AMKASYN
Device description
KHY 1 - Hybrid distributor

Version: 2023/13
Part no.:   207728
Translation of the "Original Dokumentation"
- Preliminary description -

AMK_motion_

MEMBER OF THE ARBURG FAMILY

Imprint

Name:	PDK_207728_KHY-1_Hybridverteiler_en

Version:

Version: 2023/13		
Chapter / Topic	**Change**	**Letter symbol**
First Edition		LeS

Previous version: --/--

Product version:

Product (Part no.)	**Firmware Version (Part no.)**
KHY 1 (E1274)	KHY V1.02 2022/07 (207989)
KHY 1 (H) (E1284)	KHY EEPROM V1.02 2022/07 (208117)
KHY 1 (H 8A) (E1290)	Device file EtherCAT KHY V1.02 2022/07 (207978)

Service: Phone +49 7021 50 05-190, Fax -193

For fast and reliable troubleshooting, you can help us by informing our Customer Service about the following:

- Type plate data for each unit
- Software version
- Device configuration and application
- Type of fault/problem and suspected cause
- Diagnostic messages (error messages)

E-mail service@amk-motion.com

Internet address: www.amk-motion.com

Errata

Topic	Description
CSA	CSA/UL certification is not ready yet
Device addressing error	The automatic addressing no longer works as soon as a fixed address has been entered using the DIP switch. Even if the DIP switches are set to "0" again, the "fixed" address remains in effect.

Content

1 About this documentation

1.1 Structure of this document

Topic	Chapter	Chapter number
Validity, use and the purpose of the document	Imprint	-
	About this document	1
Safety	For your safety	2
Information for planning and projecting personnel	Product overview	3
Practice information for startup, operating or maintenance personnel	Assembly	4
	Electrical connections	5
	Startup	6
	Diagnosis	7
	Service	8
	Accessories	9
	Disposal	10
Reference to Certificates e. g. CSA, CE or TÜV	Certificates	11

1.2 Keeping this document

This document must permanently be available and readable at the place where the product is in use. If the product is used at another place or changed the owner, the document must be passed on.

1.3 Target group

Any person that is qualified and intends to work with this product must read, understand and follow this document:

- Transportation and storage
- Unpacking and installation
- Connection
- Startup
- Service and repair
- Decommissioning and disposal

1.4 Purpose

This document is addressed to any person who handles the product. It gives information about the following topics:

- Safety messages which are absolutely necessary to take care of during handling the product
- Product identification
- Environmental conditions for storage, transportation and operation
- Assembly
- Electrical connections
- Diagnosis
- Decommissioning and disposal
- Technical data

1.5 Display conventions

Display	Meaning
![info symbol]	This symbol points to parts of the text to which particular attention should be paid!
'Names'	Names are represented with apostrophes e. g. parameters, variables, etc.
See 'chapter name' on page x	Executable cross-reference in electronic output media
3.7 E-6	3.7×10^{-6}

1.6 Appendant documents

Device descriptions

AMK part-no.	Title
28932	Servo drives KE/KW
203445	Decentralized drive technology iC / iX / iDT5
205186	Decentralized drive technology ihX
207770	Decentralized drive technology ihM-XX

2 For your safety

2.1 Presenting safety messages

Any safety information is configured as follows:

⚠ SIGNAL WORD	
Symbol	**Type and source of risk** Consequence(s) of non-observance **Steps to prevent:** • ...

2.2 Class of hazard

Safety and warning messages are graduated into classes of hazard (according to ANSI Z535). The class of hazard defines the potential risk of harm and is described by a single word, if the safety information is ignored. The signal word is followed by a safety alert symbol (ISO 3864, DIN EN ISO 7010). In accordance with ANSI Z535, the following signal words are used to define the class of hazard.

Safety alert symbol and signal word	Class of hazard and its meaning
⚠ **DANGER**	DANGER indicates a hazardous situation which, if not avoided, **will** result in death or serious injury
⚠ **WARNING**	WARNING indicates a hazardous situation which, if not avoided, **could** result in death or serious injury
⚠ **CAUTION**	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, **could** result in minor or moderate injury
NOTICE	NOTICE is used to address preventions to avoid material damage, but not related to personal injury.

2.3 Safety alert symbols used

Safety symbol	Meaning
⚠	Generic warning!
⚡	Warning against dangerous electrical voltage!
⚡ 5 min	Warning against dangerous electrical voltage! After being electrically disconnected, it takes at least 5 minutes until the energy storage is discharged.

2.4 Basic notes for your safety

- At electrical drive systems, hazards are present in principle that can result in death or fatal injuries:
    - Electrical hazard (e. g. electric shock due to touch on electrical connections)
    - Mechanical hazard (e. g. crush, retract due to the rotation of the motor shaft)
    - Thermal hazard (e. g. burns due to touch on hot surfaces)
- These hazards are present while starting up and operating the unit, and also during servicing or maintenance work.
- Safety instructions in the documentation and on the product warn about the hazards.
- Personnel must have read and understood the safety instructions before installing and operating the product. In the documentation about the product the usage warnings pertain to direct hazards and must therefore be followed directly when operating or handling the product by the operator.
- AMKmotion products must be kept in their original order, that means it is not allowed to do a significant constructional change on hardware side and software is not allowed to be decompiled and change the source code.
- Damaged or faulty products are not allowed to be integrated or put into operation.
- Do not start the system in which the AMKmotion products are installed (begin of intended use) until you can determine that all relevant standards, laws, and directives have been complied with, e. g. low voltage directive, EMC directive, and the machinery directive, and possible further product standards. The plant manufacturer is responsible for the compliance with the laws, directives, and standards.
- The devices must be installed, electrically connected and operated as shown in the device description documentation. The technical data and the required environmental conditions must be observed at all times.

2.5 Intended use

The AMKASYN modules are used to control AMKmotion servo motors, and are designed as installation devices of the safety class 1 (in accordance with EN 61800-5-1). They need to be installed in a closed, well-sized switch cabinet (IP 54) with a fixed connection. The fed-in air must be dry and free of electrically conductive dust, fibres, gases and vapours. If necessary, suitable filters should be used or other protective measures need to be taken.

No other loads except for synchronous or asynchronous servo motors may be connected to the AMKmotion inverters.

The protection against direct contact has to be ensured with the switch cabinet.

The AMKASYN series is designed for use in commercial applications.

Other norms apply for the use in private areas. Additional filter measures may have to be taken by the user for this.

Only components certified for use by AMKmotion may be connected to the interfaces.

The manufacturer / operator of the system is liable for any damage resulting from improper use.

With the active hybrid distributor KHY 1, KHY 1 (H) and KHY 1 (H 8A) of the AMKASYN series, a simple and easy connection of decentralized drive systems of the AMKASMART series such as iX / iDT5, ihX / ihXT or ihM-XX to the central drive system KE / KW is possible.

The following products are intended for fixed connection in industrial and commercial use in machines and systems:
- AMKASMART iX (decentralized inverter)
- AMKASMART iDT (servo motors with integrated inverter iX)
- AMKASMART ihXT, ihXD, ihXP, ihXS (rotative servo motors with integrated inverter e.g. ihX)
- AMKASMART ihXZ, iSKT (linear servo motors with integrated screw-nut system, integrated inverter e.g. ihX)
- AMKASMART ihM-XX (in preparation)

The devices are designed for the construction of decentralized drive concepts without a switch cabinet and can be mounted directly on the machine.

The products corresponding to the category C3 according to EN 61800-3 are designed to use in the "second environment", that means: use in industrial environments and technical areas of buildings, which are supplied from a dedicated transformer.

They are not intended to connect to a low voltage power supply that supplies residential areas. Due to the principle that products cause system perturbations while operating (eg. high frequency interference). To the products to operate at a low voltage system which simultaneously provides residential areas ("first environment" according to EN 61800-3), on the user side additional suppression are required.

At any time the specified limits must be adhered to. The limits are set by the type plates on the product, characteristics and technical data in the product documentation and the data sheets.

The decentralized inverters control and regulate the power supply from AMKmotion servo motors. No other loads may be connected. The operation of external motors with an AMKmotion servo controller must be expressly approved by AMKmotion.

On all interfaces, only components may be connected that AMKmotion has approved for operation.

The admission of the intended use is prohibited until it is proven that the entire system in which the servo controller and motors have been installed meets all safety-related standards and guidelines, such as the low voltage directive, EMC directive, machinery directive and possibly other product standards.

Applications in the following areas are prohibited:

- Explosive environment
- Environment with oils, acids, gases, vapours, dust, radiation,...
- Environments that do not meet the climatic conditions that are required in this documentation.

The manufacturer / operator of the entire system is liable for damages caused by unintended use.

2.6 CE mark

AMKmotion products have been constructed using the "State of the Art" and are safe to operate. AMKmotion issues an EU declaration of conformity for each of its products in which the standards and guidelines relevant for the product are listed. AMKmotion also designates the products with the CE mark which signifies conformity to the standards. Since these standards are listed in the Official Journal of the EU, it can be assumed through their application that the product meets the basic safety and health requirements of the harmonization regulation, the so-called presumption of conformity applies.

2.7 Requirements for the personnel and their qualification

Only authorized and qualified personnel may work on and with the AMKmotion drive systems.

Specialised personnel must:

- Perform mechanical and electrical work that is described in this documentation, such as mounting and connecting
- Observe all information in the documentation accompanying the product in order to work with the product safely and in an error-free manner
- Understand and know hazards that occur when handling the product
- Know connections and functions of the system
- Be familiar with the control concept in order to operate the drive system
- Be authorized to switch circuits and devices on and off, ground and label them
- Observe local specific safety requirements

2.8 Safety rules for handling electrical systems

In particular on drive systems, the instructions pertaining to safety and the following five safety rules have to be kept in the specified sequence:

1. Switch off electrical circuits (also electronic and auxiliary circuits).
2. Secure against being switched on again.
3. Determine that there is no voltage.
4. Ground and short circuit.
5. Cover or close off neighboring parts that are under voltage.

Reverse the measures taken in reverse order after completing the work.

2.9 Warranty

- All information in the documents accompanying the product must be complied with for a safe and trouble-free operation.
- The assertion of warranty claims is excluded if the information in the documents is not observed completely.
- Hardware and firmware may not be modified except by personnel authorized by AMKmotion and after consultation with AMKmotion.
- The company AMKmotion GmbH + Co KG is not liable for damages from unintended use, incorrect installation or operation, exceeding rated values and non-observance with the environmental conditions.

3 Product overview

3.1 Scope of delivery

Please check whether the delivered parts correspond with the delivery note. If the delivery is incomplete, please contact your nearest AMKmotion representative.

Check the components for signs of transport damage after their arrival. Do not install and operate any damaged components.

If there is any transport damage, immediately inform the delivering freight carrier and inform your AMKmotion representative.

3.2 Product description

The KHY 1 hybrid distributor combines the central and decentralized drive technology from AMKmotion. With the central drive technology, the devices are located in the protected control cabinet. With decentralized drive technology, the devices are placed in a less protected environment on the machine. In addition to the power, the KHY 1 also distributes the 24VDC logic and the STO (Safe Torque Off) signal.

With a KE power supply module, a DC bus circuit is generated from the three-phase network. A large power supply module KE is often used, which provides the DC link for several central devices and decentralized strands at the same time. On the mains side, the KE power supply is often secured with a far higher rated fuse current than the current carrying capacity of the decentralized cables and drives allow. As a result, additional protection of the DC bus circuit is required during the transition to the decentralized cabling, which is integrated in the KHY.

Fuse in the DC bus circuit in the event of a short circuit

In the DC bus circuit current, the overload capacity of the connected drives results in high peaks up to a multiple of the rated current. If DC fuses are designed for the nominal current of the DC bus circuit, the overload peaks will cause the fuses to age. False tripping can then occur over time. The DC fuses must be oversized accordingly to prevent this aging. Due to the oversizing, the DC fuses offer short-circuit protection, but no longer protect against overload during normal operation.

I²t counter for overload

So that the user can react to an overload of the decentralized strand, the KHY 1 monitors the DC bus circuit current via an adjustable I²t counter. The I²t counter has similar characteristics to a slow-blow circuit breaker. The overcurrent limit for the I^2t counter is set using a DIP switch. If the DC bus circuit current exceeds the set overcurrent limit for a certain period of time, a warning is output via the fieldbus and at digital output BA1 as soon as the I^2t counter has reached 50%. If the I²t counter continues to rise to 100%, an error message follows via fieldbus and at digital output BA2. The warning and error message must be evaluated by a controller, which then takes appropriate measures, for example to reduce the load.

Optionally, the automatic interruption of the STO lines by the KHY 1 can be activated in the KHY 1. If the overcurrent limit set by the DIP switch is reached during operation, the connected decentralized string can be shut down by the KHY 1 automatically interrupting the STO lines.
Additional Information:

Short-circuit and overload protection for the 24 VDC and the STO path

With the 24 VDC logic and STO supply, a large central 24 VDC power supply is often used to supply many devices and drive strands, the output current of which exceeds the current carrying capacity of the connected decentralized cables and devices. For short-circuit and overload protection, fuses are therefore integrated in the 24 VDC and STO path in the KHY 1.

Overview of added value of functionality through the KHY 1

- **Connection technology**
    - Conversion of the connection technology from stranded wiring in the control cabinet to single-cable technology (hybrid cable) or two-cable technology to the decentralized devices for the DC bus circuit, 24 VDC logic supply, STO safety signals and fieldbus
        - Additional terminals for looping through to another central device
- EtherCAT T-junction

- **Overload protection, monitoring**
  - Measurement of DC bus current, voltage and power with overvoltage monitoring
  - Measurement of the 24 VDC logic supply voltage with over- and undervoltage monitoring
  - Fuses in the 24 VDC logic supply and the STO signals for short circuit and overload protection of the connected decentralized string
  - Fuses in the DC bus circuit for short-circuit protection of the connected decentralized string
  - Adjustable overload monitoring of the DC bus to the decentralized strand. Warning and error message via fieldbus, binary outputs and optional deactivation of the decentralized string via the STO safety signals
  - Monitoring of the internal fuses
  - Detection of a ground fault > 10 A in the DC bus

- **Additional DC bus circuit capacity**

The KHY 1 device is available in 3 versions. The versions differ in the connection technology and in the fuses built into the device, which are matched to the different decentralized drive systems. The following overview shows which KHY 1 is to be used for which decentralized devices:

	KHY 1		
	Two-cable technology	**Single-cable technology**	
Device	**KHY 1**	**KHY 1 (H)**	**KHY 1 (H 8A)**
Part no.	E1274	E1284	E1290
To connect to	iX / iDT5	ihM-XX	ihXT3/4
Fuse DC bus circuit	50 A	50 A	30 A
Fuse 24 VDC logic	8 A	25 A	8 A
Fuse STO path	8 A	8 A	8 A
Recommended DC bus circuit overload monitoring	20 A	20 A	10 A
Device front view			

3.3 STO (Safe torque off)

The STO signal supplies the STO inputs of the connected drive systems.

