BUCHER automation

User Manual



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JM-T3503 / JM-T3506 / JM-T3512

Servo Amplifier 3-axis modules rev. B

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Translation of the german original User Manual

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1 Introduction

1.1 Information on this document

This document forms an integral part of the product and must be read and understood prior to using it. It contains important and safety-related information for the proper use of the product as intended.

Target Groups

This document is intended for specialists with appropriate qualifications.
Only competent and trained personnel are allowed to put this device into operation.
During the whole product life cycle, safe handling and operation of the device must be ensured. In the case of missing or inadequate technical knowledge or knowledge of this document any liability is excluded.

Availability of Information

Make sure this document is kept at the ready in the vicinity of the product throughout its service life.
For information on new revisions of this document, visit the download area on our website. This document is not subject to any updating service.

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For further information refer to the following information products:

– Online help for the JetSym software
  Functions of software products with application examples
– Application-oriented manuals
  Product-independent documentation
– Version updates
  Information about changes to the software products and operating system of your device

NOTICE! When installing the servo amplifier within the multi-axis system, the operating instructions of the other devices (servo amplifier, supply unit, controller, etc.) as well as the "Functional Description of Integrated Safety Function S1" must also be observed.

ⓘ Info

EtherCAT®

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

1.2 Typographical conventions

This manual uses different typographical effects to support you in finding and classifying information. Below, there is an example of a step-by-step instruction:

✓ This symbol indicates requirements which have to be met before executing the following action.

► This sign or a numbering at the beginning of a paragraph marks an action instruction that must be executed by the user. Execute the instructions one after the other.

⇨ The target after a list of instructions indicates reactions to, or results of these actions.

ⓘ Info

Further information and practical tips

In the info box you will find helpful information and practical tips about your product.

2 Safety

2.1 General Information

When placed on the market, this product corresponds to the current state of science and technology.
In addition to the operating instructions, the laws, regulations and guidelines of the country of operation or the EU apply to the operation of the product. The operator is responsible for compliance with the relevant accident prevention regulations and generally accepted safety rules.

2.2 Purpose

2.2.1 Intended use

The JM-3000 servo amplifiers are components designed for installation in industrial and commercial plants and machines.

Installation is only permitted in stationary equipment. The JM-3000 multi-axis motion system consists of at least one supply unit and at least one servo amplifier. In motor operating mode, the supply unit draws power from the supply network and provides it to the connected servo amplifiers via the DC link.

When the supply unit is installed in a machine, commissioning (i.e. commencement of intended use) is prohibited until it has been determined that the machine complies with Machinery Directive 2006/42/EC. Commissioning (i.e. commencement of intended use) is only permitted if the EMC Directive (2014/30/EU) is complied with.

2.2.2 Non-intended use

Use of the servo amplifier outside of the application areas given here or under operating ranges and ambient conditions other than those described in the documentation is considered non-intended use.

– The servo amplifier must not be used outside a control cabinet.
– No supply unit of another manufacturer may be used on the servo amplifier.

The following areas of application are not intended applications:

– Installation in vehicles. Use of the device in non-stationary equipment is considered an exceptional environmental condition and is only permitted after special agreement.
– Installation in environments where there are hazardous oils, acids, gases, vapors, dusts, rays, etc.
– Use in special application areas (e.g. where there is a risk of explosion, corrosion or fire).
– Untypical generation of higher frequency on-board networks.

2.3 Warnings used in this document

⚠ DANGER



High risk

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING



Medium risk

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION



Low risk

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE



Material damage

Indicates a situation which, if not avoided, could result in malfunctions or material damage.

2.4 General Safety Instructions

⚠ DANGER



Risk due to high electrical voltage

Touching live parts may result in death or severe injury.

► Carry out the following steps before starting work to ensure safety.

☑ Prepare for turning off the system. Inform everyone involved who will be affected by the process.

☑ Isolate the drive system from the power supply and secure it against being turned on again.

☑ Wait for the discharge time (approx. 10 minutes) and check all power connections to ensure they are at zero potential.

☑ Ground according to requirements.

☑ Cover over neighboring live parts.

☑ Ensure the drives cannot move.

⚠ DANGER



Danger due to high operating voltage!

The high operating voltage of the device leads to severe injuries or death.

Comply with the following rules throughout the entire work process.

- ► Do not remove any covers during operation and keep the switch cabinet doors closed.
- ► Check whether all live connections are safely protected against contact.
- ► Never open the device.
- ► Never touch the wiring terminals of the device for voltage supply and DC link voltage during operation.

⚠ DANGER



Risk of electric arc due to improper handling

Improper handling can result in an electric arc, which may lead to severe injury or death.

- ► Open the plug connections only in de-energized state.
- ► Install the device only in an environment where there is no risk of fire, without any flammable gases or vapors.
- ► Observe the specified limit values for voltage.
- ► Wire according to regulations.

⚠ WARNING



Non-observance of safety instructions may result in injuries or physical damage

- ► Prior to assembling and installing the device, read and follow the safety precautions and restrictions of use as set out in the Safety chapter.
- ► Only authorized qualified personnel is allowed to perform any kind work on the device.

⚠ WARNING



Risk of crushing due to uncontrolled axis movements

High mechanical forces due to axis movements and accelerations.

- ► Keep out of the hazard zone of the machines.
- ► Do not disable any safety equipment.
- ► Have malfunctions eliminated by qualified personnel.

⚠ WARNING



Risk of burns due to hot surfaces

The device may become hot during operation and can cause burns if touched.

- ► Take protective measures to prevent inadvertent contact with the device, e.g. protective covers.
- ► Make sure that no temperature-sensitive parts, e.g. connection cables, are attached or fastened to the device.
- ► Ensure there is adequate heat dissipation and maintain the required distances during installation so as not to prevent or restrict ventilation.
- ► Allow the device to cool off for a while before carrying out cleaning or maintenance work.
- ► Wear personal protective equipment.

⚠ WARNING



Danger for persons with pacemakers and implants!

Operating the device generates an electromagnetic field. Electric, magnetic and electromagnetic fields are a health risk in particular to persons with pacemakers and implants.

- ► If you belong to the above group of persons you must not be in the immediate vicinity of the device.
- ► Keep a minimum distance as specified below:
  300 mm from a de-energized device, for example when doing installation work;
  600 mm from an energized device running in normal operation.

⚠ WARNING



Risk of death due to falling loads during lifting and transport processes

Improperly performed lifting and transport processes as well as unsuitable or defective devices and tools can lead to severe or fatal injuries and material damage.

- ► Lifting devices, industrial trucks and load handling attachments must meet requirements.
- ► The load capacity of the lifting equipment and load handling attachments must be in line with the weight of the load being transported.
- ► Fasten and secure the load to be transported carefully to the lifting equipment.
- ► Do not stand in the swivel range of lifting equipment or under suspended loads.

⚠ CAUTION



Risk from unwanted coastdown!

Triggering the STO function by deactivating the digital input only interrupts the energy supply for the drive and the motor movement can no longer be controlled. The voltage of the DC bus is not disconnected!

- ► Always stop the drive before you trigger the STO function.
- ► In case of suspended loads, install a mechanical brake to prevent the load from falling down.

NOTICE



Damaged devices

Damaged devices may cause considerable physical damage.

- ► Check the device for external damage and faulty connections.
- ► Ensure to install only fully functional devices.

NOTICE



Material damage due to loose power connection

Vibrations or insufficient tightening torques can lead to loose power connections. This can lead to fire damage, defects in the device or malfunctions.

- ► Tighten all power connections to the specified tightening torques.
- ► Check all power connections at regular intervals, especially after transport.

NOTICE



Inadequate accessories might cause damage to the product

Parts and equipment from other manufacturers might impede the function of the device and cause damage to the product.

- ► Only use accessories recommended by Bucher Automation AG.

3 Product description

The Servo amplifier of the JM-3000 product family is servo amplifiers with EtherCAT® bus connection that can be designed and expanded modularly.

The JM-T3503 / JM-T3506 / JM-T3512 is a 3-axis module.

NOTICE! Devices of the previous JM-3000 series cannot be combined with the new JM-3000 series rev. B.

3.1 Design

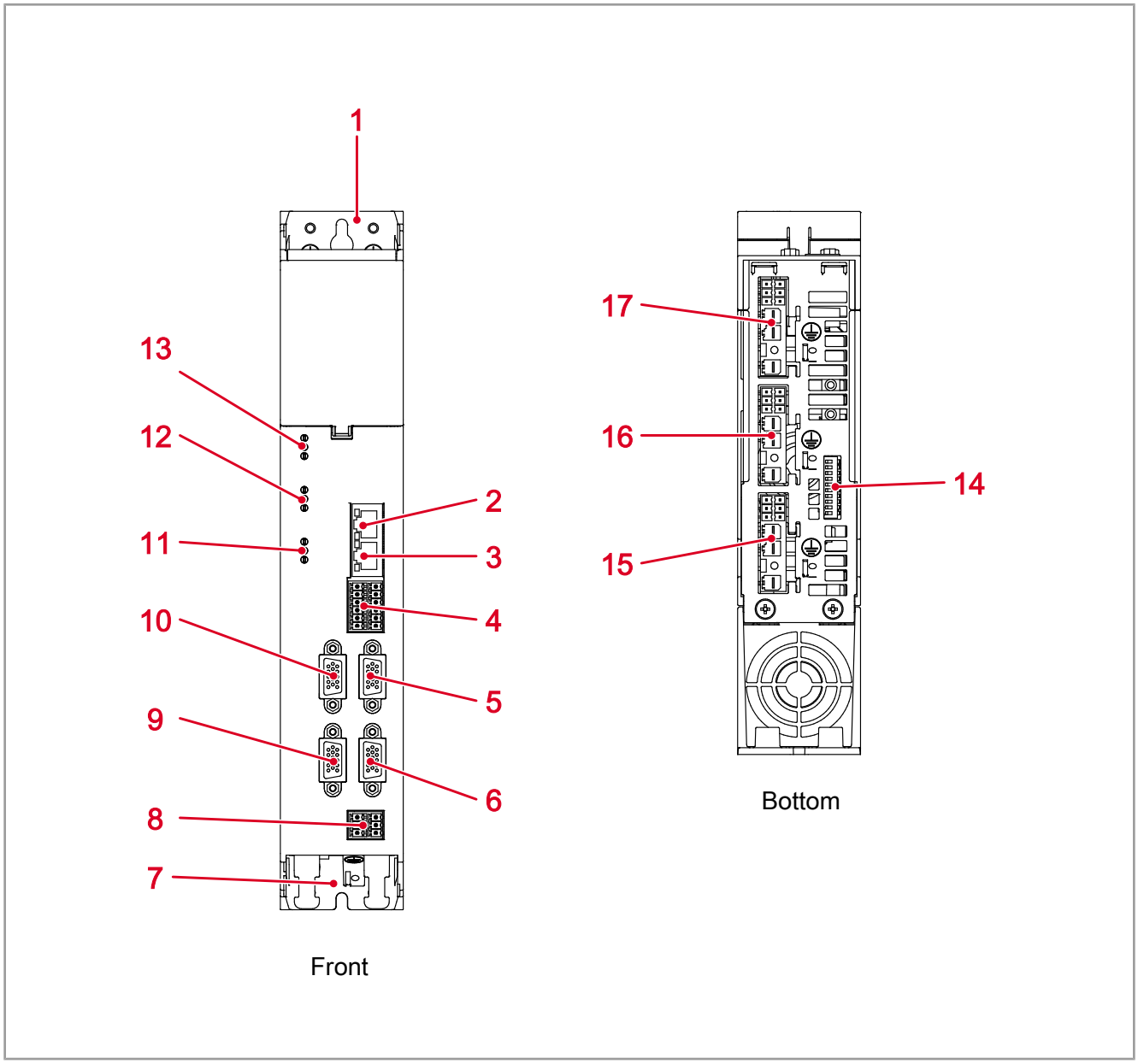


Fig. 1: 3-axis design, BG1

1	Fastening lug
2	X5.1: EtherCAT IN, fieldbus input
3	X5.2: EtherCAT OUT, fieldbus output
4	X6: Digital inputs (programmable)

5	X7: Encoder interface [▶ 45]
6	X8: Encoder interface [▶ 45]
7	Fastening lug
8	X11: Digital inputs (safety function)
9	X10: Encoder interface [▶ 47]
10	X9: Encoder interface [▶ 46]
11	Status of axis 3
12	Status of axis 2
13	Status of axis 1
14	S-ADR: DIL switch block for configuration of S1 functionality
15	X12: Power connection, motor 1
16	X13: Power connection, motor 2
17	X14: Power connection, motor 3

3.2 Product features

- Modular design
- Flexible power bus system
- Compact geometries
- Up to three axis modules per device
- High positioning accuracy
- EtherCAT® bus connection
- Integrated safety technology (S1)
- Brake resistor (supply unit) (R1)
- Easy commissioning

3.3 Status indication

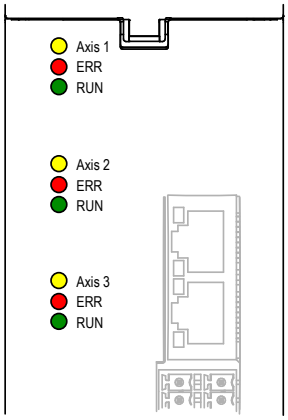


Fig. 2: Status indication of axes; e.g. 3-axis module

Depending on the version of the servo amplifier (1, 2 or 3-axis module), up to three times 3 LEDs are installed as status indicators. They are located on the front of the device and are assigned to axis 1 to axis 3 from top to bottom.

In the 1-axis modules, only the recesses for the LEDs are present for axes 2 and 3, and in the 2-axis modules for axis 3, and there is no labeling.

Color and status of the LEDs are an excellent source of information for analyzing various states.

The meaning of the LEDs is the same for all axes.

3.3.1 Lighting patterns of the LEDs

Parameter	Lighting pattern	Description
OFF	-	LED turned off
ON	Continuously lit	LED turned on
BLK	0.8 s	Slow continuous flashing
FLK	0.4 s	Fast, continuous flashing (flickering)

Tab. 1: Lighting patterns of the LEDs

3.3.2 Function of the LEDs

LED	Color	Role
Axis 1 … 3	Amber	Reset ► For BLK or FLK please contact Bucher Automation AG
ERR	Red	Error indication
RUN	Green	Ready for operation / output stage active

Tab. 2: Role

3.3.3 Status indicator and lighting patterns of the LEDs

Axis	ERR	RUN	Axis state
ON	ON	ON	Reset/start or firmware update
OFF	OFF	1 x BLK	Not ready
OFF	OFF	2 x BLK, 2 x FLK	Switch on disabled
OFF	OFF	3 x BLK, 3 x FLK	Axis ready
OFF	OFF	4 x BLK, 4 x FLK	Axis switched on
OFF	OFF	ON, 5 x FLK	Operation enabled
OFF	OFF	6 x BLK, 6 x FLK	Quick stop
OFF	ON	7 x BLK, 7 x FLK	Response to error active
OFF	ON	8 x BLK, 8 x FLK	Error, the number of flashing signals on the red LED indicates the error number
OFF	FLK	OFF	Internal error in the firmware. The number of flashing signals provides an indication of the error location.

3.4 Nameplate

Main nameplate

The main nameplate is located on the left side of the housing.

