KeDrive

D3-DA 3xx/x
Axis module
Project engineering manual V 1.07

Translation of the original manual

KEBA
Automation by innovation.

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1 Introduction

1.1 Purpose of the document

This document describes the structure of the axis module D3-DA 3xx/x.

Information

This manual is not addressed to end customers! Necessary safety notes for the end customer have to be taken into the customer manual in the respective national language by the machine builders and system providers.

1.2 Preconditions

This document contains information for persons with the following skills:

Target group	Prerequisite knowledge and abilities
Safety engineer for "Functional Safety"	Basic technical training (technical college, engineer training or corresponding professional experience). Knowledge about: ● principles of functional safety, ● relevant standards and safety regulations for the machine/system, particularly knowledge about validation according to EN ISO 13849-2, ● special risk potential of the machine/system and the production process, ● specific protective measures to avert machine-specific hazards (based on hazard and risk analysis), ● functioning and application limits of the safety components (including safety PLC), ● in-depth knowledge of national accident prevention regulations.
Project engineer	Basic technical training (technical college, engineer training or corresponding professional experience). Knowledge about: ● current valid safety regulations, ● fundamental validation concepts according to EN ISO 13849, ● method of operation of a PLC, ● the application.

Target group	Prerequisite knowledge and abilities
Electrician	Professional training in electrical engineering (based on industry- standard training guidelines). Knowledge about: ● current valid safety regulations, ● wiring guidelines, ● circuit diagrams, ● professional installation of electrical connections.
Programmer	Basic technical training (technical college, engineer training or corresponding professional experience). Knowledge about: ● current valid safety regulations, ● method of operation of a PLC, ● programming of an safety PLC.
Start-up operator	Basic technical training (technical college, engineer training or corresponding professional experience). Knowledge about: ● current valid safety regulations, ● fundamental validation concepts according to EN ISO 13849, ● the method of operation of the machine or system, ● fundamental functions of the application, system analysis and troubleshooting, ● setting options on the operating devices.
Service technician	Basic technical training (technical college, engineer training or corresponding professional experience). Knowledge about: ● Method of operation of a PLC, ● current valid safety regulations, ● fundamental validation concepts according to EN ISO 13849, ● method of operation of the machine or system, ● diagnostic options, ● systematic fault analysis and remedial action.

1.3 Intended use

The D3-DA 3xx/x is intended for installation in stationary electrical systems or machines and was developed for controlling of drives.

The D3-DA 3xx/x may only be used for the types of use described in the technical descriptions and in compliance with described technical general conditions. The D3-DA 3xx/x may only be used in conjunction with recommended/ approved third-party equipment/installations.

The D3-DA 3xx/x has been developed, manufactured, tested and documented in accordance with the appropriate directives and standards. Therefore, the products do not pose any danger to the health of persons or a risk of damage to other property or equipment under normal circumstances, provided that the instructions and safety precautions are properly observed.

The intended use also includes the attention of the notes and informations described in this document.

The D3-DA 3xx/x provides safety functions. For more information see "Safety functions".

For safety relevant control tasks in combination with axis module D3-DA 3xx/x it is recommended to use the control module D3-DU 3xx/x in the variant D3-DU 3x5/x.

Caution

Also take care of the information in the safety manual "Functional safety" provided by KEBA.

Information

The compliance of EMC directives can only be assumed under attention of chapter "CE Certification" as well as the information of cahpter "Connection and wiring", also the cable and additional components are used as specified in chapter "Connection technology" and the correct dimensioning of the mains filter is done.

1.4 Notes on this document

This manual is an integral part of the product. It is to be retained over the entire life cycle of the product and should be forwarded to any subsequent owners or users of the product. For end user necessary safety information and information must be integrated in the instruction manual for end users in the specific national language by the engine builder or the system provider.

This documentation must be legible and available to the specified persons and must be read and understood from them.

Information

This manual also applies to identically constructed and functionally identical customer variants of the D3-DA 3xx/x.

Because of the fact that customer variants may differ in their appearance (e.g. with a different front cover) from the KEBA standard variant, the pictured devices used in this manual may differ in their appearance from the devices used by you.

1.4.1 Content of this document

- Description of the module
- Mounting and installation instructions
- Description of interfaces including EMC directives
- Diagnostics functions
- Maintenance
- Technical data

1.4.2 Not contained in this document

- Programming instruction
- Application diagnosis
- Firmware description
- General functional safety information
- Examples for safety applications

1.5 Documentation for further reading

Depending on the using system solution the following documents are to be observed:

Doc.No.	Name	Target group
	System manual	• Project engineer • Electrician • Programmer • Start-up operator • Service technician

Doc.No.	Name	Target group
DE: 1008535 EN: 1008536	KEBA - Functional safety safety manual	• Safety engineer for "functional safety" • Project engineer • Electrician • Programmer • Start-up operator • Service technician
DE: 1008773 EN: 1008774	KeDrive Firmware for drive control devices	• Electrician • Programmer • Start-up operator • Service technician
Onlinehelp	DriveManager	• Programmer • Start-up operator • Service technician
DE: 1008643 EN: 1008666	D3-DP 3xx/x Project engineering manual	• Project engineer • Electrician • Start-up operator • Service technician

Information

This project engineering manual exclusively describes the D3-DA 3xx/x. You can find information about further components in the respective project engineering manual.

1.6 EtherCAT declaration

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

2 Safety notes

2.1 Representation

At various points in this manual, you will see notes and precautionary warnings regarding possible hazards. The symbols used have the following meaning:

DANGER!

indicates an imminently hazardous situation, which will result in death or serious bodily injury if the corresponding precautions are not taken.

WARNING!

indicates a potentially hazardous situation, which can result in death or serious bodily injury if the corresponding precautions are not taken.

CAUTION!

means that if the corresponding safety measures are not taken, a potentially hazardous situation can occur that may result in slight bodily injury.

Caution

means that damage to property can occur if the corresponding safety measures are not taken.

ESD

This symbol reminds you of the possible consequences of touching electrostatically sensitive components.

Safety information

Describes important safety-related requirements or informs about essential safety-related coherences.

Information

Identifies practical tips and useful information. No information that warns about potentially dangerous or harmful functions is contained.

2.2 General safety instructions

WARNING!

Safety and operating instructions for drive converters (acc. to: Low voltage directive 2014/35/EU):

- During operation, drive power converters can, in accordance with their degree of protection, have life, bare, possibly even moving or rotating parts, as well as hot surfaces.
- Inadvertently removing the necessary covering, inappropriate use, incorrect installation or operation causes the risk of severe personal injuries, material damage or even fatal injuries.
- Further information can be found in the product documentation. Commissioning is not permitted if the product documentation is missing. In this case you should immediately ask for a new product documentation.
- Commissioning is only permitted for persons, who understand the language of the enclosed product documentation.
- All work concerning transportation, installation and commissioning as well as repair and maintenance must only be carried out by qualified expert personnel.

WARNING!

- It is absolutely essential that you also observe the safety instructions in the system manual and the "Functional safety" manual for your automation system.
- The following application areas are expressly excluded for the D3-DA 3xx/x without completing a special evaluation relating to the application and implementing the necessary measures in the installation relating to the operating conditions:
  - Use in areas where there is a risk of explosion or fire
  - Use in the mining sector
  - Use in outdoor areas
  - Use in wet rooms or rooms with the risk of splashing water
  - Use in environments with heavily polluted air
  - Use in environments with harmful solutions, steams or radiations
  - Use in non-stationary applications
  - Usage in environments with constant vibrations
  - Direct use on a DC motor
- The module is defined as "open type equipment" (UL 508) or as "open equipment" (EN 61131-2) and must therefore be installed in a control cabinet.
- The D3-DA 3xx/x contains safety-relevant functions (e.g. STO). For safety-relevant control tasks and personnel security a control of KEBA in the variant D3-DU 3x5/x with correspondent safety related peripheral devices must be used. Details can be found in the safety manual "Functional safety".
- At the developement of the D3-DU 3x0/x the standard EN ISO 13849-1 or other standards for description of the functional safety were not considered.

WARNING!

Danger of personal injury due to loss of security!

Correct operation and safety of damaged components cannot be guaranteed. Damaged products must never be installed or put into operation. Defective products must be replaced immediately.

Caution

Improper use of the assembly or the control system leads to irreparable damage!

- Turn off the power supply before inserting or removing the module. Otherwise, the module can be destroyed or undefined signal states can lead to damage of the control system.
- If there are further power supply units in the system, they must also be turned off, to ensure that no electrical voltages are present at the inputs (and possibly the relay outputs) of the safety control.

KEBA shall assume no liability or warranty for consequential losses, which may arise of:

- Disregard of directives and standards
- Illegal changes
- Improper use
- Disregard of instructions in this document

Information

If information about potentially dangerous incidents of the machine or system is obtained in the course of product monitoring obligation, which could be related to products delivered by KEBA, report these promptly to KEBA.

Furthermore, it is asked to send all safety-oriented products that have failed due to a defect for purposes of analysis to KEBA, even if they are considered as non-repairable.

2.3 Safety instructions for personal safety

WARNING!

Danger of personal injury due to electric shock

- Cut-off control from all power supplies during installation and service. If the D3-DA 3xx/x is supplied by a D3-DP 3xx/x whose both supply terminals (Line IN and Line IN Aux) must be separated from power (e.g. via switching a joint main switch mechanism).
- If the D3-DA 3xx/x is supplied by a D3-DP 3xx/x 3 minutes have to be waited after switching-off due to dangerous residual voltage at the d.c. link. Afterwards the absence of voltage has to be verified. Only then the supply rails and the remaining covers may be opened.
- Protective low voltage circuits must always be installed safely insulated separated from circuits with dangerous voltage.

WARNING!

Dangerous voltage may be applied to the device, even if the device does not emit any visual or audible signals/indications!

CAUTION!

Protection against magnetic and/or electromagnetic fields during installation and operation!

Persons fitted with heart pacemakers, metallic implants and hearing aids etc. must not be allowed access to the following areas:

- Areas where drive systems are installed, repaired and operated.
- Areas where motors are installed, repaired and operated. Motors with permanent magnets pose a particular hazard.

If it is necessary to access such areas, suitability to do so must be determined beforehand by a doctor.

2.4 Safety instructions for device maintenance

WARNING!

- If this device is damaged, the device must be taken out of commission and repaired or replaced by trained specialized personnel.
- The device must only be opened by trained specialized personnel. They must only carry out maintenance work that is explicitly permitted by KEBA (see chapter "Maintenance").

Any other manipulations to the device will result in loss of warranty.

2.5 ESD information

Electronic component are generally put at risk by electro-static discharges (**E**lectro **S**tatic **D**ischarge). An electro-static charge can occur during any activity involving movement. ESD can occur with any touch.

Most discharges are so low that they are not noticeable. However, they can nevertheless put unprotected electronic components at risk or even destroy them. Therefore, any handling with open electronics is only permissible with the application of effective ESD protection.

When handling **open** electronics, please follow the following ESD measures:

- Only touch open electronics if this is absolutely necessary.
- Wear a conductive ESD wristband.
- Use conductive mats.
- Establish a conductive connection between device/system, mat, wristband, and grounding connection.
- Cotton work clothes are preferred over synthetic fiber materials.
- Keep work area free of highly isolating materials (e.g. Styrofoam, plastics, nylon, ...).
- Use ESD protection even for defective modules.

Generally avoid, for modules which are mounted in an enclosure, direct contact with any accessible electronic components, such as non-equipped terminals.

3 Description of module

The D3-DA 3xx/x is an axis module and is available in different performance ranges and variants.

3.1 Front view

The following graphic shows the full expansion of each size, depending on variant less interfaces can be on the module.

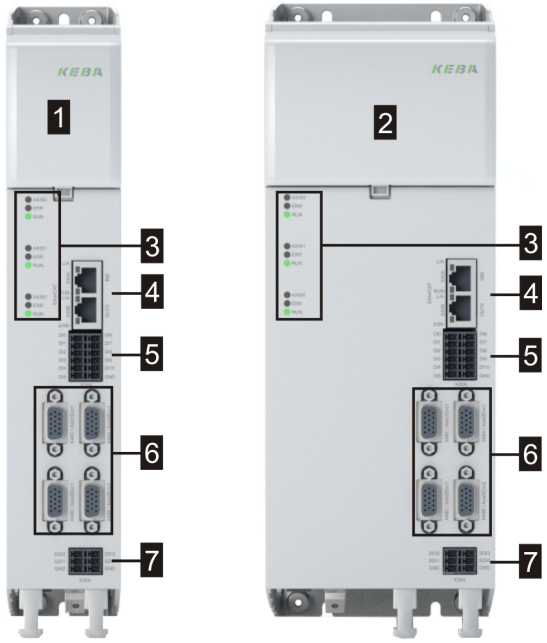


Fig. 3-1: Front side D3-DA 3xx/x

1 ... D3-DA 3xx/x size 1	2 ... D3-DA 3xx/x size 2
3 ... Status-LEDs of axis	4 ... EtherCAT interface
5 ... Digital inputs	6 ... Encoder interface
7 ... Digital inputs safety function	

3.2 Bottom view

The following graphic shows the full expansion of each size, depending on variant less interfaces can be on the module.

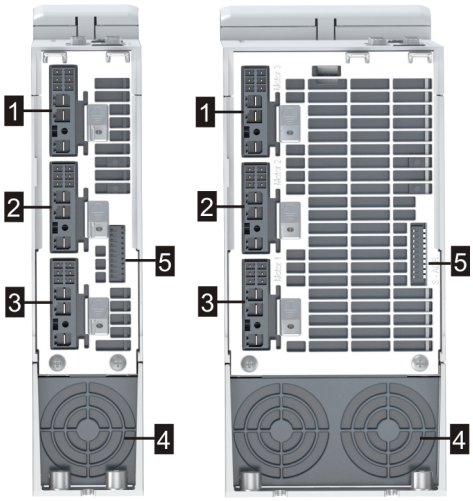


Fig. 3-2: Bottom side D3-DA 3xx/x

1 ... Motor cable 3	2 ... Motor cable 2
3 ... Motor cable 1	4 ... Fan
5 ... DIP switch S-ADR	

3.3 Type plate

The D3-DA 3xx/x has two type plates, one on the left side of the module and one on the top side of cover flap.

Type plate on left side of module

Fig. 3-3: Type plate 1

1 ... Manufacturer and manufacturer address	2 ... Product group
3 ... Material name	4 ... Technical data
5 ... Material number/revision number	6 ... Serial number
7 ... Country of origin	

Type plate on cover flap

The type plate on the cover flap is different depending on variant.

Variant with heat sink

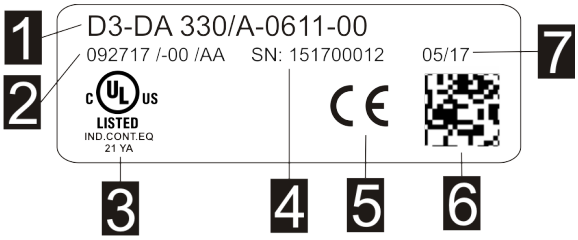


Fig. 3-4: Type plate 2

1 ... Material name	2 ... Material number/revision number
3 ... cURus marking	4 ... Serial number
5 ... CE marking of convormity	6 ... Data matrics code
7 ... Production date (month/year)	

Variant with cold plate

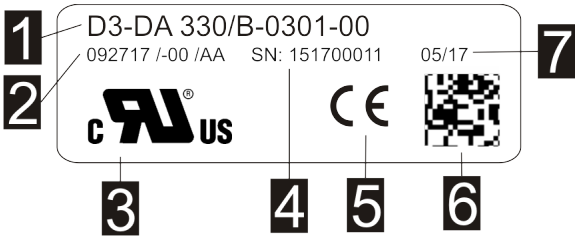


Fig. 3-5: Typenschild 2

1 ... Material name	2 ... Material number/revision number
3 ... cURus marking	4 ... Serial number
5 ... CE marking of convormity	6 ... Data matrics code
7 ... Production date (month/year)	

3.4 Overview D3-DA 3xx/x variants

Example:	DA 3	**1**	**0**	/	**A**	-	**01**	**0**	**0**	-	**00**

Products and series	DA 3										
Axis		**x**									
Single axis		1									
Double axis		2									

Tripple axis		3								
Power supply			**x**							
DC			0							
Cooling					**x**					
Cooling element					A					
Cold plate					B					
Continuous current							**x**			
1.5 A							01			
...							...			
32 A							32			
Encoder interface								**x**		
None								0		
Multi encoder interface								1		
Hiperface DSL								2		
Safety functions									**x**	
None									0	
STO + SBC									1	
Version										**x**
without limitation of output frequency										00
maximum output frequency < 600 Hz										20

Classification, number of axis, rated current and size

Axis module with ...	Size 1 Rated current $I_{nenn, eff}$[A]					Size 2 Rated current $I_{nenn, eff}$[A]			
1 axis	1,5 A	3 A	6 A	12 A	18 A	-	-	24 A	32
2 axis	2 x 1,5 A	2 x 3 A	2 x 6 A	-	-	2 x 12 A	2 x 16 A	-	-
3 axis	3 x 1,5 A	3 x 3 A	3 x 6 A	-	-	3 x 12 A	-	-	-

3.5 Accessories

3.5.1 Connector set

Caution

Only compatible mating connectors that are approved by KEBA must be used.

The technical data for the terminals are contained in the technical data sheet of the manufacturer of the female connectors.

Connector set	Connector set suitable for	Order number KEBA.
D3-XT 230/A	For control cable X25/A, X26/A	94801
D3-XT 231/A	Motor connector X31/x	94503 *)

*) The connector set fits for single axis module. For double axis or tripple axis the connector set must ordered proportionally.

4 Displays and operating elements

4.1 Status LEDs of the axis

Depending on the design of the axis module (single-axis module, double-axis module, triple-axis module) up to 3 times 3 LEDs are provided as status indicators. The LEDs are on the front of the device and are assigned to axis 1 to axis 3 from top to bottom. The significance of the LEDs is the same for each axis and is as follows:

Fig. 4-6: Status LEDs

Axis 1(2,3) ... Indication of which axis is accessed via the display on the control module assembly	ERR ... Error indication using flashing code
RUN ... Ready / power stage active	

4.2 EtherCAT LEDs (RJ45)

At the EtherCAT connectors are the following LEDs.

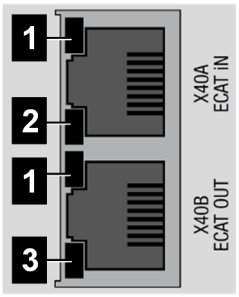


Fig. 4-7: EtherCAT connections (X40A / X40B)

1 ... Link/Acitivty LED	2 ... RUN LED
3 ... ERR LED	

Link/Activity LED

Indication	Meaning
Dark	No connection
Green flashing	Transmission of data

Indication	Meaning
Green	EtherCAT connection established (100 MBit/s, Full Duplex)

RUN LED

Indication	Meaning
Dark	No voltage supply or indication of the EtherCAT operating state INIT
Green flashing (slow)	Indication of the EtherCAT operating state PRE-OPERATIONAL
Green flashing	Indication of the EtherCAT operating state SAFE-OPERATIONAL
Green flashing (fast)	Indication of the EtherCAT operating state BOOTSTRAP
Green	Indication of the EtherCAT operating state OPERATIONAL

ERR LED

Indication	Meaning
Dark	No EtherCAT error
Red flashing	Indication of an EtherCAT error according to "ETG.1300 EtherCAT Indicator and Labeling Specification" (Table "ERR Indicator States")

5 Mounting and installation instructions

During the installation it is imperative to avoid

- Drill chippings, screws or foreign bodies dropping into the device
- Moisture entering the device

WARNING!

Dangerous voltage may be applied to the device, even if the device does not emit any visual or audible signals/indications!

WARNING!

Electric drives are dangerous:

- Dangerously high voltages ≥ 50 V (capacitor charge) may still be present up to 3 minutes after the power is cut. Before mounting installation and service check that electrical power is not present at electric circuits!
- Pay attention to warning sign on the device (see front of device).

Information

For installing the axis module within a system, also note the project manuals of the control module and the supply module.

Control cabinet

The module is designed only for installation in an stationary control cabinet. The control cabinet must be conform with IP code IP44. By usage of safety functions of the axis module or of D3-DU 3x5/x the control cabinet must be conform with protection class IP54 or higher according to EN ISO 13849-2.

Environment

The D3-DA 3xx/x must not be installed in areas where they are exposed to continuous vibration. (See 12.6 Ambient conditions).

Pollution

Max. pollution severity 2 to EN 606641. (See 12.6 Ambient conditions).

Adding and orientation

The modules must be mounted side by side directly without distance. Connecting power supply connects the modules (see chapter "Connection of supply voltages via busbars").

The modules must be added in the specified order side by side. Any other order is not permitted, otherwise problems with busbars and reciprocal thermal influcence are occured.

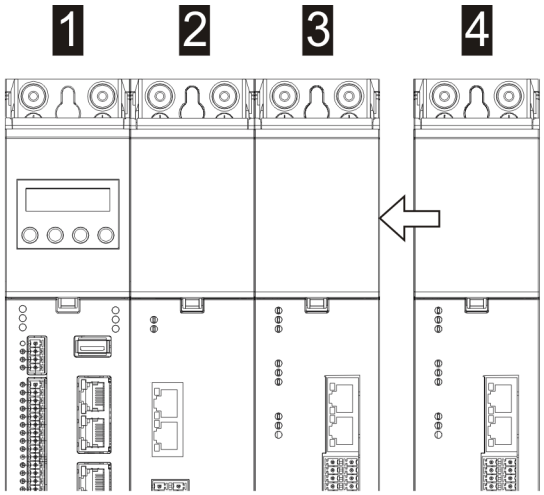


Fig. 5-8: Mounting order

1 ... D3-DU 3xx/x control module	2 ... D3-DP 3xx/x supply module
3 ... D3-DA 3xx/x axis module	4 ... Further D3-DA 3xx/x axis module

Information

The supply module must always be mounted on the left side of the axis module.