STO (safe torque off) is a safety function according to DIN EN 61800-5-2 and corresponds to an uncontrolled stopping according to EN 60204-1, stop category 0.

In the event of a requested STO, the motor is safely, immediately and automatically separated from the energy supply in the inverter if the IGBT control is safely interrupted and the motor is prevented from starting unexpectedly.

⚠**DANGER**   The DC bus circuit (terminal UZP/UZN) continues to carry life-threatening voltage even in the STO state!

If the STO is actuated while moving, the drive coasts to stop and generates the error message 2320.

The function is TÜV certified and authorized to use in applications which requires Performance Level (PL) d / Category 3 according EN ISO 13849-1 and SIL 2 according to EN 61508 if the signals STO_GND are interrupted in two channels with a switching device.

If the STO signal is looped through several drives, the STO state applies to all drives in this group. If a drive is in an error state due to a drive error (SBM = 0), it has no effect on the STO state of the other drives in this group.

Observe other important information in the product descriptions of the respective drive systems for using the STO safety function!

3.3.1 Standards and indicators

Standards	Topic	Classification
IEC / EN 62061	Safety of machinery	Applicable
EN 61800-5-2	Safety function	STO (Safe torque off)
		Sicher abgeschaltetes Moment
EN 60204-1	Stop category	0
EN ISO 13849-1	Performance Level (PL)	d
	Category	3
IEC / EN 61508	Safety integrated Level (SIL)	2

Indicators according EN ISO 13849-1	Value	Notice
PFH	7,3 E-11 1/h	<1 % of SIL 2
MTTFd	100 a	maximum permissible value according to EN ISO 13849-1
		classification: high

3.3.2 Connection examples for operation with STO

Emergency Stop with switchgear (contacts positively driven) according to EN 13849-1, PL d

Connection:

Example 1:

Supply voltage 24 VDC for electronics, motor holding brake and STO with an external power supply.

External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 10 A each by the user.
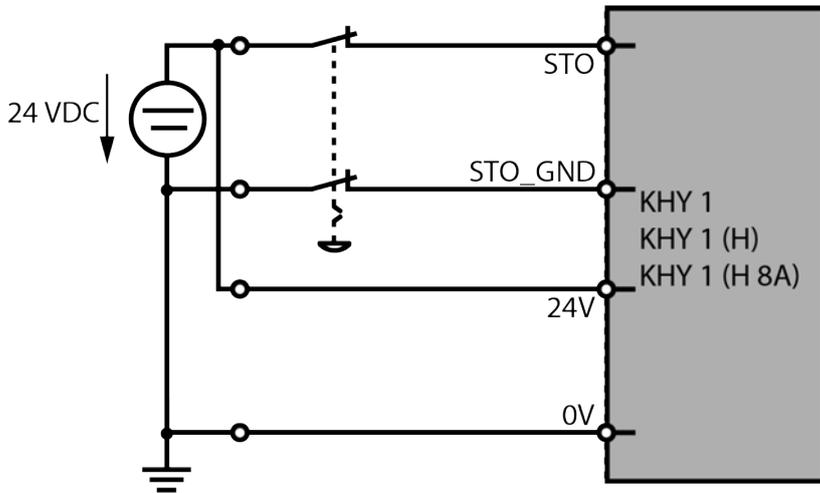
Example 2:

Supply voltage 24 VDC for electronics, motor holding brake and STO with two external power supplies.

External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 10 A each by the user.

Example 3:

Supply voltage 24VDC for electronics, motor holding brake and STO with two external power supplies.

External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 10 A each by the user.
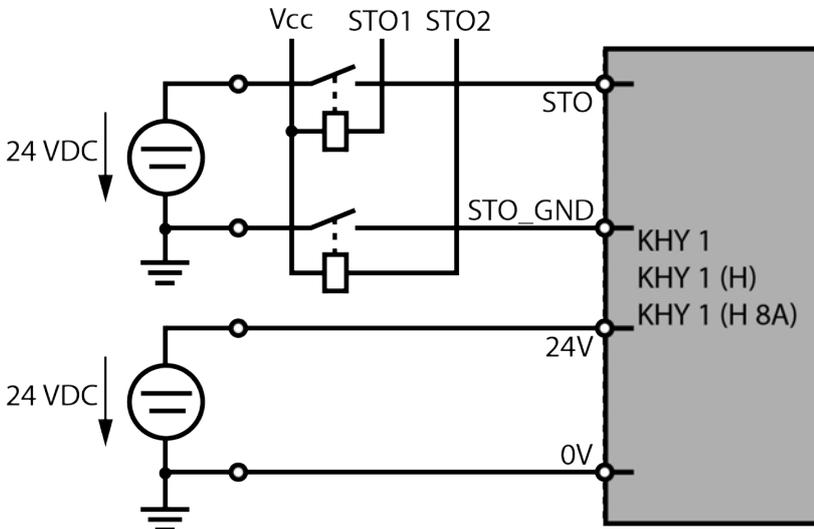
Example 4:

Supply voltage 24VDC for electronics. Bipolar supply voltage with external power supplies.
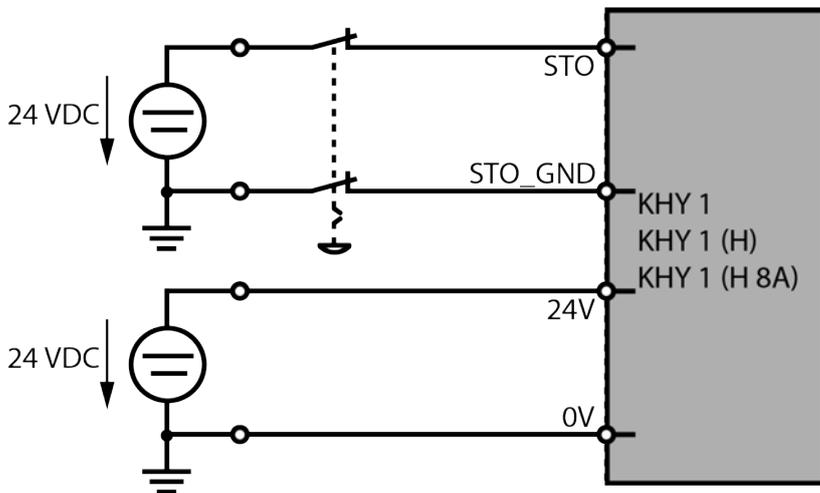
External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 10 A each by the user.
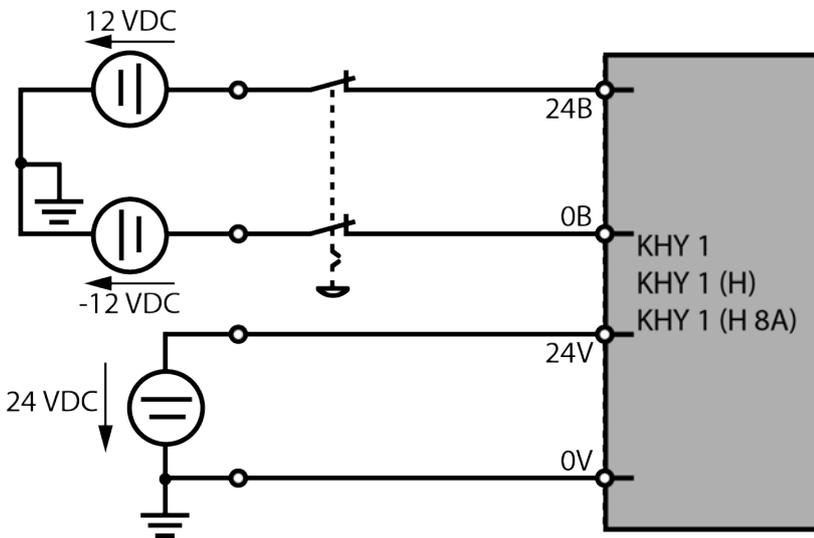
3.4 Ordering data

Product designation	Order number
KHY 1	E1274
KHY 1 (H)	E1284
KHY 1 (H 8A)	E1290

3.5 Type plate

Legend:

Abbreviation	Designation
SNo	Serial number (Part number – year + calendar week – consecutive number)
1	Type designation
2	Revision
U_{DC}	Input voltage DC bus
I_{DCmax}	Maximum current DC bus
U_{LV}	Supply voltage 24 VDC
I_{LV}	Rated current for 24 VDC
I_{LVmax}	Maximum current 24 VDC
U_{STO}	Supply voltage 24B / STO
I_{STOmax}	Maximum current 24B / STO
T_a	Permissible ambient temperature
IP	Type of protection according to EN 60529
OVC III	Overvoltage Category III according UL 61800-5-1
PD	Pollution Degree 2 according UL 61800-5-1

3.6 Device view

3.6.1 Device view KHY 1
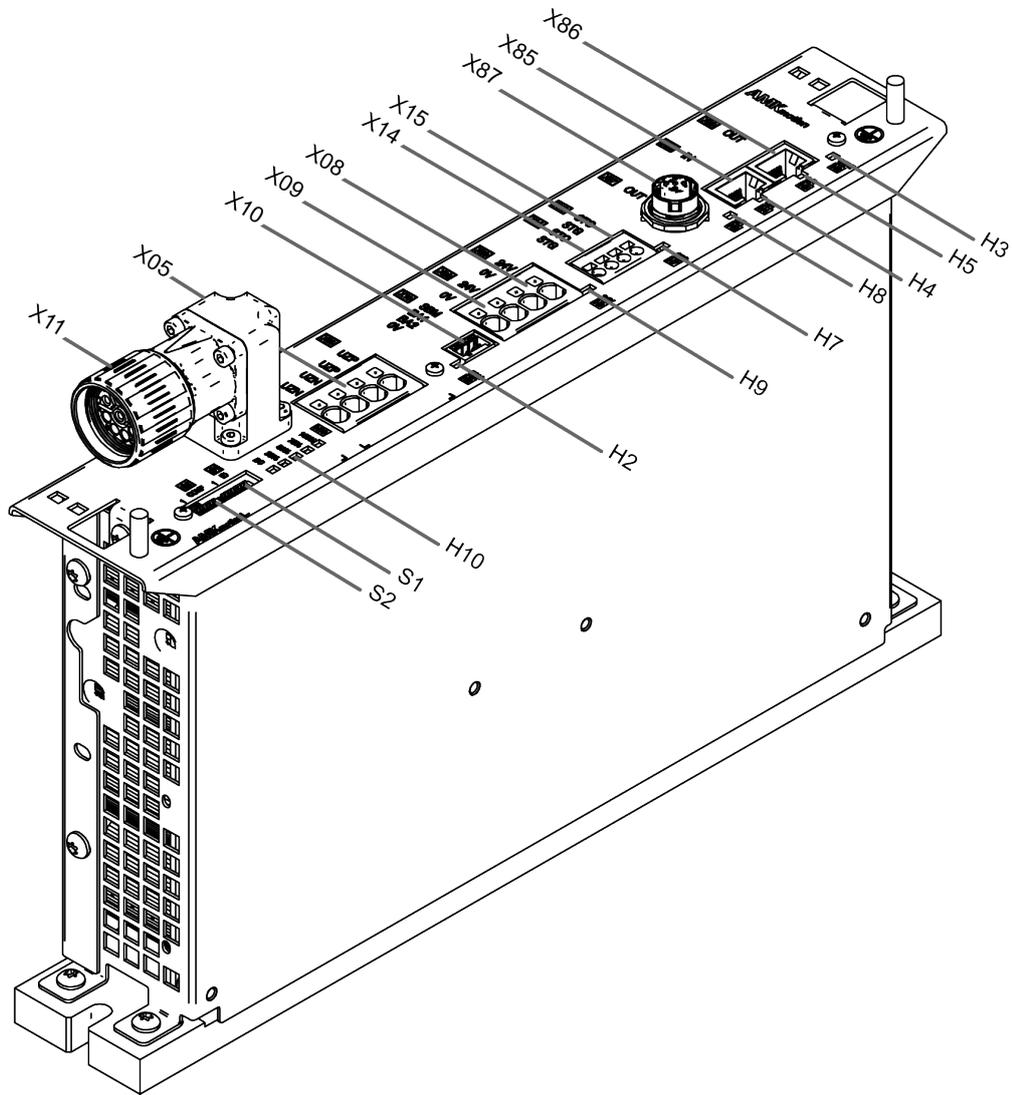
3.6.2 Device view KHY 1 (H) and KHY 1 (H 8A)
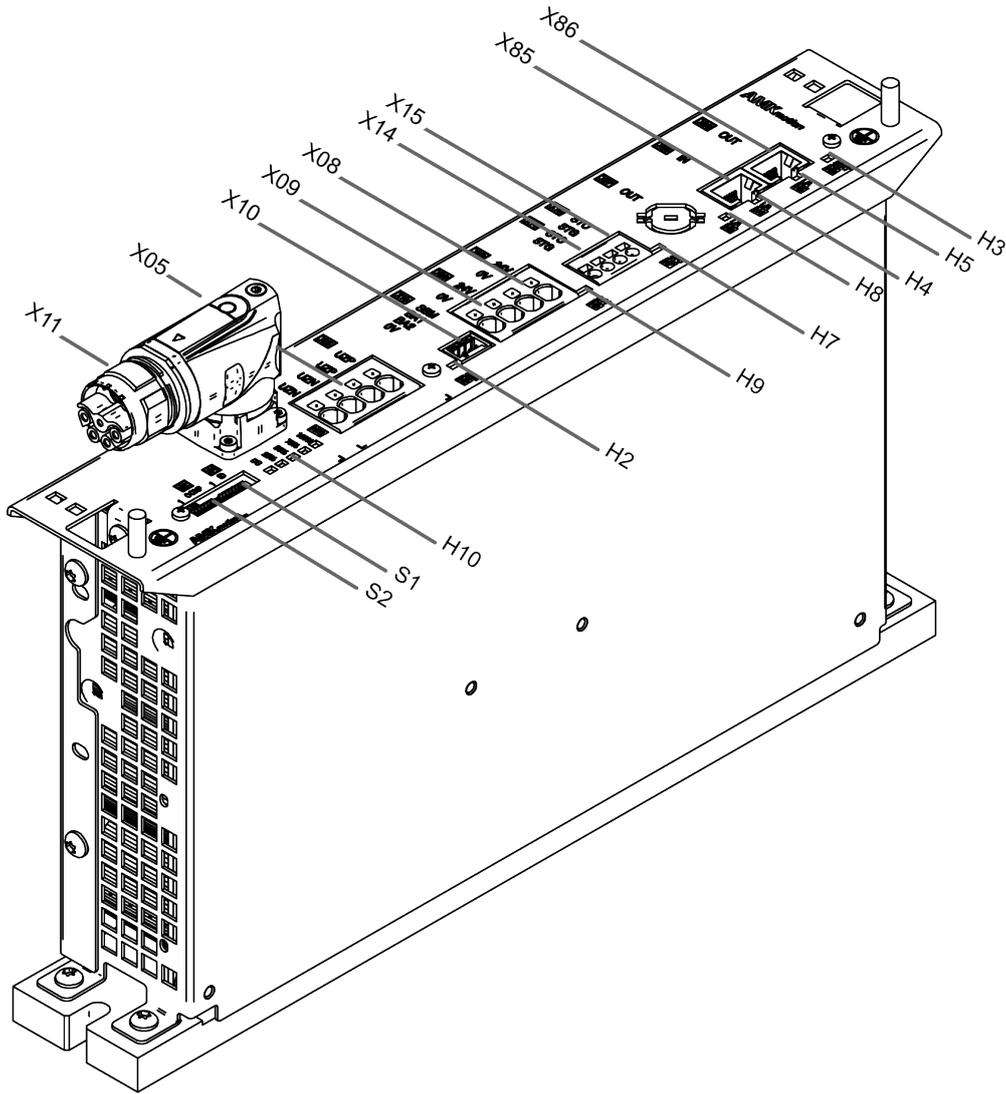
3.7 Interfaces, LEDs and switch