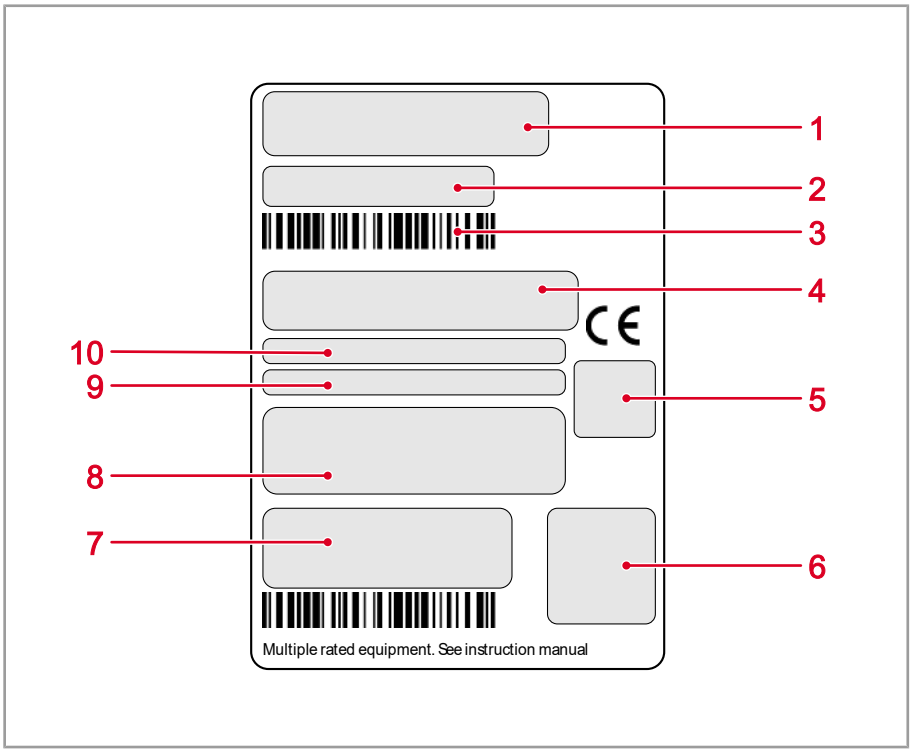


Fig. 3: Main nameplate

1	Model code number
2	Serial number
3	Barcode serial number
4	Company logo and address
5	Mandatory sign
6	Certification mark
7	Software revision and various details
8	Power data
9	Item number
10	Model code number

On the top of the front cover there is also a label with the product designation, serial number and corresponding barcode.

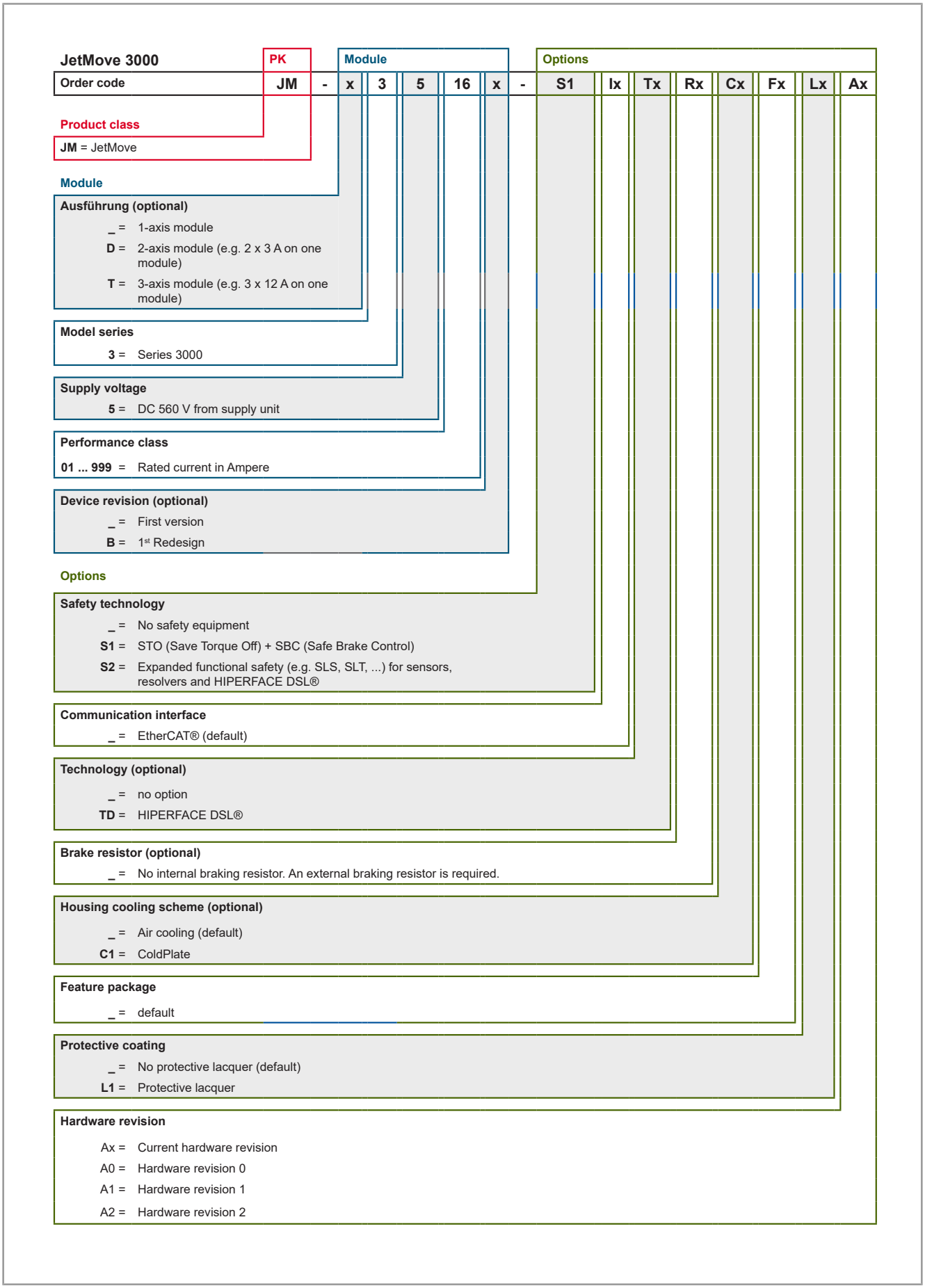
Structure of the serial number

- YY = year of prod.
- WW = calendar week (wk)
- S = production location
- XXXX = sequential no. (by wk)

See also

Order code [▶ 15]

3.4.1 Order code



3.5 Scope of Delivery

Scope of delivery	Item number	Quantity
JM-T3503 / JM-T3506 / JM-T3512	Depending on options	1
EtherCAT® patch cable, 0.25 m 8-wire, Cat 5 e PE metal bridge	60887985	1 sachet
Pre-installed busbar elements for 24 V controller supply voltage (U_{CV}) and DC link supply ($U_{DC\ link}$)		
Mating connector for power and IOs		
For 3-axis module	60879944	1 sachet
USB stick with complete documentation	60888000	1 per order

4 Technical Specifications

This chapter contains information on both electrical and mechanical data as well as on operating data of the JM-T3503 / JM-T3506 / JM-T3512 device.

4.1 Dimensions

Parameter	BG1	BG2
Dimensions (W x H x D)	55 x 310 x 241 mm	110 x 310 x 241 mm
Devices	JM-T3503, JM-T3506	JM-T3512