Caution

Protection of hot surfaces during operation. On the back side of the module temperature up to 85 °C can occur. Make sure sufficient space to modules nearby, especially over the cooling element.

CAUTION!

Hot surfaces during operation - touching may cause to burns.

Take care of an appropriate contact protection.

Caution

Condensation of humidity in the device

- Do not subject the device to high humidity for a longer period of time.
- If cold equipment is brought into a significantly warmer environment (e.g. after a longer transport in a cold environment), condensation moisture may form in the device.
  Before connecting the device to the power supply, you must wait until the device temperature is the same as the room temperature and the moisture has evaporated again.

5.1 EMC requirements

The essential EMC measures are already implemented in the design of the devices in the form of optimised housing shielding, printed circuit board lay-out, filter measures and selection of suitable connectors with shield plate. In addition to the internal measures, the following installation measures are to be noted:

- To obtain the best result for effective EMC installation you should use a well conductive mounting plate, which is well-earthed due to safety reasons.
- By mounting plates which are varnished, remove the coating from the contact area! The devices themselves have a chromated zinc frame.
- Use shielded cables: In capt. "Connection technology" are all cables listet, which are available at KEBA. It is recommended to use this cables, because all EMC tests were executed with this cables and so they are tested accordingly.

- EtherCAT connection between control module, supply module and axis modules: The supply package of axis- and supply modules also contains EtherCAT connection cables, which enable connection to the left communication partner. The order designations for longer RT-Ethernetcables are listed in the appendix.
- Provide additional shield contact for RT-Ethernet.

5.1.1 Requirements to the connectors

The following connections are available in the system:

- RT-Ethernet (RJ45) connectors
- Encoder connections
- Connections for motor
- Connections brake resistor
- Connections power supply
- Voltage equalizing cable

RT-Ethernet (RJ45) connectors

If an (RT-)Ethernet cable is led outside of the cabinet, the isolation of the cable must be opened after the RJ45 plug and the cable shield must be contacted on a suitable section with designated straps (lower end of the front plate) again. The following (RT-)Ethernet connectors can be affected:

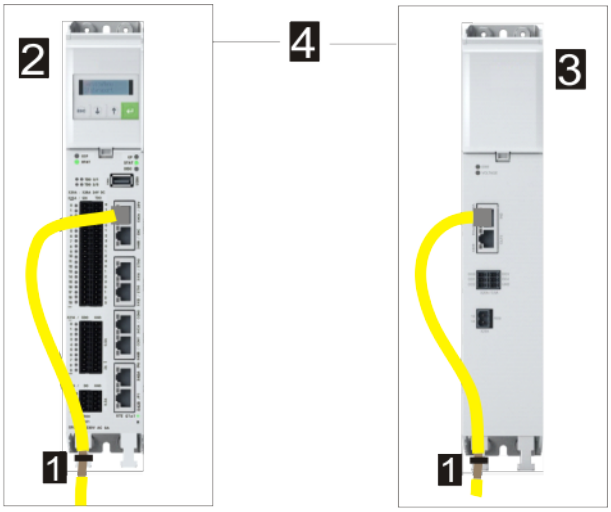


Fig. 5-9: Cable shield

1 ... Cable shield with shield clamp	2 ... Control module
3 ... Supply module	4 ... Cabinet

Encoder connectors

All encoder cables must be shielded. All available cables from KEBA are listed in the appendix. For connecting third-party motors, equivalent cables must be used.

Connectors for the motor

All motor cables must be shielded. All available cables from KEBA are listed in the appendix. For connecting third-party motors, equivalent cables must be used.

Connector break resistor

The cables to the break resistor must be shielded and connected to the respective casing on both sides. The shield connection on the supply module (plug "BR") occurs via the shield plate of the included plug. The break resistor is normally installed in a metal casing. If the break resistor is mounted on a metallic and conductive base plate, it is possible to manufacture the shield connection on the side of the the break resistor with a shield clamp on the base plate, as close as possible to the break resistor. All available break resistors from KEBA are listed in the appendix.

Supply connectors

The supply connector X01A (Line IN) of the supply module must have an appropriate filter. Appropriate filters are listed in the appendix. For demensioning on the one hand supply current and on the other hand the sum of the length of the motor cables are decisive. A shielded cable must be used between the connector Line IN and the filter. The shield connection on the supply module occurs via the shield plate on the plug. The connection plug is part of the supply package of the supply module. The mains filter needs an appropriate shield connection to the metal casing of the mains filter. This is achieved if the mains filter is mounted on a metallic and conductive base plate and if the cable shield is connected to the base plate via a shield clamp as close as possible to the connector "load" of the mains filter or is connected with the included screw-shield-connection clip on the mains filter.

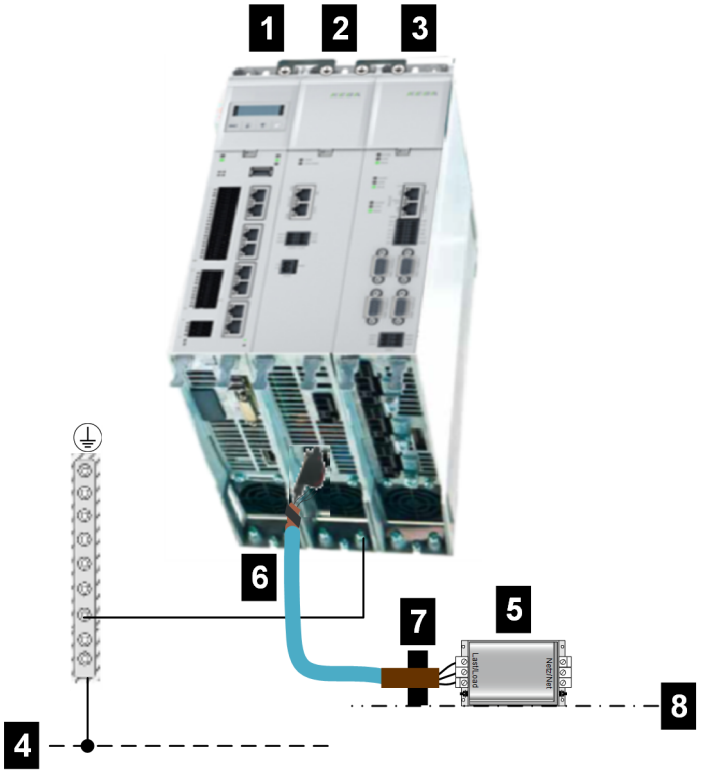


Fig. 5-10: Connector mains filter

1 ... Control module	2 ... Supply module
3 ... Axis module	4 ... Earth potential
5 ... Mains filter	6 ... X01A (Line IN) connector
7 ... Cable shield with shield clamp	8 ... Grounded metallic base plate

Equipotential bounding lines

If the cabinet is not mounted directly on the machine or severals metres away from the machine, it is recommended to install a equipotential bounding line parallel to the cables, which are lead from the cabinet to the machine. The reason for this is, that because of switching processes and indirect lightning strikes low-frequency high compensating currents can be created, which may be too high for shieldings and especially for the shield connectors and can so damage the shield connection.

5.2 Space requirements

Caution

The minimum clearance above and below (130 mm and 150 mm or 200 mm) stated in the figure applies to all devices. The clearance above is important to prevent the build-up of heat, the clearance underneath to permit correct cable laying.

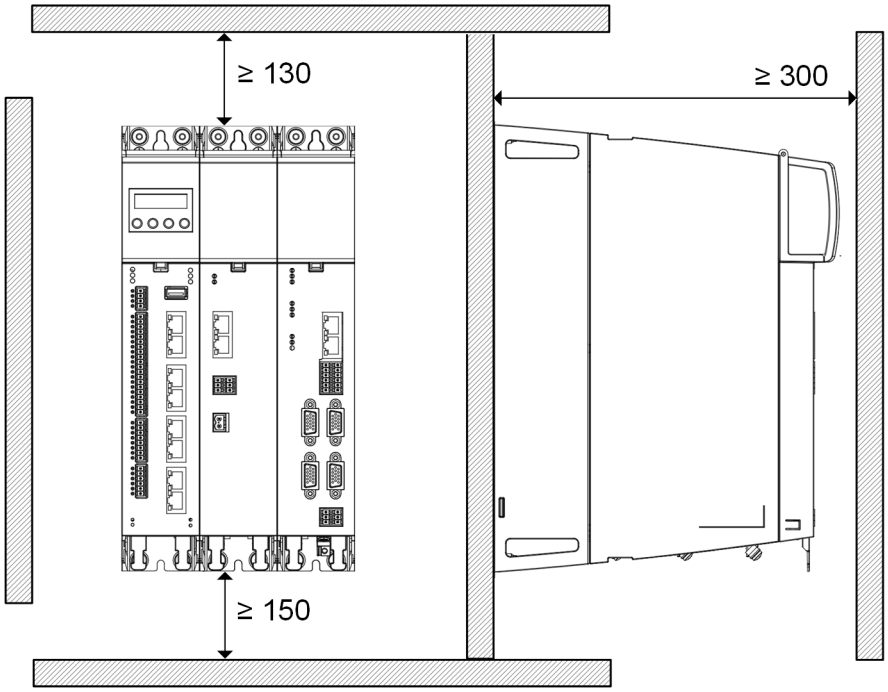


Fig. 5-11: Mounting clearances (in mm)

The bend radius of the connecting cables must be taken into account. (Up to 3 x 10 mm^2 ca. 48 - 98 mm depending on the cable version.)

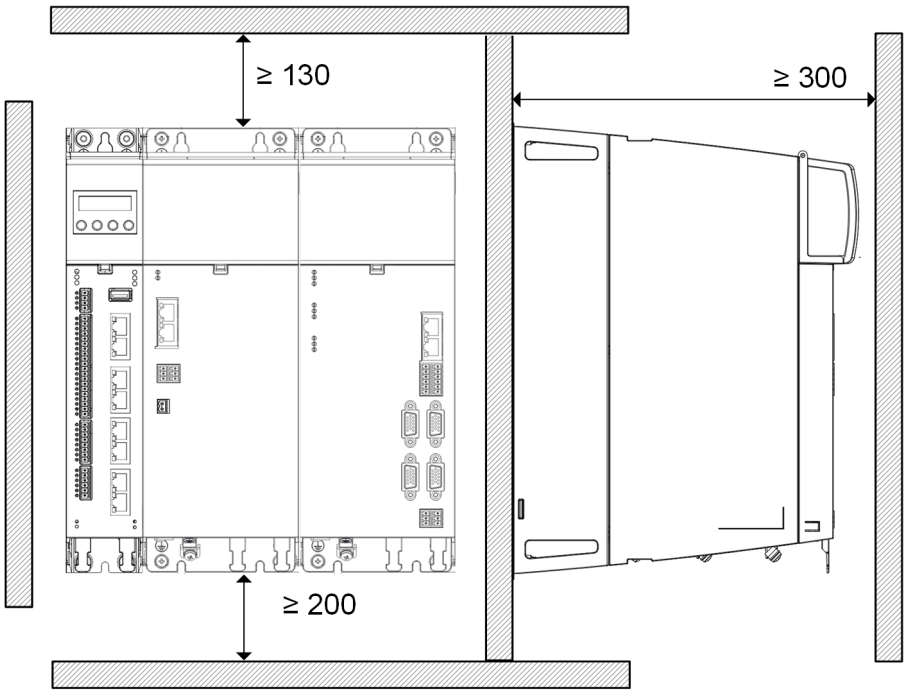


Fig. 5-12: Mounting clearances (in mm)

The bend radius of the connecting cables must be taken into account. (Up to 3 x 16 mm^2 ca. 150 - 200 mm depending on the cable version.)

KeDrive D3 example (with control module with safety functionality and with supply module)

Example with one axis module size 1 (BG1)

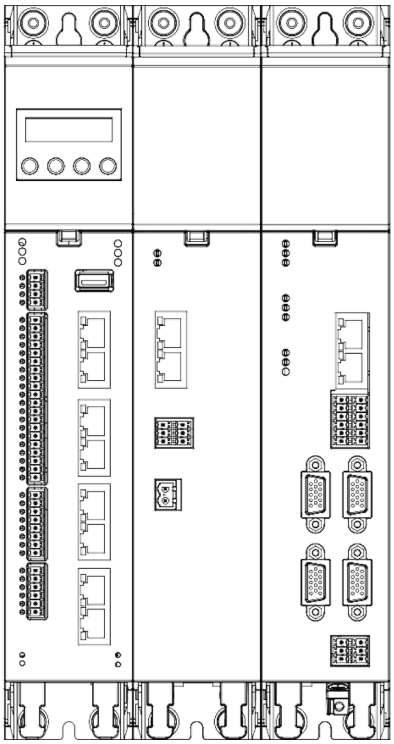


Fig. 5-13: Dimension with size 1

Dimensions

Height:	310 mm
Width:	165 mm
Depth:	241 mm

Example with one axis module size 1 (BG1) and size 2 (BG2) each

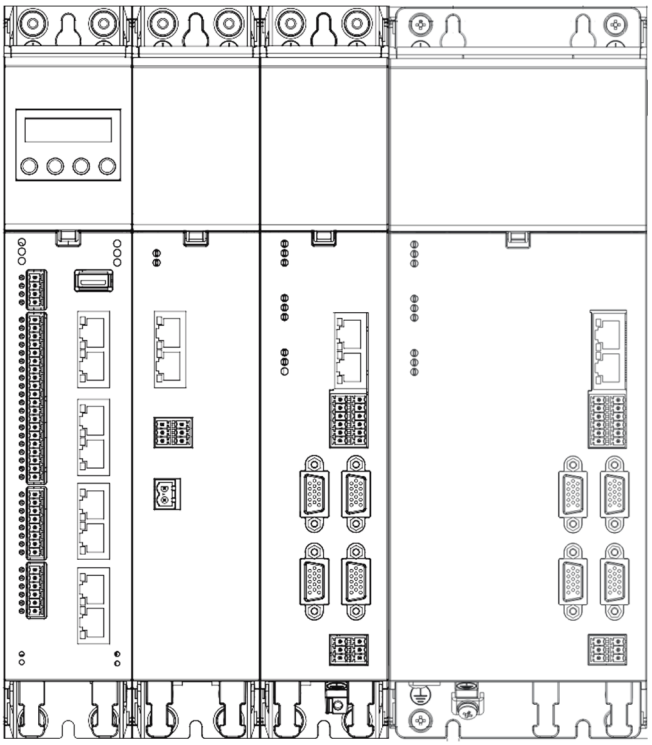


Fig. 5-14: Dimension with size 2

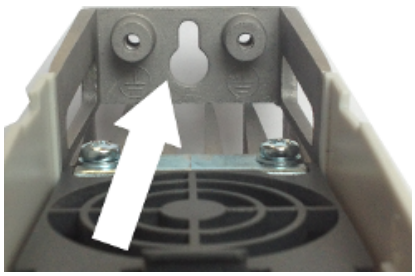
Dimensions

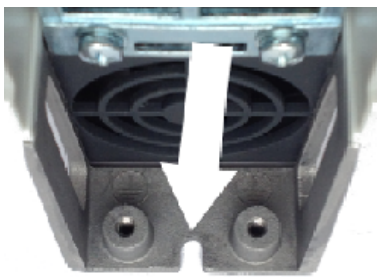
Height:	310 mm
Width:	273 mm
Depth:	241 mm

5.3 Mounting the module

The D3-DA 3xx/x is exclusively intended for the vertical installation on a plane, stable, conductive and grounded mounting plate by means of bolted connections.

Position of mounting holes:





WARNING!

The grounding points must not be used to fix the module on the mounting plate!

The following material, that is not included in the scope of delivery, is needed:

- 2 (Size 1) or 4 (Size 2) M4 screws with head diameter 8 - 9.5 mm and suitable screw type retainer, recommended length 20 mm

For mounting the cold plate additional M4 screws are needed for mounting the cooling element and the cold plate.

5.3.1 For wall mounting

For mounting the devices proceed as follows:

1) Allign the module on the mounting plate having regard to the specified space requirement. Align all the devices in a line along the top edge of the device. This is necessary to complete the d.c. link connection with rails.
2) Mark out the position of the threaded holes on the mounting plate. Drill holes in the mounting plate and cut a thread for each fixing screw in the mounting plate. (The bend radius of the connecting cables must be taken into account.)
3) Mount the modules vertically abutting on the mounting plate. Make sure the surface of the cooler is free of drill chippings or other soiling.

The D3-DA 3xx/x is now mounted and ready for cabling (see chap. "Connections and wiring").

5.3.2 For cooling element

For mounting proceed as follows:

1) Mount a cooling element with screws perpendicular to the backside of the cooling plate for each device.
2) Mount the cooling plate in the control cabinet. Therefore an opening at the backside of the control cabinet has to be provided.
3) Align the devices perpendicular to the cooling plate in height of the cooling element. Align all the devices along the top edge of the device.
4) Mount the devices successively on the cooling plate. Tighten the screws evenly so that the thermal resistance remains as low as possible. The contact area must be metallic, bare and conductive.

Caution

Please ensure that there are no particles of dirt between the cooler and the rear wall of the device during mounting. If this instruction is not followed, the device will overheat due to the poor thermal transfer. The device may fail as a result.

The D3-DA 3xx/x is now mounted and ready for cabling (see chap. "Connections and wiring").

Sizing the cooler

	D3-DA 3xx/x size BG1	D3-DA 3xx/x size BG2
Thermal resistance $R_{th}K$ [1)]	0.02 K/W	0.01 K/W
Thermal capacity of the cooling plate on the device	390 Ws/K	780 Ws/K
Max. temperature cooling plate Device	85 °C	
Surface of the cooler[2)]	max. roughness R_Z = 6,3	

[1)] Thermal resistance between active cooling surface on the device and cooler.

[2)] In this case the cooled rear panel for mounting the module is called as cooler.

5.3.2.1 Sizing the cooler

	D3-DA 3xx/x size BG1	D3-DA 3xx/x size BG2
Thermal resistance $R_{th}K$ [1)]	0.02 K/W	0.01 K/W
Thermal capacity of the cooling plate on the device	390 Ws/K	780 Ws/K
Max. temperature cooling plate Device	85 °C	
Surface of the cooler[2)]	max. roughness R_Z = 6.3	

[1)] Thermal resistance between active cooling surface on the device and cooler.

[2)] In this case the cooled rear panel for mounting the module is called as cooler.

5.4 Dismantling of the module

During the disassembly of the module it needs to be ensured and checked that it is absolutely de-energized (see chap. "Power supply").

Caution

The disassembly must not lead to damage to the enclosure, the motherboard, the plugs or the cables.

Zur Demontage der Baugruppe gehen Sie wie folgt vor:

1) De-energize all devices.
2) Disconnect all electric connections, loosen grounding bracket if existing.
3) Unfasten the fixing screws, be careful that the screws remain in the mounting plate.
4) Lift and pull out the moduel.

The module is disassembled.

5.5 Air conditioning and ventilation

Cooling air must be able to flow through the device without restriction. For installation in cabinets with convection (= heat loss is discharged to the outside via the cabinet walls), always fit an internal air circulation fan. The specified environmental conditions must to be adhered mandatorily independently of this.

6 Connections and wiring

Information

The relevant country-specific standards and regulations for electric installation have to be mandatorily observed.

The following layout plan shows the layout of the D3-DA 3xx/x axis module with the corresponding positions of connectors and terminals. To aid orientation, the connectors and terminals are labelled by abbreviations (X..).

The following pages contain detailed layout diagrams on the D3-DA 3xx/x single-axis, double-axis and triple-axis modules.

