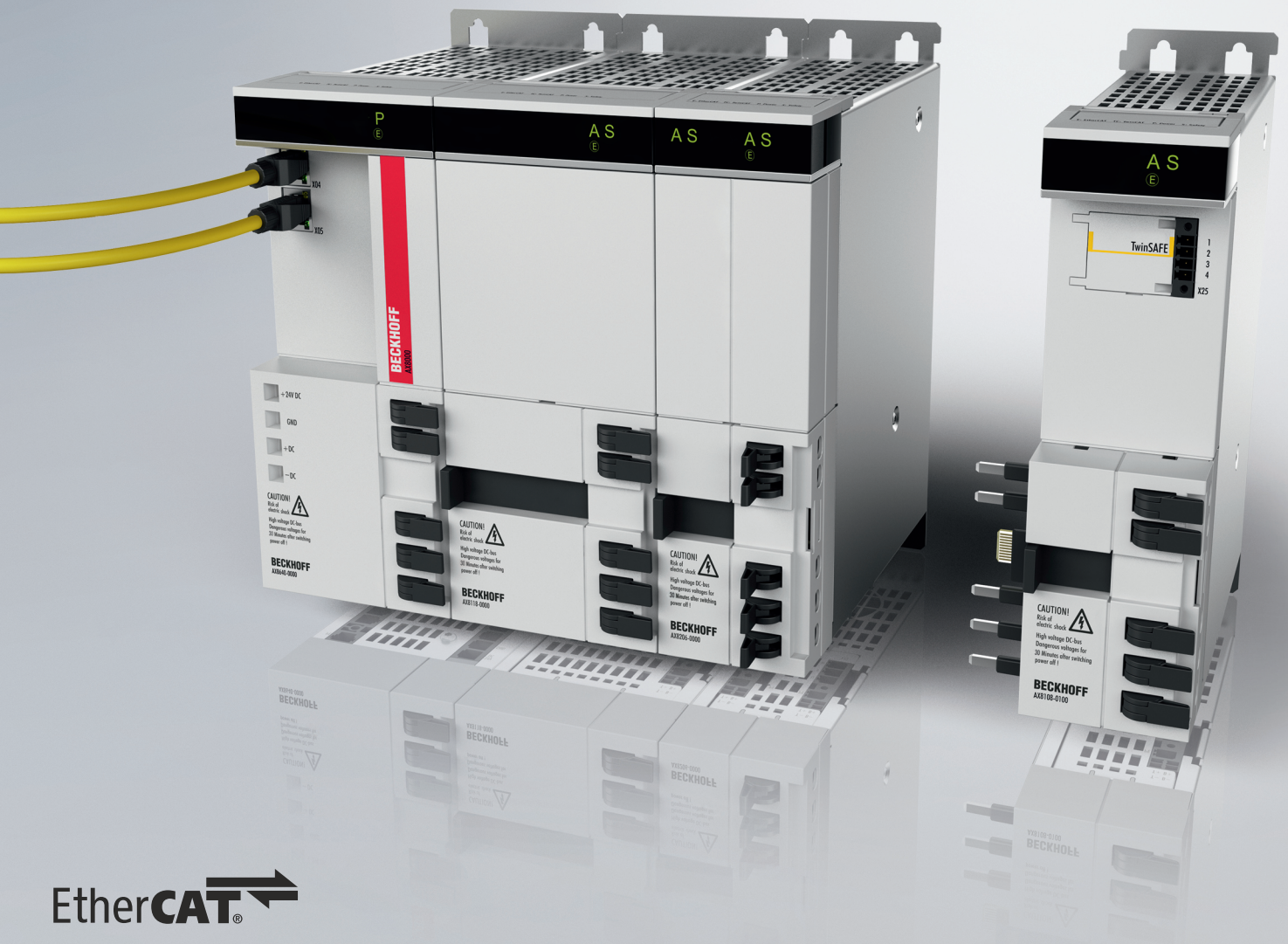


BECKHOFF

AX8000 | Multi-axis servo system

Operating instructions | EN



EtherCAT®

11/21/2019 | Version 1.0
Order No.: TDmlAX-8000-0000-0201

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- EP1789857
- EP1456722
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Version numbers

Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

Product features

The product features specified in the latest version of the original operating instructions are always applicable. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

Issue	Comment
1.0	First release

Scope of the documentation

The complete documentation consists of the following documents:

AX8000	Definition
Translation of the original instructions; this documentation	Description of the mechanical and electrical parameters as well as all information necessary for the use, installation and mounting of the AX8000 multi-axis servo system
Commissioning under TwinCAT3	Commissioning tutorial under TwinCAT3 including user information on the TC DriveManager 2 and a description of the safety function STO; Safe Torque Off over FSoE; Safety over EtherCAT
CoE object description	Documentation of the CAN over EtherCAT objects with attribute tables
Diagnostic messages	Documentation of the error messages of the AX8000 multi-axis servo system with attribute tables, problem descriptions and possible solutions
AX2090-BW80-xxxx brake resistors	Operating instructions for the use and installation of the AX2090-BW80 brake resistors as accessories for the AX8000 multi-axis servo system

Staff qualification

These operating instructions are intended for trained control and automation specialists with knowledge of the applicable and required standards and directives.

Qualified personnel must have knowledge of drive technology and electrical equipment as well as knowledge of safe working on electrical systems and machines. This includes knowledge of proper setup and preparation of the workplace as well as securing the working environment for other persons.

The documentation published at the time must be used for each installation and commissioning. The products must be used in compliance with all safety requirements, including all applicable laws, regulations, provisions and standards.

Designation of the target groups	Explanation
Instructed person	This target group has been informed about the possible dangers of improper use. The assigned scope of duties is clearly defined. Training will be provided for any tasks outside this scope. Instructions on the required protective measures and devices were provided.
Trained user	This target group meets all the requirements of an instructed person. In addition, machine-specific or plant-specific training has taken place at the machine manufacturer or vendor.
Trained specialists	Users who, based on their training, knowledge and experience, are able to assess the tasks assigned to them and recognize potential hazards, are regarded as trained specialists. Work experience over several years in a relevant field can also be considered as part of the technical training.
Qualified electricians	Qualified electricians are able to work on electrical machines or systems based on their specialist training like university degree, apprenticeship or specialist training. Possible sources of danger are automatically identified and avoided. Qualified electricians are specially trained for the working environment and are familiar with the relevant standards and guidelines. Knowledge of control engineering and automation is required. The provisions of the accident prevention regulations must be complied with.
Customer service	Customer service is provided by technicians who have been demonstrably trained and authorized by Beckhoff or the machine manufacturer to work on the respective machine or plant.

Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter "For your safety", [Page 11] in the operating instructions. Observe the warning notes in the chapters so that you can handle and work properly and safely with the product.

Explanation of symbols

Various symbols are used for a clear arrangement:

- ▶ The triangle indicates instructions that you should execute
- The bullet point indicates an enumeration
- [...] The square parentheses indicate cross-references to other text passages in the document
- [+] The plus sign in square brackets indicates ordering options and accessories

Pictograms

Pictograms are used to identify important text passages:



The warning triangle indicates warning notes.

The possible consequences of failure to observe these include:

- Damage and/or serious injuries
- Fatal injuries

The warnings are shown at the points in the documentation where it is important to observe them in order to prevent accidents and injuries.



Notes are used for important information on the product.

The possible consequences of failure to observe these include:

- Malfunctions of the product
- Damage to the product
- Damage to the environment



Information

This sign indicates information, tips and notes for dealing with the product or the software.



Example

This symbol shows examples of how to use the product or software.

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Download area

In the download area you will find product information, software updates, the TwinCAT automation suite, documentation and much more.

Web: www.beckhoff.de/download

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Read this chapter containing general safety information. The chapters in these operating instructions also contain warning notices. Always observe the safety instructions for your own safety, the safety of other persons and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

Safety pictograms

On Beckhoff products you will find attached or lasered safety pictograms, which vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms must not be removed and must be legible for the user.



Warning of high voltage!

The DC link capacitors and test contacts on all modules can carry life-threatening voltages of over 875 V_{DC}.

General safety instructions

This chapter provides you with instructions on security when handling the AX8000 multi-axis servo system. Servo drives cannot be used alone and are therefore regarded as incomplete machines. They must be installed in a machine / plant by the machine manufacturer. The documentation prepared by the machine manufacturer is to be read afterwards.

Before operation

Keep the surroundings clean

Keep your workplace and the surrounding area clean. Ensure safe working. Prevent dirt from penetrating into the components.

Secure the control cabinet

When working on machines, secure the control cabinet against inadvertent power-up.

Do not use defective servo drives

Observe the specifications in the "technical data", [Page 22] during storage, transport and operation. Do not use damaged servo drives.

Check safety pictograms

Check whether the designated pictograms are on the product. Replace missing or illegible stickers.

Observe tightening torques

Install connections and components in compliance with the specified tightening torques and check them regularly.

Ground electrical components or modules correctly

Do not touch electrical components or modules unless you are wearing protective ESD clothing. Only walk on conductive floors.

Only use original packaging for further processing

When shipping, transporting, storing and packing, use the original packaging or conductive materials. Conductive materials are foam or aluminum, for example.

During operation

Avoid contact with DC link DC+ and DC-

Measure the voltage on the DC link test contacts DC+ und DC-. Observe the following delay times after disconnecting from the mains supply:

- AX8620 and AX8640 **30 minutes**
- AX8108, AX8118 and AX8206 **30 minutes**

Do not work on live electrical parts

Do not open the AX8000 when it is live. Ensure that the protective conductor is properly connected. Never disconnect electrical connections while they are live. Only work on the AX8000 when the voltage has dropped to < 50 V. Disconnect all components from the mains and secure against reconnection.

Do not touch hot surfaces

Check cooling of the surfaces with a thermometer. Do not touch the housing during and after operation. Leave the servo drive to cool down for at least 15 minutes after it is switched off.

Avoid overheating

Operate the servo drive according to the technically foreseen specifications. Please refer to chapter: "Technical data", [Page 22]. Provide for adequate cooling and switch the servo drive off immediately if the temperature is too high.

Do not touch rotating components

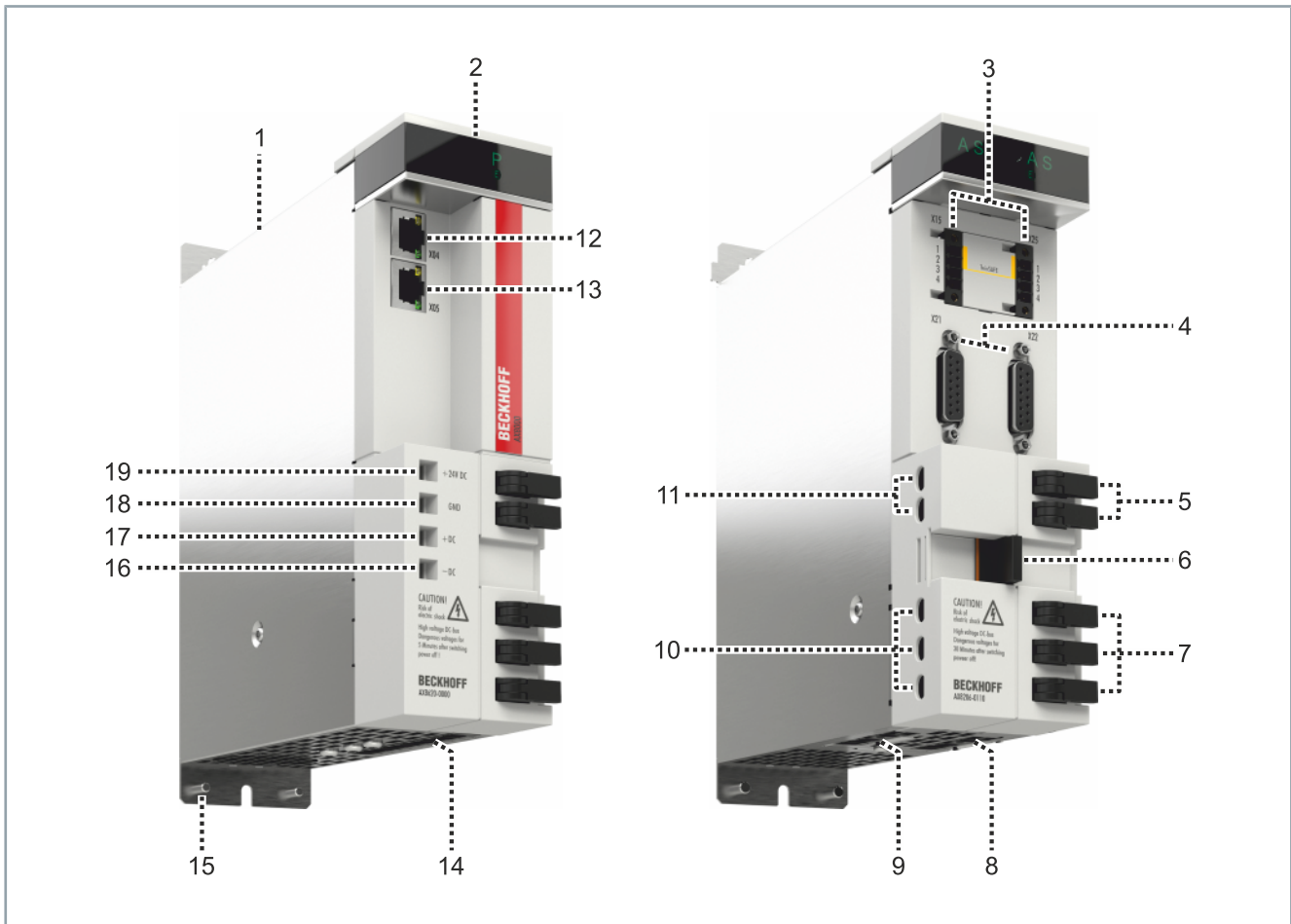
Do not touch any rotating components during the operation of a plant with the servo drive. Ensure that all parts / components on the machine / plant are firmly seated.

After operation

De-energize and switch off components before working on them

Carry out a voltage test and check all safety-relevant devices for functionality. Secure the working environment and the control cabinet against inadvertent power-up. Observe the chapter "Decommissioning", [Page 75].

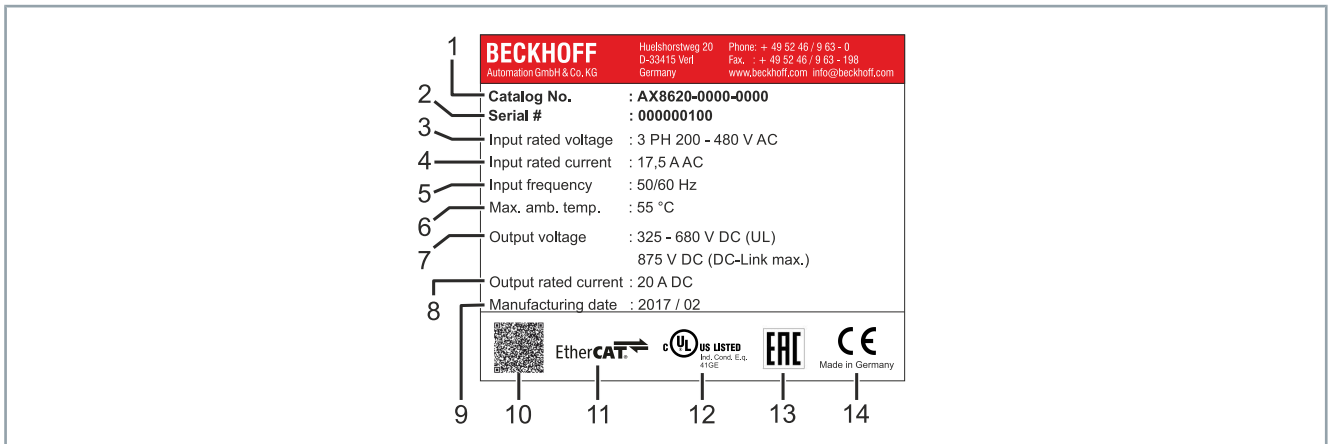
Product overview



Number	Explanation
1	Housing
2	Display; with 2-channel modules: left channel 1, right channel 2
3	Digital inputs X15, channel A and X25, channel B
4	Feedback connection X21 and X22; optional
5	Quick coupling 24 V _{DC} ; AX bridge
6	EtherCAT connection
7	Quick coupling, DC link and protective earth PE; AX bridge
8	8-pin motor connector X23, channel B; U, V, W, PE, T+ / OCT+, T- / OCT-, B+ and B-
9	8-pin motor connector X13, channel A; U, V, W, PE, T+ / OCT+, T- / OCT-, B+ and B-
10	AX-Bridge: DC link, FE
11	AX-Bridge: 24 V _{DC}
12	Fieldbus EtherCAT input X04
13	Fieldbus EtherCAT output X05
14	10-pin input terminal X01; DC, 24 V, supply network, PE and external brake resistor
15	Earthing bolt
16	Test contact DC link DC-
17	Test contact DC link DC+
18	Test contact GND
19	Test contact +24 V _{DC}

Power supply module

Name plate



Number	Explanation
1	Order number
2	Serial number
3	Rated input voltage
4	Rated input current
5	Input frequency
6	Maximum ambient temperature
7	Rated output voltage
8	Rated output current
9	Date of manufacture
10	QR code
11	EtherCAT conformity
12	cULus approval
13	EAC conformity
14	CE approval