Tab. 3: Overview of components

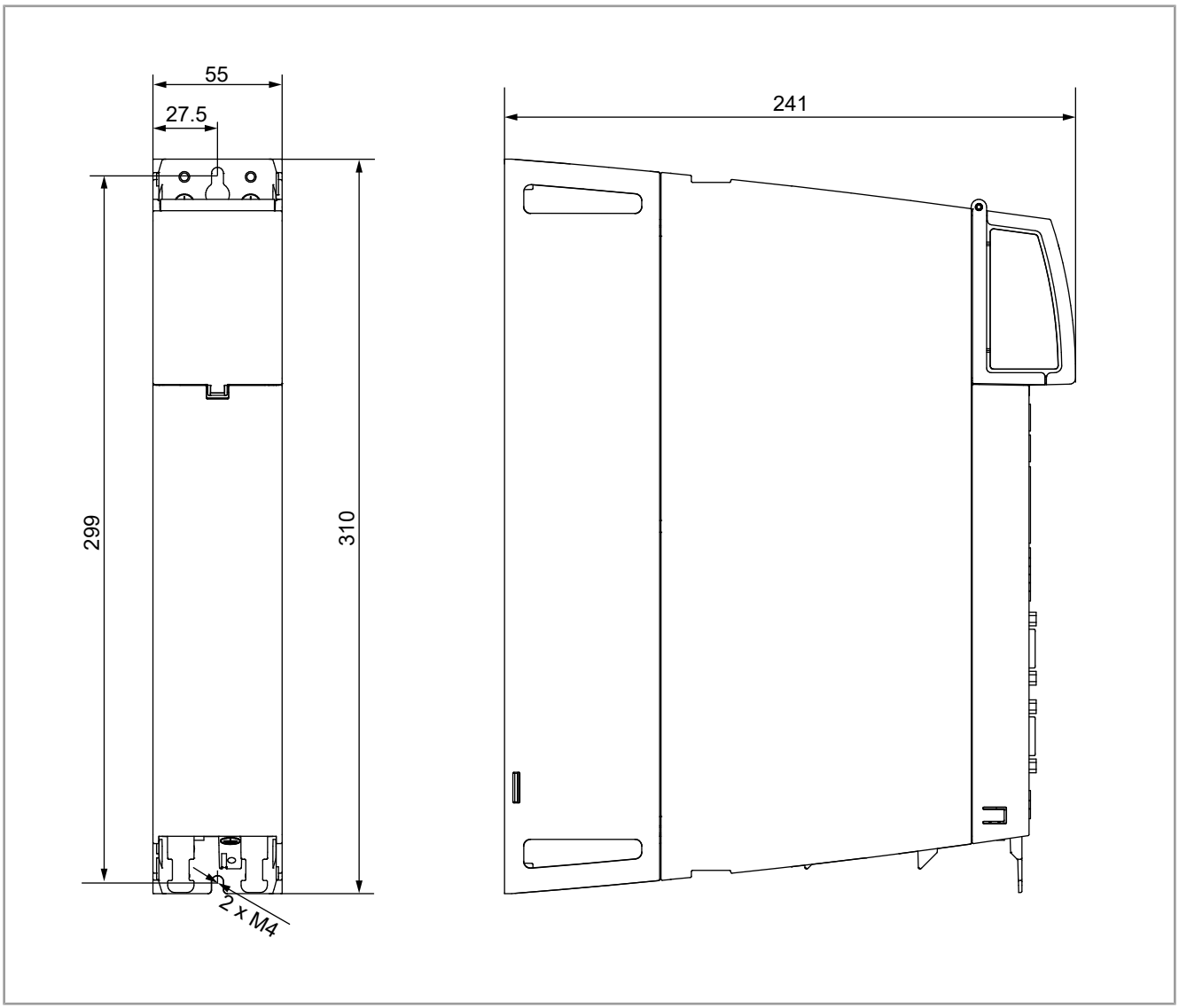


Fig. 4: Dimensions of BG1 in mm – wall mounting

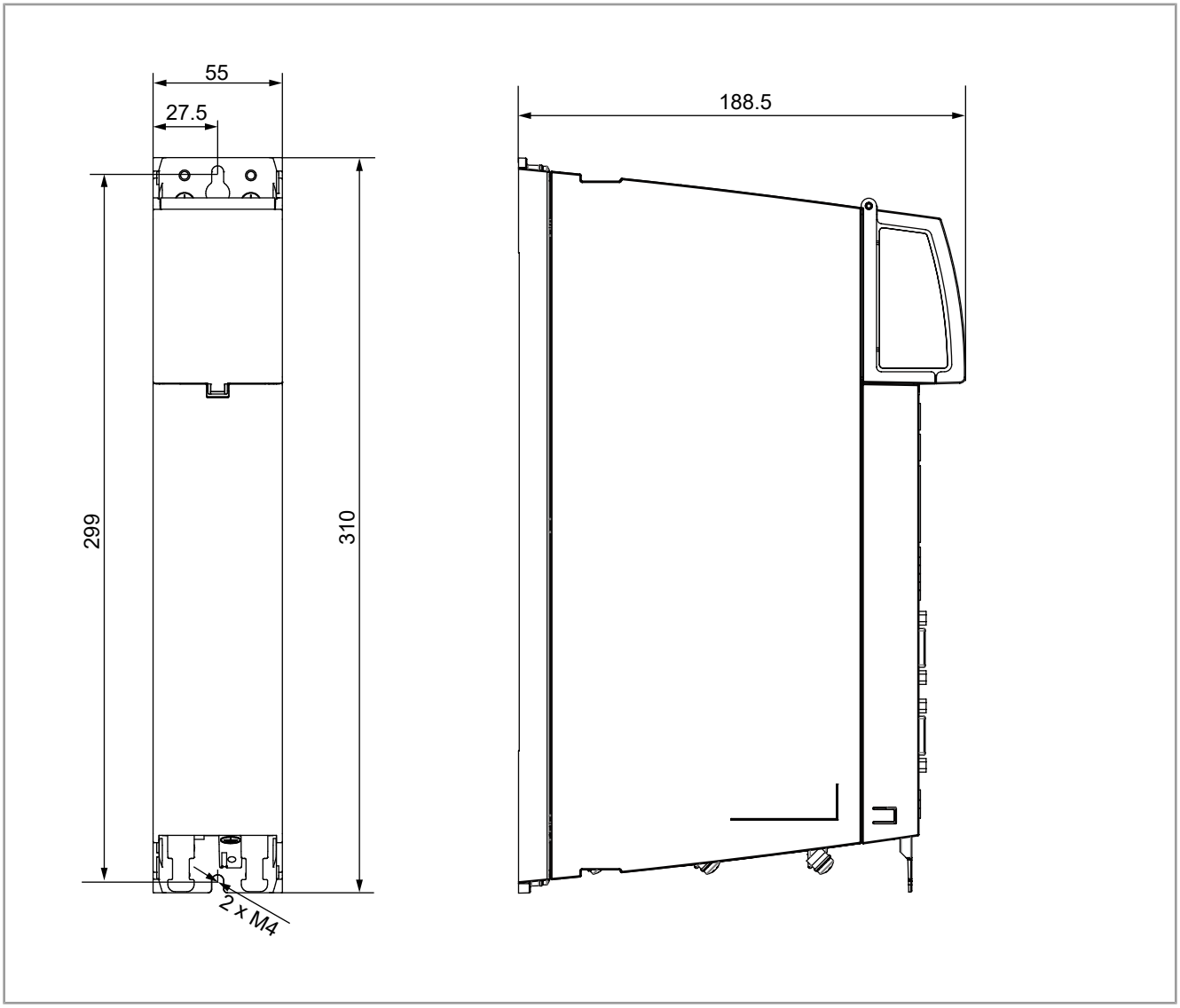


Fig. 5: Dimensions of BG1 in mm, Cold Plate mounting

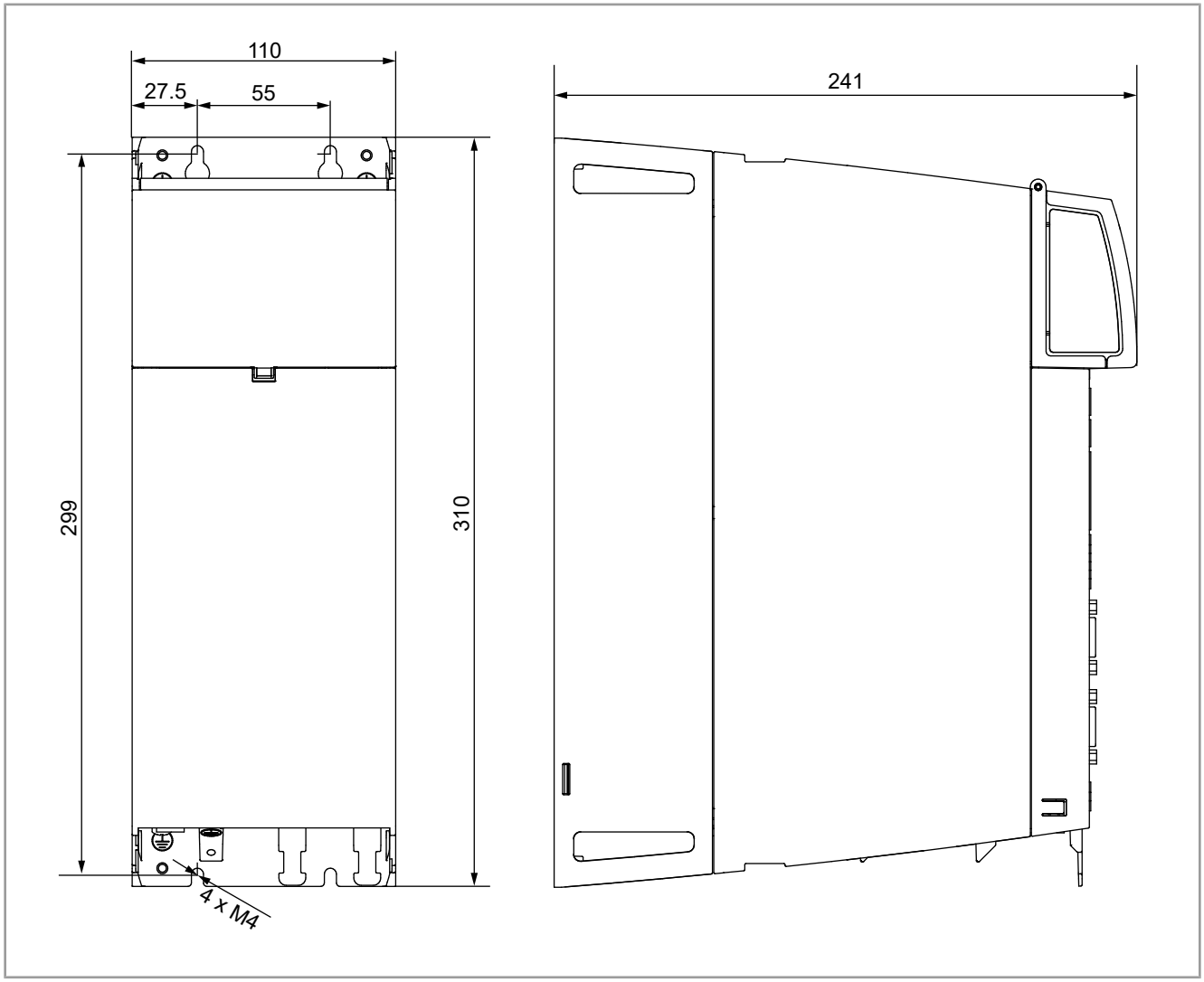


Fig. 6: Dimensions of BG2 in mm – wall mounting

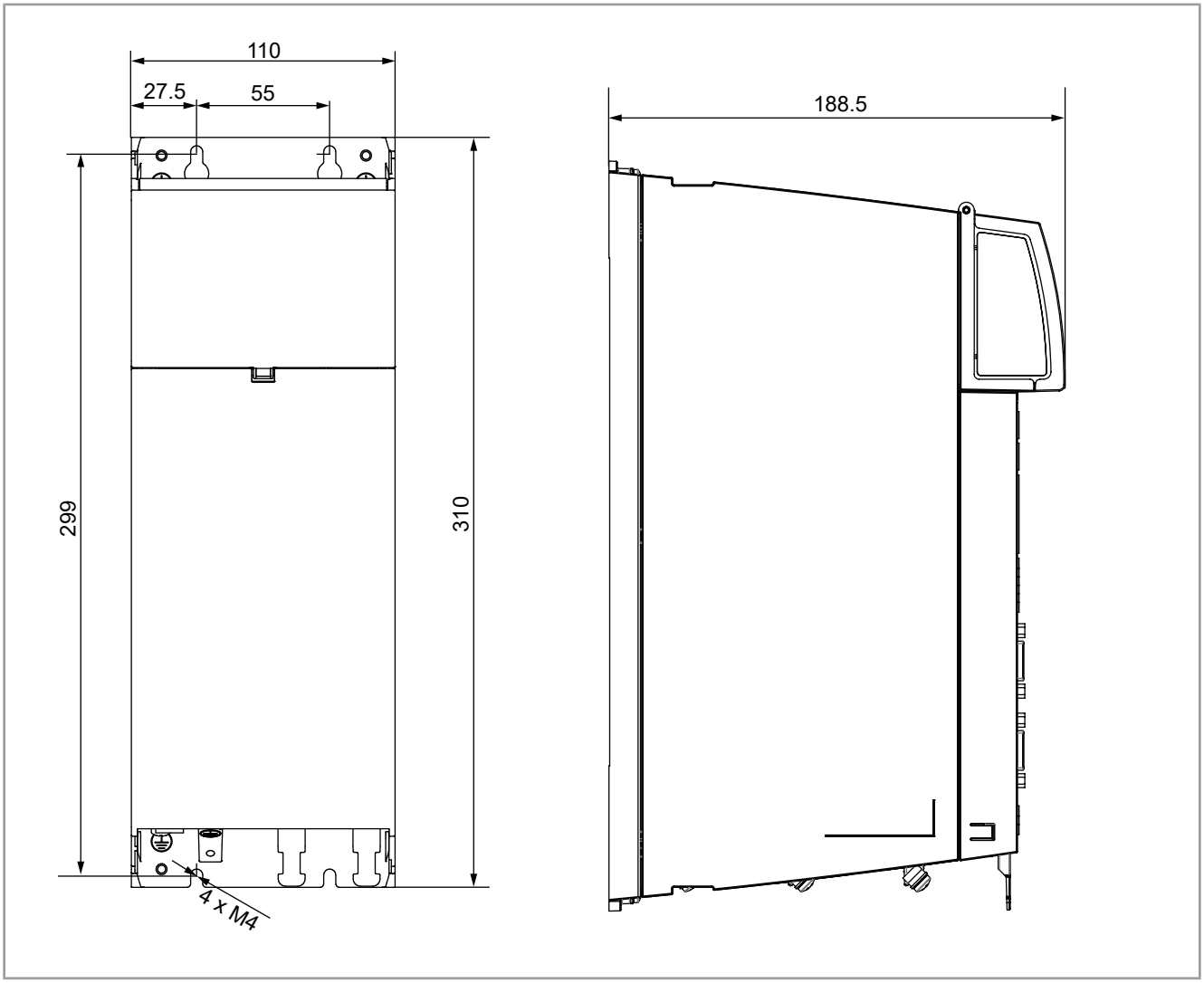


Fig. 7: Dimensions of BG2 in mm, Cold Plate mounting

Info

CAD data

CAD data of the device can be found in the download area of our homepage.

4.2 Mechanical specifications

Parameter	Description	Standards
Mounting orientation	Vertical	
Weight	2800 / 2800 / 4500g	
Enclosure specifications		
Material	Metal	
Maximum height of fall		
with shipping packaging	0.25 m	DIN EN 61131-2 DIN EN 60068-2-31
with product packaging	0.25 m	
Vibration resistance		
Vibration limit during transport		
Frequency sweeps	1 octave/minute, sinusoidal	EN 61800-2, IEC 60721-3-2 class 2M1
Constant amplitude	3.5 mm	
Frequency	2 Hz ≤ f ≤ 9 Hz	
Constant acceleration	Not applicable	
System vibration limits **NOTICE! The devices must not be installed in areas where they are exposed to continuous vibrations.**		
Constant amplitude	0.3 mm	61800-2, IEC 60721-3-3 class 3M1
Frequency	2 Hz ≤ f ≤ 9 Hz	
Constant acceleration	Not applicable	
Degree of protection		
Device	IP20	DIN EN 60529
Control cabinet	min. IP4x, with use of safety function STO min. IP54	

Tab. 4: Mechanical specifications

4.3 Environmental conditions

Parameter		Description	Standards
Operating temperature		5 … 40 °C to 50 °C with power reduction (5 %/ °C)	DIN EN 61800-2, IEC 60721-3-3 class 3K3
Storage temperature		-25 … 55 °C	DIN EN 61800-2, IEC 60721-3-1 classes 1K3 and 1K4
Transport temperature		-25 °C ... 70 °C	DIN EN 61800-2, IEC 60721-3-2 class 2K3
Relative humidity for	Transport	95 % at max. 40 °C	
	The absolute humidity is limited to max 60 g/m³. This means that, at 70 °C for example, the relative humidity must not exceed 40%.		
	Storage	5 … 95 %	
	The absolute humidity is limited to max 29 g/m³. The maximum values for temperature and relative humidity listed in the table must not occur at the same time.		
	Operation	5 % … 85 % at 40 °C, non-condensing	
	The absolute humidity is limited to max 25 g/m³. This means that the maximum values listed in the table for temperature and relative humidity must not occur at the same time.		
Max. operating altitude		1000 m above sea level Over 1000 m above sea level with power reduction (1 % per 100 m, max. 2000 m above sea level)	DIN EN 61131-2
Installation location		Control cabinet **NOTICE! The ambient conditions for the device must also be observed in the control cabinet.**	
Corrosion immunity and chemical resistance		No special anti-corrosion precautions have been taken. The ambient air must not contain higher concentrations of acids, alkaline solutions, corrosive agents, salts, metal vapors and other corrosive or electroconductive contaminants.	
Degree of pollution – Electronics		Level 2	DIN EN 61131-2
		Only non-conductive dirt occurs. However, temporary conductivity due to condensation may occur.	

Tab. 5: Environmental conditions

4.3.1 Power reduction at increased ambient temperature

If an axis controller will be used outside of the specified maximum ambient temperature ($T_{amb\text{-}nom}$), the output power must be reduced depending on the higher ambient temperature. The purpose of this temperature derating is to protect components in the device from overheating.

NOTICE! If the output power is not reduced despite the increased ambient temperature, this will lead to the output stage switching off due to overtemperature.

Device	Operation without derating up to $T_{amb-nom}$	Operation with derating up to $T_{amb-max}$	Derating for $T_{amb-nom} < T_{amb} < T_{amb-max}$
JM-D3503	40 °C	50 °C	Reduction of output power by 3.4 % per 1 °C
JM-T3503			
JM-3506			
JM-D3506			
JM-T3506			
JM-3512		55 °C	1.6 % per 1 °C
JM-3518			
JM-D3512			2.0 % per 1 °C
JM-T3512			
JM-D3516			2.6 % per 1 °C
JM-3524			2.3 % per 1 °C
JM-3532			3.0 % per 1 °C

Tab. 6: Power reduction at $T_{amb-nom} \geq 40$ °C

4.4 Electrical properties

EtherCAT® interface X5.1, X5.2

Parameter	Description
Connectivity	RJ45 jack
Port count	2
Bit rate	10 Mbit/s, 100 Mbit/s
Auto-crossover	Yes

Tab. 7: EtherCAT® interface X5.1, X5.2

I/O terminal X6

Parameter	Description
Connectivity	Plug-in terminal, 2-level
Number of pins	12 (2x6)
Type	MCDN 1.5/6-G1-3.5
Manufacturer	Phoenix contact

Tab. 8: I/O terminal X6

Safe-DI terminal X11

Parameter	Description
Connectivity	Plug-in terminal, 2-level
Number of pins	6 (2x3)
Type	MCDN 1.5/3-G1-3.5
Manufacturer	Phoenix contact

Tab. 9: Safe-DI terminal X11

Motor connectors X12, X13 and X14

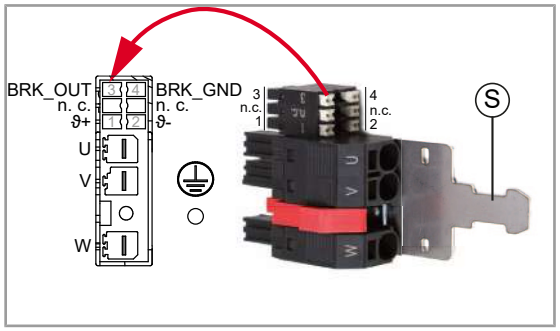


Fig. 8: Motor connector

Parameter		Description
Connectivity		Connector
Quantity		For up to 3 motors; enclosed in the packaging
Type	Triple-axis servo amplifier	Article no.: 60879944, replacement connector

Tab. 10: Motor connectors X12, X13 and X14

Encoder connections X7, X9 and X10

Role	Example / value
Resolver	
SinCos encoder with zero pulse	Heidenhain ERN1381, ROD486
EnDat 2.2 digital	
SinCos encoder with HIPERFACE® interface single and multiturn encoder	Sick-Stegmann SRS50, SRM50
Maximum signal input frequency	500 kHz

Tab. 11: High-resolution encoders X7, X9 and X10

Encoder connection X8

Role	Example / value
SinCos encoder with zero pulse	Heidenhain ERN1381, ROD486
TTL encoder RS422-5V	
Maximum signal input frequency	500 kHz

Tab. 12: Connection for additional encoder X8

4.4.1 Power data

Parameter	JM-T3503	JM-T3506	JM-T3512
Control unit			
Control voltage	24 V DC ± 20 %		
Control voltage when using a motor holding brake with cable length < 50 m	24 V DC – 5 %/+ 10 %		
Max. inrush current on 24 V power supply unit per device	1.8 A @ 24 V/1 s and 2.2 @ 18 V/1 s		
Maximum power of motor holding brake	3 x max. 48 W		
Power consumption with output stage (without motor holding brake) air cooling/ColdPlate	31/22 W		41/24 W
Typical current consumption - air-cooled servo amplifier without encoder	1.3 A		1.7 A
Typical current consumption - servo amplifier with ColdPlate without encoder	0.9 A		1.0 A
Typical current consumption - encoder SinCos/TTL/EnDat/SSI/resolver [1)]	0.3 A		0.3 A
Typical current consumption - encoder channel 4 SinCos/TTL [1)]	0.1 A		0.1 A
Typical current consumption - encoder HIPERFACE®/HIPERFACE DSL®[1)]	0.7 A		0.7 A
Typical total current consumption - servo amplifier with air cooling	1.7 A		2.1 A
Typical total current consumption - servo amplifier with ColdPlate	1.3 A		1.4 A
DC link			
Capacity in DC link	165 µF		405 µF
DC resistance in DC link (DC+ to DC-)			
Rated power @ 3 x 230 V	1.3 kW	1.7 kW	3.5 kW
Rated power @ 3 x 400/480 V	2.25 kW	3.0 kW	6.0 kW

Parameter	JM-T3503	JM-T3506	JM-T3512
Switching device			
Permissible switching frequencies	2/4/8/12/16 kHz		
Rise of voltage at output with 10 m motor cable (10 % ... 90 %)	3 … 8 kV/µs		
Output frequency range @ 2/4 kHz	0 … 400 Hz		
Output frequency range @ 8 kHz	0 … 800 Hz		
Output frequency range @ 16 kHz	0 … 1600 Hz		
Servo amplifier			
Power dissipation @ (400 V/4 kHz/I_{rated}) indoors	88 W	100 W	141 W
Power dissipation @ (400 V/4 kHz/P_{rated}) via heat sink	72 W	120 W	262 W
[1] Current consumption may vary depending on encoder type			

