AMKASMART
Device description
Decentralized drive technology
ihXT, ihXP, ihXD, ihXS, ihXZ

Version: 2022/33
Part no.: 205186

Translation of the "Original Dokumentation"

AMKmotion

MEMBER OF THE ARBURG FAMILY

Imprint

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Chapter / Topic	**Change**	**Letter symbol**
Document	• node address setting up to 250 via DIP switch S1 • New pictures • new fieldbus connectors with insulation displacement technology • twist-proof cable entry was introduced • update of the complete document	LeS

Previous version: 2021/30

Product status:

Product	Firmware version (Part no.)
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Reservation: We reserve the right to modify the content of the documentation as well as the delivery options for the product.

Publisher: AMKmotion GmbH + Co KG
Gaußstraße 37-39
73230 Kirchheim unter Teck
Germany

Phone +49 7021 50 05-0
Fax +49 7021 50 05-176

E-mail: info@amk-motion.com

Registration court: AG Stuttgart, HRA 230681, Kirchheim unter Teck,
Tax Id no.: DE 145 912 804

Complementary: AMKmotion Verwaltungsgesellschaft mbH, HRB 774646

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

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 documentation	1
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Product identification, technical data, planning, dimensioning and projecting (for planning and projecting personnel)	Product overview	3
	Projecting	4
Practice information for startup, operation, maintenance, disposal and optional accessories (for startup-, operating- or maintenance personnel)	Assembly	5
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	Startup - Operation - Maintenance	7
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Reference to Certificates e. g. CSA, CE or TÜV	Certificates	11
Abbreviations and terms will be explained	Glossary	-

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
- Projecting
- Connection
- Parameterization
- Startup
- Testing and maintenance
- 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
- Projecting, planning and dimensioning of the application
- Environmental conditions for storage, transportation and operation
- Assembly
- Electrical connections
- Startup and operation
- Maintenance
- Repair
- Replacement
- Diagnosis
- Decommissioning and disposal
- Technical data
- Conformity with standards

1.5 Appendant documents

Device descriptions

AMK part no.	Title
27859	Motor encoders
	Product specific data sheets and dimension drawings

Functional descriptions

AMK part no.	Title
25786	Diagnostic messages
203704	Parameter description (properties of controller parameters)
203771	Software description ATF - AMK Tool Flasher (PC software for firmware update)
204628	Interface description Drive Profile CiA 402
204737	Initial startup of decentralized drives
204979	Software description AIPEX PRO V3 (PC software for startup and parameterization)
206016	Interface description EtherCAT (CoE)

1.6 Display conventions

Display	Meaning
	This symbol points to parts of the text to which particular attention should be paid!
0x	0x followed by a hexadecimal number, e. g. 0x500A
'Names'	Names are represented with apostrophes e. g. parameters, variables, etc.
'Text'	Menu items and buttons in a software or on a controller, e. g.: Click the **'OK'** button in the **'Options'** menu to call up the 'Delete PLC program' function
>xxx<	Placeholder, variables, e. g. IP address of the controller: >192.168.0.1<
→	Task procedure / operating sequence, e. g. **'Start'** → **'All programs'** → **'Additional'** → **'Editor'** e. g. 0 → 1 edge
See 'chapter name' on page x	Executable cross-reference in electronic output media

2 For your safety

2.1 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.

2.2 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.

2.3 Presenting safety messages

Any safety information is configured as follows:

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

2.4 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.

2.5 Danger 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.
	Warning against crushing!
	Warning against hot surface!

2.6 Intended use

The following products are intended for fixed connection in industrial and commercial use in machines and systems:

- 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.

2.7 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 Warning signs

The following warning signs is located on the top of the devices:

Warning against hot surface!

In English and French:

Warning: dangerous electric voltage!

It takes at least 5 minutes until the energy storage is discharged after being electrically disconnected.

⚠ DANGER	
	**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:** • 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. • Caution: A voltage-free state is not signalled!

2.9 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.

2.10 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 Hardware revision version

The ihX electronics have been revised for the following innovations:

- Evaluation of temperature sensor PT1000
- STO (Safe torque off) certification
- CSA certification (in preparation)

In addition, new fieldbus connectors with insulation displacement technology were used and a twist-proof cable entry was introduced. The devices have new part numbers and revision levels:

Revision for devices with revised electronics	≥4.00	≥8.00
Connector design Real-time Ethernet X85/X86	Molex	Erni
Firmware version	≥V2.12 2018/03 (207094)	

Compatibility Notice:

If firmware ≤2.11 is loaded onto a device with revision ≥4.00 or ≥8.00, an error message appears (1071 with info 1 = 2). From now on, only devices with rev. ≥4.00 or ≥8.00 will be produced and delivered that cannot be operated with older firmware versions.

3.2 Order data

The order designation of the products is determined by the type code.

3.3 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.

3.4 Type code

3.4.1 Type code (rotativ drive)

ihX x x x - x - x - x x x - xxxx - x x

- Functional Safety
  - in process
  - **0**: not integrated
- Communication to the controller
  - **E**: Ethernet [1)]
- Idle speed [rpm]
- Cooling
  - **0**: Convection cooling
  - **F**: External fan
  - **W**: Liquid cooling
- Motor holding brake
  - **0**: without motor holding brake
  - **B**: with integrated motor holding brake
- Motor encoder type
  - **E**: Singleturn absolute encoder EnDat 2.1 (digital and sin/cos track), optical
  - **F**: Multiturn absolute encoder EnDat 2.1 (digital and sin/cos track), optical
  - **P**: Singleturn absolute encoder EnDat 2.2 light (digital), inductive
  - **Q**: Multiturn absolute encoder EnDat 2.2 light (digital), inductive
  - **S**: Singleturn absolute encoder, Hiperface, with sin/cos track, optical
  - **T**: Multiturn absolute encoder, Hiperface, with sin/cos track, optical
  - **U**: Singleturn absolute encoder, Hiperface, with sin/cos track, capacitive
  - **V**: Multiturn absolute encoder, Hiperface, with sin/cos track, capacitive
  - **I**: I encoder, with sin/cos track and zero pulse, optical
- No. of poles
- Performance indicator for the core length of the motor / continuous stall torque M_0
- Installation size
  - **3**: 55 mm square flange
  - **4**: 70 mm square flange
- Built-on gear
  - **0**: Without gear
  - **G**: With gear

Motor type

T: Torque

P: Power

D: Dynamik

S: Speed

1) Siehe 'Options' auf Seite 63.

3.4.2 Type code (linear drive with integrated screw-nut system)

ihX Z x - x - x - x - x - x x x - xxxx - x x

- Functional Safety
  - \- in process
  - **0**: not integrated
- Communication to the controller
  - **E**: Ethernet [1)]
- Idle speed [rpm]
- Cooling
  - **0**: Convection cooling
  - **F**: External fan
  - **W**: Liquid cooling
- Motor holding brake
  - **V**: Anti-twist protection
  - **P**: Anti-twist protection and brake
- Motor encoder type
  - **E**: Singleturn absolute encoder EnDat 2.1 (digital and sin/cos track), optical
  - **F**: Multiturn absolute encoder EnDat 2.1 (digital and sin/cos track), optical
  - **P**: Singleturn absolute encoder EnDat 2.2 light (digital), inductive
  - **Q**: Multiturn absolute encoder EnDat 2.2 light (digital), inductive
  - **S**: Singleturn absolute encoder, Hiperface, with sin/cos track, optical
  - **T**: Multiturn absolute encoder, Hiperface, with sin/cos track, optical
  - **U**: Singleturn absolute encoder, Hiperface, with sin/cos track, capacitive
  - **V**: Multiturn absolute encoder, Hiperface, with sin/cos track, capacitive
  - **I**: I encoder, with sin/cos track and zero pulse, optical
- Spindle
  - **K**: Ball screw (KGT)
  - **R**: Roller screw (RGT)
  - **P**: Planetary screw (PRG)
  - **W**: Planetary roller screw (PWG)
- Maximum stroke [mm]
- Screw pitch[mm]
- Performance indicator for the core length of the motor / continuous stall torque M_0
- Installation size
  - **3**: 55 mm square flange
  - **4**: 70 mm square flange
- Motor type
  - **Z**: Cylinder

1) Siehe 'Options' auf Seite 63.

3.5 Product description

ihXT, ihXP, ihXD, ihXS, ihXZ servo motors with integrated inverter ihX and hybrid connection technology

The servo motors of the AMKASMART series ihXT, ihXP, ihXD, ihXS, ihXZ combine the power of the AMK servo motors DT / DP / DD / DS / SEZ with the most modern ihX inverters in the most compact installation space.

The devices can be operated alone or in the network (EtherCAT (SoE/CoE), VARAN (SoV/EoV)) with the AMK-specific functional range. In the device connection, both the electronic supply voltages as well as the power supply can be looped from device to device (take care of the max. limit load!).

The devices have the following standard functionality:

- STO safety function (safe torque off) according to DIN EN 61800-5-2, uncontrolled stopping according to EN 60204-1, stop category 0
- Control in the 4-quadrant operation
- Torque control
- Speed control
- Position control
- Control of synchronous and asynchronous motors, also in field weakening
- Automatic actuation of an optional motor holding brake
- Communication interface
- AIPEX PRO software support

Communication interfaces:

- Real-time Ethernet
  - EtherCAT (standard)
  - VARAN (option)

For decentralized modular built machines that dispense entirely on cabinets, AMKASMART iSA combines in a compact way the controller and the decentralized power supply in an enclosure with IP 65 protection class.

See device description iSA, Part no. 205670.

3.6 Product view

3.7 Interface overview

3.7.1 Connection box ihX

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1 and 2). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

AMK delivers the device with protective plugs as transport protection to seal the openings in the connection box so that no dirt particles can penetrate. This protective plug is only suitable for transport and does not meet protection class IP65.

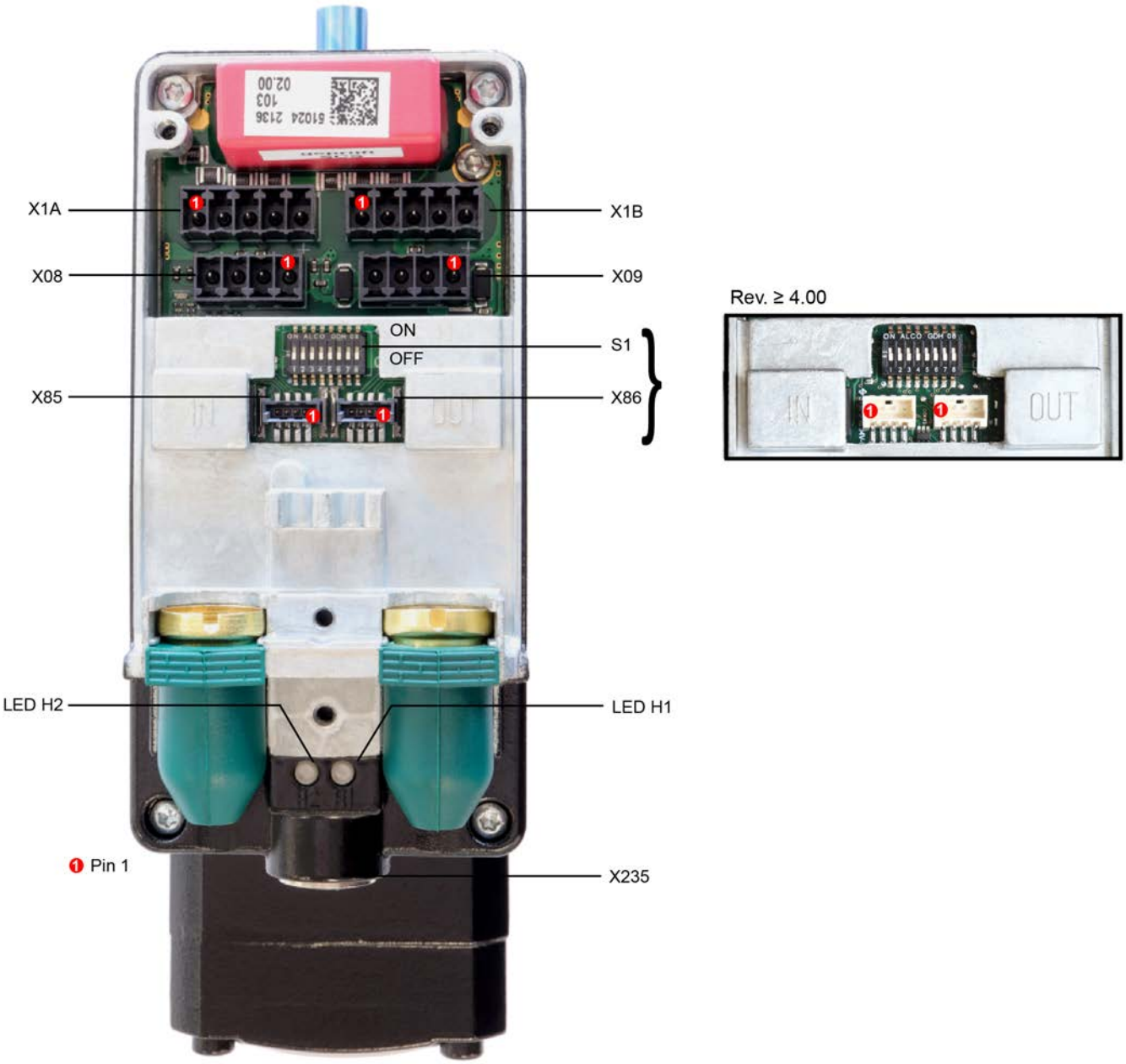
In the application, the opening must be closed with a end cap AMK part no. O971 if no forwarding transmission is used.