Interface	Function	Further information
X05	DC bus / Transmission DC bus	Siehe '[X05] DC bus' auf Seite 34.
X08	Supply voltage 24 VDC	Siehe '[X08] / [X09] Supply voltage 24 VDC / Transmission supply voltage 24 VDC' auf Seite 35.
X09	Transmission supply voltage 24 VDC	
X10	Digital outputs SBM, BA1 and BA2	Siehe '[X10] Digital outputs (BA)' auf Seite 35.
X11	Device KHY 1: Power connection M23 for decentralized drive technology (DC bus, 24 VDC and STO)	Siehe '[X11] Power supply connection for KHY 1 ' auf Seite 37.
X11	Device KHY 1 (H) and KHY 1 (H 8A): Hybrid connection M23 for decentralized drive technology (DC bus, 24 VDC, STO and real-time Ethernet)	Siehe '[X11] Hybrid connection for KHY 1 (H) and KHY 1 (H 8A)' auf Seite 39.
X14	Supply voltage 24B / STO	Siehe '[X14] / [X15] STO (Safe torque off) / Transmission STO (Safe torque off)' auf Seite 40.
X15	Transmission supply voltage 24B / STO	
X85	Real-time Ethernet	Siehe '[X85] / [X86] Real-time Ethernet / Transmission real-time Ethernet' auf Seite 42.
X86	Transmission real-time Ethernet	
X87	Device KHY 1: Real-time Ethernet M12 for decentralized drive technology Device KHY 1 (H) and KHY 1 (H 8A): Not applicable, as X87 is included in the hybrid connection X11	Siehe '[X87] Real-time Ethernet for device E1274 ' auf Seite 42.

Switch	Designation	Function	Further information
S1	ID	Setting EtherCAT address	Siehe 'Addressing bus participants' auf Seite 44.
S2	CONF	Setting optional shutdown STO	Siehe 'Configuration of the STO shutdown via DIP switch S2' auf Seite 45.
		Setting monitoring DC bus overload	Siehe 'Configuration of overload monitoring of the DC bus via DIP switch S2' auf Seite 45.

Overview LED: Siehe 'LED status' auf Seite 47.

3.8 Product in system

3.8.1 Product in system KHY 1
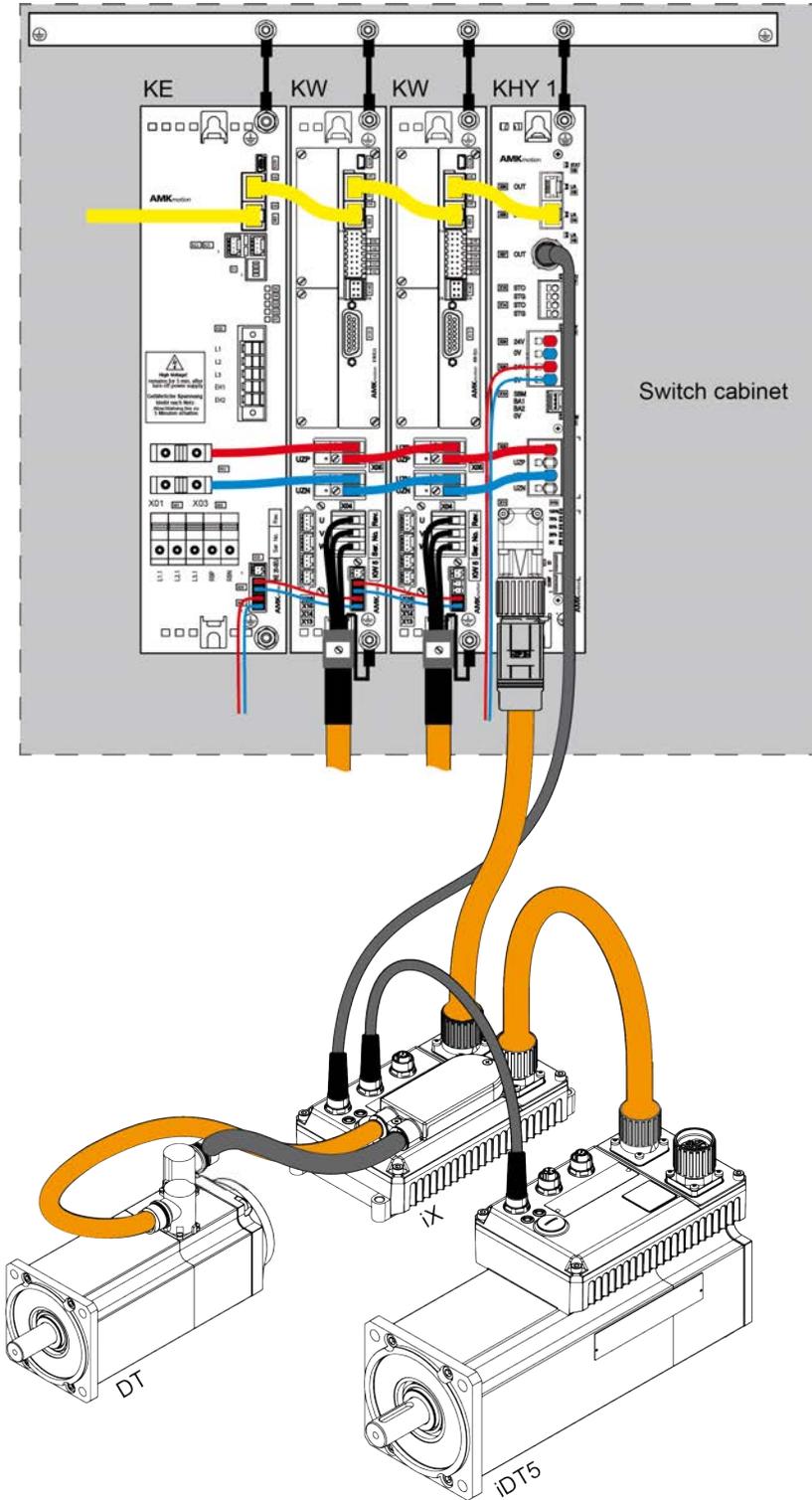
3.8.2 Product in system KHY 1 (H) and KHY 1 (H 8A)
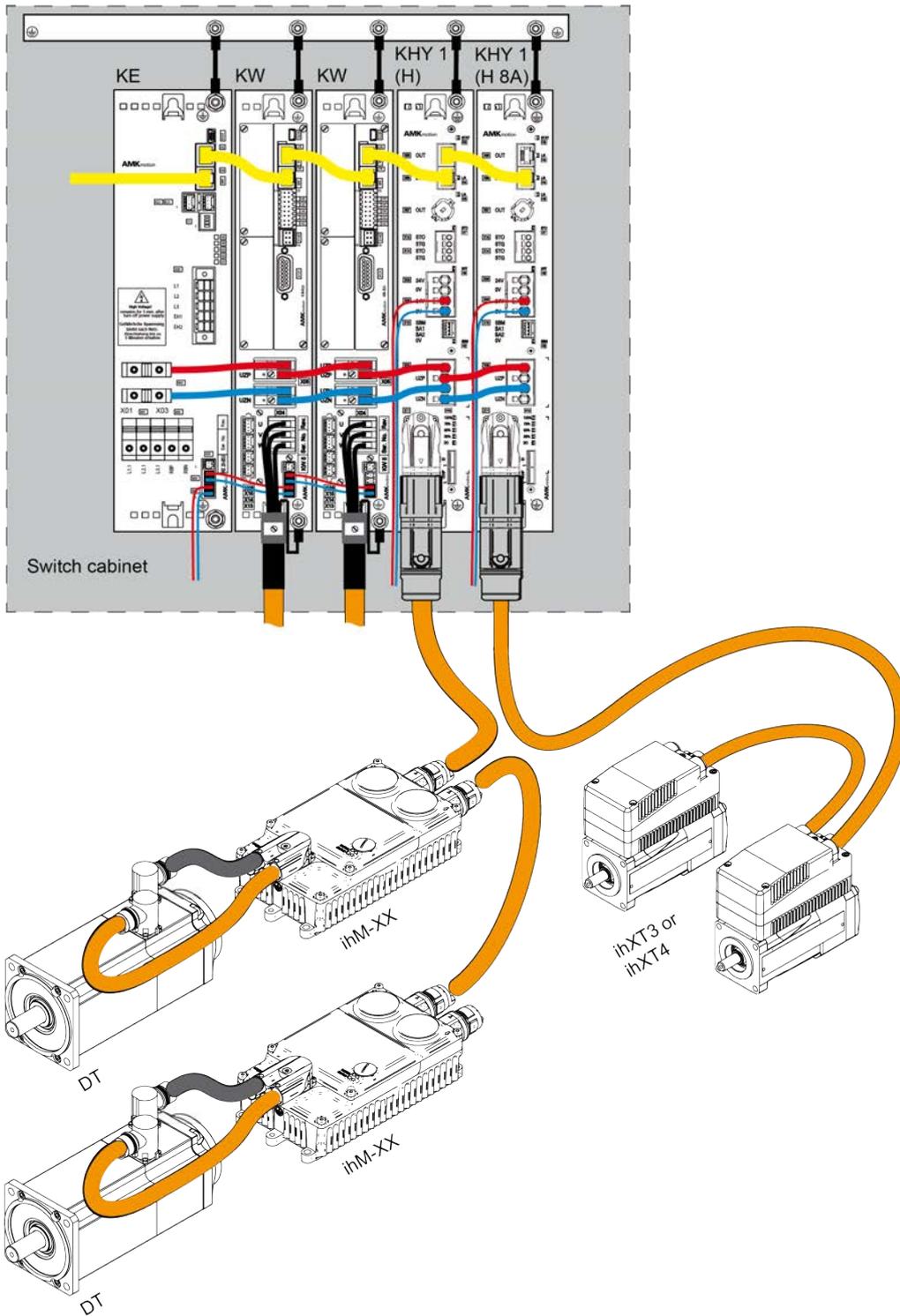
3.9 Technical data

Nominal data	Terminals	Values		
Device (Part no.)		KHY 1 (E1274)	KHY1 (H) (E1284)	KHY1 (H 8A) (E1290)
DC bus input and forwarding				
Rated voltage	X05	540 VDC - 720 VDC		
Rated current		20 A		
24 V Logic supply - input and forwarding [1]				
Rated voltage	X08 / X09	24 VDC ±15 %, ripple max. 5 %		
Rated current		0.3 A		
Input power		7.2 W		
Maximum current terminals		20 A		
24B / STO terminal input and forwarding (STO - Safe torque off) [1]				
Rated voltage	X14 / X15	Digital input according to standard EN 61131-2 type 3 24 VDC ±15 %, ripple max. 5 %		
Maximum current terminals		10 A		
Signal level		Signal level / Meaning table below		

Signal level	Meaning
11 - 24 VDC	STO = inactive
0 - 5 VDC	STO = active

Nominal data	Terminals	Values		
Digital outputs				
rated voltage	X10	24 VDC		
rated current		100 mA		
characteristics		permanently short-circuit proofed, non-isolated, exclusively for ohmic load		
Power / hybrid connector to the decentralized strand [2]				
Output voltage DC bus	X11.1 / X11.3 (X11.A / X11.B)	540 VDC - 720 VDC		
Maximum current DC bus RMS value i^2t monitored		20 A$_{eff}$	20 A$_{eff}$	10 A$_{eff}$
Cyclic overload DC bus		50 A for 3 s	50 A for 3 s	18.5 A for 1 s
Output voltage 24 V logic supply	X11.A / X11.B (X11.C / X11.D)	24 VDC ±15 %, ripple max. 5 %		
Maximum current 24 logic supply		6 A	20 A	6 A
Output voltage 24B / STO	X11.C / X11.D	PELV power supply [1]: 24 VDC ±15 %, ripple max. 5 %		
Maximum current of the output voltage 24B / STO	(X11.8 / X11.7)	6 A	1 A	1 A
Protective- / monitoring functions		short-circuit / ground fault / overtemperature electronic / current overload DC bus overload according to I^2t / overvoltage and undervoltage 24 VDC		
Cooling		-		
Module width		55 mm		
Type of protection according to EN 60529		IP 20		
Weight		2.6 kg		

1)   For applications with the STO safety function (PL d according to EN 13849-1, SIL2 according to EN 61508), the logic and STO must be supplied with PELV power supplies.

        PELV power supply (Protective Extra Low Voltage): functional extra-low voltage with safe separation

        The voltage must also be limited to a maximum of 60 VDC in the event of an error. The 0 VDC potential of the power pack must be grounded at the central PE.

2)   The current-carrying capacity of the connected lines can be smaller than the maximum current of the KHY 1, depending on the line and the type of laying. The smallest current carrying capacity applies.