Tab. 13: Data for 3-axis modules

Current data

Parameter	Description
Rated current	Possible continuously for S1 operation of a motor
Maximum current for 10 s	2 times the nominal current for short-term torque of the motor
Maximum current for 500 ms	3 times the nominal current for peak torques of the motor

Tab. 14: Definition of current load

Device	U_{Mains}	F_S	Rated current	Maximum current for 10 s	Maximum current for 500 ms	Maximum current at FM = 0 Hz
JM-T3503	230 V	2 kHz	3 x 3 A	3 x 6 A	3 x 9 A	3 x 10.39 A
	230 V	4 kHz	3 x 3 A	3 x 6 A	3 x 9 A	3 x 8.7 A
	230 V	8 kHz	3 x 3 A	3 x 6 A	3 x 6.25 A	3 x 5.66 A
	230 V	12 kHz	3 x 2 A	3 x 4 A	3 x 4.85 A	3 x 4.38 A
	230 V	16 kHz	3 x 1.45 A	3 x 2.9 A	3 x 3.8 A	3 x 3.39 A
	400 V	2 kHz	3 x 3 A	3 x 6 A	3 x 9 A	3 x 10.39 A
	400 V	4 kHz	3 x 3 A	3 x 6 A	3 x 9 A	3 x 8.7 A
	400 V	8 kHz	3 x 3 A	3 x 6 A	3 x 6.25 A	3 x 5.66 A
	400 V	12 kHz	3 x 2 A	3 x 4 A	3 x 4.85 A	3 x 4.38 A
	400 V	16 kHz	3 x 1.45 A	3 x 2.9 A	3 x 3.8 A	3 x 3.39 A
	480 V	2 kHz	3 x 3 A	3 x 6 A	3 x 9 A	3 x 8.77 A
	480 V	4 kHz	3 x 3 A	3 x 6 A	3 x 8.0 A	3 x 7.21 A
	480 V	8 kHz	3 x 2.6 A	3 x 5.2 A	3 x 5.2 A	3 x 4.67 A
	480 V	12 kHz	3 x 1.35 A	3 x 2.7 A	3 x 3.6 A	3 x 3.27 A
	480 V	16 kHz	3 x 0.6 A	3 x 1.2 A	3 x 2.75 A	3 x 2.47 A

Device	U_{Mains}	F_S	Rated current	Maximum current for 10 s	Maximum current for 500 ms	Maximum current at FM = 0 Hz
JM-T3506	230 V	2 kHz	3 x 6 A	3 x 12 A	3 x 18 A	3 x 20.79 A
	230 V	4 kHz	3 x 6 A	3 x 12 A	3 x 18 A	3 x 17.39 A
	230 V	8 kHz	3 x 6 A	3 x 12 A	3 x 12.5 A	3 x 11.31 A
	230 V	12 kHz	3 x 4 A	3 x 8 A	3 x 9.7 A	3 x 8.77 A
	230 V	16 kHz	3 x 2.9 A	3 x 5.8 A	3 x 7.6 A	3 x 6.79 A
	400 V	2 kHz	3 x 6 A	3 x 12 A	13 x 8 A	3 x 20.79 A
	400 V	4 kHz	3 x 6 A	3 x 12 A	3 x 18 A	3 x 17.39 A
	400 V	8 kHz	3 x 6 A	3 x 12 A	3 x 12.5 A	3 x 11.31 A
	400 V	12 kHz	3 x 4 A	3 x 8 A	3 x 9.7 A	3 x 8.77 A
	400 V	16 kHz	3 x 2.9 A	3 x 5.8 A	3 x 7.6 A	3 x 6.79 A
	480 V	2 kHz	3 x 6 A	3 x 12 A	3 x 18 A	3 x 17.54 A
	480 V	4 kHz	3 x 6 A	3 x 12 A	3 x 16 A	3 x 14.42 A
	480 V	8 kHz	3 x 5.2 A	3 x 10.4 A	13 x 0.4 A	3 x 9.33 A
	480 V	12 kHz	3 x 2.7 A	3 x 5.4 A	3 x 7.2 A	3 x 6.51 A
	480 V	16 kHz	3 x 1.2 A	3 x 2.4 A	3 x 5.5 A	3 x 4.95 A

Device	U_{Mains}	F_S	Rated current	Maximum current for 10 s	Maximum current for 500 ms	Maximum current at FM = 0 Hz
JM-T3512	230 V	2 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 50.91 A
	230 V	4 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 41.72 A
	230 V	8 kHz	3 x 10 A	3 x 20 A	3 x 29.3 A	3 x 28.57 A
	230 V	12 kHz	3 x 6.4 A	3 x 12.8 A	3 x 19.9 A	3 x 19.37 A
	230 V	16 kHz	3 x 5.1 A	3 x 10.2 A	3 x 14.7 A	3 x 14.28 A
	400 V	2 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 50.91 A
	400 V	4 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 41.72 A
	400 V	8 kHz	3 x 10 A	3 x 20 A	3 x 29.3 A	3 x 28.57 A
	400 V	12 kHz	3 x 6.4 A	3 x 12.8 A	3 x 19.9 A	3 x 19.37 A
	400 V	16 kHz	3 x 5.1 A	3 x 10.2 A	3 x 14.7 A	3 x 14.28 A
	480 V	2 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 50.91 A
	480 V	4 kHz	3 x 12 A	3 x 24 A	3 x 36 A	3 x 36.77 A
	480 V	8 kHz	3 x 8.7 A	3 x 17.4 A	13 x 20.9 A	3 x 20.36 A
	480 V	12 kHz	3 x 5.2 A	3 x 10.4 A	3 x 15.5 A	3 x 15.13 A
	480 V	16 kHz	3 x 4 A	3 x 8 A	3 x 12.4 A	3 x 12.02 A

Tab. 15: Current data for 3-axis modules

4.4.2 Electrical isolation concept

– All control connections are designed as a safety extra-low voltage circuits (PELV) and must only be operated with such PELV voltages according to the respective specification. This means a reliable protection from electric shock on the control side.

– The connections DC Link +/-, X12 - U/V/W, X13 - U/V/W and X14 - U/V/W are at mains potential (low voltage).

– The following overview details the potential references of the individual connections.

– This concept also achieves a higher operational reliability of the servo amplifier.

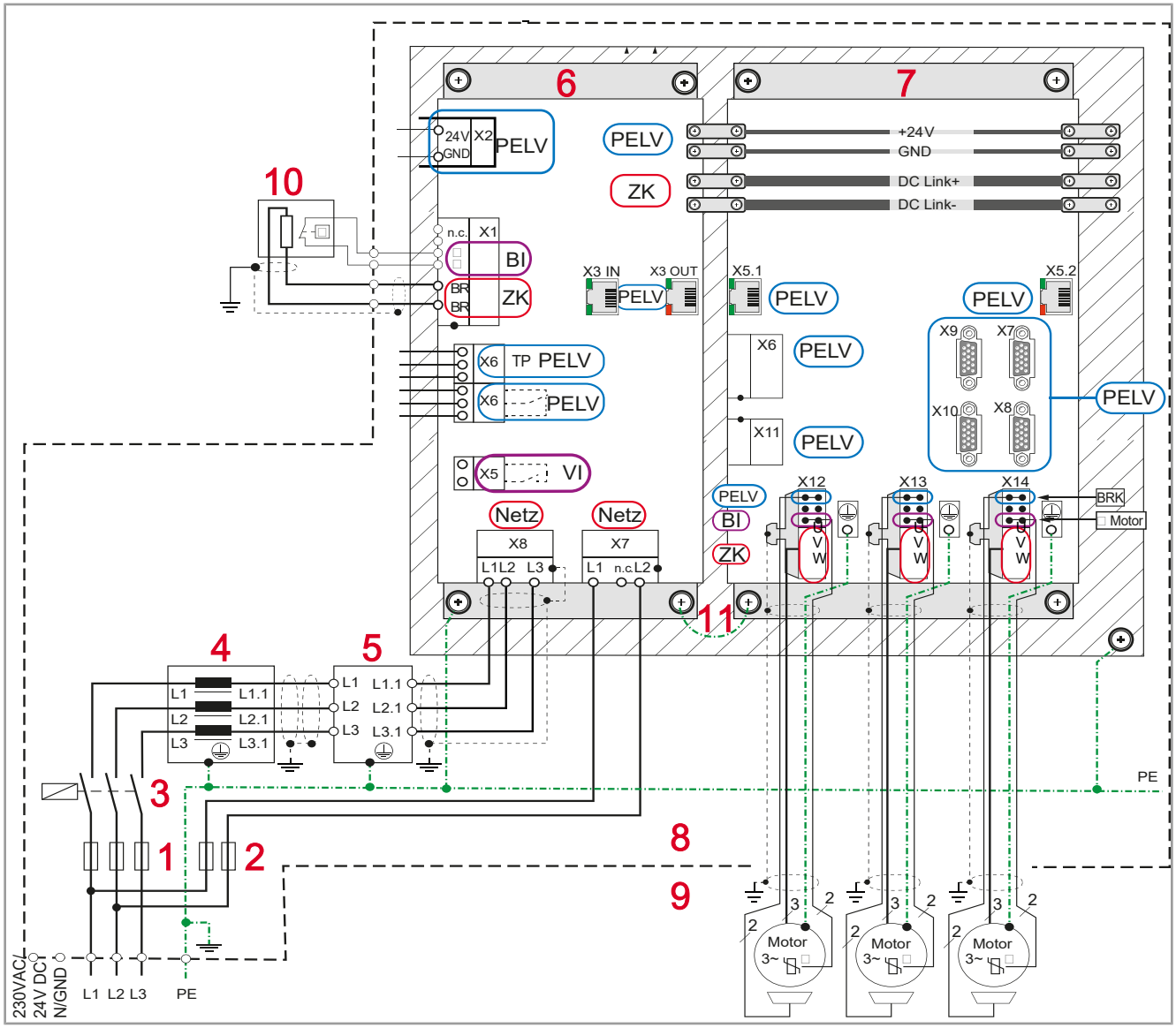


Fig. 9: Electrical isolation concept

1	Mains fuse for DC link supply
2	Mains fuse for switching power supply unit
3	Mains contactor (optional)
4	Line reactor (accessory)
5	Line filter (accessory)
6	Supply unit
7	Servo amplifier
8	Control cabinet
9	Box

10	Braking resistor with temperature monitoring (external)
11	Series protective connection to the next device

The mains contactor can be activated via 230 VAC or alternatively 24 VDC mains contactors.

Servo amplifier connections	Description	Potential	Abbreviation
Busbar 24 V DC	Supply voltage of control unit	Protective extra-low voltage circuit	PELV
Busbar DC link	Supply voltage of DC link	Low voltage	DC link
X3/X4 n. c.			
X5.1/X5.2	EtherCAT IN/OUT fieldbus connection	Protective extra-low voltage circuit	PELV
X6/DI	Digital control inputs	Protective extra-low voltage circuit	PELV
X11/Safe - DI	Safe digital inputs	Protective extra-low voltage circuit	PELV
X7/X8/X9/X10	Encoder connections	Protective extra-low voltage circuit	PELV
BRK - X12/X13/X14	Terminal for motor holding brake	Protective extra-low voltage circuit	PELV
ϑ motor - X12/X13/X14	Terminal for motor temperature sensor	Basic insulation	BI
U/V/W - X12/X13/X14	Terminal for motor phases	Low voltage	DC link

Tab. 16: Potential references of individual connections

5 Mechanical installation

This chapter describes how to install and remove the JM-T3503 / JM-T3506 / JM-T3512.

⚠ WARNING



Non-observance of safety instructions may result in injuries or physical damage

- ► Prior to assembling and installing the device, read and follow the safety precautions and restrictions of use as set out in the Safety chapter.
- ► Only authorized qualified personnel is allowed to perform any kind work on the device.

NOTICE



Damaged devices

Damaged devices may cause considerable physical damage.

- ► Check the device for external damage and faulty connections.
- ► Ensure to install only fully functional devices.

5.1 Order and arrangement

The following basic guidelines apply to the arrangement and installation of the supply unit and servo amplifiers:

– The devices can be mounted directly next to each other and without any gaps between them. They are fastened with two/four screws to the mounting plate. Control and power voltages are fed to the servo amplifiers (JM-3000) via DC link and 24 V DC busbars from the supply unit (JM-3000). Thanks to the same cooling concept, this is possible without additional compensation measures with regard to device depth.

– The devices must be mounted in the specified order in series (see illustration). A different order is not permissible, as otherwise problems with the busbar and the mutual thermal influence will occur.

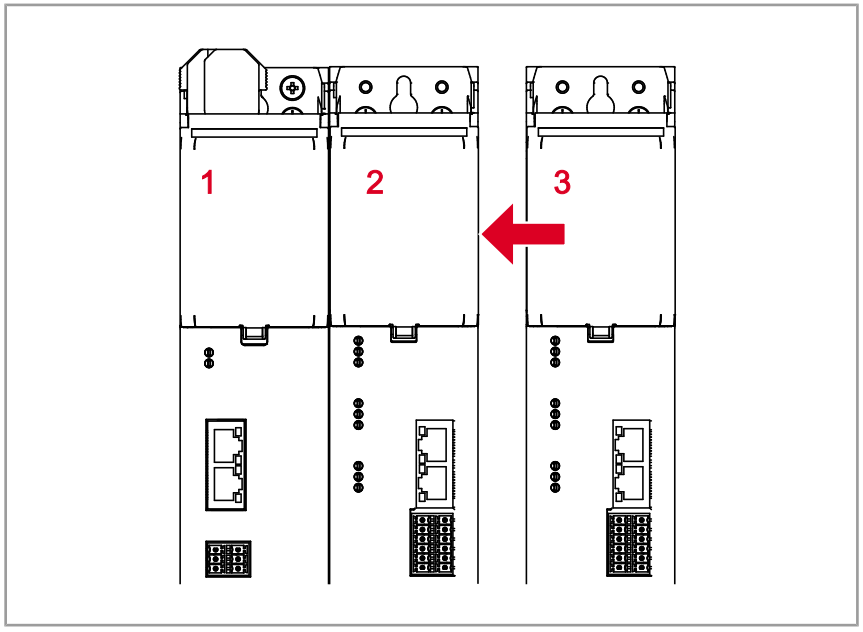


Fig. 10: Order of the devices

1	JM-3000 supply unit
2	JM-3000 servo amplifiers
3	additional JM-3000 servo amplifier

NOTICE! In the overall axis system, a DC link capacitance of ≥ 100 µF/kW (for 3 x 400 V) or ≥ 170 µF/kW (for 3 x 230 V) relative to the highest occurring rated power must be maintained. This is determined by adding the capacitances of the individual devices, see Power data.

⚠ WARNING



Risk of burns due to hot surfaces

The device may become hot during operation and can cause burns if touched.

- ► Take protective measures to prevent inadvertent contact with the device, e.g. protective covers.
- ► Make sure that no temperature-sensitive parts, e.g. connection cables, are attached or fastened to the device.
- ► Ensure there is adequate heat dissipation and maintain the required distances during installation so as not to prevent or restrict ventilation.
- ► Allow the device to cool off for a while before carrying out cleaning or maintenance work.
- ► Wear personal protective equipment.

5.2 Mounting distances and cooling

Mounting distances

Parameter	BG1	BG2
Mounting distance above	≥ 130 mm	≥ 130 mm
Mounting distance below	≥ 150 mm	≥ 200 mm
Mounting distance in front	≥ 300 mm	≥ 300 mm
The determining factor for the mounting distance below is the mains connection cable of the supply unit:		
Bending radii of the connection cable	approx. 48 … 98 mm	approx. 150 … 200 mm
	Depending on the cable design	

Tab. 17: Mounting distances

Cooling

– Cooling air must be able to flow unhindered through the unit (interior and heat sink).
– When installing in control cabinets with natural convection (= heat loss is discharged to the outside via the control cabinet walls), always provide an internal fan.
– If the unit is switched off due to excessive temperature, the cooling conditions must be improved.