The end cap with the AMK part no. O971 is required once in the drive string on the last device and must be ordered explicitly.

transport protection not IP65

IP65 compliant end cap
AMK part no. O971

Devices with hardware revision rev. ≥8.00

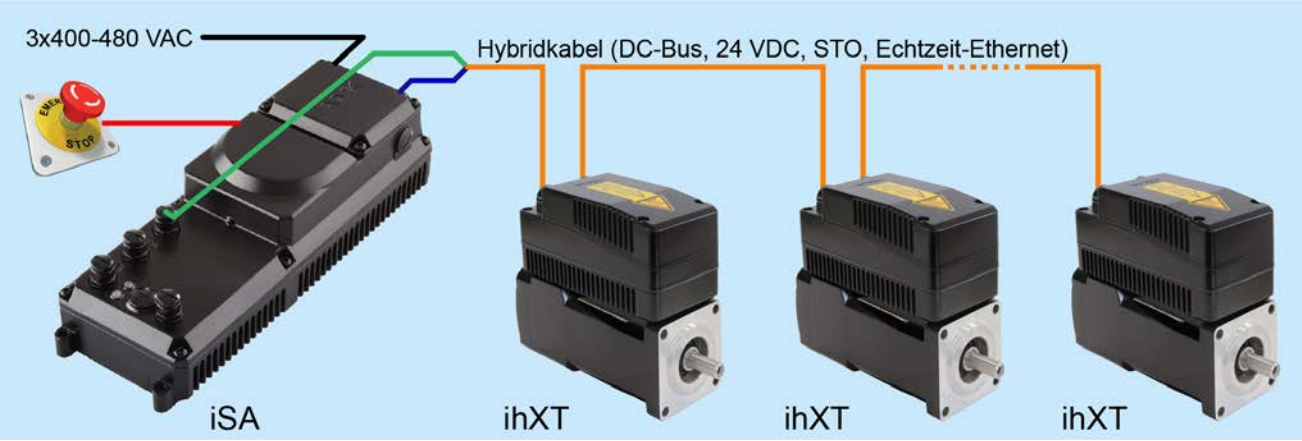


Interfaces	Function	
LED H1 State LED	**Colour**	**Meaning**
	Green	SBM: System without error, controller enable RF not set
	Flashing green (2,5 Hz)	SBM + QRF: Drive under control
	Red	Drive in error state, evaluate diagnostic message
	Flashing red (2,5 Hz)	Reserved
	Orange	Warning message when controller enable not set
	Flashing orange (2,5 Hz)	Warning message when controller enable set
	Flashing orange (16 Hz)	The new firmware will be plausibility checked and copied once into the mirror memory. This procedure takes approximately 15 seconds time.
LED H2	Reserved	

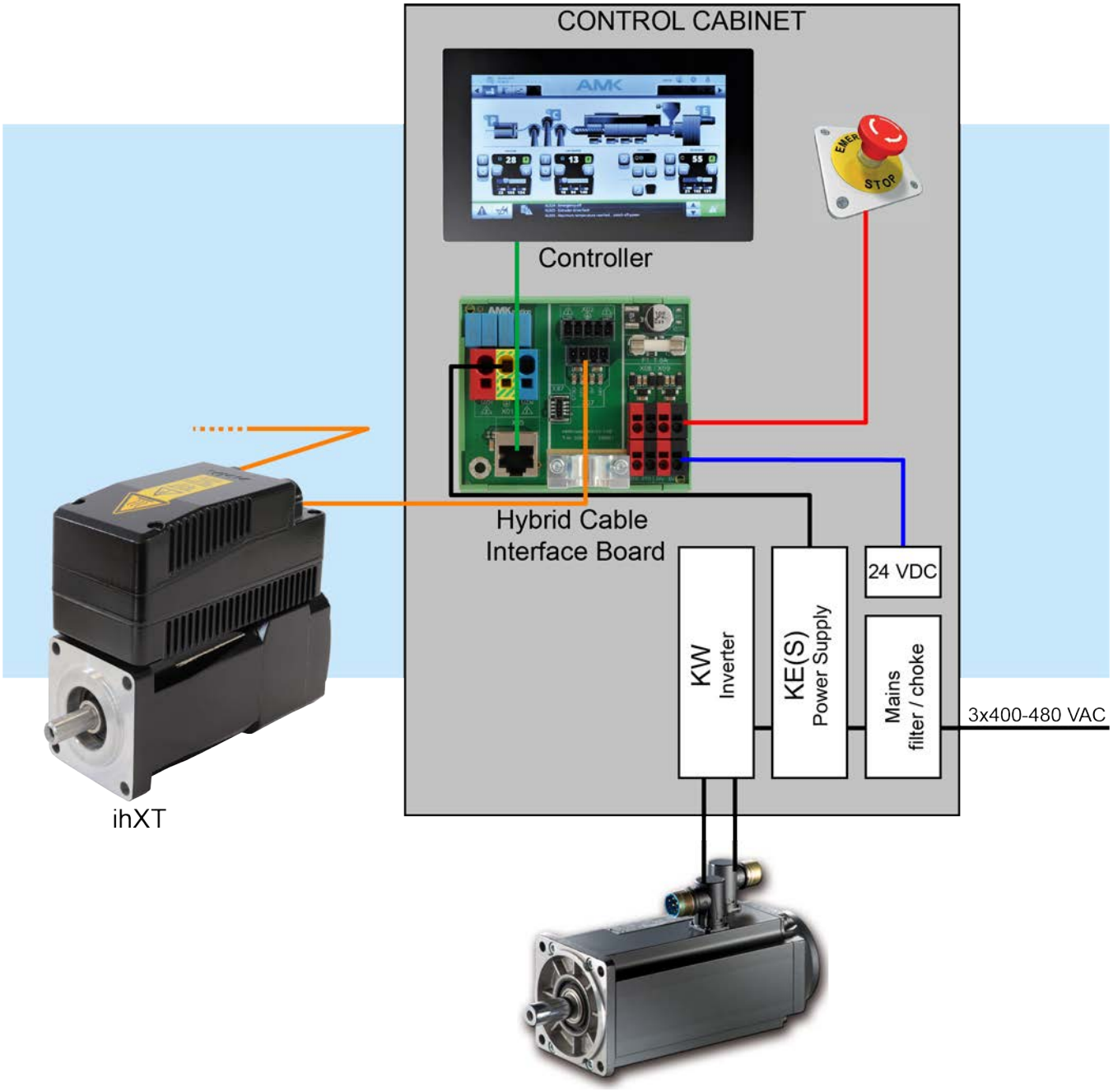
Interfaces	Function
S1	Address switch  ON OFF LSB 1 2 3 4 5 6 7 8 Siehe 'Addressing bus participants' auf Seite 58.
X1A	Power connection DC bus (UZP, UZN, PE)
X1B	Transmission of the DC bus voltage (UZP, UZN, PE)
X08	Supply voltage 24 VDC, 0 VDC: Electronic and optional motor holding brake. Signal STO and STO_GND
X09	Supply voltage transmission 24 VDC, 0 VDC: Electronic and optional motor holding brake. Transmission STO and STO_GND
X85	Real-time Ethernet: Input
X86	Real-time Ethernet: Transmission
X235	Micro-USB Type B 

3.8 Product in system

3.8.1 Decentralized solutions with iSA



3.8.2 Hybrid solution combined control cabinet with decentralized drives



3.9 Technical data

3.9.1 Electrical data ihX

Designation	Terminals	Value
DC bus input and forwarding		
Rated voltage	X1A, X1B	540 - 720 VDC
Shutdown threshold		typ. 870 VDC
Degree of efficiency of the inverter electronics		98 %
Rated current terminal		10 A
24 V Logic supply - input and forwarding		
Rated voltage	X08, X09 Connection 1, 2	PELV power supply [1)] 24 VDC ±15 %, ripple max. 5 % with integrated switch-on current limitation
Dielectric strength		60 VDC (switch off at typical 32 VDC)
Rated current without optional components and holding brake		0.18 A
Electronics power consumption without optional components and holding brake		4.32 W
Rated current for holding brake		0.35 A
Maximum current consumption of the holding brake		0.7 A
Rated current terminal		10 A
STO input and forwarding (STO - Safe torque off)		
Rated voltage	X08, X09 Connection 3, 4	Digital input according to standard EN 61131-2 type 3 PELV power supply [1)]: 24 VDC ±15 %, ripple max. 5 % with integrated switch-on current limitation
Dielectric strength		60 VDC (switch off at typical 32 VDC)
Rated current		11 mA
Signal level		**Signal level** / **Meaning** 11 - 14 VDC / STO = inactive 0 - 5 VDC / STO = active

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

3.9.2 Motor data

Product-specific characteristic data can be found on the data sheet of the drive.

The nominal data refers to an ambient temperature of 0 °C to 40 °C and and the excess temperature of the winding specified in the data sheet in Kelvin. The nominal data refers were achieved by mounting on an aluminum flange with 300 mm diameter and a thickness of 20 mm.

Motor bearings:	Ball bearings, sealed for life, otherwise observe information on the motor / motor data sheet
Motor encoder:	Integrated (type according to the type plate)
Brake:	Optional motor holding brake is integrated

3.9.3 Maximum current Hybrid Cable Interface Board and hybrid cable

Designation	Connection	Unit	Value
Hybrid Cable Interface Board			
Fuse F1 (slow) for 24 VDC electronic supply	-	A	8
Fuse F2 (automatically reset) for STO signal	-	A	0.5
Hybrid cable			
Maximum current of the DC bus strands (A = 1,5 mm^2)	-	A	10
Maximum current of the 24 VDC strands (A = 1 mm^2)	-	A	6

Thus the maximum output current can be determined for a current path, the maximum permissible currents on the connecting cable and the connector must be considered. From the previous data, the following maximum permissible currents results:

Connection	Value	Note
DC bus with hybrid cable	10 A	Must be fused by the user!
24 VDC with hybrid cable	6 A	Fuse protection via F1

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	Explanation
Ambient temperature (EN 61800-2)	-25 °C to +70 °C	Class 2K3 (IEC 60721-3-2)
Relative air humidity (EN 61800-2)	5 % to 95 % at +40 °C	Class 2K3 (IEC 60721-3-2)
Vibration stress (EN 61800-2)	-	Class 2M2 (IEC 60721-3-2)

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	Explanation
Ambient temperature (EN 61800-2)	-25 °C to +55 °C	Class 1K4 (EN 60721-3-1)
Relative air humidity (EN 61800-2)	5 % to 95 %	Class 1K3 (EN 60721-3-1)

3.10.3 Operation

Designation	Range of values	Explanation
Ambient temperature	0 °C to 40 °C	The nominal data refers to an ambient temperature of 0 °C to 40 °.
Installation height (EN 60034-1, IEC 60034-1)	0 to 1000 m above sea level	For installation heights above 1000 m and below 2000 m, the rated data for the output power must be reduced by 2% per 100 m.
Relative air humidity	5 % to 85 %	No condensation
Vibration stress Shock (EN 60721-3-3)	10g (2..200 Hz) 25g	Operation: Class 3M8
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)	1	Devices Rev. <4.00 The interior equipment is designed for no or only dry, non-conductive pollution.
	2	Devices Rev. ≥4.00 The interior of the device is usually designed for non-conductive pollution. Occasionally, however, is a short-term Condensation conductivity allowed when unit is not in use.
Overvoltage category (EN 61800-5-1)	III	up to 2000 m above see level

4 Projecting

4.1 Layout of the DC bus power supply

The power supply of the DC bus for must be selected specific to the application (e.g. iSA, iC, KE, KEN, KES) and must take the following points into account:

- Continuous rated current, which the power supply must provide
- Simultaneity factor of the connected drives
- Overload current and time duration
- Motor / regenerative operation
    - Current regeneration (if available)
    - Brake resistor

4.1.1 AC-Sicherung

The mains fuse of the AC mains supply line of the power supply must be selected to match the lowest ampacity in the overall system. For example, this can be the cable cross-section of the DC bus line or the maximum permissible current of a terminal or a plug.

4.1.2 Layout of DC fuses

Cables for the DC bus must be secured with DC fuses in the positive and negative cable path if the cables are laid outside of the switch cabinet. The fuse is to be laid according to the current-carrying capacity of the DC cable and the ampacity of the connection terminals UZP, UZN .

The DC fuse has the task of protecting the DC cable in the event of a short-circuit and preventing a cable fire.

Siehe 'DC fuses and fuse holders' auf Seite 63.

4.1.3 Cable lengths for DC cables

The total permissible DC bus cable length to a power supply depends on the power supply:

Power supply	permissible DC cable length per strand	Explanation
KE, KEN, KES	50 m	Several ihX strands can be operated in parallel on one power supply. Each strand may be a maximum of 50 m long.
iC	20 m	The DC bus of an inverter can be connected to the iC. The cable length from the iC to the last drive in the strand may be a maximum of 20 m.
iSA	20 m	The DC bus of an inverter can be connected to the iSA. The cable length from the iSA to the last drive in the strand may be a maximum of 20 m.

4.2 Configuration of the 24 VDC transmission / max. number of devices per strand

As the result of voltage drop or tolerances, the 24 VDC input voltage at the ihX must not be less than 20.4 VDC or exceed 27.6 VDC (supply voltage 24 VDC ±15 %, max. ripple 5 %). The maximum permissible voltage drop along the drive strand is 7.2 VDC (= 27.6 VDC - 20.4 VDC). The current consumption of the 24 VDC supply varies at each device due to the voltage drop along the strand.

The following measures optimize the voltage drop:

- Place devices with the highest current consumption at the start of the strand
- Place devices with short connecting cables at the start of the strand

4.3 Transmission of supply voltages between devices

When transmitting supply voltages (e.g. 24 VDC supply voltage, DC bus voltage), only so many slaves can be connected to one strand so that the maximum permissible current load at the first terminal and the cable is not exceeded. The transmission must be designed specific to the application and must take into account the simultaneity of the drives within a strand and the power requirement of the individual drives.

Maximal allowed terminal and cable loads:

Siehe 'Maximum current Hybrid Cable Interface Board and hybrid cable' auf Seite 23.

4.3.1 Determination of limiting variables

1. Cable lengths for DC cables

Siehe ' Cable lengths for DC cables' auf Seite 25.

2. Total current requirement in the DC bus

Calculate the total current requirement in the DC bus. Pay attention to the simultaneity factor. Refer to the data sheet of the drives for the currents.

Limiting variable: total current	
KEN 5 compact power supply	9.5 A
From KEN 10 compact power supply	10 A [1)]
iC servo converter	9.4 A
iSA	9.4 A

1) Limited by the terminals on the ihX [X1A] and Hybrid Cable Interface Board [X02]. In the event of a higher current requirement, an additional strand must be established.

3. Total current requirement of the 24 VDC electronics supply

Calculate the total current requirement of the 24 VDC electronics supply based on the total current for each drive in the strand.

$I_{total} = I_1 + I_2 + I_3 + ...$

The current consumption for each drive in the strand is calculated from the constant consumed power and the voltage applied to this participant for the 24 VDC supply:

I = P / U

P: power requirement of the 24 V electronics: Siehe 'Electrical data ihX' auf Seite 22.

Start the calculation at the last participant with an assumed voltage of min. 20.4 VDC and calculate the voltage drop along the cable up to the 24 VDC power supply unit.

The voltage drop between 2 loads (supply and return cable) can be determined using the following formula:

The total voltage drop can be determined using the formula below.

U_{sfi}:	Voltage drop between 2 loads in VDC
$U_{sf,total}$:	Voltage drop between the voltage supply and the last participant
L:	Length of the wire between 2 loads in m
A:	Cross-sectional area of the wire in mm²
I_s:	Current between 2 loads in A
R_L:	Line resistance
ρ:	Specific resistance
A:	0.5 mm^2 (wire cross section for the logic supply in the AMK hybrid cable)

Limiting variable:	
Hybrid cable with connectors total current	6 A [1)]

1) In the event of a higher current requirement, an additional strand must be established.

4.4 STO (Safe torque off)

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. The motor is prevented from starting unexpectedly. If the STO is actuated while moving, the drive coasts to stop.

The function is suitable up to performance level (PL) d according to EN 13849-1 if the signals STO and 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.

STO with hybrid cable looped through in the drive train

4.4.1 Standards and characteristic values

Standards	Topic	Classification
EN 61800-5-2	Safety function	STO Safe torque off
EN 60204-1	Stop category	0
EN ISO 13849-1	Performance Level (PL)	d
	Category	3
IEC 61508	Safety integrated Level (SIL)	2
EN 61131-2	Interface STO	X08.1 and X08.2 (signal STO / STO_ GND) Digital input type 3

Key values according to EN ISO 13849-1	Value	Notice
PFH	1,4 E-8 1/h	1,4 % von SIL 2
PFDavg (T = 20a)	1,2 E-3	12 % von SIL 2
MTTFd	654 a	high
DCavg	74,2 %	low

Reaction times	Value
STO is triggered by hardware input	< 5 ms
Software reacts on error (error reaction)	< 20 ms
Diagnostic message is displayed	< 200 ms
Dynamization STO: The signal to control STO must be dynamic with a pulse duration	≤ 1,5 ms

4.4.2 Notes on operation

4.4.2.1 For your safety

⚠ 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.

⚠ 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 by jerky movement of the motor shaft!** If defects in the power output stage or the control thereof at the same time can occurs a short circuit in the circuit with the following effects: • Mains fuse is triggered if safety function STO is active. • Rest movement! Jerky align of the motor (180° / pole pair). A rotating field will not be reached. Example 10 pole motor: 10 pole → 5 pole pair 180° / 5 pole pair = 36° (Rest movement)

4.4.2.2 Behavior of the motor holding brake at STO

The STO state has no effect to the motor holding brake. The motor holding brake is supplied by connection X08.1 and X08.2 (signal 24V, 0V).

