AMKASMART
Device description
Decentralized drive technology
iC servo converter
iX servo inverter
iDT servomotor with integrated iX

Version: 2023/25
Part no.: 203445

Translation of the "Original Dokumentation"

AMKmotion

MEMBER OF THE ARBURG FAMILY

Imprint

Name: PDK_203445_iDT5

Version:

Version: 2023/25		
Chapter / Topic	**Change**	**Letter symbol**
bus participants addressing	From FW FW V2.14 2021/13 207903), the S1 DIP switch can be used to specify node addresses of up to 250.	
dimensioning of an AC fuse	new topic	

Previous version: 2021/30

Product status:

Product	Firmware Version (Part no.)	
iDT5-3-10-xxx	iX V2.13 2019/24 (207408) iX V1.08 2016/04 (206178) iX-C V1.04 2016/08 (206355) iX-S V1.00 2013/29 (204664)	
iDT5-5-10-xxx		
iDT5-9-10-xxx		
iX2		
iX5		
iX5-F		
iC2		
iC5		
iC5-F		
STO function		

Reservation: We reserve the right to modify the content of the documentation as well as the delivery options for the product.

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

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

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

E-mail service@amk-motion.com

Internet address: www.amk-motion.com

Errata

<table>
<tr><th>Topic</th><th>Description</th></tr>
<tr><td>S- / T-encoder</td><td>Because of a tolerance on a component of the controller board it is feasible that iX, iDT and iC devices with iDT5-R3 board do not work in combination with S- /T-encoders. This error occurs sporadically.

Affected devices
<table>
<tr><th>AMK part no.</th><th>Product</th></tr>
<tr><td>E1237</td><td>iX5-0C-E</td></tr>
<tr><td>E1238</td><td>iC5-0C-E0U</td></tr>
<tr><td>E1241</td><td>iX5-0C-E</td></tr>
<tr><td>E1265</td><td>iX2-0C-E</td></tr>
<tr><td>E1267</td><td>iX5-0C-ES</td></tr>
<tr><td>E1268</td><td>iX5-FC-E</td></tr>
<tr><td>E1269</td><td>iC2-0C-E0U</td></tr>
<tr><td>E1270</td><td>iC5-FC-E0U</td></tr>
</table>

If your device is affected, please contact AMK.
Email: application@amk-motion.com</td></tr>
</table>

Content

1 About this documentation

1.1 Structure of this document

Content	Topic	Chapter number
Validity, use and the propose of the documentation	Imprint	-
	About this documentation	1
Safety	For your safety	2
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
	Electrical connections	6
	Startup - Operation	7
	Maintenance - Service - Repair	8
	Accessories	9
	Disposal	10
Reference to Certificates e. g. CSA, CE or TÜV	Certificates	11
Abbreviations and explanation of terms	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 Display conventions

Representation	Meaning
	This text passage requires your undivided attention!
0x	0x followed by a hexadecimal number, e.g. 0x500A
'Names' 'Parameter' 'Diagnostic messages'	E.g.: Call up the 'PLC clear program' function. ID1234 'Parameter text' 1234 'Diagnostic message'
'xxx'	Menu items and buttons in software or a control unit, e.g.: Click the **'OK'** button in the **'Options'** menu to call up the 'PLC clear program' function
>xxx<	Wildcard, variable e.g. IP address of the controller: >192.168.0.1<
->	Process of an input / operating sequence, e. g. **'Start'** -> **'All Programmes'** -> **'Accessories'** -> **'Editor'**

1.6 Appendant documents

Device descriptions

AMK part no.	Title
	Motor data sheets

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)
203878	Function descriptions (functions of the controller firmware)
204628	Interface descriptionDrive Profile CiA 402
204737	Initial startup of decentralized drives
204979	Software description AIPEX PRO V3 (PC software for startup and parameterization)
205016	Safety manual; functional safetyexcerpt for iC / iX / iDT
206016	Interface description EtherCAT (CoE)

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 5 safety rules

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 Display of safety information

Any safety information is configured as follows:

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

2.4 Hazard classes

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 iC (decentralized inverter with power supply)
- AMKASMART iX (decentralized inverter)
- AMKASMART iDT (servo motors with integrated inverter iX)

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 Warning signs

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

iC, iDT, iX

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.

iC

In English and German:

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:** • Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting. • After switching off, expect a discharge time of at least 5 minutes. • Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

2.8 CE label

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.

2.9 Requirements for the personnel and qualification

Only authorised 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 authorised to switch circuits and devices on and off, earth and label them
- Observe local specific safety requirements

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 Order data

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

3.2 Delivery

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

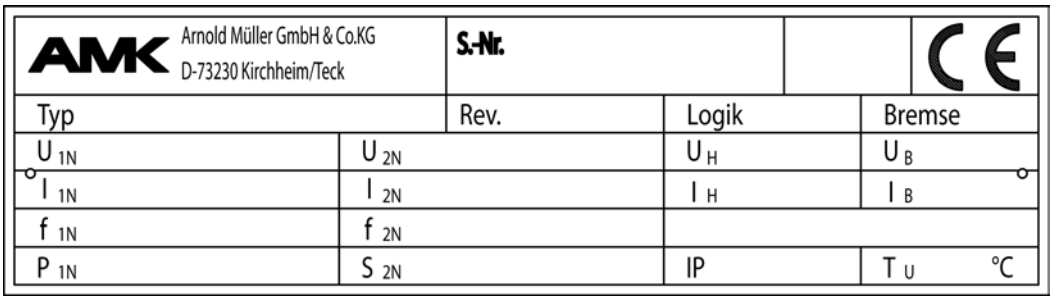
Check the components for signs of transport damage after their arrival. Do not install and operate any damaged components.

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

3.3 Type plate

The following type plates are attached to the products:

iC / iX



Legend:

Abbreviation	Designation
S-Nr.	Serial number (part no. – calendar week + year – consecutive number)
Typ	Type designation
Rev.	Revision
U_{1N}	Input voltage
I_{1N}	Rated input current
f_{1N}	Input frequency
P_{1N}	Rated input power
U_{2N}	Rated output voltage
I_{2N}	Rated output current
f_{2N}	Output frequency
S_{2N}	Rated output power
U_H	Supply voltage 24 VDC for electronic
I_H	Rated current for 24 VDC (without I/O)
IP	Type of protection according to EN 60529
U_B	Supply voltage 24 VDC for the holding brake
I_B	Maximum current consumption of the holding brake
T_U	Permissible ambient temperature

iDT

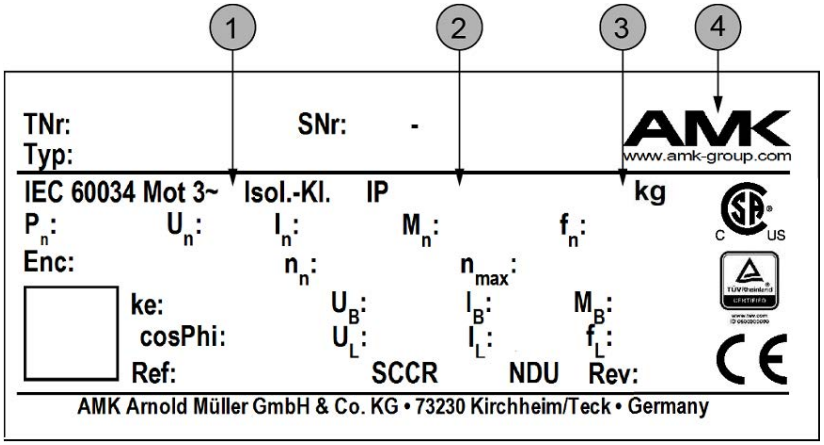
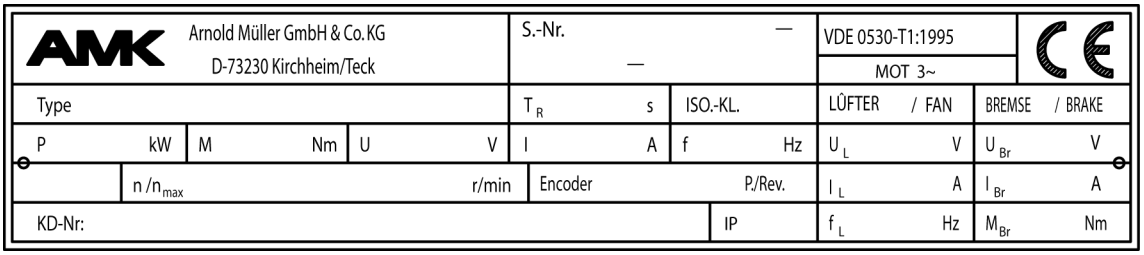


Illustration as an example: Content and scope can differ

Legend:

Abbreviation	Designation
1	Connection type
2	Duty type
3	Weight
4	Manufacturer
TNr	Part number
SNr	Serial number (year + calendar week – consecutive number)
Typ	Type designation
Isol.-Kl.	Insulation class
IP	Type of protection according to EN 60529
P_n	Rated power
U_n	Rated voltage
I_n	Rated current
M_n	Rated torque
f_n	Rated frequency
Enc	Motor encoder resolution
n_n	Rated speed
n_{max}	Max. speed of the output shaft of the system
ke	Voltage constant
U_B	Data on the motor holding brake: brake voltage
I_B	Data on the motor holding brake: brake current
M_B	Data on the motor holding brake: min. static brake torque
cosPhi	Power factor
U_L	Data on the fan: fan voltage

Abbreviation	Designation
I_L	Data on the fan: fan current
f_L	Data on the fan: fan frequency
Ref	Customer material number
SCCR	Short Circuit Current Rating
NDU	Non Dual-use
Rev	Revision



Legend:

Abbreviation	Designation
S-Nr.	Serial number (part no. – calendar week + year – consecutive number)
Type	Type designation
T_R	Rotor time constant
ISO.-KL.	Insulation class
P	Rated power
M	Rated torque
U	Rated voltage
I	Rated current
f	Rated frequency
n / n_{max}	Rated speed of the motor / max. speed of the output shaft of the system
Encoder	Motor encoder resolution
KD-Nr:	Customer material number
IP	Insulation class
U_L	Data on the fan: fan voltage
U_{Br}	Data on the motor brake: brake voltage
I_L	Data on the fan: fan current
I_{Br}	Data on the motor brake: brake current
f_L	Data on the fan: fan frequency
M_{Br}	Data on the motor brake: min. static brake torque

3.4 Type code

3.4.1 iC

iC	x	-	x	x	-	x	x	x
	|		|	|		|	|	|
	|		|	|		|	|	Power supply unit (24 VDC supply from the DC bus voltage)
	|		|	|		|	|	**0**: not integrated
	|		|	|		|	|	**U**: integrated
	|		|	|		|	Functional Safety	
	|		|	|		|	**0**: not integrated	
	|		|	|		|	**S**: integrated	
	|		|	|	Communication to the controller			
	|		|	|	**E**: Ethernet [1)]			
	|		|	|	**C**: CANopen CiA 402 Slave			
	|		|	Motor and encoder connector					
	|		|	**C**: CM3 (ITT Cannon)					
	|	Cooling							
	|	**0**: Cold plate							
	|	**F**: Air cooling							
	|	**S**: Special equipment							
	Output power [kVA]								
	2								
	5								

1) Siehe 'Options' auf Seite 94.

3.4.2 iX

iX	x	-	x	x	-	x	x
	|		|	|		|	|
	|		|	|		|	Functional Safety
	|		|	|		|	**0**: not integrated
	|		|	|		|	**S**: integrated
	|		|	|	Communication to the controller	
	|		|	|	**E**: Ethernet [1)]	
	|		|	|	**C**: CANopen CiA 402 Slave	
	|		|	Motor and encoder connector		
	|		|	**C**: CM3 (ITT Cannon)		
	|	Cooling				
	|	**0**: Cold plate				
	|	**F**: Air cooling (only for 5 KVA device)				
	|	**S**: Special equipment				
	Output power [kVA]					
	2					
	5					

1) Siehe 'Options' auf Seite 94.

3.4.3 iDT5

iDT 5 - x - x - x x x - xxxx - xx - x x

	Functional Safety
	0: not integrated
	S: integrated
	Communication to the controller
	E: Ethernet [1]
	C: CANopen CiA 402 Slave
	Design
	B5 flange
	Idle operation motor speed [U/min]
	Cooling
	0: Convection cooling
	F: External fan
	Motor holding brake
	0: without motor holding brake
	B: with integrated motor holding brake[2]
	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
	Installation size

1) Siehe 'Options' auf Seite 94.
2) The motor holding brake is not approved for personal protection from suspended loads!

3.5 Product description

iC decentralized inverter with power supply

The iC is an iX supplemented by a power section so that the iC can be operated directly on a 3-phase AC power system. The integrated brake chopper directs regenerative incoming energy to the integrated or externally connected brake resistor. A mains filter and a charging circuit are integrated in the iC. The iC contains a power supply unit that provides 24 VDC from the UZP/UZN DC bus for this iC.

iX decentralized inverter

The iX corresponds to the inverter in the iDT5 with an externally guided motor and encoder connection.

iDT5 / servo motors with integrated inverter

The servo motors of the AMKASMART series iDT combines the power of the AMK high torque servo motors DT5 with the most modern iX inverters in the most compact installation space.

The devices can be operated alone or in the network (EtherCAT (SoE/CoE), SERCOS III, VARAN (SoV/EoV), CAN (CiA 402)) 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!). All devices provide five multi-functional I/Os that can be configured as binary inputs, binary outputs or an analogue input.

The devices have the following standard functionality:

- Configurable multi-functional I/O
- 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)
  - SERCOS III (option)
- Fieldbus system CAN
  - CAN CiA 402 (option)
- Functional Safety (FSoE)

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.

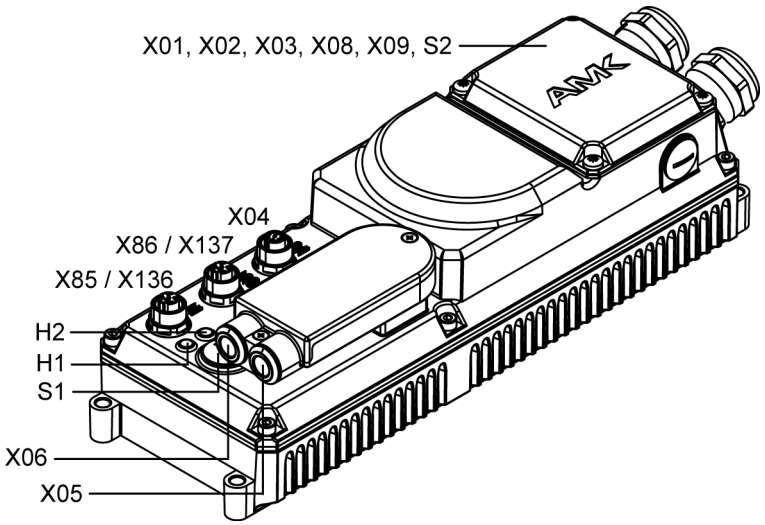
The AMKASMART decentralized drives can be easily combined with the AMKASYN KE/KW devices. Compact power supply modules KE or KES generate the DC bus voltage for the connected iX or iDT devices and feed regenerative energy back into the supply network. They are housed in a central switch cabinet, e.g. together with an controller of the AMKAMAC A-series.

AMKASYN compact power supply modules are available in the following variants:
KE: Block-commutated supply / recovery of the energy.
KEN: Power supply without recovery; regenerative operation with externally connected brake resistor is possible.
KES: Sinusoidal power supply and recovery.
See device description Servo drives KE/KW, Part no. 028932.

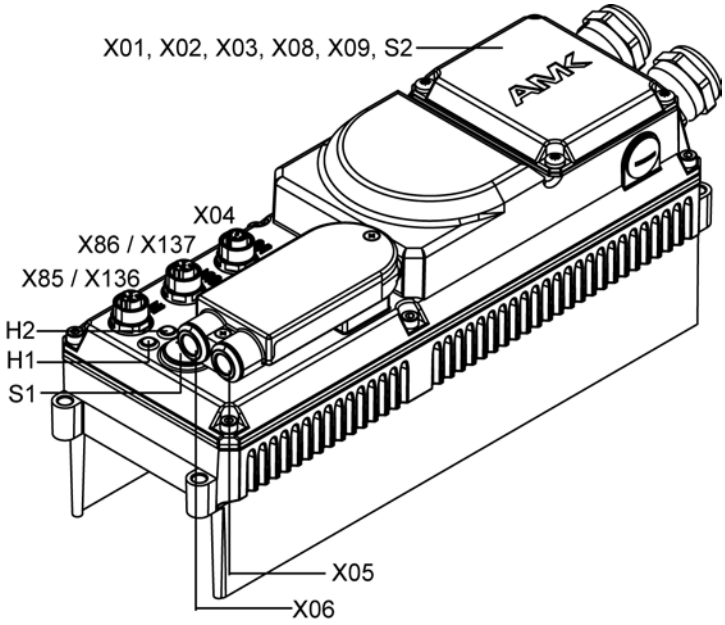
3.6 Device views

3.6.1 Servo converter iC

iC2-0C / iC5-0C

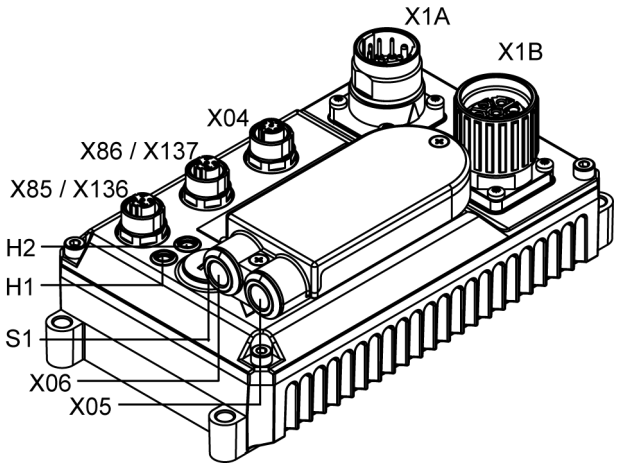


iC5-FC

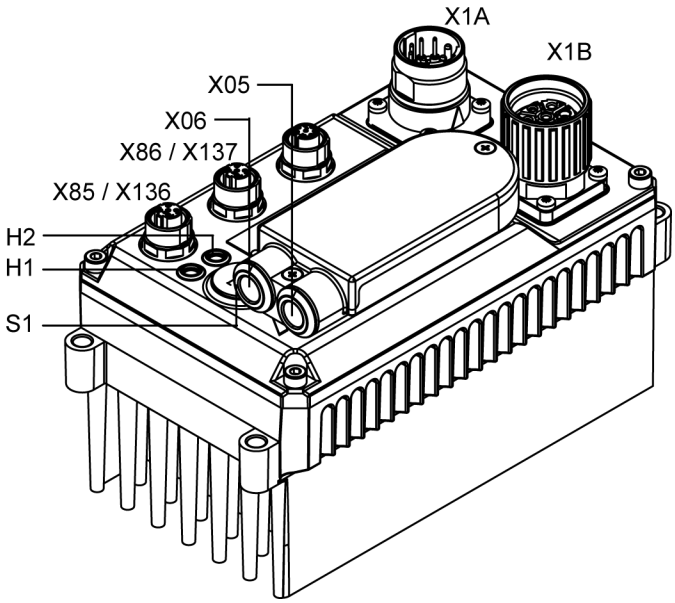


3.6.2 Servo controller iX

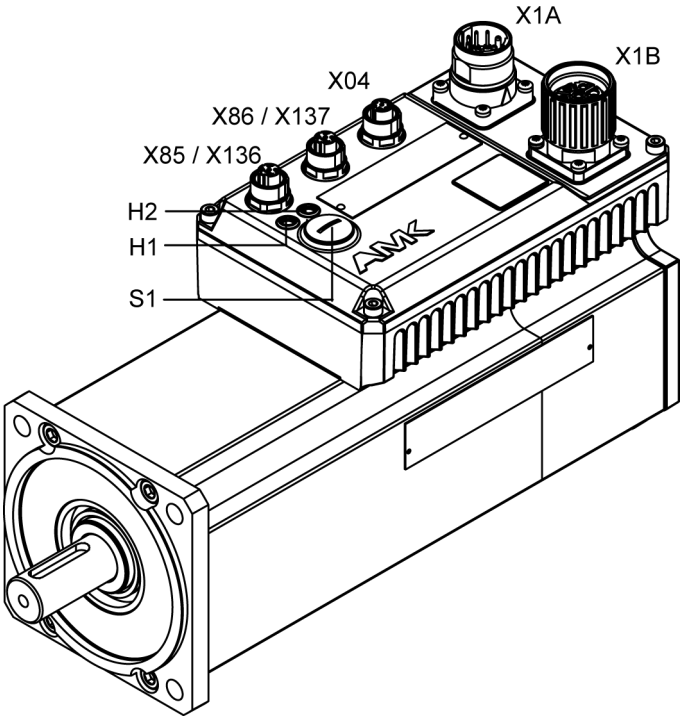
iX5-0C



iX5-FC



3.6.3 Servo motors iDT5



By default, the shaft is smooth. Feather key is optional.