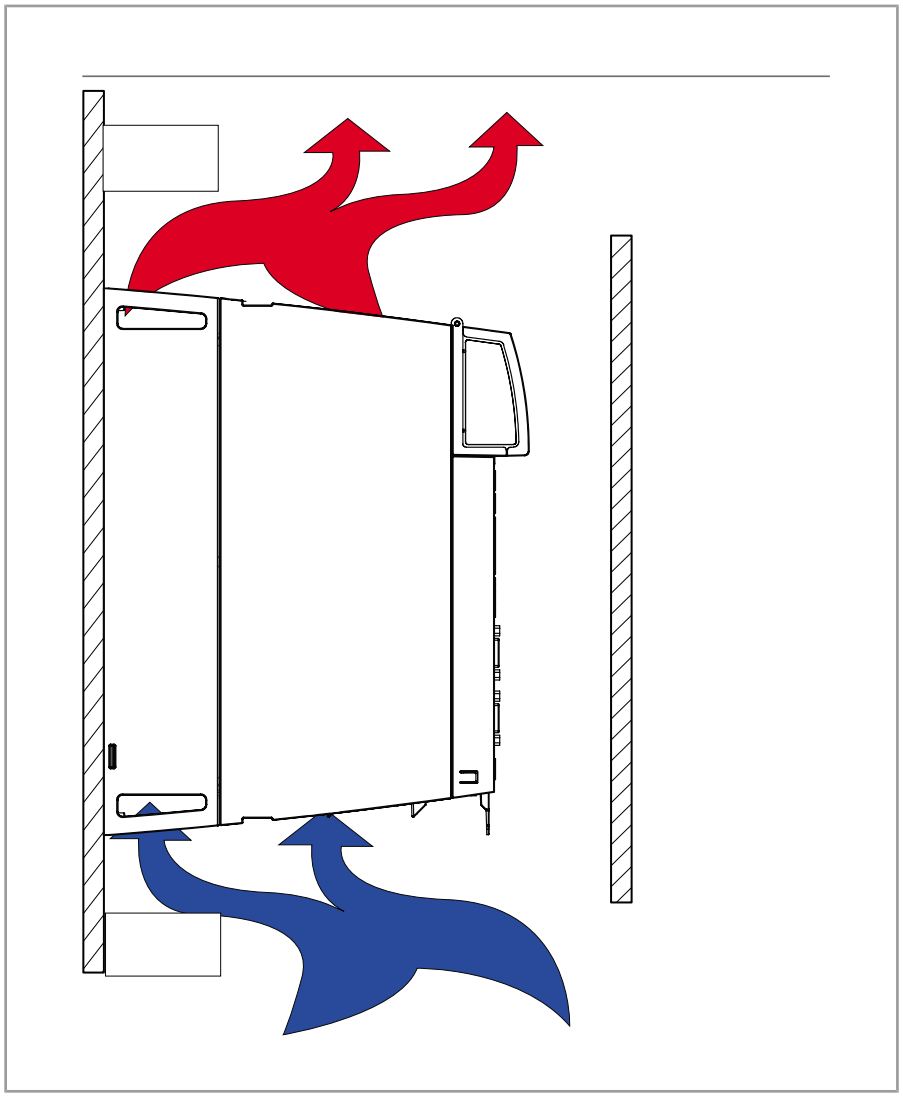


Fig. 11: Cooling by an unobstructed flow of air

5.3 Wall mounting of the servo amplifiers

For wall mounting of the JM-T3503 / JM-T3506 / JM-T3512, follow the steps below:

✓ The contact surface must be bare metal and conductive.

1. Arrange the devices on the mounting plate as shown in the illustration [▶ 32].
2. Make sure that the distance above and below the Servo amplifier is in line with the data in the table [▶ 34].
3. Align all devices of the multi-axis system in one line along the upper edge of the device.
4. On the mounting plate, mark the 2 or 4 positions of the mounting holes. For the dimensions, refer to the illustrations in the Dimensions [▶ 17] section.
5. Drill the holes and tap the threads.
6. Mount the Servo amplifier in series with the supply unit on the mounting plate.
7. Tighten the bolts down completely.

5.4 Cold Plate mounting of the servo amplifiers

Mounting on the cooler

For optimum heat transfer from the rear panel of the device to the corresponding cooler, a heat conducting film according to components BG1 or BG2 is already glued to the cooling plate of the device (see illustration). On the cooler side, the film is laminated with aluminum. The device can be mounted or dismounted with the film.

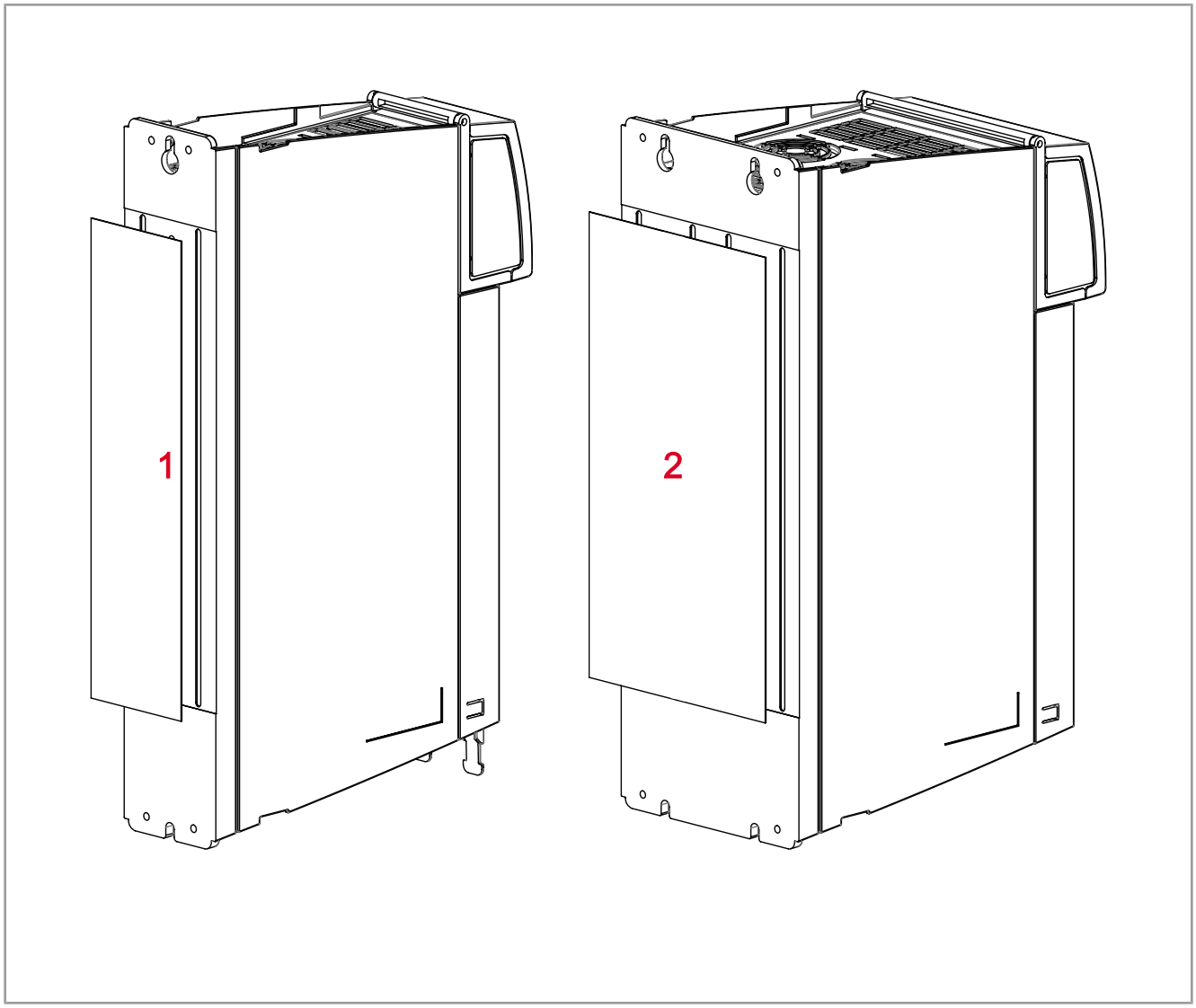


Fig. 12: Rear panel with heat conducting film

1	Rear panel with heat conducting film BG1
2	Rear panel with heat conducting film BG2

Cooling

Parameter	BG1	BG2
Thermal resistance between active cooling surface of the device and cooler $R_{th}K$	0.02 K/W	0.01 K/W
Heat capacity of the cooling plate on the device	390 Ws/K	780 Ws/K
Max. temperature of cooling plate on the device	85 °C	
Cooler surface	Maximum roughness depth R_Z = 6.3	

Tab. 18: Dimensioning of the cooler

NOTICE

Device failure due to overheating

Dirt between the cooler and rear of the device will adversely affect thermal transfer and cause the device to overheat.

► Make sure that there is no dirt between the cooler and the rear of the unit during installation.

For Cold Plate mounting of the JM-T3503 / JM-T3506 / JM-T3512, proceed as follows:

✓ The surface of the cooler is free of drilling chips or other contaminants.

1. Arrange the devices on the mounting plate as shown in the illustration [▶ 32].
2. Make sure that the distance above and below the Servo amplifier is in line with the data in the table [▶ 34].
3. Align all devices of the multi-axis system in one line along the upper edge of the device.
4. On the cooler provided, mark the 2 or 4 positions of the mounting holes. For the dimensions, refer to the illustrations in the Dimensions [▶ 17] section.
5. Drill the holes and tap the threads.
6. Mount the Servo amplifier in series with the supply unit on the cooler.
7. Tighten the fastening screws evenly to keep the thermal resistance as low as possible.

5.5 Removing the servo amplifier

To dismantle the JM-T3503 / JM-T3506 / JM-T3512, proceed as follows:

1. De-energize the JM-T3503 / JM-T3506 / JM-T3512.
2. Loosen the 2 or 4 fastening screws by unscrewing them halfway.
3. Slightly lift the JM-T3503 / JM-T3506 / JM-T3512 and remove it from the fastening screws.

6 Electrical connection

⚠ DANGER



Risk due to high electrical voltage

Touching live parts may result in death or severe injury.

► Carry out the following steps before starting work to ensure safety.

☑ Prepare for turning off the system. Inform everyone involved who will be affected by the process.

☑ Isolate the drive system from the power supply and secure it against being turned on again.

☑ Wait for the discharge time (approx. 10 minutes) and check all power connections to ensure they are at zero potential.

☑ Ground according to requirements.

☑ Cover over neighboring live parts.

☑ Ensure the drives cannot move.

⚠ WARNING



Non-observance of safety instructions may result in injuries or physical damage

► Prior to assembling and installing the device, read and follow the safety precautions and restrictions of use as set out in the Safety chapter.

► Only authorized qualified personnel is allowed to perform any kind work on the device.

NOTICE! When installing the servo amplifier within the multi-axis system, the operating instructions of the other devices (servo amplifier, supply unit, controller, etc.) as well as the "Functional Description of Integrated Safety Function S1" must also be observed.

6.1 Installation to EMC rules

The noise immunity of a system is determined by its weakest component. Key factors are correct connections, lines and proper shielding. Observe the measures set out in this chapter.

ⓘ Info

Further Information

For further information on the noise immunity of a system, please refer to the Application Note 016 *EMC-Compatible Installation of the Electric Cabinet* available for download on our website.

The following basic rules apply to the installation of servo amplifiers:

Compliance with the EMC Product Standard

– Commissioning (i.e., the start of operation as intended) is only permitted when EMC Directive (2014/30/EU) is complied with. The installer/operator of the machine and/or plant must provide proof of compliance with the protective goals required by the standard.
– The essential EMC measures are already implemented in the design of the devices through optimized enclosure shielding, PCB layout, filter measures and selection of suitable connectors with shielding plates. In addition to the internal measures, the following installation measures must also be observed:

Cable type

– Use shielded mains, motor and signal cables with double copper braiding providing at least 60 to 70 % overlapping.

Laying cables

– If possible, route signal lines into the control cabinet from only one side.
– Twist the lines of the same circuit.
– Keep cable lengths and loops as minimal as possible.

NOTICE



Inadequate accessories might cause damage to the product

Parts and equipment from other manufacturers might impede the function of the device and cause damage to the product.

► Use only connecting cables of other manufacturers that are at least equivalent.
⇨ However, Bucher Automation AG cannot guarantee stable and safe operation with such cables.

Grounding measures

– Mount the devices on a conductive, grounded mounting plate. The mounting plate must be connected with the central grounding rail of the control cabinet.

External components

– Place larger consumers near the electric supply.
– Connect contactors, relays, solenoid valves (switched inductances) with quenching circuits.
  – The wiring must be directly on the respective coil.
– Switched inductances should be at least 0.2 m distant from process-controlled components.

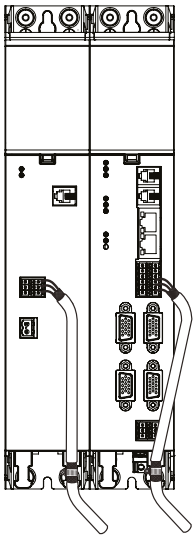


Fig. 13: Exam. shield connection of control connections

Shielding measures

– Strip the cable shields to the required length, but not too soon, and use the shield lugs on the respective connectors for contacting the components.

– Place the other side of the cable shield with the greatest possible surface area on the PE rail (main ground) or the mounting plate.

If you would like more detailed information about installation, please contact our Technical support [▶ 60].

6.2 Control connections

1. Establish a connection between EtherCAT® interface X5.1 [▶ 41] and the individual servo amplifiers and to the supply unit for the JetControl motion controller with an 8-wire Cat 5e EtherCAT® cable.
2. Connect all other servo amplifiers to the first servo amplifier via EtherCAT® interfaces X5.1 and X5.2 [▶ 41]
3. Wire the control inputs to X6 [▶ 41] with shielded cables as required. Ground the cable shields over a wide area on both sides.
4. If you want to use safety function STO and/or STB, wire the safe control inputs to X11 [▶ 48] with shielded cables. Ground the cable shields over a wide area on both sides.
5. Check all connections again!

6.3 EtherCAT® connection

For a shielded connection up to a length of ≤ 20 m, the following tested cable or one of equivalent quality must be used:

Patch cable Cat 5e, S/STP 4 x 2 x 0.14 mm2, twisted pair and shielded data cable with characteristic impedance Rw = 100 Ω ± 15 %

See Accessories EtherCAT® cables [▶ 63]

NOTICE! For cable lengths ≥ 20 m, special installation cables with larger cross-sections must be used.

6.3.1 Connection X5.1 - EtherCAT®

Connect the following devices to port X5.1:

– JetControl controller with EtherCAT® master

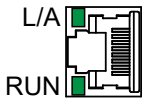


Fig. 14: X5.1, ECAT IN

Signal	LED	Specification	Color	Description
ECAT IN	L/A	Port0 Link/Activity		Displays the connection speed
			OFF	10 Mbit/s
			Green	100 MBit/s BASE-T
	RUN	Device/EtherCAT	Green	Connected to network
			Green, flashing	Data transfer

6.3.2 Connection X5.2 - EtherCAT®

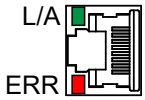


Fig. 15: X5.2, ECAT OUT

Signal	LED	Specification	Color	Description
ECAT OUT	L/A	Port1 Link/Activity		Displays the connection speed
			OFF	10 Mbit/s
			Green	100 MBit/s BASE-T
	ERR	Device/EtherCAT	Red	Error

6.4 Connection X6 - I/O signals

– The digital inputs are provided for connecting the limit and reference switches and the touch probe signals.