Type key

AX 8x yz - a b c d - 0000	Explanation
AX	Product line Servo drive
8	Series AX8000
x	Supply 6 In combination with "a"
yz	Rated output current 20 = 7 A _{DC} - single-phase supply 20 = 20 A _{DC} - three-phase supply 40 = 40 A _{DC} - three-phase supply
a	Supply 0 = three-phase 200 to 480 V _{AC} 1 = single-phase or three-phase 100 to 240 V _{AC}
b	Reserved 0 = Standard
c	Hardware features 0 = Standard
d	Execution 0 = Standard

Product overview

Axis module

Name plate

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Germany
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1 Catalog No. : AX8206-0000-0000
2 Serial # : 000000100
3 Input rated voltage : 680 V DC (UL)
: 875 V DC (DC-Link max.)
4 Max. amb. temp. : 55 °C
5 Output rated voltage : 3 PH 0V AC - mains voltage
6 Output rated current : 2 x 6 A
Output frequency range : 0 - 599 Hz
7 Manufacturing date : 2017 / 02

8 9 10 11 12 13

EtherCAT, cULus LISTED, EAC, CE Made in Germany

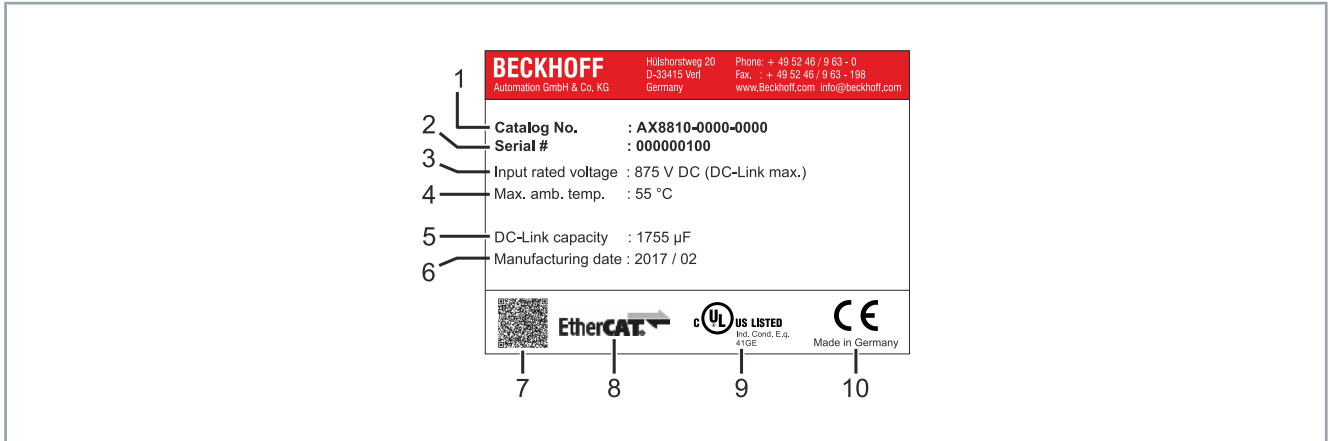
Number	Explanation
1	Order number
2	Serial number
3	Rated input voltage
4	Maximum ambient temperature
5	Rated output voltage
6	Rated output current
7	Output frequency range
8	Date of manufacture
9	QR code
10	EtherCAT conformity
11	cULus approval
12	EAC approval
13	CE conformity

Type key

AX 8x yz - a b c d - 0000	Explanation
AX	Product line Servo drive
8	Series AX8000
x	Axis module 1 = single-channel servo axis 2 = two-channel servo axis
yz	Rated channel current 08 = 1 x 8 A 18 = 1 x 18 A 06 = 2 x 6 A
a	DC link voltage 0 = 0 to 875 V _{DC}
b	Safety function 0 = No safety function 1 = Safety functions, see "Ordering options", [Page 19] 2 = Safety functions, see "Ordering options", [Page 19]
c	Hardware features 0 = OCT 1 = EnDat 2.2, BiSS C; Multi-Feedback Interface
d	Execution 0 = Standard

Capacitor module

Name plate



Number	Explanation
1	Order number
2	Serial number
3	Rated input voltage
4	Maximum ambient temperature
5	DC link capacitance
6	Date of manufacture
7	QR code
8	EtherCAT conformity
9	cULus approval
10	CE conformity

Type key

AX 8 8 yz - a b c d - 0000	Explanation
AX	Product line Servo drive
8	Series AX8000
8	Option module
yz	Option modules 10 = capacitor module
a	Supply 0 = 0 to 875 V _{DC}
b	Reserved 0 = Standard
c	Hardware features 0 = Standard
d	Execution 0 = Standard

Product characteristics

Short cycle times

With the servo drive you can implement fast and highly dynamic positioning tasks through the integrated control technology. EtherCAT enables the ideal connection to the PC-based control technology. With EtherCAT and the AX8000 multi-axis servo system you can achieve minimum cycle times, synchronicity and simultaneity in the drive technology.

Scalable rated motor power

With the axis modules you can operate different rated motor powers through scalable motor current measurement. A rated motor current of between 1 A and 8 A can be set on an 8 A module without influencing the quality of the resolution.

Operation of different motor sizes

With a two-channel axis module you can connect two identical motor sizes or also different ones. The sum of the rated currents of both servo motors is relevant for the selection of the axis module. The sum of the rated currents of the axis modules is the most that can be provided at the same time here.

High-speed capture inputs

The digital high-speed capture inputs record binary control signals from the process level and make them available for latching / capturing an encoder position. The signal propagation delay of these inputs is 15 μ s.

Diagnostics and parameter display

The display of the AX8000 multi-axis servo system shows error groups in various categories and is based on the 7-segment technology. The output takes place as LED.

Toolless connection

The simple and fast connection of the DC link of power supply modules and several axis modules is enabled by the AX bridge. The connection takes place without tools with spring-loaded terminals for DC link, control circuit and EtherCAT. The compact design of the AX8000 multi-axis servo system enables simple mounting inside the control cabinet.

Ordering options

Ordering options are defined via the type key and must be ordered separately. The listed components cannot be retrofitted.

Drive-integrated safety technology

The axis modules are optionally available with integrated safety functions. These conform to IEC 61800-5-2 and fulfill the following safety standards:

- EN ISO 13849-1:2015, up to Cat 4, PL e
- EN 61508:2010, SIL 3
- EN 62061:2005 + A1:2013/A2:2015 SILCL3

Communication takes place via the Safety-over-EtherCAT FSoE protocol according to IEC 61784-3-12. The safety function STO can optionally be activated via two safely integrated digital inputs or FSoE.

Order designation	Safety functions
AX8xxx-x1xx	STO ; safe torque off
	SS1 ; safe stop 1
	SBC ; safe brake control
AX8xxx-x2xx	STO ; safe torque off
	SOS ; safe operating stop
	SS1 ; safe stop 1
	SS2 ; safe stop 2
	SLP ; safely-limited position
	SCA ; safe cam
	SLI ; safely-limited increment
	SDIp ; safe direction positive
	SDIn ; safe direction negative
	SLS ; safely-limited speed
	SSR ; safe speed range
	SSM ; safe speed monitor
	SMS ; safe maximum speed
	SMA ; safe maximum acceleration
	SAR ; safe acceleration range
SBC ; safe brake control	
SBT ; safe break test	



Observe the TwinSAFE documentation

Before putting the axis module with integrated safety technology into operation, read the documentation:

- "AX8911 TwinSAFE Drive Option for servo drives from the AX8000 series"

Multi-feedback interface

The "multi-feedback interface", [Page 63] supports the digital feedback systems EnDat 2.2 or BiSS-C.

There are two further D-Sub 15-pin connectors behind the front cover of the axis module. Therefore, up to two EnDat 2.2 or BiSS-C feedbacks can be connected with a single-axis module. With a dual-axis module one feedback interface is assigned to each axis.

Intended use

The AX8000 multi-axis servo system may be operated exclusively for the activities foreseen and defined in this documentation, taking into account the prescribed environmental conditions. The components are to be installed only in closed control cabinets in electrical plants or machines and put into operation only as integrated components of the plant or machine.



Read the entire drive system documentation:

- This translation of the original instructions
- Complete machine documentation provided by the machine manufacturer

Improper use

Any use exceeding the permissible values specified in the Technical data is considered improper and therefore prohibited.

The AX8000 multi-axis servo system is not suitable for use in the following areas:

- ATEX zones without suitable housing
- Areas with aggressive environments, for example aggressive gases or chemicals

The relevant standards and directives for EMC interference emissions must be complied with in residential areas.

Dual Use

According to the published EU Regulation 1382/2014, commercially available frequency converters are categorized as products with a double purpose of use. The Beckhoff AX8000 multi-axis servo system thus newly belongs to the dual use products.

The goods list, Annex 1 of the Dual Use directive 428/2009 has been amended accordingly:

- Frequency converters, listed in goods list position 3A225, ≥ 600 Hz are subject to export control
- Frequency converters such as the AX8000 multi-axis servo system with a rotary field frequency of 599 Hz are not subject to export controls

According to the current state of production, the AX8000 multi-axis servo system is delivered with a maximum rotary field frequency of 599 Hz. This is sufficient to operate all synchronous servomotors from the AM8x00 series at full power.

Data for operation and environment



Operate servo drives only under the specified environmental conditions

Operate the servo drives only in accordance with the specifications for operation and the environment listed in this chapter. This ensures a long service life and proper operation.

The lifetime of the servo drive may be shortened at temperatures above 40 °C and with encapsulated installation.

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products.

Environmental requirements	
Climate category operation	2K3 according to EN 60721
Ambient temperature during operation	0 °C to +40 °C Extended temperature range up to +55 °C with power derating of 2 % / K
Ambient temperature during transport	-25 °C to +70 °C, maximum fluctuation 20 K per hour
Ambient temperature during storage	-25 °C to +55 °C, maximum fluctuation 20 K per hour
Power derating	Up to 1000 m above normal zero no power reduction From 1000 m to a maximum of 3000 m above sea level with power reduction of 1 % / 100 m
Installation altitude	From 2000 m to a maximum altitude of 3000 m above sea level, the overvoltage category must be reduced. Note "Derating".
Permissible humidity in operation	15 % relative humidity, no condensation
Permissible humidity during transport and storage	15 % to 85 % relative humidity, no condensation
Corrosion protection	Not required: Special measures are to be taken in consultation with the vendor if the environmental conditions are extreme or if they differ from those described in this chapter.
Level of contamination	2 according to EN 60204 and EN 50178
Specifications for intended use	
Ventilation	Integrated and temperature-controlled fan
Insulation material class	F according to IEC 60085 and UL1446 class F
Protection class	Devices IP 20 Terminals IP 00
Installation position	Vertical
Vibration resistance	1 G, 150 Hz according to EN 61800-5-1
Shock resistance	5 G, 30 ms according to EN 60068-2-27
EMC requirements	conforms to EN 61800-3:2004 + A1:2012
Approvals	CE cULus EAC See chapter: "Guidelines and Standards", [Page 77]

Power supply modules

- 100 to 480 V_{AC}

Electrical data	Single-phase	Three-phase	
	AX8620-0000	AX8620-0000	AX8640-0000
Mains supply			
Rated input current [A _{AC}]	10	17.5	35
Maximum rated input current [A _{AC}]	20	35	70
Rated supply voltage [V _{AC}]	1 x 100 ^{-10%} / 240 ^{+10%}	3 x 200 ^{-10%} / 480 ^{+10%}	
24 V system voltage and peripheral voltage [V]	24 ± 10%; dependent on the holding brake		
24 V current consumption [mA]	120		
Mains filter	Integrated, category C3		
SCCR value [kA]	5		
Power loss			
Without holding brake [W+W/A]	8 + 6		
Rated output power			
240 V _{DC} mains voltage [kW]	2	---	---
400 V _{DC} mains voltage [kW]	---	10.7	21.4
DC link			
Maximum voltage [V _{DC}]	875		
Capacitance [μF]	405	405	625
Maximum rated output current [A _{DC}] for maximum 5 seconds	14	40	80
Rated output current without mains choke [A _{DC}]	5	20	40
Rated output current with mains choke [A _{DC}]	7	20	40
Internal brake resistor			
Continuous braking power [W]	50	50	100
Maximum braking power [kW]	21.8	21.8	43.6
External brake resistor Dependent on the connected resistor			
Continuous braking power [kW]	1.6	1.6	3.2
Maximum braking power [kW]	21.8	21.8	40.1
Minimum brake resistor [Ω]	33	33	18
Mechanical data			
	AX8620		AX8640
Width [mm]	60		90
Height without connectors [mm]	230		
Depth without connectors / accessories [mm]	192		
Weight [kg]	2.5		3.5

Technical data

Axis modules

- 0 to 875 V_{DC}

Electrical data	Single-channel		Two-channel
	AX8108-0000	AX8118-0000	AX8206-0000
Rated output current [A]	8	18	Per channel: 6
24 V current consumption without holding brake [mA]	500	530	570
Minimum rated output current with full current resolution [A]	1	5	1
Power loss			
Without holding brake [W+W/A]	12		
At 230 V _{AC} mains connection voltage [W+W/A]	+9	+8	+9
At 400 V _{AC} mains connection voltage [W+W/A]	+11	+10	+11
At 480 V _{AC} mains connection voltage [W+W/A]	+12.5	+11	+12.5
DC link			
Maximum voltage [V _{DC}]	875		
Capacitance [μF]	135	405	135
Output current at 400 V_{AC} mains connection voltage			
Peak output current [A] I _{eff} for maximum 5 seconds	20	40	---
Peak output current [A] I _{eff} for maximum 5 seconds for channel A	---		14
Peak output current [A] I _{eff} for maximum 5 seconds for channel B	---		20
Maximum rated output current [A] for channel A	---		6
Maximum rated output current [A] for channel B	---		8
Rated output current as total device current [A]	---		12
Peak output current I _{eff} for maximum 5 seconds as total device current [A]	---		28
Output current at 480 V_{AC} mains connection voltage			
Peak output current [A] I _{eff} for maximum 5 seconds	18	36	---
Peak output current [A] I _{eff} for maximum 5 seconds for channel A	---		14
Peak output current [A] I _{eff} for maximum 5 seconds for channel B	---		18
Maximum rated output current [A] for channel A	---		6
Maximum rated output current [A] for channel B	---		8
Rated output current as total device current [A]	---		12
Peak output current I _{eff} for maximum 5 seconds as total device current [A]	---		28
Mechanical data			
Width [mm]	60		90
Height without connectors [mm]	230		
Depth without connectors / accessories [mm]	192		
Weight [kg]	2		2.5

Capacitor module

Electrical data	AX8810-0000
DC link	
Maximum voltage [V _{DC}]	875
Capacitance [μF]	1755
Mechanical data	AX8810-0000
Width [mm]	60
Height without connectors [mm]	230
Depth without connectors / accessories [mm]	192
Weight [kg]	1.9

Brake resistor [+]

- Dimensions according to the chapter "Dimensional drawings", [Page 28]

Electrical data	AX2090-BW80-xxxx			
	1000	1600	2000	3200
Type power at 40 °C [W] 4 % power loss per 10 K temperature increase	1000	1600	2000	3200
Resistance [Ω]	18	33	18	18
Mechanical data				
Weight [kg]	4	5.8	6.7	10.3
Dimensions according to the dimensional drawing				
O [mm]	749	649	749	649
R [mm]	92	185	185	185
H [mm]	120	120	120	210
M [mm]	630	530	360	530
U [mm]	80	150	150	150