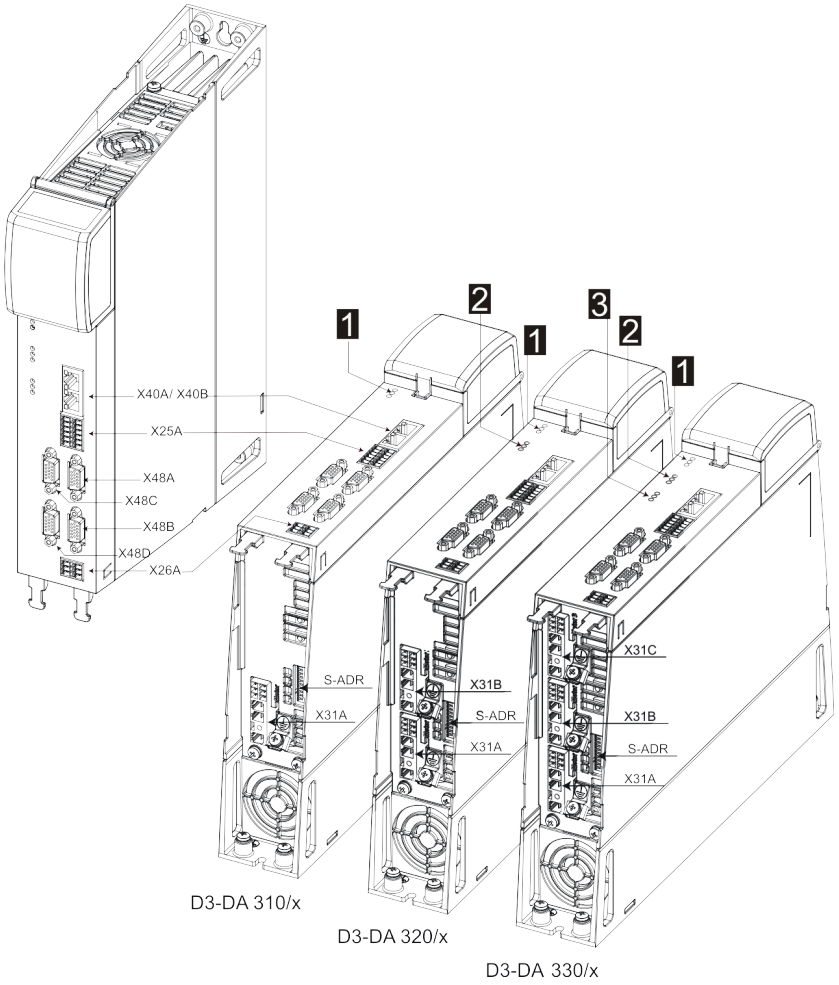


Fig. 6-15: Overview D3-DA 3xx/x axis modules

1 ... Status axis 1	2 ... Status axis 2
3 ... Status axis 3	

Abbreviation	Designation	Details
Via busbars	24 V supply voltage	See 6.6.1 24 V voltage supply
	D.c. link voltage (DC-Link +/-)	See 6.6.2 D.c. link
X40A	EtherCAT IN, input, field bus	See 6.9 Specification of EtherCAT connection interface).
X40B	EtherCAT OUT, output, field bus	See 6.9 Specification of EtherCAT connection interface
X25A	Digital inputs (programmable)	See 6.7.1 Digital inputs on X25A (standard functions)
X48A	Encoder interface	See 6.10 Encoder connections
X48B	Encoder interface	
X48C	Encoder interface	
X48D	Encoder interface	
X26A	Digital inputs (safety function)	See 6.7.2 Safe digital input (terminal X26A)
S-ADR	DIL switch bank for the configuration of the SD0 functionality	See 8 Safety functions
X31A	Power connection motor 1	With integrated connections for motor brake and motor temperature monitoring For variants with Hipferface DSL motor temperature monitoring happen via Hiperface DSL signales
X31B	Power connection motor 2	
X31C	Power connection motor 3	
D3-DA-310/x	D3-DA 3xx/x single-axis module	
D3-DA-320/x	D3-DA 3xx/x double-axis module	
D3-DA-330/x	D3-DA 3xx/x triple-axis module	

6.1 Single-axis module

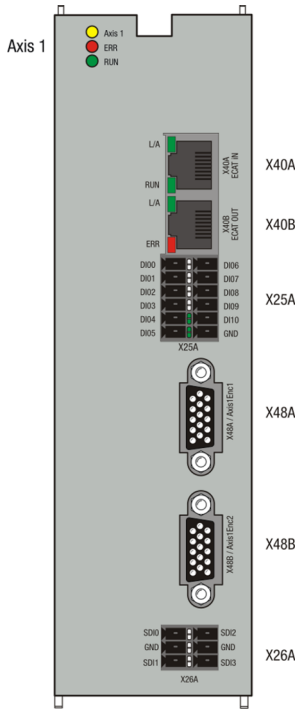


Fig. 6-16: Single-axis module

X40A ... EtherCAT IN, input, field bus (configurable via software as Ethernet)	X26A ... Digital inputs safety function
X40B ... EtherCAT OUT, output, field bus	Axis 1 ... LED yellow
X25A ... Digital inputs	ERR ... LED red (State axis 1 ERR LED red)
X48A ... Encoder connection 1 (axis 1)	RUN ... LED green
X48B ... Additional encoder connection (axis 1)	

For informations about the status LEDs of the axes see 4.1 Status LEDs of the axis.

Single-axis module encoder axis 1

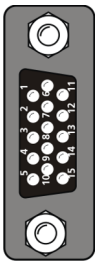


Fig. 6-17: Pin assignment connector X48A single-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

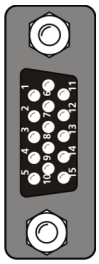


Fig. 6-18: Pin assignment connector X48B single-axis module

Pin	SinCos and TTL
1	A -
2	A +
3	max. +5.4 V / max. 250 mA
4	R +
5	R -
6	B -
7	-
8	GND
9	-
10	-
11	B +

Pin	SinCos and TTL
12	-
13	-
14	-
15	-

6.2 Double-axis module

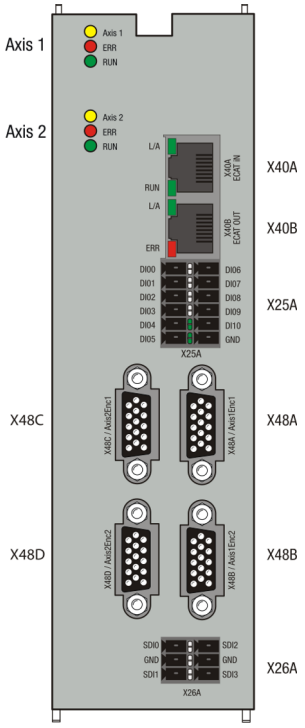


Fig. 6-19: Layout double-axis module

X40A ... EtherCAT IN, input, field bus (Configurable via software as Ethernet)	X26A ... Digital inputs safety function
X40B ... EtherCAT OUT, output, field bus	Axis 1 ... LED yellow
X25A ... Digital inputs	ERR ... LED red (State axis 1 ERR LED red)
X48A ... Encoder connection 1 (axis 1)	RUN ... LED green
X48B ... Additional encoder connection (axis 1)	Axis 2 ... LED yellow
X48C ... Encoder connection 1 (axis 2)	ERR ... LED red (State axis 2 ERR LED red)
X48D ... Additional encoder connection (axis 2)	RUN ... LED green

For informations about status LEDs of the axes see 4.1 Status LEDs of the axis.

Double-axis module encoder axis 1

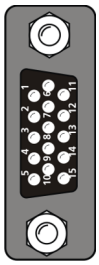


Fig. 6-20: Pin assignment connector X48A double-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

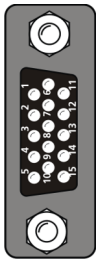


Fig. 6-21: Pin assignment connector X48B double-axis module

Pin	SinCos and TTL
1	A -

Pin	SinCos and TTL
2	A +
3	max. +5.4 V / max. 250 mA
4	R +
5	R -
6	B -
7	-
8	GND
9	-
10	-
11	B +
12	-
13	-
14	-
15	-

Double-axis module encoder axis 2

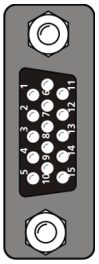


Fig. 6-22: Pin assignment connector X48C double-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

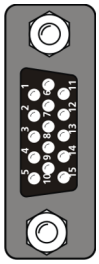


Fig. 6-23: Pin assignment connector X48D double-axis module

Pin	SinCos and TTL
1	A -
2	A +
3	max. +5.4 V / max. 250 mA
4	R +
5	R -
6	B -
7	-
8	GND
9	-
10	-
11	B +
12	-
13	-
14	-
15	-

6.3 Triple-axis module

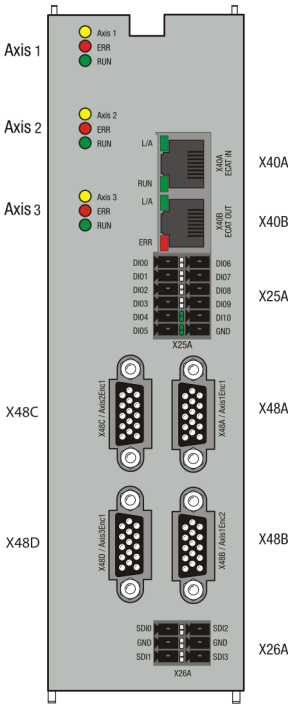


Fig. 6-24: Layout triple-axis module

X40A ... EtherCAT IN, input, field bus (Configurable via software as Ethernet)	ERR ... LED red (State axis 1)
X40B ... EtherCAT OUT, output, field bus	RUN ... LED gree
X25A ... Digital inputs	Axis 2 ... LED yellow
X48A ... Encoder connection 1 (axis 1)	ERR ... LED red (State axis 2)
X48B ... Additional encoder connection (axis 1)	RUN ... LED green
X48C ... Encoder connection 1 (axis 2)	Axis 3 ... LED yellow
X48D ... Encoder connection 1 (axis 3)	ERR ... LED red (State axis 3)
X26A ... Digital inputs safety function	RUN ... LED green
Axis 1 ... LED yellow	

For informations about the status LEDs of the axes see 4.1 Status LEDs of the axis.

Triple-axis module encoder axis 1

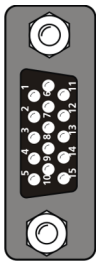


Fig. 6-25: Pin assignment connector X48A triple-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

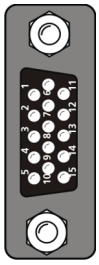


Fig. 6-26: Pin assignment connector X48B triple-axis module

Pin	SinCos and TTL
1	A -
2	A +
3	max. +5.4 V / max. 250 mA

Pin	SinCos and TTL
4	R +
5	R -
6	B -
7	-
8	GND
9	-
10	-
11	B +
12	-
13	-
14	-
15	-

Triple-axis module encoder axis 2

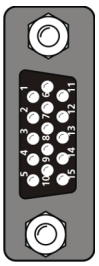


Fig. 6-27: Pin assignment connector X48C triple-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

Triple-axis module encoder axis 3

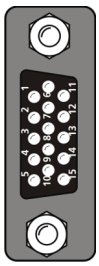


Fig. 6-28: Pin assignment connector triple-axis module

Pin	SinCos and TTL	EnDat / SSI	Hiperface	Resolver	Nikon
1	A -		REFCOS	S3 / COS- (A-)	-
2	A +		+ COS	S1 / COS+ (A +)	-
3	max. +5.4 V / max. 250 mA		-	-	Vcc
4	R +	Data +		-	SD+
5	R -	Data -		-	SD-
6	B -		REFSIN	S4 / SIN- (B-)	-
7	-	-	10 V / 110 mA	-	-
8	GND			-	GND
9	-	-	-	R2 (resolver excit. -)	-
10	-		-	R1 (resolver excit. +)	-
11	B +		+ SIN	S2 / SIN+ (B+)	-
12	Safety Sense +		-	-	-
13	Safety Sense -		-	-	-
14	-	CLK +	-	-	-
15	-	CLK -	-	-	-

6.4 Grounding

1) Ground each device!
   Connect the PE connections (screw socket M4) on the supply module, the axis modules and the controller in series with the PE connections (profile 16 mm²) included in the delivery as shown in the following figure

or with a protective conductor with enough crosssection. Make a connection from one of the devices to the PE rail (main earth) in the cabinet.As the leakage current >3.5 mA, the following applies to the PE connection: Use protective conductors with the same crosssection as the mains cables. If the crosssection of the mains cable is ≤10 mm² the PE connections are to be doubled, or a copper cable with a minimum cross-section 10 mm² is to be laid.

2) Also connect the PE-conductor terminals of all other components, such as main filters etc. in a star configuration with the PE bar (main earth) in the cabinet.
These further components are only required for the D3-DP 3xx/x supply module.

Information

Material of the cooler or cold plate: aluminium with high conductive transparent passivation.

Protective earth conductor with mains cable crosssection ≥ 10 mm²

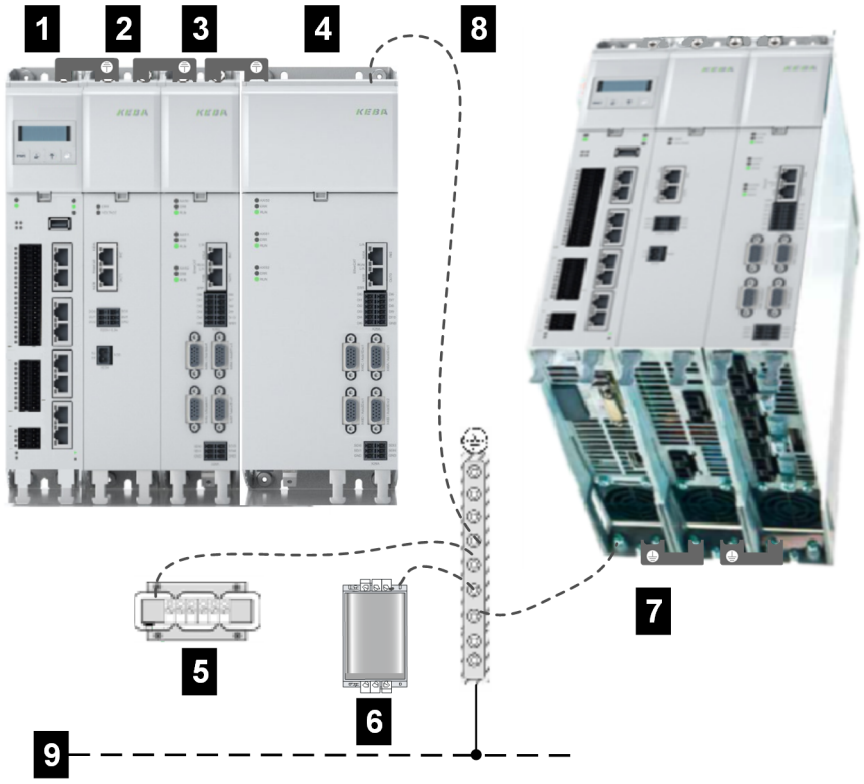


Fig. 6-29: Protective earth conductor

1 ... D3-DU 3xx/x control module	2 ... D3-DP 3xx/x supply module
3 ... D3-DA 3xx/x axis module size 1	4 ... D3-DA 3xx/x axis module size 2

5 ... Mains choke (optional)	6 ... Mains filters
7 ... Series earthing from below	8 ... Earthing alternatively from above
9 ... Protective earth (PE)	

Information

Also comply with local and national regulations and conditions.

WARNING!

The protective earth conductor connection is a safety feature. Therefore, make sure that all connections have good contact and are sufficiently secure that they cannot come loose.

Protective earth conductor with mains cable crosssection < 10 mm²

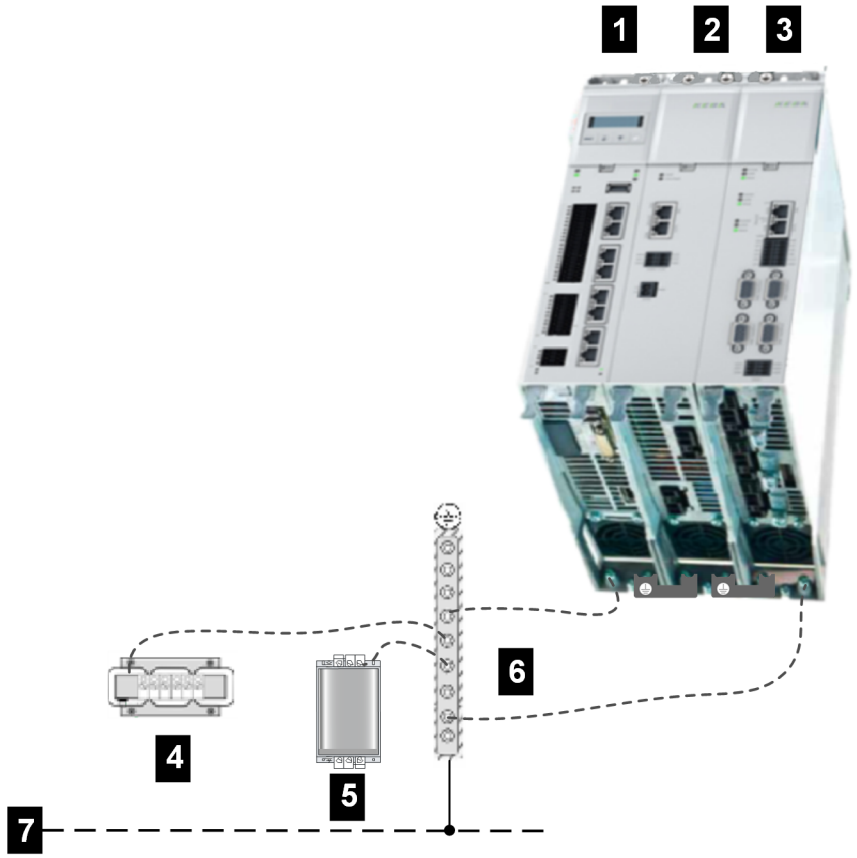


Fig. 6-30: Double protective earth conductor

1 ... D3-DU 3xx/x control module	2 ... D3-DP 3xx/x supply module
3 ... D3-DA 3xx/x axis module	4 ... Mains choke (optional)

5 ... Mains filters	6 ... Double protective earth conductor connection
7 ... Protective earth (PE)	

6.5 Electrical isolation method

The connector cables are conducted as protective extra low voltage circuit (PELV) and may be operated only with PELV voltage according to respective specification. This provides reliable protection against electric shock.

The connector X31A - X31C are voltage potential (low voltage).

The necessary supply of 24 V for PELV circuit is provided from the 24 V DC/ GND (supply) busbars of the supply module.

The following overview shows detailed potential reference of each connector. With this concept a higher operational safety is reached.

Connections	Description	Potential	Acronym
Busbars 24 V DC	Power supply control module	Protective extra low voltage circuit [3]	PELV
D.c. link circuit supply (DC-Link +/-)	Power supply d.c. link	Low voltage [1]	ZK
X40A	EtherCAT IN field bus connection	Protective extra low voltage circuit [3]	PELV
X40B	EtherCAT OUT field bus connection	Protective extra low voltage circuit [3]	PELV
X25A	Digital control inputs	Protective extra low voltage circuit [3]	PELV
X26A	Safety digital inputs	Protective extra low voltage circuit [3]	PELV
X48A - X48D	Encoder interface	Protective extra low voltage circuit [3]	PELV
X31A/BRK - X31C/ BRK	Connection motor holding brake	Protective extra low voltage circuit [3]	PELV
X31A/ϑ - X31C/ϑ	Connection motor temperature sensor	Basic isolation [2]	ELV
X31A/UVW - X31C/ UVW	Connection motor 1 - 3	Low voltage [1]	LV

[1] Low voltage = AC: U ≤ 1000 V

[2] Simple isolation low voltage to PELV

[3] PELV (Protective Extra Low Voltage) = DVC A according to EN 61800-5-1 max. 25 V AC or 60 V DC

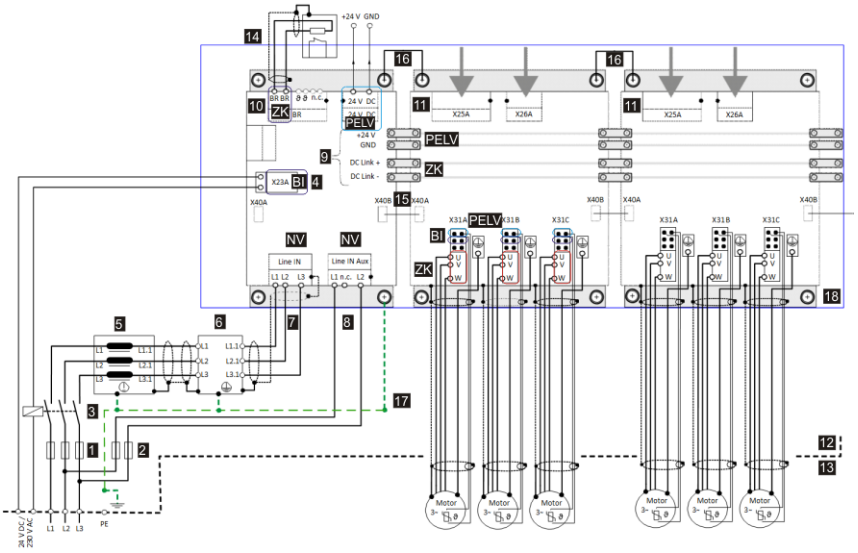


Fig. 6-31: Electrical isolation method

1 ... Mains fuse for d.c. link	2 ... Mains fuses for switching power supply of supply module
3 ... Mains contactor with protective circuitry (optional)	4 ... Switch contact for for mains contactor (optional)
5 ... Power choke (optional)	6 ... Mains filter
7 ... Power supply of supply module	8 ... Main connection (24 V switching power supply)
9 ... Main connection of supply module	10 ... D3-DP 3xx/x power supply
11 ... D3-DA 3xx/x axis module	12 ... Control cabinet
13 ... Field	14 ... Braking resistor
15 ... EtherCAT connection	16 ... Conductive mounting plate
17 ... PE connection	18 ... Conductive mounting plate
PELV ... Protective extra low voltage circuit	BI ... Basic isolation
VI ... Strenghten isolation	ZK ... Low voltage d.c. link
NV ... Low voltage	

Information

The electrical isolation method correspond to EN 61800-5-1.

The following conditions apply for safety digital inputs of the D3-DA 3xx/x:

- The inputs SDI00/SDI01/GND are isolated against SDI02/SDI03/GND.
- All inputs are isolated against 24 V power supply.
- All inputs are isolated against PE.
- Maximum allowed isolation voltage: PELV
- Maximum allowed input voltage: -60 V ... 60 V

6.6 Connection of supply voltages via busbars

The voltage supply to the axis module is separate for the control and power sections. The control section receives its 24 V supply from switched-mode power supply in the supply module via the upper busbar (+24V DC and GND).
The power section in the axis module receives its DC link supply from the supply module via the lower busbar (DC-Link+ and DC Link-).