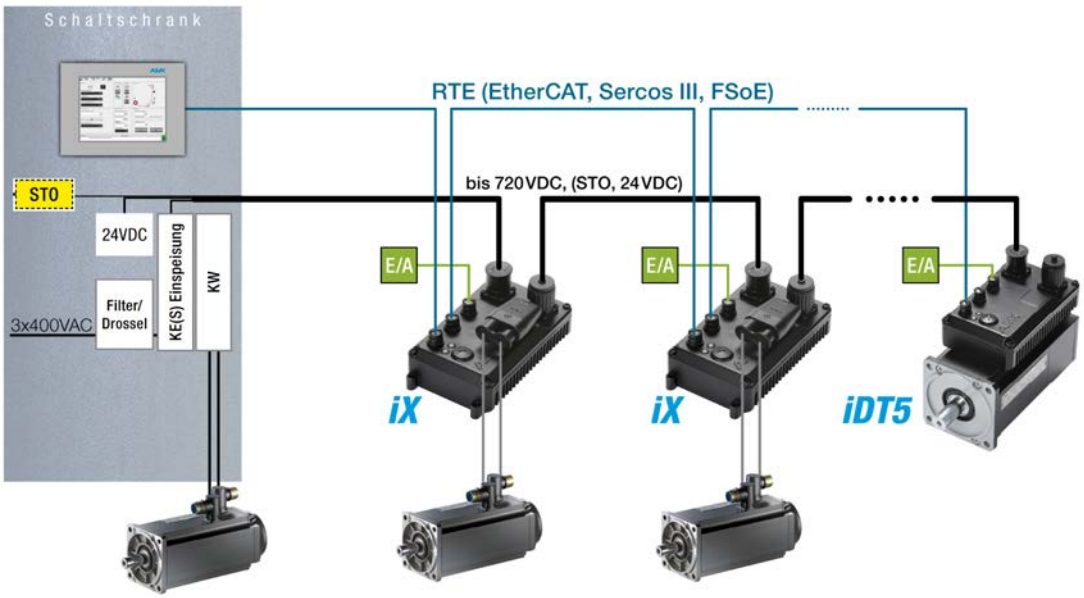
3.7 Interface overview, LEDs and address switch

Interfaces	Function		Product
LED H1 LED status	**Colour**	**Meaning**	iX / iC / iDT5
	Green	SBM: System without error, controller enable RF not set	
	Flashing green *)	SBM + QRF: Drive under control	
	Red	Drive in error state, evaluate diagnostic message	
	Flashing red *)	reserved	
	Orange	Warning message when controller enable not set	
	Flashing orange *)	Warning message when controller enable set	
	Flashing orange [1 Hz]	The new firmware will be plausibility checked and copied once into the mirror memory. This procedure takes approximately 15 seconds time.	
	*) Flashing cycle: T_{on} = 200 ms; T_{off} = 200 ms		

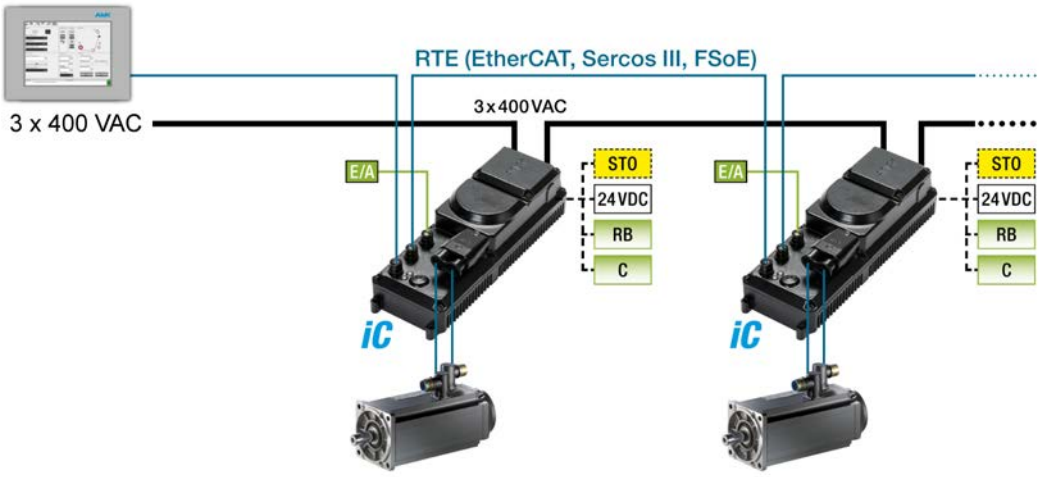
<table>
<tr><th>Interfaces</th><th>Function</th><th>Product</th></tr>
<tr><td>LED H2
Safety LED</td><td>After power on<table><tr><th>Colour</th><th>Meaning</th></tr><tr><td>LED OFF</td><td>Safe parameter set is NOT valid
The reason can be detected by diagnostic message</td></tr><tr><td>Green</td><td>Safe parameter set is valid</td></tr></table>During transmission of safe parameter set to the device<table><tr><th>Colour</th><th>Meaning</th></tr><tr><td>Green flashing
(1 second cycle)</td><td>Validation request: Enter the check sum</td></tr><tr><td>Orange</td><td>Safe parameter set was successfully transmitted
Switch the device OFF and ON again</td></tr><tr><td>LED OFF</td><td>Safe parameter set was NOT transmitted successfully
The reason can be detected by diagnostic message</td></tr></table></td><td>iX / iC / iDT5</td></tr>
<tr><td>S1</td><td>Address switch, Micro-USB for AMK internal use only</td><td>iX / iC / iDT5</td></tr>
<tr><td>S2</td><td>Switch for the internal power supply unit 24 VDC.</td><td>iC</td></tr>
<tr><td>X01</td><td>Mains connection / mains transmission</td><td>iC</td></tr>
<tr><td>X02</td><td>Transmission of the DC bus voltage</td><td>iC</td></tr>
<tr><td>X03</td><td>Connection of external brake resistor</td><td>iC</td></tr>
<tr><td>X1A</td><td>Supply line power connection: DC bus, 24 VDC supply voltage for electronics, brakes and STO</td><td>iX / iDT5</td></tr>
<tr><td>X1B</td><td>Power connection transmission: DC bus, supply voltage for electronics, motor holding brake and STO</td><td>iX / iDT5</td></tr>
<tr><td>X04</td><td>I/O interface
Multi-functional use as binary inputs and outputs, analogue input</td><td>iX / iC / iDT5</td></tr>
<tr><td>X05</td><td>Connection of the encoder signals</td><td>iX / iC</td></tr>
<tr><td>X06</td><td>Connection of the motor phases, the temperature sensor for the motor coil and the motor holding brake</td><td>iX / iC</td></tr>
<tr><td>X08</td><td>Supply voltage for electronics
Supply voltage for motor holding brake and STO</td><td>iC</td></tr>
<tr><td>X09</td><td>Transmission
Supply voltage for electronics
Supply voltage for motor holding brake and STO</td><td>iC</td></tr>
<tr><td>X85</td><td>Real-time Ethernet: input</td><td>iX / iC / iDT5</td></tr>
<tr><td>X86</td><td>Real-time Ethernet: transmission</td><td>iX / iC / iDT5</td></tr>
<tr><td>X136</td><td>CAN bus input (DSP 402 protocol)</td><td>iX / iC / iDT5</td></tr>
<tr><td>X137</td><td>CAN bus transmission (DSP 402 protocol)</td><td>iX / iC / iDT5</td></tr>
</table>

3.8 Device interconnection with switch components

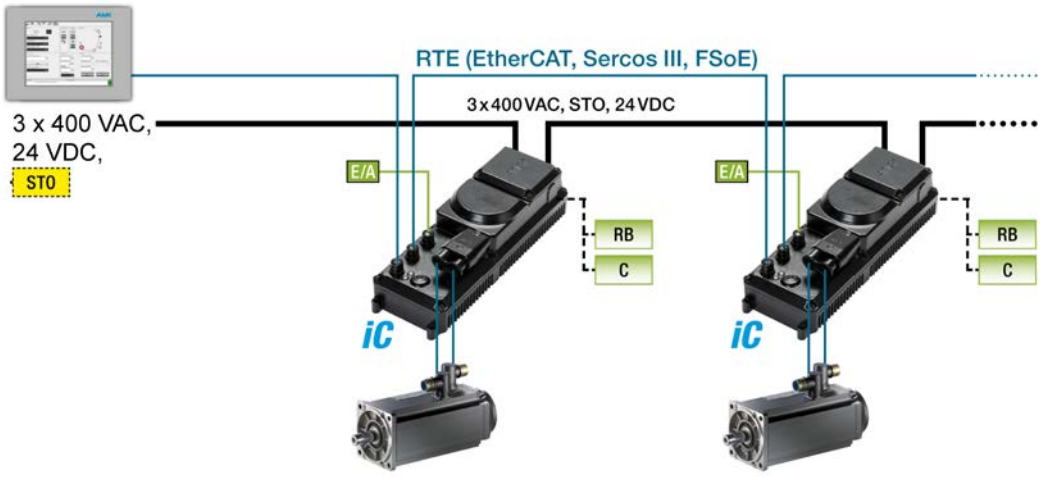
iX - iDT interconnection with DC transmission and supply in the central switch cabinet



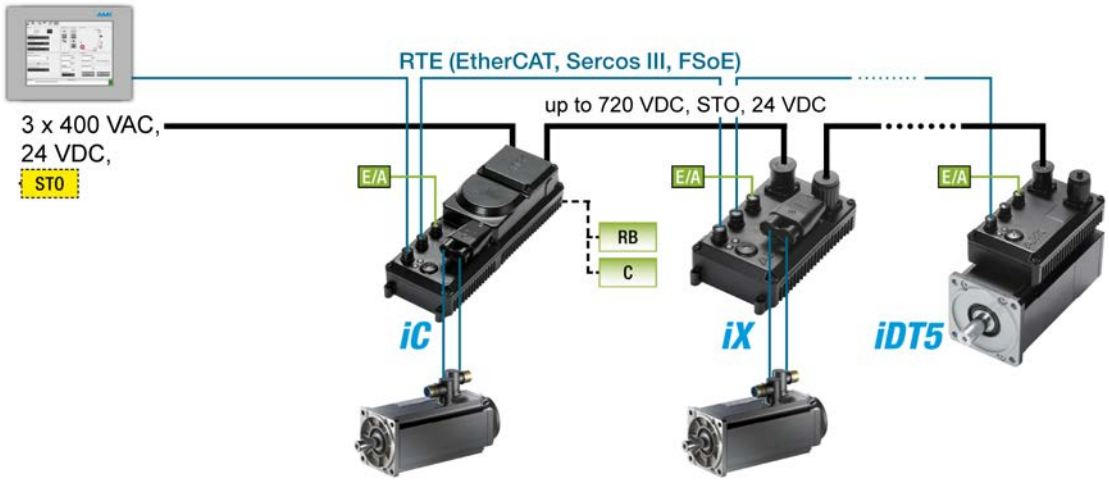
iC interconnection with 400 VAC transmission, STO and 24 VDC single supply, without switch cabinet



iC interconnection with 400 VAC, STO and 24 VDC transmission, without switch cabinet



iC - iX - iDT interconnection with DC, STO and 24 VDC transmission, without switch cabinet



Legend:

STO: 24 VDC supply for the safety function "Safe Torque Off"
RB: Connection of external brake resistor
C: Connection of external DC bus capacity
RTE Real-time Ethernet, real-time Ethernet

3.9 Technical data

3.9.1 iC

Designation	Connection	Unit	iC		
			iC2-0	iC5-0	iC5-F
Permissible ambient temperature	-	°C	0-45	0-45	0-45
Derating factor[1), 4)] at 55 °C	-		0.70	0.70	0.70
Derating factor[1), 4)] at 60 °C	-		0.55	0.55	0.55

Designation	Connection	Unit	iC		
			iC2-0	iC5-0	iC5-F
Mains input voltage [5]	X01	VAC	Operating range: 3 x 230..480 ±10 %, 47..63 Hz Rated data is valid: 3 x 400..480 ±10 %, 47..63 Hz		
Rated mains current (individual unit)		A (eff.)	8		
Power factor			0.93		
Rated input power		kW	5		
24 VDC supply voltage	X08 / X09	V	24 ±15 %, ripple max. 5 %		
Rated current for 24 VDC (max. with I/O)		ADC	0.4 (0.9)	0.4 (0.9)	0.5 (1)
24B supply voltage for the holding brake / STO	X08 / X09	VDC	24 ±15 %, ripple max. 5 %		
Maximum permissible current consumption of the holding brake (terminal X06.1, CM3 connector 3 and 4)		A	0.5 (supply from an internal power supply unit) [8] 0.7 (supply with external 24B) [8]		
STO current consumption		A	0.02		
Rated output power	X06	kVA	2	5	5
Rated output current		A (eff.)	3.3	8.2	8.2
Maximum output current (duration < 1 s)		A (eff.)	6.6	16.5	16.5
Rated output voltage (sinusoidal)		V	3 x 350		
Output frequency:[6]		Hz	0 - 800		
DC bus voltage transmission	Terminal UZN, UZP	VDC	300 - 650		
Rated current of the DC bus with 540 VDC		A	9.4		
Maximum current of the DC bus with 540 VDC (duration < 1 s)		A	18.8		
Shutdown threshold of the DC bus voltage		VDC	850		
Braking power of the integrated brake resistor (max. energy consumption Q = 600 Ws)		W	Peak performance: 3000 Rated power: 30		
External brake resistor	Terminal RBN, RBP	Ohm	≥47		
Current regeneration	Terminal L1, L2, L3, PE		no		
Short Circuit Current Rating (SCCR)		kA	42		
Dimensions (W x L x H) without sockets / connector		mm	293 x 100 x 76	293 x 100 x 76	293 x 100 x 122
Weight		kg	2.1	2.1	2.7
Cooling[2]			Cold plate alternative convection-cooled metal plate[7]	Cold plate	Integrated air cooling
Type of protection according to EN 60529			IP 65[3]	IP 65[3]	IP 54[3]
Degree of efficiency of the inverter electronics		%	98		

Designation	Connection	Unit	iC		
			iC2-0	iC5-0	iC5-F
DC bus capacity C_Z internal		µF	20		

1) At this ambient temperature, the rated output power, the rated output current and the rated maximum current must be multiplied by the derating factor and the user must reduce the performance data to these values.
2) Siehe 'iC and iX' auf Seite 46.
3) Unconnected interfaces and the terminal box must be closed.
4) The operation at increased ambient temperature, considering the derating factor, is only allowed, if the internal power supply is switched off. Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.
5) Single-phase operation (e.g. 230 V) is not allowed.
6) Valid for devices with firmware versions beginning up from V2.12 2018/03:

V/f-operation:	Output frequency max. 599 Hz
Operation in closed loop control with encoder feedback):	Speed setpoint values are limited to 30000 rpm. The actual speed value is monitored for the maximum speed of 30000 rpm. Actual speed values are detected above 30000 rpm. The drive generates the error 2319 'n > n_{max} 'and runs down.

7) Nominal data was achieved if the device has been mounted to a 500 x 500 x 5 mm metal plate.
8) Motor holding brakes with higher power requirements, must be controlled with an external auxiliary relay.

3.9.2 iX

Designation	Connection	Unit	iX		
			iX2-0	iX5-0	iX5-F
Permissible ambient temperature	-	°C	0 - 50	0 - 55	0 - 50
Derating factor[1)] at 55 °C	-		0.75	1	0.66
Derating factor[1)] at 60 °C	-		0.5	0.5	0.33
Rated output power	X06	kVA	2	5	5
Rated output current		A (eff.)	3.3	8.2	8.2
Maximum output current (duration < 1 s)		A (eff.)	6.6	16.5	16.5
Rated output voltage (sinusoidal)		V	3 x 350		
Output frequency:[5)]		Hz	0 - 800		
Supply voltage of the DC voltage intermediate circuit	X1A.1, X1A.3	VDC	540 - 720		
Supply current of the DC bus with 540 VDC		A	3.7	9.4	9.4
Shutdown threshold of the DC bus voltage		VDC	850		

Designation	Connection	Unit	iX		
			iX2-0	iX5-0	iX5-F
24 V supply voltage	X1A.A, X1A.B	VDC	24 ±15 %, ripple max. 5 %		
Rated current: • electronics iX • + option I/O Valid for all standard devices regardless of the revision level *) *) Except: A2553AD, A2777AD and E1241		A	0.25 max. 0.5		0.4 max. 0.5
Rated current: • electronics iX • + option I/O • + motor holding brake Valid only for the following devices: A2553AD, A2777AD and E1241 if Rev. ≥ 4.00		A	0.25 max. 0.5 max. allowed 0.7 6)		0.4 max. 0.5 max. allowed 0.7 6)
24 B supply voltage	X1A.C, X1A.D		24 ±15 %, ripple max. 5 %		
Rated current: • STO current consumption • + motor holding brake Valid for all standard devices regardless of the revision level *) *) Except: A2553AD, A2777AD and E1241		A	0.02 max. allowed 0.7 6)		
Rated current: • STO current consumption Valid only for the following devices: A2553AD, A2777AD and E1241 if Rev. ≥ 4.00		A	0.02		
Short Circuit Current Rating (SCCR)		kA	42 7)		
Dimensions (W x L x H) without sockets / connector	-	mm	162 x 100 x 43	162 x 100 x 43	162 x 100 x 89
Weight	-	kg	0.8	0.8	1.2
Cooling 2)	-		Cold plate alternative convection-cooled metal plate 3)	Cold plate	Integrated air cooling
Type of protection according to EN 60529	-		IP 65 4)	IP 65 4)	IP 54 4)
Degree of efficiency of the inverter electronics	-	%	98		
DC bus capacity C_Z internal		µF	10		

1) At this ambient temperature, the rated output power, the rated output current and the rated maximum current must be multiplied by the derating factor and the user must reduce the performance data to these values.
2) Siehe 'iC and iX' auf Seite 46.
3) Nominal data was achieved if the device has been mounted to a 500 x 500 x 5 mm metal plate.
4) Unconnected interfaces must be closed.
5) Valid for devices with firmware versions beginning up from V2.12 2018/03:

V/f-operation:	Output frequency max. 599 Hz
Operation in closed loop control with encoder feedback):	Speed setpoint values are limited to 30000 rpm. The actual speed value is monitored for the maximum speed of 30000 rpm. Actual speed values are detected above 30000 rpm. The drive generates the error 2319 'n > n_{max} 'and runs down.