Technical data

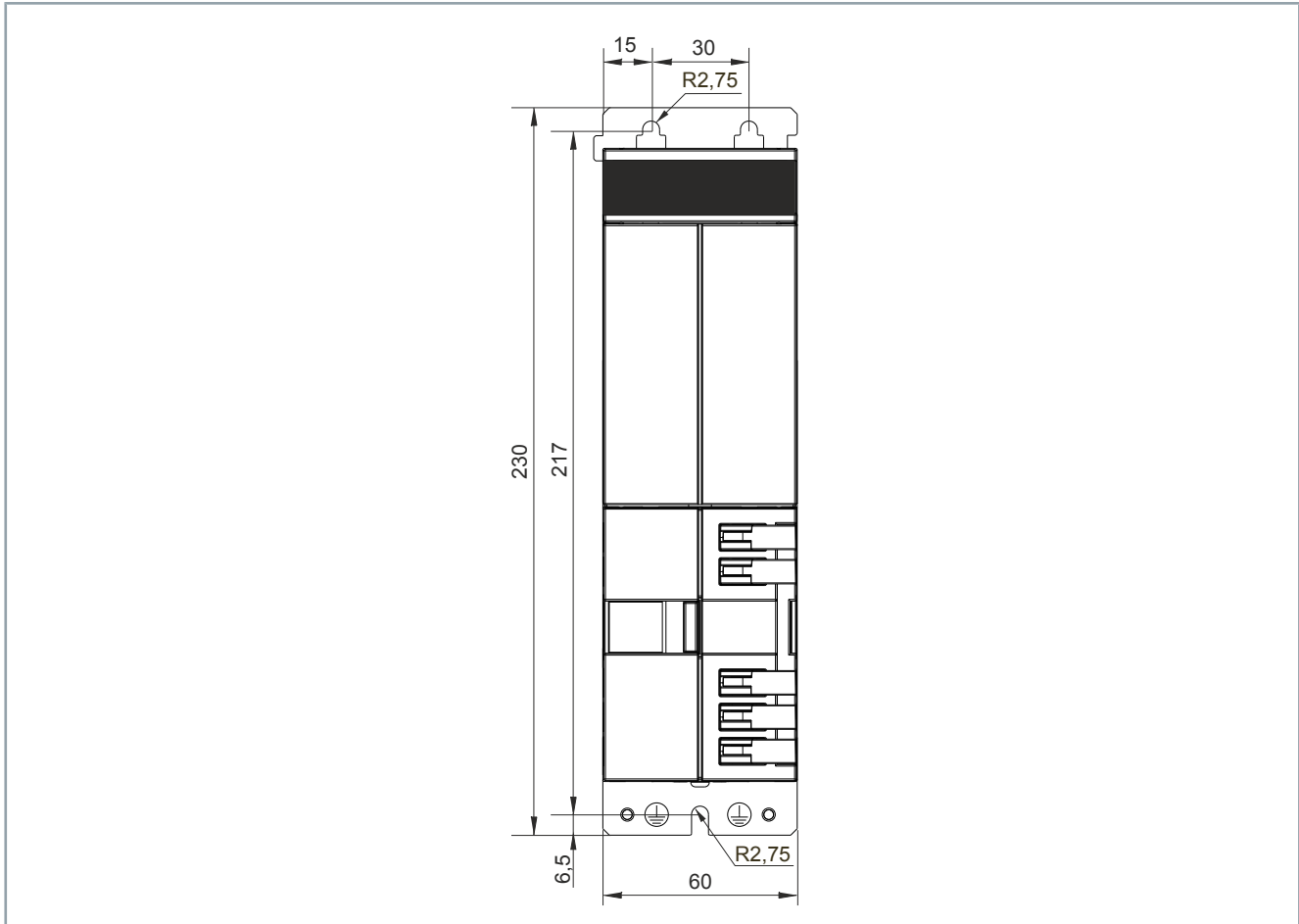
Dimensional drawings

- Dimensions without connectors and cables
- All figures in millimeters

Narrow modules

The following table provides you with information regarding which modules can be assigned to the dimensional drawing:

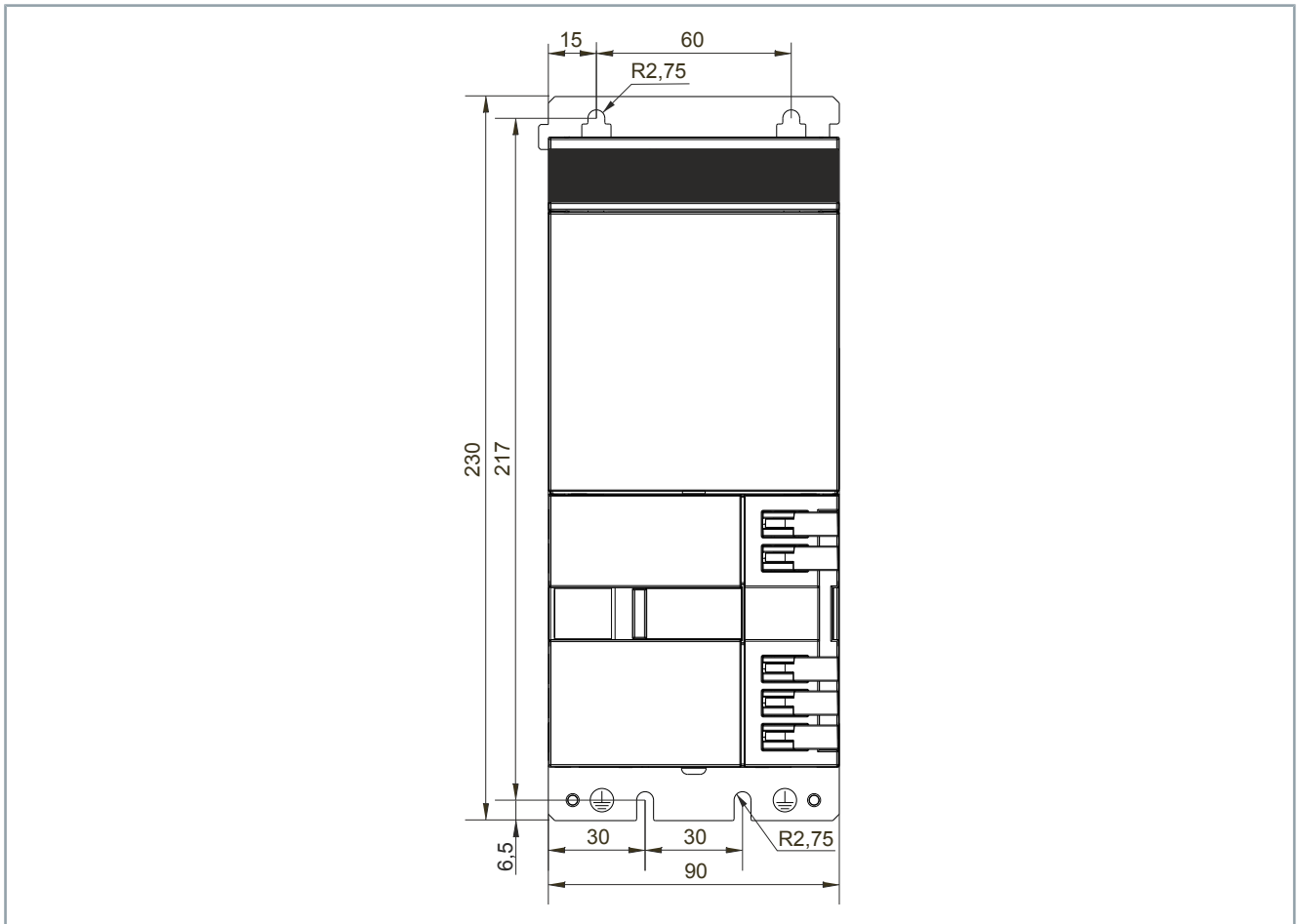
Power supply modules	Axis modules	Capacitor modules
AX8620	AX8108, AX8206	AX8810



Wide modules

The following table provides you with information regarding which modules can be assigned to the dimensional drawing:

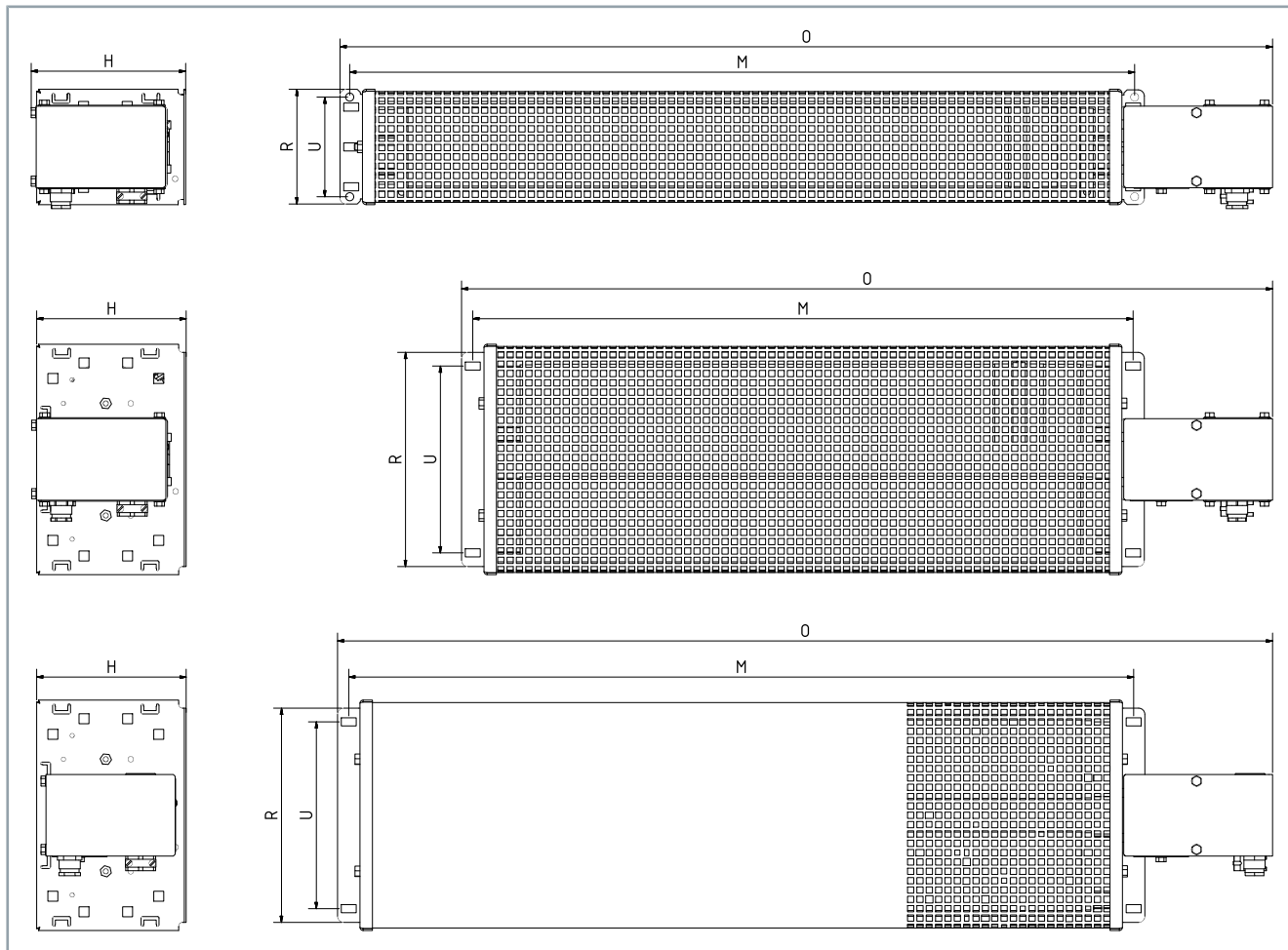
Power supply modules	Axis modules
AX8640	AX8118



Technical data

Brake resistor [+]

- All data in millimeters according to the table "Technical data", [Page 25]



Dimensions according to the dimensional drawing	AX2090-BW80-xxxx			
	1000	1600	2000	3200
O [mm]	749	649	749	649
R [mm]	92	185	185	185
H [mm]	120	120	120	210
M [mm]	630	530	360	530
U [mm]	80	150	150	150



Check missing or damaged parts

Check your delivery for completeness. If any parts are missing or became damaged during transport, contact the carrier, vendor or our service department immediately.

The scope of delivery always includes the following documents:

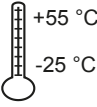



Translation of the original instructions	Instruction leaflet
• Power supply modules	• Axis module

Depending on the application, the scope of delivery may consist of different components. Please check the delivery:

Components	Connector
Power supply module AX8620	X01 Mains supply DC link 24 V supply External brake resistor [+]
Power supply module AX8640	X01 Mains supply X02 DC link 24 V supply External brake resistor [+]
Axis modules AX8108 and AX8118	X15 Digital inputs and outputs
Axis module AX8206	X15 Digital inputs and outputs X25 Digital inputs and outputs
Capacitor module	---

Packaging

Instructions for handling are printed on the packaging:

Symbol	Explanation
	That is the highest and lowest temperature at which you may store.
	This is the correct position for the packaging.
	The packaging must be protected from moisture.
	The contents are fragile.

The following table shows the dimensions of the packages for the individual modules:

Dimension	AX8108	AX8206	AX8620	AX8118	AX8640
Height [mm]		370		395	
Width [mm]		275		275	
Depth [mm]		130		170	



Protect the servo drive against damage

Protect the servo drive against damage during transport and storage and adhere to the conditions.

Damage may result in hazardous voltages being present on the housing or exposed components and can lead to serious or even fatal injuries.



Avoid damage to the servo drive and loss of the guarantee

Observe the conditions and the following chapters on transport and storage.

Disregarding the conditions can lead to damage to the servo drive and invalidation of the guarantee.

Avoid short-circuit due to moisture

Condensed water can form during transport in cold weather or in case of extreme temperature differences. Make sure that no moisture collects in the servo drive. Equalize room temperatures slowly. Switch the servo drive on only when it is dry.

If the servo drive is not fully dry, condensed water can lead to a short-circuit and damage to the servo drive when switching on.

Conditions

Care must be taken that the servo drive and individual components are not damaged during transport and storage. Observe the specifications in the following chapters and comply with the following conditions:

- Avoid electrostatic charging
- Avoid contact with highly insulating materials
- Temperature: -40 °C to +55 °C, maximum fluctuation 20 K/hour
- Air humidity: Max. relative humidity 95 %, non-condensing
- Use of suitable means of transport
- Use of the vendor's original packaging

The table shows the maximum stacking height in which you may store and transport the servo drives in their original packaging on a pallet:

Servo drive type	Stacking height of original packages [qty]
AX8000	8

Transport



Avoid high mechanical stresses

Use suitable means of transport and secure servo drives against high mechanical stress.

High mechanical stresses damage the servo drive and individual components.

All modules can be transported without aids.

Long-term storage



Observe the maximum storage time

Do not exceed a maximum storage time of five years.

Exceeding the specified maximum storage time can lead to a change in the properties of the servo drive used and may damage it in operation.

Observe forming in case of a storage duration of one year

The capacitors must be reformed before putting the servo drive into operation. To do this, release all electrical connections and supply up to 240 V_{AC} single-phase for 30 minutes to the servo drive on terminal points L1 and L2 or L2 and L3.

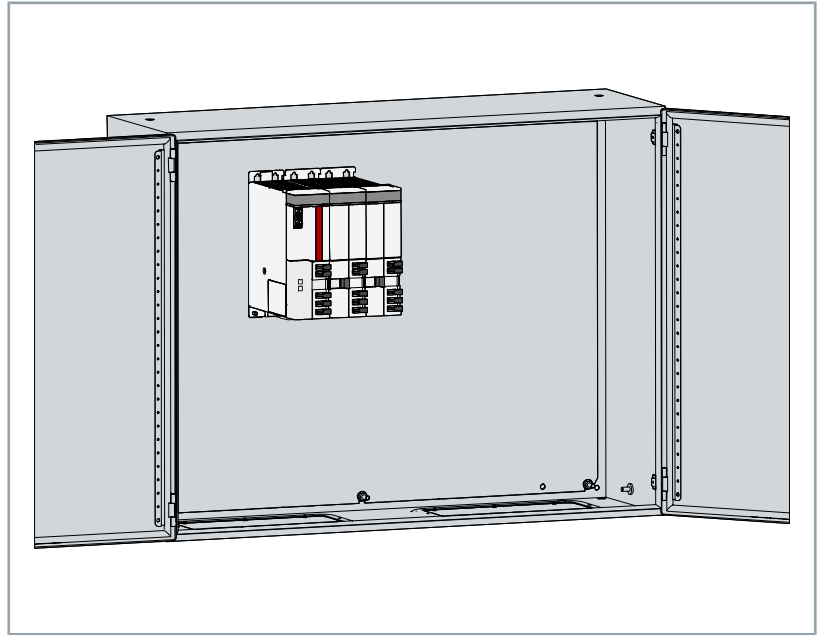
The connection of unformed capacitors to a supply network can damage the servo drive.

You have the option to store the servo drive over a short or longer period. For storage we always recommend the original packaging. Observe the conditions specified in chapter: "Transport and storage", [Page 31].

Ensure the storage space is vibration-free.

Installation position

The standard installation position of the servo drives in the control cabinet is the vertical installation position.



Residual current circuit breaker

Servo drives with a built-in mains filter may exhibit a small leakage current due to the capacitors in the filter. This fault current may cause malfunctions of standard residual current circuit breakers. Therefore, use so-called AC/DC-sensitive residual current circuit breakers type B, in which DC current is also accounted for. Beckhoff recommends residual current circuit breakers with switch-on delay.

Safe system stop

A power failure can lead to the uncontrolled run-out of the drive axes. Linear axes or lifting axes could then drive without braking against the end stop. Via the uninterruptible power supply in the Industrial PC, you have the possibility to buffer the supply voltage to the control electronics until all axes are safely stopped.

Wide voltage range

Due to the wide voltage range of the power supply modules, the AX8000 multi-axis servo system can be operated worldwide on different voltage systems.

All networks with a grounded center point are permitted; TT / TN.

Data are given below for the wide voltage range of the power supply modules for the different supply networks:

Single-phase supply networks	Three-phase supply networks
1 x 100 _{-10%} V _{AC} to 1 x 240 _{+10%} V _{AC}	3 x 200 _{-10%} V _{AC} to 3 x 480 _{+10%} V _{AC}



Country-specific examples

The following table contains examples of different network systems in various countries:

Country	Single-phase supply networks	Three-phase supply networks
Japan	1 x 100 V _{AC}	3 x 200 V _{AC}
North America	1 x 115 V _{AC}	3 x 480 V _{AC}
Europe	1 x 230 V _{AC}	3 x 400 V _{AC}

Dimensioning

Important information on the DC link capacitance, the total motor cable lengths and the dimensioning of the 24 V_{DC} control voltage can be found below. Subsequently, there is a practical example.

DC link capacitance



Observe the maximum chargeable DC link capacitance

The maximum chargeable DC link capacitance must be considered when designing the machine or plant:

- Drive system up to 240 V_{AC} supply = **16725 µF**
- Drive system up to 400 V_{AC} supply = **6000 µF**
- Drive system up to 480 V_{AC} supply = **4226 µF**

The power supply modules charge up the entire DC link when the mains supply is first switched on.