1) First make sure that all D3-DA 3xx/x axis modules with the D3-DP 3xx/x supply module are arranged in a line and are in contact with each other.
2) Always first connect the 24 V power supply for the axis module.
   For this purpose use the pre-assembled busbar elements. To be able to rotate the busbar elements it is necessary to unscrew the screws slightly.
3) Only connect the DC link supply for the axis modules when you want to place the axis modules in operation. If you want to use several axis modules, all DC Link+ connections and all DC Link- connections must be connected together.
   For this purpose also use the pre-assembled busbar elements. To be able to rotate the busbar elements it is necessary to unscrew the screws slightly.

Caution

Once all busbar elements have been fitted, make sure that all connections have good contact and are sufficiently secure (2.1 Nm / 18.5 lb-in) that they cannot come loose. On the usage of connection elements that do not meet the requirements, KEBA does provide any guarantee for stable, reliable operation. Also expires certification marks and CE conformity.

Also expires certification marks and CE conformity.

Information

You will find more detailed information on the mains connections for the supply module in the Project Manual for the D3-DP 3xx/x supply module.

6.6.1 24 V voltage supply

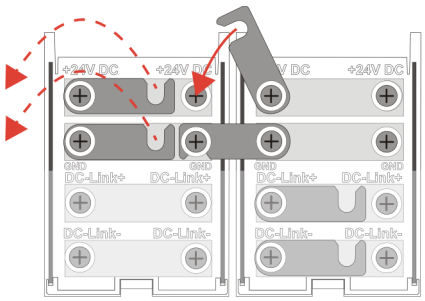


Fig. 6-32: connection of 24 V voltage supply

- U_V = +24 V DC ±20% stabilized and filtered
- Continuous output power of the switched mode power supply (SNT) max. 470 W
- Internal polarity reversal protection
- The power supply unit used must have a safe and reliable isolation in relation to the mains acc. to EN 61131-2 or EN 61800-5-1
- Tightening torque for the busbar fittings 2.1 Nm / 18.5 lb-in

6.6.2 D.c. link

Caution

Busbars

The busbars supplied are to be used for the electrical coupling of the devices. On the usage of connection elements that do not meet the requirements, KEBA does provide any guarantee for stable, reliable operation.

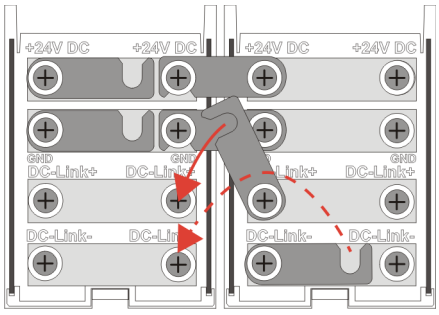


Fig. 6-33: D.c. link

- D.c. link 325 / 565 / 678 V DC depending on power supply voltage (230 / 400 / 480 V AC) of the power supply
- Tightening torque for the busbar 2.1 Nm / 18.5 lb-in

6.6.3 Overview busbars

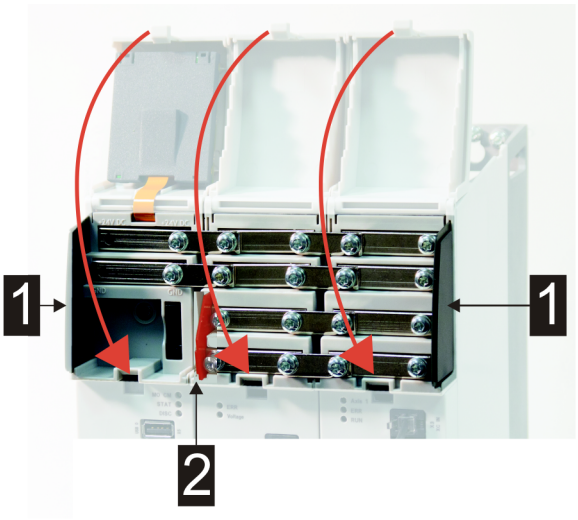


Fig. 6-34: Cover

1 ... Side cover	2 ... Barrier strip

DANGER!

The multi-axis system is only allowed to be operated with the cover on the busbars closed! It is also important that the side covers (1) and the barrier strip (2) are fitted. Both provide protection against physical contact with bare and live parts. Death or serious injuries may occur if these protective measures are not taken.

6.7 Control connections

6.7.1 Digital inputs on X25A (standard functions)

The digital inputs are provided for axis-related tasks, e.g. limit switches. They can be programmed individually via the EtherCAT bus system. The inputs DI09 and DI10 are suitable for touch probe applications due to their fast signal processing. The axis assignment can also be programmed via the EtherCAT bus system.

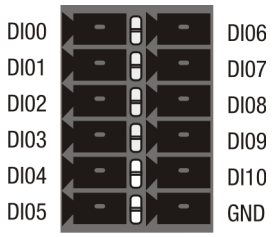


Fig. 6-35: I/O Terminal X25A/DI

Allocation of the control inputs (example triple-axis controller)

Des-ig-na-tion	Type	Function	Axis 1	Axis 2	Axis 3
DI00	Digital input	See following table	DI01	-	-
DI01	Digital input		DI02	-	-
DI02	Digital input		DI03	-	-
DI03	Digital input		-	DI01	-
DI04	Digital input		-	DI02	-
DI05	Digital input		-	DI03	-
DI06	Digital input		-	-	DI01
DI07	Digital input		-	-	DI02
DI08	Digital input		-	-	DI03
DI09	Fast digital input	Touch Probe TP1	DI09	DI10	DI08
DI10	Fast digital input	Touch Probe TP2	DI10	DI08	DI09
GND	GND	Reference ground	All axis		

Digital inputs are galvanic isolated from GND rail of 24 V supply. GND must be connected with the reference mass of the sensors.

Information

At the digital inputs only PNP sensors are allowed to be connected.

Selection list, function of the control inputs

Axis 1/2/3	No function	Pos. limit switch (LimP)	Neg. Limit switch (LimN)
DI01	0	LimP(1)	LimN(2)
DI02	0	LimP(1)	LimN(2)
DI03	0	LimP(1)	LimN(2)

The safety terminal X26A is realized with a 2-floor 2x3 pole clamp grid dimension 3.5 mm.

- Typ: MCDN 1,5/3-G1-3,5

6.8 Motor connection

1) Specify the cable cross-section dependent on the continuous current of the drive axis and ambient temperature. The best method is use the pre-assembled motor cable.
2) Connect the shielded motor cable to terminals X31/A / X31/B / X31/C, U, V, W connect the motor to earth at earth symbol. Mount shield at both ends to reduce interference emission. Fasten shield connection plate for the motor connection Motor1 using both screws. When using the appropriate motor cable the shield contacts already exist on both sides.
3) Wire the temperature sensor (if fitted) to X31/A / X31/B / X31/C using separate shielded cables and activate the temperature evaluation using DriveManager. The motor cables from KEBA have a shielded wire pair for temperature evaluation integrated and the shield has contact with the connectors on both sides.
4) If fitted, connect the motor brake to X31/A / X31/B / X31/C -1, 2. The motor cables from KEBA have a shielded wire pair for motor brake integrated and the shield has contact with the connectors on both sides

Motor cable

All motor cables must be shielded. Equivalent shielded cables must be used for the connection of motors from other manufacturers.

For more information about motor cables see 16.3 Connection technology.

Information

In the event of a short-circuit or earth fault in the motor cable, the power stage is disabled and an error message is issued.

6.8.1 Connection diagram motor connections

Caution

For the connections X31/A / X31/B / X31/C -1, 2 it is to be ensured that the temperature sensor used has minimum one basic isolation according to EN 61800-5-1 in relation to the motor winding and the brake lines must have a double or strengthened isolation to dangerous voltages.

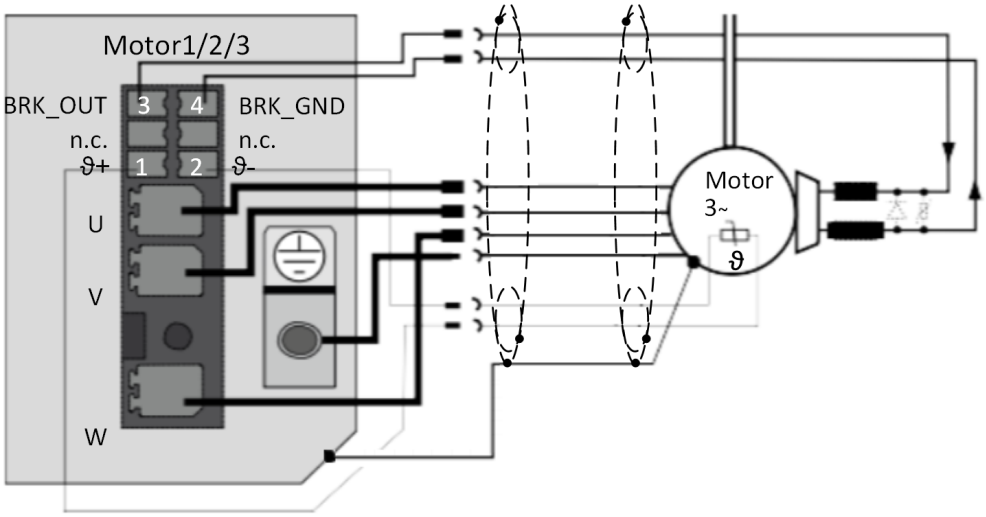


Fig. 6-37: Connection of a servomotor with motor holding brake

Information

Recommended connection of the motor holding brake up to max. 2 A motor brake current.

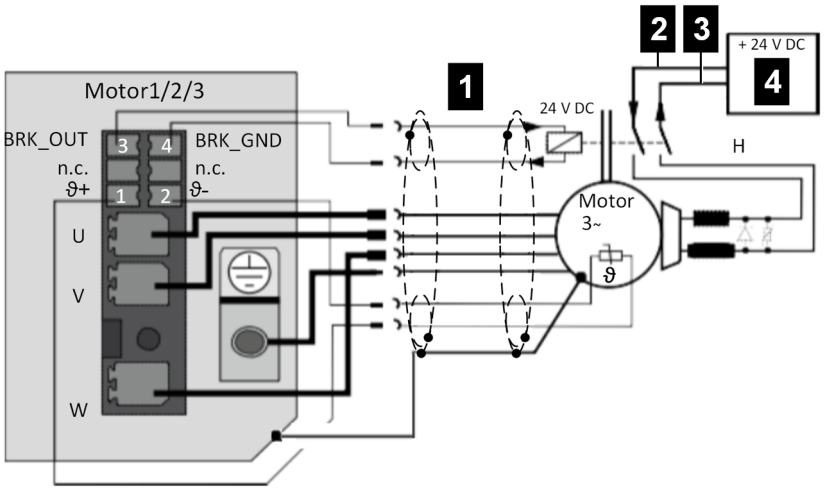


Fig. 6-38: Connection of a servomotor with motor holding brake

1 ... Control motor brake	2 ... Brake (+)
3 ... Brake (-)	4 ... Supply for brake

The temperature sensor connection is shown in the version with "standard encoder interface".

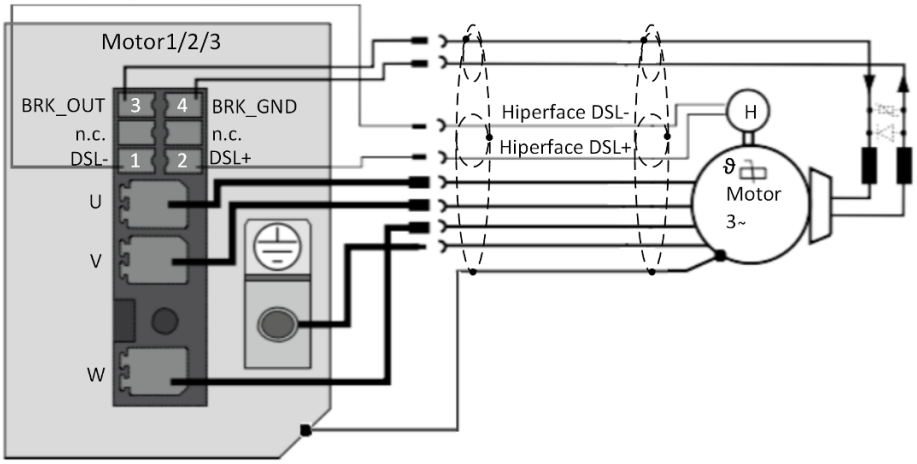


Fig. 6-39: Connection of a servomotor with Hiperface DSL encoder system

Information

Recommended connection of the motor holding brake up to max. 2 A motor brake current.

On the model "Hiperface DSL" the two-wire connection for the encoder is connected to the terminals X31/A / X31/B / X31/C - 1 + 2. You will find a suitable motor connecting cable (one-cable solution) in 16.3 Connection technology.

WARNING!

Electric shock!

Isolation of temperatur sensors to motor winding must have a double or strengthened isolation.

6.8.2 Monitoring output motor holding brake

The motor brake output (BRK_Out and BRK-GND) is continuously monitored independently of the usage SBC.
The monitoring uses shut-down pulses that are sent with a maximum time window of 7.5 ms (depending on the load) and a minimum time window of 1.5 ms.

Information

Due to this brief shutdown, on high impedance loads the "Time window exceeded" error may be triggered.

6.8.3 Specification of motor connections

The connections X31/A / X31/B / X31/C (Motor1 / Motor2 / Motor3)are provided for up to three motors with motor temperature monitoring and motor holding brake. The necessary motor connectors are to be ordered separately depending on the number of motors to be used.

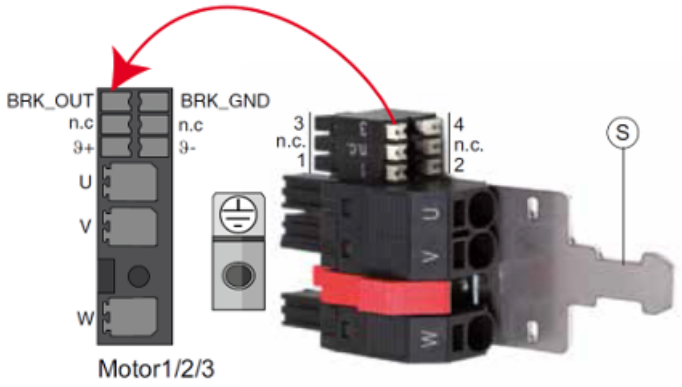


Fig. 6-40: Motor connection

Specification of motor connections X31/A / X31/B / X31/C

X31/A (motor 1) X31/B (motor 2) X31/C (motor 3)	Function	Specification
2 (ϑ- / DSL+) 1 (ϑ+ / DSL-)	Connection motor temperature sensor or Hiperface DSL	Control terminals: Crioss section = 0.25 - 1 mm² or AWG 26 - 16 I_N = 10 A
3 (BRK_OUT) 4 (BRK_GND)	Connection motor brake I_{BR} = max. 2 A	
U / V / W	Connection motor phase	Connectable cross section without ferrule = max. 6 mm²
PE symbol	Connection PE of motors	M4 screw with serrated washer, connection using ring lug
(S)	Connection cable shield	

6.8.4 Switching in the motor cable

Caution

Switching in the motor cable is not allowed. If this instruction is not followed, malfunctions may occur in the device and result in the shutdown of the axis module.
It cannot be excluded that switching in the motor cable will result in the destruction of the axis module.
To interrupt the supply of power to the servo motor, the safety function STO is available (See 8 Safety functions).

6.9 Specification of EtherCAT connection interface

The EtherCAT field bus interface X40A is typically used for the connection of the control module D3-DU 3xx/x or another EtherCAT compliant control module with EtherCAT master. The connection with D3-DU 3xx/x another EtherCAT compliant control module takes place only with D3-DP 3xx/x.

The supply module is with regard to the EtherCAT interface a cable extension to the first axis module (the first EtherCAT slave of the axis block, consisting of a supply module and one or more axis modules). It is recommended to use the cable included in the deliery for the connection to the EtherCAT master.

The EtherCAT field bus interface can also be used as a service and diagnostics interface. However, it is then only suitable for the connection of a PC for commissioning, service and diagnostics using the software DriveManager.

Technical specification:

- Transfer rate 10/100 MBits/s BASE-T
- Transfer profile IEEE802.3 compliant

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

- "Silverline Gold" Cat. 5 patch cable, S/STP 4x2x0.14 mm^2, twisted pair and shielded data cable with characteristic impedance R_w = 100 Ω ±15 %

Information

For cable lengths ≥ 20 m special installation cables with larger cross-sections are to be used.

All modules (axis- and supply modules) have enclosed suitable EtherCAT cables. They can be used for a connection to the left, nearby module.

6.9.1 Pin assignment

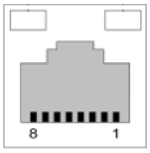


Fig. 6-41: RJ45 plug

Pin-No.	Signal designation		Input/Output
1	Tr. Data+	Transmit Data +	Output
2	Tr. Data-	Transmit Data -	Output

Pin-No.	Signal designation		Input/Output
3	Re. Data+	Receive Data +	Input
4	Bi-Data+	Bidirectional Data +	---
5	Bi-Data-	Bidirectional Data -	---
6	Re. Data-	Receive Data -	Input
7	Bi-Data+	Bidirectional Data +	---
8	Bi-Data-	Bidirectional Data -	---

Through the signals "Bi-Data+" and Bi-Data-" runs a proprietary cross communication between the supply module and the axis modules of an axis block.

6.10 Encoder connections

All encoder connections are located on the front of the device. All encoder cables must be shielded. The cables available from KEBA are listed in chapter 16.3 Connection technology. Equivalent shielded cables must be used for the connection of motors from other manufacturers.

6.10.1 Matching motor/encoder cables

Compare the rating plates of the components. Make absolutely sure to use the correct components according to variant A, B or C!

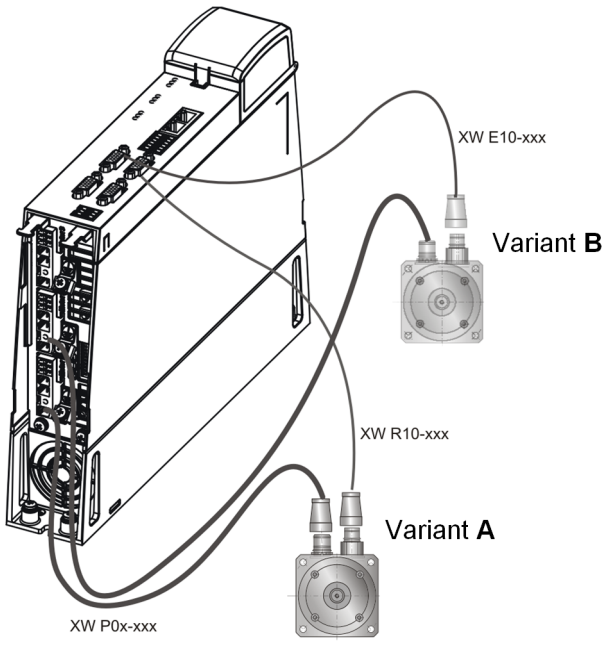


Fig. 6-42: Motor/encoder allocation (as an example a double-axis module is shown)

Variants of motors, encoder types and encoder cables

	Servo motor (with installed encoder)	Encoder cable for servo motor	Motor cable
Variant A	With resolver e.g. DMS2-xxx-xxxx-xx-Bx90xx without further option	XW R10	XW P0x
Variant B	SinCos singleturn/multiturn encoder with HIPERFACE® interface (e.g. DMS2 variants)	XW E10	XW P0x

Information

Do not split the encoder cable, for example to route the signals via terminals in the cabinet. The knurled screws on the D-Sub connector housing must be tightly locked!

6.10.2 Connection for high-resolution encoder

The interfaces X48A, X48C and X48D make it possible to evaluate the encoder types listed in the following, as a function of the design as single-axis, double-axis or triple-axis module X40. The connection X48B can however, always only be SinCos or TTL.

Function	Example
SinCos encoder with zero pulse	Heidenhain ERN1381, ROD486
Heidenhain SinCos encoder with EnDat interface (EnDat 2.1 and EnDat 2.2)	13 Bit singleturn encoder (ECN1313.EnDat01) and 25 Bit multiturn encoder (EQN1325-EnDat01)
SinCos encoder with SSI interface	13 Bit singleturn- and 25 Bit multiturn encoder (ECN413-SSI, EQN425-SSI)
Sick-Stegmann SinCos encoder with HIPERFACE® Interface	Single- and multiturn encoder, e.g. SRS50, SRM50

The usage of encoders not included in the range supplied by KEBA requires special approval by KEBA.
The maximum signal input frequency is 500 kHz. Encoders with a supply voltage of 5 V ± 5 % must use the supply voltage from pin 3 (max. 5.4 V). The encoder cable detects the actual supply voltage at the encoder, thereby compensating for the voltage drop on the cable. Only use of the sensor cable ensures that the encoder is supplied with the correct voltage. The sensor cable must always be connected.

Select the cable type specified by the motor or encoder manufacturer. During this process bear in mind the following:

- Always used shielded cables. Connect shield on both sides.
- Connect the differential track signals A/B, R or CLK, DATA to each other via twisted wires.

Information

The encoder supply on X48A to X48D is short-circuit proof on both 5 V and 11 V operation. The module remains in operation enabling the generation of a corresponding error message when evaluating the encoder signals.

6.11 Operation on special systems

TN- and TT system

The operation is only permitted if for three-phase devices with external conductor voltages 3x 230 V AC, 3x 400 V AC, 3x 480 V AC the star point of the supply system is earthed and the supply system conforms to the maximum overvoltage category III as per EN 61800-5-1 at a system voltage (external conductor → star point) of maximum 277 V.