3.10 Ambient conditions

3.10.1 Transport

In the original AMK factory packaging, the product can be transported under the following conditions:

- No condensation allowed on the product surface (note the dew point table)

Designation	Range of values
Ambient temperature (EN 61800-2)	-25 °C to +75 °C
Relative air humidity (EN 61800-2)	5 % to 85 % at +40 °C

3.10.2 Storage

The product must be stored under the following conditions:

- clean, dry storage location, indoors, protected from rain, snow, hail,
- protected against dust (in the original packaging)
- Temperature fluctuations must not occur to the extent that the product surfaces are exposed to the conditions of sweating and freezing.
- No condensation allowed on the product surface (note the dew point table)
- Products out of the storage must be unpacked and installed if the product has to come to room temperature, otherwise it may cause condensation.
- Storage up to 1 year

Designation	Range of values
Ambient temperature (EN 61800-2)	-25 °C to +75 °C
Relative air humidity (EN 61800-2)	5 % to 85 %

3.10.3 Operation

Designation	Range of values	Explanation
Ambient temperature	0 °C to +40 °C	Rated data refers to an ambient temperature of 0 °C to 40 °.
Installation height	0 to 2000 m above sea level	Rated data is valid up to 2000 m above sea level.
Relative air humidity	5 % to 85 %	No condensation
Vibration resistance (EN 60068-2-6)	1 g at 10 - 150 Hz	
Shock resistance (EN 60068-2-27)	15 g for 6 ms	

Designation	Range of values	Explanation
EMC **(EN 61800-3)**	second environment: category C3	Places of the second environment are industrial areas and technical areas of buildings fed from a dedicated transformer. Devices of the second environment have no direct connection to a low voltage network that also supplies residential buildings. Category C3 devices with a rated voltage less than 1000 V, for use in the second environment.
Pollution degree **(EN 61800-5-1)**	2	The interior equipment is designed for no or only dry, non-conductive pollution. The device must be installed and operated in a control cabinet with degree of protection IP54.
Overvoltage category **(EN 61800-5-1)**	III	up to 2000 m above see level

3.11 Dimensional drawings

3.11.1 Front view

KHY 1
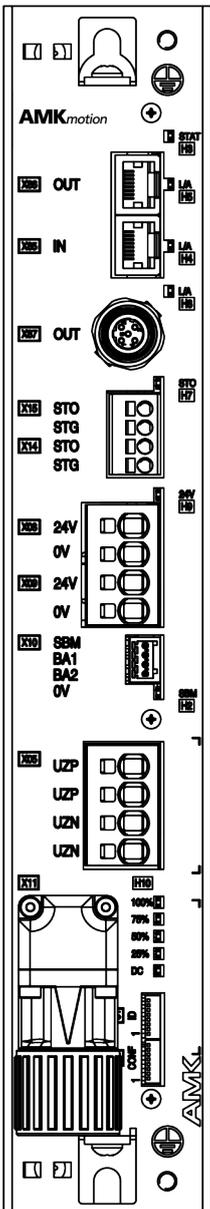
KHY 1 (H)

KHY 1 (H 8A)
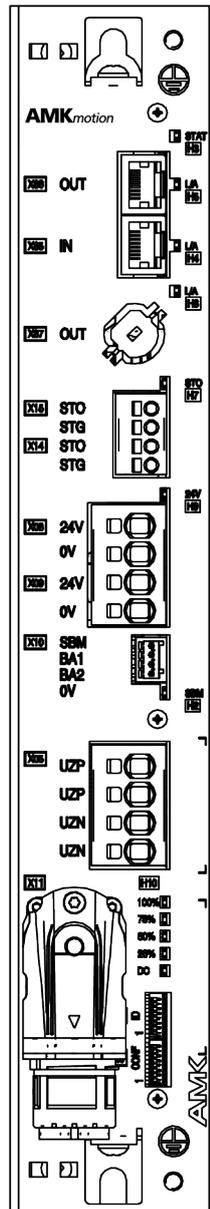
3.11.2 View from below
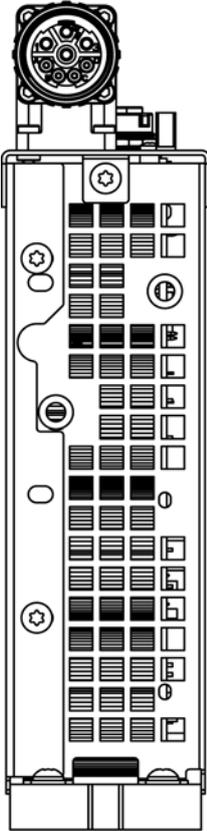
KHY 1   KHY 1 (H)
                                               KHY 1 (H 8A)
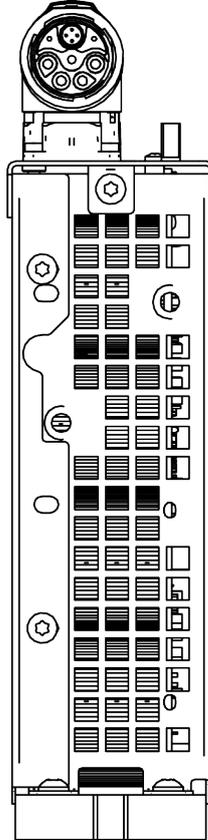
3.11.3 Side view

KHY 1
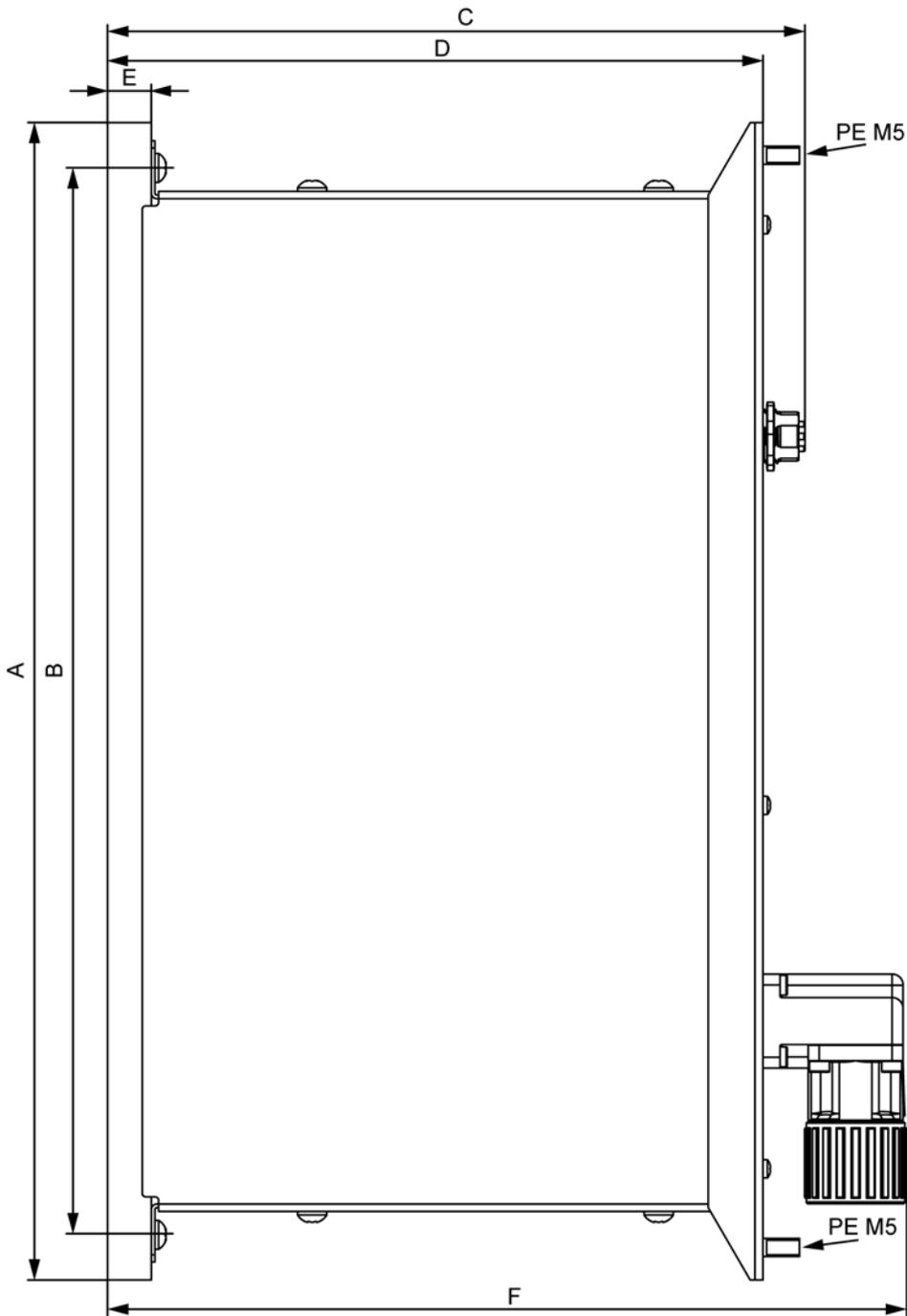
KHY 1 (H)

KHY 1 (H 8A)
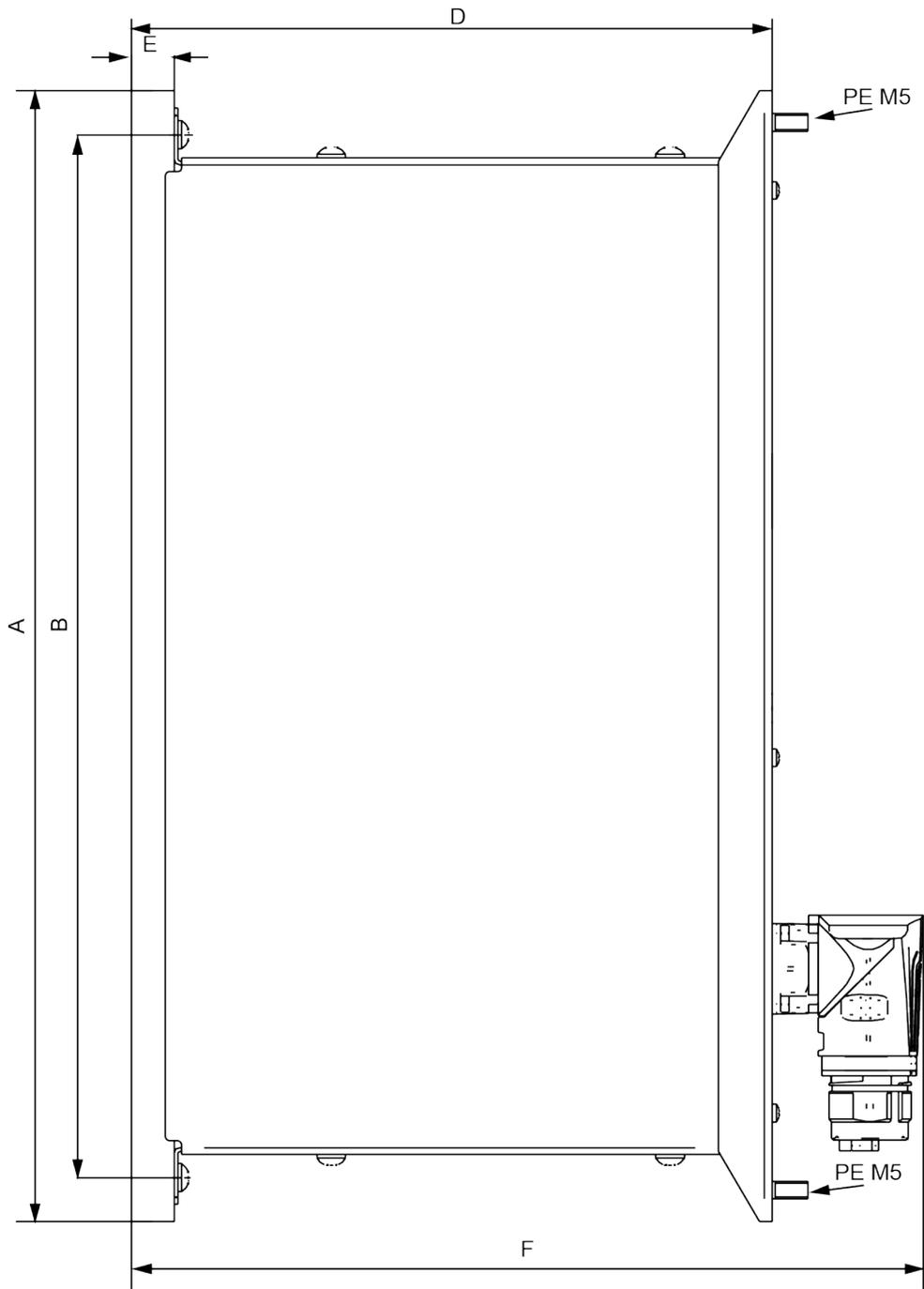
Device	Dimensions in mm					
	A	B	C	D	E	F
KHY 1	320	301.5	191	180	12	219
KHY 1 (H) KHY 1 (H 8A)	320	301.5	191	180	12	222

3.11.4 Hole pattern
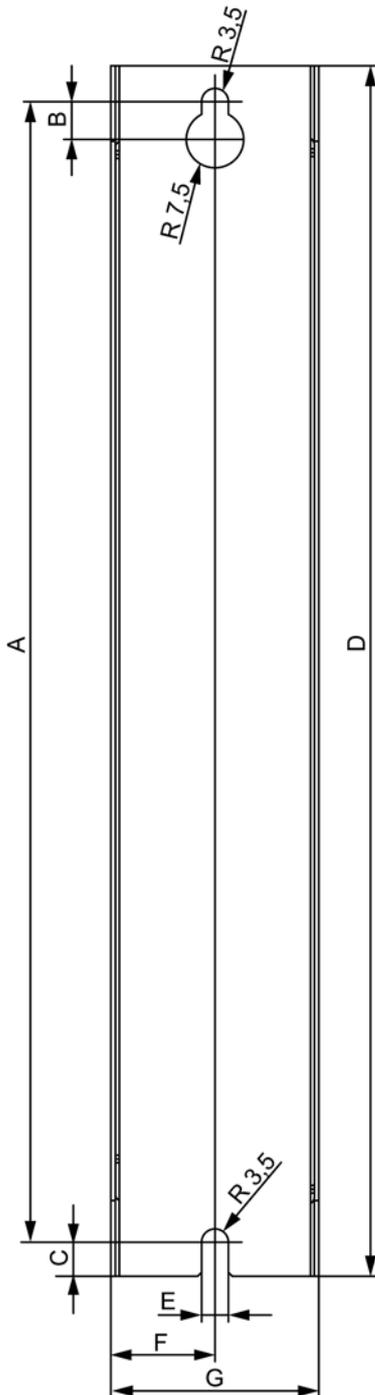
Device	Dimensions in mm						
	A	**B**	**C**	**D**	**E**	**F**	**G**
KHY 1 KHY 1 (H) KHY 1 (H 8A)	301.5	10	9	320	7	27.5	55

4 Assembly

4.1 Arrangement of KE/KW and KHY 1 modules in the switch cabinet

NOTICE	
Material Damage!	**Overload of DC bus cable and terminals!** The connected rating of the DC bus terminals is restricted based on the conductivity of the UZ terminals and the cross-section of the UZ connecting cable. **Steps to prevent:** • Do not exceed the maximum possible connected rating of the modules.