Maximum chargeable DC link capacitance at 400 V_{AC}

The system includes:

- 1 x AX8640-0000 with 675 µF
- 10 x AX8206-0000 with 1350 µF
- 1 x AX8810-0000 with 1755 µF

That makes a total capacitance of 3870 µF.

The system is permissible, because a power supply module on the 400 V_{AC} supply network can charge up a capacitance of 6000 µF.

Technical description

Total motor cable length

In compliance with the EMC category C3, various total motor cable lengths apply to the AX8000 multi-axis servo system.

Without mains choke

Motor cable length	Total motor cable length	Number of axes per drive system
Maximum 25 m per motor	Maximum 300 m per drive system	Limited by the maximum chargeable DC link capacitance and the 24 V _{DC} supply with maximally 40 A _{DC} The requirement is determined via the module current and motor braking current.

With mains choke

- Mains choke to be used: AX2090-ND80-xxxx

Motor cable length	Total motor cable length	Number of axes per drive system
Maximum 50 m per motor	Maximum 500 m per drive system	Limited by the maximum chargeable DC link capacitance and the 24 V _{DC} supply with maximally 40 A _{DC} The requirement is determined via the module current and motor braking current.

Control voltage



Dimensioning the 24 V_{DC} control voltage

The connected consumers must be summed in order to dimension the control voltage power supply unit:

- Power supply module
- Axis module
- Capacitor module
- Motors with holding brake

Data for 24 VDC power requirement

These data can be found in the chapter: "Technical data", [Page 22] or in the translation of the original instructions for the AM8000 & AM8500 synchronous servomotors.

Practical example

The configured 480 V_{DC} drive system consists of:

Number	Component
4	Servomotors from the AM8031-0D21 series with a cable length of 4 m, 10 m, 15 m and 22 m
4	Servomotors from the AM8051-0G21 series with a cable length of 16 m, 18 m, 21 m and 25 m
4	Dual-axis modules from the AX8206 series
1	Power supply modules from the AX8620 series

Total standstill current I_0

The total standstill current I_0 relates to all servomotors listed in the practical example and corresponds to:

- $4 \times 1.95 \text{ A for the AM8031} + 4 \times 4.75 \text{ A for the AM8051} = 26.8 \text{ A}$

The total standstill current I_0 is now multiplied by the simultaneity factor. In the case of a machine tool this is relatively high, e.g. 0.9, because all axes can drive into the material at the same time. In the case of a handling system the factor is more likely to be 0.7.

This then corresponds to:

- $26.8 \text{ A} \times 0.7 = 18.76 \text{ A}$

The AX8620 power supply module was selected on the basis of the calculations.

24 V_{DC} current consumption

The 24 V_{DC} current consumption relates to all the components listed in the practical example and corresponds to:

- $0.12 \text{ A for the AX8620} + 4 \times 0.57 \text{ A for the AX8206} + 4 \times 0.33 \text{ A for the holding brake with the AM8031} + 4 \times 0.54 \text{ A for the holding brake with the AM8051} = 5.88 \text{ A}_{\text{DC}}$

Result

The maximum single cable length for the AM8051-0G21 is 25 m and is thus $\leq 25 \text{ m}$

The total cable length of all servomotors is 131 m and is thus $\leq 300 \text{ m}$

- Therefore no AX2090-ND80-xxxx mains choke is required

The 24 V_{DC} current consumption of all components is $5.88 \text{ A}_{\text{DC}}$ and is thus $\leq 40 \text{ A}_{\text{DC}}$

- A 24 V_{DC} power supply unit with a rated current of at least 6 A must be provided

The maximum DC link capacitance is always related to the connection to a common AX86x0 power supply module with 945 μF and is thus $\leq 4226 \mu\text{F}$

Display

Information about the states of the individual modules is shown on the display of the AX8000 multi-axis servo system. There are different symbols for each module.



Display black:

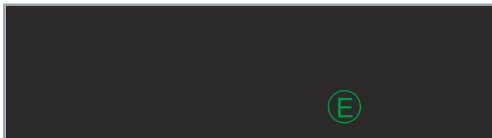
The module is switched off.

Power supply module display

Information about the meaning of the different symbols on the display of the power supply module is given below:

EtherCAT

E = EtherCAT



EtherCAT symbol lights up green:

The EtherCAT master is active.



EtherCAT symbol flashes green:

The EtherCAT master is active, the configuration is inactive.



EtherCAT symbol flashes red:

EtherCAT error.

Mains voltage

P = Power supply



Power symbol lights up green:

The mains voltage is connected, and the DC link is charged.



Symbol flashes green:

The DC link is being charged / discharged.

Fast blinking: DC link voltage > 48 V

Slow flashing: DC link voltage ≤ 48 V



Power symbol lights up red:

Error.



Power symbol flashes red:

An error has occurred, but the DC link is being charged/discharged:

Fast blinking: DC link voltage > 48 V

Slow flashing: DC link voltage ≤ 48 V



EtherCAT and power symbol light up green:

The power supply module is ready to operate.

Technical description

Axis module display

In the case of a two-channel axis module, the display is vertically divided. The left column shows the symbols for channel A, the right column shows the symbols for channel B. The EtherCAT symbol is shown in the center.

Information on the meaning of the different symbols on the display of the single-channel axis module is given below:

EtherCAT

E = EtherCAT

Corresponds to the description for the power supply module:
See chapter "Power supply module display", [Page 38]

Axis module

A = axis module



Axis symbol lights up green:

The axis is enabled and free from errors.



Axis symbol flashes green:

Fast blinking: The axis is disabled and is being initialized.

Slow flashing: The axis is disabled and free from errors.



Axis symbol lights up red:

The module is in EtherCAT INIT state.



Axis symbol flashes red:

Error.



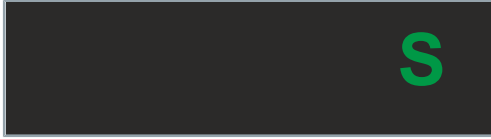
Axis symbol flashes green-red:

The error reaction of the axis is active.

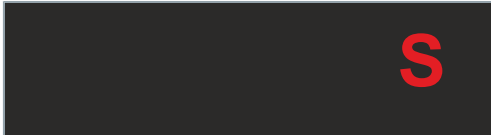
Information on the meaning of the different symbols on the display of the safety axis module is given below:

Safety

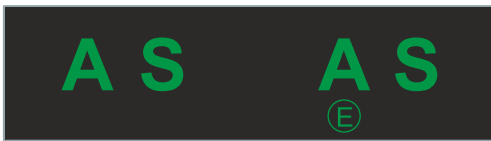
S = Safety



Safety symbol lights up green:
No safety error.



Safety symbol lights up red:
The axis is in state "STO".



Symbols of EtherCAT, axis module and safety light up green:
The safety axis module is in the normal operating state.
These symbols are only visible when the two-channel safety axis module has reached its operating state.

Capacitor module

You can extend the DC link capacitance with the capacitor module. Use in combination with the single-phase supply to the AX8620-0000 is particularly suitable for supporting the DC link. Voltage peaks during motor braking are absorbed and stored. This provides you with the possibility to largely avoid switching in a brake resistor and to achieve a reduction in the power loss.

Placement in the group

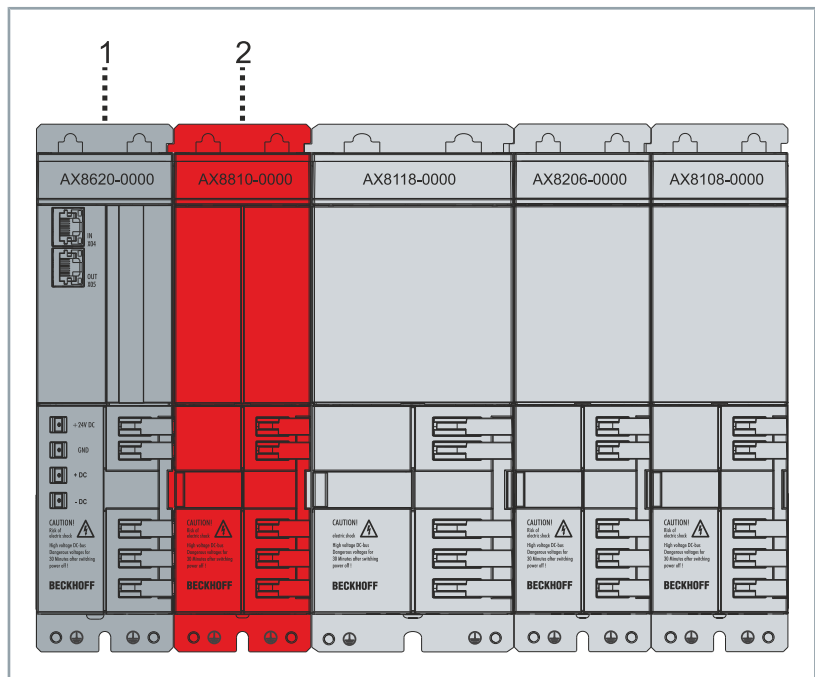


Example: system group with capacitor module

In decreasing order from the highest to the lowest rated output current:

- AX8620 power supply module
- AX8810 capacitor module
- AX8118; 18 A axis module
- AX8602; 2 x 6 A axis module
- AX8108; 8 A

Beckhoff recommends that you place the optional capacitor module 2 directly adjacent to the power supply module 1. Construct the AX8000 multi-axis servo system in decreasing order from the highest to the lowest rated output current.



Preparation



Establish the voltage-free and de-energized condition

Remove all fuses in the supply network and turn off the main switch on the control cabinet. Secure the control cabinet against being switched on again.

Although a motor is no longer rotating, current on the control and power connections or a residual voltage in the capacitors of the servo drive can lead to serious injuries.



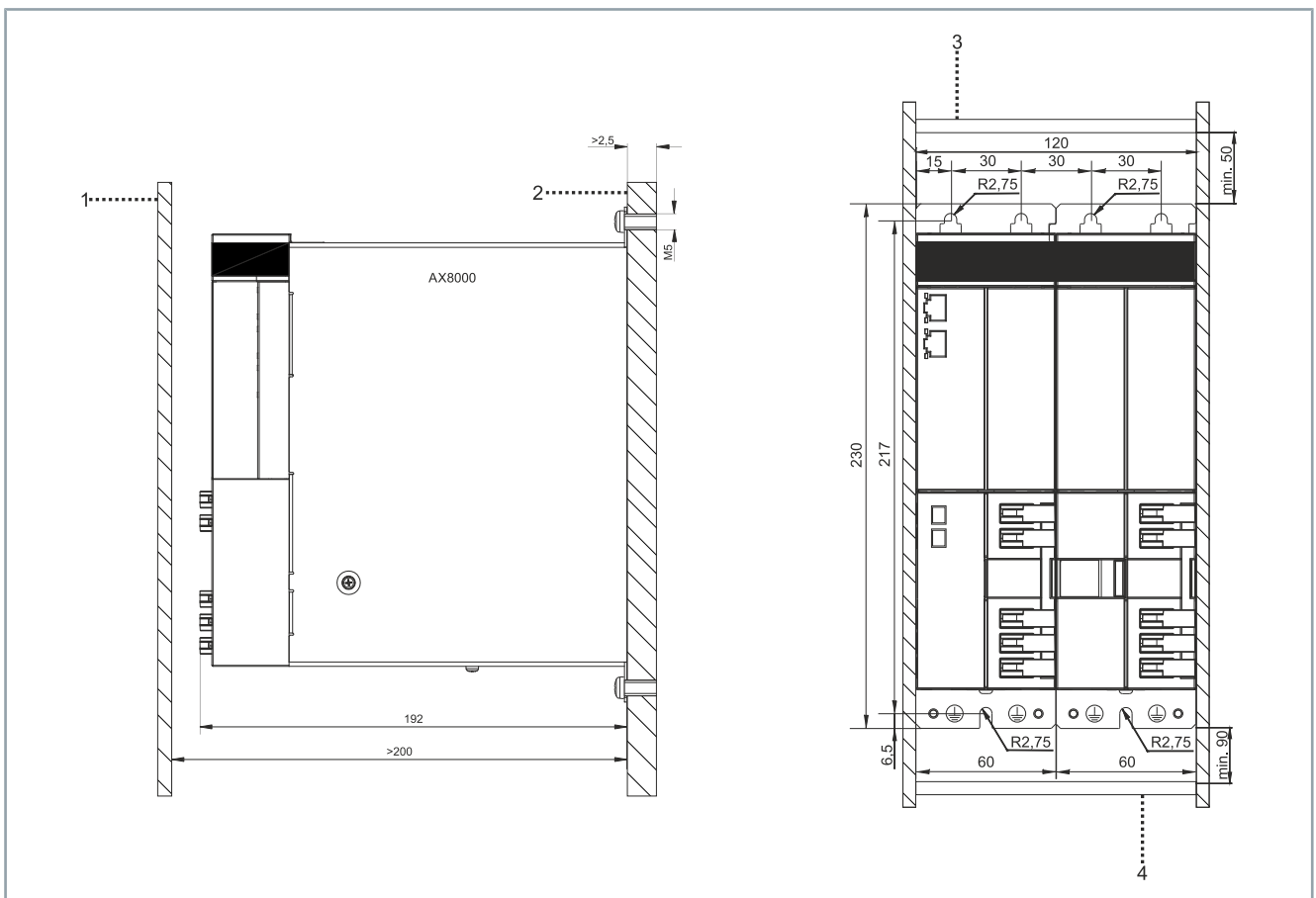
Mount servo drives vertically and with sufficient ventilation

Observe the permissible data for operation and environment as well as the notes in this chapter.

Inadequate ventilation and incorrect installation can lead to damage to the servo drive and its components due to heat development.

Note that when dimensioning the control cabinet you may have to mount input filters, mains chokes and brake resistors for your application. Allow sufficient space in the control cabinet for these components so that cooling air circulation is ensured.

The following illustration contains recommended dimensions that you should observe when mounting the servo drive in the control cabinet:



Number	Explanation
1	Control cabinet door
2	Conductive and galvanized mounting plate
3	Cable duct
4	Cable duct

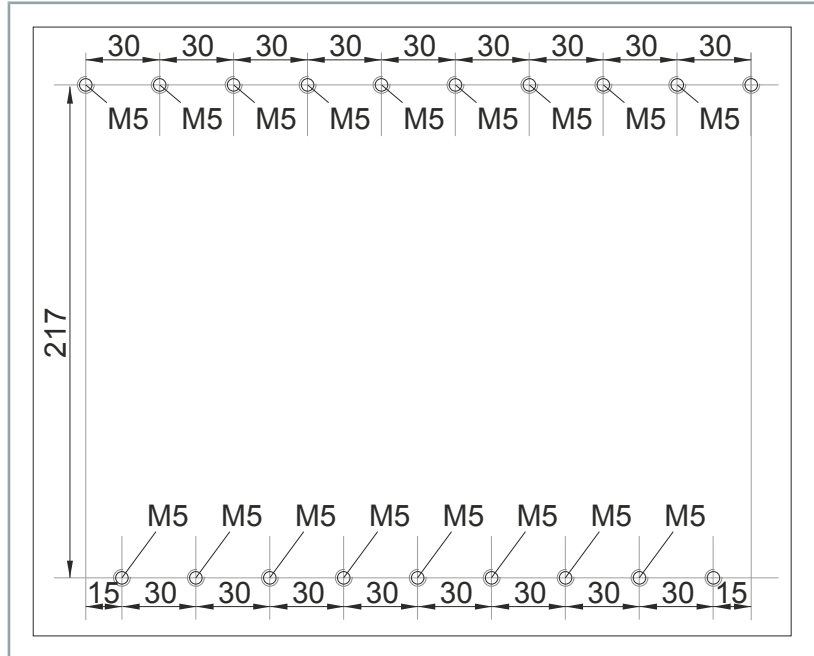
Drilling pattern



Beckhoff universal drilling pattern

You have the possibility – at any time and without having to drill new holes – to change the configuration of the servo drive modules if you provide the mounting plate with the universal drilling pattern.

Information is given in the illustration below on how to make tapped holes in the mounting plate in accordance with the drilling pattern.



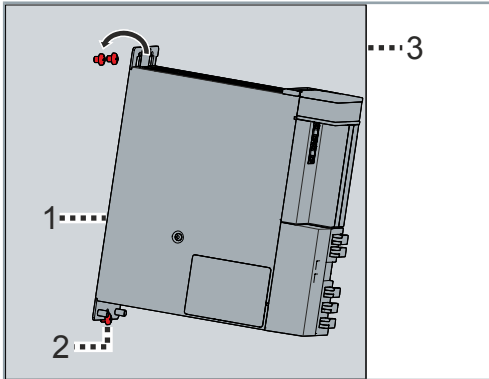
Modules



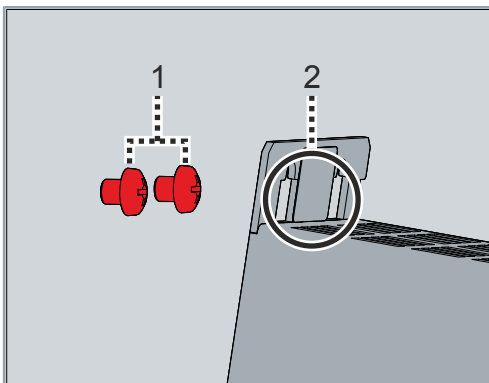
Mounting example

This chapter provides information on the mounting of power supply modules and other modules. A power supply module and other axis modules are bayed as an example.