IT system

The operation is only possible for three-phase supply with 3 x 230 V. The compliance of EMC directives 2014/30/EC has to be ensured by the user!

The operation for three-phase supply with 3 x 400 V or 3 x 480 V is not permitted! Otherwise, in case of an earth fault the electrical stress is approx. twice as high. Clearances and creepages to EN 61800-5-1 are no longer maintained.

6.12 DIP-Switch (S-ADR)

The DIP-Swith S-ADR is located on the bottom side of the module and serves for configuration of the safety functions of the D3-DA 3xx/x. For more details see 8 Safety functions.

7 Configuration

The configuration of the D3-DA 3xx/x is done via configuration tools integrated in the delivery.

For information to configuration see online help of D3-DA 3xx/x. For information of parametrization of a drive see functional description "KeDrive D3 - Firmware for axis controller devices".

8 Safety functions

Drive controller malfunctions must be detected by the superimposed monitoring of the movement or by other measures in the application.The detection and the reaction are the responsibility of the user. The D3-DA 3xx/x provides the safety functions STO and SBC that the user can use as a reaction to drive controller malfunctions in the application.

This chapter describes the following safety functions:

- STO (Safe Torque OFF)
- SBC (Safe Break Control)
- Diagnoses via cross circuit test

The connection of this safety functions are done via terminal X26A. The desired behaviour of the safety functions can be configured via DIP switch (S-ADR).

Both inputs of a safety function must be "active", to switch on the corresponding output. Switching on can be done with a time offset from 1 ms up to 200 ms because of internal diagnosis.

8.1 STO (Safe Torque OFF)

The axis module supports the safety function ”STO” (safe torque off) in accordance with EN 61800-5-2, EN ISO 13849-1 „PL e“ category 4 and EN 61508 / EN 62061 „SIL 3“. For the safety function STO the supply to the drive is interrupted safe (no galvanic isolation). The drive must not create torque and therefore dangerous movements. The stand still position is not monitored. The function "STO" corresponds to the stop categorie 0 according to EN 60204-1.

You will find the safety related characteristics in chapter "Technical Data". The STO shutdown takes place within 2,5 ms.

The safety-related parts must be designed such that:

- A single failure in any of these parts does not result in the loss of the safety function.
- The single failure is detected on or before the next demand upon the safety function.

For the function STO the axis module is equipped with additional logic circuits. The logic interrupts the supply voltage for the pulse amplifier for the operation of the power stage. By means of two inputs the motor is prevented from generating torque using a two-channel process.

DANGER!

Hazard due to dangerous voltage!

- In the state "STO" motor and mains cable, braking resistor and DC link supply cable will carry dangerous voltages in relation to the PE conductor.
- Without additional measures it is not possible to implement "shutdown of the power supply in an emergency" using the function "STO". There is no galvanic isolation between motor and drive controller! As such there is a risk due to electric shock and other risks of an electrical origin

DANGER!

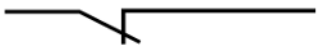
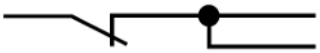
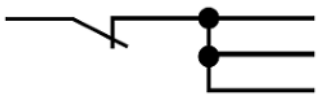
Hazard due to axis movement at the motor!

- If the action of external force has to be expected with the safety function "STO", e.g. due to a suspended load, this movement must be safely prevented by additional measures, e.g. by means of two brakes, locking device or clamping device with brake.
- Despite correct shutdown, in the case of a short-circuit in two offset branches of the power section an axis movement of max. 180° may be triggered electrically.

8.1.1 Configuration of STO safety function

Via DIP switch (S-ADR) the desired behaviour of the safety function STO can be configured. Because the D3-DA 3xx/x can be equipped as single-, double- or tripple axis module, it must be configured via DIP switch on which axis the STO takes affect.

The following presettings can be choosen:

Settings	Description	Function	affect to
	Separate switching of all existing axis (Default setting)	STO1: 	Axis 1
		STO2: 	Axis 2*) Axis 3*)
	Common switching of all existing axis	STO1: 	Axis 1 Axis 2*) Axis 3*)
		STO2:	Without function

*) If axis exits

Information

All other combinations on the DIP switch are invalid and lead at the latest on demand of safety function (e.g. validating of safety function) to an error message and the system changes into safe state.

8.2 SBC (Safe Brake Control)

The function SBC is used for safe of controlling a holding brake. A holding brake, which is active in the unpowered state, is operated and monitored using two-channel technology. Depending on the pre-selection of the DIP switch (S-ADR) the SBC will be automatically activated in case of release parallely with STO1. The function SBC always effects to all brake outputs of the axis module.

The function SBC is used in conjunction with the functions STO to prevent the movement of an axis in the torque-free state, e.g. due to gravity.

The axis module supports the safety function ”SBC” (safe brake control), according to the requirements of EN 61800-5-2, EN, EN ISO 13849-1 „PL d“ category 3 and EN 61508 / EN 62061 „SIL 2“. You will find the safety-related characteristics in chapter „Technical Data“. The SBC shutdown takes place within 3 ms.

Information

It is only allowed to connect brakes, contactors or relays with a minimum holding voltage ≥ 5 V to the brake driver outputs on the system. The switching elements used must be designed as per the required PL and category in accordance with EN ISO 13849-1 or SIL in accordance with EN 61508 / EN 62061 or have appropriate safety-related approval. The release of the brake can be delayed by up to 200 ms by the internal diagnostics on the brake output.

Caution

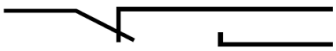
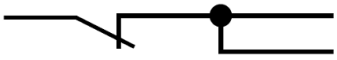
If the brake does not release due to a failure, the safety function may be lost due to wear or irreparable damage to the brake. The failure "Brake does not release" must be taken into account during the design of the brake(s) and the validation.

The failure "Brake does not engage" must be excluded by one of the following measures:

- Usage of a safety brake with a manufacturer's specification that excludes this failure with the necessary safety integrity.
- Definition and validation of a second means of braking in the application. For instance this feature can be achieved by using two brakes where each brake is in itself capable of applying the necessary braking torque. In addition, the function of the brakes must be validated regularly.

8.2.1 Configuration SBC safety function

Via DIP switch (S-ADR) can be configured, if the safety function SBC should be activated additional to the safety function STO.

Settings	Description	Function	affect to
	SBC deactivated (Default setting)	STO1: 	STO axis 1-3 SBC deactivated
		STO2:	Without function
	SBC activated	STO1: 	STO axis 1-3 SBC axis 1-3
		STO2:	Without function

WARNING!

Personnel injury due to unbraked drives!

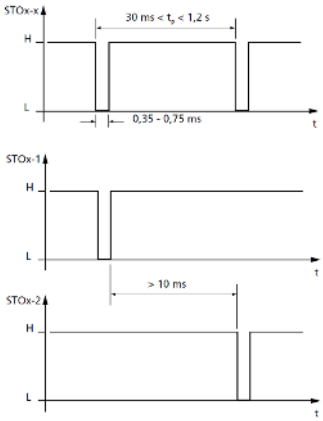
The SBC safety function is bounded hard on the safe digital input STO1 (SDI00 and SDI01). So STO1 must be used coercively for all axes because otherwise it can not ensured that currentless drives are always braked and that they never drive against closed brakes.

Information

All other combinations on the DIP switch are invalid and lead at the latest on demand of safety function (e.g. validating of safety function) to an error message and the system changes into safe state.

8.3 Diagnosis via cross circuit test

To detect short circuits and cross circuits in the wiring of safe digital inputs (terminal X26A) via DIP switch (S-ADR) a cross circuit test can be activated. In this case the testoutputs of the D3-DP 3xx/x must be used or own testoutputs which meet the signal format of the following table:

Settings	Description	Signal format of testoutputs
	Cross circuit test deactivated (Default setting)	
	Cross circuit test activated	

Information

All other combinations on the DIP switch are invalid and lead at the latest on demand of safety function (e.g. validating of safety function) to an error message and the system changes into safe state.

Information

With deaktivated cross circuit test the system changes into safe state if a test pulse, which does not meet the specification, occures.

Information

The failures "Short circuit output brake driver" and "Short circuit between any cores in the motor supply cable" must be excluded by means of suitable wiring.

Testoutput assignment:

- On the STO both test pulse must have a time offset.
- On usage of redundant inputs different testoutputs must be used.

8.4 Recommended connection examples

The following chapter describes recommended examples for connecting safety functions STO and SBC. In the following circuit examples it is a prerequisite that the switching elements used have safety-related approval or are designed as per the required PL in accordance with EN ISO 13849-1 or SIL in accordance with EN 61508 / EN 62061. In addition the following points must be noted:

- The safety regulations and EMC directives must be met
- In relation to the failure exclusions assumed, reference is made to the table in annex D of EN ISO 13849-2.

The examples shown in the following and their characteristic architecture define the allocation to a category in accordance with EN ISO 13849-1. The resulting maximum possible performance levels in accordance with EN ISO 13849 continue to be dependent on the following factors related to the external components:

- Structure (single or redundant)
- Detection of common cause failures (CCF)
- Diagnostic coverage on demand (DC_{avg})
- Time to the dangerous failure of a channel ($MTTF_D$)

8.4.1 Example: STO and SBC control via safety control

The control of safety function STO is done via corresponding logical processing of the safety control, whereby the safety function STO and SBC of the single axis modules are controlled from the safety control via separate outputs

In this example multi axis, emergency stop switch, which activates STO and SBC on all axis and safety door are realized. To release after unlocking of emergency stop switch as well as closing the safety door a reset button (start test on switching module is activated) is implemented. In the shown DIP switch configuration it is configured, to use STO1 for all axes and SBC is released simultaneously with STO1.

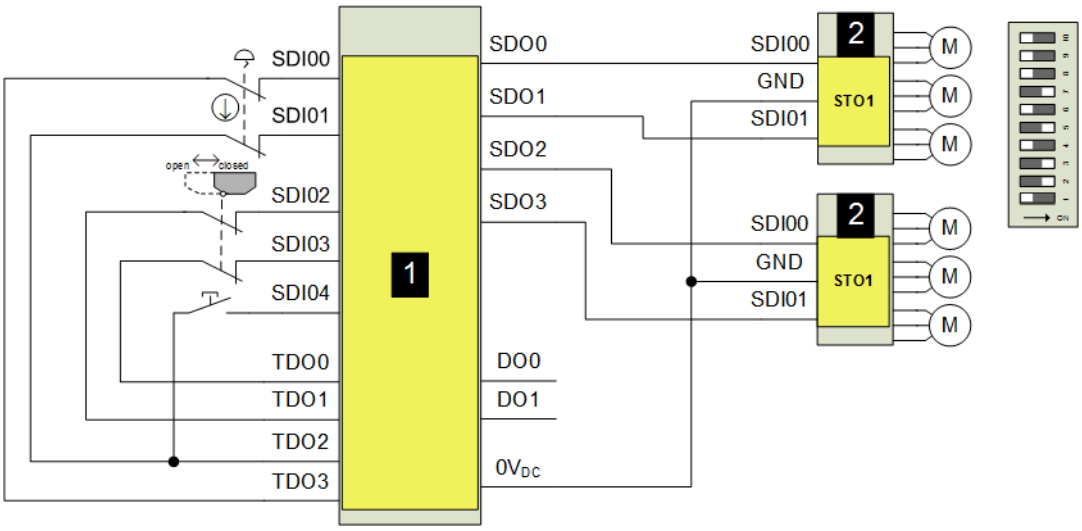


Fig. 8-43: STO and SBC control

1 ... D3-DU 3x5/x	2 ... D3-DA 3xx/x

Should safety functions STO and SBC of the single axis modules controlled via same outputs of the safety control, the wiring can be copied as shown below:

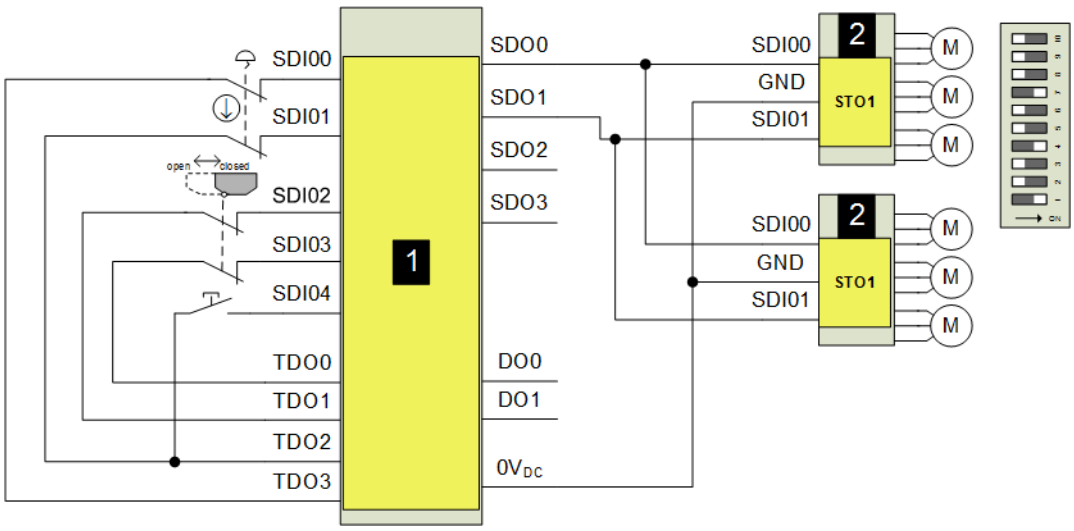


Fig. 8-44: STO and SBC control

1 ... D3-DU 3x5/x	2 ... D3-DA 3xx/x

Information

- Short circuits on the OSSD outputs to 24 V an other outputs are detected from the safety control via diagnosis measurements if the output test is activated. It is changed into safe state.
- The failure "Simultaneous short circuit of both outputs to 24 V" must be excluded by suitable wiring!

8.4.2 Example: STO without SBC control via safety control

The D3-DA 3xx/x supports a separate STO controlling of the axes. STO1 is fix assigned to the first axis, the both other axes can be assigned to STO1 or STO2 depending on the DIP switch setting. If sperated STO controlling is used the safety function SBC may not be activated, because it is always assigned to STO1.

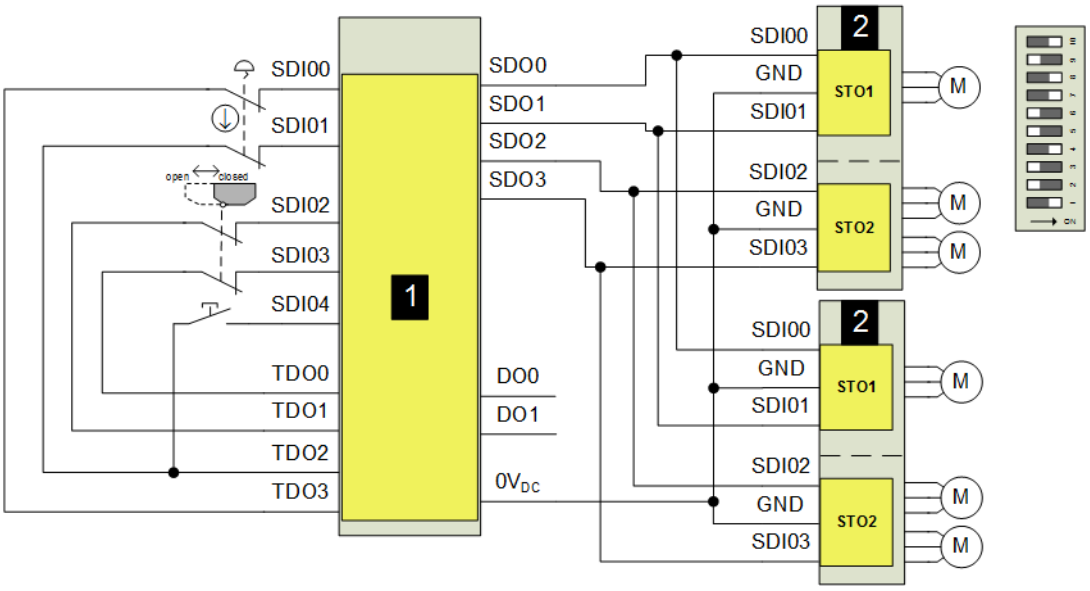


Fig. 8-45: STO without SBC control

1 ... D3-DU 3x5/x	2 ... D3-DA 3xx/x

Caution

By usage of STO1 and STO2 on an axis module the safety function SBC must be deactivated via DIP switch, because SBC is always released with STO1. Otherwise no SBC is released on the requested STO2 or SBC will be activated on all axes with the requested STO1, although axis 2 and 3 have no STO!

8.4.3 Example: STO and SBC control via light grid

The control of STO1 is done via a safety light grid with OSSD outputs. The reset button releases after leaving the danger area (start/restart interlock).

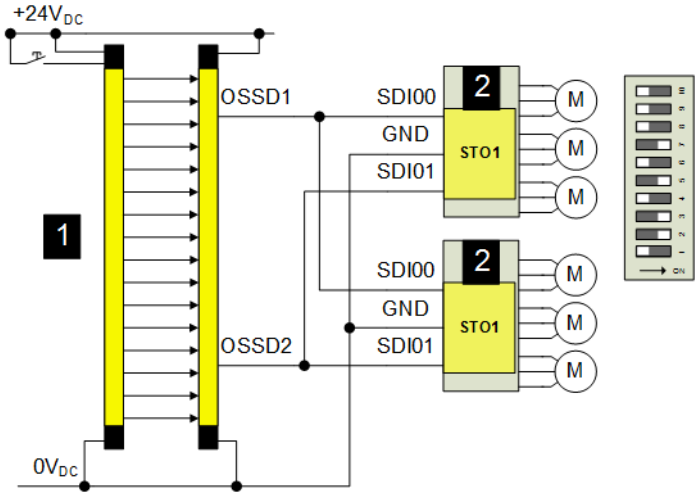


Fig. 8-46: STO control via light grid

1 ... Light grid	2 ... D3-DA 3xx/x

Information

- Short circuits on the OSSD outputs to 24 V an other outputs must be detected from the light grid via diagnosis measurements and then changed into safe state.
- The failure "Simultaneous short circuit of both outputs to 24 V" must be excluded by suitable wiring!

8.4.4 Example: STO and SBC control directly via supply module

It is for example possible to control the safety functions STO and SBC via safety door, without using the safety control. Therefore the door switch must be supplied via testoutputs of the D3-DP 3xx/x (to recognize cross circuits in the input circuit). The cross circuit test must be configured suitable via the DIP switch.

Information

It is recommended to use a safety control and use prefered one of the above mentioned connection examples!

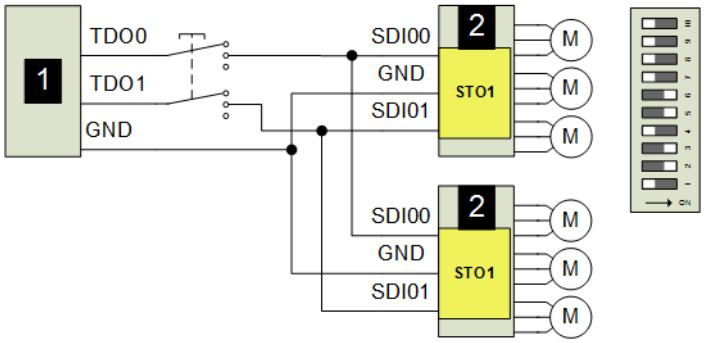


Fig. 8-47: STO control dircet via supply module

1 ... D3-DP 3xx/x	2 ... D3-DA 3xx/x

8.5 Validation of safety functions

It is recommended to define always a validation plan. In the plan the tests and analyses used to demonstrate the compliance of the solution with the requirements from the application are defined.

8.6 Validation of STO safety function

The safety function STO is to be validated against the safety requirements from the application in the following cases:

- During commissioning
- After changes of the application
- After repair or device replacement

The following table shows the test steps to be undertaken. The table has to be worked through from top to bottom.

Designation	State/Event	Expected result
Initial state	• System is switched on • Torque is enabled (STO input is "active"). • Axis module generates torque.	Motor axis is actively in motion or torque is present.
Test step 1	STO input becomes "inactive".	Motor axis coasts down or there is no torque and no error message occurs.
Test step 2	STO input becomes "active".	Axis module can apply torque.

8.7 Validation of SBC safety function

The safety function SBC has to be validated against the safety requirements from the application in the following cases:

- During commissioning
- After changes of the application
- After repair or device replacement
- Once a year

The following table shows the test steps to be undertaken. The table has to be worked through from top to bottom.

Description	State/Event	Expected result
Initial state	• System is switched on • SBC is activated • Brakes are released (STO1 input is active)	Brake(s) is/are released.
Test step 1	STO1 input becomes inactive.	Brake(s) is/are applied and there is no error message.
Test step 2	STO1 input becomes active.	Brake(s) is/are released.

8.8 Validate cross circuit test

If monitoring of STO inputs is undertaken by means of usage of testoutputs, e.g. usage of testoutputs of the supply module, this has to be validated in the following cases:

- During commissioning
- After changes to the application
- After repair or device replacement

The following table shows the test steps to be undertaken. The table must worked through from top to bottom.

Description	State/Event	Expected result
Initial state	• System is switched on • Inputs of safety functions are active (switched on). • Axis module has released brake(s).*).	Brake*) and torque are enabled.
Test step 1	One of the testoutputs is shorting against 24 V	The safety system switchs off break*) and torque after max. 2,4 s and an error message occures.

*) Only applies in case SBC is active.

Information

A restart is necessary to start the system again.

9 Diagnosis

9.1 Blink code

The yellow LED has a defined function only during software update.