4.4.2.3 Hybrid cable

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.

4.4.2.4 Assembly

Observe the installation instructions for heat dissipation so that the safety function is operated within the permissible temperature range.

Siehe 'Assembly instructions' auf Seite 34.

4.4.2.5 Function test STO

Check STO safety function!

The achievable safety categories are only valid if the customer will performs the following checks:

- When startup, you must checked the operation of STO safety function and the signal transitions 'STO inactive' → 'STO active'
- Annually review of the operation and signal transitions 'STO inactive' → 'STO active'

Following states must be checked::

- Switch contacts closed → **STO inactive**

Controller enable	Description
0	**SBM = 1 - Regular operating state** Pulses enabled No error messages
1	**SBM = 1 - Regular operating state** QRF → PWM-control active

- Switch contact STO or STO_GND interrupted → **STO active**

Controller enable	Description
0	**SBM =1 - Regular operating state** Safe pulse inhibitor No error messages
1	**SBM = 0** Safe pulse inhibitor Error message 2320 'EF inactive'

- Switch contact STO and STO_GND interrupted → **STO active**

Controller enable	Description
0	**SBM =1 - Regular operating state** Safe pulse inhibitor No error messages
1	**SBM = 0** Safe pulse inhibitor Error message 2320 'EF inactive'

4.4.2.6 Further Information

Siehe '[X08] Supply voltage 24 VDC and STO supply line' auf Seite 42.
Siehe '[X09] Transmission supply voltage 24 VDC and STO' auf Seite 45.
Siehe 'Connection examples for operation with STO' auf Seite 43.
Siehe 'Diagnosis STO' auf Seite 61.

4.5 Monitoring functions

Hardware monitoring

- Motor (A) overcurrent (maximum current)
- Short-circuit (A)
- Processor monitoring by watchdog (A)
- Short-circuit / over current of holding brake (A)
- Short-circuit of encoder (A)
- Overvoltage 24 VDC supply (A)
- Open load detection on an optionally available motor holding brake up

Software monitoring

- Excess temperature of the motor and inverter (W)
- Over / under-voltage of DC bus connection at the connector X1A (A)
- Current overload according to i^2t for motor and inverter (W)
- Unacceptable control deviation (limit value via parameters) (A)
- Unacceptable velocity (limit value via parameters) (A)
- Unacceptable position increase (limit value via parameters) (A)
- Overheating of the power transistors (temperature model) (A)

- Encoder monitoring (A)
- Participants are monitored for presence (connector X85 / X86 EtherCAT) (B)
- Monitoring deceleration after RF withdrawal (A)

Behaviour in the event of an error

A - Shutdown; Power output stage is blocked, drive coast to stop and has no torque

B - Brake and then shut down

W - Warning and shut down as soon as the warning time has expired (warning time set to 4 seconds by default)

4.6 High voltage test

NOTICE	
Material Damage!	**High voltage or insulation testing at the customer's location** All devices are insulation tested according to EN 60950 and high voltage tested according to EN 61800-5-1 at the factory. If an insulation testing is to take place on site after installation according to EN 60950, all connections on the device must be disconnected! The devices contain suppression capacitors and circuits with protective impedance against PE. AMK is not liable for devices on which the user has carried out a high voltage test.

- The following power terminals must be short-circuited during testing to protect voltage-sensitive devices and semiconductors:

Device	Power connection
ihX	UZP, UZN

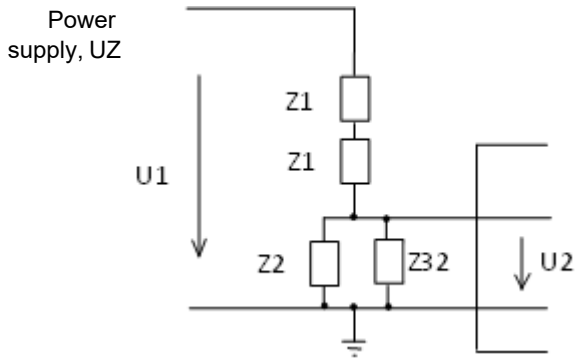
  All other terminals must be short-circuited and be connected to PE.
- The devices contain suppression capacitors and are therefore to consider with DC voltage.
- Due to the protective impedances in the device, a current flows during the test in accordance with the following table. Testing time: 1 second.

Device	Test current	Test voltage
ihX	2 mA	2120 VDC

Higher test voltage and the test period extension may cause damage to the device (e. g. overload of the protective impedance).

4.7 Insulation resistance

AMKASMART devices are equipped with a not potential-free circuit for detecting and monitoring the DC bus voltage. This is according to EN50178 resp. EN 61800-5-1 carried out as a protective impedance with limited voltage



Example: Power supply detection
U1 = Voltage UZP - PE
U1 = 400 VDC
Z2//Z3 = 20 kΩ // 20 kΩ
Z2//Z3 = 10 kΩ

Condition: U2 ≤ 25 VAC resp.
U2 ≤ 60 VDC
is satisfied

The multiple built-in protection impedances reduce the measurable insulation resistance of the device.

In among each other shorted power terminals results in a measurable insulation resistance to PE in according to the table below.

Device	Insulation resistance
ihX	1250 kΩ

The AMKASMART devices are factory checked for insulation (high voltage test) and protective earth conductor test according to EN61800-5-1.

With the insulation resistance test on electrical machines are detected insulation faults in the cabling.
In the insulation resistance testing of electrical equipment, according to EN 60204-1 (VDE 0113) must therefore be removed during the test AMKASMART devices both on the input side (power) and the output side (motor).

A measurement of the insulation resistance can be done by all power terminals are shorted together and the resistance to PE is measured.

Device	Power connection
ihX	UZP, UZN

5 Assembly

5.1 For your safety

⚠ 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 terminals UZP and UZN for the DC bus. **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 UZP / UZN are free of voltage.

⚠ DANGER	
	**Risk of injury from crushing, cutting and hitting.** When transporting and mounting sharp-edged and / or heavy components, there is a risk of crushing, cutting and bruising of the persons involved. Suspended loads can fall down and people suffer fatal injuries. **Steps to prevent:** • Utilize suitable assembly and transport equipment, such as hoists and carriages. • Wear protective clothing, e.g. safety gloves and boots, during the assembly. • Use only appropriate tools during the assembly. • Make sure that there are no persons or body parts located under suspended loads during the transport or assembly. • Prevent catching and crushing by mechanical devices.

5.2 Avoiding material damage

NOTICE	
Material Damage!	**Material damage when lifting and transporting the motor!** The motors may not be lifted and transported by • the shaft • the connectors • the terminal box **Steps to prevent:** • Lift the motor by the lifting lugs screwed in for this purpose. • Motors without lifting lugs can be lifted with two loop hoisting slings that are attached around the motor housing. • Motors with lifting lugs may also be lifted with loop hoisting slings when the main force is not applied to any of the above listed parts. • The existing holes and threads for mounting the motor can be used for transportation purposes. Damage to the flange surface and the fittings attached there to the shaft and housing must be avoided.

NOTICE	
Material Damage!	**Material damage caused by incorrect assembly!** The mounting flange of the motor has to lie evenly on the surface to which it will be mounted, else mechanical tension could occur when the fastening screws are tightened. **Steps to prevent:** • Before tightening the fastening screws, check whether the flange is lying evenly on the surface to be mounted.

NOTICE	
Material Damage!	**Material damage caused by impact to the motor shaft!** All impacts to the shaft can cause damage to the bearings or encoder. **Steps to prevent:** • Use the specified tools and equipment for mounting drive elements • Use the threading provided to tighten the attachment parts to the fits with using the fastening screws.

5.3 Requirements and preparation for the assembly

- Check the products for damage prior to installation. Damaged parts may not be installed!
- Any existing transport securing devices, such as cardboard covers and protective films, as well as corrosion inhibitors on the shaft must be removed before installation.
- Ensure that the required ambient conditions are met. Siehe 'Operation' auf Seite 24.

5.4 Assembly instructions

- During assembly, ensure that the flange mounting absorbs both the motor's weight and the forces occurring during operation. Siehe 'Tightening torques for screws' auf Seite 34..
- The motor flange must be screwed flat onto the machine design.
- In order to ensure sufficient heat dissipation during operation, the motor bracket must be thermally conductive (Nominal data: Siehe 'Motor data' auf Seite 22.).
- A minimum distance of 100 mm to adjacent components must exist with convection cooling.
- The permissible mounting position is determined by the specified design in the motor data sheet.

5.5 Mounting and removing drive elements

- Couplings, gears, pulleys, etc. may only be mounted and removed with suitable equipment.
- Use the threaded hole in the shaft end to fix the removing tool
- Observe the tightening torques for screws.
- Heat the drive elements if necessary.
- When removing the drive elements, a cushioning disc is to be used to protect the centring in the shaft end.
- If necessary, balance the motor with drive elements according to ISO 1940.

5.6 Tightening torques for screws

Mounts	ihXT
Terminal box cover	M3 x 6 (1,2 Nm) M3 x 20 (1,2 Nm)
Motor flange mounting	M5 (5,7 Nm)

6 Electrical connections

6.1 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.

6.2 Avoiding material damage

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.

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1 and 2). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

6.3 EMC-compliant wiring

- Metallic conductive housing of products sufficiently protects incoming and outgoing electromagnetic radiation
- Use shielded cables as short as possible
- Separate the undisturbed area (mains connection) and the disturbed area (drive components) from one another with space

6.4 PE connection

During the proper operation, there is an earth leakage current of less than 3.5 mA (AC) respectively 10 mA (DC). In this case, the standard EN 61800-5-1 does not demand an additional connection to PE.

6.5 Connecting the hybrid cable

⚠ 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)

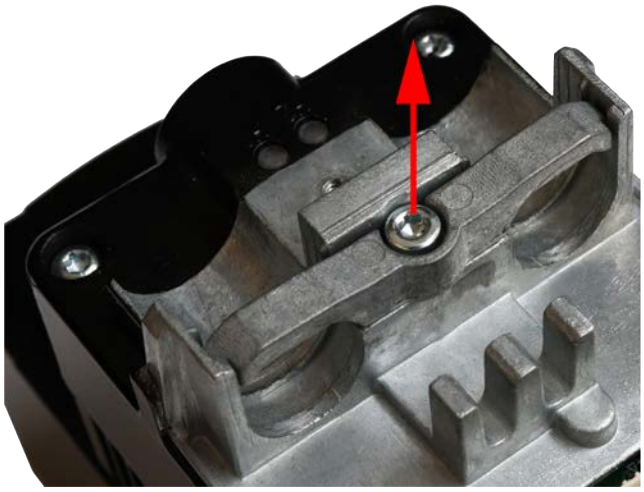
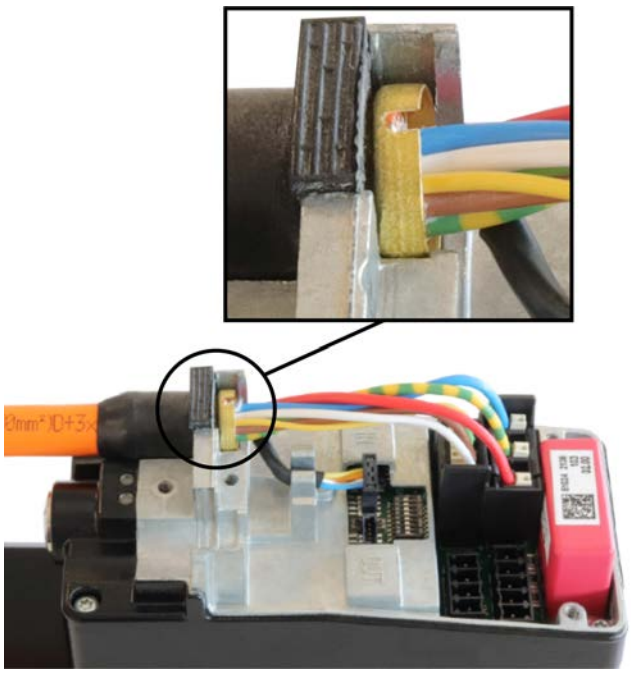
NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1 and 2). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

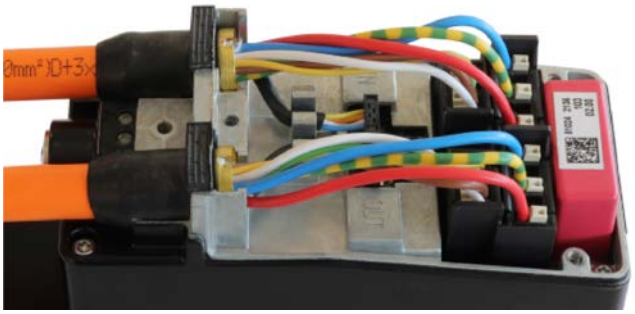
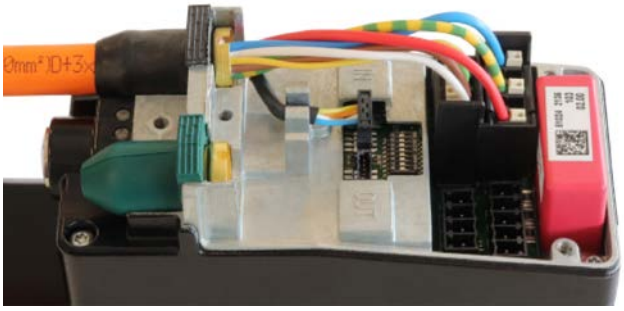
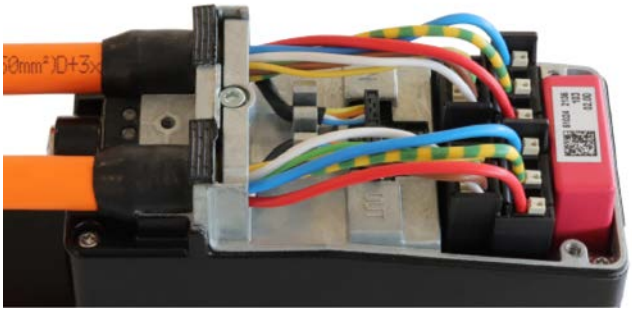
NOTICE	
Material Damage!	**Material damage caused by incorrect handling!** Mechanical damage to terminals! Disconnected signal lines. **Steps to prevent:** • The plug connectors are partially encoded. Do not push in with force. • Never pull on the cable, but rather on the connector casing.

Procedure:

The following steps are shown with devices with Rev. ≥8.00, but also valid for devices with Rev. ≥4.00 with the other connectors of the communication ports.

Step	Activity	Illustration
1	**Undo the screws (3 pieces) on the terminal box cover** Tool: size 2.5 Allen key Remove the terminal box cover	

Step	Activity	Illustration
2	**Undo the screw (1) on the clamp** Tool: size 2.5 Allen key (tightening torque 1.2 Nm) Remove the clamp	 
3	**Insert the hybrid cable and plug in the connections** Hybrid cable for supplying the drive	Align the punching of the brass sleeve upwards! 

Step	Activity	Illustration
4	Plug in an additional hybrid cable for transmission, if necessary If no transmission is connected, the opening must be closed with the end cap (AMK part no. O971) so that the device has protection class IP65.	 
5	**Screw the clamp in place** (Tightening torque 1.2 Nm) Tool: size 2.5 Allen key	When tightening the bracket, make sure that the bracket's coding pins engage in the punched holes in the brass sleeves!  