Power supply modules



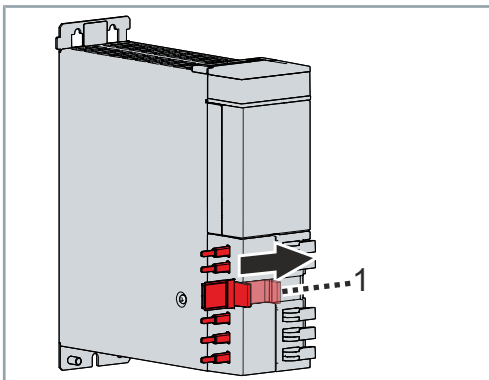
- ▶ Screw screws into the control cabinet mounting plate in accordance with the drilling pattern
- ▶ Place the power supply module 1 onto the screw 2 and carefully press against the mounting plate 3



- ▶ Guide the screws 1 through the rectangular cut-outs in the module housing 2
- ▶ Screw all the screws tight in the elongated holes in the module housing
- ▶ Observe tightening torques:

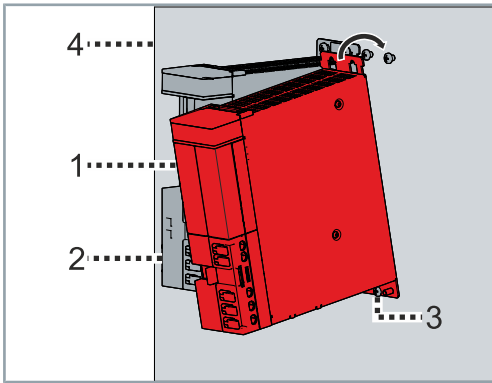
Components	Tightening torque [Nm]
Screws M5 x 5	3

Axis modules and capacitor modules

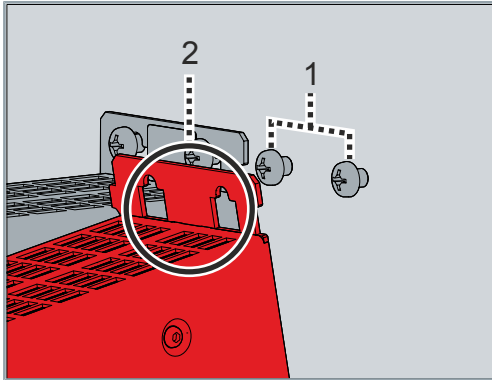


- ▶ On all relevant modules, slide the bar for the AX bridge 1 to the right
- The contacts can then no longer be seen.
- ▶ Screw screws once again into the control cabinet mounting plate in accordance with the drilling pattern

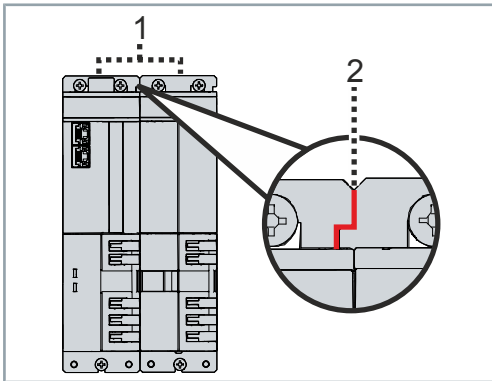
Mechanical Installation



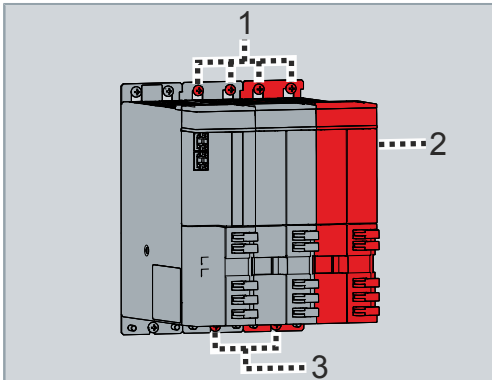
► Place the axis module 1 at the right side of the power supply module 2 onto the screw 3 and carefully press against the mounting plate 4



► Once again, guide the screws 1 through the rectangular cut-outs in the module housing 2



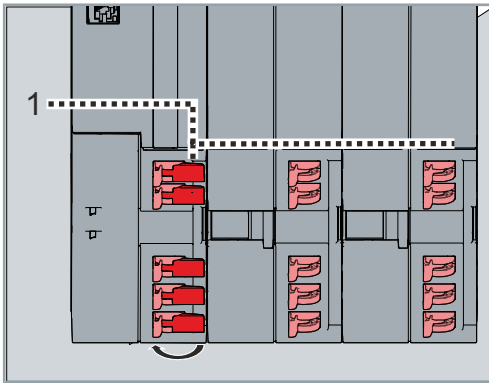
► Make sure that the plates of the rear panel of the module 1 are not lying on top of one another and that the modules are sitting flush in the cut-out 2



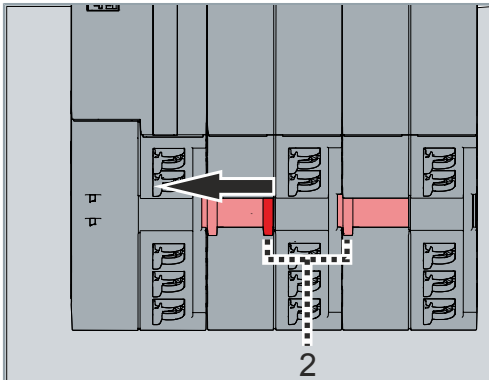
► Bay further modules 2 and screw all remaining screws 1 and 3 tight on the module housings

► Observe tightening torques:

Components	Tightening torque [Nm]
Screws M5 x 5	3



- ▶ On all modules that you wish to connect, open the quick connectors 1 and place them in the 90° position



- ▶ Slide all bars 2 for the AX bridge to the left
 - ▶ Close all quick connectors again
- The modules are now connected to one another.



Avoid contact with DC link DC+ and DC-

Measure the voltage on the DC link test contacts DC+ und DC-. Keep to the waiting times after disconnection from the supply network:

- AX8620 and AX8640; 30 minutes
- AX8108, AX8118 and AX8206; 30 minutes

There is still a life-threatening voltage of $> 875 V_{DC}$ on the capacitors after disconnection from the supply network. Serious or even fatal injuries may result if this is ignored.



Establish a safe connection to the TN-S network

Establish a permanent, optimally conductive connection with all conductive parts that is sufficiently capable of carrying current. The connection is to be established by "protective conductors", [Page 54].

Electromagnetic compatibility

Establish a conductive connection of all components. Ground the shields of the ready-made cables via the mounting plate. Place the star point centrally on the unpainted mounting plate. In the case of larger applications, implement the potential equalization via PE rails.

Improper grounding or faulty contacting can lead to damage to the AX8000 multi-axis servo system or to EMC interference emissions.

The minimum cross-sections of separate protective conductors can be found in EN 61439-1.

Project planning

The project planning is the detailed planning of your drivetrain. Taking into account various views, you can design your drive system with the help of the following information. Please note that this support is only an example.

Energy management

If the supply network is impaired due to high voltage fluctuations, you must consider the specifications of the servo drive and the speed range of the servo motor. Observe the upper limit value of the wide voltage input on the AX8000.

Check whether the lowering of the speed due to lacking voltage is permissible.

With servo motors you can use the field weakening as a remedy. If the supply network does not correspond to the specification for the operation of the servo drive, then isolating transformers, mains chokes, mains filters or other measures must be added.

This system operates in a drive system with a common DC link and a commonly used internal or external brake resistor. In the case of already existing drive systems, you can determine the utilization rate of the brake resistor with the aid of the diagnostic system and transfer the values. The Beckhoff software "TC Motion Designer" is available for energy management purposes.

Control cabinet structure

You must dimension the control cabinet in such a way that you can install all components with the prescribed spacing.

Forced cooling must be used in case of high temperatures. Place the control cabinet as close as possible to the machine. Dimension the motor cables as short as possible. Apart from that, the control cabinet must have a metallic, grounded rear panel, to which the AX8000 and the peripherals are attached. This makes secure grounding possible.

If you cannot satisfy the requirements, you must ground the AX8000 multi-axis servo system and corresponding components using a permissible and adequately dimensioned cable.

Drivetrain

The application, servo drives, motors and gear units must be matched to one another so that sufficient safety is ensured for all components. Mechanical stiffness can occur after a while due to wear.

Make sure that the components in the working area of the system have adequate reserves so that the working life is not impaired and the necessary control quality can be maintained.

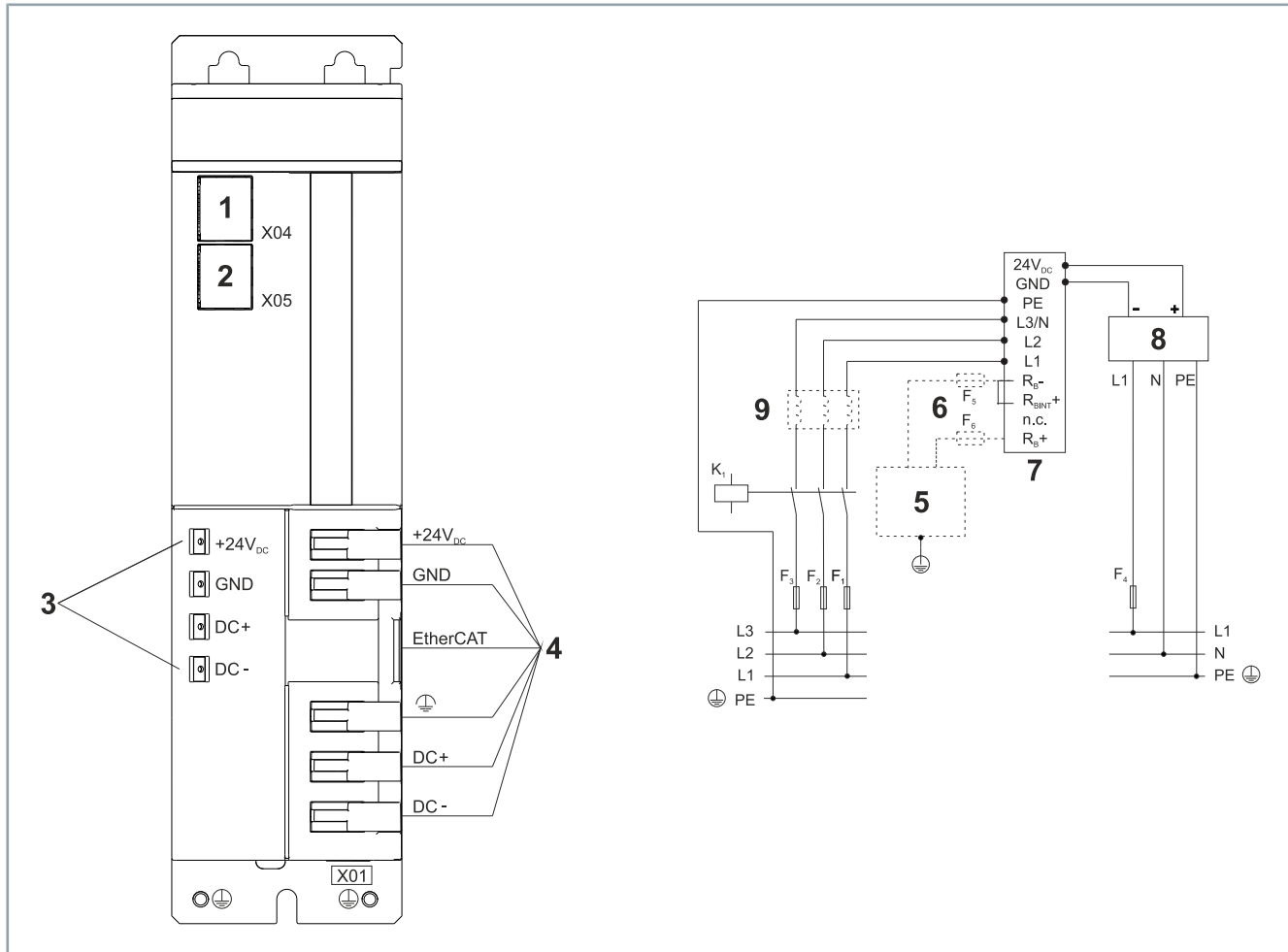
The Beckhoff software "TC Motion Designer" is available for configuration of the drivetrain and selection of suitable components.

Electrical installation

Block diagrams

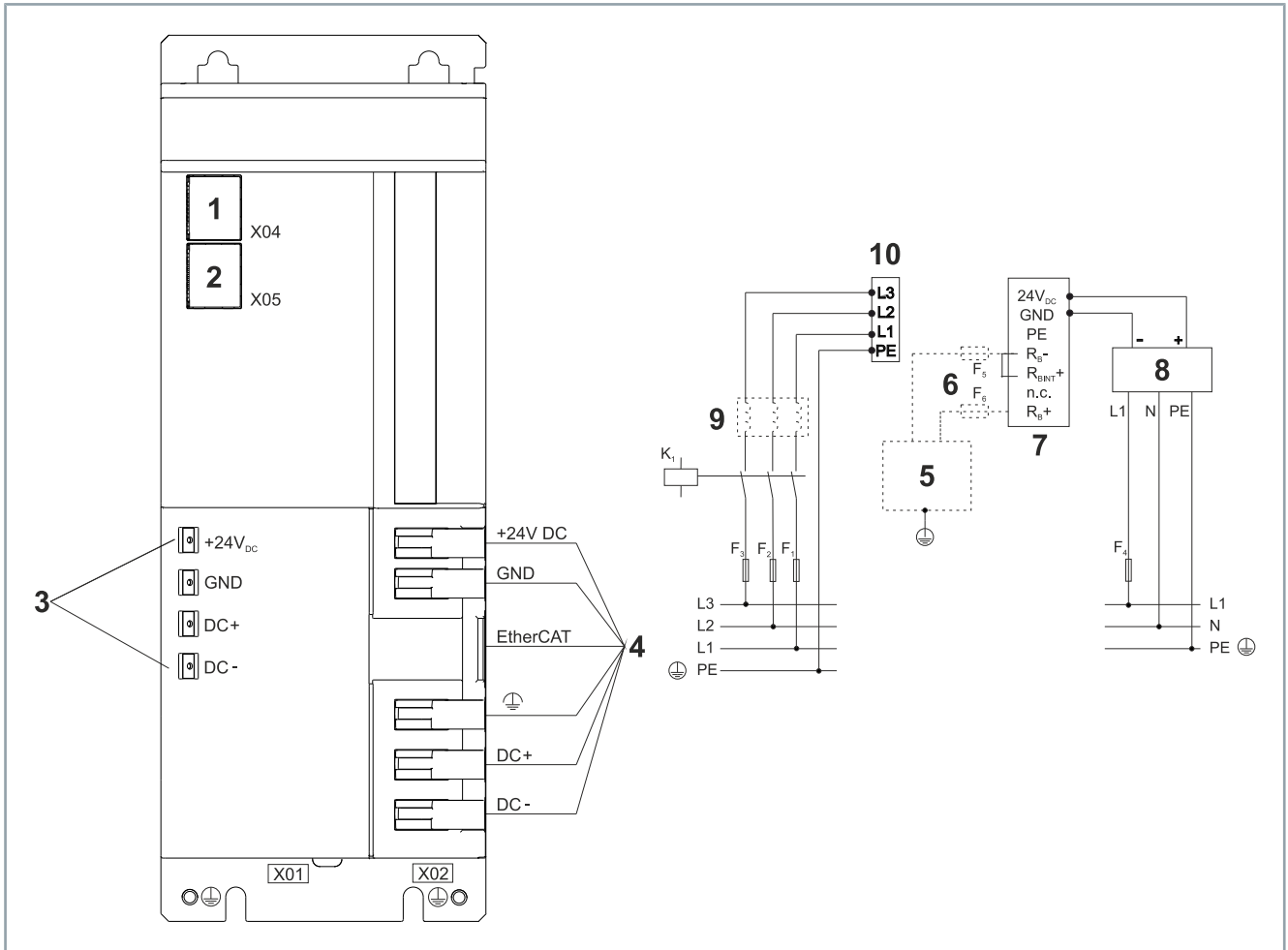
Sample connection scenarios are presented below using schematic connection diagrams for the power supply modules and axis modules.