LED yellow	LED red	LED green		Axis - status
	long (0,8 s)	long (0,8 s)[1]	short (0,4 s)[2]	
On	On	On	-	Restart / Start or loading firmware update
-	-	-	-	Initialisation during starting device
-	Off	1 x	1 x	Not ready to switch on
-	Off	2 x	2 x	Axis switch on disabled
-	Off	3 x	3 x	Axis ready to switch on
-	Off	4 x	4 x	Axis switched on
-	Off	On	On	Operation enabled
-	Off	6 x	6 x	Quickstop
-	Error code	7 x	7 x	Fault reaction active
-	Error code	8 x	8 x	Error (Fault)

[1] LED green long = Operation with real motor
[2] LED green short = Operation with simulated motor

10 Maintenance

The D3-DA 3xx/x is basically maintenance free, however, the fundamental, cyclical validation of safety functions needs to be considered. In case of error replace the device. It is asked to send back defect devices to KEBA.

10.1 Update firmware

The firmware can be updated via the tool DriveManager, included in the delivery. For more information see online help of DriveManager.

Information

All D3-DA 3xx/x of an axis group need to have the same version of the firmware. For information see functional description "KeDrive D3 - Firmware for axis controller devices".

11 Disposal

11.1 Disposal of the module

Caution

Please observe the regulations regarding disposal of electric appliances and electronic devices!

- The symbol with the crossed-out waste container means that electrical and electronic devices including their accessories must not be disposed of in the household garbage.
- The materials are recyclable in accordance with their labeling. You can make an important contribution to protecting our environment by reusing, renewing and recycling materials and old appliances.

12 Technical data

12.1 D3-DA 3x0/x-01xx, D3-DA 3x0/x-03xx

Control section

Control voltage:	24 V DC ±10 %
Control voltage on usage of a motor holding brake with cable length < 50 m:	24 V DC -5 % / +10 %
Inrush current:	max. 1.8 A
Current consumption (without fan, motor brake or encoder):	
● D3-DA 310/x:	0.5 A
● D3-DA 320/x:	0.7 A
● D3-DA 330/x:	0.9 A
Current output brake driver:	
● D3-DA 310/x:	max. 2 A
● D3-DA 320/x:	max. 2 x 2 A
● D3-DA 330/x:	max. 3 x 2 A
Current consumption fan:	400 mA

D.c. link

Capacity:	165 µF
DC resistance in (DC+ to DC-):	146 kΩ

Power section

Ambient temperature	5 - 40 °C (upt o 50 °C with derating)
Permissible switching frequencies:	2 / 4 / 8 / 12 / 16 kHz
without motor holding brake with 10 m motor cable:	3 - 8 kV / µs
Recommended output frequency range:	
● @ 2/4 kHz:	0 - 400 Hz
● @ 8 kHz:	0 - 800 Hz*)
● @ 16 kHz:	0 - 1600 Hz*)

*) For Variants with limitation of output frequency the max. output frequency is limited to 599 Hz.

Axis module

Dissipation @ (400 V / 4 kHz / I_{nom}) in the interior:	
● D3-DA 310/A-01xx:	60.5 W

• D3-DA 310/A-03xx:	64 W
• D3-DA 320/A-01xx:	69 W
• D3-DA 320/A-03xx:	76 W
• D3-DA 330/A-01xx:	77.5 W
• D3-DA 330/A-03xx:	88 W
• D3-DA 310/B-01xx:	25 W
• D3-DA 310/B-03xx:	29 W
• D3-DA 320/B-01xx:	33 W
• D3-DA 320/B-03xx:	40 W
• D3-DA 330/B-01xx:	41 W
• D3-DA 330/B-03xx:	51 W
Dissipation @ (400 V / 4 kHz / P_{nom}) via cooling element/cold plate:	
• D3-DA 310/x-01xx:	12 W
• D3-DA 310/x-03xx:	24 W
• D3-DA 320/x-01xx:	24 W
• D3-DA 320/x-03xx:	48 W
• D3-DA 330/x-01xx:	36 W
• D3-DA 330/x-03xx:	72 W

12.1.1 Current data D3-DA 3x0/x-01xx

Information

Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.

The value in the following table is output current and specified for each axis of the respective product variant (see 3.4 Overview D3-DA 3xx/x variants).

At U_{supply} = 230 V und 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	1.5 A	1.5 A	1.5 A	1.0 A	0.8 A
Maximum current for 10 s:	3 A	3 A	3 A	2 A	1.6 A
Maximum current for 500 ms:	4.5 A	4.5 A	3.2 A	2.5 A	1.9 A
Maximum current at F_M = 0 Hz:	3.7 A	3.1 A	2 A	1.6 A	1.2 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	1.5 A	1.5 A	1.3 A	0.7 A	0.3 A
Maximum current for 10 s:	3 A	3 A	2.6 A	1.4 A	0.6 A
Maximum current for 500 ms:	4.5 A	4.0 A	2.6 A	1.8 A	1.4 A

Maximum current at F_M = 0 Hz:	3.1 A	2.6 A	1.7 A	1.2 A	0.9 A

12.1.2 Current data D3-DA 3x0/x-03xx

> ***Information***
>
> *Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.*

The value in the following table is output current and specified for each axis of the respective product variant (see 3.4 Overview D3-DA 3xx/x variants).

At U_{supply} = 230 V und 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	3 A	3 A	3 A	2 A	1.45 A
Maximum current for 10 s:	6 A	6 A	6 A	4 A	2.9 A
Maximum current for 500 ms:	9 A	9 A	6.25 A	4.85 A	3.8 A
Maximum current at F_M = 0 Hz:	7.35 A	6.15 A	4 A	3.1 A	2.4 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	3 A	3 A	2.6 A	1.35 A	0.6 A
Maximum current for 10 s:	6 A	6 A	5.2 A	2.7 A	1.2 A
Maximum current for 500 ms:	9 A	8 A	5.2 A	3.6 A	2.75 A
Maximum current at F_M = 0 Hz:	6.2 A	5.1 A	3.3 A	2.3 A	1.75 A

12.2 D3-DA 3x0/x-06xx, D3-DA 3x0/x-12xx

Control section

Control voltage:	24 V DC ±10 %
Control voltage on usage of a motor holding brake with cable length < 50 m:	24 V DC -5 % / +10 %
Inrush current:	max. 1.8 A
Current consumption with power stage (without fan, motor brake or encoder):	
• D3-DA 310/x-06xx:	0.5 A
• D3-DA 310/x-12xx:	0.5 A
• D3-DA 320/x-06xx:	0.7 A
• D3-DA 320/x-12xx:	0.8 A
• D3-DA 330/x-06xx:	0.9 A
• D3-DA 330/x-12xx:	1 A

Current output, output motor holding brake:	
● D3-DA 310/x:	max. 2 A
● D3-DA 320/x:	max. 2 x 2 A
● D3-DA 330/x:	max. 3 x 2 A
Current consumption fan:	
● Size 1:	400 mA
● Size 2:	700 mA

D.c. link

Capacity:	
● D3-DA 3x0/x-06xx:	165 µF
● D3-DA 310/x-12xx:	225 µF
● D3-DA 320/x-12xx:	405 µF
● D3-DA 330/x-12xx:	405 µF
DC resistance in d.c. link (DC+ to DC-):	146 kΩ

Power section

Ambient temperature	5 - 40 °C (upt o 50 °C with derating)
Permissible switching frequencies:	2 / 4 / 8 / 12 / 16 kHz
without motor holding brake with 10 m motor cable:	3 - 8 kV / µs
Recommended output frequency range:	
● @ 2/4 kHz:	0 - 400 Hz
● @ 8 kHz:	0 - 800 Hz*)
● @ 16 kHz:	0 - 1600 Hz*)

*) For Variants with limitation of output frequency the max. output frequency is limited to 599 Hz.

Axis module

Dissipation @ (400 V / 4 kHz / I_{nom}) in the interior:	
● D3-DA 310/A-06xx:	67.6 W
● D3-DA 310/A-12xx:	95 W
● D3-DA 320/A-06xx:	83.2 W
● D3-DA 320/A-12xx:	118 W
● D3-DA 330/A-06xx:	98.8 W
● D3-DA 330/A-12xx:	141 W
● D3-DA 310/B-06xx:	32 W
● D3-DA 310/B-12xx:	64 W
● D3-DA 320/B-06xx:	47 W
● D3-DA 320/B-12xx	85 W

• D3-DA 330/B-06xx:	62 W
• D3-DA 330/B-12xx:	107 W
Dissipation @ (400 V / 4 kHz / P_{nom}) via cooling element/cold plate:	
• D3-DA 310/x-06xx:	40 W
• D3-DA 310/x-12xx:	87.3 W
• D3-DA 320/x-06xx:	80 W
• D3-DA 320/x-12xx:	175W
• D3-DA 330/x-06xx:	119 W
• D3-DA 330/x-12xx:	262 W

12.2.1 Current data D3-DA 3x0/x-06xx

Information

Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.

The value in the following table is output current and specified for each axis of the respective product variant (see 3.4 Overview D3-DA 3xx/x variants).

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	6 A	6 A	6 A	4 A	2.9 A
Maximum current for 10 s:	12 A	12 A	12 A	8 A	5.8 A
Maximum current for 500 ms:	18 A	18 A	12.5 A	9.7 A	7.6 A
Maximum current at F_M = 0 Hz:	14.7 A	12.3 A	8 A	6.2 A	4.8 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	6 A	6 A	5.2 A	2.7 A	1.2 A
Maximum current for 10 s:	12 A	12 A	10.4 A	5.4 A	2.4 A
Maximum current for 500 ms:	18 A	16 A	10.4 A	7.2 A	5.5 A
Maximum current at F_M = 0 Hz:	12.4 A	10.2 A	6.6 A	4.6 A	3.5 A

12.2.2 Current data D3-DA 3x0/x-12xx

Information

Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.

The value in the following table is output current and specified for each axis of the respective product variant (see 3.4 Overview D3-DA 3xx/x variants).

D3-DA 310/x-12xx (size BG1)

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	12 A	12 A	10.7 A	8.3 A	6.5 A
Maximum current for 2 s:	24 A	24 A	21.4 A	16.6 A	13 A
Maximum current for 500 ms:	36 A	36 A	21.4 A	16.6 A	13 A
Maximum current at F_M = 0 Hz:	25 A	21 A	13.5 A	10.5 A	8.2 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	12 A	12 A	8.8 A	6.2	4.7 A
Maximum current for 2 s:	24 A	24 A	17.6 A	12.4	9.4 A
Maximum current for 500 ms:	36 A	27.2 A	17.6 A	12.4	9.4 A
Maximum current at F_M = 0 Hz:	21 A	17.3 A	11.2 A	15.1	6 A

D3-DA 320/x-12xx, D3-DA 330/x-12xx (size BG2)

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	12 A	12 A	10 A	6.4 A	5.1 A
Maximum current for 10 s:	24 A	24 A	20 A	12.8 A	10.2 A
Maximum current for 500 ms:	36 A	36 A	29.3 A	19.9 A	14.7 A
Maximum current at F_M = 0 Hz:	36 A	29.5 A	20.2 A	13.7 A	10.1 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	12 A	12 A	8.7 A	5.27 A	4 A
Maximum current for 10 s:	24 A	24 A	17.4 A	10.4 A	8 A
Maximum current for 500 ms:	36 A	36 A	20.9 A	15.5 A	12.4 A
Maximum current at F_M = 0 Hz:	36 A	26 A	14.4 A	10.7 A	8.5 A

12.3 D3-DA 320/x-16xx, D3-DA 310/x-18xx

Control section

Control voltage:	24 V DC ±10 %

Control voltage on usage of a motor holding brake with cable length < 50 m:	24 V DC -5 % / +10 %
Inrush current:	max. 1.8 A
Current consumption with power stage (without fan, motor brake or encoder):	
● D3-DA 320/x-16xx:	0.8 A
● D3-DA 310/x-18xx:	0.5 A
Current output, output motor holding brake:	
● D3-DA 320/x-16xx:	max. 2 x 2 A
● D3-DA 310/x-18xx:	max. 2 A
Current consumption fan:	
● Size 1:	400 mA
● Size 2:	700 mA

D.c. link

Capacity:	
● D3-DA 320/x-16xx:	405 µF
● D3-DA 310/x-18xx:	275 µF
DC resistance in d.c. link (DC+ to DC-):	146 kΩ

Power section

Ambient temperature	5 - 40 °C (upt o 50 °C with derating)
Permissible switching frequencies:	2 / 4 / 8 / 12 / 16 kHz
without motor holding brake with 10 m motor cable:	3 - 8 kV / µs
Recommended output frequency range:	
● @ 2/4 kHz:	0 - 400 Hz
● @ 8 kHz:	0 - 800 Hz*)
● @ 16 kHz:	0 - 1600 Hz*)

*) For Variants with limitation of output frequency the max. output frequency is limited to 599 Hz.

Axis module

Dissipation @ (400 V / 4 kHz / I_{nom}) in the interior:	
● D3-DA 320/A-16xx	128.7 W
● D3-DA 310/A-18xx	102 W
● D3-DA 320/B-16xx:	95 W
● D3-DA 310/B-18xx:	66 W
Dissipation @ (400 V / 4 kHz / P_{nom}) via cooling element/cold plate:	
● D3-DA 320/x-16xx:	233 W
● D3-DA 310/x-18xx:	120 W

12.3.1 Current data D3-DA 320/x-16xx

> ***Information***
>
> *Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.*

The value in the following table is output current and specified for each axis of the respective product variant (see 3.4 Overview D3-DA 3xx/x variants).

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	16 A	16 A	15.4 A	10.5 A	7.7 A
Maximum current for 2 s:	32 A	32 A	29.3 A	19.9 A	14.7 A
Maximum current for 500 ms:	40 A	40 A	29.3 A	19.9 A	14.7 A
Maximum current at F_M = 0 Hz:	36 A	29.5 A	20.2 A	13.7 A	10.1 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	16 A	16 A	11 A	8.2 A	6.3 A
Maximum current for 2 s:	32 A	32 A	21 A	15.5 A	10.4 A
Maximum current for 500 ms:	40 A	36 A	20.9 A	15.5 A	12.4 A
Maximum current at F_M = 0 Hz:	36 A	26 A	14.4 A	10.7 A	8.5 A

12.3.2 Current data D3-DA 310/x-18xx

> ***Information***
>
> *Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.*

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	18 A	18 A	16 A	12.4 A	9.6 A
Maximum current for 2 s:	36 A	36 A	32 A	24.8 A	19.3 A
Maximum current for 500 ms:	48 A	48 A	32 A	24.8 A	19.3 A
Maximum current at F_M = 0 Hz:	37.5 A	31.4 A	20.3 A	15.8 A	12.3 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	18 A	18 A	13.2 A	9.2 A	7 A

Maximum current for 2 s:	36 A	36 A	26.4 A	18.4 A	14 A
Maximum current for 500 ms:	48 A	40.8 A	26.4 A	18.4 A	14 A
Maximum current at F_M = 0 Hz:	31.5 A	26 A	16.8 A	11.7 A	8.9 A

12.4 D3-DA 310/x-24xx, D3-DA 310/x-32xx

Control section

Control voltage:	24 V DC ±10 %
Control voltage on usage of a motor holding brake with cable length < 50 m:	24 V DC -5 % / +10 %
Inrush current:	max. 1.8 A
Current consumption with power stage (without fan, motor brake or encoder):	
• D3-DA 310/x:	0.9 A
Current output, output motor holding brake:	
• D3-DA 310/x-24xx:	max. 2 A
• D3-DA 310/x-32xx:	max. 2 x 2 A
Current consumption fan:	700 mA

D.c. link

Capacity:	675 µF
DC resistance in d.c. link (DC+ to DC-):	146 kΩ

Power section

Ambient temperature	5 - 40 °C (upt o 50 °C with derating)
Permissible switching frequencies:	2 / 4 / 8 / 12 / 16 kHz
without motor holding brake with 10 m motor cable:	3 - 8 kV / µs
Recommended output frequency range:	
• @ 2/4 kHz:	0 - 400 Hz
• @ 8 kHz:	0 - 800 Hz*)
• @ 16 kHz:	0 - 1600 Hz*)

*) For Variants with limitation of output frequency the max. output frequency is limited to 599 Hz.

Axis module

Dissipation @ (400 V / 4 kHz / I_{nom}) in the interior:	
• D3-DA 310/A-24xx	103 W
• D3-DA 310/A-32xx	112 W
• D3-DA 310/B-24xx:	78 W

• D3-DA 310/B-32xx:	87 W
Dissipation @ (400 V / 4 kHz/ P_{nom}) via cooling element/cold plate:	
• D3-DA 310/x-24xx:	176 W
• D3-DA 310/x-32xx:	240 W

12.4.1 Current data D3-DA 310/x-24xx

Information

Current data per axis in the axis module 230/400/480 V AC refers to the supply voltage for the supply module.

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	24 A	24 A	20 A	12.5 A	9.9 A
Maximum current for 10 s:	48 A	48 A	45.7 A	31.1 A	22.9 A
Maximum current for 500 ms:	72 A	66.8 A	45.7 A	31.1 A	22.9 A
Maximum current at F_M = 0 Hz:	53.9 A	39.2 A	26.8 A	18.2 A	13.4 A

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	24 A	24 A	17.1 A	10.1 A	8.2 A
Maximum current for 10 s:	48 A	48 A	32.6 A	24.1 A	19.3 A
Maximum current for 500 ms:	72 A	59 A	32.6 A	24.1 A	19.3 A
Maximum current at F_M = 0 Hz:	52.5 A	34.6 A	19.1 A	14.2 A	11.3 A

12.4.2 Current data D3-DA 310/x-32xx

Information

Current specification for each axis module 230/400/480 V AC referes to the supply voltage of the supply module.

At U_{supply} = 230 V and 400 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	32 A *)	32 A	31 A	22.5 A	17 A
Maximum current for 1.5 s:	64 A	64 A	62 A	50.8 A	37.4 A
Maximum current for 500 ms:	100 A	100 A	74.8 A	50.8 A	37.4 A
Maximum current at F_M = 0 Hz:	64 A	64 A	51.4 A	35 A	25.7 A

*) The nominal current constitues 26 A for the operation in the scope of CSA / UL.

At U_{supply} = 480 V

F_S	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
Nominal current:	32 A	32 A	28.5 A	18.5A	13.7 A
Maximum current for 1.5 s:	64 A	64 A	53.3 A	39.5 A	31.6 A
Maximum current for 500 ms:	100 A	90.7 A	53.3 A	39.5 A	31.6 A
Maximum current ati F_M = 0 Hz (for 2 s):	64 A	62.4 A	36.7 A	27.2 A	21.7 A

12.5 General safety specifications

STO

Safety category:	• up to category 4, PL e to EN ISO 13849-1 • up to SIL 3 to EN 62061 and EN 61508
System structure:	2-channel
PFH:	5,29 x 10^{-11} for each axis, according to EN 62061 / EN 61508
DC_{avg}:	High
Proof-test-interval:	20 years
Dimensioning the operating mode:	"high demand" according to EN 61508 (high demand rate)
Reaction time:	2.5 ms

SBC

Safety category:	• up to category 3, PL d to EN ISO 13849-1 • up to SIL 2 to EN 62061 and EN 61508
System structure:	2-channel
PFH:	3,55 x 10^{-10} for each axis, according to EN 62061 / EN 61508
DC_{avg}:	Medium
Proof-test-interval:	20 years
Dimensioning the operating mode:	"high demand" according to EN 61508 (high demand rate)
Reaction time:	3 ms

12.6 Ambient conditions

According to EN 61800-1 and the included and referenced environment classifying of standards IEC 60421-3.

Operation:	According to EN 61800-2, IEC 60721-3-3 class 3K3
● Temperature:	+5 °C to +40 °C (4, 8, 16 kHz) +40 °C bis +55 °C with performance reduction[1)]
● Relative humidity of air:	5 to 85 %[2)]
Storage:	According to EN 61800-2, IEC 60721-3-1 class 1K3 and 1K4
● Temperature:	-25 °C to +55 °C
● Relative humidity of air:	5 to 95 %[3)]
Transport:	According to EN 61800-2, IEC 60721-3-2 class 2K3
● Temperature:	-25 °C to +70 °C
● Relative humidity of air:	95 % to max. +40 °C[4)]
Vibration resistance:	According to EN 61800-2
Shock resistance:	According to EN 61800-2
Protection class:	IP20 (all connections terminals IP00), in case of using safety functions installation in control cabinet conform with IP code IP44 is neccessary
Mounting height:	To 1.000 m over NN (with overvoltage category III), above with performance reduction (1% per 100 m, max. 2,000 m over NN)[5)]
Contamination level:	2

[1)] Performance reduction:

D3 DA 3x0/A-01xx, D3 DA 3x0/A-03xx, D3 DA 3x0/A-06xx:	3.4 % per °C
D3 DA 310/A-12xx, D3 DA 310/A-18xx:	1.6 % per °C
D3 DA 320/A-12xx, D3 DA 330/A-12xx:	2 % per °C
D3 DA 320/A-16xx :	2.6 % per °C
D3 DA 310/A-24xx:	2.3 % per °C
D3 DA 310/A-32xx:	3.0 % per °C

[2)] The absolute humidity is limited to max. 25 g/m³. That means that the maximum values for temperature and relative humidity stipulated in the table must not occur simultaneously.

[3)] The absolute humidity is limited to max. 29 g/m³. So the maximum values for temperature and relative humidity stipulated in the table must not occur simultaneously.

[4)] The absolute humidity is limited to max. 60 g/m³. This means, at 70 °C for example, that the relative humidity may only be max. 40 %.