- For KHY 1 devices cooling is not necessary, but for assembly purposes the modules can be installed on a liquid- or air-cooled AL assembly plate.
- Recommended installation position: vertical. Other installation positions are permitted upon prior consultation with AMK.
- Place the modules in a way that the signal and power cables are always kept separate from each other during wiring (distance > 20 cm).
- The inverter must be connected to the power supply in the order from the highest to lowest rated output.
- Avoid installing the system above devices that generate a lot of heat. The air inlet temperature must be < 40°.
- A direct connection is permitted; sufficient space must be available for air circulation on the module casing above and below. Recommended distance: 100 mm.
- For multi-row mounting, we recommend a minimum distance of 100 mm between the module rows (1st row - 100 mm spacing - 2nd row - 100 mm spacing - 3rd row, etc.)

4.2 Installation of cold plate modules on the cooling system

NOTICE	
Material Damage!	**Short circuit due to penetrating foreign objects or water** Foreign objects such as metal shavings, screws, etc. cause short circuits. In particular it needs to be prevented that water, e.g. condensation water, seeps in through the cooling units. A temporary forming of dew may only occur as long as the devices are out of operation. **Steps to prevent:** • The modules need to be protected against penetrating foreign objects or water. • When applying mains voltage, no dew may be present any longer.

The AMKASYN modules are installed directly on the cooling system **without** heat transfer paste.
Note the following during assembly:

- The protective cardboard on the bearing face (cold plate) of the modules needs to be removed.
- The mounting surface for the modules must be clean and free of scratches.
- The cold plate features a T-slot on the top and bottom acc. to DIN 508 used to fasten the modules in place. The corresponding slot nuts with inner thread M6 for fastening screws M6 x 20 mm (AMK part no. 18139) must be inserted into these.
- The modules must be place on the lower stop angle and can be right-justified using the markings (above and below the T-slots). During assembly, the top fastening screws must first be fastened, followed by the bottom fastening screws. Tightening torque for mounting rear panel of modules: 8 Nm (Tool: Allen size 5)

5 Electrical connections

5.1 For your safety

⚠ **DANGER**	
⚡	**Danger to life from touching electrical connections!** Electrical terminals and connectors carry voltages that may cause death or serious injury upon contact. When the LEDs on the front panels are OFF, this does not indicate that the electrical terminals have been de-energized. **Steps to prevent:** • Prior to any work on the device: Observe the 5 safety rules. • Measure the terminal voltages. There may be no voltage present. • Plug and pull connections only when there is no voltage. • For devices that are connected to a DC bus, or generate it yourself, you need to consider the discharge times of the dc bus capacitors mentioned in the converter documentation • Before commencing work, the connections must be isolated from the voltage supply at both ends! (both ends mean: AC and DC bus supply side)

⚠ **DANGER**	
⚠	**Danger to life due to unexpected movements!** The drive will be torque-free in the status 'Safe torque off (STO)', in case of mains failure or in case of faulty drive controller. External application of force on the drive axis may result in life-threatening movements (e.g. hanging axes can fall down). **Steps to prevent:** • Install an external, mechanical brake that prevents a movement. • Install a counterweight in order to maintain the axis in balance.

5.2 Avoiding material damage

NOTICE	
Material Damage!	**Mechanical damage!** Contact problems due to pins that are bent or out of alignment. Damage may result if the screw joints are not straight when connecting the two parts. **Steps to prevent:** • Never force connectors and plug-in cards! • Before tightening the screw joints (e.g., power and encoder plugs), check whether the connector (spring) and socket (slot) are properly positioned. After this is complete, tighten the screw connection according to the specifications.

NOTICE	
Material Damage!	**Electronic components could be destroyed through static discharge!** Therefore touching of the electrical connections (e. g. signal and power supply cable) must be avoided. Otherwise you can be damaged the components when touching by static discharge. **Steps to prevent:** • Avoid touching electrical connections and contacts. • During handling the electronic component discharge yourself by touching PE. • Pay attention to the ESD-notes (electrostatic discharge).

5.3 Wiring

- The recommended connection diameters for cables are based on EN 60204-1, installation type C, ambient temperature ≤ 40°C.
- Please refer to chapter 'Earthing' before switching the system on the first time: Further information:
- Only devices, electrical elements, or wiring may be connected to the AMKSYN series signal interfaces that feature a "secure disconnection" of the connected circuits according to EN 50178.

5.4 Earthing

⚠ DANGER
Danger to life from electrical shock!   In the event of an interruption to the PE connection, avoid touching the casing because life-threatening levels of voltage may be present!   **Steps to prevent:**   • EN 61800-5-1 requires that the devices be firmly connected on the power side.   • The PE conductor must have a cross-section of at least 10 mm^2 or must have a second PE connection with a cross-section at least equal to the mains feeder (cf. EN 61800-5-1).

All AMKASYN casings are separate and should be connected to the earth using the shortest route possible (central PE bus bar switch cabinet). Throughout the entire system, the earth should be star-like in shape, extending from the central earthing point.

Connection PE bolts on casing: Siehe 'PE connection' auf Seite 32.

PE is the reference potential for internal power supply and voltage sensing purposes.

The 0V potential of the external power supply units must be connected to the central PE bar.

Installation, connection and earthing should be performed according to the applicable local regulations (e.g. EN 60204 Ch. 8 Protective earth conductor system, equipotential bonding).

PE Sammelschiene

PE | KE | KW | KW | KHY 1 | KHY 1 (H) / KHY 1 (H 8A)

externes 24 VDC Netzteil

Schaltschrank

Zugentlastung (und Erdung) der Netzzuleitung (Schirm) mit Schirmklemmen KP-SK8...KP-SK35

Zugentlastung (und Erdung) der Motorleitung (Schirm) mit Schirmklemmen KP-SK8...KP-SK35
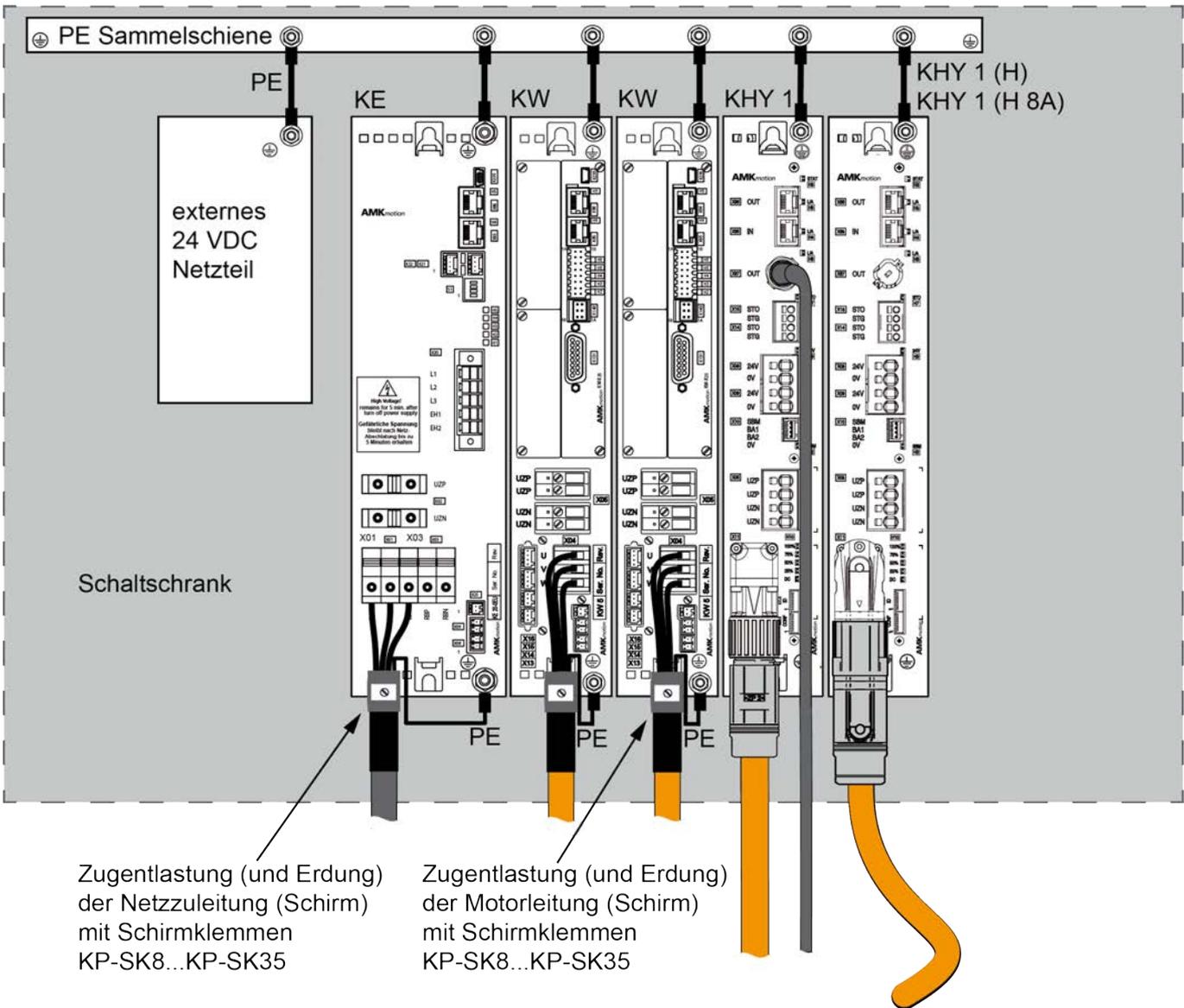
5.5 Connections

5.5.1 PE connection

	⚠ **DANGER**
⚡	**Danger to life from electrical shock!** In the event of an interruption to the PE connection, avoid touching the casing because life-threatening levels of voltage may be present! **Steps to prevent:** • EN 61800-5-1 requires that the devices be firmly connected on the power side. • The PE conductor must have a cross-section of at least 10 mm^2 or must have a second PE connection with a cross-section at least equal to the mains feeder (cf. EN 61800-5-1).

Technical data

Description	The PE connection is a M5 screw bolt on the module casing (see front view) for attaching PE lines and cable shields.
	Configure as follows:
Connection design	M5 screw bolt
Tightening torque	5,5 Nm
Cable	1-wire, unshielded
Recommended cable cross section	10 mm²
	AWG 6
cable assembly	Ring cable lug
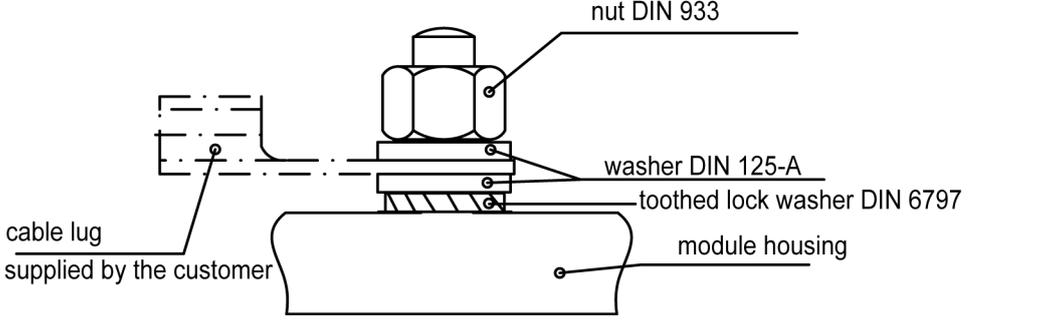
5.5.2 [X05] DC bus

⚠ DANGER

	Danger to life from electric shock!
⚡ (warning symbol) ⏱ 5 min	LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free. After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage. **Steps to prevent:** • Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting. • After switching off, expect a discharge time of at least 5 minutes. • Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

Assignment

[X05]	Connection	Signal	Description
front view, device side 	1	UZP	DC bus (+)
	2	UZP	Transmission DC bus (+)
	3	UZN	DC bus (-)
	4	UZN	Transmission DC bus (-)
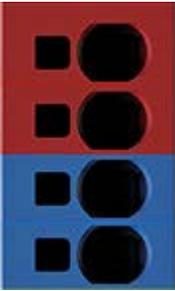
Technical data

Description	DC bus
connection design	Terminal with spring-cage connection SPT 5/ 4-H-7,5
Operating tool	Slot screwdriver (size: 0.6 x 3.5 mm)
Poles	4
Electrical data	Siehe 'Technical data' auf Seite 22.
Cable	2-wire, unshielded; Use only AMKmotion DC bus UZ cable sets. Part no.: 47546 KW-UZ 55/2 (length 180 mm, cross-section 4 mm^2, AWG 10)
Recommended cable cross section	2.5 mm^2 AWG 12 The cable cross-section must be selected depending on the current load, the connected device types and the number of connected devices.
Cross section min./max.	0.25 mm^2 - 6 mm^2 AWG 22 - AWG 8
cable stripping length	15 mm
Maximal cable length	1 m
cable assembly	Wire end ferrule with plastic sheath
Shield connection	If available, apply on both sides
Accessories	Prefabricated cable available
Notes	A maximum length of 1 meter is permitted for the cable to connect the DC bus voltage when assembling the device with a distance between the modules. (Use of longer cables only after consulting with AMKmotion). A 2-wire shielded cable might have to be used in order to limit interference radiation. In this case, the cable shield has to be stranded on both sides.

5.5.3 [X08] / [X09] Supply voltage 24 VDC / Transmission supply voltage 24 VDC

NOTICE	
Material Damage!	**Overload of the terminal and the internal circuit board!** The current of the terminal X08 has to be limited to maximum 20 A.