6) Motor holding brakes with higher power requirements, must be controlled with an external auxiliary relay.
7) The indication of the Short Circuit Current Rating (SCCR) also applies to iDT5

3.9.3 iDT5

Specifications for your iDT5 see the data sheet.

3.10 Ambient conditions

3.10.1 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)

3.10.2 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)

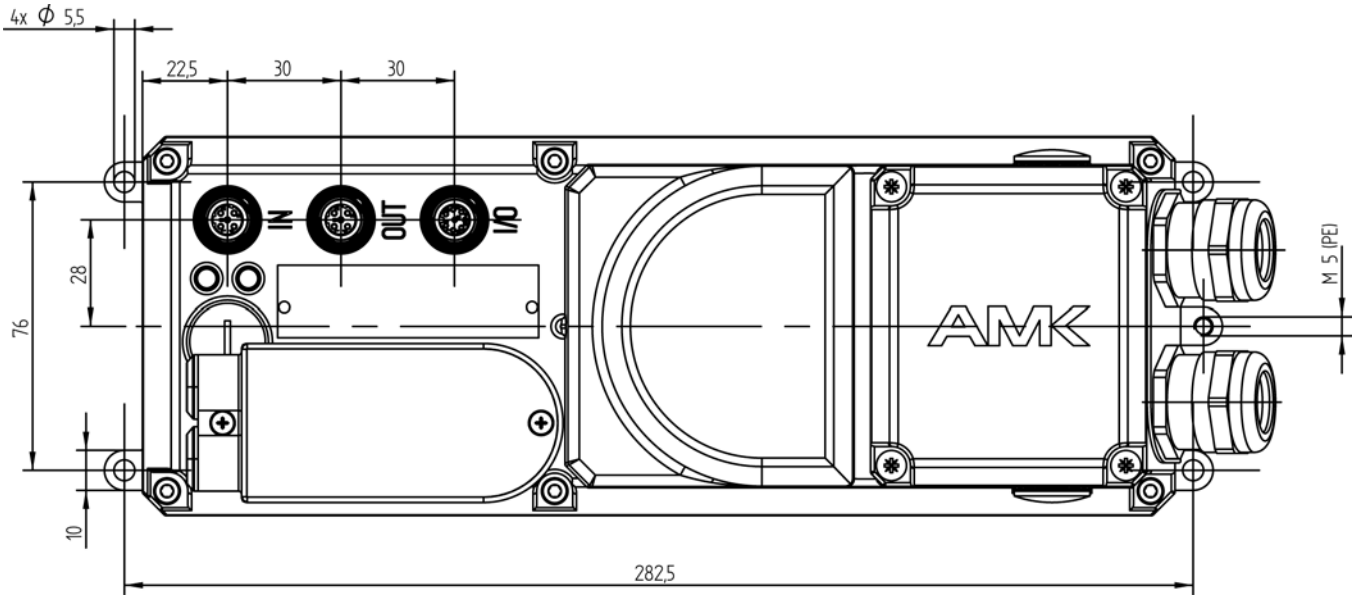
3.10.3 Operation

Designation	Range of values	Explanation
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.
	0 to 2000 m above sea level	Without derating, possible for devices with "cold plate" mounting only: iX2-0, iX5-0, iC2-0, iC5-0 Prerequisite: The cold plate must be able to dissipate the accumulating power loss. Siehe iC and iX ab Seite 46
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	The interior equipment is designed for no or only dry, non-conductive pollution.
Overvoltage category (EN 61800-5-1)	III	up to 2000 m above see level