[5)] Mounting height higher than 2,000 m is possible under the following conditions:

- It must be guaranteed with appropriate measures, that the power supply conforms to the overvoltage category II (IEC 60664-1). Overvoltage must be limited to values < 2.5 kV phase-phase and phase-ground.
- If safe electrical isolation (according to EN61880-5-1) is required e.g. for control interface, it must be realized outside of the module or the module may not be run directly on mains (e.g. on a isolating transformer with secondary earthed star point).
- A performance reduction must be considered (1 % per 100 m, starting at 1,000 m over NN).

Information

The climatic conditions are valid for the device. Therefore they must be complied also in the control cabinet.

12.7 Safe digital inputs

Quantity:	4
Type:	Type 1 (to EN 61131-2)
Nominal voltage:	24 V DC PELV
Input current:	Max. 15 mA
Low-level range:	-3 V DC to +5 V DC
High-level range:	+15 V DC to +30 V DC
Electrical isolated:	Yes
Cross-circuit detection:	Yes, via test outputs
OSSD compatible:	Yes *)
Effect by incorrectly connected inputs:	Potential defect

*) OSSD (Output Signal Switching Device) Test pulse, which should be filtered, must get the following specifications:

- Duration of the test pulses must be ≤ 0.75 ms.
- Repetation rate must be ≥ 30 ms.
- The minimal difference of the test pulses between both channels must be > 10 ms.

Caution

Duration of the test pulses between 0.75 ms and 2 ms results an unwanted shutdown after unpredictable time. This information applies irrespective of wheter the monitoring of external test pulses is switched off or on.

12.8 Digital inputs

Input type:	Type 1 (according to EN 61131-2:2007)
Voltage range for HIGH:	18 V ≤ UH ≤ 28.8 V
Voltage range for LOW:	0 V ≤ UL ≤ 5 V
Galvanic isolation toward the control electronics:	Yes
Galvanic isolation of the inputs:	No
Cycle time (processing time):	1 ms
Filter:	Digital inputs: 500 Hz
Wiring:	Sink

Interrupt-driven inputs

Input type:	Type 1 (according to EN 61131-2:2007)
Voltage range for HIGH:	18 V ≤ UH ≤ 28.8 V
Voltage range for LOW:	0 V ≤ UL ≤ 5 V
Galvanic isolation toward the control electronics:	Yes
Galvanic isolation of the inputs:	No
Reaction time HIGH:	< +/- 0.75 us
Reaction time LOW:	< +/- 5.5 us
Wiring:	Sink

12.9 Dimensions, weight

Size 1

Dimensions with cooling element

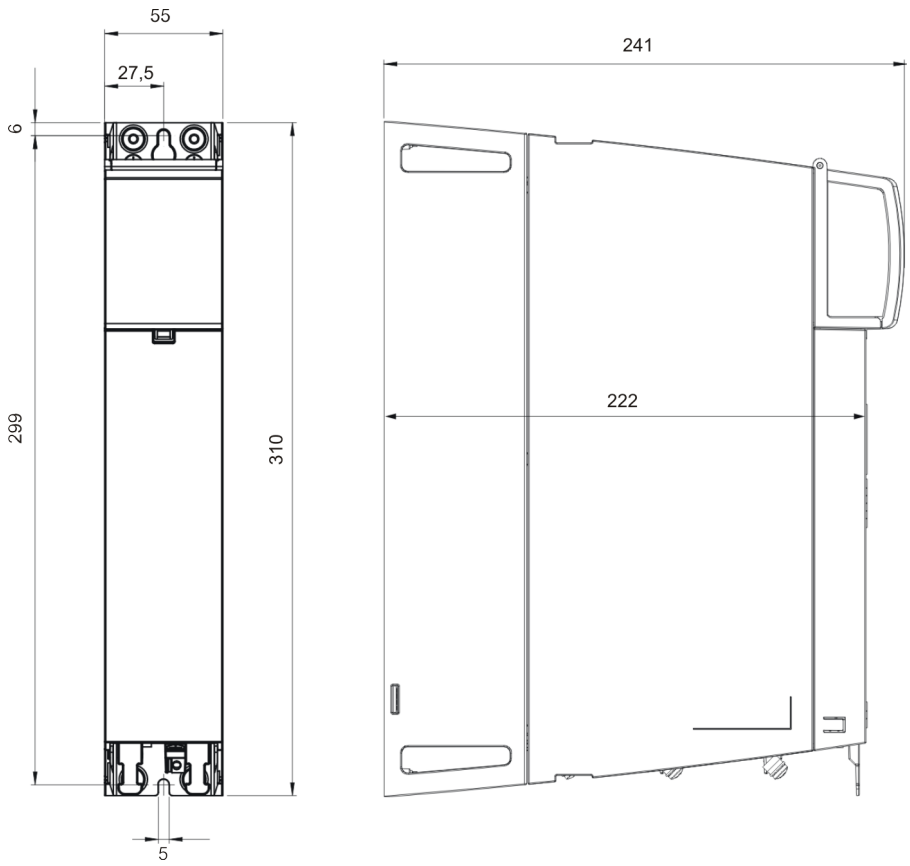


Fig. 12-48: Dimensional drawing, measures in mm

Dimensions with cold plate

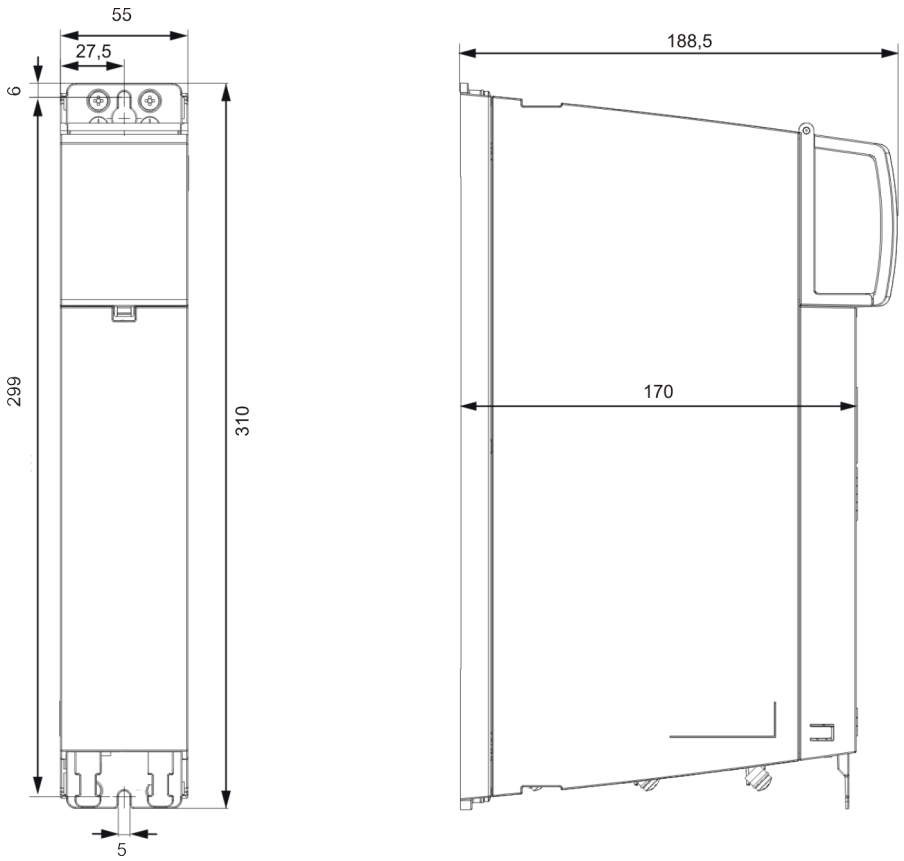


Fig. 12-49: Dimensional drawing, measures in mm

Size 2

Dimensions with cooling element

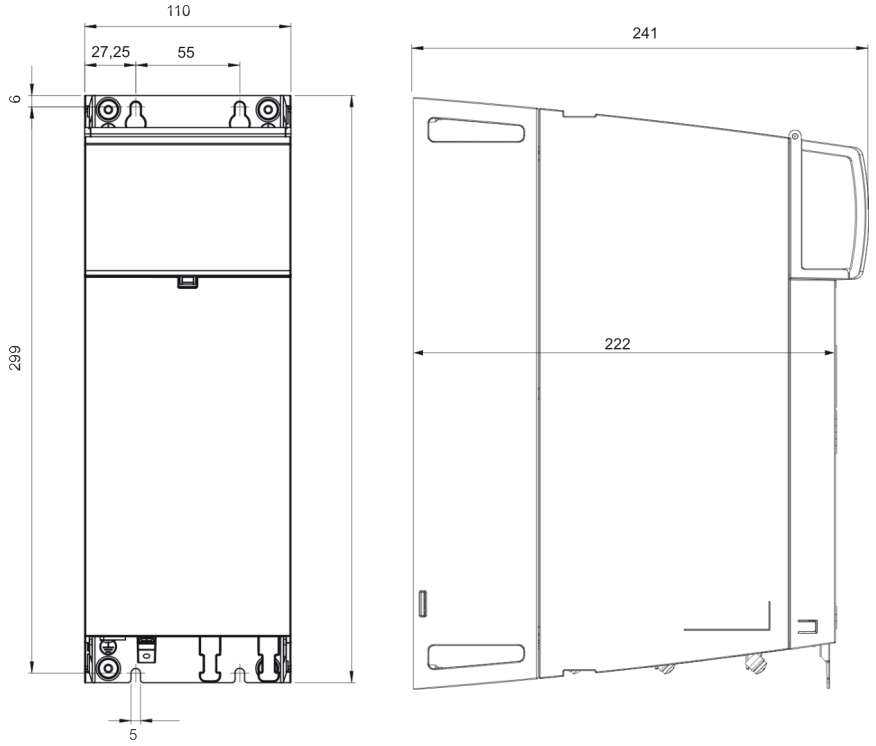


Fig. 12-50: Dimensional drawing, measures in mm

Dimensions with cold plate

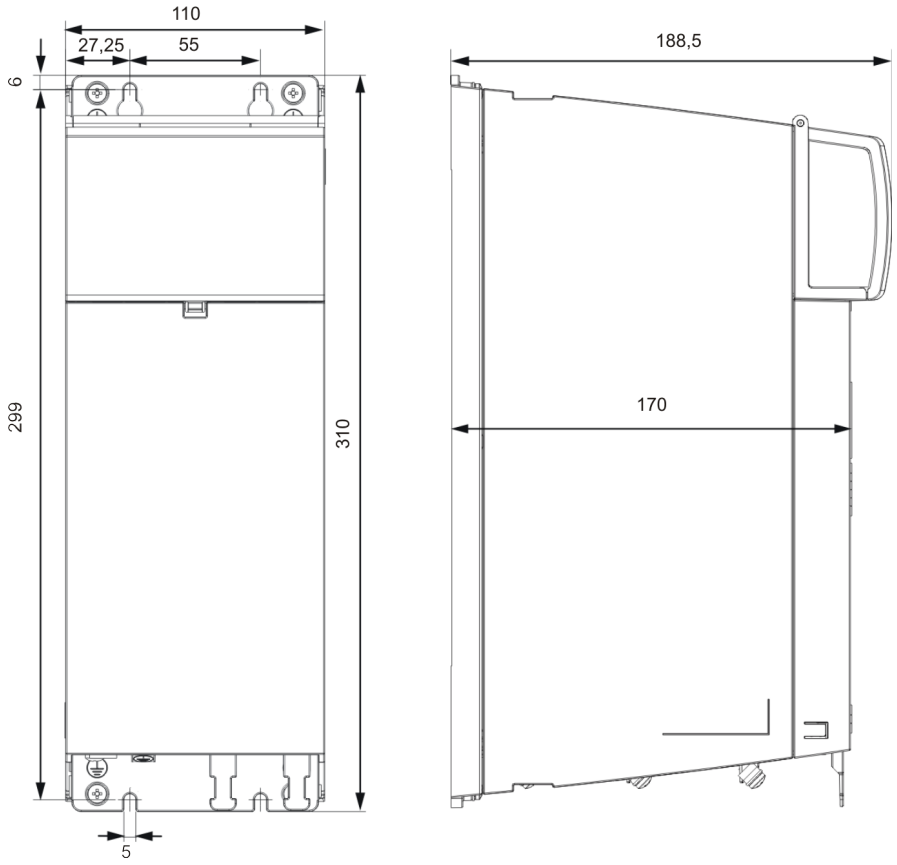


Fig. 12-51: Dimensional drawing, measures in mm

Dimensions, weight

Height:	310 mm
Width:	
● Baugröße 1:	55 mm
● Baugröße 2:	110 mm
Depth:	
● D3-DA 3x0/A (with / without cover flap):	241 mm / 222 mm
● D3-DA 3x0/B (with / without cover flap):	188.5 mm / 170 mm
Weight:	
● D3-DA 3x0/A (Size 1):	2,650 g
● D3-DA 3x0/B (Size 1):	2,300 g
● D3-DA 3x0/A (Size 2):	5,100 g
● D3-DA 3x0/B (Size 2):	3,700 g

13 EC directives and standards

13.1 EC directives

2014/30/EU	Directive on electromagnetic compatibility
2011/65/EU	ROHS directive
2014/35/EU	Low voltage directive
2006/42/EG	Machinery directive

13.2 Standards

To check the conformity of the system with the directives, the following non-binding legal European standards were applied.

13.2.1 Machine safety and functional safety

EN ISO 13849-1:2008 + AC:2009	Safety-related parts of control systems - Part 1: General principles for design
EN 62061:2005	Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN 61800-5-2:2007	Functional Safety requirements of adjustable speed electrical power drive systems
IEC 61508 1-7:2010	Functional safety of electrical, electronic, programmable electronic safety-related systems

13.2.2 EMC directives

EN 61800-3:2004 + A1:2012	Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods
EN 61326-3-1:2008	Electrical equipment for measurement, control and laboratory use – EMC requirements Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications

13.2.3 Electrical safety and fire protection

EN 60204-1:2006 + A1:2009	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61800-5-1:2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy

13.2.4 Environmental and surrounding conditions

EN 61800-2: 2015	Adjustable speed electrical power drive systems - Part 2: General requirements; rating specifications for low voltage adjustable frequency a.c. power drive systems

13.3 CE marking

The D3-DA 3xx/x meets the requirements for installation in a machine or plant in the context of the Machinery directive 2006/42/EG and the Low voltage directive 2014/35/EU. The D3-DA 3xx/x is accordingly CE marked. The D3-DA 3xx/x axis modules in a group with the D3-DP 3xx/x supply modules and on observing the installation instructions and on the usage of cabels and accessories suggested in chapters 16.2 Accessories and 16.3 Connection technology meet the requirement of EMC directives 2014/30/EU.

For validity of CE declaration also the data of the mains filters (for number max. allowed axes and max. allowed complete cable length for all axes) must be considered.

13.4 UL certification

Information

The following requirements must be observed for a valid UL mark.

Common terms to comply with the UL certification (UL 61800-5-1) for all the sizes of D3-DA 3xx/x.

Multiple rated equipment. Operation only within the technical ratings of the drive, details see "Technical data".

Ensure that surrounding air temperature exceeds not the maximum approbate ambient temperature (see table below in this chapter).

Use in a pollution degree 2 environment according to IEC60664-1 only. This means device shall be mounted in a suitable switchgear cabinet.

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance to the manufacturer instructions, National Electrical Code and any additional local codes.

Use the following UL-certified device wiring (mains, motor and control cables) only:

- Copper conductors rated min. 75 °C.
- Recommended terminal connectors and specified tightening torques for terminals (see "Connections and wiring")

The internal overload protection operates within max. 10 sec (exception: 2 sec for 16, 18 and 32 A device,) when reaching 200 % of the motor full load current. Details see chapter "Technical Data".

Motor over temperature sensing (such as thermal sensor or switch embedded in the motor) must connected during operation of these drives.

Auxiliary supply voltage 24 V DC

Use D3-DA 3xx/x only in combination with D3-DP 3xx/x supply unit only. For use only in electric supply mains with maximum overvoltage category III and for circuits delivering not more than maximum short circuit current capability of 5000 A RMS symmetrical Amperes at maximum voltage of 480 V AC, when protected by fuses as required. Ratings and fuse classes refer to chapter "UL certification" in project engineering manual of D3-DP 3xx/x.

Overload protection:	
• D3-DA 3xx/x-01 - D3-DA 3xx-12:	200 % @ 10 sec
• D3-DA 3xx/x-16 - D3-DA 3xx-32:	200 % @ 2 sec
Max. ambient temperature:	45 °C
Certification:	
• D3-DA 3xx/A:	c UL us
• D3-DA 3xx/B:	c UR us

Information

Valid for all variants with firmware version V1.40-13 or higher.

13.5 Loads on the mains due to harmonics

Information to EN 61000-3-2 :2006

The devices in the KeDrive are "professional equipment" in the context of EN61000 such that with a nominal connected load ≤ 1kW (or ≤ 16 A per mains phase) they fall within the scope of the standard. On the direct connection of the supply module ≤ 1 kW to the public low voltage grid, either measures to conform with the standard are to be taken or the responsible utility must grant approval for connection. If you use our drives as a component in your machine / system, the directive of the standards must be checked for the entire machine / system.

14 Declaration of conformity

14.1 With safety

KEBA

EU Declaration of Conformity

CE

KEBA AG
Gewerbepark Urfahr
4041 Linz
AUSTRIA

Document No.: **92717/CE/4**

We declare for the following products

Description: **KeDrive D3**
with Safety Functions STO and SBC

Name of product: **D3-DA 3x0/x-xxx1-xx x**

Variants: **see Annex I**

the conformity with the following relevant Union harmonisation legislation :

- **EC-Directive 2006/42/EC relating to machinery**
- **EU-Directive 2014/30/EU relating to electromagnetic compatibility**
- **EU Directive 2011/65/EU on the restiction of the use of certain hazardous substances in electrical and electronic equipment**

Following relevant harmonised standards were used as the basis for the presumption of the conformity with the directive 2006/42/EC for the safety functions “Safe Torque Off” and “Safe Brake Control” (if available):

- **EN ISO 13849-1:2015**
- **EN 61800-5-2:2007**
- **EN 62061:2005**
- **EN 61326-3-1:2009**
- **EN 61800-5-1:2007**
- **EN 60204-1:2006 + A1:2009**

Following notified body has issued a type examination process according Annex IX:

TÜV Rheinland
Am Grauen Stein, 51105 Cologne, Germany
Notified Body: 0035
Number of the type examination certificate: 01/205/5402.00/14

Following relevant harmonised standard was used as the basis for presumption of conformity with the directive 2014/30/EU:

- **EN 61800-3:2004 +A1:2011**

The following additional standards have been taken into account with regard to product safety:

- **EN 61326-3-1:2009**
- **IEC 61508 part 1:2010 to part 7:2010**

Following relevant harmonized standard/s was/were used as the basis for the presumption of the conformity with the directive 2011/65/EU:

- **EN 50581:2012**

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Important notes:
This declaration of conformity is issued under the sole responsibility of the manufacturer.

For the validity of this EU declaration of conformity the client has to fulfil the requirements of the system and its system boundary documented in the manual to meet the limit values of category C3 acc. to EN 61800-3 for the drive system.

STO and SBC (if avialable) are part of the safety control circuits of a machine. Therefore the fundamental safety requirements in accordance with Appendix 1 of the Directive for machines can only be met with all safety control circuits.

By any modification on the product, that is performed without KEBA's consent will loss the products the presumption of conformity.

This declaration certifies the conformity with the directives mentioned, but does not imply any warranty of the product features.

The safety instructions contained in the available documentation for this product(s) must be followed.

Authorised person to compile the technical file is Ernst Steller, KEBA AG, Gewerbepark Urfahr, A-4041 Linz.

Linz, 20.11.2017
Place, Date

Dipl.-Ing. Gerhard Ensinger
Vice President Product Compliance

KEBA

Annex I

Variants
KeDrive D3 drive units

D3-DA 330/(X)-01(Y)1-(U)(Z) (V)	D3-DA 320/(X)-16(Y)1-(U)(Z) (V)
D3-DA 330/(X)-03(Y)1-(U)(Z) (V)	D3-DA 310/(X)-01(Y)1-(U)(Z) (V)
D3-DA 330/(X)-06(Y)1-(U)(Z) (V)	D3-DA 310/(X)-03(Y)1-(U)(Z) (V)
D3-DA 330/(X)-12(Y)1-(U)(Z) (V)	D3-DA 310/(X)-06(Y)1-(U)(Z) (V)
D3-DA 320/(X)-01(Y)1-(U)(Z) (V)	D3-DA 310/(X)-12(Y)1-(U)(Z) (V)
D3-DA 320/(X)-03(Y)1-(U)(Z) (V)	D3-DA 310/(X)-18(Y)1-(U)(Z) (V)
D3-DA 320/(X)-06(Y)1-(U)(Z) (V)	D3-DA 310/(X)-24(Y)1-(U)(Z) (V)
D3-DA 320/(X)-12(Y)1-(U)(Z) (V)	D3-DA 310/(X)-32(Y)1-(U)(Z) (V)

(X) Cooling	A: cooling element (heat sink) B: cold plate
(Y) Encoder interface	0: none 1: multi encoder interface
(U) Options	0: none 1: coated PCB 2: output frequency <600Hz 3: combination of options 1 and 2
(Z) Version	0
(V)	D blank

15 Appendix: Estimation of system performance

In this chapter, an example for the calculation of the maximum available effective power in the DC link of the axis group as well as for the estimation of the rated power output of an axis module is given.