AX8620



Number	Explanation
1	Connection socket for incoming EtherCAT cable
2	Connection socket for outgoing EtherCAT cable
3	Measuring and test contacts on the devices
4	Quick coupling of the AX8000 multi-axis servo system; AX bridge
5	Optional brake resistor When using an optional brake resistor on the AX8000 multi-axis servo system, the bridge of the 10-pin supply plug "X01" between R_{B-} and R_{Bint} must be removed
6	Fuses F_5 and F_6 for the optional brake resistor If you add the optional brake resistor, the cable must be protected by the fuses F_5 and F_6 .
7	Schematic contacts on the 10-pin supply plug "X01"
8	Power supply unit with 24 V_{DC} supply voltage
9	Optional mains choke

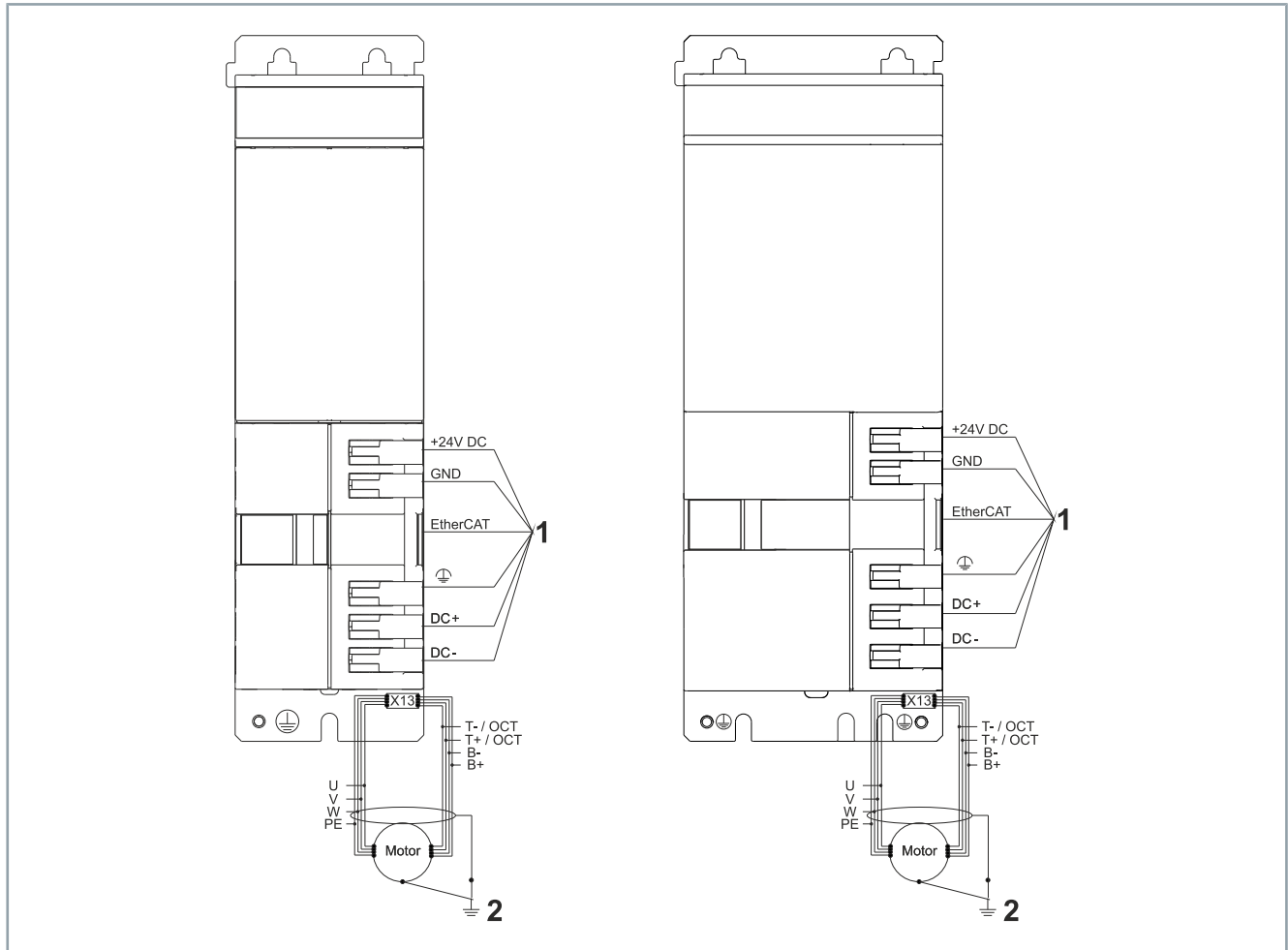
AX8640



Number	Explanation
1	Connection socket for incoming EtherCAT cable
2	Connection socket for outgoing EtherCAT cable
3	Measuring and test contacts on the devices
4	Quick coupling of the AX8000 multi-axis servo system; AX bridge
5	Optional brake resistor When using an optional brake resistor on the AX8000 multi-axis servo system, the bridge of the 10-pin supply plug "X01" between R _B and R _{Bint} must be removed
6	Fuses F5 and F6 for the optional brake resistor If you add the optional brake resistor, the cable must be protected by the fuses F5 and F6.
7	Schematic contacts on the 7-pin supply plug "X02"
8	Power supply unit with 24 V _{DC} supply voltage
9	Optional mains choke
10	Schematic contacts on the 4-pin supply plug "X01"

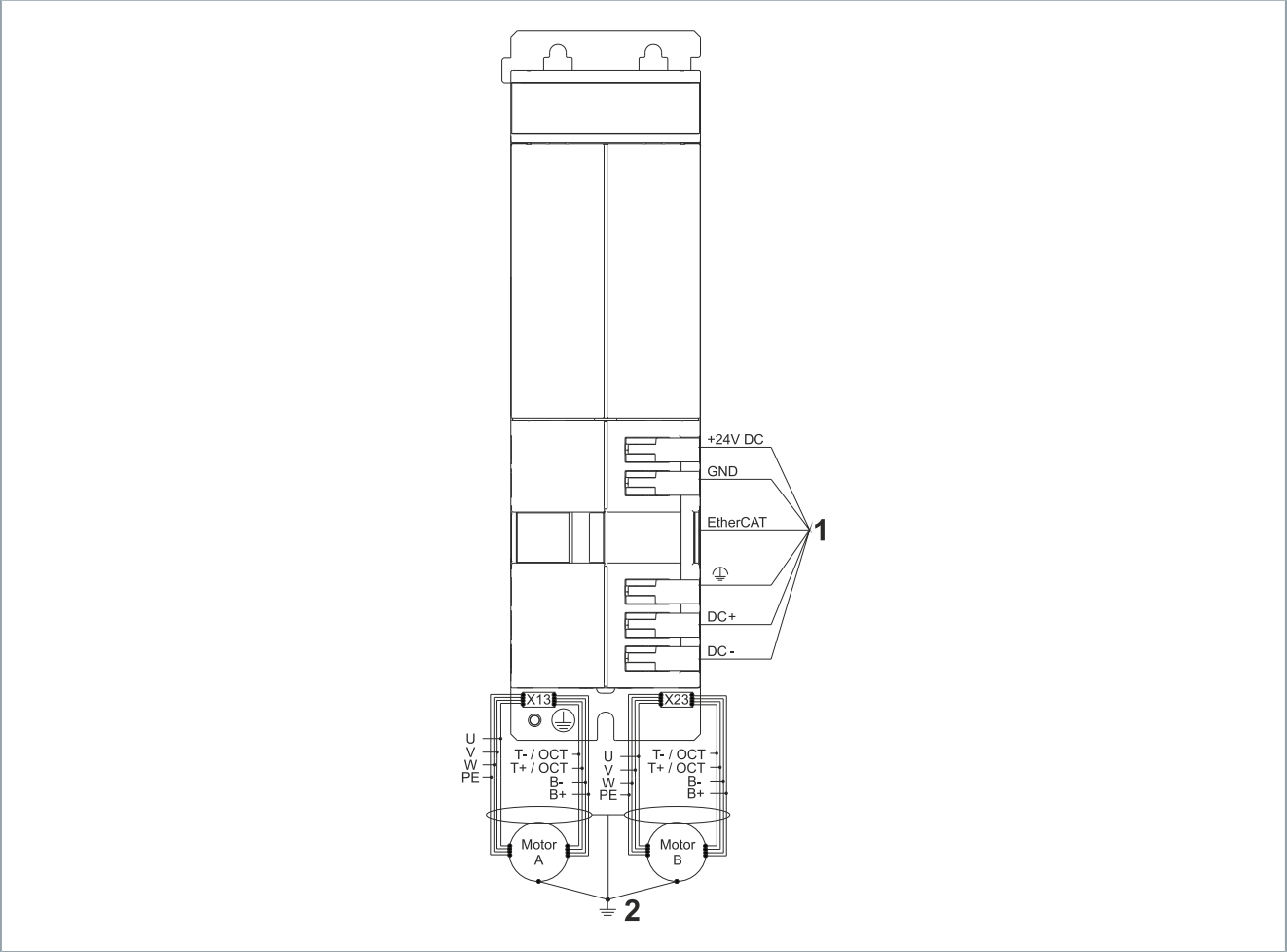
Electrical installation

AX81x8



Number	Explanation
1	Quick coupling of the AX8000 multi-axis servo system; AX bridge
2	ZK4800-80xx-xxxx motor cable; including OCT

AX8206



Number	Explanation
1	Quick coupling of the AX8000 multi-axis servo system; AX bridge
2	ZK4800-80xx-xxxx motor cable; including OCT

Grounding

The ground connection of all relevant components must be made with the largest possible cross-section, with a low impedance, over a wide area and via a short connection to a conductive fastener with a wide area. The shields have to be applied with a sufficiently large contact area on both sides.

The shield of the AX8000 multi-axis servo system is connected via the grounding hangers and hexagonal nuts, similar to DIN 6923 with flange and serrations class 8 with the galvanized surface. These components are included in the scope of supply of the AX8206 or AX81x8 axis module.

Use of components of a higher EMC category

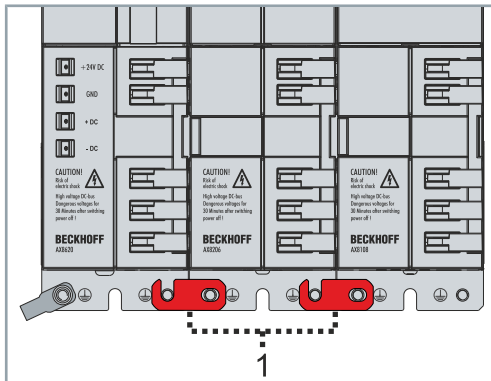
The AX8000 multi-axis servo system conforms to EMC category C3 for industrial areas with respect to conducted interference emissions. If you wish to use components that conform to a higher category, you can limit the conducted interference emissions using additional filters to the extent that the EMC category C2 for residential and industrial areas is complied with.



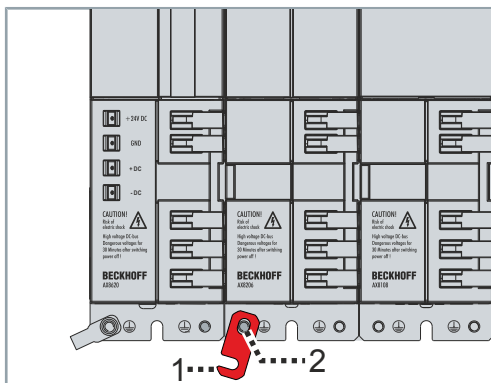
Example drive system

In this chapter, the device connection is shown by the example of a multi-axis drive system consisting of an AX8620 power supply module and two AX8206 and AX8108 axis modules.

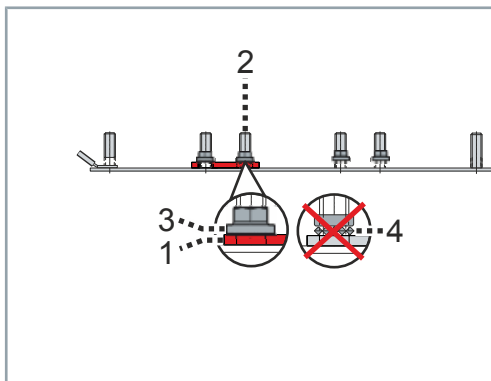
Module connection



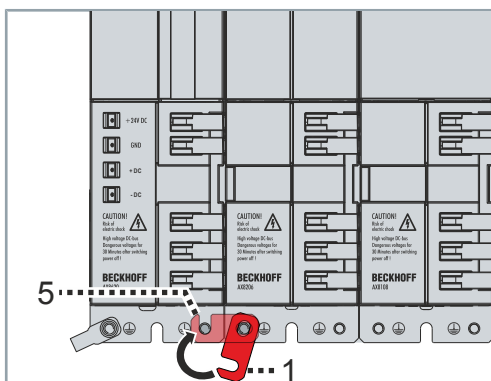
The connection of the individual modules in a drive system takes place via the grounding hangers 1. These are each mechanically locked to the right-hand earthing bolt of the module and swiveled onto the left-hand earthing bolt of the adjacent module, where they are mechanically locked by the nuts and serrations.



- ▶ Push the grounding hanger 1 onto the earthing bolt 2 of the right-hand module
- ▶ Make sure that the opening in the grounding hanger 1 is facing upwards

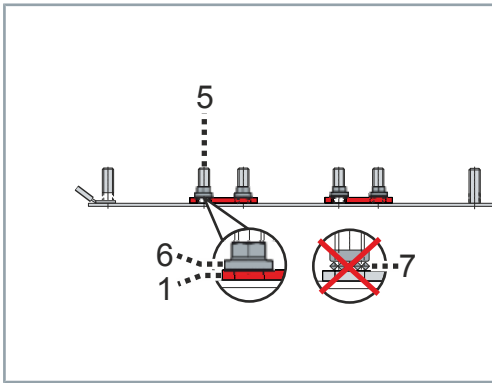


- ▶ Screw the nut 3 onto the earthing bolt 2 on top of the grounding hanger 1
- ▶ Do not use a spring washer 4



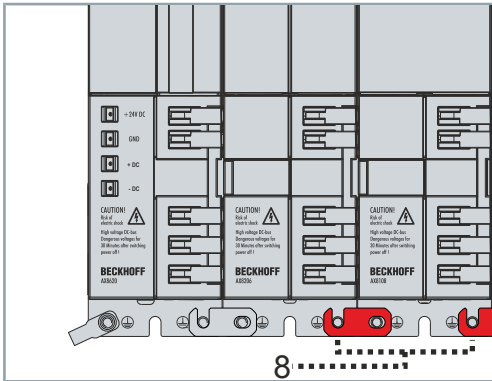
- ▶ Swivel the grounding hanger 1 onto the earthing bolt 5 of the left-hand module

Electrical installation



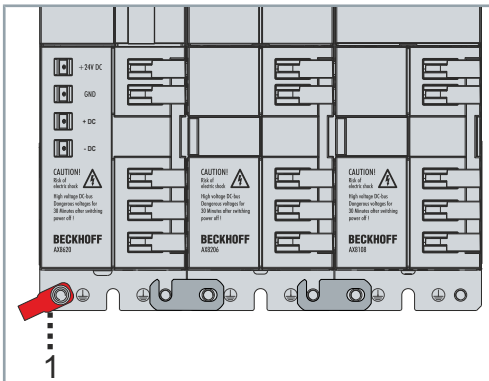
- ▶ Screw the nut 6 onto the earthing bolt 5 on top of the grounding hanger 1
- ▶ Do not use a spring washer 7
- ▶ Tighten both nuts firmly
- ▶ Observe tightening torques:

Components	Tightening torque [Nm]
Hexagonal nut with serration	2.3



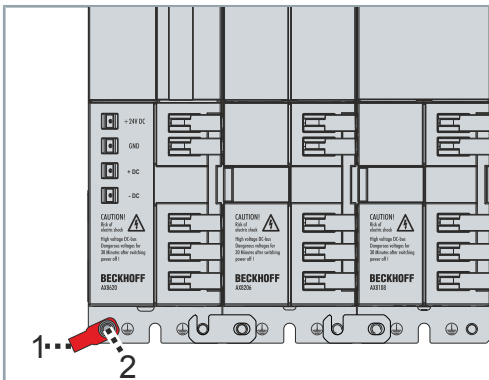
- ▶ Mount further protective conductors 8

Protective earth



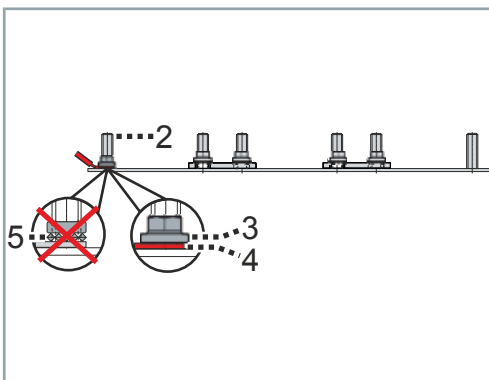
The protective earth is established via the left-hand earthing bolt on the power supply module and the mounting plate on the control cabinet. The connection is made via a cable with a ring-shaped cable lug and spring washer 1. Use a cable with a cross-section of at least 10 mm² for a protective conductor.

Optionally, an additional protective earth can be attached via the right-hand earthing bolt of the last module.



► Make up a cable with a ring-shaped cable lug and a cross-section of at least 10 mm²

► Plug the cable with the cable lug 1 onto the left-hand earthing bolt 2 of the first module in the drive system



► Place nut 3 on the earthing bolt 2 on top of the cable lug 4 and screw it tight

► Do not use a spring washer 5

► Observe tightening torques:

Components	Tightening torque [Nm]
Hexagonal nut with serration	2.3

► Attach the assembled cable properly to the control cabinet mounting plate. Clean the contact surfaces prior to the assembly and ensure that the mounting plate is not painted.

Power supply



Observe the voltage tolerances for safe operation

When connecting servo motors with a holding brake, observe the prescribed voltage tolerances.

Observe the order of connection

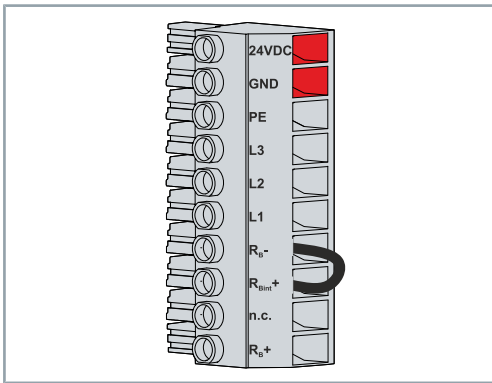
The rated current of the device should decrease from the power supply module onwards. Beckhoff recommends the following order of connection of the modules:

- AX8640 – AX8118 – AX8206 – AX8108

Supply connections for the 24 V_{DC} power supply are available on the power supply modules AX8620, AX8640 and AX85xx.