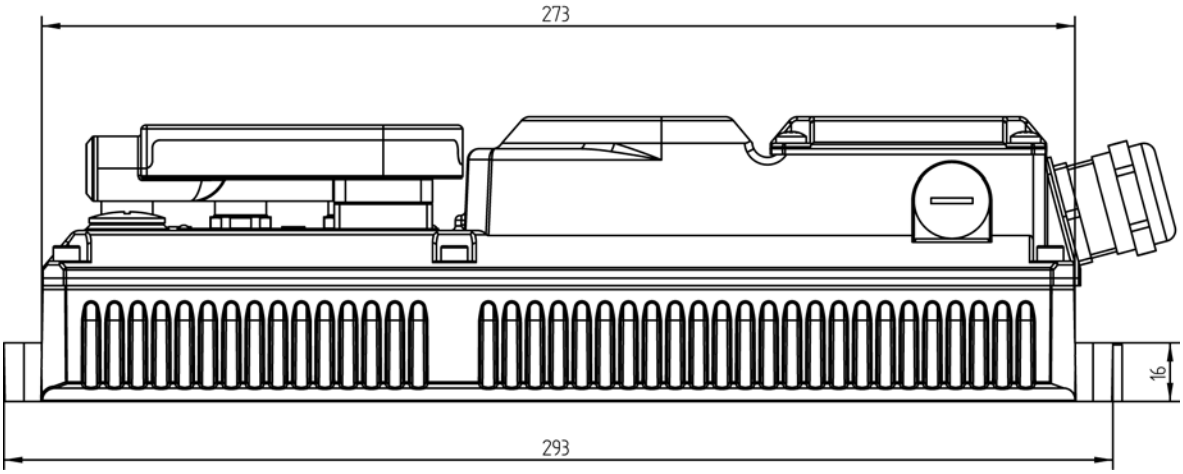
3.11 Dimension drawings

3.11.1 iC2-0 / iC5-0

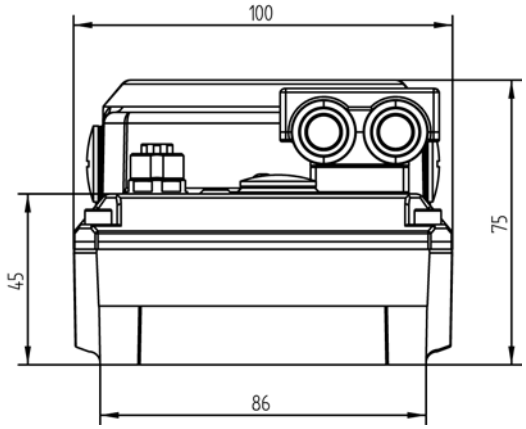
Top view



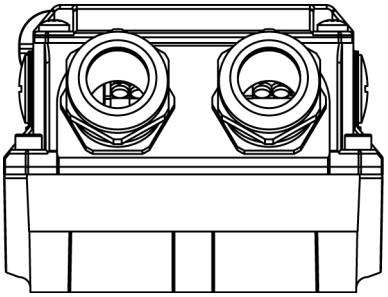
Side view



Front view

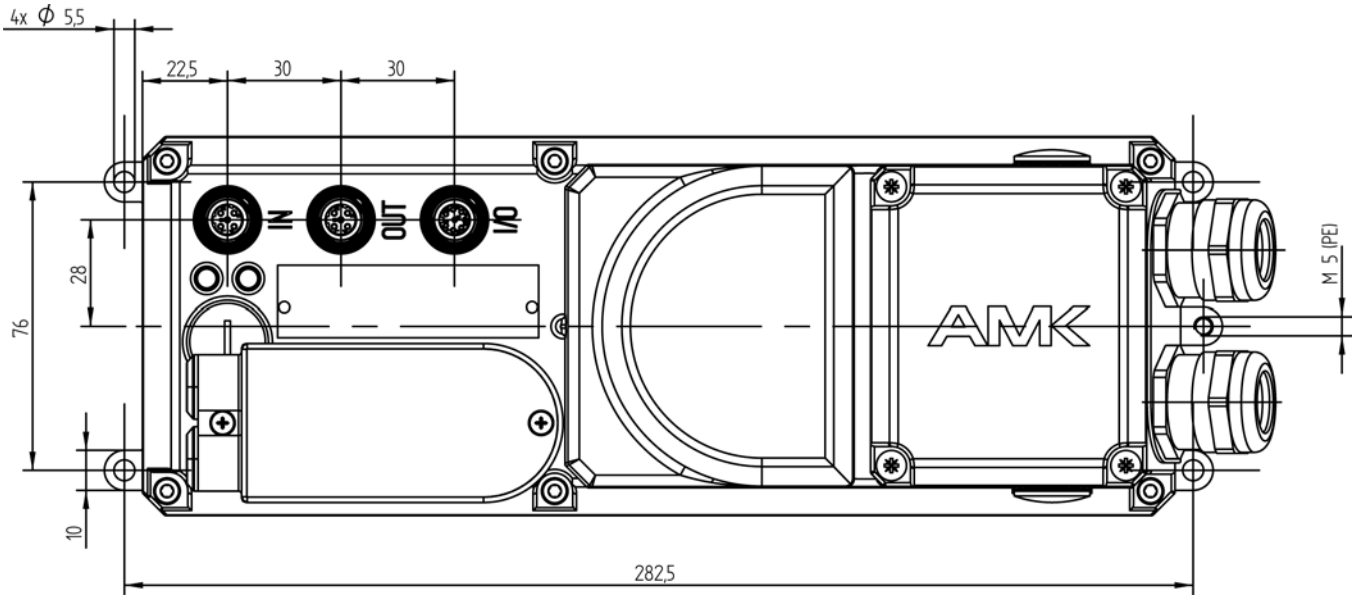


Back view

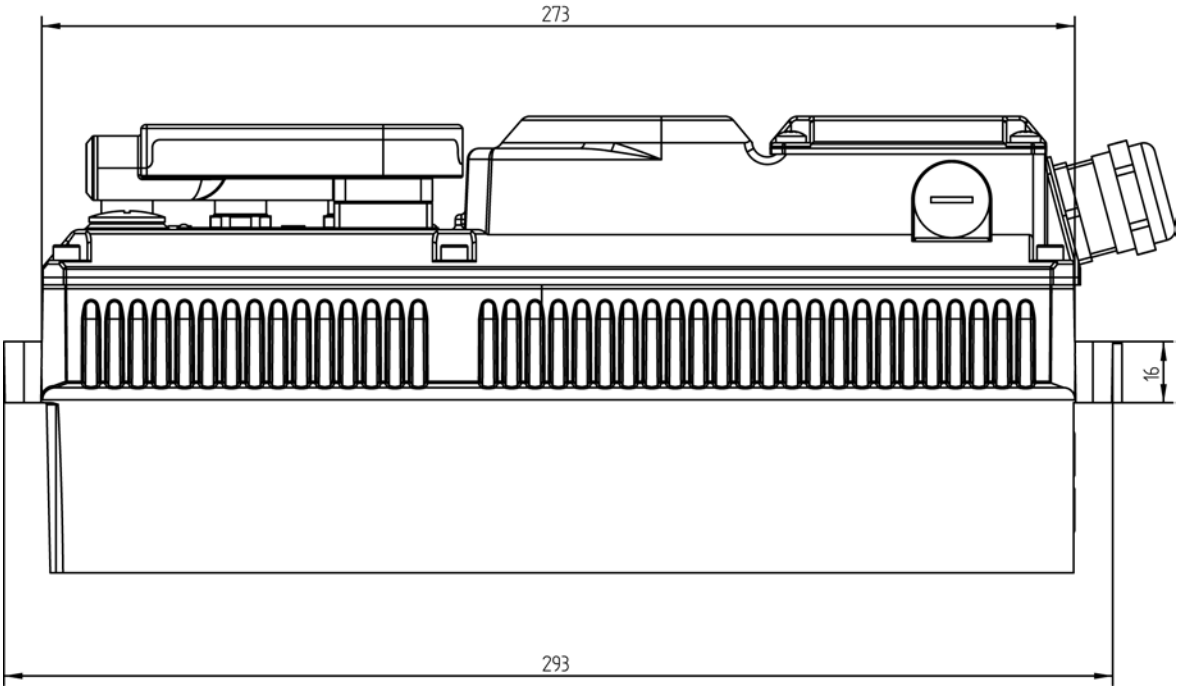


3.11.2 iC5-F

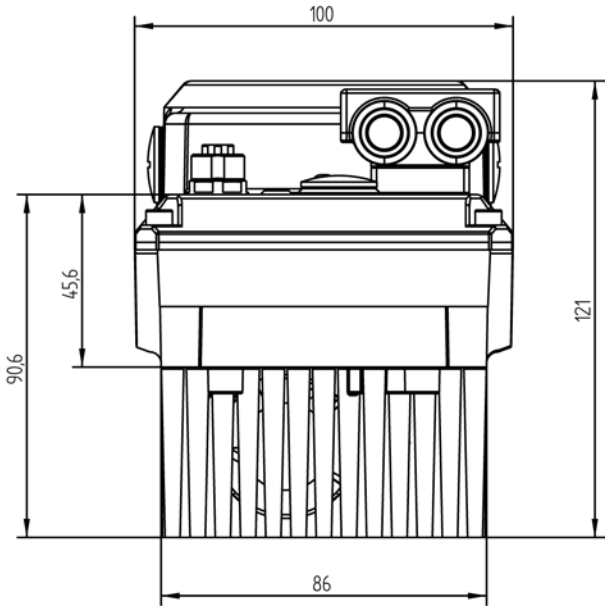
Top view



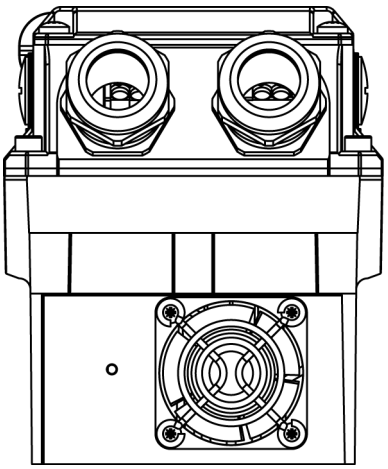
Side view



Front view

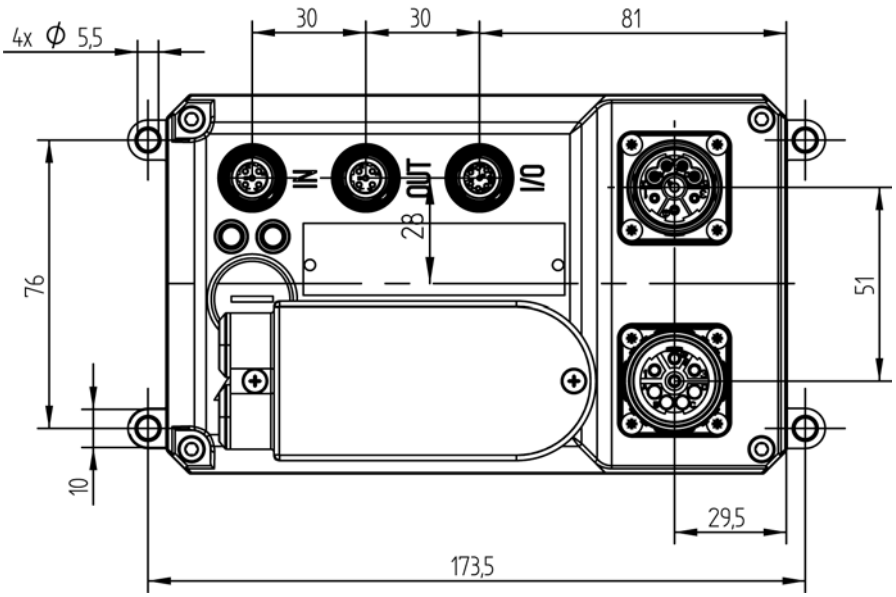


Back view

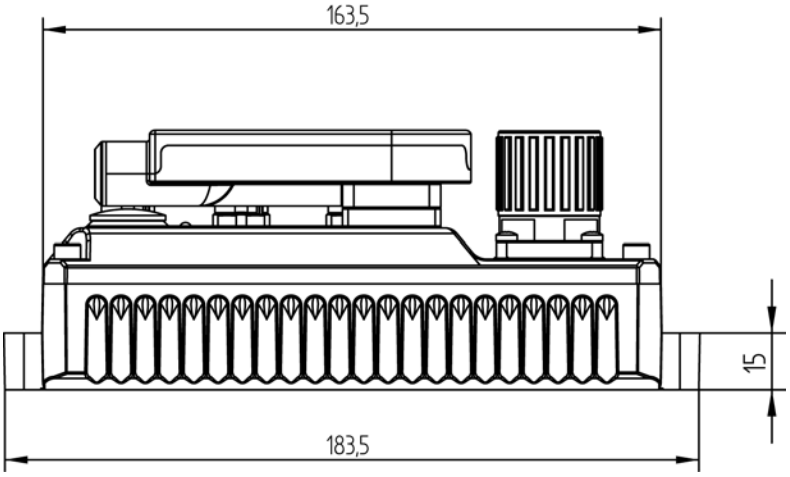


3.11.3 iX2-0 / iX5-0

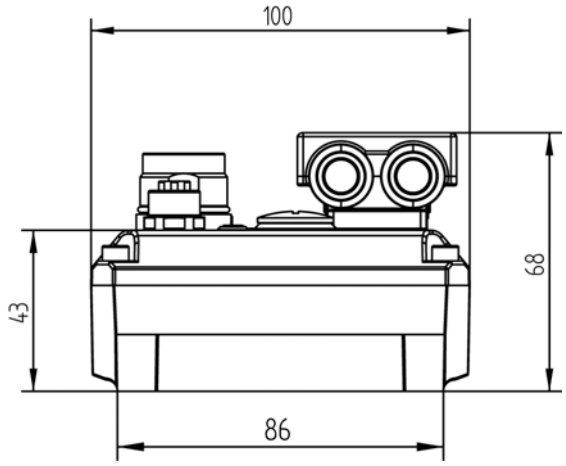
Top view



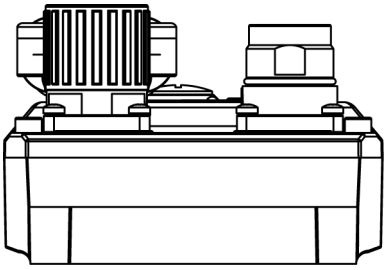
Side view



Front view

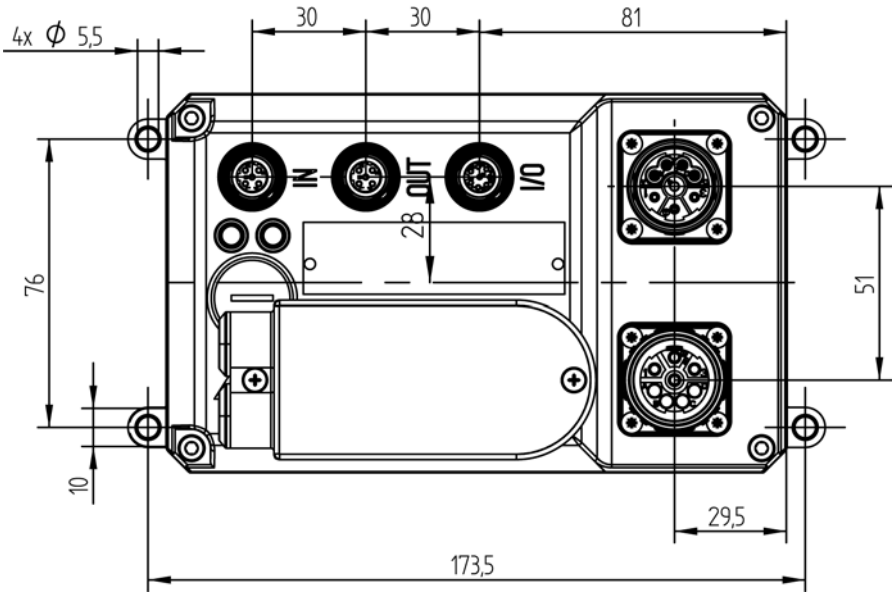


Back view

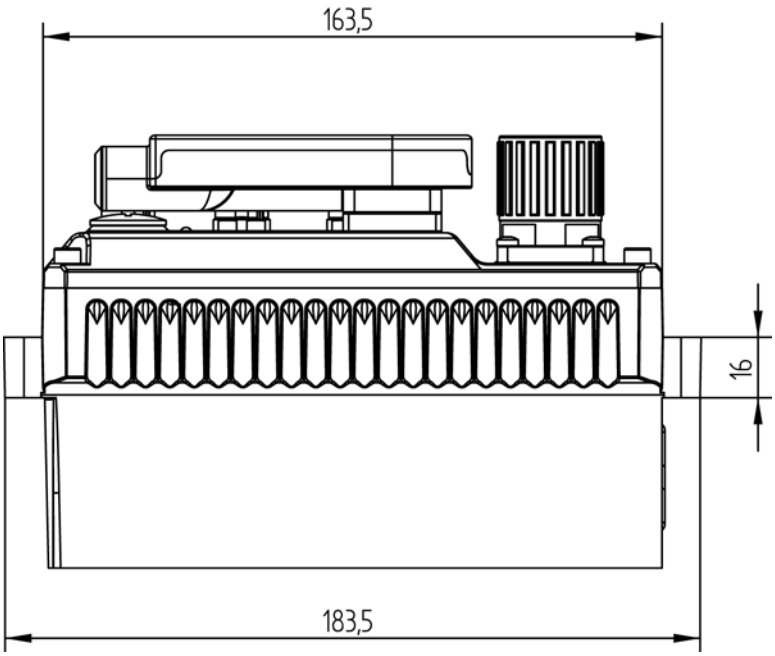


3.11.4 iX5-F

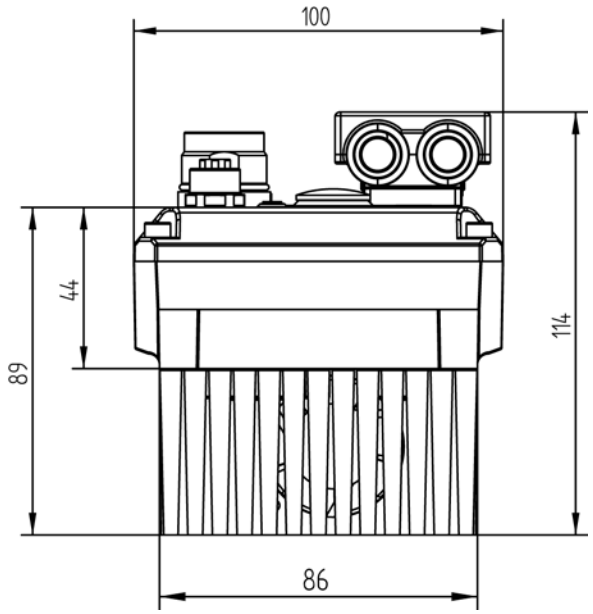
Top view



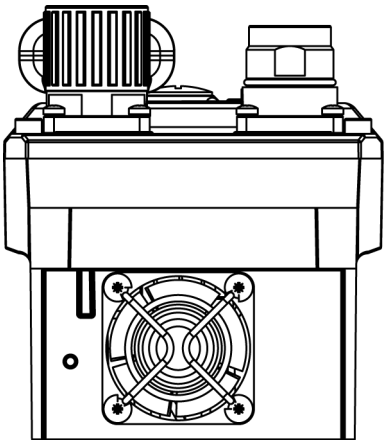
Side view



Front view

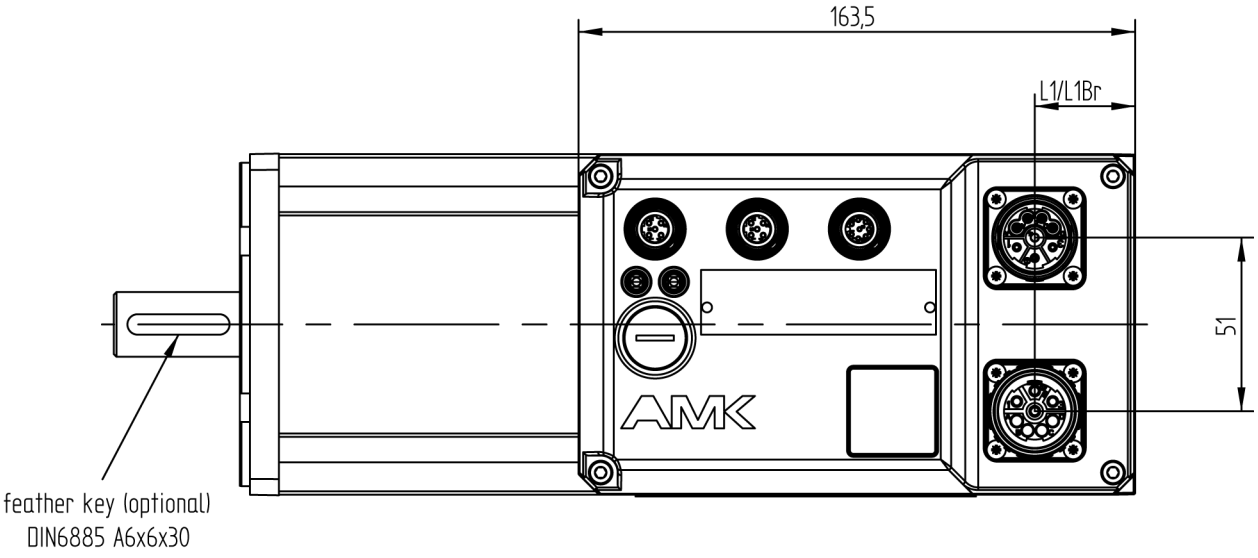


Back view

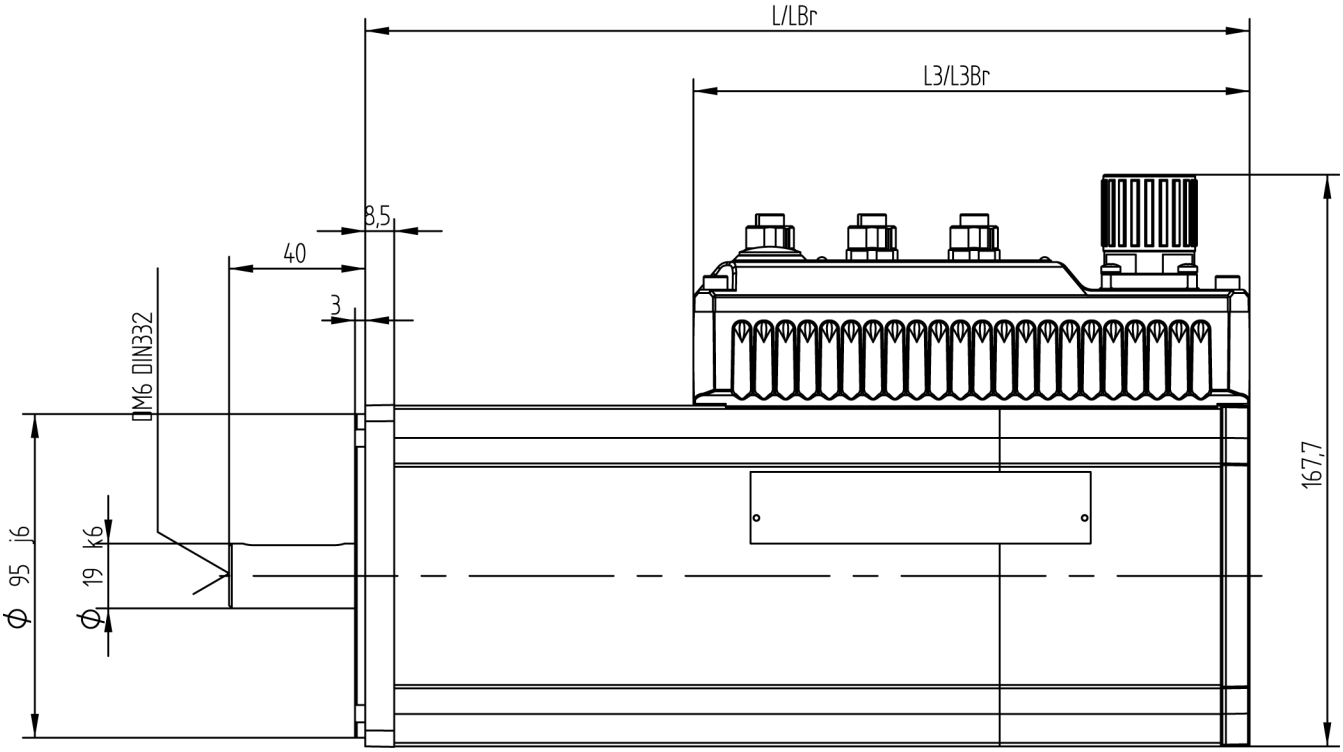


3.11.5 iDT5

Top view

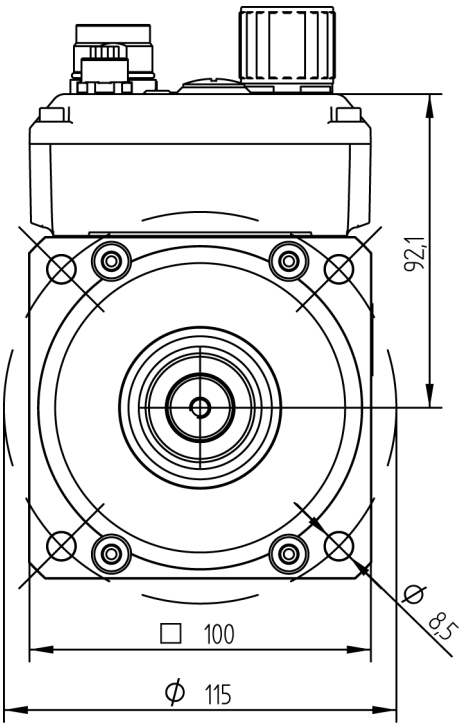


Side view



Motor type	L [mm]	LBr [mm]	L3 [mm]	L3Br [mm]
iDT5-3-10-xOO	163.5	-	163.5	-
iDT5-3-10-xBO	-	191.5	-	191.5
iDT5-5-10-xOO	195	-	163.5	-
iDT5-5-10-xBO	-	223	-	191.5
iDT5-9-10-xOO	258	-	163.5	-
iDT5-9-10-xBO	-	286	-	191.5

Front view



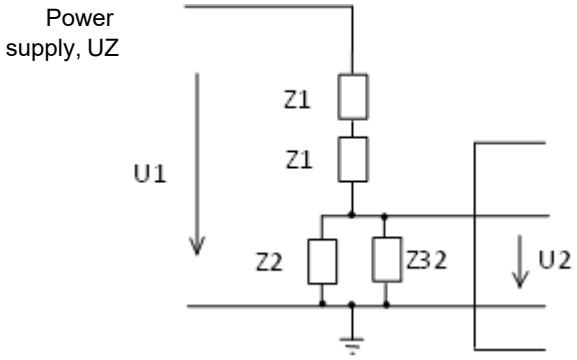
4 Projecting

4.1 Insulation resistance and high voltage test

NOTICE	
Material Damage!	**High voltage or insulation testing at the customer's location** All devices are insulation tested according to EN 50178 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 50178, 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.

4.1.1 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
iX	1250 kΩ
iDT5	1250 kΩ
iC	350 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
iX	UZP, UZN, U, V, W
iDT5	UZP, UZN
iC	UZP, UZN, U, V ,W, L1, L2, L3, RBP, RBN

4.1.2 High voltage test

NOTICE	
Material Damage!	**High voltage or insulation testing at the customer's location** All devices are insulation tested according to EN 50178 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 50178, 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
iX	UZP, UZN, U, V, W
iDT5	UZP, UZN
iC	UZP, UZN, U, V ,W, L1, L2, L3, RBP, RBN

  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
iX	2 mA	2120 VDC
iDT5	2 mA	2120 VDC
iC	7 mA	2120 VDC

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

4.2 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

4.2.1 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.

4.2.2 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 (iX: terminal [X1A] / iC: terminal [X02]).

Siehe 'iC' auf Seite 24..

Siehe 'iX' auf Seite 26..

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 97.

4.2.3 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 iX 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.

4.3 Layout of the iC mains connection

The iC servo inverters do not contain their own mains separation. The mains must be connected to the servo inverter via an external contactor or a main switch. The mains must be a symmetrical three-phase power system. A single-phase operation is not permitted!

An external fuse must be connected upstream in a manner suitable to the cable cross section:

Terminal cross-section	Fuse for cable protection*)
1.5 mm^2 / AWG 14	3 x 10 A (gG)
2.5 mm^2 / AWG 12	3 x 16 A (gG)

*) Installation type B2 according to EN 60204, multi-core cable, laid in the cable duct

Dimensioning fuse for different cable cross sections:

The fuse must be designed for the smallest cross-section!

Fuse for cable protection	10 A	10A	10 A	16 A
X01 mains connection power supply	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2
X01 mains connection - transmission (forwarding)*	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2
X02 DC-bus connection / - DC-bus transmission* to the inverter	1,5 mm^2	2,5 mm^2	1,5 mm^2	2,5 mm^2

* optional

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.

⚠ DANGER **Danger to life from electric shock! Earth leakage current >3.5 mA**

Under proper operation, an earth leakage current of >3.5 mA can flow (inherent to its functional principle), which requires the devices to be connected in a fixed manner. AC / DC sensitive earth leakage circuit breakers can be used conditionally. Earth leakage circuit breakers for personal protection against electric shock with an operating current of ≤ 30 mA are not suitable, because the rated fault current can be greater than 30 mA. Only earth leakage circuit breakers with the following properties are suitable:

- Type B according to IEC 60755 A2, AC / DC sensitive (according to EN 50178 chap. 5.2.11.2) (e.g. by company ABB Stotz-Kontakt GmbH type F 804)
- Operating current ≥ 300 mA (no personal protection!)
- Response delay ≥ 40 ms
- Surge current resistance ≥ 3000 A

EN 61800-5-1:2008 requires a PE connection with at least 10 mm^2 cable cross-section. The PE cable is fastened to the housing with a ring terminal lug and an M5 screw.

Recommendation:

An optional upstream mains choke reduces current harmonics and increases the power factor. The mains choke is connected between the main switch (or contactor) and the mains connection terminal. Siehe 'Mains choke' auf Seite 96.

4.4 Transmission of supply voltages between devices

When transmitting supply voltages (e.g. 24 VDC supply voltage, mains 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.

Overview of the limiting sizes:

Device	Transmission	Limiting size	Connection / terminal	Value
iC	DC bus	Rated input power (total power)	X01	5 kW
	Mains voltage	Maximum current of the mains terminal (device with transmission)	X01	20 A
	24 VDC from an external supply	Maximum current of the 24V terminal	X08 / X09	6 A
	24 VDC from an external supply	Maximum current of the 24B terminal	X08 / X09	6 A
iX / iDT5	DC bus	Maximum current of the DC bus connector	X1A.1, X1A.3	25 A
	24 VDC from an external supply	Maximum current for the 24V connector	X1A.A, X1A.B	6 A
	24 VDC from an external supply	Maximum current of the 24B connector	X1A.C, X1A.D	6 A

Maximal allowed terminal and cable loads:

Siehe 'iX' auf Seite 26.

Siehe 'iC' auf Seite 24.

Siehe 'iDT5' auf Seite 28.

4.5 iC with internal 24 VDC power supply unit

iC devices (siehe ' iC' auf Seite 16, iCx-xx-xxU) are equipped with an internal power supply unit (max. output current: 3A) that is fed from the DC bus in order to ensure the 24 VDC internal self supply. It is not allowed to loop the internally generated 24 VDC supply to other devices!

If the 24 VDC supply is to be independent of the power supply, the 24 VDC supply must be fed by an external power supply unit (max. output current: 6A) via the terminals 24V, 0V, 24B and 0B and the internal 24 VDC supply from the DC bus must be disabled with the SMD DIP switch S2. Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.

4.6 Motor cable lengths

The total permissible length of all motor cables depends on the power supply:

Power supply	total permissible length of all motor cables
KE, KEN, KES	100 m
iC, iSA	20 m
KEN5-FN KEN5-0N	25 m

4.7 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 and the motor is prevented from starting unexpectedly. If the STO is actuated while moving, the drive coasts to stop and generates the error message 2320.

The function is suitable for Performance Level (PL) d and category 3 according to EN 13849-1 if the signals 24B and 0B 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.

Standards		
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	X1A.C and X1A.D (signal 24B / 0B)

Behavior of the motor holding brake at STO

Valid for all standard devices regardless of the revision level *)	**Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00**
For motors with a motor holding brake, the brake automatically closes with STO. The motor holding brake is not approved for personal protection from suspended loads! STO is always effective when the 24 VDC supply voltage at the connection X1A.C and X1A.D (signal 24B, 0B) is missing.	The state of STO has no effect on the motor holding brake. The motor holding brake is supplied by connection X1A.A and X1A.B (signal 24V, 0V).

*) Except: A2553AD, A2777AD and E1241

Dynamization STO

Valid for all standard devices regardless of the revision level *)	**Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00**
Not possible.	The signal to control STO must be dynamic with a pulse duration ≤ 2 ms.

*) Except: A2553AD, A2777AD and E1241

Reaction times

	Valid for all standard devices regardless of the revision level *)	**Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00**
STO is triggered by hardware input	< 1 ms	< 5 ms
Software reacts on error (error reaction)	< 20 ms	< 20 ms
Diagnostic message is displayed	< 200 ms	< 200 ms

*) Except: A2553AD, A2777AD and E1241

Further Information

Siehe '[X1A] Power supply' auf Seite 49.
Siehe '[X1B] Power supply transmission' auf Seite 52.
Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.
Siehe 'Connection examples for operation with STO' auf Seite 70.
Siehe 'Diagnosis STO' auf Seite 89.

4.7.1 For your safety

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)

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'

4.7.2 Key figures according to EN ISO 13849-1

Parameter	Value	Notice
PFH	2.0 E-08 1/h	2 % of SIL 2
PFDavg (T = 20a)	1.7 E-03	17 % of SIL 2
MTTFd	287 a	high
DCavg	66 %	low

4.7.3 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 24B or 0B 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 24B and 0B 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'

4.8 Monitoring functions

Hardware monitoring

- Motor (A) overcurrent (maximum current)
- Short-circuit, accidental ground of the motor phases (A)
- Processor monitoring by watchdog (A)
- Internal operating voltages (A)
- Short-circuit of external brake resistor (A)

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)

4.9 Additional temperature monitoring enables higher I_N in the converter

I^2t monitoring functions protect AMK devices from overload. AMK converters supports 2 independent i^2t monitoring functions, one to protect the motor and the other one to protect the converter electronic.