Step	Activity	Illustration
6	Attach the terminal box cover and secure with the 3 screws (Tightening torque 1.2 Nm) Tool: size 2.5 Allen key	

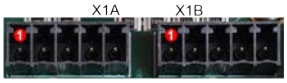
6.6 Interfaces

6.6.1 [X1A] Power supply DC bus

⚠ DANGER	
	**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:** • 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. • Caution: A voltage-free state is not signalled!

⚠ 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 terminals UZP and UZN for the DC bus. **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 UZP / UZN are free of voltage.

Assignment

[X1A] in terminal box	Connection	Signal	Description
	1	UZN	Supply of the DC bus -
	2	-	-
	3	PE	Protective earthing conductor
	4	-	-
	5	UZP	Supply of the DC bus +

1) Maximum current of the terminal: 10 A
The current of the DC bus must be limited to 10 A by the user!

Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	The DC bus supplies the compact inverter integrated in the ihX. With the terminal X1B, the DC bus can be transmitted to further devices.
Connection design	Terminal (on the device): connector, 5-poles, 1-row pin strip Mating plug: 5-poles, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	3 x 1.5 mm^2, flexible The fuse for the DC current path must be designed for the smallest current carrying capacity within the current path. The current-carrying capacity can be limited, for example, by terminals or cable cross-sections in the path. The path can be secured on the AC side just before the power supply if the AC fuse is designed for the lowest current carrying capacity in the subsequent path, otherwise additional DC fuses must be provided in the DC path. The DC path must have its own fuse if it runs outside the control cabinet.
Maximal cable length	Siehe ' Cable lengths for DC cables' auf Seite 25.
cable assembly	Wire end ferrule with plastic sheath
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.

6.6.2 [X1B] Transmission DC bus

⚠ DANGER

Danger to life from electric shock!

LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.

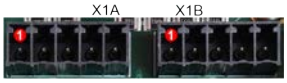
After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.

Steps to prevent:

- 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.
- Caution: A voltage-free state is not signalled!

⚠ 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 terminals UZP and UZN for the DC bus. **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 UZP / UZN are free of voltage.

Assignment

[X1B] in terminal box	Connection	Signal	Description
	1	UZN	Transmission X1A connection 1
	2	-	-
	3	PE	Transmission X1A connection 3
	4	-	-
	5	UZP	Transmission X1A connection 5

1) Maximum current of the terminal: 10 A
The current of the DC bus must be limited to 10 A by the user!

Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	With the terminal X1B, the DC bus can be transmitted to further devices.
Connection design	Terminal (on the device) connector, 5-poles, 1-row pin strip Mating plug 5-poles, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	3 x 1.5 mm^2, flexible The fuse for the DC current path must be designed for the smallest current carrying capacity within the current path. The current-carrying capacity can be limited, for example, by terminals or cable cross-sections in the path. The path can be secured on the AC side just before the power supply if the AC fuse is designed for the lowest current carrying capacity in the subsequent path, otherwise additional DC fuses must be provided in the DC path. The DC path must have its own fuse if it runs outside the control cabinet.
Maximal cable length	Siehe ' Cable lengths for DC cables' auf Seite 25.
cable assembly	Wire end ferrule with plastic sheath
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.

6.6.3 [X08] Supply voltage 24 VDC and STO supply line

Note only for devices with rev.<4.00:

NOTE	
Material damage!	**Material damage due to overvoltage!** An overvoltage at the connections X08 and X09 (24 VDC) is not monitored and damages the device[1]. (**Steps to prevent:** • Comply with the specifications for the electronics supply voltage 24 VDC. (24 VDC ± 15 %, ripple max. 5 %)

1) Devices with Rev. <4.00 do not have STO certification (no TÜV logo on the nameplate) and do not have overvoltage monitoring. An overvoltage > 24 VDC ± 15% at 24V or STO will destroy the device.

Assignment

[X08] in terminal box	Connection	Signal	Description
	1	24V 1)	Supply voltage 24 VDC for electronic and an optional motor holding brake.
	2	0V	Reference potential for 24 VDC (Connection 1)
	3	STO 1)	STO (Safe torque off) The supply voltage directly controls the STO state. Siehe 'STO (Safe torque off)' auf Seite 27.
	4	STO_GND	Reference potential for STO (Connection 3)

1) Maximum current of the terminal: 10 A
Maximum current hybrid cable : 6 A
The current of the 24 VDC supply voltage must be limited by the user!

Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	• 24 VDC supply voltage supply line • Connection of the control signal STO and STO_GND • Transmission to further drives or Hybrid Cable Interface Board via terminal [X09]
Connection design	Terminal (on the device) connector, 4-poles, 1-row pin strip Mating plug 4-poles, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	2 x 1,0 mm^2 + 2 x 0,5 mm^2, flexible
cable assembly	Wire end ferrule with plastic sheath
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.
Notes	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.

6.6.3.1 Connection examples for operation with STO

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

Connection:

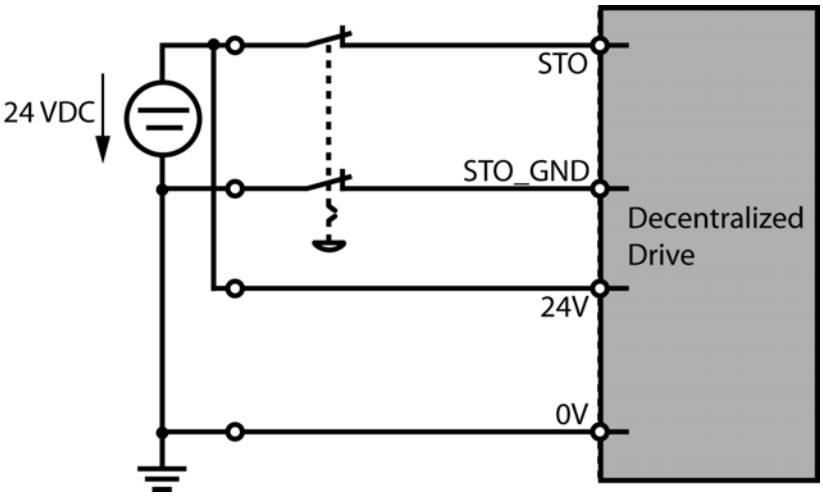
ihXT: Siehe '[X08] Supply voltage 24 VDC and STO supply line' auf Seite 42.

See '[X08] / [X09] Supply voltage 24 VDC / Transmission supply voltage 24 VDC' on page 1. See '[X14] / [X15] STO (Safe torque off) / Transmission STO (Safe torque off)' on page 1.

Example 1:

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

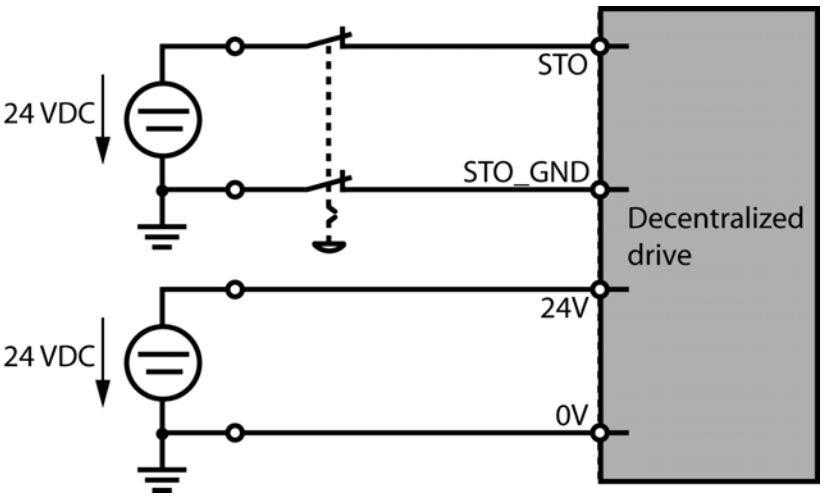
External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 6 A each by the user.



Example 2:

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

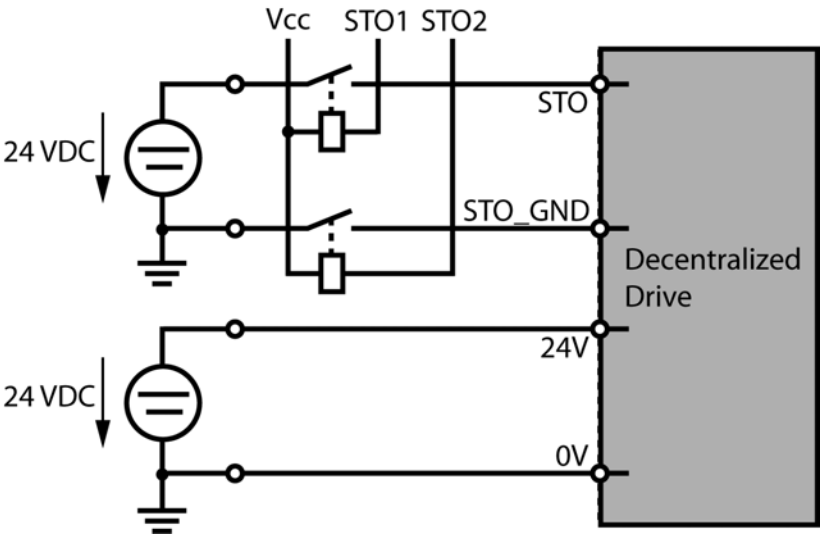
External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 6 A each by the user.



Example 3:

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

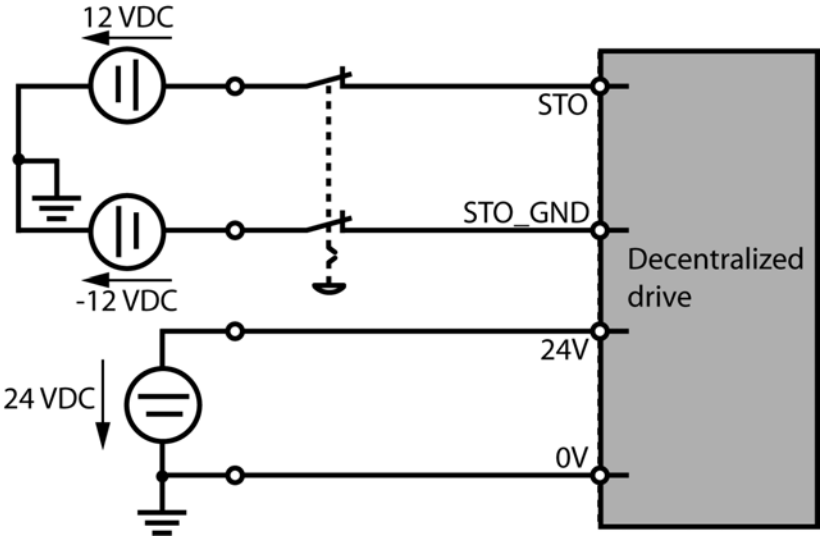
External power supply units that provides the 24 VDC supply voltage for connections 24V and STO they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and STO supply must be limited to 6 A each by the user.



Example 4:

Supply voltage 24VDC for electronics and motor holding brake. 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 6 A each by the user.



6.6.4 [X09] Transmission supply voltage 24 VDC and STO

Note only for devices with rev.<4.00:

NOTE	
Material damage!	**Material damage due to overvoltage!** An overvoltage at the connections X08 and X09 (24 VDC) is not monitored and damages the device[1]. (**Steps to prevent:** • Comply with the specifications for the electronics supply voltage 24 VDC. (24 VDC ± 15 %, ripple max. 5 %)

1) Devices with Rev. <4.00 do not have STO certification (no TÜV logo on the nameplate) and do not have overvoltage monitoring. An overvoltage > 24 VDC ± 15% at 24V or STO will destroy the device.

Description

Assignment

[X09] in terminal box	Connection	Signal	Description
	1	24V 1)	Transmission X08 connection 1
	2	0V	Transmission X08 connection 2
	3	STO 1)	Transmission X08 connection 3
	4	STO_GND	Transmission X08 connection 4

1) Maximum current of the terminal: 10 A
Maximum current hybrid cable : 6 A
The current of the 24 VDC supply voltage must be limited by the user!

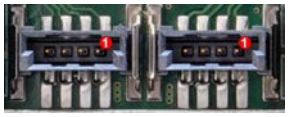
Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	• Transmission of the supply voltage 24 VDC • Transmission of the STO and STO_GND signals
Connection design	Terminal (on the device) connector, 4-poles, 1-row pin strip Mating plug 4-poles, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	2 x 1,0 mm^2 + 2 x 0,5 mm^2, flexible
cable assembly	Wire end ferrule with plastic sheath
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.
Notes	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.

6.6.5 [X85] Real-time Ethernet input

Assignment

[X85] in terminal box	Connection	Signal	Description
Rev. ≥8.00 	1	RX-	Receive Data -
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	TX+	Transmission Data +

[X85] in terminal box	Connection	Signal	Description
Rev.<8.00 	1	TX+	Transmission Data +
	2	TX-	Transmission Data -
	3	RX+	Receive Data +
	4	RX-	Receive Data -

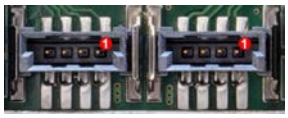
Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	• Device-dependent real-time Ethernet interface. • The communication protocol has to be set as an option, an named set in the type code. • X85: Connection master or previous node
Connection design	Terminal (on the device) connector, 4-poles, 1-row pin strip Mating plug 4-pole, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	4 x 0.12 mm^2, flexible
Maximal cable length	50 m (point to point between two participants)
cable assembly	• Insulation displacement technology from device rev. ≥8.00 • Crimp contact on devices rev. <8.00
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.
Notes	• 100BASE-T 100 Mbit/s Ethernet standard

6.6.6 [X86] Real-time Ethernet output

Assignment

[X85] in terminal box	Connection	Signal	Description
Rev. ≥8.00 	1	RX-	Receive Data -
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	TX+	Transmission Data +

[X86] in terminal box	Connection	Signal	Description
Rev. <8.00 	1	TX+	Transmission Data +
	2	TX-	Transmission Data -
	3	RX+	Receive Data +
	4	RX-	Receive Data -

Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	• Real-time Ethernet interface. • The communication protocol is booked additionally as an option. • X86: Connection next node.
Connection design	Terminal (on the device) connector, 4-poles, 1-row pin strip Mating plug 4-poles, socket
Electrical data	Siehe 'Electrical data ihX' auf Seite 22.
Cable	4 x 0.12 mm^2, flexible
Maximal cable length	50 m (point to point between two participants)
cable assembly	• Insulation displacement technology from device rev. ≥8.00 • Crimp contact on devices rev. <8.00
Accessories	Prefabricated cable: Siehe 'Hybrid cable configured' auf Seite 69.
Notes	• 100BASE-T 100 Mbit/s Ethernet standard

6.6.7 [X235] USB interface

Assignment

[X235] under the M12 screw plug	Connection	Signal	Description
	1	5 VDC	5 VDC from USB master
	2	D-	Data -
	3	D+	Data +
	4	-	Reserved
	5	GND	Reference potential supply

Siehe 'Connection box ihX' auf Seite 17.

Technical data

Description	About the Micro-USB interface, the device can be connected with a PC and the software AIPEX PRO for commissioning and diagnostics.
Connection design	Terminal (on the device) Micro-USB V1.1 type B , 5-poles, 1-row pin strip Mating plug 5-poles, socket
Cable	0.08 mm² / AWG 28 Data+ und Data- twisted pair, shielded
Accessories	Prefabricated cables: Siehe USB cable auf Seite 76.

7 Startup - Operation - Maintenance

7.1 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.