– DI09 and DI10 are suitable for touch probe tasks due to their fast signal processing.

– DI08 (standard DI) can be used for the touch probe function, too.

– A total of two touch probe inputs can be used for all three axes.

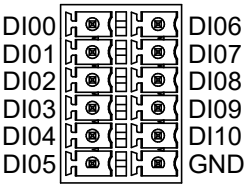


Fig. 16: Terminal X6, 12 pins

Assignment	Ref.	Type	Role
Axis 1	DI00	Standard DI	Limit switch+, A1
	DI01	Standard DI	Limit switch-, A1
	DI02	Standard DI	Ref. switch A1
	DI09	Fast DI	Touch probe
	DI10	Fast DI	Touch probe
Axis 2	DI03	Standard DI	Limit switch+, A2
	DI04	Standard DI	Limit switch-, A2
	DI05	Standard DI	Ref. switch A2
	DI08	Standard DI	Touch probe
	DI10	Fast DI	Touch probe

Assignment	Ref.	Type	Role
Axis 3	DI06	Standard DI	Limit switch+, A3
	DI07	Standard DI	Limit switch-, A3
	DI08	Standard DI	Ref. switch A3
	DI08	Standard DI	Touch probe
	DI09	Fast DI	Touch probe
	GND	DGND	Ground reference

Tab. 19: Assignment of the control inputs for 3-axis module

6.4.1 Control terminal specifications

No. dig. Input	Parameter	Specification	Electrical isolation
DI00 … DI08	U_{Inmax}	+24 V DC +20 %	Yes
	I_{max}	at 24 V = 10 mA typ.	
	Low/High switching level	≤ 5 V/≥ 18 V	
	Frequency band	≤ 500 Hz	
	Sampling cycle	1 ms	
	Digital input DI08 can optionally also be used as a touch probe input.		

Tab. 20: Specification of standard digital inputs

Inputs for touch probe (measuring sensor) for fast saving of process data (e.g. actual position).

No. dig. Input	Parameter	Specification	Electrical isolation
DI08 … DI10	U_{Inmax}	+24 V DC +20 %	Yes
	I_{max}	at 24 V = 10 mA typ.	
	Low/High switching level	≤ 5 V/≥ 18 V	
The internal signal delay resulting from the hardware runtimes is compensated by the software. This gives rise to the following inaccuracies:			
DI08	Inaccuracy of pos. signal edge change	+/- 0.75 µs	Yes
	Inaccuracy of neg. signal edge change	+/- 5.5 µs	
DI09 and DI10	The inaccuracies are negligible.		

Tab. 21: Specification of inputs for touch probe

6.5 Encoder connection

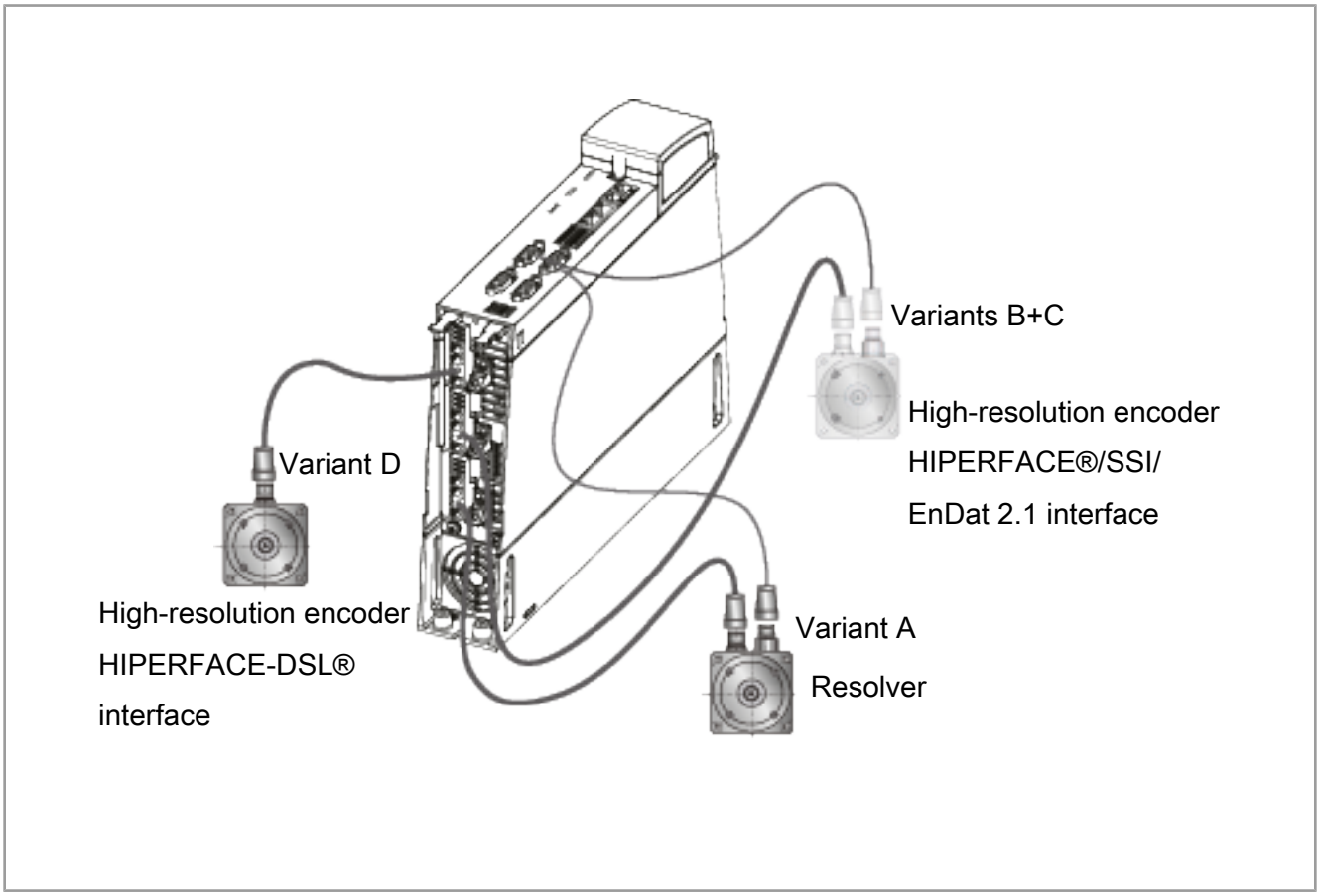


Fig. 17: Assignment of motor and encoder cable

Variant	Motor (with built-in encoder)	Encoder cable	Motor cable
		Bucher Automation servo motors	
A	with resolver	See "Accessories" in Industrial Automation catalog	
B	Absolute encoder with HIPERFACE® interface		
C	Absolute encoder with EnDat®/SSI interface		
D	Absolute encoder with HIPERFACE DSL® interface	HIPERFACE DSL® single-cable solution	

Tab. 22: Variants of motors, encoder type and encoder cable

The encoder connections are located on the front and/or bottom of the device.

NOTICE! Do not unravel the encoder cable, for example to route the signals via terminals in the control cabinet. Lock the knurled screws on the D-Sub connector enclosure tightly!

- ► To connect Bucher Automation synchronous motors, please use pre-assembled motor and encoder cables from Bucher Automation AG (see Accessories Catalog).

Assignment of motor encoder cable connection and servo amplifier

- ► Compare the nameplates of the components. Make absolutely sure that you use the correct components according to the respective variant A, B, C or D!

6.5.1 Encoder plug-in slots

The JM-T3503 / JM-T3506 / JM-T3512 has 4 encoder connections.

The encoder types differ as follows:

– **Enc1** – multi-encoder interface
– **Enc2** – single-encoder interface

X7, X9, X10

Interfaces X7, X9 and X10 enable evaluation of the encoder types listed below.

Prerequisites:

– The use of encoders not included in the product range of Bucher Automation AG requires a special release through Bucher Automation.
– The maximum signal input frequency is 500 kHz.

1. Choose the cable type according to the specification of the motor or encoder manufacturer.
2. Observe the following rules:
3. Always use shielded cables. Connect the shield at both ends.
4. Connect the differential track signals A/B, R or CLK, DATA using twisted-pair wires.
5. Never unravel the encoder cable, for example to route the signals via terminals in the control cabinet.

X8

Interface X8 enables evaluation of the encoder types listed below.

Prerequisites:

– The use of encoders not included in the product range of Bucher Automation AG requires a special release through Bucher Automation.
– The maximum signal input frequency is 500 kHz.
– Encoders with a supply voltage of 5 V ± 5 % must use the supply of X8/pin 3 (5.15 V typically max. 5.25 V).

6.5.2 Connection X7 - encoder connection

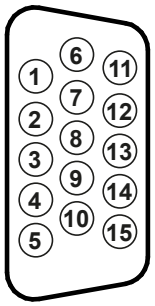


Fig. 18: X7/Axis1Enc1

Pin	SinCos and TTL	EnDat/SSI	HIPERFACE®	BISS	Resolver
1	A-		REFCOS	-	S3/COS- (A-)
2	A+		+COS	-	S1/COS+ (A+)
3	Typ. +5.15 V, max. 250 mA		(+5 V)	(+5 V)	(+5 V)
4	R+	Data+		SL+	-
5	R-	Data-		SL-	-
6	B-		REFSIN	-	S4/SIN- (B-)
7	(10 V / 110 mA)		Typ. 10 V, max. 110 mA	(10 V / 110 mA)	
8	GND				
9	-	-	-		R1 (resolver modulation +)
10	-		-		R2 (resolver modulation -)
11	B+		+SIN		S2/SIN+ (B+)
12	Temp +				
13	Temp -				
14	-	CLK+	-	MA+	-
15	-	CLK-	-	MA-	-

Tab. 23: Pin assignment of connector X7 (Enc1) - servo amplifier, 1-axis

NOTICE! The encoder supply at X7, X9 and X10 is short-circuit-proof in both 5 V and 11 V operation. The servo amplifier remains in operation so that a corresponding error message can be generated when the encoder signals are evaluated.

6.5.3 Connection X8 - encoder connection

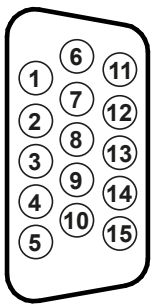


Fig. 19: X8/Axis1Enc2

Pin	SinCos and TTL	Resolver
1	A-	S3/COS- (A-)
2	A+	S1/COS+ (A+)
3	Typ. +5.15 V, max. 250 mA	(+5 V)
4	R+	-
5	R-	-
6	B-	S4/SIN- (B-)
7	(10 V / 110 mA)	
8	GND	
9	-	R1 (resolver modulation +)

Pin	SinCos and TTL	Resolver
10	-	R2 (resolver modulation -)
11	B+	S2/SIN+ (B+)
12	Temp+	
13	Temp+	
14	-	
15	-	

Tab. 24: Pin assignment of connector X8 (Enc2) - servo amplifier, 1-axis

NOTICE! The encoder supply at X8 is short-circuit-proof in 5 V operation. The servo amplifier remains in operation so that a corresponding error message can be generated when the encoder signals are evaluated.

6.5.4 Connection X9 - encoder connection

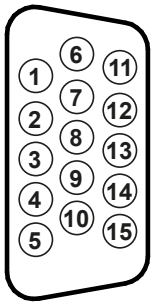


Fig. 20: X9/Axis2Enc1

Pin	SinCos and TTL	EnDat/SSI	HIPERFACE®	BISS	Resolver
1	A-		REFCOS	-	S3/COS- (A-)
2	A+		+COS	-	S1/COS+ (A+)
3	Typ. +5.15 V, max. 250 mA		(+5 V)	(+5 V)	(+5 V)
4	R+	Data+		SL+	-
5	R-	Data-		SL-	-
6	B-		REFSIN	-	S4/SIN- (B-)
7	(10 V / 110 mA)		Typ. 10 V, max. 110 mA	(10 V / 110 mA)	
8	GND				
9	-	-	-		R1 (resolver modulation +)
10	-		-		R2 (resolver modulation -)
11	B+		+SIN		S2/SIN+ (B+)
12	Temp +				
13	Temp -				
14	-	CLK+	-	MA+	-
15	-	CLK-	-	MA-	-

Tab. 25: Pin assignment of connector X9 (Enc1) - servo amplifier, 2-axis

NOTICE! The encoder supply at X7, X9 and X10 is short-circuit-proof in both 5 V and 11 V operation. The servo amplifier remains in operation so that a corresponding error message can be generated when the encoder signals are evaluated.

6.5.5 Connection X10 - encoder connection

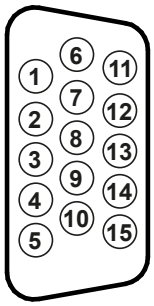


Fig. 21: X10/Axis3Enc1

Pin	SinCos and TTL	EnDat/SSI	HIPERFACE®	BISS	Resolver
1	A-		REFCOS	-	S3/COS- (A-)
2	A+		+COS	-	S1/COS+ (A+)
3	Typ. +5.15 V, max. 250 mA		(+5 V)	(+5 V)	(+5 V)
4	R+	Data+		SL+	-
5	R-	Data-		SL-	-
6	B-		REFSIN	-	S4/SIN- (B-)
7	(10 V / 110 mA)		Typ. 10 V, max. 110 mA	(10 V / 110 mA)	
8	GND				
9	-	-	-		R1 (resolver modulation +)
10	-		-		R2 (resolver modulation -)
11	B+		+SIN		S2/SIN+ (B+)
12	Temp +				
13	Temp -				
14	-	CLK+	-	MA+	-
15	-	CLK-	-	MA-	-

Tab. 26: Pin assignment of connector X9 (Enc1) - servo amplifier, 2-axis

NOTICE! The encoder supply at X7, X9 and X10 is short-circuit-proof in both 5 V and 11 V operation. The servo amplifier remains in operation so that a corresponding error message can be generated when the encoder signals are evaluated.

6.6 Connection X11 - STO

Connect to terminal X11:

– Safe digital inputs; the cables must be shielded

⚠ CAUTION

Drive malfunction

High currents flowing across the ground terminals can cause a high-impedance separation from the device ground.

► Avoid circulating currents in the wiring.

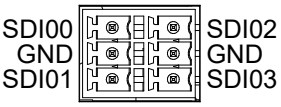


Fig. 22: Terminal X11, 6 pins

Ref.	Type	Role
SDI00	Safe digital input	STO 1 CH1
SDI01	Safe digital input	STO 1 CH2
SDI02	Safe digital input	STO 2 CH1
SDI03	Safe digital input	STO 2 CH2
GND	Ground reference	GND
GND	Ground reference	GND

Tab. 27: Specification of the control inputs X11/Safe DI

NOTICE! Further details on the S1 function in conjunction with the DIP switch block S-ADR can be found in the document "Functional Description of Integrated Safety Function S1".

6.7 Protective conductor terminal

⚠ DANGER

Electric shock

An incorrect connection can lead to high electrical voltage.

► Connect the power grid and grounding according to applicable safety requirements.

⚠ CAUTION

Safety hazard due to loose protective conductor terminal

The protective conductor terminal is a safety feature. Insufficient tightening torques or vibrations can lead to loose power connections, resulting in injuries.