Generally the i^2t counter starts counting above an operating current (rated current) specified in the data sheet. If the i^2t counter reaches 100% the device is switched off to protect against temperature damages.

Normally applications are sized in that way, that the electronic will not become overload caused of the power data of the connected motor but the motor will be exploited best possible.

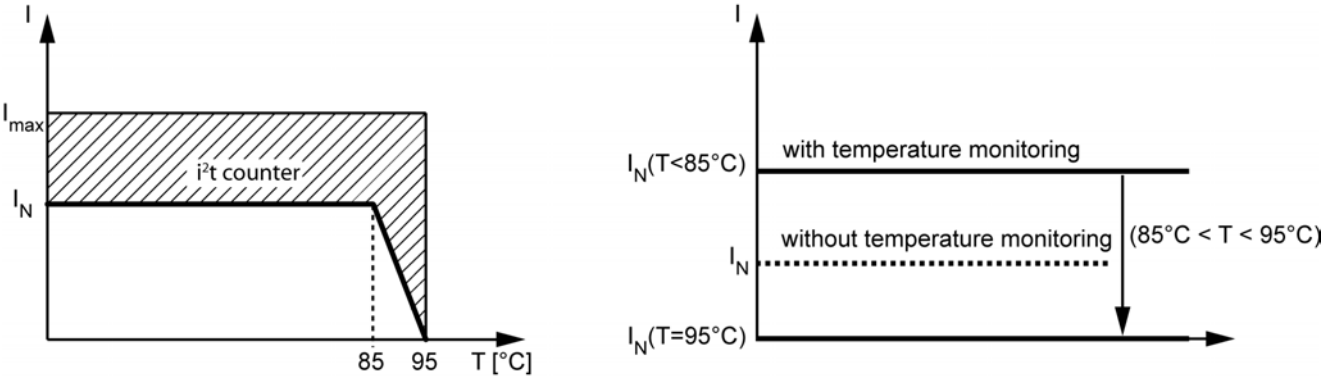
The i^2t monitoring does not consider the real heating of a device. Specially at the integrated systems, where the converter electronic is integrated inside the motor, the electronic will be heated up by the motor additional to their own heating. To make sure that such influences will not cause temperature damage, AMK has implemented a temperature monitoring additional to the i^2t monitoring which starts derating the allowed rated current I_N linear until zero depending on the temperature, if a defined temperature threshold was reached (see left drawing).

Thereby a warning message (2357 'Device overload warning') is generated, which the controller can evaluated to initiate measures to prevent a further temperature rise. If the temperature rises further on, the controller enable will be withdrawn if the switch-off temperature (100 °C) is reached and an error message (2358 'Device overload error') is generated by the system.

The advantage of the additional temperature monitoring is, that the rated current for the i^2t monitoring can be set significantly higher than systems only using the i^2t monitoring (see right drawing).

The specified rated current is available as long until the temperature monitoring is triggered by the measured temperature level.

The application can counteract against heating up of the devices by mounting the device is that way, that maximal heat is conducted by convection via the mounting surface. Further the convection cooling can be improved by a fan.



The drawing (left side) shows the area higher the rated current I_N where the i^2t counter is counting. The right side drawing shows, that the rated current for devices with additional temperature monitoring can be higher than for devices working without additional temperature. Both drawings show, that the rated current is linear derated automatically, depending the measured temperature if higher 85 °C, until 95 °C where the rated current will be limited to 0 A.

The i^2t monitoring of the motor is not changed.

Additional the motor winding temperature is monitored to 140 °C (PTC resistor motor).

Example for iDT5:

Motor data (Extract of the document PDK_203445_iDT5)

Designation		Unit	Motor type		
			iDT5-3-10-xx0	iDT5-5-10-xx0	iDT5-9-10-xx0
I_N	Rated current for operation only with i^2t monitoring converter	A (eff.)	1.2 1)	1.7 1)	2 1)
	Rated current for operation with i^2t monitoring **and additional temperature monitoring** in the converter		**3.3**	**3.3**	**3.3**
I_{max}	Maximal current for 1 s for operation only with i^2t monitoring converter	A (eff.)	8.5	8.5	8.5
	Maximal current for 1 s for operation with i^2t monitoring converter **and additional temperature monitoring** in the converter		**8.5**	**8.5**	**8.5**

1) The values for the rated current are specific and can differ depending on the motor type.

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 housing of the electronic • 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 29.

5.4 iC and iX

5.4.1 Cold plate

iX2-0, iX5-0, iC2-0 and iC5-0 must be mounted to a surface with a maximum temperature of 40 °C in order to achieve the specified data.

Siehe 'iX' auf Seite 26..

Siehe 'iC' auf Seite 24.

The cold plate must be able to dissipate the accumulating power loss.

Power loss

iX2-0	iX5-0	iC2-0	iC5-0
40 W	100 W	90 W	150 W

The assembly surface must meet the following requirements: (Evenness ≤ 0.3 mm, surface roughness Rz10).

With this technique the accumulating heat losses will be dissipated by the mounting surface. In this case, the heat convection to the environment has no effect to the performance of the device.

5.4.2 Air-cooled devices

iX5-F and iC5-F are cooled with fans via the integrated air heat sink. The device must form a closed air duct with the assembly surface.

The preferred direction is vertical and upward with the airflow. At least 100 mm distance to adjacent devices must be kept at the air inlet and outlet.

Tightening torques for the mounting: Siehe 'Tightening torques for screws' auf Seite 47..

5.5 iDT5

- 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 47..
- 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.
- 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.

5.5.1 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	iC	iX	iDT
Terminal box cover	M4 x 8 (2.8 Nm)	-	-
Cover for address switch	M16 x 1.5 (2 Nm)	M16 x 1.5 (2 Nm)	M16 x 1,5 (2 Nm)
Mount on the assembly or cooling plate	M5 x 25 (5.5 Nm) iC 5-F: M5 x 70 (5.5 Nm)	M5 x 25 (5.5 Nm) iX5-F: M5 x 70 (5.5 Nm)	-
Motor flange mounting	-	-	M8 (23 Nm)
CM3 ITT Cannon connector (cover)	2 Nm	2 Nm	-
PE connection to the housing	M5 x 10 (5.5 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!	**Mechanical damage!** Contact problems due to pins that are bent or out of alignment. Damage may result if the screw joints are not straight when connecting the two parts. **Steps to prevent:** • Never force connectors and plug-in cards! • Before tightening the screw joints (e.g., power and encoder plugs), check whether the connector (spring) and socket (slot) are properly positioned. After this is complete, tighten the screw connection according to the specifications.

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

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). 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 for power cables and signal cables
- Connect the cable shield on both sides according to EMC (e.g. use EMC cable glands)
- For motors with a terminal box, you must apply the shield to the PE connection in the terminal box by drilling together the shield, pressing it into a cable lug and insulating with a heat-shrinkable sleeve.
- Lay the power cables and signal lines separated from one another with space
- Separate the undisturbed area (mains connection) and the disturbed area (drive components) from one another with space

6.4 PE connection

⚠DANGER	
	**Danger to life from electrical shock!** In the event of an interruption to the PE connection, avoid touching the casing because life-threatening levels of voltage may be present! **Steps to prevent:** • EN 61800-5-1 requires that the devices be firmly connected on the power side. • The PE conductor must have a cross-section of at least 10 mm^2 or must have a second PE connection with a cross-section at least equal to the mains feeder (cf. EN 61800-5-1). • iC: The PE conductor is connected by a ring cable lug an a M5 screw to the iC housing • The PE is connected by the power supply

You will find the M5 fastener for PE in the scale drawings:

Siehe 'iC2-0 / iC5-0' auf Seite 29.
Siehe 'iC5-F' auf Seite 31.

6.5 [X1A] Power supply

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

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

Description

External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B 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 24B supply must be limited to 6 A each by the user.

In the event of a failure of the 24 VDC supply to the electronics > 10 ms, the system ready message is internally reset.

Wiring for STO safety function according to EN 61800-5-2

According to EN 61800-5-2 the error 'Short circuit between two conductors' will be excluded in the following cases:

- For permanently connected conductors which are protected from external damage (e.g. cable channel)
- Different sheathed cables (e.g. separate cables at iC for 24B / 0B and 24V / 0V)
- Inside an electrical installation space
- The conductors are separately screened and have a earth connection (e.g. cable transmission: Siehe 'Cable for power connection [X1A] and transmission iC to iX / iDT5' auf Seite 94.)

Technical data

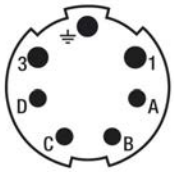
Siehe 'iX' auf Seite 26.

Siehe 'iDT5' auf Seite 28.

Design

Type	Pole	Sort
M23	6	Pin

Assignment

<table>
<tr><th>[X1A]</th><th>Connection</th><th>Signal</th><th>Description</th></tr>
<tr><td rowspan="6">Front view, device side
 
</td><td>1</td><td>UZP</td><td>Supply of the DC bus +</td></tr>
<tr><td>3</td><td>UZN</td><td>Supply of the DC bus -</td></tr>
<tr><td>A</td><td>24V</td><td>Valid for all standard devices regardless of the revision level *)
Supply voltage 24 VDC for electronics

Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00
Supply voltage 24 VDC for electronics and motor holding brake
*) Except: A2553AD, A2777AD and E1241</td></tr>
<tr><td>B</td><td>0V</td><td>Reference potential for 24V</td></tr>
<tr><td>C</td><td>24B</td><td>Siehe 'STO (Safe torque off)' auf Seite 41.

Valid for all standard devices regardless of the revision level *)
Supply voltage 24 VDC for STO / motor holding brake
<table><tr><th>Signal level</th><th>Meaning</th></tr><tr><td>16 - 24 VDC</td><td>STO = inactive,
Motor holding brake = can be opened</td></tr><tr><td>0 - 5 VDC</td><td>STO = active,
Motor holding brake = close</td></tr></table>The supply voltage directly controls the STO state and at the same time supplies an optional motor holding brake with power.

Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00
Supply voltage 24 VDC for STO
<table><tr><th>Signal level</th><th>Meaning</th></tr><tr><td>16 - 24 VDC</td><td>STO = inactive</td></tr><tr><td>0 - 5 VDC</td><td>STO = active</td></tr></table>The supply voltage directly controls the STO state.
*) Except: A2553AD, A2777AD and E1241</td></tr>
<tr><td>D</td><td>0B</td><td>Reference potential for 24 B</td></tr>
<tr><td>PE</td><td>PE</td><td>Protective earthing conductor on housing</td></tr>
</table>

Connection

Mating connector	M23, 6-pole, socket
Cable	3 x 2.5 mm^2 + 4 x 0.75 mm^2 (pairs shielded) + PE, shielded
Shield connection	Apply on both sides
Tightening torque	5 - 6 Nm
Accessories	Prefabricated cable Siehe 'Cable for power connection [X1A] and transmission iC to iX / iDT5' auf Seite 94.
Note	Use cord 1 and 3 for UZP and UZN, cord 2 remains unused

6.6 [X1B] Power supply transmission

⚠ 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.

Description

Other drives can be supplied via the power connection transmission.

Wiring for STO safety function according to EN 61800-5-2

According to EN 61800-5-2 the error 'Short circuit between two conductors' will be excluded in the following cases:

- For permanently connected conductors which are protected from external damage (e.g. cable channel)
- Different sheathed cables (e.g. separate cables at iC for 24B / 0B and 24V / 0V)
- Inside an electrical installation space
- The conductors are separately screened and have a earth connection (e.g. cable transmission: Siehe 'Cable for power connection [X1A] and transmission iC to iX / iDT5' auf Seite 94.)

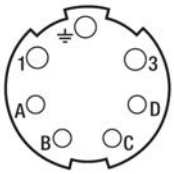
Technical data

Siehe 'iX' auf Seite 26.
Siehe 'iDT5' auf Seite 28.

Design

Type	Pole	Sort
M23	6	Socket

Assignment

[X1B]	Connection	Signal	Description
Front view, device side 	1	UZP	Supply of the DC bus +
	3	UZN	Supply of the DC bus -
	A	24V	**Valid for all standard devices regardless of the revision level** *) Supply voltage 24 VDC for electronics **Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00** Supply voltage 24 VDC for electronics and motor holding brake *) Except: A2553AD, A2777AD and E1241
	B	0V	Reference potential for 24V
	C	24B	**Valid for all standard devices regardless of the revision level** *) Supply voltage 24 VDC for STO and motor holding brake **Valid only for the following devices:A2553AD, A2777AD and E1241 if Rev. ≥ 4.00** Supply voltage 24 VDC for STO *) Except: A2553AD, A2777AD and E1241
	D	0B	Reference potential for 24B
	PE	PE	Protective earthing conductor on housing

Connection

Mating connector	M23, 6-pole, pin
Cable	3 x 2.5 mm^2 + 4 x 0.75 mm^2 (pairs shielded) +PE, shielded
Shield connection	Apply on both sides
Tightening torque	5-6 Nm
Accessories	Prefabricated cable: Siehe 'Cable for transmitting the connection [X1B]' auf Seite 95.
Comment	Use cord 1 and 3 for UZP and UZN, cord 2 remains unused

6.7 [X04] I/O interface

Description

Multi-functional I/O interface with 5 connections: either up to five binary inputs, 3 binary outputs and one analogue input. Each I/O connection can only be assigned one functionality.

The diagnostic message 1100 is generated in the event of a short-circuit or overload longer than 500 µs.

Configuration at delivery

Connection	Use	Meaning
2	BI1	Controller enable (RF)
3	BI2	Clear error (FL)
4	BI3	Cam signal (NK)
5	BO2	Acknowledgment controller enable
6	BO3	System ready message (SBM)

Configuration of the binary inputs

			Configuration at delivery		
Connection	**Binary inputs**	**Parameters**	**Code**	**Meaning**	**Binary input image ID34100**
2	BI1	ID32978 'Port 3 Bit 0'	32904	Controller enable (RF)	Bit 0
3	BI2	ID32979 'Port 3 Bit 1'	32913	Clear error (FL)	Bit 1
4	BI3	ID32980 'Port 3 Bit 2'	32905	Cam signal (NK)	Bit 2
5	BI4	ID32981 'Port 3 Bit 3'	0	open	Bit 3
6	BI5	ID32982 'Port 3 Bit 4'	0	open	Bit 4

Configuration of the binary outputs

			Configuration at delivery		
Connection	**Binary outputs**	**Parameters**	**Code**	**Meaning**	**Binary output image ID34120**
2	Not available	-	-	-	-
3	Not available	-	-	-	-
4	BO1	ID32865 'Port 3 Bit 0'	-	-	Bit 0
5	BO2	ID32866 'Port 3 Bit 1'	33031	Acknowledgement controller enable (QRF)	Bit 1
6	BO3	ID32867 'Port 3 Bit 2'	33029	System ready message (SBM)	Bit 2

In addition to the binary inputs, the binary outputs are shown in the binary input image.

Configuration of the analog input

			Configuration at delivery		
Connection	**Analogue input**	**Parameters**	**Code**	**Meaning**	**Binary input image ID34100**
2	AE+	ID32978 'Port 3 Bit 0'	33917	Analog speed control	-
3	AE-	ID32979 'Port 3 Bit 1'	33917	Analog speed control	-
4	Not available	-	-	-	-
5	Not available	-	-	-	-
6	Not available	-	-	-	-

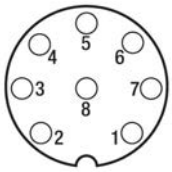
Technical data

- Signal specification according to standard EN 61131-2, digital input type 3
  Limit value 1-signal: min. 11 V / 2 mA, max. 30 V / 15 mA
  Limit value 0-signal: min. -3 V / 0 mA, max. 5 V / 15 mA
  Minimum signal duration > 2 ms
- no electrical isolation, all I/O connections are connected internally with the supply voltage 24 VDC for electronics (terminal X1A, X1B, connection A and B).
- A protective circuit must be provided externally for inductive loads at the binary outputs.

Design

Type	Pole	Sort
M12	8	Socket, A-coded

Assignment

[X04]	Connection	Signal	Description
Front view, device side 	1	GND	Reference potential 0 V
	2	BE1	Binary input, 24 V / 8 mA, non-isolated
		AE+	Analogue input not inverted, ±10V DC, 12 bit resolution
	3	BE2	Binary input, 24 V / 8 mA, non-isolated
		AE-	Analogue input inverted, ±10 VDC, 12 bit resolution
	4	BE3	Binary input, 24 V / 8 mA, non-isolated
		BA1	Binary output, 24 V / max. 100 mA
	5	BI4	Binary input, 24 V / 8 mA, non-isolated
		BA2	Binary output, 24 V / max. 100 mA
	6	BI5	Binary input, 24 V / 8 mA, non-isolated
		BA3	Binary output, 24 V / max. 250 mA[2)]
	7	Data+	[1)]
	8	Data-	[1)]

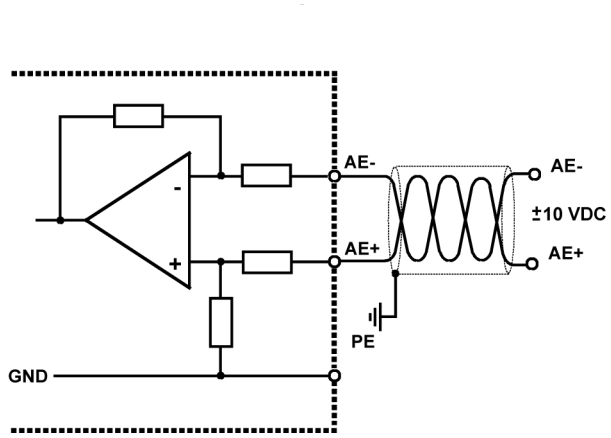
1) The interface is not released
2) The binary output 3 can be parameterized as power supply 24 V / max. 250 mA (code 33079). The current must be limited to 250 mA on the user side.

Connection

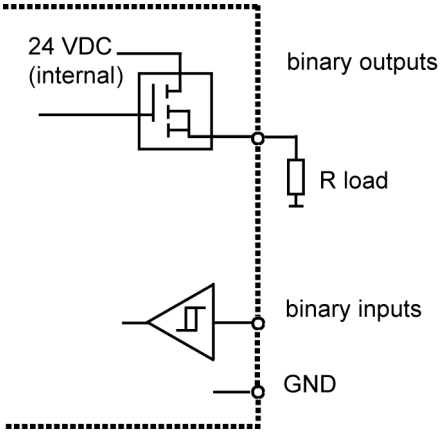
Mating connector	M12, 8-pole pin, A-coded
Cable	8-wire, shielded
Shield connection	Apply on both sides
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for I/O interface [X04]' auf Seite 95.