⚠ DANGER	
	**Danger to life by jerky movement of the motor shaft!** If defects in the power output stage or the control thereof at the same time can occurs a short circuit in the circuit with the following effects: • Mains fuse is triggered if safety function STO is active. • Rest movement! Jerky align of the motor (180° / pole pair). A rotating field will not be reached. Example 10 pole motor: 10 pole → 5 pole pair 180° / 5 pole pair = 36° (Rest movement)

⚠ DANGER

Motor shaft movement (rotating parts)!

Hair, body parts and clothes can be captured and wrapped by rotating parts and people result suffer fatal injuries.

Hazardous motor movement occurs when the motor shaft moves in an uncontrolled or unintentional manner.

Even the intended drive movement may be hazardous, if persons remain inside the range of movement.

Uncontrolled motor shaft movement occurs when the motor is no longer controllable. may have lethal consequences. Possible causes include the following:

- Faulty wiring, e.g., faulty phase sequence while connecting motor
- Faulty components
- Faulty motor parameters
- Software error

Unintended motor shaft movement is caused by errors in the motor control. may have lethal consequences. Possible causes include the following:

- Operator errors
- Controller or application program faults
- Faulty setpoint specification and scaling
- Improper operating mode

The monitoring devices in the drive system are capable of detecting various fault states. However, the monitoring devices by themselves are not sufficient to completely and reliably prevent uncontrolled movement. Uncontrolled movement cannot be prevented completely, even if it occurs only for a brief period of time before a monitoring device trips and shuts down the drive or switch off power supply.

Steps to prevent:

- Always ensure that the is fully de-energized before commencing work on the .
- Check the limit values for torque, speed, and position, as well as the acceleration and deceleration ramps.
- Specify the maximum permissible process speed and set ID113 accordingly.

⚠ DANGER

Danger from magnetic and electromagnetic fields

Magnetic and electromagnetic fields can be dangerous for people with pacemakers, implants and electronic hearing aids, because the correct functioning of these devices can be interfered with by magnetic and electromagnetic fields.

Permanent magnets, such as in synchronous motors, create magnetic fields. Current-carrying leads are generally surrounded by electromagnetic fields.

Steps to prevent:

- Persons with pacemakers, hearing aids or metallic implants may not enter the following areas without a doctor's approval:
  - Places where electrical drives are commissioned and operated
  - Places where permanent magnets and rotor shafts are stored, mounted and fitted with permanent magnets for electric motors.
  - Places where electric motors with permanent magnets are opened. (Only an electric motor with closed housing shields its inner electromagnetic fields with respect to the environment.)

⚠ WARNING

Danger due to flying feather key coming off from the motor shaft!

Feather keys can come off from the motor shaft while the motor is running and be thrown uncontrollably. When people hit by the flying off key, it can lead to serious injury.

Steps to prevent:

- Secure the feather key e.g. with cable ties before running the motor.
- Remove the feather key secure not before the motor will be connected to the mechanics.

⚠ WARNING	
	**Risk of burns when touching hot surfaces!** The casing temperature can be more than 70 °C during and even after operation. Contact causes burns. **Steps to prevent:** • Make sure that the surfaces have cooled down before you touch. • Wear protective clothing such as gloves if hot parts need to be touched. • Fit a warning sign with warning hot surface. • Do not mount any flammable objects near the device.

⚠ WARNING	
	**Risk of injury from loud noise!** Servomotors can suddenly produce loud noises while operating, which affect your ears or cause frightful movements of the persons concerned. The noise is generated by resonance frequencies in conjunction with the driven mechanical parts. **Steps to prevent:** • build machine so or change that occur within the permissible operating range of the machine no resonant frequencies • attach sound insulation • setting up the machine in noise-sensitive areas

7.2 Preparations and prerequisites

- Assembly complete
- Connections established for:
  - DC bus power [X1A], connections 1, 3, and 5
  - 24 VDC supply voltage for electronics including optional motor holding brake and 24 VDC for STO (safe torque off) [X08], connections 1, 2, 3, and 4
- Installation of the AMK AIPEX PRO PC software (See document Software description AIPEX PRO V3)
  (ihXT is supported from AIPEX PRO V3.02)

7.3 Parameterization

The AMK PC software AIPEX PRO is available for startup and parameterization (from AIPEX PRO V3.02: ihXT is supported).

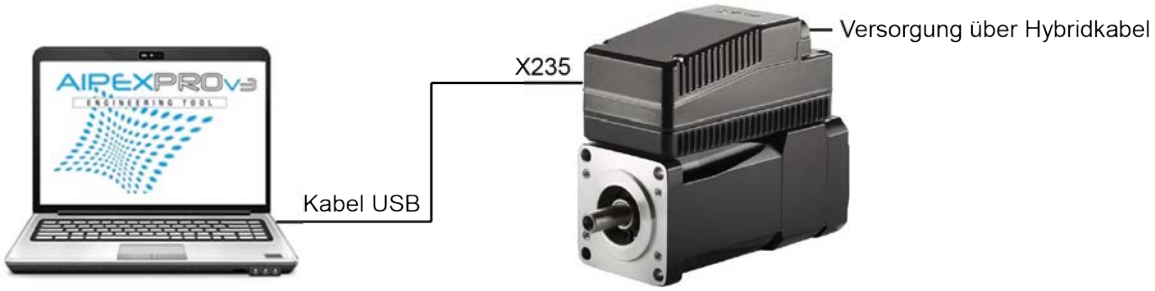
⚠ WARNING	
	**Hazard due to changing parameters!** The incorrect entering of parameters into the controller card significantly influences the drive system characteristics and creates an increased risk of accidents and damages! **Steps to prevent:** • Parameters may not be modified by the machine operator unless consultation takes place with the machine manufacturer. • Change parameters only if you are sure of the meanings and the consequences. If you are unsure, read the parameter documentation or ask the manufacturer or supplier.

For the parameterization, the device must be supplied with 24 VDC electronic voltage. The DC bus must not be connected. After parameter changes in the device, a system booting (24 VDC OFF / ON) must be performed in order for the changes to take effect.

A connection between the device and the PC must be established for parameter changes

7.4 Startup interface

7.4.1 Connection PC → ihX via USB



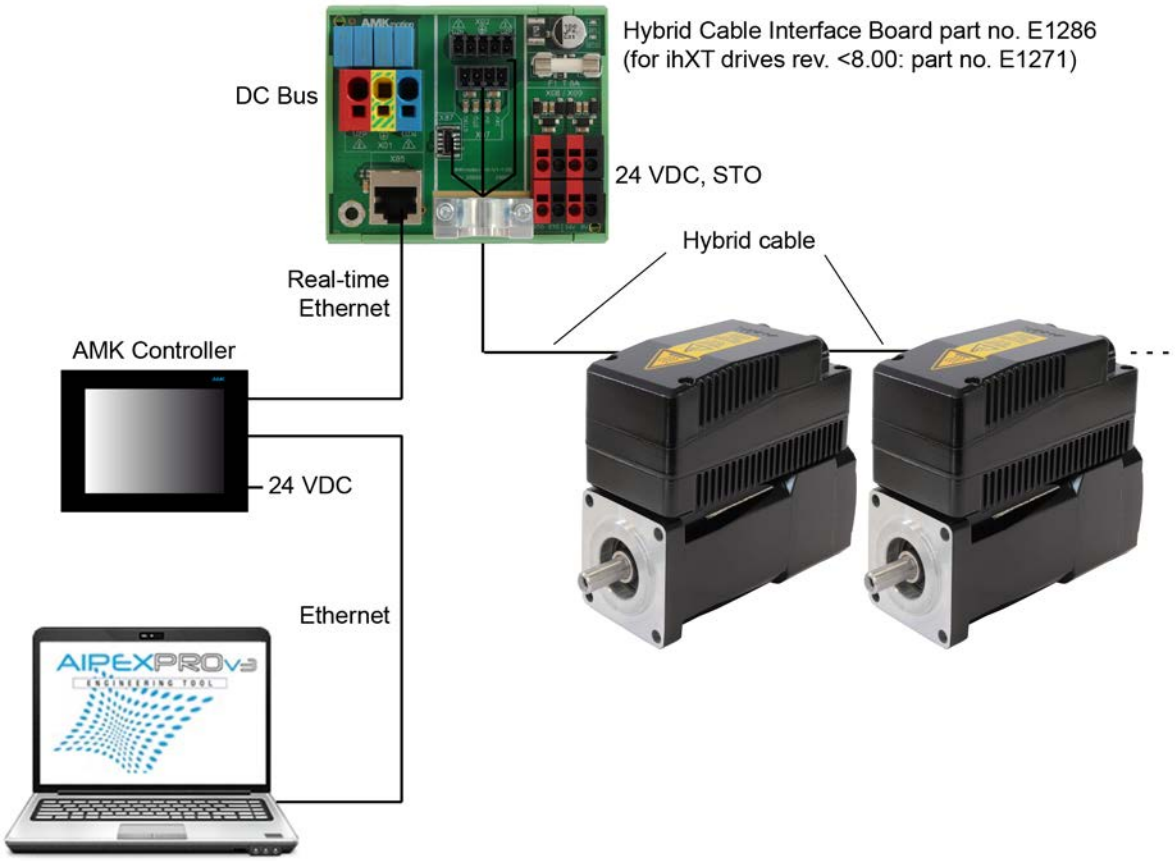
Possible functionality:

- Parameter read and write
- Diagnostic messages will read from the drive
- ...

Settings:

See documentSoftware description AIPEX PRO V3 (Part no. 204979), Chapter Communication PC - AMK device.

7.4.2 Connection PC → ihX via EtherCAT



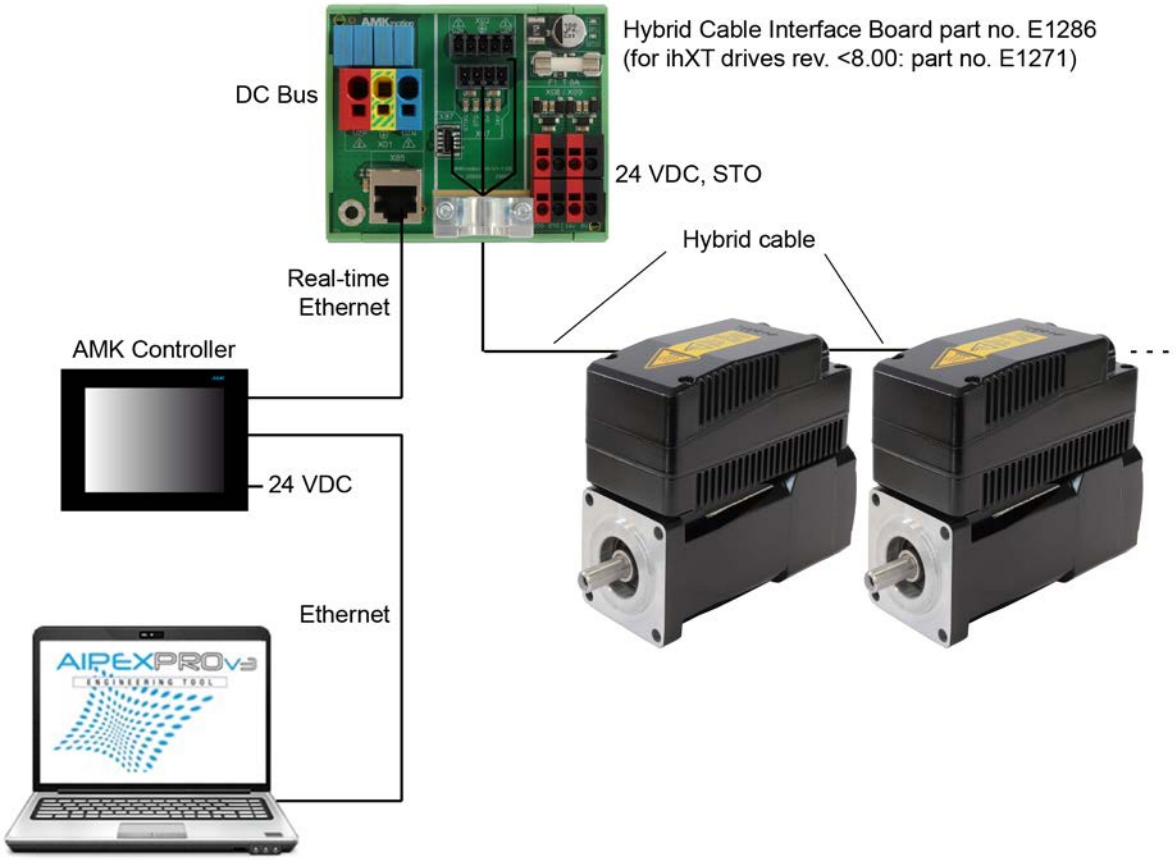
Possible functionality:

- Parameter read and write
- Diagnostic messages will read from the drive
- ...

Settings:

See document Software description AIPEX PRO V3 (Part no. 204979), Chapter Communication PC - AMK device.

7.4.3 Connection PC → EtherCAT controller → ihX



Possible functionality:

- Parameter read and write
- Diagnostic messages will read from the drive
- Access to the drive image in the PLC (control and status data)
- ...

Settings:

See documentSoftware description AIPEX PRO V3 (Part no. 204979), Chapter Communication PC - AMK device.

7.5 Basic parameterization

The parameter memory for the drive controller is pre-allocated with a default set. The parameters must be configured specific to the application.

Parameters for the basic startup:

Parameter	Name	Meaning
ID32800	'AMK main operating mode'	Set operating mode and setpoint source
ID32796	'Source RF'	The control is enabled by the controller enable, the drive is powered and controlled in the current operating mode.

Parameter	Name	Meaning
Motor parameter group:	Motor / encoder data	Motor parameter, motor encoder resolution,...
ID82	'Positive torque limit'	Torque parameter (torque limits)
ID83	'Negative torque limit'	
ID38	'Positive velocity limit'	Speed / velocity parameter
ID39	'Negative velocity limit'	
ID100	'Speed control proportional gain KP'	Speed controller setting
ID101	'Integral-action time speed control TN'	
ID102	'Differentiating time speed control TD'	
ID104	'Position loop factor KV'	Position controller setting
ID113	'Maximum speed'	ID113 defines the maximum permissible process speed! If the actual value exceeds the specified value in ID113 by a factor of 1.25, then the output stage is blocked by the system and the motor runs down.
ID32773	'Service bits'	Bit 14 = 1, in order to switch on the I^2t-monitoring for the motor
ID32780	'Acceleration ramp'	Acceleration and deceleration times in the speed controller operating mode
ID32781	'Deceleration ramp'	
ID32782	'Deceleration ramp RF inactive'	Drive braking time from the maximum permissible process velocity (ID113) until coming to a stop when removing the controller enable RF, e.g. in EMERGENCY OFF
ID2	'SERCOS cycle time'	Bus cycle time
ID34023ff ...	'BUS address participant'	The group of the communication parameters from ID34023 are to be parameterized in the respective instances: EtherCAT: Instance 1

7.6 Setting the control loops automatically

The drive controller control loops can be set automatically and optimized using the AMK AIPEX PRO startup software:
See document Software description AIPEX PRO Startup (Part no. 205171).

7.7 Status and control signals

The operation state of the drive system will be commanded and acknowledged by means of control and status signal.
The STO input must be supplied with 24 VDC on the user side. Any other signals and states can controlled and read by fieldbus.