Assignment

[X08] / [X09]	Connection		Signal	Description
front view, device side X09 X08	X09	1	24 VDC	Transmission - 24 VDC supply voltage for electronics
		2	0 VDC	Transmissoin - Reference potential for 24 VDC
	X08	1	24 VDC	24 VDC supply voltage for electronics
		2	0 VDC	Reference potential for 24 VDC
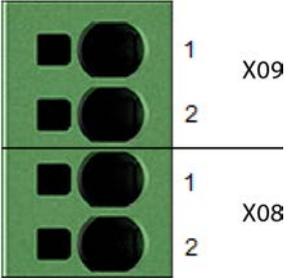
Technical data

Description	X08: 24 VDC supply voltage for electronic X09: Transmission 24 VDC supply voltage for electronic
connection design	print terminal with spring-cage connection SPT 5/ 4-H-7,5
Operating tool	Slot screwdriver (size: 0.6 x 3.5 mm)
Poles	2
Electrical data	Siehe 'Technical data' auf Seite 22.
Cable	2-wire, unshielded
Recommended cable cross section	The cable cross-section must be selected depending on the current load, the connected device types and the number of connected devices.
Cross section min./max.	0.25 mm^2 - 6 mm^2 AWG 22 - AWG 8
stripping length	15 mm
Maximal cable length	30 m
cable assembly	Wire end ferrule with plastic sheath
Notes	For applications with the STO safety function (PL d according to EN 13849-1, SIL2 according to EN 61508), the logic and STO must be supplied with PELV power supplies: PELV power supply (Protective Extra Low Voltage): functional extra-low voltage with safe separation The voltage must also be limited to a maximum of 60 VDC in the event of an error. The 0 VDC potential of the power pack must be grounded at the central PE.

5.5.4 [X10] Digital outputs (BA)

NOTICE	
Material Damage!	**Material damage caused by incorrect handling!** Mechanical damage to terminals! Disconnected signal lines. **Steps to prevent:** • The plug connectors are partially encoded. Do not push in with force. • Never pull on the cable, but rather on the connector casing.

Assignment

[X10]	Connection	Signal	Description
front view, device side PIN 4 PIN 3 PIN 2 PIN 1	1	SBM	System ready message, error free state
	2	BA1	Digital output 1
	3	BA2	Digital output 2
	4	0V	Reference potential 0V for digital outputs
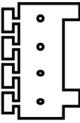
Technical data

Description	KHY 1 supports 3 digital outputs at terminal X10. The function of the outputs is fixed and cannot be changed: BA1: Warning I^2t: active ("1") when the I^2t monitoring of the DC bus reaches 50 % BA2: Error I^2t: active ("1") when the I^2t monitoring of the DC bus reaches 100 %
Connection design	Terminal (on the device): MC 0.5/4-G-2.5 Mating plug: FK-MC 0.5/4-ST-2.5
Operating tool	Slot screwdriver (size: 0.4 x 2.0 mm)
Poles	4
Electrical data	Siehe 'Technical data' auf Seite 22.
Cable	4-wire, unshielded
Recommended cable cross section	0.5 mm^2 AWG 20
Cross section min./max.	0.25 mm^2 - 0.5 mm^2 AWG 24 - AWG 20
stripping length	8 mm
Maximal cable length	30 m
cable assembly	Flexible line or wire end ferrule without plastic sheath

5.5.4.1 Connection technology - plug connector

NOTICE	

Material Damage!	**Material damage caused by incorrect handling!**
	Mechanical damage to terminals!
	Disconnected signal lines.
	
	Steps to prevent:
	   • The plug connectors are partially encoded. Do not push in with force.
	   • Never pull on the cable, but rather on the connector casing.

For plug connectors the conductor connection is realised by spring tension.

For inserting and removing the conductor **(1)**, the loosening switch **(2)** on the terminal front has to be loosened with a screw driver.

For service purposes, a control tap **(3)** with a check plug D = 1.2 mm is possible with these terminals.
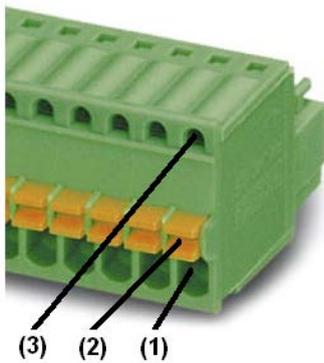
Observe the recommended wire cross-section and the cable stripping length when wiring.

The connection information can be found in the terminal descriptions.

5.5.5 [X11] Power supply connection for KHY 1

(DC bus, 24 VDC and STO)

⚠ DANGER	

⚡	**Danger to life from touching electrical connections!**
	The permanent magnets of the rotor induce dangerous voltage at the motor connections when the axis rotates, even when the motor is not electrically connected. If the motor is connected to an inverter, the induced DC voltage is linked to the .
	
	Steps to prevent:
	   • Make sure that the motor shaft does not rotate.
	   • Make sure that shock-hazard protection is installed at the motor connections.
	   • Make sure that the terminals are free of voltage.

⚠ DANGER	

⚡
 	
🕐 5 min
	Danger to life from electric shock!
	LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.
	After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.
	
	Steps to prevent:
	   • Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting.
	   • After switching off, expect a discharge time of at least 5 minutes.
	   • Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

Assignment

[X11]	Connection	Signal	Description	
front view, device side	1	UZP	Supply of the DC bus +	
	3	UZN	Supply of the DC bus -	
	A	24V	iX / iDT5	**Valid for all standard devices regardless of the revision level** [*)] Supply voltage 24 VDC for electronics **Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00** Supply voltage 24 VDC for electronics and motor holding brake *) Except: A2553AD, A2777AD and E1241
	B	0V	Reference potential for 24V	
	C	24B / STO	iX / iDT5	**Valid for all standard devices regardless of the revision level** [*)] Supply voltage 24 VDC for STO and motor holding brake **Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00** Supply voltage 24 VDC for STO *) Except: A2553AD, A2777AD and E1241
	D	0B / STO_ GND	Reference potential for 24B / STO	
	PE	PE	Protective earthing conductor on housing	

Technical data

Description	The DC link, the 24 VDC supply voltage, STO and STO_GND are passed on to the decentralized drives via the M23 power connection.	
Connection design	M23, socket	
Mating plug	M23, 6-pole + PE, pin	
Poles	2 + 4 + PE	
Tightening torque	5 - 6 Nm	
Electrical data	Siehe 'Technical data' auf Seite 22.	
Maximal cable length	20 m	
Shield connection	Apply on both sides	
Accessories	Prefabricated cable for connection of	
	iX / iDT5:	Siehe 'iX/iDT5 to KHY 1 ' auf Seite 51.
		Siehe 'M12 connection cable from iX/iDT5 to KHY 1 for connector [X87]' auf Seite 53.
Notes	**Wiring for the STO safety function according to EN 61800-5-2** According to EN 61800-5-2 the error 'Short circuit between two conductors' will be excluded in the following cases: • For permanently connected conductors which are protected from external damage (e.g. cable channel) • Different sheathed cables • Inside an electrical installation space • The conductors are separately screened and have a earth connection	

5.5.6 [X11] Hybrid connection for KHY 1 (H) and KHY 1 (H 8A)

(DC bus, 24 VDC, STO and Real-time Ethernet)

⚠ **DANGER**

	Danger to life from electric shock!
⚡ 5 min	LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.
	After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.
	Steps to prevent:
	• Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting.
	• After switching off, expect a discharge time of at least 5 minutes.
	• Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

⚠ **DANGER**

	Danger to life from touching electrical connections!
⚡	The permanent magnets of the rotor induce dangerous voltage at the motor connections when the axis rotates, even when the motor is not electrically connected. If the motor is connected to an inverter, the induced DC voltage is linked to the .
	Steps to prevent:
	• Make sure that the motor shaft does not rotate.
	• Make sure that shock-hazard protection is installed at the motor connections.
	• Make sure that the terminals are free of voltage.

Assignment

[X11]	Connection	Signal	Description
front view, device side	1	RX-	Receive Data -
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	TX+	Transmission Data +
	A	UZP	Supply of the DC bus +
	B	UZN	Supply of the DC bus -
	C	24VDC	Supply voltage 24 VDC for electronic and an optional motor holding brake.
	D	0VDC	Reference potential for 24 VDC (Connection C)
	PE	PE	Protective earthing conductor
	7	STO_GND	Reference potential for STO (Connection 8)
	8	STO	STO (Safe torque off)

The supply voltage directly controls the STO state. |

Technical data

Description	The DC link, the 24 VDC supply voltage, STO and STO_GND and the real-time Ethernet (EtherCAT) are forwarded to the decentralized drives via the M23 hybrid connection. (100BASE-T 100 Mbit/s Ethernet standard)
Design	M23 hybrid, socket
Pole	6 + 4 + PE
Tightening torque	5 - 6 Nm
Electrical Data	Siehe 'Technical data' auf Seite 22.
Maximal cable length	20 m
Shield connection	Apply on both sides
Accessories	Prefabricated cable for connection of
	ihM-XX: Siehe 'ihM-XX to KHY 1 (H) ' auf Seite 55.
	ihXT3/4: Siehe 'ihX(T)3/4 an KHY 1 (H 8A)' auf Seite 53.
Notes	**Wiring for the STO safety function according to EN 61800-5-2:** • According to EN 61800-5-2, the fault 'short circuit between two conductors' can be excluded in the following cases: • For permanently connected conductors that are protected against external damage (e.g. cable duct) • Different sheathed cables • Within an electrical installation space • The conductors are individually shielded and the shield is connected to earth

5.5.7 [X14] / [X15] STO (Safe torque off) / Transmission STO (Safe torque off)

⚠ **DANGER**
Danger to life due to unexpected movements!   The drive will be torque-free in the status 'Safe torque off (STO)', in case of mains failure or in case of faulty drive controller. External application of force on the drive axis may result in life-threatening movements (e.g. hanging axes can fall down).   **Steps to prevent:**   • Install an external, mechanical brake that prevents a movement.   • Install a counterweight in order to maintain the axis in balance.

⚠ **DANGER**
Danger to life from touching electrical connections!   In the status 'Safe torque off (STO)', the pulses for controlling of the output stage are blocked, the device remains connected to the mains (no automatic mains separation). Electrical terminals and connectors carry further voltages that may cause death or serious injury upon contact.   **Steps to prevent:**   • Provide shock-hazard protection   • Prior to any work on the device: Turn off the main switch to disconnect the power supply, and secure switch against being turned on again.   • Wait at least 5 minutes for components to discharge.   • Connection or disconnection of terminals is only allowed if they are free of voltage.   • Measure the terminals voltage to verify that the terminal is de-energized. One suitable measuring point is the DC bus between the UZP and UZN terminals.

Assignment

[X14] / [X15]	Connection	Signal	Description
front view, device side	X14	STO	24 VDC supply voltage for STO (Safe torque off)
		STO_GND	Reference potential for STO
	X15	STO	Transmission - 24 VDC supply voltage for STO (Safe torque off)
		STO_GND	Transmission - Reference potential for STO
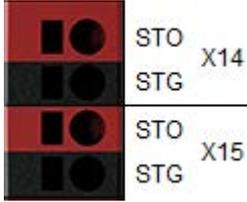
Technical data

Description	In regular operation, input 'STO' must be set to "1" to enable the power output stage (STO inactive).
	STO input is equal to "0" activates STO. If STO active is requested (STO = "0"), the motor is safely, immediately and automatically separated from the energy supply in the inverter. The IGBT control is safely interrupted and the motor is certainly prevented from starting unexpectedly.
	If STO is requested while moving (STO = "0"), the drive coasts to stop and the error message 2320 is generated.
	X14: STO (Safe torque off)
	X15: Transmission STO (Safe torque off)
Connection design	Connector with spring connection SPT 5/ 4-H-5,0
Operating tool	Slot screwdriver (size: 0.6 x 3.5 mm)
Poles	2
Electrical data	Siehe 'Technical data' auf Seite 22.
Cable	2-wire, unshielded
Recommended cable cross section	0.75 mm^2 AWG 18
Cross section min./max.	0.25 mm^2 - 1.5 mm^2 AWG 22 - AWG 16
stripping length	15 mm
Maximal cable length	30 m
cable assembly	Wire end ferrule with plastic sheath
Notes	STO (safe torque off) is a safety function according to DIN EN 61800-5-2 and corresponds to an uncontrolled stopping according to EN 60204-1, stop category 0.
	For applications with the STO safety function (PL d according to EN 13849-1, SIL2 according to EN 61508), the logic and STO must be supplied with PELV power supplies:
	PELV power supply (Protective Extra Low Voltage): functional extra-low voltage with safe separation
	The voltage must also be limited to a maximum of 60 VDC in the event of an error. The 0 VDC potential of the power pack must be grounded at the central PE.

5.5.8 [X85] / [X86] Real-time Ethernet / Transmission real-time Ethernet

Assignment

[X85] / [X86]	Connection		Signal	Description
front view, device side	X85	1	Tx+	Transmit data +
		2	Tx-	Transmit data -
		3	Rx+	Receive data +
		4	-	Reserved
		5	-	Reserved
		6	Rx-	Receive data -
		7	-	Reserved
		8	-	Reserved
	X86	1	Tx+	Transmit data +
		2	Tx-	Transmit data -
		3	Rx+	Receive data +
		4	-	Reserved
		5	-	Reserved
		6	Rx-	Receive data -
		7	-	Reserved
		8	-	Reserved

Technical data

Description	The interface is constructed as a real-time Ethernet interface.
	X85: Connection to master or previous node
	X86: Connection to next node
Connection design	RJ45, socket
Mating plug	RJ45, plug
Poles	8
Cable	Patch cable of the category CAT5e, shielded
Maximal cable length	50 m (industrial environment) (real-time Ethernet point to point between 2 participants)
cable assembly	RJ45, plug
Shield connection	Apply on both sides
Accessories	Prefabricated cables: Siehe 'EtherCAT cable for connector [X85] / [X86]' auf Seite 57.
Notes	• 100BASE-T 100 Mbit/s Ethernet standard
	• Data frame and assignment of the RJ45 socket acc. to IEEE802.3

5.5.9 [X87] Real-time Ethernet for device E1274

Assignment

[X87]	Connection	Signal	Description
Front view, device side	1	TX+	Transmit Data +
	2	RX+	Receive Data +
	3	TX-	Transmit Data -
	4	RX-	Receive Data -
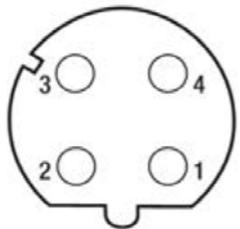
Technical data

Description	Real-time Ethernet interface. With connection X87, the communication via EtherCAT is established to the decentralized drives.
Connection design	M12, socket, D-coded
Mating plug	M12, 4-pole pin, D-coded
4	4
Tightening torque	0.4 Nm
Maximal cable length	50 m (industrial environment) (real-time Ethernet point to point between 2 participants)
Shield connection	Apply on both sides
Accessories	Prefabricated cable: Siehe 'M12 connection cable from iX/iDT5 to KHY 1 for connector [X87]' auf Seite 53.
Notes	• 100BASE-T 100 Mbit/s Ethernet standard

5.6 Connection technology - Print terminal

For print terminals the conductor connection is realized by spring tension.