Input wiring

Analog input



Binary inputs and outputs



6.8 [X05] Encoder connection

Description

This terminal supports the following encoder types: E, F, H, I, P, Q, S, T, U, V

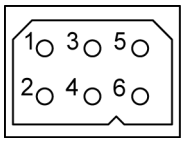
Linear scales of the company Heidenhain: LC183 and LC483 (each with EnDAT interface and SIN/COS analog tracks

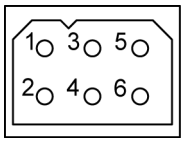
Technical data

- Maximum input frequency is 200 kHz
- Input signals matches the requirements of RS485 specification
- Maximum encoder line length: 20 m

Design

Type	Pole	Sort	Manufacturer	Designation
-	6	Socket	ITT Cannon	Red socket insert for connector CM3 [X05.1]
-	6	Socket	ITT Cannon	Blue socket insert for connector CM3 [X05.2]

[X05.1] CM3 connector	Connection	I- / H-encoder	E- / F-encoder	P- / Q-encoder[3)]	S- / T-, U- / V-encoder
Front view, device side 	1	+REF [4)]	+EN_DAT	+EN_DAT	-
	2	-REF [4)]	-EN_DAT	-EN_DAT	-
	3	GND	GND	GND	-
	4	5 VDC [1)]	5 VDC [1)]	5 VDC [1)]	-
	5	-	-EN_Clk	-EN_Clk	-RS485
	6	-	+EN_Clk	+EN_Clk	+RS485

[X5.2] CM3 connector	Connection	I- / H-encoder	E- / F-encoder	P- / Q-encoder[3)]	S- / T-, U- / V-encoder
Front view, device side 	1	GND	GND	GND	GND
	2	-	-	-	8 VDC [2)]
	3	+SIN	+SIN	-	+SIN
	4	-SIN	-SIN	-	-SIN
	5	+COS	+COS	-	+COS
	6	-COS	-COS	-	-COS

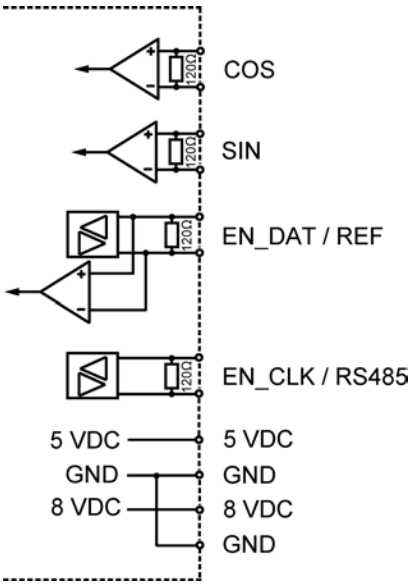
1) 5 VDC ±5 %, max. 350 mA
2) 8 VDC ±5 % under load, max. 150 mA; 9 VDC ±20 % when idle
3) P- and Q-encoder with analog tracks can be used and parameterized in ID32953 as E-and F-encoder
4) Only for I-encoder, not for H-encoder

Siehe 'CM3 (ITT Cannon) connector' auf Seite 59.

Connection

Connector plug	CM3
Mating connector	2 x 6-pole, pin
Cable	4 x (2 x 0.25mm^2) + 4 x 0.5 mm^2 / AWG 24 + AWG 20, shielded
Shield connection	Apply on both sides
Tightening torque	-
Accessories	Prefabricated cable Siehe 'Cable for encoder connection [X05]' auf Seite 95.

Controller input circuit



Requirements for the encoder

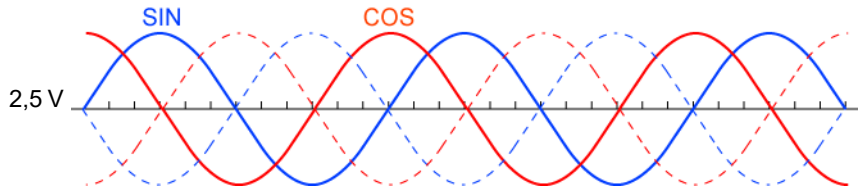
Encoder evaluation in accordance with ID32953		I- / H-encoder	E- / F-encoder	S- / T-, U- / V-encoder	P- / Q-encoder
Data		Sine encoder	EnDat 2.1	Hiperface	EnDat 2.2 light (digital) [3)]
Voltage supply to the encoder					
Input voltage	VDC	5 ±5 % [1)]	5 ±5 % [1)]	8 ±5 % [2)]	5 ±5% [1)]
Output signals of the analog tracks					
Output voltage	V_{SS}	0.6 - 1.1			-
Offset	V	2.5 ± 0.5			-
Output signal of the homing track					
Resting value		200 mV	-	-	-

Encoder evaluation in accordance with ID32953		I- / H-encoder	E- / F-encoder	S- / T-, U- / V-encoder	P- / Q-encoder
Data		**Sine encoder**	**EnDat 2.1**	**Hiperface**	**EnDat 2.2 light (digital) 3)**
Signal width		90 ... 270° el.	-	-	-

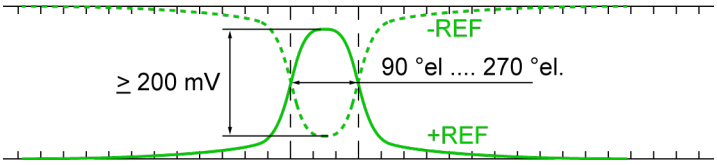
1) 5 VDC ±5 % max. 350 mA
2) 8 VDC ±5 % with load, max. 150 mA; 9 VDC ±20 % at idle
3) EnDat 2.2 light means, that the encoder supports EnDat 2.2, which is used only with the commands of EnDat 2.1 from the AMK controller.

Encoder signal

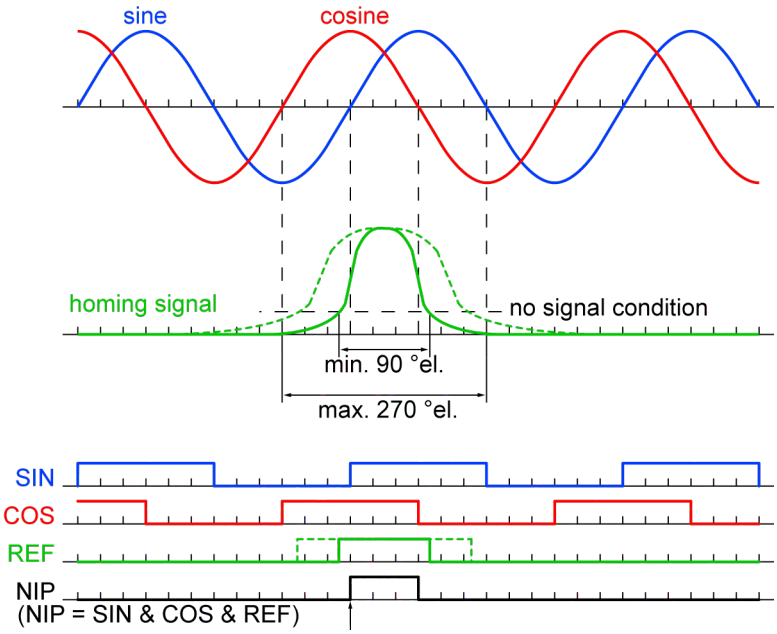
Analog tracks



Homing signal



To receive a unique signal, the homing signals (+REF and -REF) must overlap by at least 200 mV. The overlap range must be at least 90 °el. and maximum 270 °el. long.



The zero pulse NIP is determined in the controller. A logic AND link of SIN, COS and REF results in the NIP signal. The positive edge (for right-turning motor) is evaluated for exact determination of the zero pulse.

Encoder signal evaluation

In ID32953 'Encoder type' is defined how to evaluate the incoming encoder signals.

6.9 [X06] Motor connection

⚠ 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.

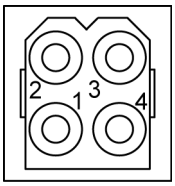
NOTICE	
Material Damage!	**Material damage resulting from Overheating!** AMK servo motors are provided with sensors for temperature monitoring. Motors without or with bypassed sensors for temperature can overheat and be destroyed. **Steps to prevent:** • Connect the sensors for temperature of the servo motor for temperature monitoring • Activate the I²t monitoring of the servo motor in ID32773 'Service bits' Bit 14.

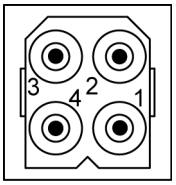
Technical data

- Maximum cable length 20 m

Design

Type	Pole	Sort	Manufacturer	Designation
-	4	Socket	ITT Cannon	Black insulating body type 1 for connector CM3 [X06.1]
-	4	Pin	ITT Cannon	Black insulating body type 0 for connector CM3 [X06.2]

[X06.1] CM3 connector	Connection	Signal	Description
Front view, device side 	1	KTY84-	Temperature sensor for the motor coil
	2	KTY84+	Temperature sensor for the motor coil
	3	Brake -	Holding brake
	4	Brake +	Holding brake

[X06.2] CM3 connector	Connection	Signal	Description
Front view, device side 	1	U	Phase 1
	2	V	Phase 2
	3	W	Phase 3
	4	PE	Protective earth

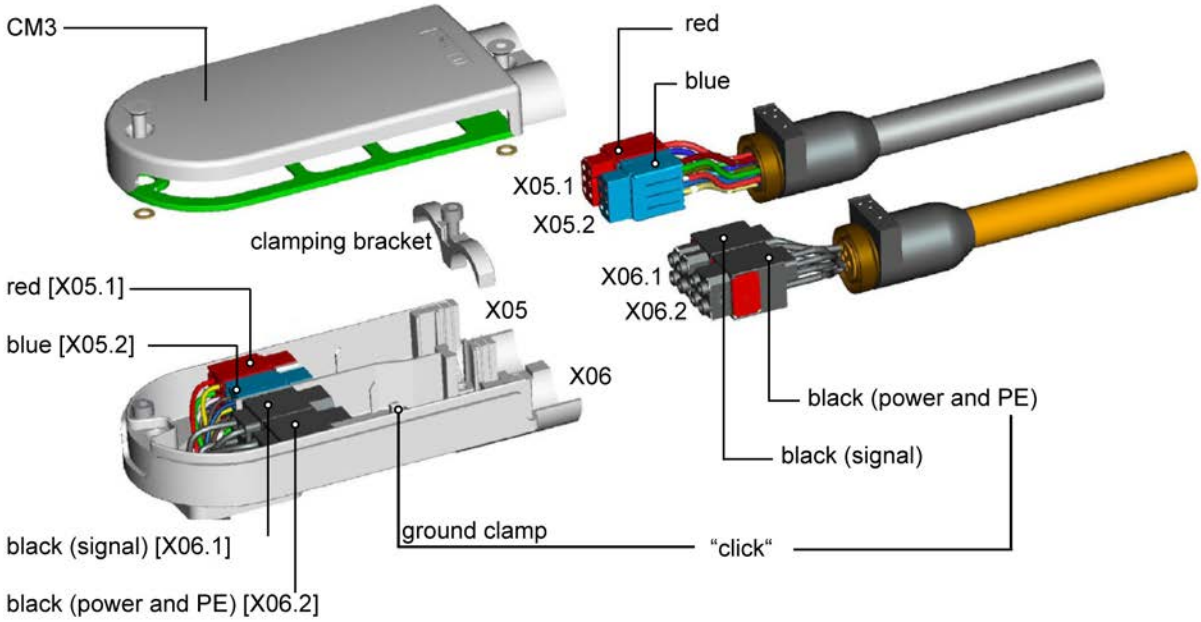
Siehe 'CM3 (ITT Cannon) connector' auf Seite 59.

Connection

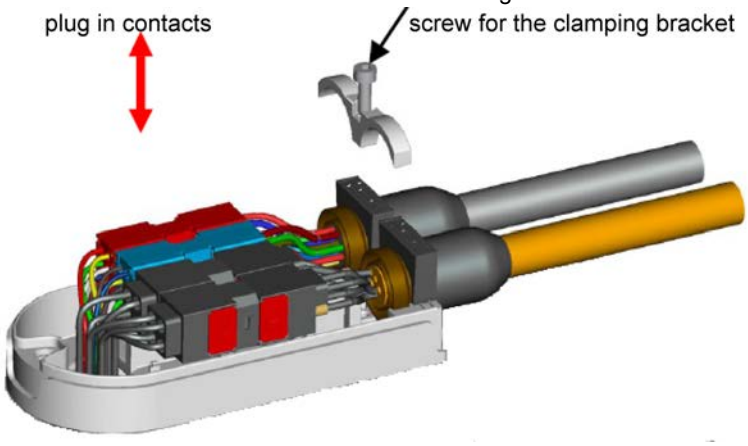
Connector plug	CM3
Mating connector	1 x 4-pole, socket and 1 x 4-pole, pin
Cable	Signal cable: 4 x 0.25 - 050 mm^2 / AWG 24, shielded Motor output: 4 x 1 - 1.5 mm^2 / AWG 18, shielded
Shield connection	Apply on both sides
Tightening torque	
Accessories	Prefabricated cable: Siehe 'Cable for the motor connection [X06]' auf Seite 95.

6.10 CM3 (ITT Cannon) connector

1. Loosen both of the screws (M3 x 10 mm) with a hex screwdriver 2,0 and open the CM3 connector housing.
2. Loosen the screw (M2,5 x 10 mm) for the clamping bracket with a hex screwdriver 2,0 and remove the clamping bracket.

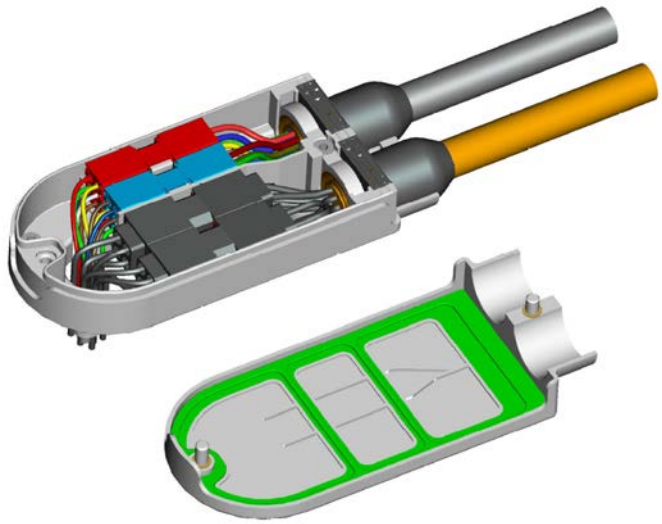


3. Lift the contacts out of the CM3 connector housing.

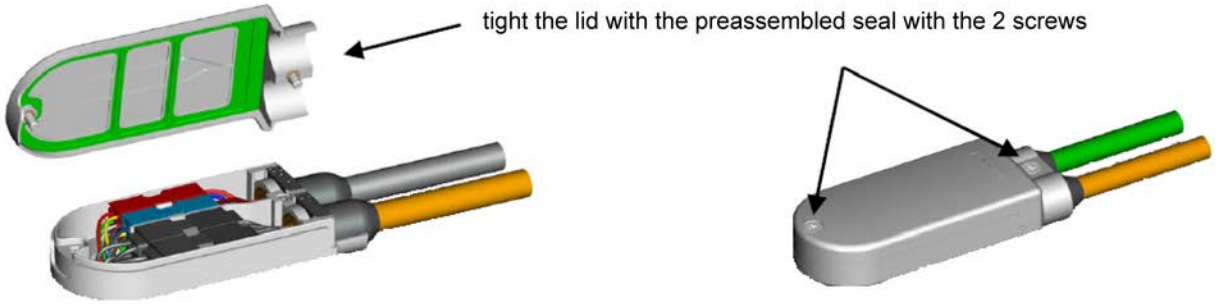


4. Connect the raised contacts with the respective counter contact of the motor and encoder cable.

5. Insert the connected contacts into the CM3 connector housing.



6. Align the cable and tighten the clamping bracket (tightening torque 0.7 Nm).
7. Screw the cover on the CM3 connector (tightening torque 1.2 Nm). Ensure that the seal is not damaged.



6.11 [X85] Real-time Ethernet input

Description

Device-dependent real-time Ethernet interface. The communication protocol is set in the type code.
X85: Connection master or previous node

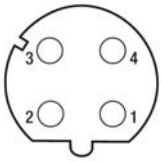
Technical data

- 100BASE-T 100 Mbit/s Ethernet standard
- Maximum length 50 m (point to point)

Design

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment

[X85]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X85] and [X86] ' auf Seite 96.

6.12 [X86] Real-time Ethernet transmission

Description

Device-dependent real-time Ethernet interface. The communication protocol is set in the type code.

X86: Connection next node.

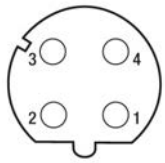
Technical data

- 100BASE-T 100 Mbit/s Ethernet standard
- Maximum length 50 m (point to point)

Design

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment

[X86]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X85] and [X86] ' auf Seite 96.

6.13 [X136] CAN bus input

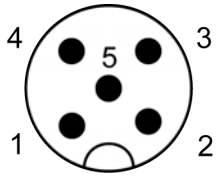
Description

The CAN bus interface meets the CAN standard 2.0 B. TheCiA 402 protocol is supported with AMK-specific functionality. (See document 'PDK_204628_DS_402_Standard, Part no. 204628)

Design

Type	Pole	Sort
M12	5	Pin, A-coded

Assignment

[X136]	Connection	Signal	Description
Front view, device side 	1	GND/PE	Ground potential / cable shield
	2	SYNC_H	Hardware synchronisation High
	3	SYNC_L	Hardware synchronisation Low
	4	CAN_H	CAN_High
	5	CAN_L	CAN_Low

Connection

Mating connector	M12, 5-pole socket, A-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 96.
Note	A bus terminal resistor is required at the first and last participant. The AMK bus terminal resistor connects the CAN bus lines CAN_H and CAN_L as well as the hardware synchronisation line SYNC_H and SYNC_L with 120 ohm resistance. Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 96.

6.14 [X137] CAN bus transmission

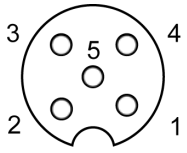
Description

The CAN interface meets the CAN standard 2.0 B

Design

Type	Pole	Sort
M12	5	Socket, A-coded

Assignment

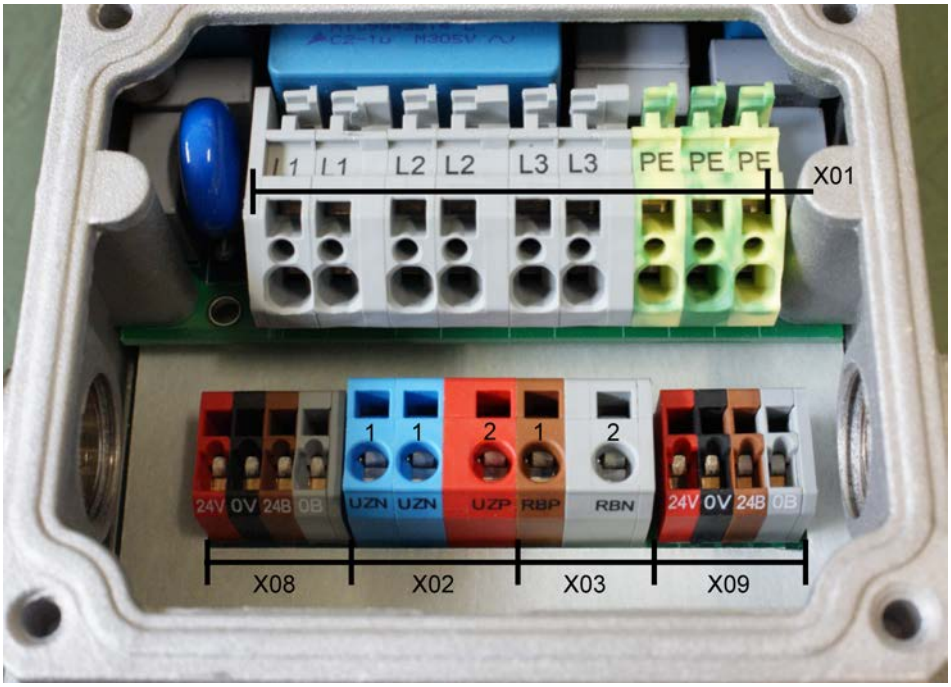
[X137]	Connection	Signal	Description
Front view, device side 	1	GND/PE	Ground potential / cable shield
	2	SYNC_H	Hardware synchronisation High
	3	SYNC_L	Hardware synchronisation Low
	4	CAN_H	CAN_High
	5	CAN_L	CAN_Low

Connection

Mating connector	M12, 5-pole pin, A-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 96.
Note	A bus terminal resistor is required at the first and last participant. The AMK bus terminal resistor connects the CAN bus lines CAN_H and CAN_L as well as the hardware synchronisation line SYNC_H and SYNC_L with 120 ohm resistance. Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 96.