7.7.1 Status signals

Signal	Name	Meaning
SBM	'System ready message'	After system booting without an error, SBM will be set and shows that the system is free of error. In case of an error SBM will be reset and a diagnosis message will be generated. The system reaction in case of an error (e.g. running out, brake down according ID32873 'Deceleration ramp RF inactive', system booting abort) depends on the kind of error. (See document Diagnostic messages (Part no. 25786), chapter Meaning of the diagnostic messages. The diagnosis messages can be read out with the software AIPEX PRO or read and evaluated by a controller. After the error cause is removed a system booting (ID33730 'System booting') has to be executed.
QRF	'Acknowledgement controller enable'	QRF acknowledges the active control mode of the drive. Setpoints can be set depending on the configured operation mode (ID32800...). If QRF = 0 the drive is free of torque and no control mode is active.

Signal	LED	Parameter	PLC access
SBM	H1 'green'	ID135 'Drive status word' Bit 14, Bit 15	FB STANDARD_AXIS_ihX
QRF	H1 'flashing green'		

7.7.2 Control signals

Signal	Name	Meaning
FL	'Clear error'	FL causes a system booting after the reason for an error message is remedied and the drive is still in error state SBM = 0). The sucessfully finished system booting is acknowledged with the SBM = 1 signal. Clear error can only be executed if RF = QRF = 0 by a pulse signal. Clear error can be executed as follow: • ID99 'Diagnosis reset status class 1' • ID32913 'Clear error'
RF	'Controller enable'	RF (signal-edge controlled) causes a system booting if at least one parameter has been changed before. RF activates the motor control in the current operation mode (e.g ID32800 'AMK main operating mode'. The motor is energized, setpoints are processed and the acknowledgement signal QRF will be set. RF can only be activated if SBM = QUE = 1. If RF is set, the power output stage are active. If the prerequisites are not fulfilled, the device generates an error message and resets SBM if someone try to set RF. IF RF is withdrawal during operation the motor is ramped down according ID32782 'Deceleration ramp RF inactive' until standstill (≤ 6 RPM) and unenergized. QRF will be reset. If a motor holding brake is active the signals RF and QRF on/off will be delayed device internal, depending on parameter ID206 'Drive on delay time' and ID207 'Drive off delay time'.

Signal	Terminal	Parameter	PLC access
RF	-	ID134 'Master control word'Bit 14, Bit 15	FB STANDARD_AXIS_ihX
FL	-	ID99 'Diagnosis reset status class 1' ID32913 'Clear error'	FB STANDARD_AXIS_ihX

7.8 Motor holding brake

⚠ DANGER

Risk of injury from hanging axes

The optional motor brake is a holding brake and does NOT provide sufficient protection for persons.

Hanging axes can fall and lead to severe injury.

Steps to prevent:

- All hanging axes must be mechanically secured against falling with a fall arrester or a supplementary external brake, for instance.
- People must not stand under hanging loads

NOTICE

Material Damage!

Material damage of the holding brake!

The brake optional integrated into the motor is a holding brake. The holding brake can be irreparably damaged if it is used as main brake.

Steps to prevent:

- Make sure that the motor holding brake is open, when movement commands are sent to the motor.
- Make sure that the motor holding brake only closes after the motor shaft has come to a standstill.

A motor holding brake fixes the motor shaft in the energy-free state, for example in an application with a hanging axis.

The 'Motor brake control' function opens and closes the motor holding brake automatically, taking into account the parameterized response times of the motor holding brake.

The motor holding brake is opened and closed automatically and timely by the drive controller in fault-free operation by setting and resetting RF (controller enable).

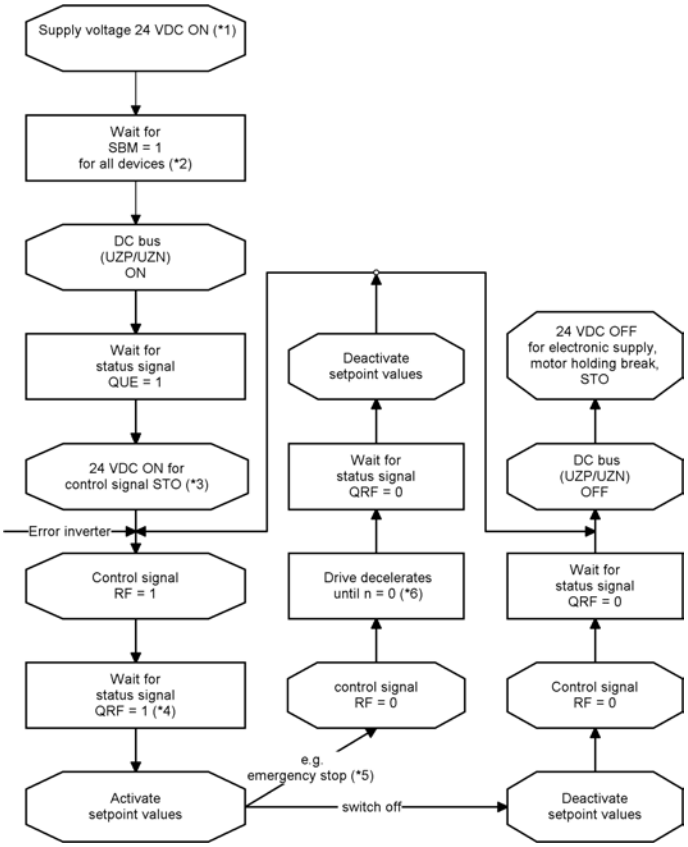
In principle, the drive controller needs a control deviation at the input before outputting output values. As long as the axis is fixed by the motor brake, the control can not establish a holding torque. As soon as the motor brake is opened, an axis which is under load moves and a control deviation is generated. To reduce the control deviation, the controller (I-component in the speed controller) builds a holding torque. The magnitude of the compensating movement after the brake is released depends on the set control parameters and the mechanical conditions.

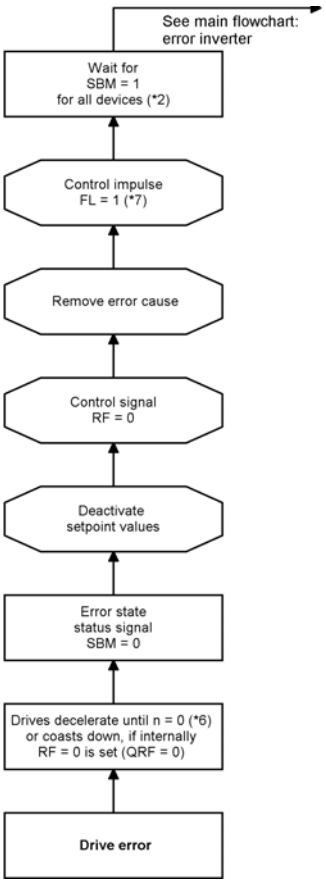
The torque feed-forward control principle can be used to apply a starter torque that builds up immediately while the brake is opening. The better the feed-foreward torque is adapted to the load, the lower the initial axial movement. The torque feed-forward control value can be specified externally via parameter (ID81 'Additive torque command value') or with the functions 'load model'.

There must be the 24 VDC supply voltage at X08 to control the holding brake.

See document Function descriptions (Part no. 203878), chapter Actuation of the motor holding brake.

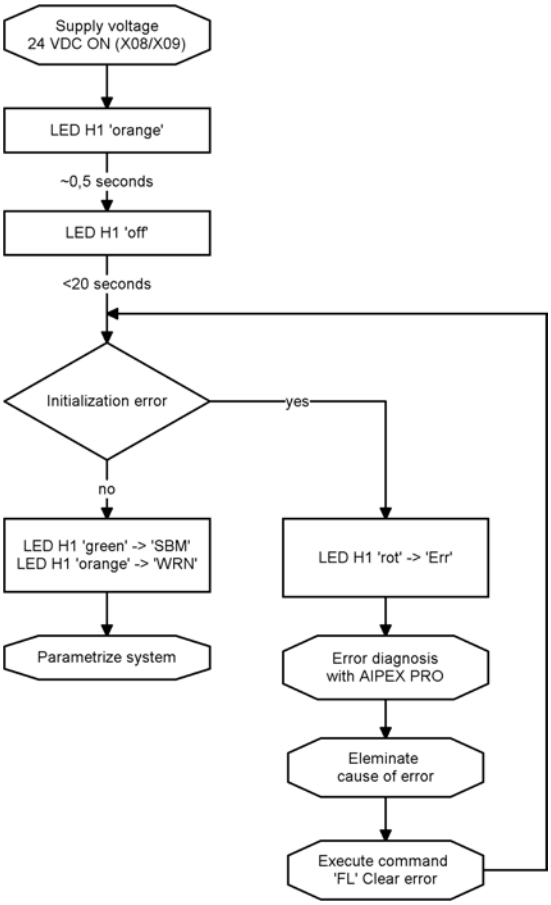
7.9 Switch-on and -off flow chart





*1	The power supply automatically supplies an optional motor holding brake. Brake OPEN / CLOSE is automatically controlled by the RF signal.
*2	The device specific 'System ready' messages (SBM = 1) from the devices signal the error-free states. The monitoring of all SBM messages takes place in the higher-ranking controller. Time t to SBM: 2 < t < 20 seconds.
*3	24 VDC STO must be applied at the latest at that time.
*4	Delay time until QRF is set depends on the connected motor resp. whether the data set must be newly calculated because of a modification of drive specific parameters.
*5	RF is removed by the user program of the controller.
*6	Motor is braked to a standstill after the ramp ID32782 'Deceleration ramp RF inactive'.
*7	Pulse ≥ 1 ms.

7.10 LED state diagram in system booting



7.11 Addressing bus participants

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

The addressing of the drives 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.

Fieldbus	Addressing possible by ...			Range
	Bus master (automatic)	DIP switch S1	Parameter	
ihX				
EtherCAT Slave (SoE, CoE)	■	■	ID34023 Instance 1	1 ≤ ID34023 ≤ 65535 1 ≤ S1 ≤ 250[2)]
VARAN Slave	■	-	-	The VARAN master will assign addresses to the slaves; no address presetting is possible
CAN (CiA 402)	-	■	ID34023 Instance 0	1 ≤ ID34023 ≤ 65535 1 ≤ S1 ≤ 250[2)]

2) From firmware V2.14 2021/13, the node address with DIP switch S1 can be in the range 1 to 250.

7.11.1 EtherCAT: Automatic addressing

On delivery ex works AMK, the DIP switch S1 as well as the parameter ID34023 'BUS address participant' are set to 0 in all instances.

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 or by Parameter ID34023 'BUS address participant'.

Automatic addressed devices can not be marked as 'optional' bus participant in the AIPEX PRO software.

7.11.2 VARAN: Automatic addressing

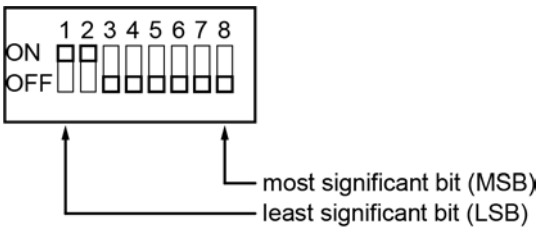
In VARAN bus protocol, no address presetting is possible. The VARAN master will address the coupled slaves automatically.

7.11.3 EtherCAT: Addressing by DIP switch S1

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1 and 2). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

The address setting by DIP switch is prior to addresses via parameter ID34023 'BUS address participant'.

Address range up to 250



Example: address = 3

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

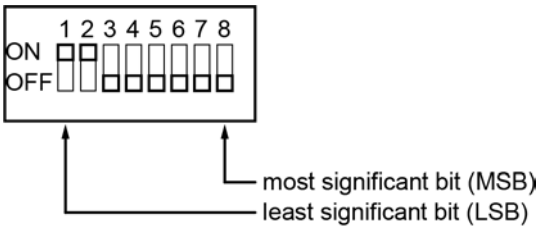
Consequence of addressing

DIP switch	Parameter ID34023	Active EtherCAT address
= 0	= 0	address automatically set by master
= 0	≠ 0	address according ID34023 parameter setting
≠ 0	= 0	address according DIP switch setting
≠ 0	≠ 0	address according DIP switch setting

7.11.4 CAN (CiA 402): Addressing by DIP switch S1

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1 and 2). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

Address range up to 250



Example: Address = 3

If the dip switch is set to 0, bus participant address 2 is automatically active.

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

7.11.5 EtherCAT: Addressing by parameter ID34023 'BUS address participant'

If the DIP switch S1 is set to 0, the address can be set by parameter ID34023 'BUS address participant'.
The setting of the parameter can be done by means of software AIPEX PRO via the EtherCAT master without connecting point-to-point to each single device.
(See document Software description AIPEX PRO V3 (Part no. 204979), chapter 'Direct mode', function 'Communication'.)

7.12 Controller programming

Instructions for creating a project with an AMK controller: See document Software description AIPEX PRO V3 (Part no. 204979), chapter First steps CODESYS V3 and chapter AFL standard function blocks.

8 Service

8.1 Diagnosis

Using the AIPEX PRO software, warnings and error messages can be read from the connected devices.

See document Software description AIPEX PRO V3 (Part no. 204979)

See document Diagnostic messages (Part no. 25786)

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

8.1.1 Diagnosis STO

The device monitors the correct operation with a internal plausibility check. Status bit SBM indicates the current status of the device and can be provided via fieldbus . A controller evaluate the status SBM.

If an error occurs, the pulses for controlling of the output stage are blocked.

Following states may occur:

- Switch contact STO and STO_GND interrupted → **STO active**

Controller enable	Description
0	**SBM =1 - Regular operating state** Safe pulse inhibitor No error messages
1	**SBM = 0** Safe pulse inhibitor Error message 2320 'EF inactive'

- Switch contacts closed → **STO inactive**

Controller enable	Description
0	**SBM = 1 - Regular operating state** Pulses enabled No error messages
1	**SBM = 1 - Regular operating state** QRF → PWM-control active

- Internal error → **State is not plausible**

Controller enable	Description
0	**SBM = 0** Safe pulse inhibitor Error message 2361 'EF Logic'
1	**SBM = 0** Safe pulse inhibitor Error message 2320 'EF inactive'

A restart of the device or 'Clear Error' resets an error message. In error free state of the drive can be switched by a positive edge at RF in control.

8.2 Firmware update

See Software description ATF - AMK Tool Flasher, Part no. 203771.

9 Accessories

9.1 Options

Real-time Ethernet

Designation	AMK part no.	Description
O-SECS	O823	EtherCAT (SoE) Slave (contains EoE [1)])
O-SECC	O948	EtherCAT (CoE)
O-SVNS	O824	VARAN (SoV) Slave

1) Ethernet over EtherCAT (EoE)
With the EoE protocol can AMK PC tools to access via controllers on AMK Drives.
Currently can be read and written parameter.

Prerequisite:
The controller must support the EoE protocol.