Calculation of the maximum available effective power

The maximum effective power of the DC link of the axis group is restricted by:

- Effective power of the supply module (10 kW or 22 kW at a supply voltage of 3 x 400 V AC)
- Available DC link capacity (for 1 kW 100 µF are required)

Example

A supply module with 10 kW supplies a single axis module with 24 A and a triple axis module with 12 A. The supply module can provide up to 10 kW effective power output at the DC link permanently, if the sum of all DC link capacities is ≥ 1,000 µF.

Module	Power	DC link capacity
Supply module	10 kW	330 µF
Single axis module	24 A	675 µF
Triple axis module	12 A	405 µF

```
330 + 405 + 675 = 1,410
```

The available DC link capacity of the axis group in this example is 1,410 µF. Therefore the available effective power of the DC link is 10 kW. All axis can not take more than in total 10 kW effective power permanently from the DC link.

Estimation of output power

The effective power of the DC link as well as the power output of one or more axis depends on the used supply module and the supplied axis modules. The following example shows an estimation of the effective power output of a triple axis module with 12 A.

Example

A supply module with 10 kW supplies a triple axis module with 12 A. With sufficient DC link capacity, the supply module can provide permanently up to 10 kW effective power at the DC link.

Module	Power	DC link capacity
Supply module	10 kW	330 µF

Module	Power	DC link capacity
Triple axis module	12 A	405 µF

```
330 + 405 = 735
```

The available DC link capacity of the axis group in this example is 735 µF and thus smaller than 1,000 µF. Therefore the effective power is reduced to 7.35 kW due to the actual available DC link capacity.

The sum of the available power output with a typical efficiency of the axis modules of 98 % is calculated as shown below:

```
7.35 x 0.98 = 7.2
```

The sum of the available power output over all axis is 7.2 kW.

The available power output for an axis with 12 A with a maximal motor voltage of 326 V (depending on the modulation type) is calculated as shown below:

```
326 x 12 x √3= 6.78 kW
```

The available power output for one axis is 6.78 kW.

Reduction of the effective power

Supply voltage 3 x 230 V AC

For supply modules, which can be supplied with 3 x 230V AC, the effective, permanently available power of the DC link is reduced by a factor of 1.732. The condition 100 µF per 1 kW effective power remains unchanged.

Supply voltage 230 V AC

For supply modules, which can be supplied also single-phased with 230 V AC, the effective power of the DC link is 1 kW. The peak power is limited to 2 kW. For 1 kW effective power, additional DC link capacitiy of 900 µF is neccessary.

16 Appendix: Further components

16.1 Cooling plate and cooling element

The following cooling plates and cooling elements are available:

Designation	Material number
Cooling element D3-XM 310-055	95179
Cooling plate D3-XM 300-060	95521
Cooling plate D3-XM 300-080	102204

16.1.1 Cooling Element D3-XM 310-055

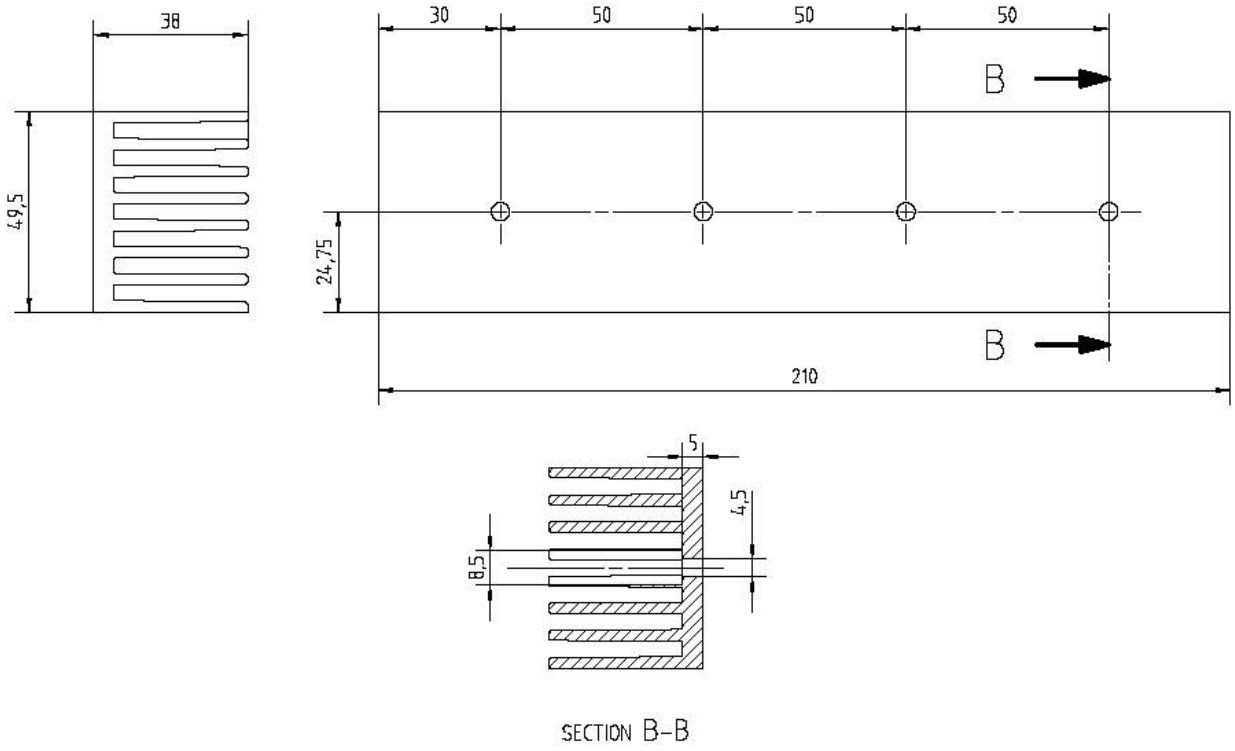

Fig. 16-52: Dimensions of cooling element D3-XM 310-055, dimensions in mm

16.1.2 Cooling plate D3-XM 300-060

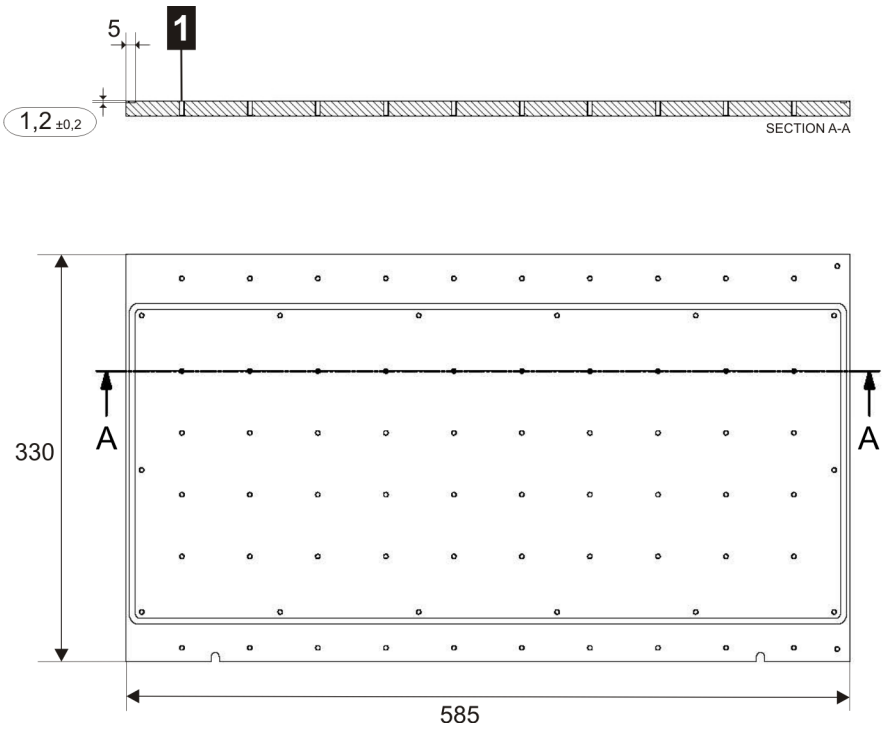

Fig. 16-53: Dimensions of cooling plate D3-XM 300-060, dimensions in mm

1 ... all thread M4 passage	

16.1.3 Cooling plate D3-XM 300-080

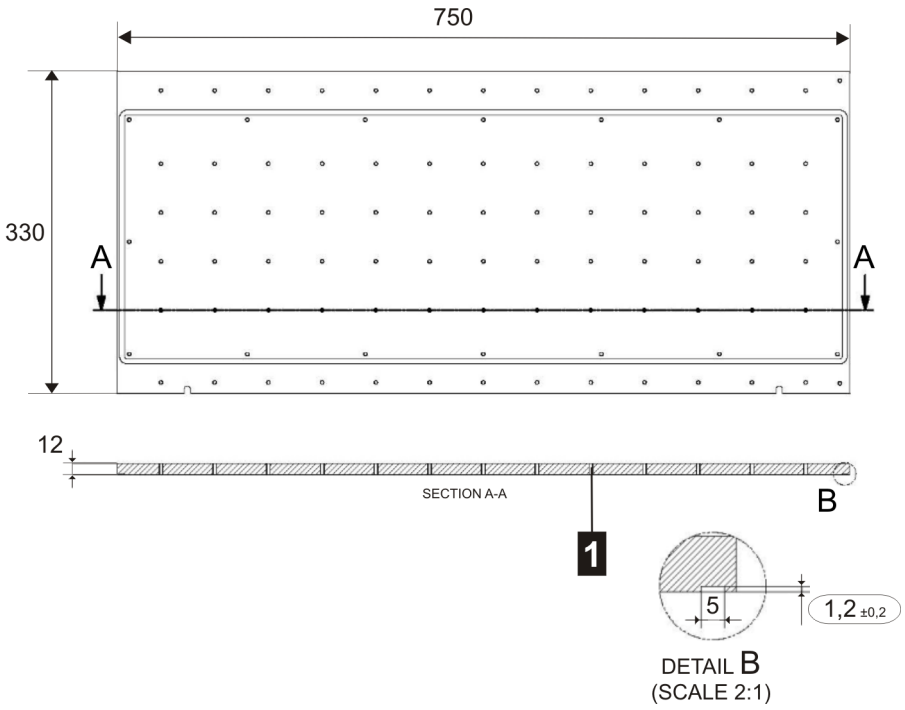

Fig. 16-54: Dimensions of cooling plate D3-XM 300-080, dimensions in mm

1 ... all thread M4 passage	

16.2 Accessories

The KeDrive system was supplemented with the following accessories:

- DMS2 synchronous servomotors, with:
  - Encoders of type Hiperface, Hiperface DSL and Resolver
  - Pre-assembled motor cable
  - Pre-assembled encoder cable
- Data cables - for fieldbus and communication with supply module
- Connector sets, PE-connection plate
- PC-usersoftware - e.g. KeStudioDriveManager
- Mains filter - reduces conducted high frequency interference of the D3-DA 3xx/x axis module (For use on the D3-DP 3xx/x supply module)
- Mains choke - reduces the voltage distortions (THD) in the system and prolongs the life of the D3-DA 3xx/x axis module (for use on the D3-DP 3xx/x supply module)
- Brake resistor - converts surplus regenerated energy into heat and in this way permits an even more dynamic movement process (for usage on theD3-DP 3xx/x supply module).

Information

All accessoires may only be used with modules of the KeDrive D3 series.

16.3 Connection technology

This chapter describes the various cables for connecting motors, which are available as accessories from KEBA.

Caution

If D3-DA 3xx/x connection cables are equipped with an user specific connector and not with KEBA proposed connector, reduced electromagnetic immunity is possible. In this case the user has to ensure that the requirements of the EMC directive are met.

16.3.1 Connection cable XW P0x-xxx

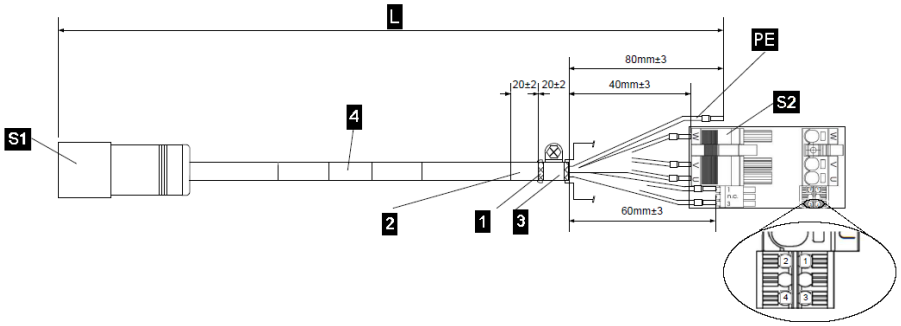

Fig. 16-55: Structure of the connection cable XW P0x-xxx

S1 ... Connector motor-sided	S2 ... Connector drive control system-sided
1 ... Outer and inner shields connected to copper strip	2 ... Shrinking tube overlaps the copper strip (5 mm)
3 ... Shield is fixed at the mounting plate	4 ... Cable of length L
PE ... Not connected	

Pin assignment at connection cable XW P0x-xxx

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Drive control system-sided)
U	1	Black, white figure 1	U
PE	2	Green-yellow	n.c.
V	3	Black, white figure 2	V

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Drive control system-sided)
W	4	Black, white figure 3	W
Temp +	A	Black, white figure 5	1
Temp -	B	Black, white figure 6	2
Br +	C	Black, white figure 7	3
Br -	D	Black, white figure 8	4

16.3.2 Connection cable XW H0x-xxx

Information

The cables are also used for signal connection of Hiperface DSL encoder and are only intended for a direct connection from the axis module to the motor. If intermediate sockets are required, ensure that a continuous shielding of the Hiperface DSL elements from the axis module to the motor is retained. The existing M23 connector may need to be replaced by another suitable connector.

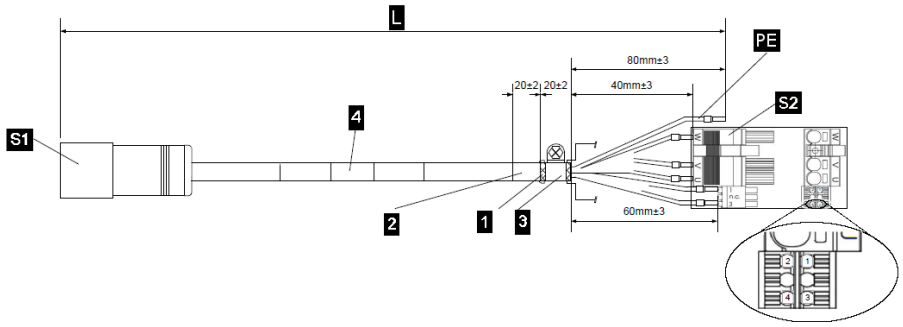

Fig. 16-56: Structure of the connection cable XW H0x-xxx

S1 ... Connector motor-sided	S2 ... Connector axis module-sided
1 ... Outer and inner shields connected to copper strip	2 ... Shrinking tube overlaps the copper strip (5 mm)
3 ... Shield is fixed at the mounting plate	4 ... Cable of length L
PE ... Not connected	

Pin assignment at connection cable XW H0x-xxx

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Axis module-sided)
U	1	Black, white imprint U	U
PE	2	Green-yellow	n.c.

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Axis module-sided)
V	3	Black, white imprint V	V
W	4	Black, white imprint W	W
HDSL +	A	White	2
HDSL -	B	Brown	1
Br +	C	Black, white figure 5	3
Br -	D	Black, white figure 6	4

16.3.3 Signal cable XW E10-xxx

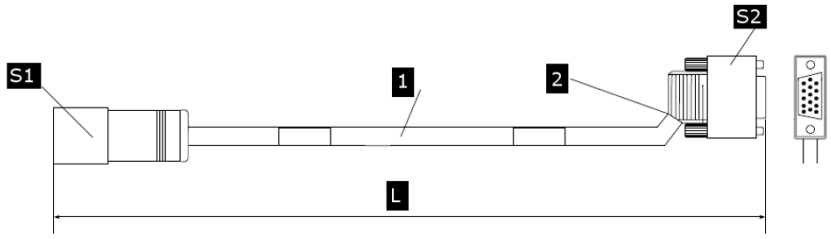

Fig. 16-57: Structure of the signal cable XW E10-xxx

S1 ... Connector motor-sided	S2 ... Connector HDSUB
1 ... Cable of length L	2 ... Outer shield connected with copper strip to housing

Pin assignment at signal cable XW E10-xxx

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Drive control system-sided)
Us	1	White	7
GND	2	Brown	8
Ref Sin	3	Blue	6
Ref Cos	4	Green	1
Data +	5	Red	4
Data -	6	Black	5
Sin +	7	Purple	11
Cos +	8	Brown	2
n.c.	9	-	n.c.
n.c.	10	-	n.c.
n.c.	11	-	n.c.
n.c.	12	-	n.c.

16.3.4 Signal cable XW R10-xxx

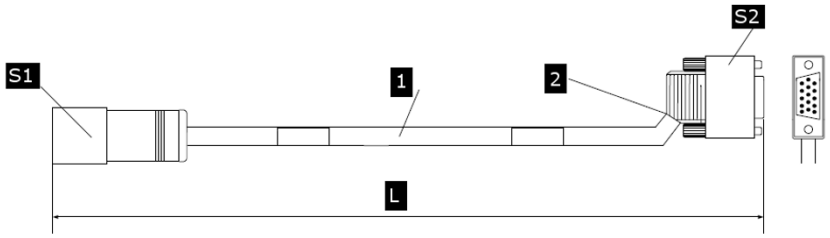

Fig. 16-58: Structure of the signal cable XWR10-xxx

S1 ... Connector motor-sided	S2 ... Connector HDSUB
1 ... Cable of length L	2 ... Outer shield connected with copper strip to housing

Pin assignment at signal cable XW R10-xxx

Signal	Connector S1 (Motor-sided)	Color of wires / identification	Connector S2 (Drive control system-sided)
S2	1	Black	11
S1	2	Green	2
S3	3	Yellow	1
n.c.	4	-	n.c.
n.c.	5	-	n.c.
S4	6	Brown	6
R1	7	Brown-Red	10
n.c.	8	-	n.c.
n.c.	9	-	n.c.
n.c.	10	-	n.c.
R2	11	Brown-Blue	-
n.c.	12	-	n.c.

16.3.5 Signal cable XW 020

The signal cable XW 020 serves as connection within a drive block (D3-DU 3xx/x, D3-DP 3xx/x, D3-DA 3xx/x).

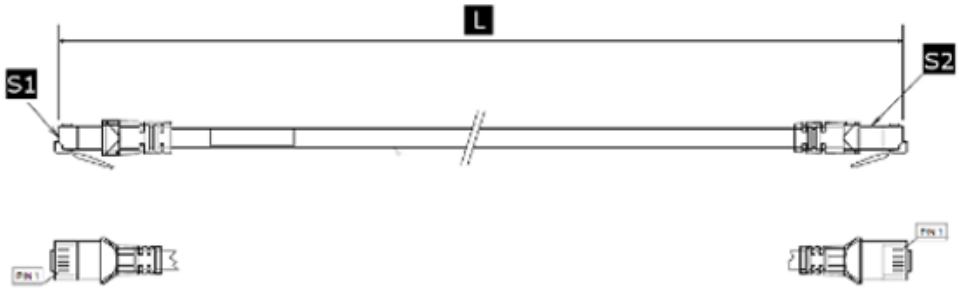

Fig. 16-59: Structure of the signal cable XW 020

S1 ... Connector device 1	S2 ... Connector device 2
1 ... Cable of length L	

Signal	Connector S1	Color of wires / identification	Connector S2
Tr. Data +	1	White-Orange	1
Tr. Data -	2	Orange	2
Re. Data +	3	White-green	3
Bi-Data +	4	Blue	4
Bi-Data -	5	White-Blue	5
Re. Data -	6	Green	6
Bi-Data +	7	White-Brown	7
Bi-Data -	8	Brown	8

16.3.6 Signal cable XW 021

The signal cable XW 021 serves as connection between drive blocks (D3-DU 3xx/x, D3-DA 3xx/x, D3-DP 3xx/x). It is to connect the last axis module of the drive block with the supply module of the next drive block.

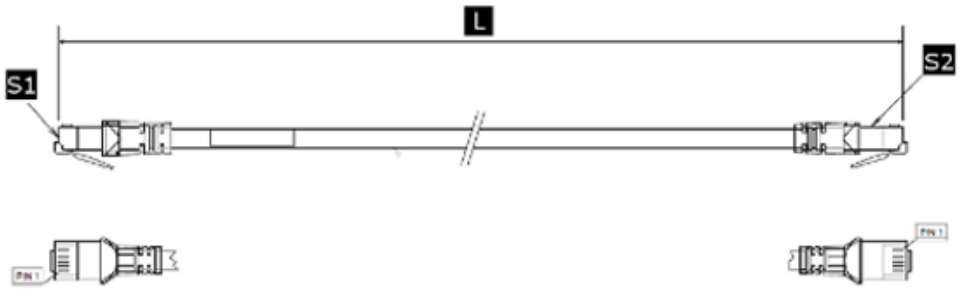

Fig. 16-60: Structure of the signal cable XW 021

S1 ... Connector device 1	S2 ... Connector device 2
1 ... Cable of length L	

Signal	Connector S1	Color of wires / identification	Connector S2
Tr. Data +	1	White-Orange	1
Tr. Data -	2	Orange	2
Re. Data +	3	White-green	3
n.c.	4	-	4
n.c.	5	-	5
Re. Data -	6	Green	6
n.c.	7	-	7
n.c.	8	-	8

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