► Make sure there is good and solid contact for all connections so they cannot come loose by themselves.

► Check all power connections at regular intervals.

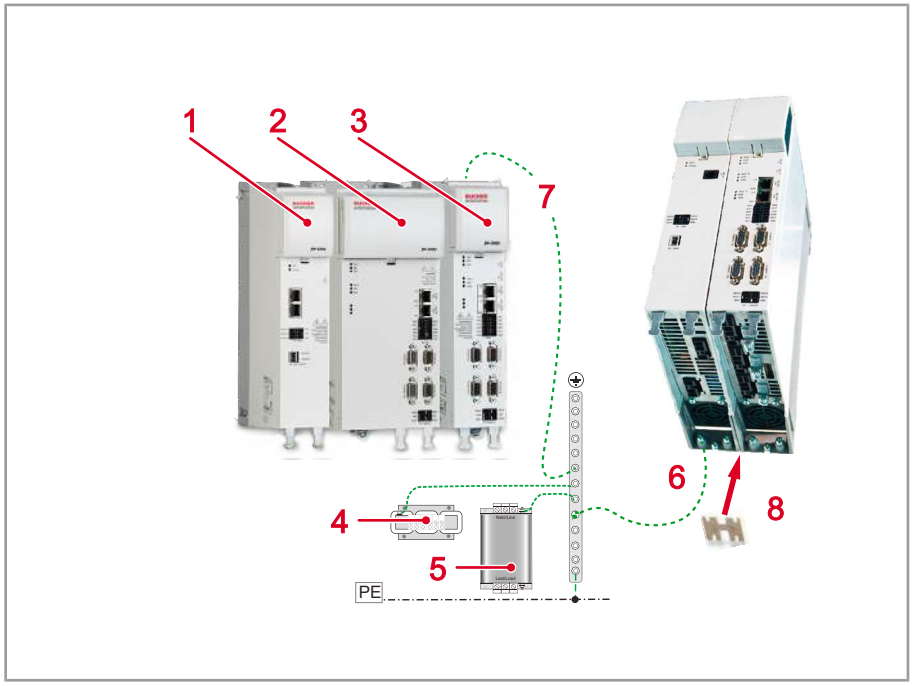


Fig. 23: Protective conductor terminal of the JM-3000 system

1	Supply unit
2	Servo amplifier
3	Servo amplifier
4	Line reactor
5	Line filter
6	Grounding in series from below
7	Alternative ground connection from above
8	Connect the devices with the PE metal bridges included with delivery. The connection can be made from below or above.

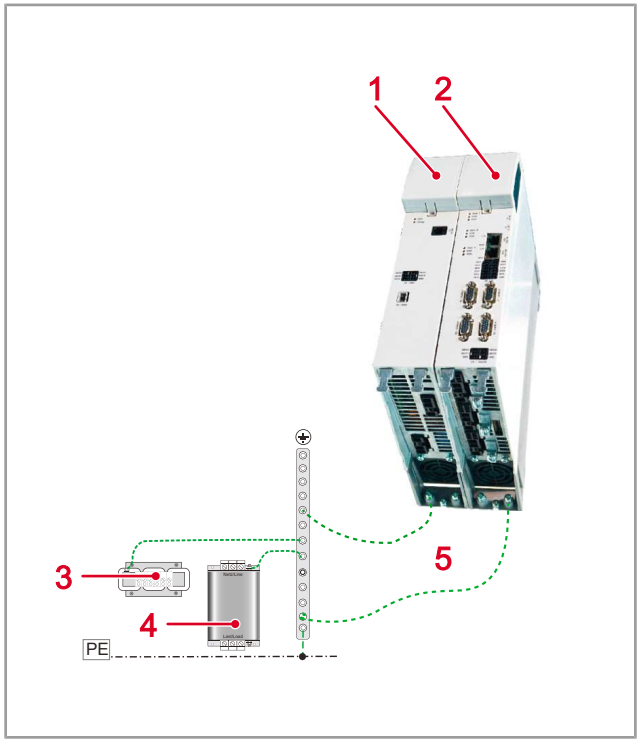


Fig. 24: Connection of the JM system with double PE cables

1	Supply unit
2	Servo amplifier (optional)
3	Line reactor
4	Line filter
5	Double grounding connection

PE mains connection to DIN EN 61800-5-1

Since the leakage current is >3.5 mA, the following applies to the PE connection:

– Use protective conductors with the same cross-section as the mains cables.

– If the cross-section of the mains cable is < 10 mm2, the PE connections must be doubled (see Fig. 3.7), or a copper cable with a minimum cross-section of 10 mm² must be laid.

Connections

1. Connect the PE connections of the supply unit and the servo amplifiers in series.
2. Connect one of the devices to the PE rail (main ground) in the control cabinet.
3. Connect the protective conductor terminal of all other components, such as line filter and line reactor, etc. to the PE rail (main ground) in a star configuration in the control cabinet.

6.8 Connecting the supply voltages

The has separate voltage supplies for the control unit and for the switching device.

– The control unit receives its 24 V supply voltage via the upper busbar (+24 V DC and GND) from the switching power supply integrated into the supply unit or from the 24 V DC power supply unit in the control cabinet.

– The switching device of the servo amplifier receives its DC link supply also from the supply unit via the lower busbar (DC Link+ and DC Link-).

Controller supply voltage (+24 V DC)

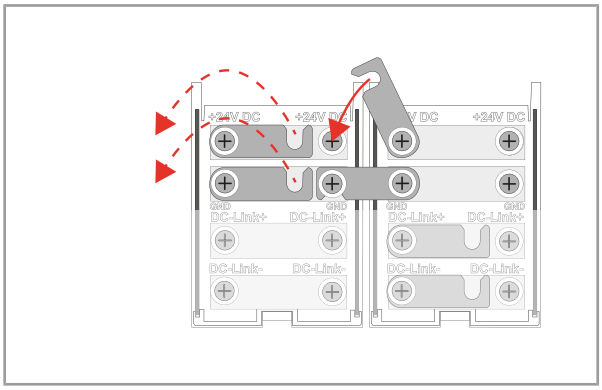


Fig. 25: Supply voltage busbar

Parameter	Value
U_V	+24 V DC ± 20 %, stabilized and smoothed
Output power of the internal switching power supply integrated into the supply unit	Max. 470 W continuous current
Protection against polarity reversal	internal
Power supply unit	Safe electrical isolation from the mains in accordance with EN 61131-2 is a precondition
Tightening torque of the busbar screws	2.1 Nm

Tab. 28: Specification of supply voltage busbar

DC link supply

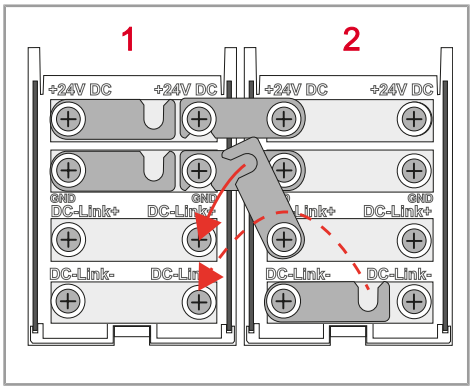


Fig. 26: Busbar connection for DC link supply

1	JM-3000 supply unit
2	JM-3000 servo amplifiers

Parameter		Value
DC link voltage depending on the supply voltage of the supply unit	AC 400 V	DC 565 V
	AC 480 V	DC 678 V
Tightening torque of the busbar screws		2.1 Nm

Tab. 29: Specification of busbar connection for DC link supply

Connections

✓ The supply unit is isolated from the mains.

1. First make sure that all JM-3000 servo amplifiers are arranged in a row with the JM-3000 supply unit.
2. Always connect the 24 V controller supply voltage for the servo amplifiers first. If you are using several servo amplifiers, all 24 V DC and all GND connections must be connected.
3. To do this, use the pre-assembled rail elements as shown in the figure above. To be able to rotate the rail elements, the screws must be slightly open.
4. Only connect the DC link supply when you want to put the servo amplifiers into operation. If you are using several servo amplifiers, all DC Link+ and DC Link- connections must be connected.
5. Use the pre-assembled rail elements for this as well. To be able to rotate the rail elements, the screws must be slightly open.
6. Once all rail elements are in place, the screws must be tightened again!

To protect against access to the rail elements from the side, plastic side parts are included with delivery of the upper folding front panels.

1. Insert one of them in the front panel all the way to the left outside or right outside.
2. Then close the front panels.

⇨ The rail elements are touch-proof.

⚠ DANGER



Danger due to high operating voltage

The high operating voltage will lead to serious injuries or death in case of contact with bare live parts.

► Operate the multi-axis system only with the cover of the rails closed and with the side covers inserted as protection against contact.

NOTICE



Susceptibility to malfunction due to differing firmware

All devices in an axis system must have the same firmware.

► When replacing a device, adjust the firmware through JetControl.

7 Motor connection

Terminals X12, X13 and X14 are designed for connecting up to three motors with motor temperature monitoring and motor holding brake.

Connect the following to the individual connections:

– Motor 1 to X12
– Motor 2 to X13
– Motor 3 to X14

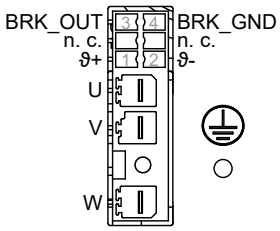


Fig. 27: Motor connections X12, X13, X14

Pin	Description	Specification
1	ϑ+: Terminal for motor temperature sensor or DSL-: HIPERFACE DSL®	Sectional area = 0.14 … 1.5 mm² AWG 24 ... AWG 16 I_N = 10 A
2	ϑ-: Terminal for motor temperature sensor or DSL+: HIPERFACE DSL®	
3	BRK_OUT: Connection of motor holding brake I_{BR} = max. 2 A	
4	BRK_GND	
U/V/W	Terminal for motor phases	Sectional area = max. 6 mm²
⏚	PE terminal for the motor	M4 screw with shakeproof washer for lug
(S)	Cable shield terminal	See lower illustration

Tab. 30: Specification of motor connectors

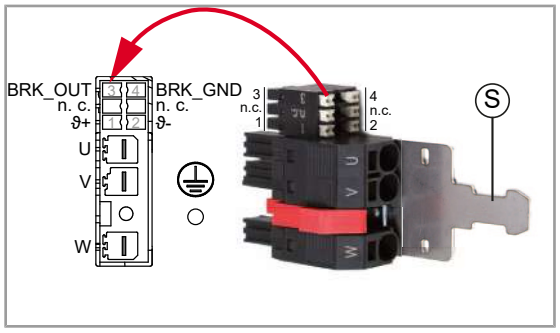


Fig. 28: Motor connector

7.1 Motor connection diagram

Motor cable

✓ All motor cables must be shielded.

1. To connect servo motors, use an assembled motor cable from Bucher Automation.
2. Use equivalent shielded cables for connecting third-party motors.

Connection of motor holding brake, up to 2 A motor braking current

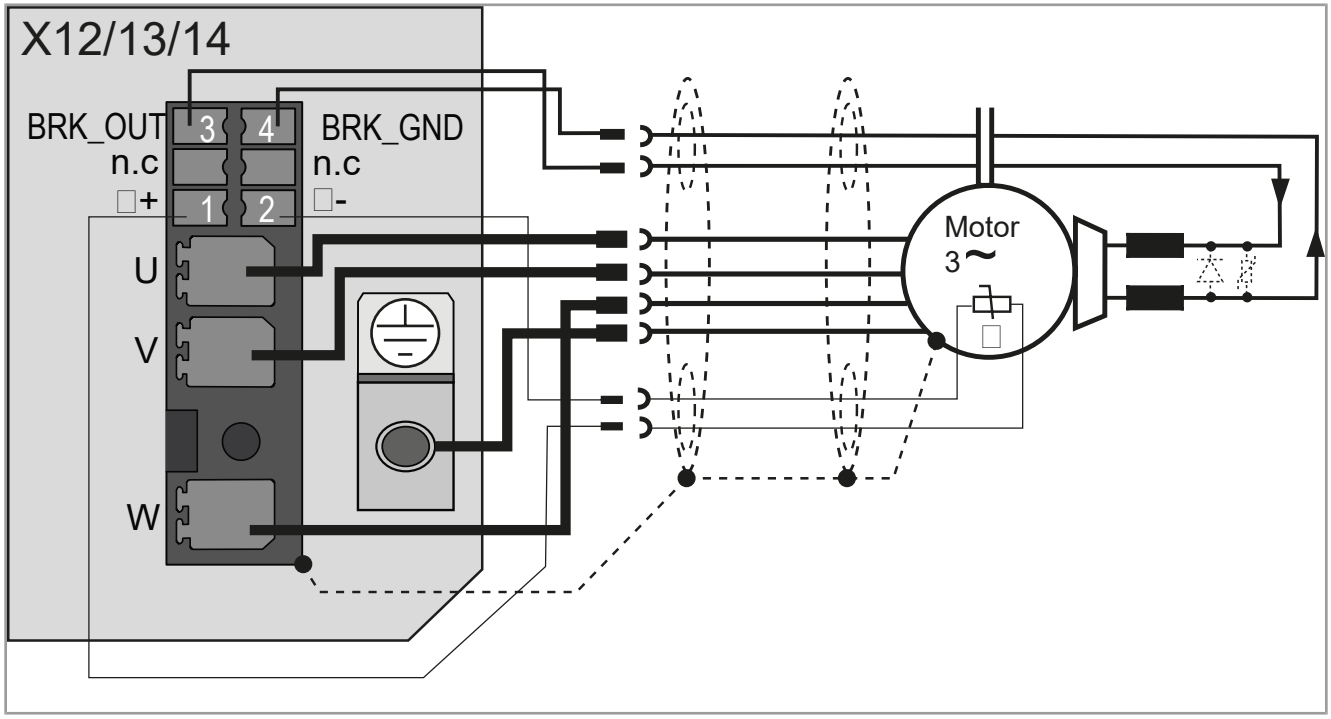


Fig. 29: Connection of motor holding brake, up to 2 A

► Place the outer shield and the brake shield on the M23 connector enclosure.

⇨ The connector enclosure and motor housing are electrically conductively connected with each other.