6.15 Terminal box (iC)

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). 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.



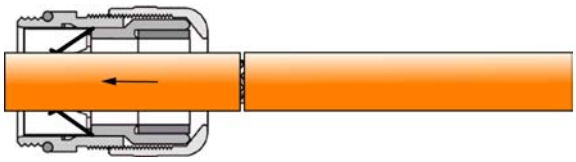
Siehe 'Cable glands' auf Seite 96.

Installation note

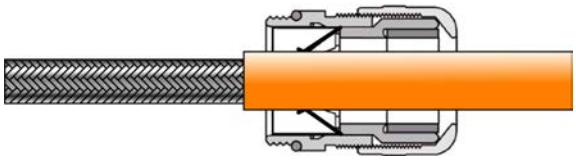
If you use an EMC-compliant cable gland (Part no. 101005), the cable is installed as follows:

1. Cut the cable sheath around but do not strip

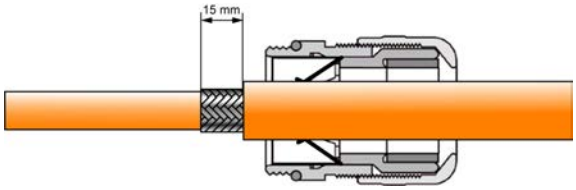
2. Pass the cable through the cable gland



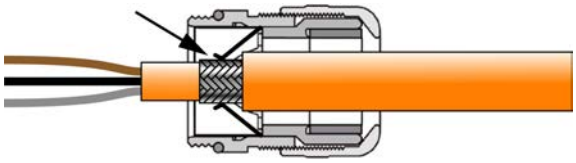
3. Strip the cable sheath



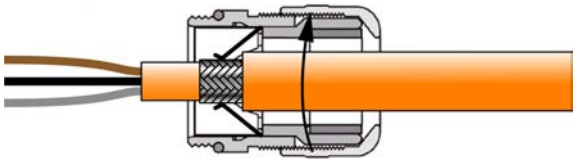
4. Cut the cable shield at about 15 mm



5. Pull the cable back until the shield gets contact to the spring



6. Close the cap nut and tighten with 12 Nm



6.15.1 [X01] terminal L1 / L2 / L3 / PE mains connection - mains transmission

⚠ 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)

Description

Siehe 'Layout of the iC mains connection' auf Seite 39.

Technical data

Siehe 'iC' auf Seite 24.

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	9		WAGO	745

Actuating tool: Screwdriver with a blade 3.5 x 0.5 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X01]	Connection	Signal	Description
Siehe 'Terminal box (iC)' auf Seite 62.	1	L1	Mains phase L1
	2	L1	Mains phase L1 transmission
	3	L2	Mains phase L2
	4	L2	Mains phase L2 transmission
	5	L3	Mains phase L3
	6	L3	Mains phase L3 transmission
	7	PE	Protective earth
	8	PE	Protective earth
	9	PE	Protective earth

Connection

Cable	4 x 1.5 mm^2 / AWG 16 4 x 2.5 mm^2 / AWG 14
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar 2.5 mm^2
Stripping length	11 - 12 mm
Shield connection	-

6.15.2 [X02] UZP / UZN DC bus transmission

⚠ 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:

- Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting.
- After switching off, expect a discharge time of at least 5 minutes.
- Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

⚠ DANGER	
	**Danger to life from touching electrical connections!** The permanent magnets of the rotor induce dangerous voltage at the motor connections when the axis rotates, even when the motor is not electrically connected. If the motor is connected to an inverter, the induced DC voltage is linked to the 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.

Description

The DC bus supplies the compact inverter integrated in the iC. With the terminal UZP / UZN, the DC bus can be transmitted to e.g. an iX device.

Technical data

- Max. cable length of 20 m (from the power supply to the last drive inverter in the strand)

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	2		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X02]	Connection	Signal	Direction	Description
Siehe 'Terminal box (iC)' auf Seite 62.	1	UZN	A	Supply of the DC bus -
	2	UZP	A	Supply of the DC bus +

Connection

Cable	2 x 2.5 mm^2 / AWG 14, shielded 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.
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve without a plastic collar 2.5 mm^2
Stripping length	8 - 9 mm
Shield connection	Apply on both sides Siehe 'Cable glands' auf Seite 96.

6.15.3 [X03] RBP / RBN external brake resistor

⚠ 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:** • Prior to all work on the device, the power supply is to be separated from the main switch and secured against restarting. • After switching off, expect a discharge time of at least 5 minutes. • Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

⚠ DANGER	
	**Danger to life from touching electrical connections!** The permanent magnets of the rotor induce dangerous voltage at the motor connections when the axis rotates, even when the motor is not electrically connected. If the motor is connected to an inverter, the induced DC voltage is linked to the 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.

NOTICE	
Material Damage!	**Fire hazard!** Brake resistors can burn in the event of an overload. **Steps to prevent:** • Use brake resistors with self-protection

Description

An externally connected brake resistor converts excess energy into heat.

The controller and brake transistor are integrated in the device.

Technical data

Switching threshold on: 800 VDC, off: 780 VDC

Shutdown threshold: 850 VDC

Minimum ON duration: 187.5 µs

Minimum OFF duration: 187.5 µs

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	2		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X03]	Connection	Signal	Direction	Description
Siehe 'Terminal box (iC)' auf Seite 62.	1	RBP	A	Connection of external brake resistor
	2	RBN	A	Connection of external brake resistor

Connection

Cable	2 x 1.5 mm^2 / AWG 16, shielded
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar: 1.5 mm^2
Stripping length	8 - 9 mm
Shield connection	Apply on both sides

6.15.4 [X08 / X09] 24 VDC supply voltage - Transmission

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 **Steps to prevent:** • Comply with the specifications for the electronics supply voltage 24 VDC. (24 VDC ± 15 %, ripple max. 5 %)

Description:

X08: 24 VDC supply voltage supply line for electronics and STO / motor holding brake

X09: 24 VDC supply voltage transmission for electronics and STO / motor holding brake

External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B 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 24B supply must be limited to 6 A each by the user.

A power supply unit is integrated into the iC that supplies the 24 VDC from the DC bus for the electronics supply. The power supply unit is active when the SMD-DIP switch S2 is in the "ON" switch setting (delivery status for devices with an integrated power supply unit).Siehe ' iC' auf Seite 16.

If the internal 24 VDC power supply is active (S2 = ON), no external 24 VDC power supply must be connected to the terminals X08 / X09.

In the following cases, the internal 24 VDC power supply unit must be switched off (S2 = OFF) and the 24 VDC (for connections 24V and 24B) is be supplied externally:

- At applications using functional safety (via FSoE protocol) or STO hardware input on the device: Siehe 'Connection examples for operation with STO' auf Seite 70.
- When 24 VDC is transmitted to a device (e.g. iX, iDT5) via the terminal X09
- For applications with motor holding brakes with i > 0.5 A
- Operating with derating at increased ambient temperature. Siehe 'iC' auf Seite 24.

Significant prerequisite for certification of a machine with functional safety:

When using the functional safety the internal power supply unit must be deactivated (S2 = OFF), and the 24 VDC (for connections 24V and 24B) is provided externally with a PELV power supply, otherwise the conditions for the use of functional safety are not satisfied!

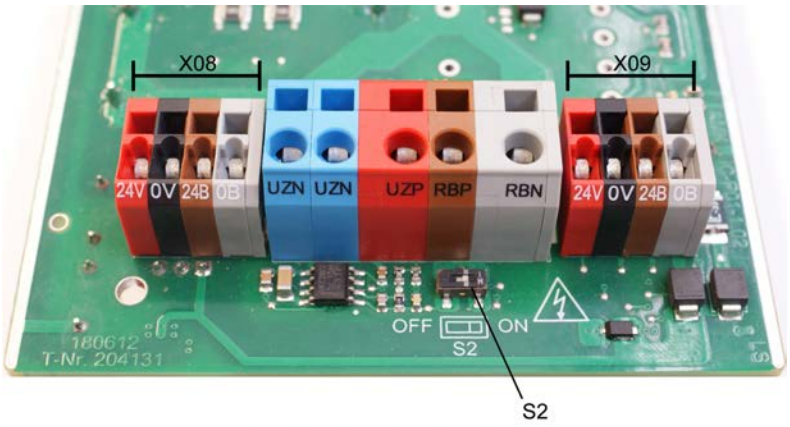
In the event of a failure of the 24 VDC supply to the electronics > 10 ms, the system ready message is internally reset.

Switch off the internal 24 VDC supply voltage from the DC bus with the switch S2

⚠ DANGER	
	**Danger to life from electric shock!** The switch S2 is always on UZN potential and can lead to life-threatening DC voltage. 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 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 and S2 switch are voltage-free.

⚠ DANGER	
	**Danger to life from touching electrical connections!** The permanent magnets of the rotor induce dangerous voltage at the motor connections when the axis rotates, even when the motor is not electrically connected. If the motor is connected to an inverter, the induced DC voltage is linked to the 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.

The S2 switch is located in the iC terminal box below the insulating paper in front of the terminal block. The insulating paper must be lifted carefully to reach the S2 switch.



Wiring for STO safety function according to EN 61800-5-2

Switch off the internal 24 VDC supply voltage from the DC bus with the switch S2

According to EN 61800-5-2 the error 'Short circuit between two conductors' will be excluded in the following cases:

- For permanently connected conductors which are protected from external damage (e.g. cable channel)
- Different sheathed cables (e.g. separate cables at iC for 24B / 0B and 24V / 0V)
- Inside an electrical installation space
- The conductors are separately screened and have a earth connection (e.g. cable transmission: Siehe 'Cable for power connection [X1A] and transmission iC to iX / iDT5' auf Seite 94.)

Technical data

Siehe 'iC' auf Seite 24.

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	4		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X08]	Connection	Signal	Description
Siehe 'Terminal box (iC)' auf Seite 62.	1	24V [1)]	24 VDC supply voltage for electronics
	2	0V	Reference potential for 24 VDC for electronics
	3	24B [1)]	Supply voltage 24 VDC for STO / motor holding brake **Signal level** / **Meaning** 16 - 24 VDC: STO = inactive, Motor holding brake = can be opened 0 - 5 VDC: STO = active, Motor holding brake = close The supply voltage directly controls the STO state and at the same time supplies an optional motor holding brake with power. Siehe 'STO (Safe torque off)' auf Seite 41.
	4	0B	Reference potential for 24B / transmission

1) The current of the 24V and 24B supply must be limited to 6 A each by the user.

[X09]	Connection	Signal	Description
Siehe 'Terminal box (iC)' auf Seite 62.	1	24V [1)]	24 VDC transmission
	2	0V	Reference potential for 24 VDC
	3	24B [1)]	24 VDC transmission
	4	0B	Reference potential for 24B

1) Please refer to the device description of the connected device for the pin assignment

Connection

Cable	4 x 0.5 mm^2 / AWG 20, shielded
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar: 1 mm^2
Stripping length	5 - 6 mm
Shield connection	Apply on both sides Siehe 'Cable glands' auf Seite 96.

6.15.4.1 Connection examples for operation with STO

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

Connection:

iX/iDT: Siehe '[X1A] Power supply' auf Seite 49.

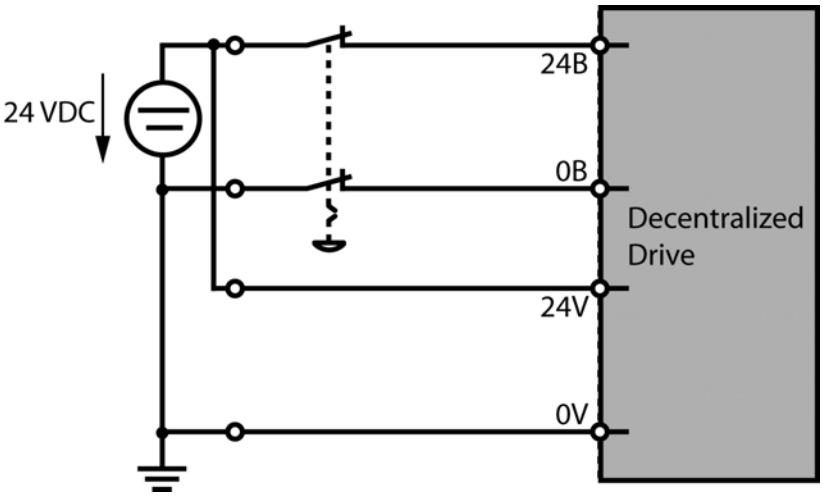
iC: Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.

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.

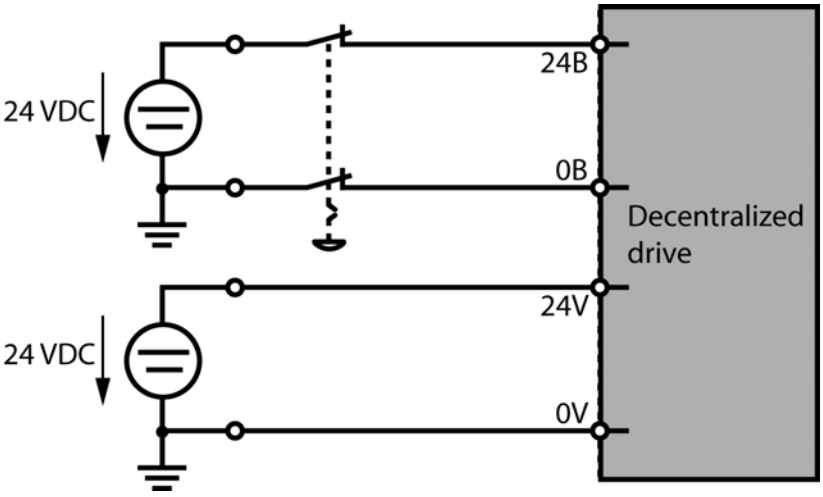
External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and 24B supply must be limited to 6 A each by the user.



Example 2:

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

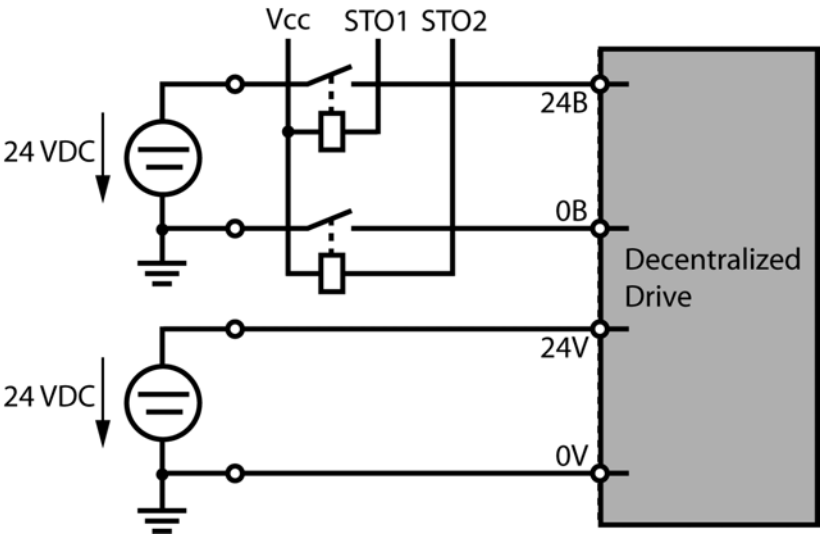
External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and 24B supply must be limited to 6 A each by the user.



Example 3:

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

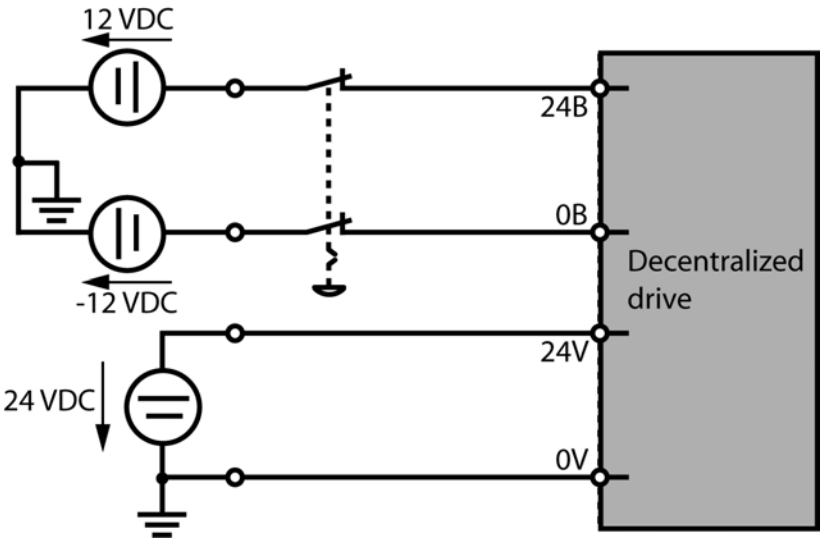
External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and 24B supply must be limited to 6 A each by the user.



Example 4:

Supply voltage 24VDC for electronics. Bipolar supply voltage with external power supplies.

External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B 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 24B supply must be limited to 6 A each by the user.



7 Startup - Operation

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 machine's range of movement.

Uncontrolled motor shaft movement occurs when the motor is no longer controllable. Depending on the type of machine, this 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. Depending on the type of machine, this 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. Their purpose is to reduce the drive speed to zero in a controlled manner before switching off the power supply. 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:

- Never allow personnel to remain in the vicinity of the machine while it is operating.
- Always ensure that the machine is fully de-energized before commencing work on the machine or within the machine's vicinity.
- Install an emergency off / stop switch.
- All suspended axles must be mechanically secured against falling down.
- 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 Air-cooled devices with fan

The fans of the "-F" devices are connected to 24 VDC internal and are always operating if the supply voltage 24 VDC for electronic or the power supply (for iC) is on.

