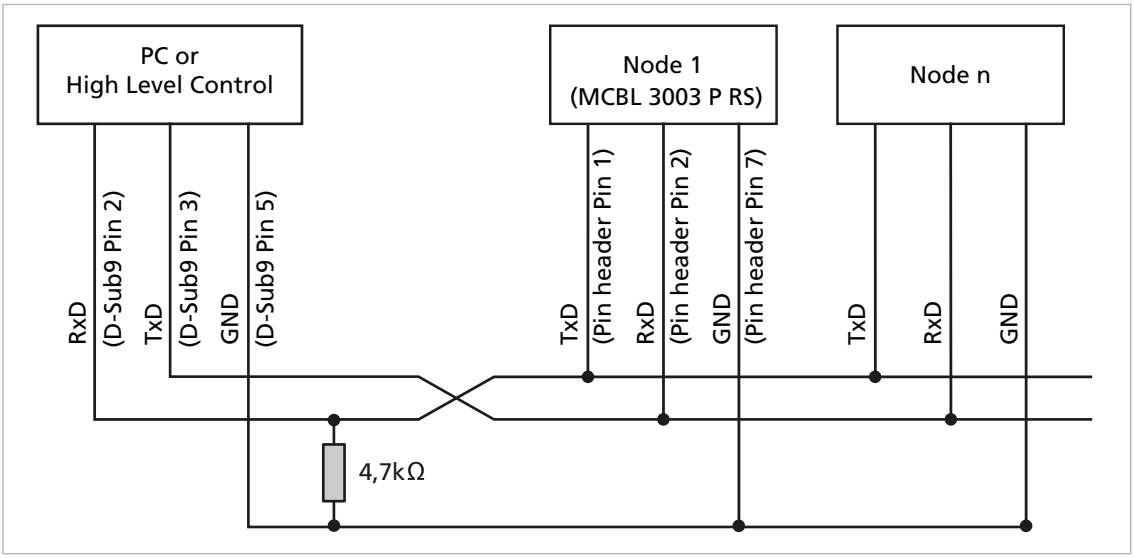


Fig. 14: Wiring with several Motion Control Systems in RS232 network operation (example: MCBL 3003 P RS)

Wiring between PC/controller and a drive

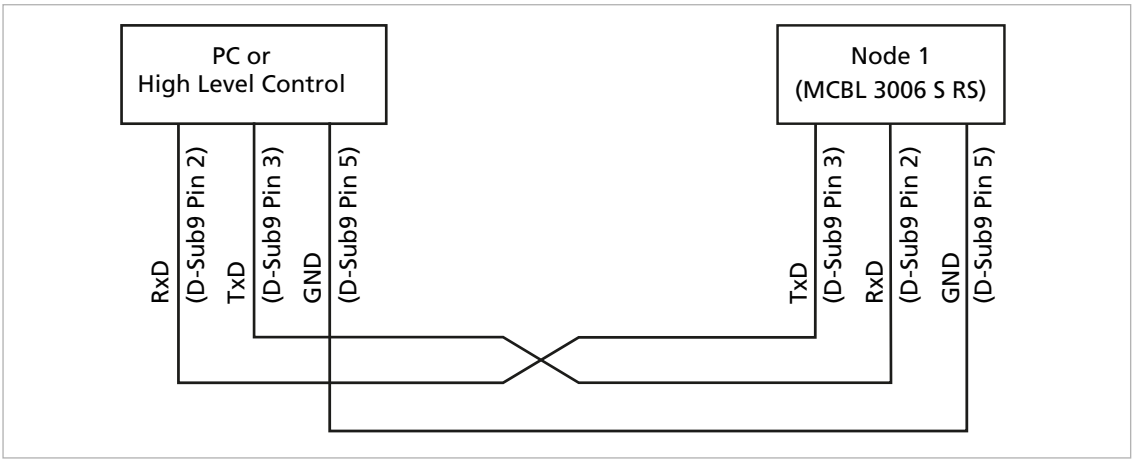


Fig. 15: Wiring between PC/controller and a drive (example: MCBL 3006 S RS)

Connection to the CANopen network

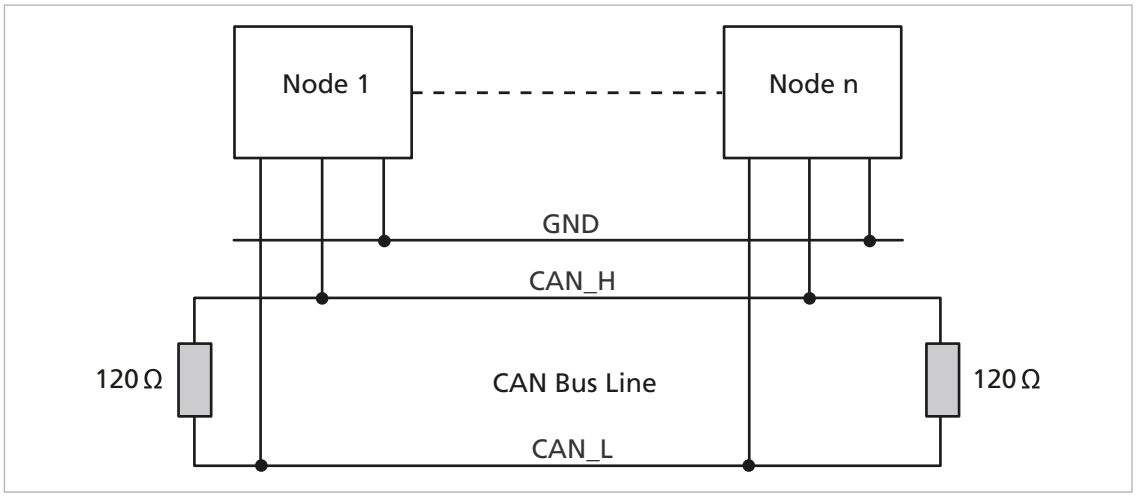


Fig. 16: Connection to the CANopen network

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.

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	1 000 m
20 kBit/s	2 500 m
10 kBit/s	5 000 m

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.

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