Direct insertion of the conductor **(1)**. No tools are required

For removing the conductor **(1)**, the loosening switch **(2)** on the terminal front has to be loosened with a screw driver.
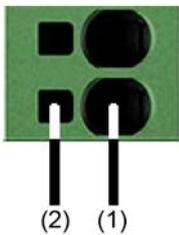
Observe the recommended wire cross-section and the cable stripping length when wiring.

The connection information can be found in the terminal descriptions.

6 Startup

6.1 Addressing bus participants

Within a machine, the master PLC controller acts as field bus master. The subordinated bus participants are slaves.

The addressing of the bus participants can either be done automatically by the master, or the address can be set by DIP switch S1 or by parameter.

Without a valid bus participant address, the bus master cannot establish any communication with the slaves.

6.1.1 EtherCAT: Automatic addressing

On delivery ex works AMK, the DIP switch S1 is set to 0.
In this case the EtherCAT master will assign an address automatically to each bus participant in order to start communication between master and slaves.

The slave addresses correspond to the physical slave positions in the EtherCAT bus.

> Within the PLC, the bus participants are identified by their addresses. If you change the system configuration, e.g. adding, changing, removing bus participants, the EtherCAT master sets new addresses to the bus participants.
>
> Therefore, the addresses of the bus participant change.
>
> This means that an EtherCAT master with EtherCAT configuration file (ID1204 ff) generate at start up 'Error EtherCAT configuration 2727 Info1 = 2'.
>
> Then the slaves change to state 'Pre-Operational'. In the state 'Pre- Operational', it is possible to get access to the slaves (ID read and ID write). The used addresses are given by the EtherCAT master. In this case the PLC accesses, via the service channel a wrong bus participant.
>
> The bus address can be set as fix address by DIP switch S1

6.1.2 EtherCAT: Addressing by DIP switch S1

The DIP switch is read in at system start (24 VDC ON). If the addressing is changed with the DIP switch while the device is switched on, it must be switched off and on again.

> If you change a fieldbus participant which is addressed by DIP switch S1, make sure that the address of the new device is set to the same address.

Consequence of addressing

DIP switch	Active EtherCAT address
= 0	address automatically set by master
≠ 0	address according DIP switch setting

Range
1 ≤ S1 ≤ 255

Example: address = 3

most significant bit (MSB)
least significant bit (LSB)
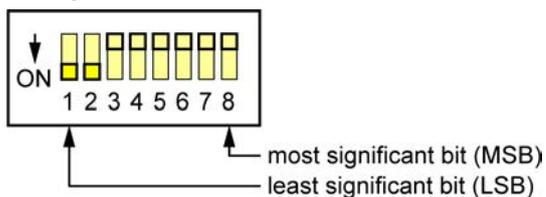
6.2 Configuration of the STO shutdown via DIP switch S2

Switch 1 (bit 1) activates or deactivates the shutdown of the power output stages in the connected decentralized drives via STO in the event of an overload of the DC bus (i2t monitoring).

This is a functional, non-safe related shutdown to protect the DC bus from overload.

On delivery ex works AMK, the DIP switch S2 (bit 1) is set to 1. Shutdown STO is activated.

The following values are set at the factory:

Device	connected Drives	Factory configuration
KHY 1	to iX / iDT5	20 A
KHY 1 (H)	to ihM-XX	20 A
KHY 1 (H 8A)	to ihXT3/4	10 A

The DIP switch is read in at system start (24 VDC ON).

.Configuration Bit8 - Bit1	Meaning
xxxx xxx0 (LSB)	Shutdown STO deactivated in case of overload. A warning message is output on the controller and the digital output BA2 is set.
xxxx xxx1	Shutdown STO activated in case of overload. A warning message is output on the controller and the digital output BA2 is set.

Example: Shutdown STO activated in case of overload
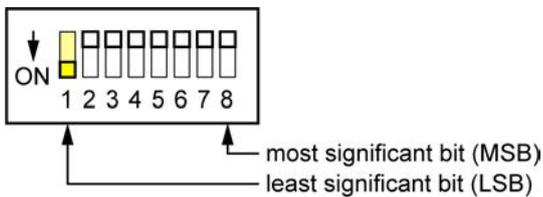
6.3 Configuration of overload monitoring of the DC bus via DIP switch S2

Switch 2 (bit 2) to switch 8 (bit 8) define the adjustable current limit for monitoring of the DC bus.

The DIP switch is read in only at system start (24 VDC ON). On delivery ex works AMK, the DIP switch S2 (bit 3) is set to 1. The current limit 10 A is selected. If several DIP switches are "on", the lowest current limit of the set DIP switches is effective.

Configuration Bit8 - Bit1	Current limit in A
0000 000x (LSB)	5
0000 001x	8
0000 010x	10 [1]
0000 100x	12
0001 000x	16
0010 000x	20 [2]
0100 000x	25
1000 000x	Reserved

1) Setting when connecting ihXT3/4 to KHY 1 (H 8A)

2) Setting when connecting iX / iDT5 to KHY 1 or ihM-XX to KHY (H)

Example: Switch-off threshold 20 A

most significant bit (MSB)

least significant bit (LSB)
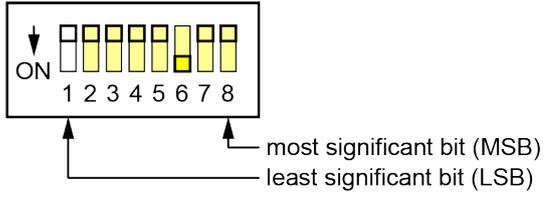
7 Diagnosis

If you can not solve the cause of the error, please contact the AMK Service. If the error can not be rectified by the AMK Service, the service employee will define the further procedure with you:

- Service on site
- Replacing the device or assembly
- Return defective equipment for repair at AMK

7.1 LED status

LED	Designation	Status/Colour	Meaning
H2	SBM	Green	System ready
		Red	Ground fault
			DC bus overload ($I^2t \geq 100\%$)
			DC bus fuse (F1 / F2) defective
			Undervoltage 24 VDC (U_{24V} < 18 VDC)
			Overvoltage 24 VDC (U_{24V} > 30 VDC)
		Flashing red	Overtemperature
		Flashing orange	Firmware version doesn´t match to the hardware revision, please contact AMKmotion service department
H3	STAT (Status real-time Ethernet)	Off	Initialisation
		Green flashing	Pre-operational
		Green single flash	Safe-operational
		Green	Operational
		Red flashing	Configuration error
		Red flashing (1 time)	Error-dependent switch back to the Operational, Safe-operational, Pre-operational or Initialising states
H4	L/A (Real-time Ethernet X85)	Off	No physical connection
		Green	EtherCAT in link mode (physical connection)
		Flashing green	EtherCAT in link/activity mode (connection with data traffic)
H5	L/A (Real-time Ethernet X86)	Off	No physical connection
		Green	EtherCAT in link mode (physical connection)
		Flashing green	EtherCAT in link/activity mode (connection with data traffic)
H7	STO	Off	STO = 0 (Safety function active)
		Green	STO = 1 (Safety function inactive, aperating state)
		Orange	STO shutdown not successful in case of overload (DIP switch S2.1 = On)
		Red	STO switched off due to overload (DIP switch S2.1 = On)
H8	L/A (Real-time Ethernet X87)	Off	No physical connection
		Green	EtherCAT in link mode (physical connection)
		Flashing green	EtherCAT in link/activity mode (connection with data traffic)
H9	24 V	Off	Supply voltage 24 VDC < 5 VDC (U_{24V} < 5 VDC or fuse F3 defective)
		Green	Supply voltage 24 VDC in the specified range (18 VDC $\leq U_{24V} \leq$ 30 VDC)
		Red	Undervoltage 24 VDC (5 VDC $\leq U_{24V}$ < 18 VDC)
		Flashing red	Overvoltage 24 VDC (U_{24V} > 30 VDC)
H10	DC	Off	DC bus inactive (U < 20 VDC)
		Green	DC bus active (U > 60 VDC)
		Orange	Transition state (20 VDC < U < 60 VDC)
		Red	DC bus fuse (F1 / F2) defective

LED	Designation			Status/Colour	Meaning
				Flashing red	Ground fault DC bus
	Utilization / Overload [1]	25 %		Off	Utilization DC bus < 25 %
				Green	Utilization DC bus ≥ 25 %
		50%		Off	Utilization DC bus < 50 %
				Green	Utilization DC bus ≥ 50 %
		75%		Off	Utilization DC bus < 75 %
				Green	Utilization DC bus ≥ 75 %
		100%		Off	Utilization DC bus < 100 %, no overload ($I^2t ≤ 0$ %)
				Green	Utilization DC bus ≥ 100 %, overload < 50 % ($I^2t < 50$ %)
				Orange	Overload (50 % < I^2t < 100 %)
				Red	Overload error ($I^2t ≥ 100$ %)

1)   The display of the utilization refers to the current limit set at the DIP switch S2

7.2 Status PDO

The status PDO is a data field that provides numerous states (warnings, errors, status messages) of the KHY 1. In order to have read access to the information in the data field, the PDO must be configured in the EtherCAT master.

Status PDO

Index/Sub [Hex]	Name	Class	Description "1" state	Scaling / Unit	Type
6000/01	Status: Device Status SBM	Status	System ready message, device has no error state	-	BIT
6000/02	Warning: DC Bus Overload	Warning	I²t counter ≥ 50%	-	BIT
6000/03	Error: DC Bus Overload	Error	I²t counter ≥ 100%	-	BIT
6000/04	Error: DC Bus Earth Leakage	Error	Earth Leakage in the DC bus	-	BIT
6000/05	Error: DC Bus Fuse blown	Error	DC bus fuse blown	-	BIT
6000/06	Warning: DC Bus Overvoltage	Warning	DC-Bus voltage > 868 VDC	-	BIT
6000/07	Status: DC Bus below 60V	Status	DC-Bus voltage < 60 VDC	-	BIT
6000/08	Error: Logic Supply Undervoltage	Error	Supply voltage 24 VDC ≤ 18 VDC	-	BIT
6000/09	Error: Logic Supply Overvoltage	Error	Supply voltage 24 VDC > 30 VDC	-	BIT
6000/0A	Error: Logic Supply Fuse blown	Error	Fuse blown for the supply voltage 24 VDC	-	BIT
6000/0B	Status: STO Switch off configured	Status	STO switch off is active at overload DIP switch S2 (1) = 1 (ON)	-	BIT
6000/0C	Status: STO Voltage present at Output	Status	Supply voltage STO is on at [X11]	-	BIT
6000/0D	Error: STO Switch off failed	Error	STO switch-off relay did not open in the event of a DC bus overload	-	BIT
6000/0E	Error: Over Temperature	Error	Device temperature > 85 °C	-	BIT
6000/0F	reserved	-	reserved	-	BIT
6000/10	reserved	-	reserved	-	BIT
6000/11	DC Bus Input Voltage	Status	measured DC bus voltage [X05]	0,1 V	UINT
6000/12	DC Bus Output Voltage	Status	measured DC bus voltage [X11]	0,1 V	UINT
6000/13	Internal Temperature	Status	Measured device temperature	0,1 °C	INT
6000/14	UZP Current	Status	Measured current (pos. / neg.) in UZP [X11]	0,01 A	INT
6000/15	UZN Current	Status	Measured current (pos. / neg.) in UZN [X11]	0,01 A	INT
6000/16	UZP absolute Current	Status	Measured absolute current of UZP filtered [X11]	0,01 A	INT

Index/Sub [Hex]	Name	Class	Description "1" state	Scaling / Unit	Type
6000/17	UZN absolute Current	Status	Measured absolute current of UZN filtered [X11]	0,01 A	INT
6000/18	DC Bus Power	Status	DC bus power	10 VA	INT
6000/19	I^{2}t Counter	Status	I^{2}t counter overload DC bus	0,1 %	UINT
6000/1A	Logic Supply Voltage In	Status	measured supply voltage 24 VDC at input [X08]	0,01 V	UINT
6000/1B	Logic Supply Voltage Out	Status	measured supply voltage 24 VDC at output [X11]	0,01 V	UINT
6000/1C	Configured Current Limit	Status	DC bus current limit configured at DIP switch S2 bit 2 - bit 8	0,01 A	UINT
6000/1D	EtherCAT ID	Status	EtherCAT ID configured at DIP switch S1 bit 1 - bit 8	-	UINT
6001/0- Service	Power ON Time	Status	Total switch-on time 24 VDC on	-	UDINT
6002/0- Service	Over Temperature counter	Status	Error counter: Over temperature device	-	UINT
6003/0- Service	DC Bus Fuse Error Counter	Status	Error counter: DC bus fuse tripping	-	UINT
6004/0- Service	DC Bus Earth Leakage Error Counter	Status	Error counter: DC bus Earth Leakage	-	UINT
6005/0- Service	DC Bus I2t Error Counter	Status	Error counter: DC bus I^{2}t error	-	UINT
6006/0- Service	24V Overvoltage Error Counter	Status	Error counter: Overvoltage 24 VDC	-	UINT
6007/0- Service	24V Fuse Error Counter	Status	Error counter: 24 VDC fuse tripping	-	UINT
6008/0- Service	STO Relay Error Counter	Status	Error counter: STO relay trip failed	-	UINT
6009/0	Production Date	Status	YYWW decimal production date	-	UINT
600A/0	Serial Number	Status	Device serial number	-	UDINT
600B/0	Device Integration Version	Status	Device hardware revision	-	UINT
600C/0	Device Software Version	Status	Device firmware version (SVN)	-	UINT

7.3 Control PDO

Control PDO

Index/Sub [Hex]	Name	Class	Description	Scaling / Unit	Type
7000/01	Command Word	Control	Control word: The "Delete errors" command is executed when the "Command Word" is set from the value 0 to the value 5. A command must be present for at least 1 second so that it can be reliably recognized by the device. The "Command Word" must be set to the value 0 for at least 1 second between each "clear error" command. 	Value (dec.)	Meaning
---	---
0	no command active
5	Command "Clear error"	 In order for the commands to be recognized by the device, the commands must be pending in the control PDO for at least 100 ms.	-	UINT

8 Service

8.1 Fuse

The KHY 1 device is maintenance-free.