ZS4800-2001

AX8620

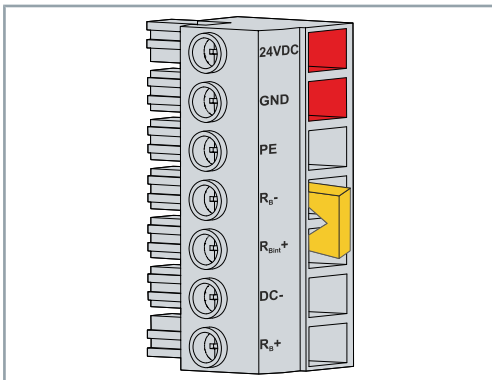


- X01 slot on AX8620 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
24 VDC	24 VDC ± 10% system voltage and peripheral voltage; dependent on the holding brake	Maximum 6 mm ² AWG 8	Screws with tightening torque 0.5 Nm – 0.6 Nm / 4.4 lbf in – 5.3 lbf in
GND	GND		

ZS4800-2042

AX8640



- X02 slot on AX8640 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
24 VDC	24 VDC ± 10% system voltage and peripheral voltage; dependent on the holding brake	Maximum 16 mm ² AWG 6	Screws with tightening torque 1.2 Nm – 1.5 Nm / 10.6 lbf in – 13.3 lbf in
GND	GND		

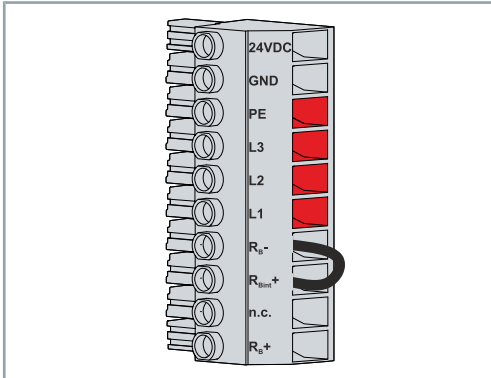
Voltage input



Do not remove the bridge between $R_{\text{Bint}+}$ and $R_{\text{B-}}$. Proper commissioning is only possible if the bridge between the terminal points $R_{\text{Bint}+}$ and $R_{\text{B-}}$ is not removed. Alternatively, an external brake resistor can be connected.
Without this measure the AX8000 multi-axis servo system will be shut down with an error message.

ZS4800-2001

AX8620

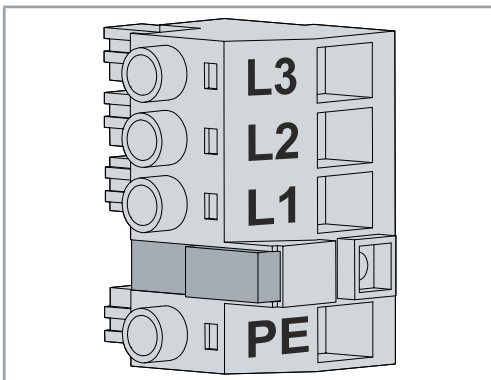


- X01 slot on AX8620 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
PE	Protective conductor	Maximum 6 mm ² AWG 8	Screws with tightening torque 0.5 Nm to 0.6 Nm / 4.4 lbf in to 5.3 lbf in
L3 / N	Phase L3 / N for single-phase supply		
L2	Phase L2		
L1	Phase L1		

ZS4800-2041

AX8640



- X01 slot on AX8640 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
L3 / N	Phase L3	Maximum 16 mm ² AWG 6	Screws with tightening torque 1.2 Nm to 1.5 Nm / 10.6 lbf in to 5.3 lbf in
L2	Phase L2		
L1	Phase L1		
PE	Protective conductor		

Brake chopper



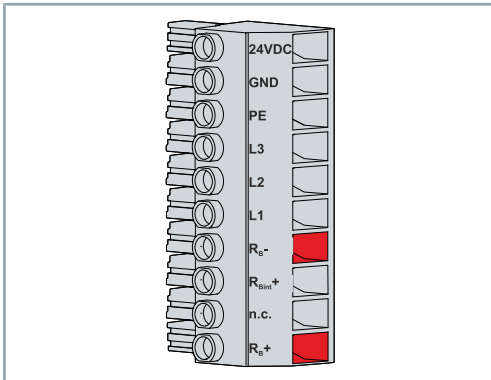
Remove the bridge between contact points R_{B-} and R_{B+}
 Before connecting the external brake resistor, remove the bridge between the contacts R_{B-} and R_{B+} .

Establish the protective earth via the earthing bar
 Connect the protective earth of the external brake resistor to the earthing bar in the control cabinet.

Various outputs are available on the power supply modules AX8620, AX8640 and AX85xx for the connection of an: external brake resistor:

ZS4800-2001

AX8620

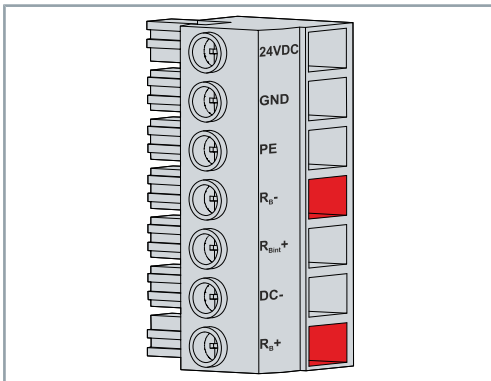


- X01 slot on AX8620 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
R_{B-}	Brake resistor -	Maximum 6 mm ² AWG 8	Screws with tightening torque 0.5 Nm to 0.6 Nm / 4.4 lbf in to 5.3 lbf in
R_{B+}	Brake resistor +		

ZS4800-2042

AX8640



- X02 slot on AX8640 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
R_{B-}	Brake resistor -	Maximum 16 mm ² AWG 6	Screws with tightening torque 1.2 Nm to 1.5 Nm / 10.6 lbf in to 13.3 lbf in
R_{B+}	Brake resistor +		

DC link

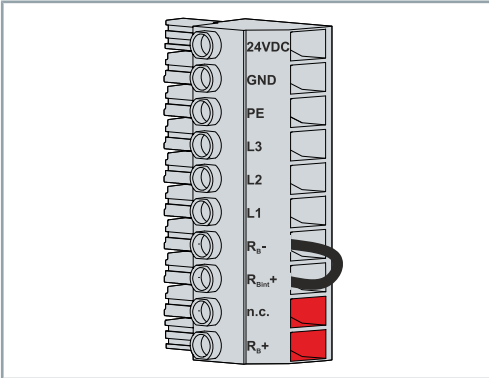


No external DC link group possible

In order to avoid damaging the AX8000 multi-axis servo system, an external DC link group with a servo drive from the AX5000 series is not permissible.

ZS4800-2001

AX8620

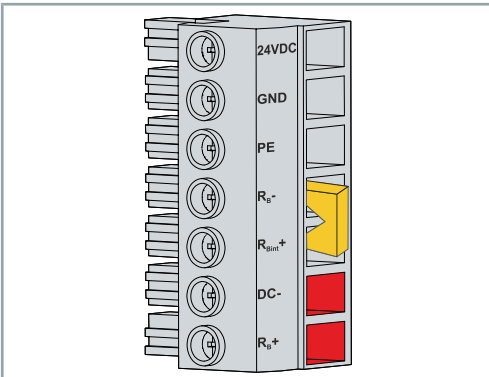


- X01 slot on AX8620 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
n.c.	Not used	Maximum 6 mm ² AWG 8	Screws with tightening torque 0.5 Nm to 0.6 Nm / 4.4 lbf in to 5.3 lbf in
R _{B+}	Brake resistor + DC link potential DC +		

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AX8640



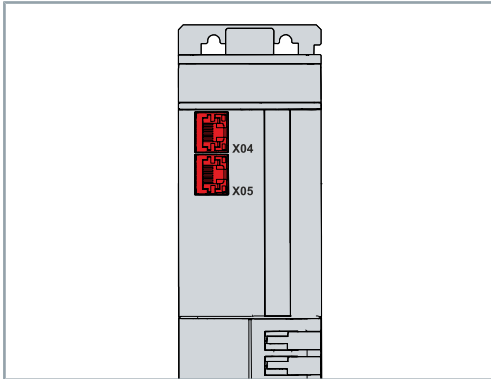
- X02 slot on AX8640 power supply modules

Terminal point	Connection	Wire cross-section	Mounting
DC -	DC link -	Maximum 16 mm ² AWG 6	Screws with tightening torque 1.2 Nm to 1.5 Nm / 10.6 lbf in to 13.3 lbf in
R _{B+}	DC link +		

Fieldbus system

The EtherCAT real-time Ethernet fieldbus is available in the AX8000 multi-axis servo system.

EtherCAT



- X04 slot and X05 slot on power supply modules AX8620, AX8640 and AX85xx

Terminal point	Connection
X04 IN	Incoming EtherCAT line
X05 OUT	Outgoing EtherCAT line

Multi-feedback

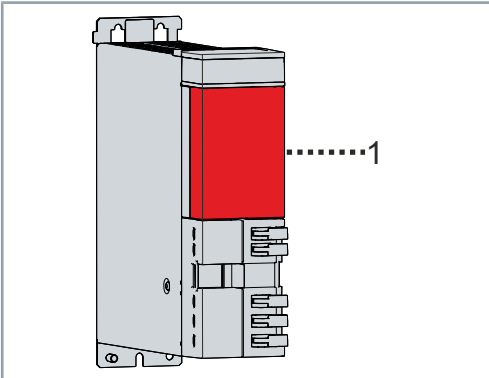
EnDat 2.2 or BiSS C

An optional interface is available for the AX8xxx-0x10 modules.

You have the possibility to use the optional interface EnDat 2.2 or BiSS C in the following cases:

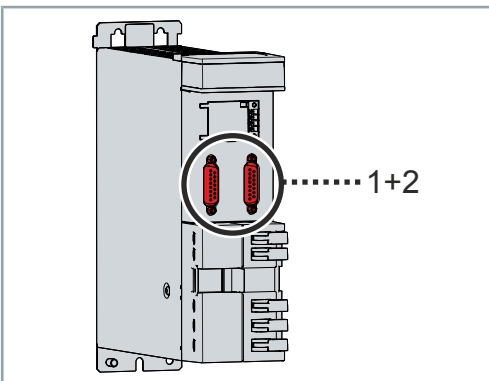
- As a commutation encoder, for example with linear motors
- As an external second feedback for position optimization
- In combination with two feedbacks: EnDat 2.2 or BiSS C

► Remove cover 1



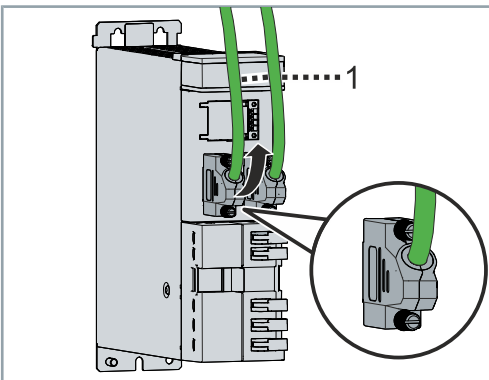
The D-Sub connectors 1 and 2 are exposed.

► Connect feedback



The connectors are angled upwards. If the connectors are connected correctly, the cables can only be guided upwards.

► Guide cable 1 upwards



Cables

The following cable is available for the feedback system EnDat 2.2 / 22 with M12 connection:

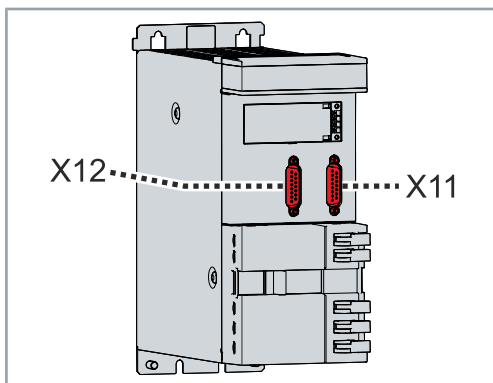
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Electrical installation

Definition of slots

X a b	Explanation
X	Name Slot
a	Channel 1 = channel 1 2 = channel 2
b	Number of the connector 1 = first connector 2 = second connector

AX81xx-0x10

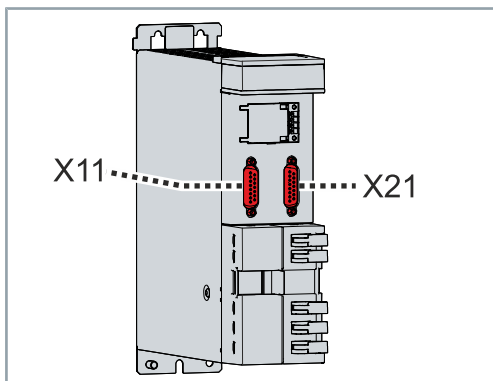


Two D-Sub slots are available for the AX81xx-0x10 single-axis module:

- Right slot X11: Primary connection, e.g. as Commutation encoder for external motors
- Left slot X12: In addition, for example, as secondary feedback

Pin	EnDat 2.2	BISS C
1	n.c.	n.c.
2	GND	GND
3	n.c.	n.c.
4	---	5 V _{DC} ± 10%
5	Data; DX+ Data	Data+ / SLO+
6	Us 11 V _{DC}	---
7	n.c.	n.c.
8	Clock; CLK+	CLK+ / MA+
9	n.c.	n.c.
10	n.c.	n.c.
11	n.c.	n.c.
12	n.c.	n.c.
13	Data; DX-	Data- / SLO-
14	n.c.	n.c.
15	Clock; CLK-	CLK- / MA-

AX82xx-0x10



For the AX82xx-0x10 double axis module, there is one D-Sub slot in each case is available:

- Left slot X11: Assignment to the left axis channel 1
- Right slot X21: Assignment to the right axis channel 2

Pin	EnDat 2.2	BISS C
1	n.c.	n.c.
2	GND	GND
3	n.c.	n.c.
4	---	5 V _{DC} ± 10%
5	Data; DX+	Data+ / SLO+
6	Us 11 V _{DC}	---
7	n.c.	n.c.
8	Clock; CLK+	CLK+ / MA+
9	n.c.	n.c.
10	n.c.	n.c.
11	n.c.	n.c.
12	n.c.	n.c.
13	Data; DX-	Data- / SLO-
14	n.c.	n.c.
15	Clock; CLK-	CLK- / MA-

Motor feedback

For the axis modules AX81xx and AX8206 you need a combined motor connector and feedback connector. The connector is part of the preassembled Beckhoff motor cable.

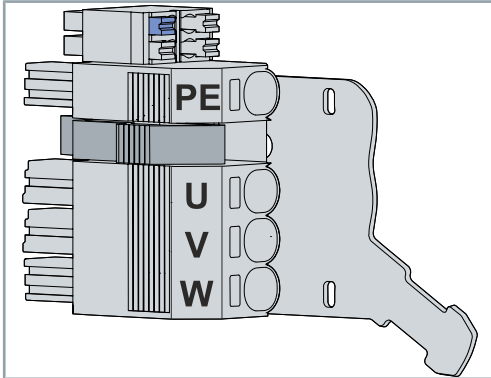
ZS4800-2013



Maximum output current for the motor brake B- and B+:

AX8108 and AX8206 = 1 A
 AX8118 = 2 A

AX81xx and AX8206



- X13 slot and X23 slot on AX81xx and AX8206 axis modules

Terminal point	Connection	Wire cross-section	Mounting
PE	Protective conductor	Maximum 6 mm ² AWG 8	push in
U	Motor connection U		
V	Motor connection V		
W	Motor connection W		
T-	OCT- or temperature -		
T+	OCT+ or temperature +		
B-	Motor brake GND		
B+	Motor brake +		

*Digital: KTY 83-1xx, KTY 84-1xx, KTY 21-6 or PT1000

Digital inputs

ZS4800-2015



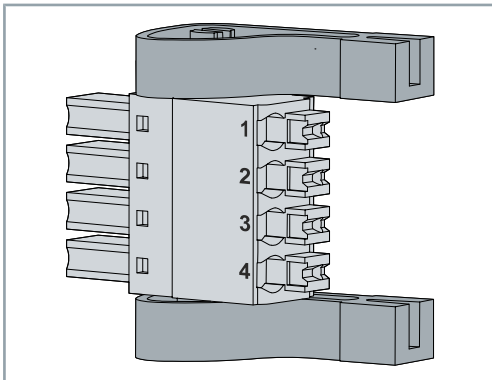
Support for safety functions STO and SS1

Before putting the axis modules with the order designation AX8xx-x1xx into operation, read the documentation for:

- AX8911 TwinSAFE Drive Option

AX8xx-x1xx axis modules support the safety functions STO "Safe Torque Off" and SS1 "Safe Stop 1".