Connection of motor holding brake, 2 A or more motor braking current

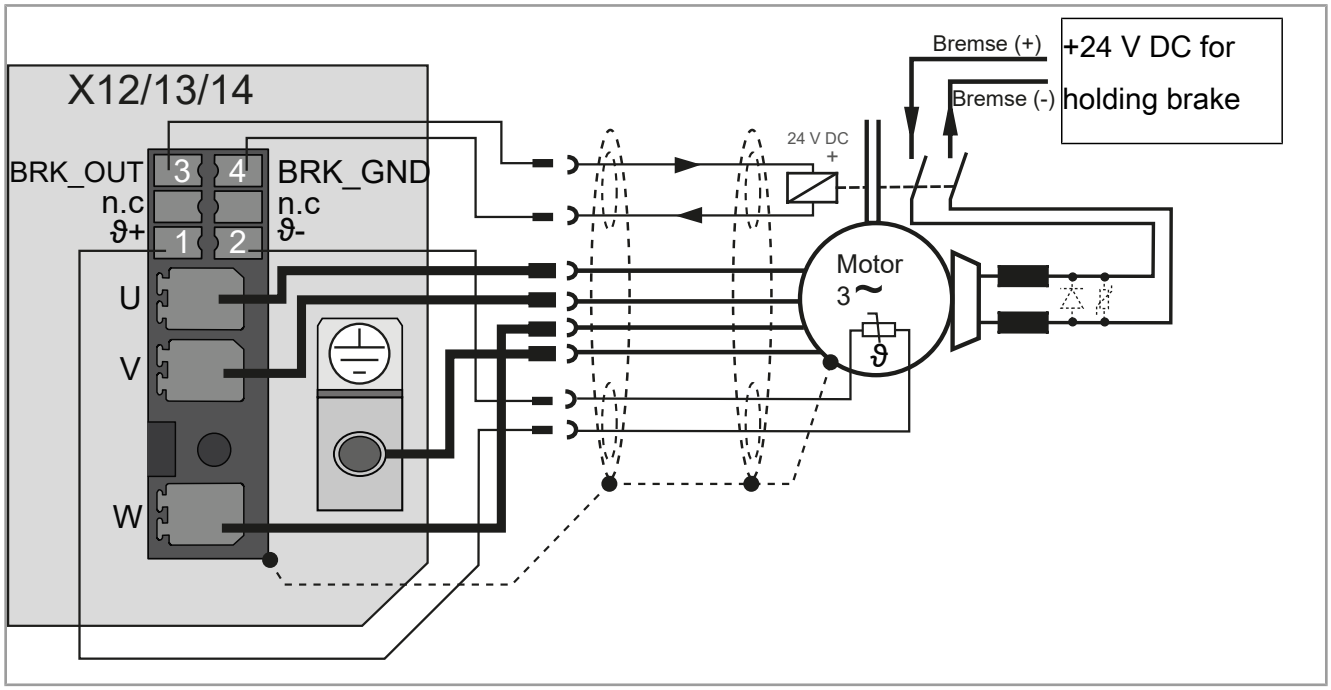


Fig. 30: Connection of motor holding brake, 2 A or more

NOTICE! This type of connection has no broken wire detection!

- ► Place the outer shield and the brake shield on the M23 connector enclosure.
- ⇨ The connector enclosure and motor housing are electrically conductively connected with each other.

Connection of a servo motor with HIPERFACE DSL encoder system

In the "HIPERFACE DSL" version, the two-wire connection of the encoder is connected to terminals X12, X13 and X14 at pins 1 and 2. The DSL shield that is placed on one pin of the M23 connector is connected with the bridge provided internally in the motor by the motor manufacturer and grounded.

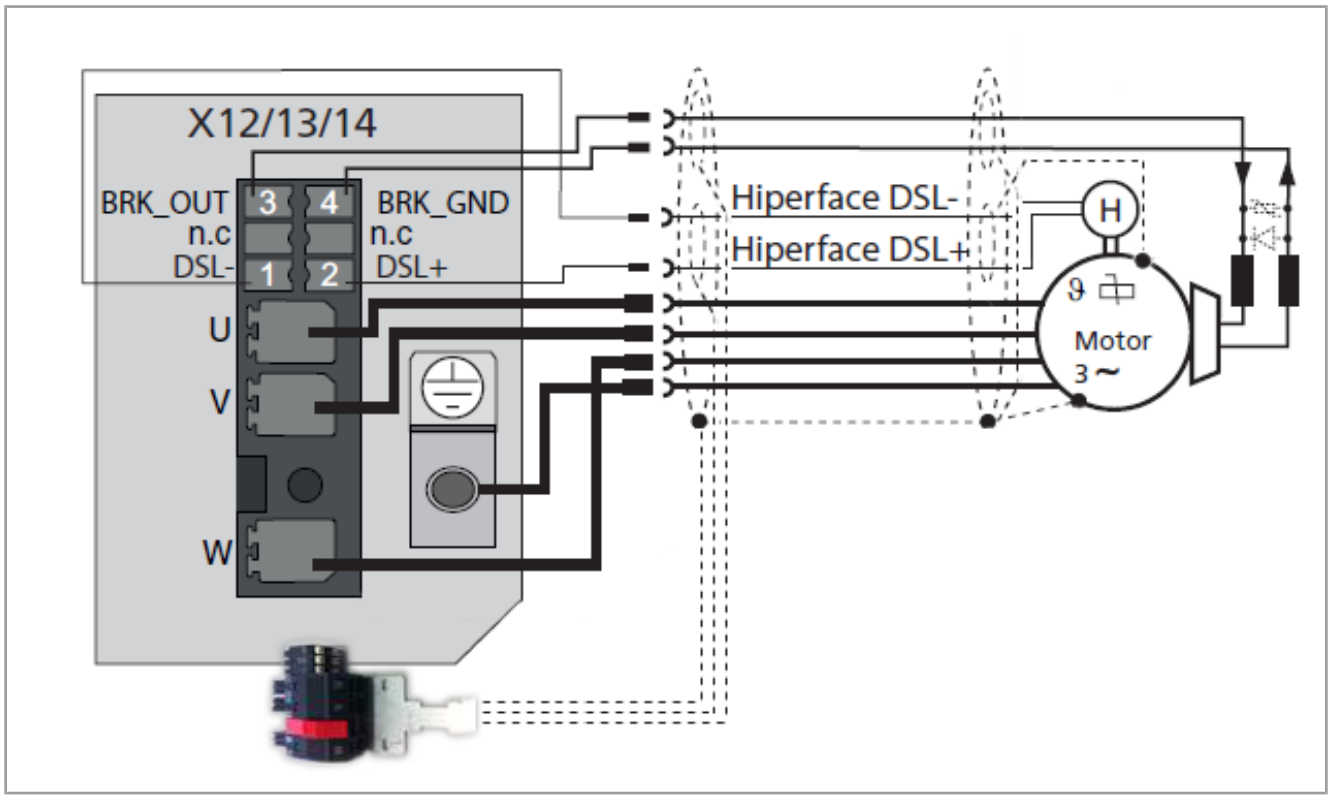


Fig. 31: Servo motor with HIPERFACE DSL

► Place the outer shield and the brake shield on the M23 connector enclosure.

⇨ The connector enclosure and motor housing are electrically conductively connected with each other.

Connections

Requirement:

– The motor temperature sensor must be designed with at least basic insulation against the motor coil for connection in motor connector X12/X13/X14, terminals 1 and 2.

– For a connection in encoder plug X7 ... X10, the motor temperature sensor must be designed with enhanced insulation in accordance with EN 61800-5-1.

CAUTION! If a ground fault or a short circuit in the motor cable occurs during operation, the output stage is locked and a fault message is generated. The motor coasts to a stop.

✓ You have defined the conductor cross-section depending on the maximum current and ambient temperature and in accordance with the local and country-specific conditions and circumstances.

1. To reduce radiated interference, connect the shielded motor cable to terminals X12/X13/X14 - U, V and W and ground the motor.
2. Place the shield on both sides.
3. Wire the temperature sensor (if present) and, for the 1-cable system option, the DSL cables to terminals 1 and 2 of connectors X12/X13/X14 with separately shielded cables and use JetSym to activate the encoder and temperature sensor variant.
4. Connect the motor holding brake, if any, to X12/X13/X14 - 3 and 4.
5. Place the shield of the brake wire pair on both sides of the motor and on the servo amplifier.

NOTICE



Danger of destroying the servo amplifier.

Switching operations in the motor cable are not permitted. Failure to comply may result in malfunctions in the device and lead to the servo amplifier being switched off or even destroyed.

► Use the STO safety function to safely interrupt the energy supply to the servo motor.

7.2 Monitoring of output for motor holding brake

– The motor brake outputs (BRK_Out and BRK_GND) are permanently monitored regardless of the use of SBC.

– The monitoring works with switch-off test pulses which are sent with a maximum time frame of 7.5 ms (depending on the load) and a minimum time frame of 1.5 ms.

NOTICE! In the case of high-impedance consumers, this short-time switch-off can trigger the error "Time frame exceeded".

7.3 Electronic overload protection of the motor

– The motor protection function records the motor frequency, motor current and other parameters as a thermal memory. Depending on these factors and the rated motor current, the motor protection function ensures that the protective function will be tripped in case of overload.

– The thermal memory is retained when the motor comes to a standstill with the device turned on.

– The devices do **not** retain the thermal memory if the device is **switched off**.
  – The function of the electronic motor overload protection is reset when the voltage supply is turned off and back on again.
  – The electronic motor overload protection can be increased by using a motor temperature sensor.

8 Maintenance

This device is maintenance free.
Therefore, for the operation of the device, no inspection or maintenance is required.

8.1 Repairs

Defective components could cause dangerous malfunctions and could compromise safety.
Only the manufacturer is allowed to repair the device.
It is forbidden to open the device.

Modifications to the device

Modifications and alterations to the device and its functions are not allowed. In the case of modifications to the device, any liability is excluded.

The original parts are specifically designed for the device. Parts and equipment from other manufacturers must, therefore, not be used.

Any liability for any damages resulting from the use of non-original parts and equipment is excluded.

8.2 Storage and Shipment

Storage

When storing the device observe the environmental conditions given in chapter “Technical specifications”.

Shipment and packaging

The device contains electrostatically sensitive components which can be damaged if not handled properly. Damages to the device may impair its reliability.

To protect the device from impact or shock, it must be shipped in its original packaging, or in an appropriate protective ESD packaging.
In case of damaged packaging inspect the device for any visible damage, and inform your freight forwarder and the Bucher Automation AG of the damage caused during shipment. If the device is damaged or has been dropped, it is strictly forbidden to use it.

8.3 Return and Disposal

Disposal options

Return your Bucher Automation AG product to us for proper disposal. Visit our website for detailed information and to download the required Returns form.

Meaning of WEEE icon



Fig. 32: WEEE icon – crossed out trash can

The product is waste electronic equipment and must be disposed of by a certified waste management facility. Do not dispose of the product with normal household waste. Applicable local environmental directives and regulations must be complied with.

Batteries

Prior to disposing of waste electronics, remove any batteries where this is possible in a safe and non-destructive way. Dispose of batteries properly.

Personal data

It is the responsibility of the customers to delete any personal data stored on waste electric and electronic equipment prior to disposal.

9 Service

9.1 Technical support

In case of questions, suggestions, or issues, please contact our experts from Technical Support. You may reach out by phone or through the contact form on our homepage:

Technical Support | Bucher Automation - We automate your success.

Or send an email to:

support@bucherautomation.com

Please supply the following information when contacting Technical Support:

– Hardware revision and serial number
  The hardware revision and serial number is printed on the nameplate of the product.
– OS version
  To determine the operating system version, use the functions of the development environment.

10 Spare parts and accessories

NOTICE



Inadequate accessories might cause damage to the product

Parts and equipment from other manufacturers might impede the function of the device and cause damage to the product.

► Only use accessories recommended by Bucher Automation AG.

10.1 Spare parts

Scope of Delivery	Item number	Quantity
EtherCAT® patch cable, 0.25 m 8-wire, Cat 5 e PE metal bridge	60887985	1 sachet
Pre-installed busbar elements for 24 V controller supply voltage (U_{CV}) and DC link supply ($U_{DC\ link}$)		
Mating connector for power and IOs		
For 3-axis module	60879944	1 sachet
USB stick with complete documentation	60888000	1 per order

10.2 Accessories

Accessories can be ordered optionally.

10.2.1 Pre-assembled cables

Encoder cables

Component	Cable type
KAY_1323A2_xxxx Resolver cable	(4 x 2 x 0.25)
KAY_1323YA2_xxxx Resolver cable for motor with Y-Tec connector (12-pin operation)	(4 x 2 x 0.25)
KAY_1331_xxxx EnDat-2.2 cables, 6 wires	(4 x 2 x 0.25)
KAY_1333A2_xxxx HIPERFACE® cable	(5 x 2 x 0.25)

Power cables

Component	Cable type
KAY_1310_xxxx 1.5 mm² power cable without brake (2-cable system)	(4 x 1.5)
KAY_1310Y_xxxx 1.5 mm² power cable without brake (2-cable system), for motor with Y-Tec connector	(4 x 1.5)
KAY_1312_xxxx 1.5 mm² power cable with brake (2-cable system)	(4 x 1.5 + (2 x 1.5))
KAY_1312Y_xxxx 1.0 mm² power cable with brake (2-cable system), for motor with Y-Tec connector	(4 x 1.0 + (2 x 0.75))
KAY_1314_xxxx power cable with brake (2-cable system)	(4 x 2.5 + (2 x 1.5))
KAY_1316_xxxx power cable with brake (2-cable system)	(4 x 4.0 + (2 x 1.5))
KAY_1318_xxxx power cable with brake (2-cable system)	(4 x 4.0 + (2 x 1.5))

HIPERFACE® DSL cables (always includes brake-by-wire)

Component	Cable type
KAY_1311_xxxx 1.0 mm² HIPERFACE® DSL (1-cable system) for motor with M23 connector	(4 x 1.0 + (2 x 0.75) + (2 x AWG22))
KAY_1311I_xxxx 1.0 mm² HIPERFACE® DSL (1-cable system) for motor with I-Tec connector	(4 x 1.0 + (2 x 0.75) + (2 x AWG22))
KAY_1313_xxxx 1.5 mm² HIPERFACE® DSL (1-cable system) for motor with M23 connector	(4 x 1.5 + (2 x 0.75) + (2 x AWG22))
KAY_1315_xxxx 2.5 mm² HIPERFACE® DSL (1-cable system) for motor with M23 connector	(4 x 2.5 + (2 x 1.0) + (2 x AWG22))
KAY_1317_xxxx 2.5 mm² HIPERFACE® DSL (1-cable system) for motor with M23 connector	(4 x 4.0 + (2 x 1.0) + (2 x AWG22))

10.2.2 EtherCAT® cables

Connection	Component	Item number
Slave from the last JM-3000 Rev. B on another EtherCAT® slave e.g. JM-100x.	Patch cable 1:1, 0.6 m, 4-wire green, Lütze GmbH, Cat 5e, shielded	60887934
	Patch cable 1:1, 1.0 m, 4-wire green, Lütze GmbH, Cat 5e, shielded	60887935
	Patch cable 1:1, 2.0 m, 4-wire green, Lütze GmbH, Cat 5e, shielded	60887936
From JetControl (EtherCAT® master) on JM-3000 Rev. B supply unit	Patch cable 1:1, 1.0 m 8-wire gray HIROSE	60537500
	Patch cable 1:1, 2.0 m 8-wire gray HIROSE	60854512
	Patch cable 1:1, 3.0 m 8-wire gray HIROSE	60887736

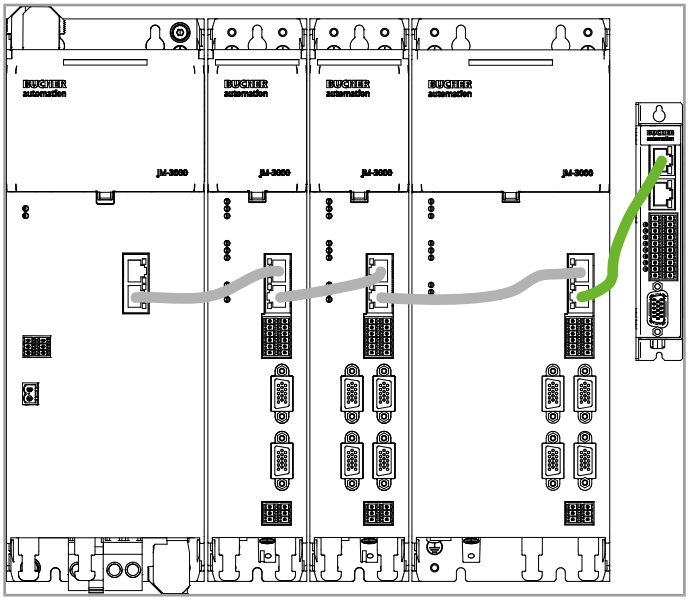


Fig. 33: Example of an EtherCat® cable connection

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