If one or more fuses in the KHY 1 device have blown, they must be replaced. For the fuse replacement the device must be sent to AMKmotion. Please contact our service department.

The fuses are installed inside the device and cannot be replaced from the outside. The device may only be opened by authorized AMKmotion employees. If you open the device anyway, you lose all warranty claims!

9 Accessories

9.1 Connection cable

9.1.1 Instructions for installation of safety-related cables

Cables like hybrid cable contains power, signal and communication wires as well as safety-relevant cables. Always install the safety related cables in accordance with EN ISO 13849-2 Table D.4 permanently (fixed) and protected against external damage, e.g. in the cable channel or armored tube. An energy chain can also be a suitable protection against external damage.

Consider possible causes of damage to cables and take appropriate preventive measures:
- Driving over cables by the machine itself
- Driving over doe to vehicles or other machines
- Touching the cable with the machine construction or other nearby parts during the movement
- Running in or out of cable baskets or cable reels
- Acceleration forces and wind forces on cable garland systems or overhead lines
- Excessive friction due to line pickup
- Exposure to excessive radiant heat

Further information on correct cable routing can be found in the standard EN 60204-1.

To prevent failure due to wear, replace cables when the maximum permissible number of bending cycles has been reached (relevant for cables that are subjected to cyclic bending, for example in a drag chain).
The shield must be placed on PE on both sides.

9.1.2 iX/iDT5 to KHY 1

Designation	AMK part no.	Description
Power cable 2.5 mm^2	47390	Power cable for connecting iX/iDT5 to the KHY 1 (E1274) at connector [X11] M23 pin straight ↔ M23 socket straight Length of y m$^{1)}$ The cable includes assembled lines for: • DC bus • 24 VDC and STO supply voltage

1) The cable is to be ordered under the aforementioned part number in the desired length.

M23 Pin assignment M23-hybrid

Pin	Wire identification	Cross section [mm²]	Max. curr. [A] $^{1)}$ (cable lay type)	Signal	Description
1	Black 1	2.5	25 (C)	UZP	DC bus + supply
3	Black 3	2.5	23 (B2)	UZN	DC bus - supply

Pin	Wire identification	Cross section [mm²]	Max. curr. [A] [1] (cable lay type)	Signal	Description
A	White 5	0.75	6 (C) 5 (B2)	24 VDC	24 VDC supply voltage for electronics
B	Brown 6	0.75		0 VDC	Reference potential for 24 VDC
C	Green 7	0.75		24B-	24 VDC supply voltage for STO and for an optional available holding brake
D	Yellow 8	0.75		0B	Reference potential for 24 VDC for STO and for an optional available holding brake
PE	Green / yellow	2.5	-	PE	Protective earth conductor

1) Valid up to 40 °C ambient temperature

Technical data

Description	Value
Short description	(2x0.75mm²)C+(2x0.75 mm²)C + 4x2.5 mm²
Outer diameter	13.8 ±0.4mm
Material coat	PUR
Color coat	similar RAL2003
Admission	UL/CSA
Operating voltage	1000 V UL
AWM style	AWM Style 21223
Specific cable weight	314 kg/km
RoHS	Conform to the EU-guideline
Halogen free	yes
Silicone-free	yes
Oil resistance outer jacket	yes

Thermal properties

Ambient temperature Transport and storage	-50 … +80 °C
Operating temperature fixed installation	-50 … +80 °C
Operating temperature flexible installation	-20 … +60 °C
Operating temperature moves in energy chain	-20 … +60 °C

Power conductors

Core cross-section	2.5 mm^2
Colors	black 1+3, green/yellow ,black 2 not used
Operating voltage	≤ 800 VDC
Conductor resistance at 20 ° C	7.98 Ω/km

Signal wires 24 VDC electronic supply

Cross-section	0.75 mm^2
Colors	white 5, brown 6
Operating voltage	24 VDC
Conductor resistance at 20 ° C	26 Ω/km

Signal wires 24 VDC STO

Cross-section	0.75 mm^2
Colors	green 7, yellow 8
Operating voltage	24 VDC

Description	Value
Conductor resistance at 20 ° C	26 Ω/km
Use in energy guiding chains	
Min. bending cycles	10 Mio.
Minimum bending radius	≥ 6 x D for permanent installation
	≥ 12 x D in the energy supply chain
Max. acceleration	5 m/s^2
Max. traversing	3 m/s
Max. horizontal travel length	5 m
Torsion	max. ±30 °/m

9.1.3 M12 connection cable from iX/iDT5 to KHY 1 for connector [X87]

Designation	AMK part no.	Description
EtherCAT 2 x M12 pin	203500	1 m, 4-pole
EtherCAT 2 x M12 pin	203501	2 m, 4-pole
EtherCAT 2 x M12 pin	203973	5 m, 4-pole
EtherCAT 2 x M12 pin	204266	10 m, 4-pole

9.1.4 ihX(T)3/4 an KHY 1 (H 8A)

Designation	AMK part no.	Description
Cable hybrid V2 ihX → ihM-XX	51128	Hybrid cable for connecting ihXT3/4 **(rev. ≥8.00)** to KHY 1 (H 8A) at connection [X11]
		M23 hybrid pin straight ↔ ihXT3/4 hybrid connection
		Length of y m[1]
		The cable includes assembled lines for: • DC bus • 24 VDC and STO supply voltage • Real-time Ethernet bus

1) The cable is to be ordered under the aforementioned part number in the desired length.

Pin assignment M23-hybrid

Pin	Wire identification	Cross section [mm²]	Max. curr. [A] [1] (cable lay type)	Signal	Description
A	Red	1.5	10 (C + B2)	UZP	DC bus + supply
B	Blue	1.5		UZN	DC bus - supply
C	White	1.0	6 (C + B2)	24 VDC	24 VDC supply voltage for electronics and an optionally available motor holding brake.
D	Brown	1.0		0 VDC	Reference potential for 24 VDC
PE	Green / yellow	1.5	-	PE	Protective earth conductor
1	Blue	0.12		RX-	Receive Data -
2	White	0.12		RX+	Receive Data +
3	Orange	0.12		TX-	Transmission Data -
4	Yellow	0.12		TX+	Transmission Data +
5	-	-	-	-	-
6	-	-	-	-	-

Pin	Wire identification	Cross section [mm²]	Max. curr. [A] [1] (cable lay type)	Signal	Description
7	Yellow	0.5	6 (C + B2)	STO_GND	Reference potential for STO
8	Green	0.5		STO	STO (Safe torque off)

1) Valid up to 40 °C ambient temperature

Technische Daten

Description	Value
Short description	(2x2x0.12 mm²)C + (2x1.0mm²+2x0.50 mm²)D + 3x1.5 mm²
Outer diameter	10.8 ±0.2 mm
Material coat	PUR
Color coat	similar RAL2003
Admission	UL/CSA
Operating voltage	1000 V UL
AWM style	AWM Style 21223
Specific cable weight	175 kg/km
RoHS	Conform to the EU-guideline
Halogen free	yes
Silicone-free	yes
Oil resistance outer jacket	yes
Thermal properties	
Ambient temperature Transport and storage	-40 … +80 °C
Operating temperature fixed installation	-40 … +80 °C
Operating temperature flexible installation	-30 … +80 °C
Operating temperature moves in energy chain	-20 … +60 °C
Power conductors	
Core cross-section	1.5 mm^2
Colors	red, blue, green/yellow
Operating voltage	≤ 850 VDC
Conductor resistance at 20 ° C	13.3 Ω/km
Signal wires 24 VDC electronic supply	
Cross-section	1 mm^2
Colors	white, brown
Operating voltage	≤ 50 VDC
Conductor resistance at 20 ° C	19.5 Ω/km
Signal wires 24 VDC STO	
Cross-section	0.5 mm^2
Colors	green, yellow
Operating voltage	≤ 50 VDC
Conductor resistance at 20 ° C	39 Ω/km
Data element	
Cross-section	0.12 mm^2
Colors	white, blue; yellow, orange
Operating voltage	≤ 50 VDC
Conductor resistance at 20 °C	166.7 Ω/km

Description	Value
Use in energy guiding chains	
Min. bending cycles	5 Mio.
Minimum bending radius	≥ 5 x D for permanent installation
	≥ 7.5 x D in the energy supply chain, optimal ≥ 12 x D
Max. acceleration	50 m/s^2
Max. traversing	5 m/s
Torsion	max. ±30 °/m
Welding spatter resistance	The cable sleeve has a good resistance to welding spatter.
	These must not burn in, they must roll off.

9.1.5 ihM-XX to KHY 1 (H)

Designation	AMK part no.	Description
Cable ihM-XX hybrid M23/M23	M3478	Hybrid cable for connecting ihXT to the KHY 1 (E1284), at connection [X11] M23 hybrid pin straight ↔ M23 hybrid socket straight Length of 5 m The cable includes assembled lines for: • DC bus • 24 VDC and STO supply voltage • Real-time Ethernet bus

Pin assignment M23-hybrid

Pin	Wire identification	Cross section [mm²]	Max. curr. [A] [1] (cable lay type)	Signal	Description
A	Red	2.5	25 (C) [2]	UZP	DC bus + supply
B	Blue	2.5	19 (B2) [2]	UZN	DC bus - supply
C	White	2.5	22 (C) [3] 17 (B2) [3]	24 VDC	24 VDC supply voltage for electronics and an optionally available motor holding brake.
D	Brown	2.5		0 VDC	Reference potential for 24 VDC
PE	Green / yellow	2.5	-	PE	Protective earth conductor
1	Blue	0.12		RX-	Receive Data -
2	White	0.12		RX+	Receive Data +
3	Orange	0.12		TX-	Transmission Data -
4	Yellow	0.12		TX+	Transmission Data +
5	-	-	-	-	-
6	-	-	-	-	-
7	Yellow	0.5	6 (C + B2)	STO_GND	Reference potential for STO
8	Green	0.5		STO	STO (Safe torque off)

1) Valid up to 40 °C ambient temperature

2) The current carrying capacity of the individual strands in the hybrid cable also depends on the current load of the other strands in the hybrid cable. The specified current carrying capacity of the UZP/UZN wires applies to a current load of the 24 VDC/0 VDC wires with max. 20A.

3) The specified current carrying capacity of the 24 VDC/0 VDC wires applies to a current load of the UZP/UZN wires with a maximum of 20A.

Technical data

Description	Value
Short description	(2x2x0.12 mm2)C + (2x2.5mm2+2x0.50 mm2)C + 3x2.5 mm²
Outer diameter	typ. 13.5 mm, max. 14.8 mm
Material coat	PUR
Color coat	similar RAL2003
Admission	UL/CSA
Operating voltage	1000 V UL
AWM style	AWM Style 21223
Specific cable weight	293 kg/km
RoHS	Conform to the EU-guideline
Halogen free	yes
Silicone-free	yes
Oil resistance outer jacket	yes

Thermal properties

Ambient temperature Transport and storage	-50 … +80 °C
Operating temperature fixed installation	-50 … +80 °C
Operating temperature flexible installation	-40 … +80 °C
Operating temperature moves in energy chain	-20 … +60 °C

Power conductors

Core cross-section	2.5 mm^2
Colors	red, blue, green/yellow
Operating voltage	≤ 900 VDC
Conductor resistance at 20 ° C	7.98 Ω/km

Signal wires 24 VDC electronic supply

Cross-section	2.5 mm^2
Colors	white, brown
Operating voltage	≤ 60 VDC
Conductor resistance at 20 ° C	7.98 Ω/km

Signal wires 24 VDC STO

Cross-section	0.5 mm^2
Colors	green, yellow
Operating voltage	≤ 60 VDC
Conductor resistance at 20 ° C	7.98 Ω/km

Data element

Cross-section	0.12 mm^2
Colors	white, blue; yellow, orange
Operating voltage	≤ 60 VDC
Conductor resistance at 20 °C	166.7 Ω/km

Use in energy guiding chains

Min. bending cycles	5 Mio.
Minimum bending radius	≥ 5 x D for permanent installation
	≥ 7.5 x D in the energy supply chain, optimal ≥ 12 x D
Max. acceleration	50 m/s^2

Description	Value
Max. traversing	5 m/s
Max. horizontal travel length	20 m
Torsion	max. ±30 °/m
Welding spatter resistance	The cable sleeve has a good resistance to welding spatter. These must not burn in, they must roll off.

9.1.6 EtherCAT cable for connector [X85] / [X86]

Designation	AMK part no.:	Description
Cable RJ45 CAT5e PUR 0.20 m	202665	0.20 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 0.30 m	202666	0.30 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 0.40 m	202667	0.40 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 1.00 m	202668	1.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 2.00 m	202669	2.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 5.00 m	202670	5.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 10.00 m	202671	10.00 m length with straight plug, snap in

10 Disposal

Clarify with your local waste disposal company which materials and chemicals need to be separated and how to dispose of them. Observe the local regulations for disposal.

Examples of materials to be disposed of separately:

Components

- Electronic scrap, e. g., encoder electronics
- Iron scrap
- Aluminium
- Non-ferrous metal, e. g., motor windings
- Insulating materials

Chemicals

- Oils (disposal as hazardous waste, in acc. with the pertinent legislation; in Germany, the Waste Oil Ordinance (AltölV) applies)
- Grease
- Solvents
- Paint residue
- Coolant

11 Certificates

The certificates are available through AMKmotion sales or on the AMKmotion website.

- Declaration of conformity

You can get it as follows:

- AMKmotion homepage - service - download - registration - start online documentation - certificates
  (One-time manual activation by AMKmotion sales department is necessary.
  The auto-registration via AMKmotion homepage does not include access to the entire documentation.)
  www.amk-motion.com/en/content/download_area

Your opinion is important!

With our documentation we want to offer you the highest quality support in handling the AMKmotion products.

That is why we are now working on optimizing our documentation.

Your comments or suggestions are always of interest to us.

We would be grateful if you take a bit of time and answer our questions. Please return a copy of this page to us.

e-mail: *Documentation@amk-motion.com*

or

fax no.: +49 7021/50 05-199

Thank you for your assistance.
Your AMKmotion documentation team

1. How would you rate the layout of our AMKmotion documentation?

   (1) very good (2) good (3) satisfactory (4) less than satisfactory (5) poor

2. Is the content structured well?

   (1) very good (2) good (3) moderate (4) hardly (5) not at all

3. How easy is it to understand the documentation?

   (1) very easy (2) easy (3) moderately easy (4) difficult (5) extremely difficult

4. Did you miss any topics in the documentation?

   (1) no (2) if yes, which ones:

5. How would you rate the overall service at AMKmotion?

   (1) very good (2) good (3) satisfactory (4) less than satisfactory (5) poor