9.2 PC software

Designation	AMK part no.	Description
CD software AIPEX PRO	O907	CD with PC software AIPEX PRO V3.x and ATF
AMK PC software AIPEX PRO Add In Gateway for TwinCAT	O878	Software for being able to access AMK drives operated on a TwinCAT controller by using the AMK PC software AIPEX PRO.
Device description file for EtherCAT controller AMK_ECsoe_vvv_AMK_part-no.xml	-	This file is part of the AIPEX PRO software but you can also get it separately from AMK

9.3 DC fuses and fuse holders

Designation	AMK part no.	Description
FWP-30A14	206048	DC fuse 30 A_{eff} from the company Cooper Bussmann, type FWP-30A14F Dimensions: 14 x 51 mm Rated voltage: 800 V DC Operating class: aR The DC fuse can be used for the following loads: [1)] Continuous rated current for DC bus $I_{DC, RMS}$: 8.5 A_{eff} Maximum current for DC bus I_{max}, 2 times overload, 1 second: 17 A
FWP-40A14F	205826	DC fuse 40 $A_{eff}$from the company Cooper Bussmann, type FWP-40A14F Dimensions: 14 x 51 mm Rated voltage: 800 V DC Operating class: aR The DC fuse can be used for the following loads: [1)] Continuous rated current for DC bus $I_{DC, RMS}$: 13.5 A_{eff} Maximum current for DC bus I_{max}, 2 times overload, 1 second: 27 A

Designation	AMK part no.	Description
FWP-50A14F	206047	DC fuse 50 A_{eff} from the company Cooper Bussmann, type FWP-50A14F Dimensions: 14 x 51 mm Rated voltage: 800 V DC Operating class: aR The DC fuse can be used for the following loads: 1) Continuous rated current for DC bus $I_{DC, RMS}$: 20.5 A_{eff} Maximum current for DC bus I_{max}, 2 times overload, 1 second: 41 A
fuse holder 14 x 51 mm	205829	Fuse holder 14 x 51 mm for hat rail mounting

1) The actual current value at which the DC fuse triggers, depends on factors such as temperature, duty cycle, the terminal cross sections and can be significantly below the rated value of the fuse.

9.4 End cap

Designation	AMK part no.	Description
End cap	O971	The unused opening in the connection box is sealed with the end cap in accordance with IP65. 

9.5 Hybrid Cable Interface Board

The Hybrid Cable Interface Board is mounted on a top hat rail in the switch cabinet and supplies the connected drive strand via a hybrid cable. The Hybrid Cable Interface Board supplies the DC bus, the 24 VDC supply voltage, the STO signals, and the real-time Ethernet connection to a hybrid cable.

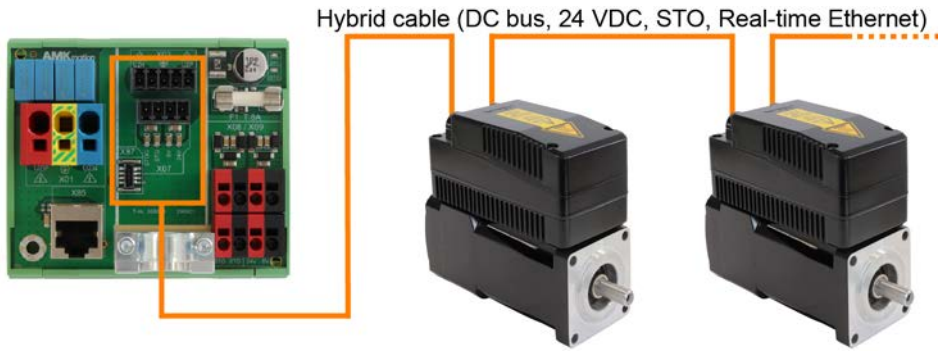
Dimensions: 90 x 70 x 54 mm (length x width x height)

Input:

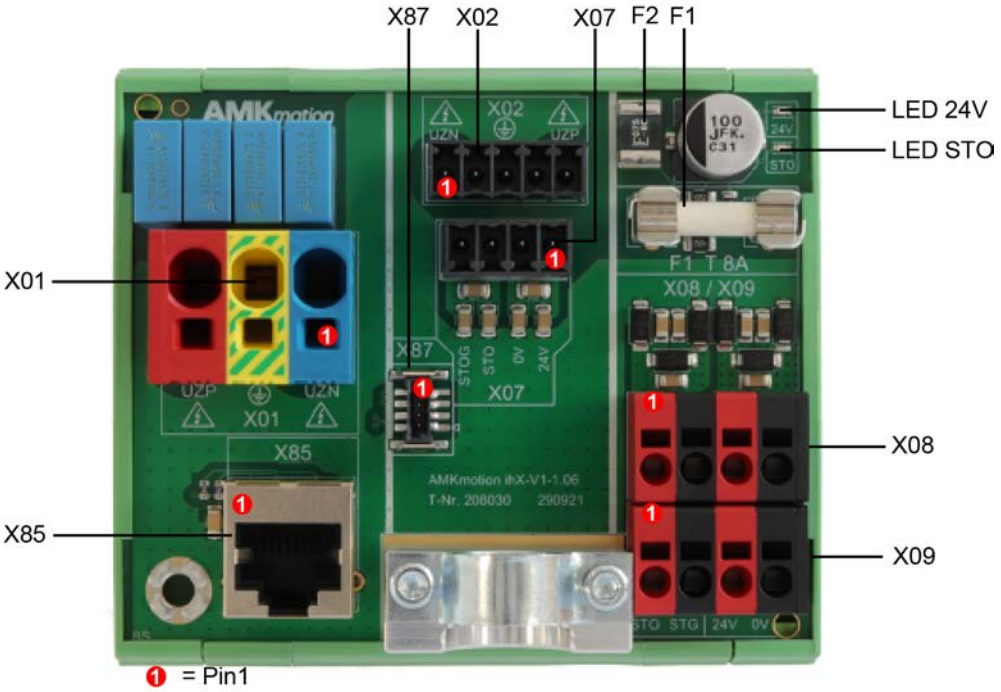
- DC bus
- 24 VDC supply voltage
- Signal cable for STO
- Real-time Ethernet

Output:

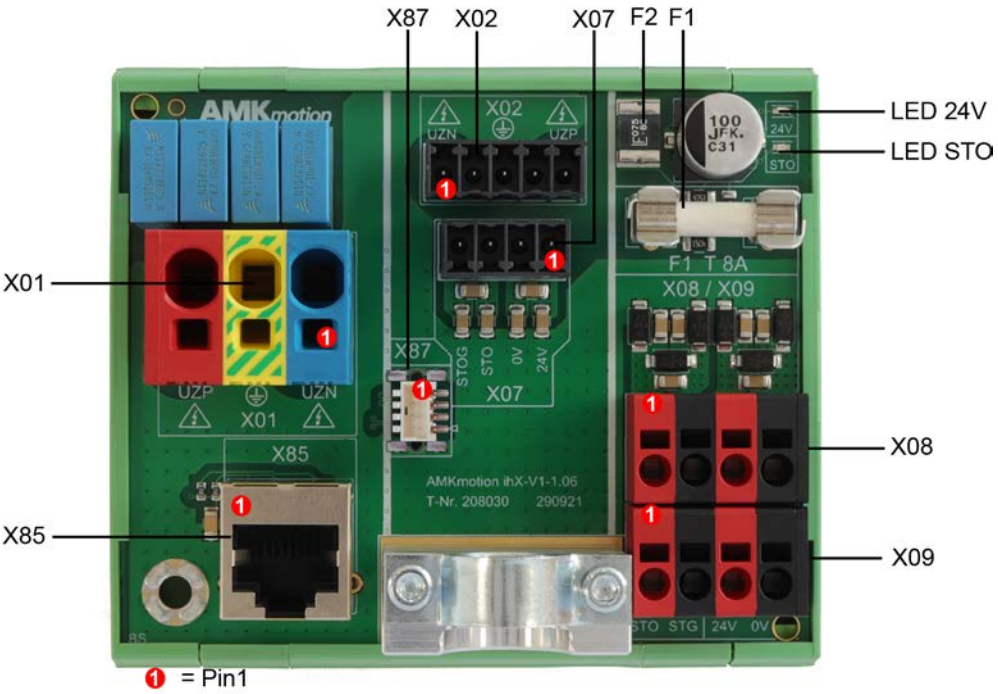
- Connections for the hybrid cable to supply the ihX inverters and servo motors
- Terminals for transmission of the 24 VDC and STO supply voltage



Designation	AMK part no.	Description
Hybrid Cable Interface Board	E1286	Suitable for ihX revision ≥8.00 (Erni connector) + hybrid cable assembled with Erni connector on X87: e.g. part no. 51112



Designation	AMK part no.	Description
Hybrid Cable Interface Board	E1271	Suitable for ihX with revision < 8.00 (Molex connector) + hybrid cable assembled with Molex connector on X87: e.g. part no. 47774



9.5.1 LED´s on Hybrid Cable Interface Board

LED´s	Function
LED 24 V	Lights up green when 24 VDC is applied to X08 / X09 and the F1 fuse is ready for operation.
LED STO	Lights up green when the STO signal is applied to X08 / X09, i.e., the drive is not in the STO state and the F2 fuse is ready for operation.

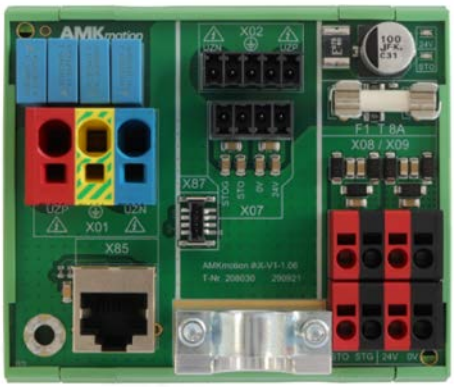
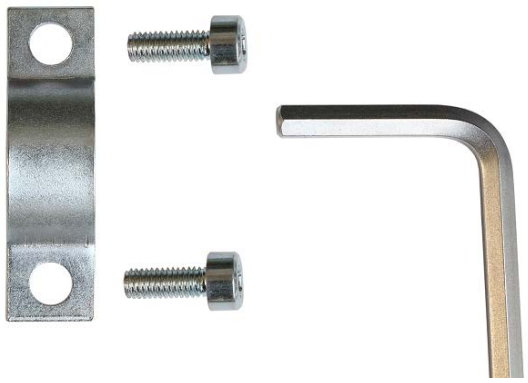
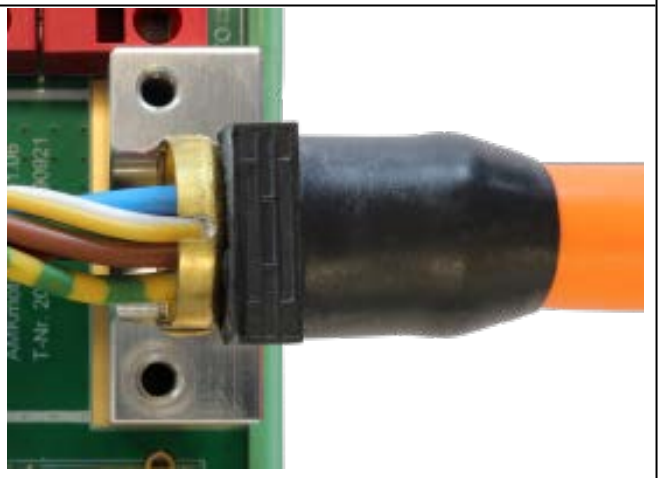
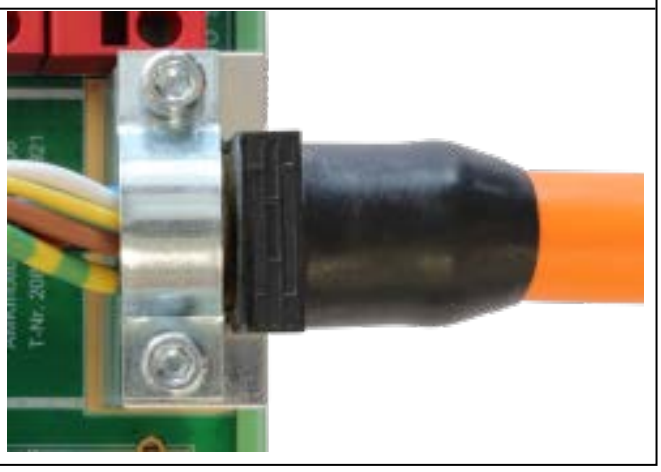
9.5.2 Connections on Hybrid Cable Interface Board

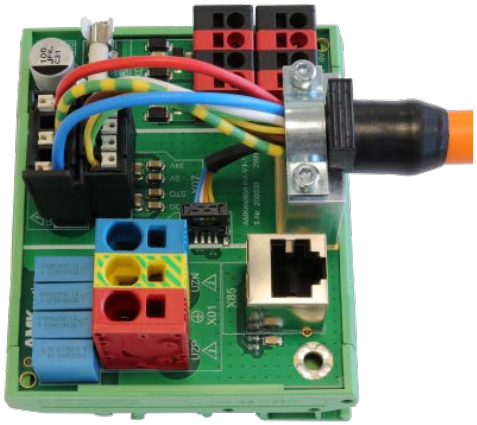
NOTICE	
Material Damage!	**Hybrid cable line protection** DC fuses to protect the wires in the hybrid cable and the connection terminals on the Hybrid Cable Interface Board must be enabled in the supply cables for the DC bus. The connection of the hybrid cable is specified for max. 10 A. A path must be installed in the UZP and UZN path for each fuse. Siehe 'DC fuses and fuse holders' auf Seite 63.

Interfaces	Cable cross section [mm²]	Function
F1	-	Fine wire fuse, 8 A (slow-blowing) to protect the 24 VDC wire in the hybrid cable Siehe 'Fine wire fuse F1' auf Seite 69.
F2	-	Self-resetting fuse, 0.5 A for the STO signal.

Interfaces	Cable cross section [mm²]	Function
X01	Rigid: max. 10 mm² Flexible: max. 6 mm², wire end ferrule without plastic sleeve max. 4 mm², wire end ferrule with plastic sleeve Cable stripping length: 8 mm	DC bus supply The UZP, UZN, and PE DC bus is connected to the Hybrid Cable Interface Board. Pin assignment: Pin 1: UZN Pin 2: PE Pin 3: UZP
X02	1.5 mm²	Connection of the DC bus to the hybrid cable. Siehe 'Hybrid cable configured' auf Seite 69.
X07	2x1,0 mm² + 2x0,5 mm²	Connection of the supply voltage for 24 VDC electronics and motor holding brake, STO and STO_GND signals to the hybrid cable. Siehe 'Hybrid cable configured' auf Seite 69.
X08 / X09	Rigid: max. 4 mm² Flexible: max. 2.5 mm², wire end ferrule without plastic sleeve max. 1.5 mm², wire end ferrule with plastic sleeve Cable stripping length: 8 mm	Supply and transmission of the supply voltage for 24 VDC electronics and motor holding brake and STO signal Max. input voltage: 30 VDC Pin assignment: Pin 1: STO Pin 2: STO_GND Pin 3: 24 VDC Pin 4: 0 VDC The hybrid cable connection is protected by the F1 and F2 fuses.
X85	-	Supply of real-time Ethernet Pin assignment: Pin 1: TX+ Pin 2: TX- Pin 3: RX+ Pin 6: RX- Connection data: Cable: CAT5e patch cable, shielded and applied on both sides Siehe 'Ethernet cable' auf Seite 77.
X87 ihX Revision ≥4.00	0.12 mm²	Connection of real-time Ethernet to the hybrid cable Siehe 'Hybrid cable configured' auf Seite 69.