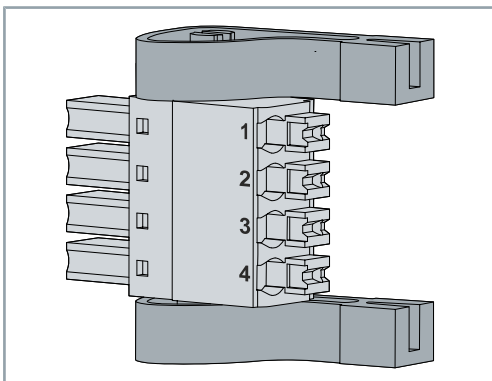
AX8xxx-x1xx and AX8xxx-x2xx



- X15 slot and X25 slot on AX81xx and AX8206 axis modules

Terminal point	Connection	Wire cross-section	Mounting
1	Safety input 1; 20 µs	With ferrule and collar according to DIN 46 228/4 maximum 1 mm ² AWG 17	push in
2	Safety input 2; 20 µs		
3	Input 3; 8 µs		
4	Input 4; 8 µs		

AX8xxx-x0xx



- X15 slot and X25 slot on AX81xx and AX8206 axis modules

Terminal point	Connection	Wire cross-section	Mounting
1	Input 1; 20 µs	With ferrule according to DIN 46 228/1 maximum 1.5 mm ² AWG 16	push in
2	Input 2; 20 µs		
3	Input 3; 8 µs		
4	Input 4; 8 µs		

Supply networks



Use an isolating transformer

Use an isolating transformer with asymmetrically grounded or ungrounded 100 – 480 V networks.

The system will be damaged or destroyed if you do not use an isolating transformer under these circumstances.



EMC law in Europe

In Europe, the AX8000 multi-axis servo system may be operated on an IT network only with an isolating transformer on account of the electromagnetic emission.

Standard

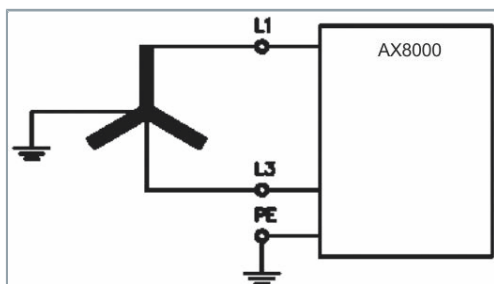
The power supply modules are equipped with a wide-range voltage input X01 and can be connected to the following voltage systems:

- Single-phase 100 V_{AC} to 240 V_{AC}
- Three-phase 200 V_{AC} to 480 V_{AC}

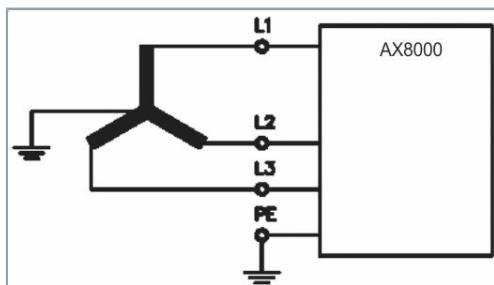


Standard supply network TT/TN

The connection to the standard supply network with grounded center point is described below. Connections to other supply networks like IT or two-wire networks without grounding, necessitate additional measures, such as isolating transformers.



- Single-phase
- 100 V_{AC} to 240 V_{AC} 50/60 Hz



- Three-phase
- 200 V_{AC} to 480 V_{AC} 50/60 Hz

Fuse protection



Observe fuses and data for operation and environment

The servo drives are equipped with integrated self-protection. The recommended fuses are used for line protection. Adhere to the dimensioning according to the prescribed data for operation and environment.

The system may be damaged if this is ignored.

CE conform

Use mains fuses of the operating class "gG(A)" according to IEC60269 or automatic circuit-breakers with the characteristic "C".

External fuse protection

Fuse protection	AX8620	AX8640
Maximum AC supply	25 A	50 A
Maximum 24 V supply	20 A	

Internal fuse protection

Fuse protection	Fuse
24 V – system voltage / peripherals	electronic
Internal brake resistor	electronic

UL-compliant



Circuit breakers are not permitted

Circuit breakers are not permitted for external fusing of the UL network.

Use exclusively the UL mains fuses specified in this chapter.

Fuse holders with UL approval

Before implementing a UL configuration, it is mandatory that you contact your UL certificate authority and discuss the necessary boundary conditions. When using fuse holders, care must be taken that they have also been tested and manufactured in accordance with the applicable standards of the UL certificate authority.

The integrated protection against short circuit is no substitute for the external mains protection. The fusing must comply with the manufacturer's data as well as the national and international regulations and laws.

Use UL mains fuses of the class "J".

With regard to alternatives to the UL fuses of the class "J", be sure to refer to the UL standard "UL 508A, chapter SB4.2.3, exception no. 1".

External fuse protection

Fuse protection	AX8620	AX8640
Maximum AC supply	25 A	50 A
Maximum 24 V supply	20 A	

Internal fuse protection

Fuse protection	Fuse
24 V – system voltage / peripherals	electronic
Internal brake resistor	electronic

Device fusing

The device fusing can be selected according to various methods:

Conservative

Select the fusing in accordance with the maximum device fusing of the corresponding power supply module.

Power supply modules	Fuse
AX8620-0000	Maximum 25 A
AX8640-0000	Maximum 50 A

Application-oriented

Add together the motor currents of all connected servomotors. Multiply the sum by the application-typical simultaneity factor. In the case of a machine tool this is relatively high, e.g. 0.9, because all axes can drive into the material at the same time. In the case of a handling system the factor is more likely to be 0.7.



Example: handling system with three axes:

	X	Y	Z
Servomotor	AM8042-0JH0	AM8031-0DH0	AM8021-0BH1
Current	6.90 A	1.95 A	0.85 A

Total sum current: 9.70 A x simultaneity factor 0.7 = 6.8 A

Selected power supply module: AX8620-0000

Selected fusing: 10 A



Commissioning example

The procedure for commissioning is described as an example. A different method may be appropriate or necessary, depending on the application of the components.

Before commissioning

- Check components for damage
- Check installation and alignment
- Check correct seating of the modules in the control cabinet and on the machine
- Tighten screw connections correctly
- Mount mechanical and electrical protective devices
- Check the wiring, connection and proper earthing

During commissioning

- Make sure that all fittings were checked for function and adjustment
- Observe information for environment and operation
- Check protective measures against moving and live parts

Configuration

Beckhoff recommends the use of the latest TwinCAT version and the TwinCAT Drive Manager 2 for the configuration of new projects.

- Create a new TwinCAT project and select the target system
- Add modules to the I/O devices via the Scan function
- Create a TwinCAT Drive Manager 2 project
- Scan components or manually insert a configuration
- Configure components inserted in the I/O devices
- Check the state and activate TwinCAT

Commissioning

Prerequisites during operation

- Pay attention to atypical noise development
- Pay attention to smoke development
- Always check drive surfaces and cables for dirt, leaks, moisture or dust
- Check temperature development
- Observe recommended maintenance intervals
- Check function of safety devices

After operation



Ensure safe condition of the machine / system

Make sure that all moving parts on the machine come completely to a standstill.

After switching off the power supply, the components of the AX8000 multi-axis servo system may perform uncontrolled movements and cause serious injuries.



Ensure safe condition for cleaning work

Basically, electronic devices are not fail-safe. The condition is always safe when the unit is switched off and not energized. For cleaning work, place the connected servo drives and the machine in a safe state.

Carrying cleaning work during operation can lead to serious or fatal injuries.



Do not immerse or spray the servo drives

Wipe off the servo drives only with a cleaning agent and a cloth.

Cleaning by immersion will destroy the servo drive. Impermissible solutions will damage the servo drives and surfaces.

The components of the AX8000 multi-axis servo system are maintenance-free. However, dirt, dust or swarf can negatively affect the function of the components. In the worst case, contamination can lead to failure. Therefore, clean the components regularly and carefully with a cloth or brush.

Intervals



All modules of the AX8000 multi-axis servo system are maintenance-free

The modules are subject to protection class IP20 and may only be installed and operated in accordance with the "data for operation and environment", [Page 22].

Operation beyond the permissible environmental conditions and operating states will shorten the service life of the components of the AX8000 multi-axis servo system.

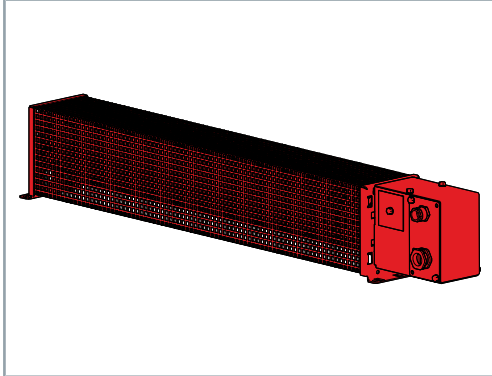
The service life of consumables may be shortened depending on the mechanical dynamics due to mounted devices and movements.



Use accessories with UL approval

Accessories with UL approval are also required for the operation of the AX8000 in the USA or Canada.

Brake resistor



Regenerative energy is converted into heat via the brake resistors of the AX2090-BW80 series when braking a servo motor.

For further information on the brake resistor, read the translation of the original instructions for the brake resistors of the AX2090-BW80-xxxx series.

Disassembly may only be carried out by qualified and trained personnel. For more information please refer to Chapter: "Documentation notes", [Page 5].

When disposing of electronic waste, make sure that you dispose of it in accordance with the regulations applicable in your country. Read and follow the instructions for proper disposal.

Disassembly



Avoid contact with DC link DC+ and DC-

Measure the voltage on the DC link test contacts DC+ und DC-. Keep to the waiting times after disconnection from the supply network:

- AX8620 and AX8640; 30 minutes
- AX8108, AX8118 and AX8206; 30 minutes

There is still a life-threatening voltage of $> 875 V_{DC}$ on the capacitors after disconnection from the supply network. Serious or even fatal injuries may result if this is ignored.



Impermissible removal of servo drive components

Only Beckhoff Automation GmbH & Co. KG is permitted to dismantle the servo drives.

Contact Beckhoff Service for further information.

Removal of the servo drive from the machine

- Remove cables and electrical connections
- Loosen and remove the servo drive fixing screws
- Transport the servo drive to the workplace or put it into storage

Disposal

When you dispose of your servo drive, observe the following instructions for the proper disposal of the components:

Cast iron and metal

Cast and metal parts can be handed over to scrap metal recycling.

Plastics and hard plastics

Plastic and hard plastic parts can be recycled via the waste management center or reused in accordance with the component regulations and labels.

Oils and lubricants

All oils and lubricants used in the machine/plant are to be collected in separate containers and disposed of at used oil collection points.

Disposal by the vendor

In accordance with the WEEE 2012/19/EU Directives we take old devices and accessories back for professional disposal, provided the transport costs are taken over by the sender.

Send the devices with the note "For disposal" to:

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
D-33415 Verl

Alternatively, you can contact a certified specialist disposal company for waste electrical and electronic equipment in your area. Dispose of the old components in accordance with the regulations applicable in your country.

Test procedures and certifications vary by product. Beckhoff products are certified and tested according to the following directives and standards.

Standards

- Generic standard EN 6100-6-2:2005
"Interference immunity for industrial environments"
- Generic standard EN 61000-6-4:2007+A1:2011
"Interference emission standard for industrial environments"
- Product standard EN 61800-3:2004+A1:2012
"Adjustable speed electrical power drive systems. EMC requirements and specific test methods"
- Product standard EN 61800-3:2004+A1:2012
"Adjustable speed electrical power drive systems. Safety requirements"
- RoHS: EN 50581:2012
"Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances"
- Product standard IEC/EN 61800-5-3
"Adjustable speed electrical power drive systems. Part 5-2: Safety requirements for encoders. Functional, electrical and environmental"

Guidelines

- Low Voltage Directive 2014/35/EU
- RoHS Directive 2011/65/EU
- EMC Directive 2014/30/EU



Installation with protective conductor connection

When installing electrical systems and components, the protective conductors must be connected first. They must be disconnected last when uninstalling.

Depending on the magnitude of the leakage currents, observe the following regulations for the implementation of the protective conductor connection:




- Minimum requirement for protective conductor: KU value of 4.5
- Minimum requirement for leakage currents:
 $I_L < 10 \text{ mA}$; $KU = 6$ for $I_L > 10 \text{ mA}$

Value	Explanation
KU	Variable for the classification of safety-related types of failure for protection against dangerous shock current and excessive heating
KU = 4.5	Achieved in relation to interruption: With a permanently attached protective conductor $\geq 1.5 \text{ mm}^2$ With a protective conductor connection of $\geq 2.5 \text{ mm}^2$ via a plug connector for industrial plants according to IEC 60309-2
KU = 6	Achieved in relation to interruption: With permanently connected conductors $\geq 10 \text{ mm}^2$; type of connection and laying must conform to the applicable standards for PE cables

Electrical isolation

The power section, consisting of motor connection, DC link connection and mains connection, as well as the control unit are to be double-insulated against each other. This guarantees secure shock protection on all terminals in the control unit, even without further measures. The air gaps and creepage distances conform to EN 50178 / VDE 0160.

Test centers

	<p>The AX8000 multi-axis servo system does not fall within the area of applicability of the Machinery Directive. However, Beckhoff products are designed and evaluated in full compliance with all relevant regulations for personal safety and use in a machine or system.</p>
	<p>The AX8000 multi-axis servo system meets all requirements of the Eurasian Economic Union. These include Russia, Belarus, Armenia, Kazakhstan and Kyrgyzstan. The EAC logo can be found on the name plate.</p>
	<p>The AX8000 multi-axis servo system meets the requirements according to UL and is certified as a cURus component for the USA and Canadian markets in accordance with the standards applicable in the USA and Canada. The cURus logo can be found on the name plate.</p>

EU conformity



Placing at disposal

Beckhoff Automation GmbH & Co KG will be pleased to provide you with EU declarations of conformity and manufacturer's declarations for all products on request.

Please send your request to: info@beckhoff.com

UL certification

The modules may be used as components in a system with a UL-Listing test mark.

USA and Canada



The English translation is binding

Note that all statements made in this chapter on UL certification are binding only in the English version.

The German version of this chapter is purely informative.

A UL certificate is necessary for the operation of the AX8000 multi-axis servo system in the economic area of the USA or Canada. The devices have been certified according to the standards of the UL test laboratory and are permitted to bear the cULus logo on the name plate. The test number is: E195162.

Canada



Approval in Canada only with transient suppression

In Canada the devices are only approved with a transient suppression on the input side.

The technical requirements are:

- Three-phase networks with 240 V and 480 V, as well as three-wire systems and four-wire systems with 480 Y / 277 V
- Overload category = 3
- Protection against a rated surge voltage peak of 4 kV

Specifications

- Components from the AX8000 multi-axis servo system may be used in an environment with non-conductive dirt. This corresponds to the degree of soiling 2. Note that occasionally, depending on the environmental conditions, temporary conductivity can be expected due to condensation.
- The wiring must be done using copper conductors with a thermal conductivity of at least 60 to 75 °C.
- The AX8000 multi-axis servo system does not offer an overheating sensor for the connected motor.
- You have the option to operate motors of various sizes. You can adjust the level of the internal overload protection of the motor.

System group



Note the configuration example of a system group

The configuration example shows a possible system group with UL approval. Prior to implementing a machine or plant, it is mandatory to consult the responsible UL certificate authority. Observe the current directives and standards when using fuse holders. These must conform to the UL certificate authority's standards and must be tested on the basis of same.

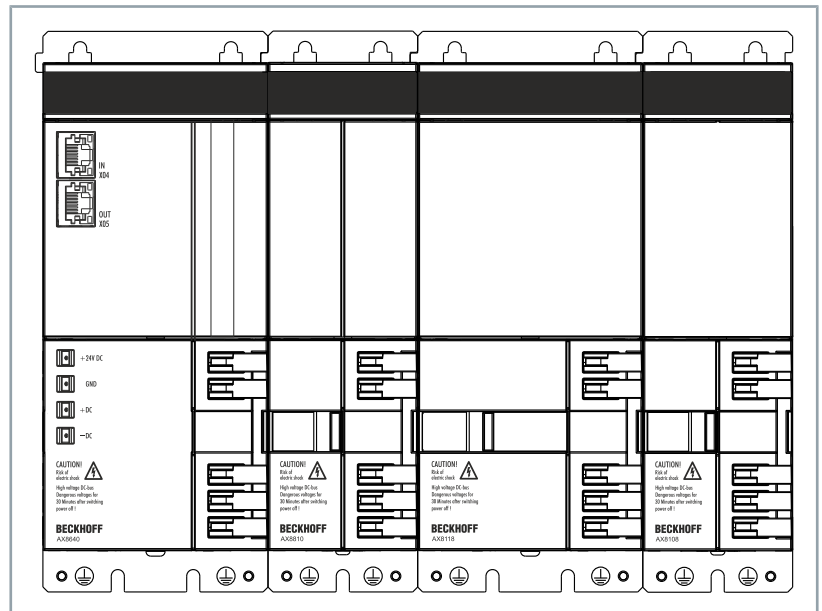
Use tested fuses of the class "J"

Please note that the tested system group of the AX8000 multi-axis servo system has been "protected", [Page 69] with a current-limiting circuit breaker of class "J" with 50 A.

A higher class has not been tested and is therefore impermissible for a system group.



Example of the design of the current-limiting circuit breakers in the system group



Rated output current of the axis modules is 18 A for AX8118-0000 and 8 A for AX8108-0000 = 26 A

Total rated output current = 26 A

The system group must have a 26 A fuse.

Select the next larger standard step according to UL 508A, Tab. SB4.2. This corresponds to the class "J" with 40 A.

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