9.5.3 Connecting the hybrid cable

Step	Activity	Illustration
1	**Undo the screws (2 pieces) on the clamp** Tool: size 2.5 Allen key	 
2	**Insert the hybrid cable**	
3	**Screw on the clamp** Tool: size 2.5 Allen key	

Step	Activity	Illustration
	Plug in the connections	

9.6 Fine wire fuse F1

Designation	AMK part no.	Description
Fine wire fuse	27340	T (slow) 8 A / 250 V 5 x 20 mm ceramic

9.7 Hybrid cable configured

9.7.1 Instructions for laying 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).

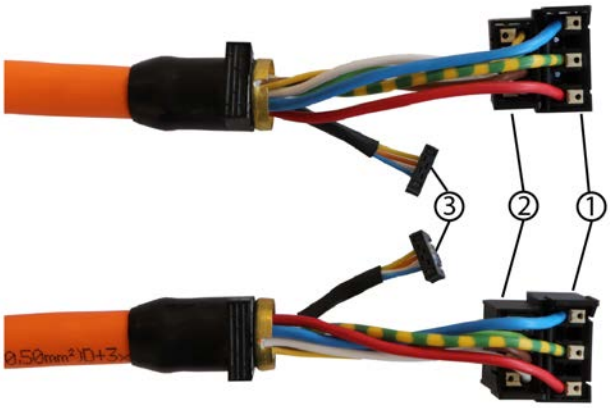
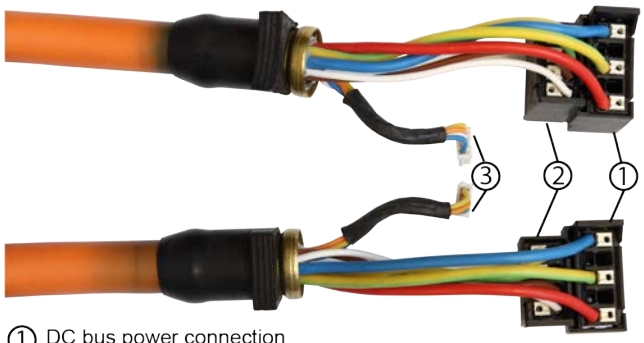
The shield must be placed on PE on both sides.

9.7.2 Technical data

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

Description	Value
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
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.

9.7.3 ihX to ihX (transmission) or connection ihX to hybrid Interface board

Designation	AMK part no.	Description
ihX hybrid cable	e.g. 51112	Cable assembled on both sides for ihX **(rev. ≥8.00)** Length y m[1)]  ① DC bus power connection ihX connection box: [X1A], [X1B] Hybrid Cable Interface Board: [X02] ② Supply voltage 24 VDC, STO ihX connection box: [X08], [X09] Hybrid Cable Interface Board: [X07] ③ Real-time-Ethernet ihX connection box: [X85], [X86] Hybrid Cable Interface Board: [X87]
ihX hybrid cable	e.g. 47774	Cable assembled on both sides for ihX **(rev. <8.00)** Length y m[1)]  ① DC bus power connection ihX connection box: [X1A], [X1B] Hybrid Cable Interface Board: [X02] ② Supply voltage 24 VDC, STO ihX connection box: [X08], [X09] Hybrid Cable Interface Board: [X07] ③ Real-time-Ethernet ihX connection box: [X85], [X86] Hybrid Cable Interface Board: [X87] 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 for the DC bus power connection

Pin	Wire identification	Cross section [mm²] 2)	Max. current [A]	Signal	Description
1	Blue	1.5	10 1)	UZN	DC bus - supply
2	-	-		-	
3	Green / yellow	1.5	-	PE	Protective earth conductor
4	-	-		-	
5	Red	1.5	10 1)	UZP	DC bus + supply

1) The connector plug is specified for a maximum of 10 A and reduces the permissible current for this current path to 10 A.
2) The wires must be assembled with wire end ferrules without plastic sleeves for 1.5 mm^2. Required crimping tool: Weidmüller PZ 6/5

Pin assignment for 24 VDC and STO supply voltage

Pin	Wire identification	Cross section [mm²] 1)	Max. current [A]	Signal	Description
1	White	1.0	6	24 VDC	24 VDC supply voltage for electronics and an optionally available motor holding brake.
2	Brown	1.0	6	0 VDC	Reference potential for 24 VDC
3	Green	0.5	6	STO	STO (Safe torque off)
4	Yellow	0.5	6	STO_GND	Reference potential for STO

1) The wires must be assembled with wire end ferrules without plastic sleeves for 0.5 mm^2 or 1.0 mm^2. Required crimping tool: Weidmüller PZ 6/5

Pin assignment for real-time Ethernet

Device mit Rev. ≥8.00:

Pin	Wire identification	Cross section [mm²]	Signal	Description
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 +

The cable meets the CAT5e standard

Device mit Rev.≥4.00 und <8.00:

Pin	Wire identification	Cross section [mm²]	Signal	Description
1	Yellow	0.12	TX+	Transmission Data +
2	Orange	0.12	TX-	Transmission Data -
3	White	0.12	RX+	Receive Data +
4	Blue	0.12	RX-	Receive Data -

The cable meets the CAT5e standard

Technical data:

Siehe 'Hybrid cable configured' auf Seite 69.

9.7.4 ihX to iSA or iC

Designation	AMK part no.	Description

Connection cable ihX → iC
(straight plug)
	51125	Use:
		• Connects ihX **(rev. ≥8.00)** to iSA or iC
		
		Length of y m[1)]
		
		Assembled for the iSA or iC connection:
		• DC bus
		  • 3 x stranded wires
		• 24 VDC and STO supply voltage
		  • 4 x stranded wires
		• Real-time Ethernet bus
		  • M12 D-coded, outer thread, pin, 360° shield

Connection cable ihX → iC
(straight plug)
	403935	Use:
		• Connects ihX **(rev. <8.00)** to iSA or iC
		
		Length of y m[1)]
		
		Assembled for the iSA or iC connection:
		• DC bus
		  • 3 x stranded wires
		• 24 VDC and STO supply voltage
		  • 4 x stranded wires
		• Real-time Ethernet bus
		  • M12 D-coded, outer thread, pin, 360° shield

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

Stranded wire pin assignment

Pin	Wire identification	Cross section [mm²]	Max. current [A]	Signal	Description
Power					
3	Green / yellow	1.5	10 [1)]	PE	Protective earth conductor
5	Red	1.5	10 [1)]	UZP	DC bus + supply
1	Blue	1.5	10 [1)]	UZN	DC bus - supply
Signal					
1	White	1.0	6	24 VDC	24 VDC supply voltage for electronics and an optionally available motor holding brake.
2	Brown	1.0	6	0 VDC	Reference potential for 24 VDC
3	Green	0.5	6	STO	STO (Safe torque off)
4	Yellow	0.5	6	STO_GND	Reference potential for STO

1) The terminal is specified for max. 10 A and reduces the permissible current for this path to 10 A.

M12 pin assignment

Pin	Wire identification	Cross section [mm²]	Max. current [A]	Signal	Description
1	Yellow	0.12	-	TX+	Transmission Data +
2	White	0.12	-	RX+	Receive Data +
3	Orange	0.12	-	TX-	Transmission Data -
4	Blue	0.12	-	RX-	Receive Data -

Technical data

Siehe 'Hybrid cable configured' auf Seite 69.

9.7.5 ihX to iX

Designation	AMK part no.	Description

Connection cable ihX → iX
(straight plug)
	51126	Use:
		• Connects ihX **(rev. ≥8.00)** to iX
		
		Length of y m[1)]
		
		Assembled for the iX connection:
		• DC bus and 24 VDC and STO supply voltage
		  • M23 outer thread, pin, straight / angled, 360° shield
		• Real-time Ethernet bus
		  • M12 D-coded, external thread, pin, 360° shield

Connection cable ihX → iX
(straight plug)
	403936	Use:
		• Connects ihX **(rev. <8.00)** to iX
		
		Length of y m[1)]
		
		Assembled for the iX connection:
		• DC bus and 24 VDC and STO supply voltage
		  • M23 outer thread, pin, straight / angled, 360° shield
		• Real-time Ethernet bus
		  • M12 D-coded, external thread, pin, 360° shield

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

M23 pin assignment

Pin	Wire identification	Cross section [mm²]	Max. current [A]	Signal	Description
-	Green / yellow	1.5	10 [1)]	PE	Protective earth conductor
1	Red	1.5	10 [1)]	UZP	DC bus + supply
4	N.c.	-	-	-	-
3	Blue	1.5	10 [1)]	UZN	DC bus - supply
A	White	1	6	24 VDC	24 VDC supply voltage for electronics and an optionally available motor holding brake.
B	Brown	1	6	0 VDC	Reference potential for 24 VDC
C	Green	0.5	6	STO	STO (Safe torque off)
D	Yellow	0.5	6	STO_GND	Reference potential for STO

1) The connector plug is specified for a maximum of 10 A and reduces the permissible current for this current path to 10 A.

M12 pin assignment

Pin	Wire identification	Cross section [mm²]	Max. current [A]	Signal	Description
1	Yellow	0.12	-	TX+	Transmission Data +
2	White	0.12	-	RX+	Receive Data +
3	Orange	0.12	-	TX-	Transmission Data -
4	Blue	0.12	-	RX-	Receive Data -

Technical data

Siehe 'Hybrid cable configured' auf Seite 69.

9.7.6 ihX to KHY 1 (H 8A)

Designation	AMK part no.	Description
Cable hybrid V2 ihX → ihM-XX	51128	Hybrid cable for connecting ihX **(rev. ≥8.00)** to KHY 1 (H 8A) at connection [X11] M23 hybrid pin straight ↔ ihX 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	-	-	-	-	-
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

Siehe 'Hybrid cable configured' auf Seite 69.

9.7.7 ihx revision <8.00 (Molex plug) to ihX revision ≥8.00 (Erni plug) cable adapter

Cable assembly 1x for ihX revision ≥8.00 and 1x for ihX revision <8.00

Designation	AMK part no.	Description
Adapter cable ihX revision <8.00 (Molex plug) - ihX Revision ≥8.00 (Erni plug)	51114	Use: This cable can be used to connect devices (ihX or Hybrid Cable Interface Board) that have a 'Molex'-connector on one side and an 'Erni'-connector on the other side. It doesn't matter which side is assembled and how, as the cable can be rotated. Length of y m[1)]

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

Technical data:
Siehe 'Hybrid cable configured' auf Seite 69.

9.8 Real-time Ethernet cable for ihX

Designation	AMK part no.	Description
ihX hybrid cable (transmission)	51124	Use: • Transmission real-time Ethernet from the ihX **(rev. ≥8.00)**to the next node. Length of y m[1)] The cable includes assembled lines for: • Real-time Ethernet bus
ihX hybrid cable (transmission)	51067	Use: • Transmission real-time Ethernet from the ihX to the next node. Length of y m[1)] The cable includes assembled lines for: • Real-time Ethernet bus

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

Pin assignment RJ45

Pin	Wire identification	Cross section [mm²]	Signal	Description
1	Yellow	0.14	TX+	Transmission Data +
2	Orange	0.14	TX-	Transmission Data -
3	White	0.14	RX+	Receive Data +
6	Blue	0.14	RX-	Receive Data -

Pin assignment ihX

Pin	Wire identification	Cross section [mm²]	Signal	Description
1	Yellow	0.14	TX+	Transmission Data +
2	Orange	0.14	TX-	Transmission Data -
3	White	0.14	RX+	Receive Data +
4	Blue	0.14	RX-	Receive Data -

The cable meets the CAT5e standard

Technical data
Siehe 'Hybrid cable configured' auf Seite 69.

9.9 USB cable

Designation	AMK part no.	Description
Cable USB	205349	PC connection cable USB-A / Micro USB-B Length 2 m

9.10 Ethernet cable

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

DANGER	

	**Danger from magnetic and electromagnetic fields**
	Magnetic and electromagnetic fields can be dangerous for people with pacemakers, implants and electronic hearing aids, because the correct functioning of these devices can be interfered with by magnetic and electromagnetic fields.
	Permanent magnets, such as in synchronous motors, create magnetic fields. Current-carrying leads are generally surrounded by electromagnetic fields.
	Steps to prevent:
	• Persons with pacemakers, hearing aids or metallic implants may not enter the following areas without a doctor's approval:
	  • Places where electrical drives are commissioned and operated
	  • Places where permanent magnets and rotor shafts are stored, mounted and fitted with permanent magnets for electric motors.
	  • Places where electric motors with permanent magnets are opened. (Only an electric motor with closed housing shields its inner electromagnetic fields with respect to the environment.)

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
- TUEV

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

Glossary

A

A1
Analog input 1

A4 / A5 / A6
AMKAMAC controller A4 / A5 / A6

AIPEX
AMK startup and parameterizing software (PC software): Programming, parameterization, configuration, diagnosis, oscilloscope, status information

ATF
AMK Tool Flasher (PC software for transferring firmware to device)

AWG
American Wire Gauge (Coding of wire diameter)

B

Bootstrap
Firmware update

C

CiA 402
CAN in Automation / CAN bus Draft Standard Proposal 402 Device Profile (Commanding protocol for drives)

CoE
CAN application protocol over EtherCAT

CAN
Controller Area Network

D

DZR
Speed control

Default
Factory setting

E

E-encoder
Absolute encoder, singleturn, EnDAT 2.1 with additional sine and cosine track

EMV
Electromagnetic compatibility

EMC
Electromagnetic compatibility

EnDat 2.1
Motor encoder interface protocol of the company Heidenhain

EnDat 2.2
Motor encoder interface protocol of the company Heidenhain

EtherCAT
Real-time Ethernet bus

EoE
Ethernet over EtherCAT

F

FSoE
Fail-Safe over EtherCAT

Firmware
System software, loaded by AMK

F-encoder
Absolute encoder, multiturn, EnDAT 2.1 with additional sine and cosine track

FL
Command (Causes a new system run-up)

H

Hiperface DSL
Motor encoder interface protocol of the company Sick Stegmann

Hiperface
Motor encoder interface protocol of the company Sick Stegmann

I

iC
AMKASMART decentralized inverter with power supply

iDT
AMKASMART Servo motors with integrated inverter

I-encoder
Incremental encoder, optical encoder with sine and cosine track and zero pulse

IGBT
Power electronic component, e. g. transistor

iX
AMKASMART decentralized inverter

iSA
AMKASMART decentralized controller with power supply

ihXT
AMKASMART Servo motors with integrated inverter

K

KE/KW
Modular AMK drive system (contains compact power supply KE, compact inverter KW with controller card and applicable option card)

KE
AMKASYN compact power supply with recovery

KEN
AMKASYN compact power supply without recovery

KES
AMKASYN compact power supply with sinusoidal voltage and current

L

LSB
Least Significant Bit

M

MSB
Most Significant Bit

O

Operational
In state operational, data are transferred cyclically via fieldbus

P

PDK_xxxxxx_abcdefgh
Product documentation; xxxxxx - AMK part no. , abcdefgh - name

PL
Performance Level

PELV
Protective Extra Low Voltage

Pre-operational
In pre-operational state, the controller can access the bus participants via the service channel. No cyclic data is exchanged.

P-encoder
Absolute encoder singleturn, EnDAT 2.2 light

Q

QRF
Acknowledgment controller enable; the drive is controlled in the activated operation mode

Q-encoder
Absolute encoder multiturn, EnDAT 2.2 light

R

RF
Command 'Controller enable'; the drive is energized and will be controlled depending on the selected operation mode. Controller enable can only be set if the device is error-free (SBM = TRUE) and acknowledgement DC bus on is set (QUE = TRUE).Acknowledgement controller enable (QRF) is set.

S

STO
Safe torque off (Safety function acc. to DIN EN 61800-5-2)

SoV
Servo Drive Profile over VARAN (Nach IEC 61800-7-300)

S-encoder
Absolute encoder, singleturn, RS485 Hiperface with sine and cosine track

SBM
System ready message; shows that the device is error-free In case of error. SBM will be reset

T

T-encoder
Absolute encoder, multiturn, RS485 Hiperface with sine and cosine track

U

UZP
DC bus voltage pole positive

U-encoder
Absolute encoder, singleturn, RS485 Hiperface with sine and cosine track

UZN
DC bus voltage pole negative

V

V-encoder
Absolute encoder, multiturn, RS485 Hiperface with sine and cosine track

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

AMKmotion GmbH + Co KG
Phone : +49 7021/50 05-0, fax: +49 7021/50 05-199
E-Mail: info@amk-motion.com
Homepage: www.amk-motion.com