7.3 Guide to startup

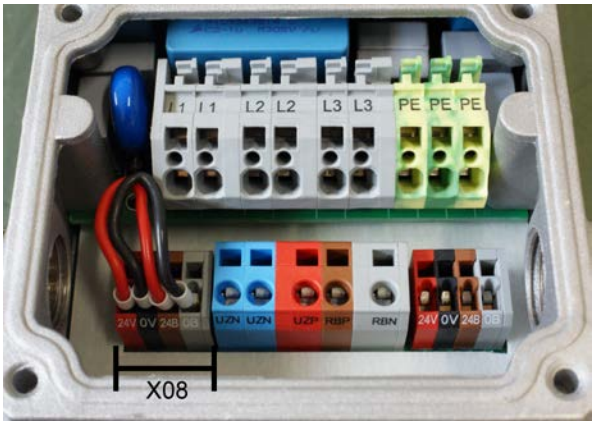
See also: Description Initial startup of decentralized drives, Part no. 204737

7.3.1 iC

Variant 1: Supply voltage 24 VDC for electronics from an internal power supply unit. STO is not used

Siehe ' iC' auf Seite 16., iCx-xx-xxU.

Bridge required between 24 VDC - 24 B and 0 VDC - 0B. An optional motor holding brake is supplied by the internal power supply unit. Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.



Variant 2: Supply voltage 24 VDC for electronics and (24B, 0B) for STO and motor holding brake is supplied over externally power supply

The 3 x 400 V mains voltage is applied independently of the 24 VDC voltages. The S2 switch must be off.

⚠DANGER The switch S2 is always on UZN potential and can lead to life-threatening DC voltage!
Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.

Siehe 'Connection examples for operation with STO' auf Seite 70.

Procedure for all variants

1. Check the installed products for damage. Damaged parts may not be put into operation!
2. Check whether all information in the assembly, project planning and connections chapters were taken into consideration.
3. Check that all interfaces and openings, e.g. iC terminal box, cover of address switch S1 and non-connected interfaces, are properly sealed. Otherwise, the device may not be operated.
4. Ensure that the required ambient conditions are met. (Siehe 'Operation' auf Seite 29.)
5. For the following startup, observe the information in the Startup chapter. (Siehe 'For your safety' auf Seite 73.)

6. Establish a connection to the PC software AIPEX PRO and parameterisation:
    1. Establish a connection between the device and AIPEX PRO (Siehe 'Parameterization' auf Seite 78.)
    2. Apply supply voltage(s):
       Variant 1:
       apply 3 x 400 V mains voltage. (Siehe '[X01] terminal L1 / L2 / L3 / PE mains connection - mains transmission' auf Seite 64.)
       24 VDC, 24B is supplied to X08 from the internal power supply unit.
       Variant 2:
       Externally provide 24 VDC supply voltage for electronics: The S2 switch must be off.

       ⚠DANGER The switch S2 is always on UZN potential and can lead to life threatening DC voltage! Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.

       24 VDC supply voltage for the STO / motor holding brake is to be supplied and connected externally.
    3. Carry out basic parameterisation (Siehe 'Basic parameterization' auf Seite 83.)
    4. Perform system booting
       Variant 1: 3 x 400 V mains voltage off / on
       Variant 2: 24 VDC for electronics supply off / on
    5. Triggering of the motor holding brake and brake test for motors with a motor holding brake

       ⚠DANGER Danger to life when opening the brake!
       Life-threatening movements may occur when external force is applied to the drive axis. Suspended axes can fall.
       Siehe 'Motor holding brake' auf Seite 82.

       See 'Procedure for switching on and off' sub-chapter 'Triggering the motor holding brake with AIPEX PRO' starting on page 1
7. Procedure for switching on and off: See description Initial startup of decentralized drives, Part no. 204737
8. Only operate the devices within the specified characteristics
   Siehe 'iC' auf Seite 24.

7.3.2 iX / iDT5

1. Check the installed products for damage. Damaged parts may not be put into operation!
2. Check whether all information in the assembly, project planning and connections chapters were taken into consideration.
3. Check that all interfaces and openings, e.g. cover of address switch S1 and non-connected interfaces, are properly sealed. Otherwise, the device may not be operated.
4. Ensure that the required ambient conditions are met. (Siehe 'Operation' auf Seite 29.)
5. For the following startup, observe the information in the Startup chapter. (Siehe 'For your safety' auf Seite 73.)
6. Establish a connection to the PC software AIPEX PRO and parameterisation:
    1. Establish a connection between the device and AIPEX PRO (Siehe 'Parameterization' auf Seite 78.)
    2. Apply 24 VDC supply voltage for electronics: (Siehe '[X1A] Power supply' auf Seite 49.)
    3. Carry out basic parameterisation (Siehe 'Basic parameterization' auf Seite 83.)
    4. System booting by 24 VDC on / off
    5. Apply 24 VDC (24B, 0B) system voltage for STO and motor holding brake (Siehe '[X1A] Power supply' auf Seite 49.)
    6. Triggering of the motor holding brake and brake test for motors with a motor holding brake

       ⚠ DANGER Danger to life when opening the brake!
       Life-threatening movements may occur when external force is applied to the drive axis. Suspended axes can fall.
       Siehe 'Motor holding brake' auf Seite 82.
7. Procedure for switching on and off: See description Initial startup of decentralized drives, Part no. 204737
8. Only operate the devices within the specified characteristics. Siehe 'iDT5' auf Seite 28.
   Siehe 'iDT5' auf Seite 28.

7.4 Parameterization

⚠ 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, it suffices to supply the device with 24 VDC electronic voltage. After parameter changes in the device, a system booting (24 VDC OFF / ON) must be performed in order for the changes to take effect.

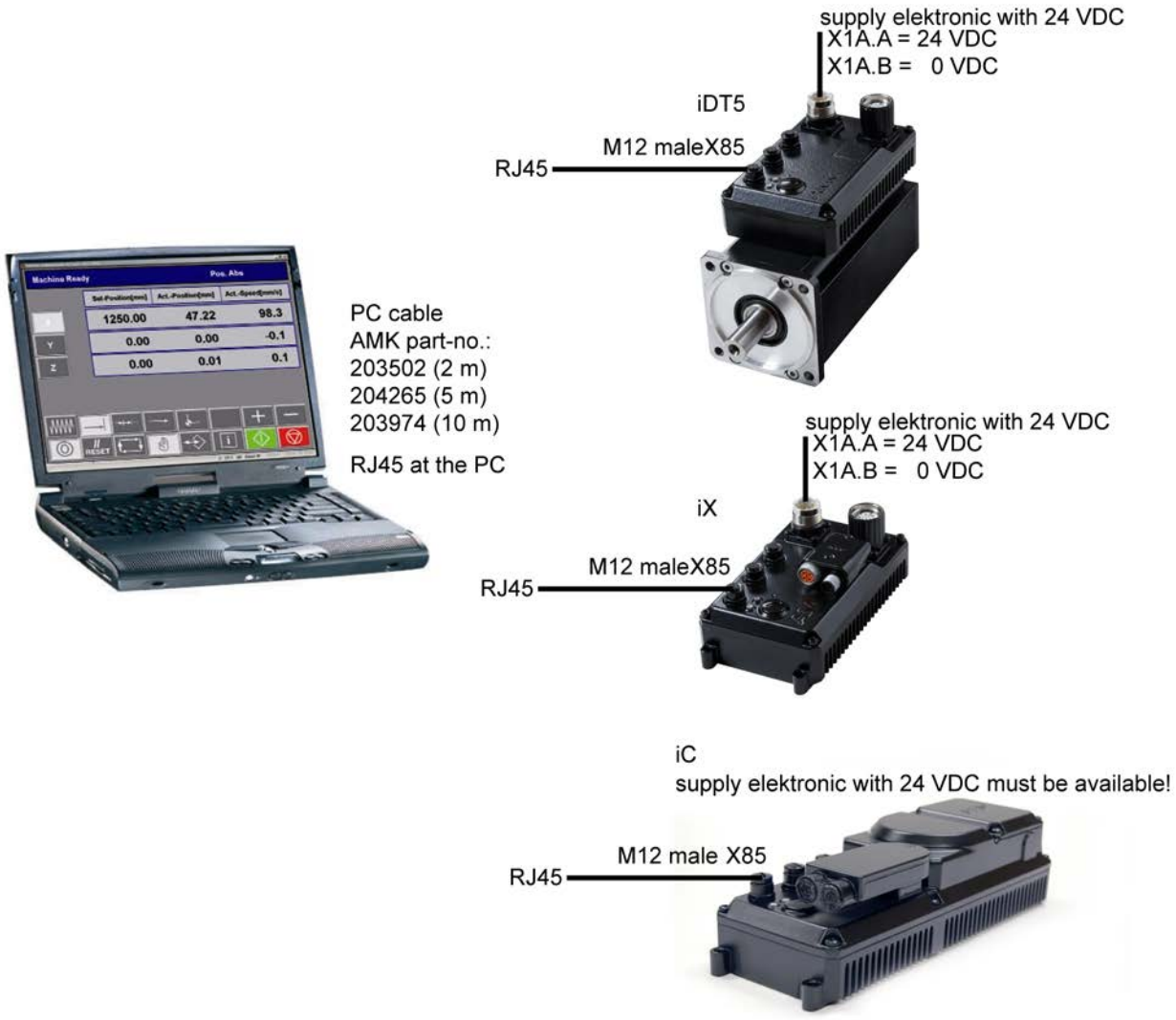
With the AMK PC software AIPEX PRO (from version 1.08 with service pack SP04), you can adjust and optimise all of the device parameters specific to the application.

Attention for iDT5 off-line projects with AIPEX PRO:
With the adoption of an iDT5 from the hardware configuration in the project, the motor data is not automatically transferred from the motor database to the parameters. In order to adopt the motor data from the database in the parameters, the motor must also be selected in the motor database.

All supported device parameters are described in the documentation PDK_203704_Parameter_KW-R06_iX_A5_KE_de/en.
Functions are specified in the description PDK_203878_AMKASYN_Functions_de/en.

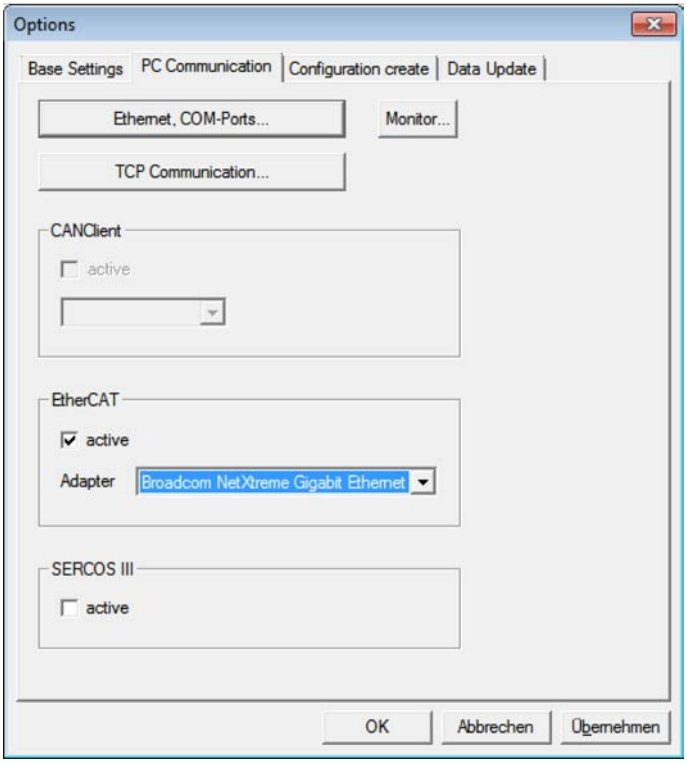
7.4.1 Point to point connection for devices with an EtherCAT interface

PC Ethernet interface --> X85 EtherCAT input
(accessories: Siehe 'Cable for EtherCAT connector [X85] and [X86] ' auf Seite 96.)



Setting in AIPEX PRO:

AIPEX PRO menu **'Extras' -> 'Options' -> 'PC Communication'**



7.4.2 Connection between PC and an EtherCAT controller (with connected iX, iC, iDT network)

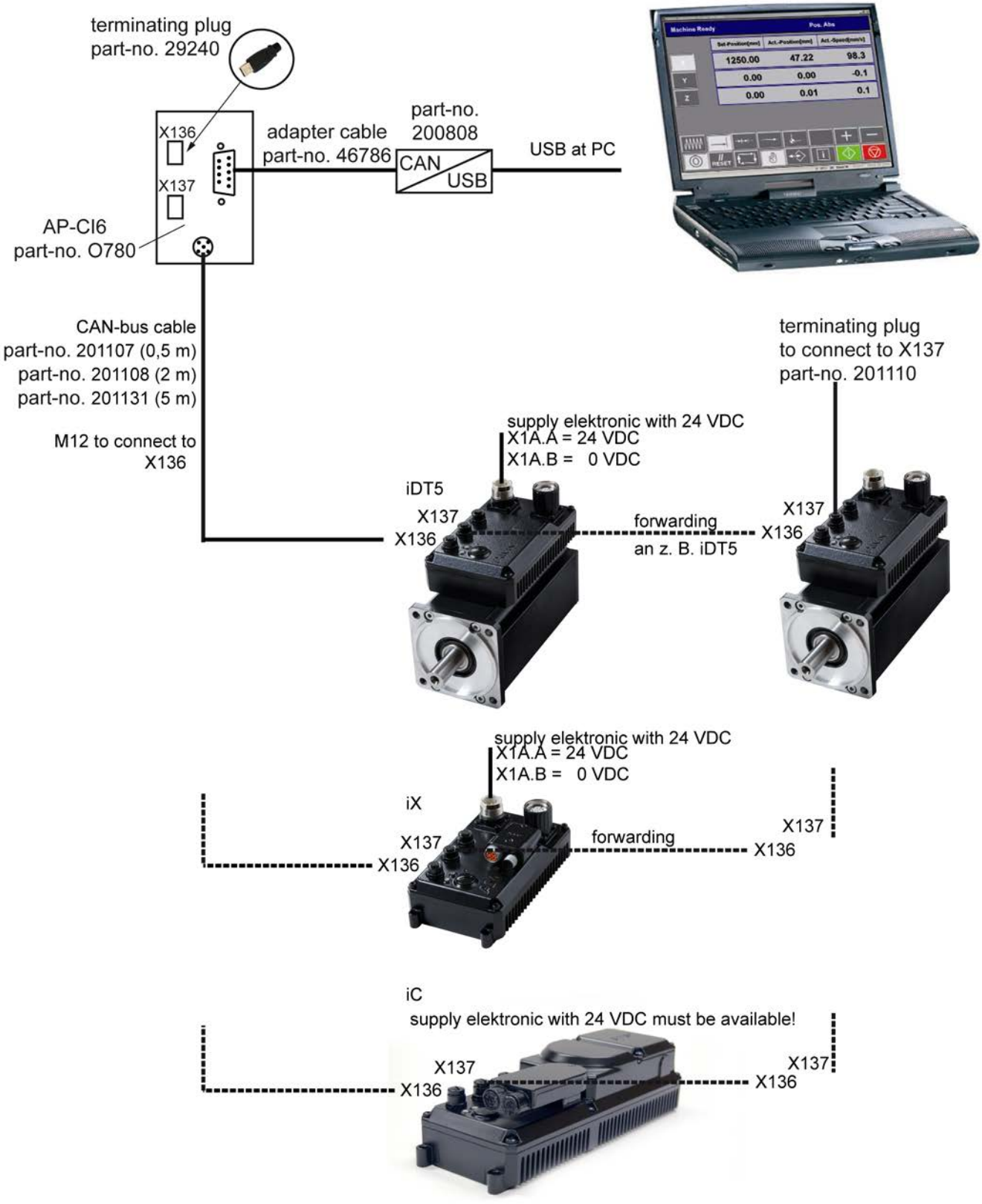
A PC Ethernet interface must be connected with the Ethernet input of the controller or be connected to the same network. (See documentation PDK_202975_A4-A5_Product_Description_de/en).

If several devices are linked via EtherCAT and connected to a controller, AIPEX PRO can access all of the devices connected to the bus via the controller. The controller must be configured as an EtherCAT master.

Beckhoff TwinCAT controller: See PDK_204072_AIPEXPRO_AddIn_TwinCAT_Gateway_de/en.pdf. Siehe 'PC software and converter' auf Seite 94.

7.4.3 Connection between PC and devices with a CAN bus interface

The shown connection between the PC and CAN bus participant can be established as a point to point connection to individual devices or as a connection to a CAN bus device connection. In the device connection, AIPEX PRO has access to all of the participants connected to the CAN bus. The connection with AIPEX PRO also works when a CAN bus controller is connected in parallel to AIPEX PRO.



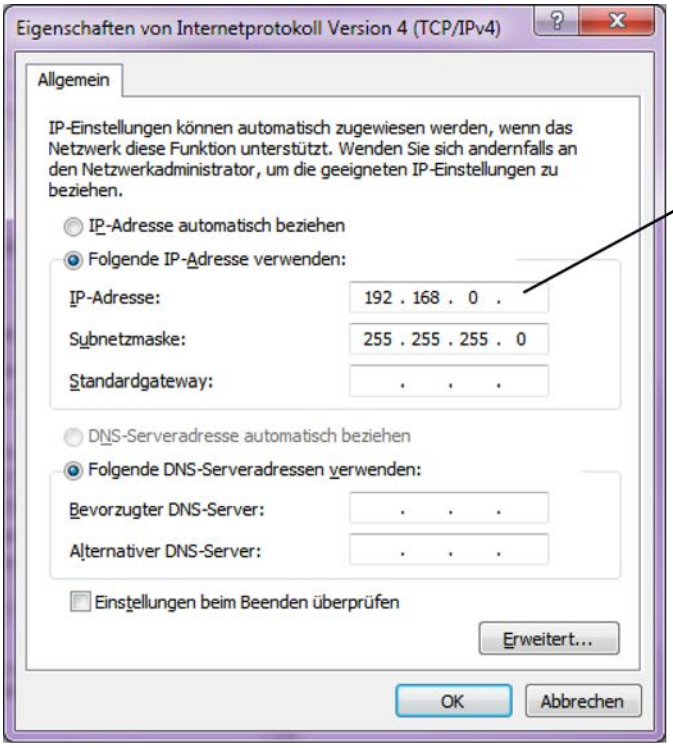
Setting in AIPEX PRO:

Menu **'Extras'** -> **'Option'** -> **'PC communication'** - activate the **'CANClient'** there, enter the baud rate as in the CAN slave participant, see ID34024 'BUS transmit rate'

7.4.4 Connection between PC and devices with a SERCOS III interface

Ports and connection as with EtherCAT. SERCOS III devices have an IP access. The IP address is permanently set to 192.168.0.x.

Setting in the PC (LAN properties)



Enter a number between 0..255, which is not used as node number in the SERCOS III network.

Setting in AIPEX PRO:

Menu **'Extras'** -> **'Option'** -> **'PC communication'** - activate **'SERCOS III'** there. The connection with AIPEX PRO also works when a SERCOS III controller is connected in parallel to AIPEX PRO.

7.4.5 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 STO / holding brake supply voltage to control the motor holding brake:

iX / iDT5: Siehe '[X1A] Power supply' auf Seite 49.

iC: Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 68.

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

7.4.6 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.
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

7.4.7 Startup of a Hall encoder

From firmware version 1.03 2013/18 (Part no. 204515) on, Hall encoders of linear motors are supported. The signals of the Hall encoder are read via sine encoder input.

ID32953 'Encoder type' must set to 0x00+**1**.

Contact the AMK Service!

7.5 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	
iC / iX / iDT5				
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
SERCOS III	-	■	-	1 ≤ S1 ≤ 250[2)] The configured address (XX) becomes part of the IP address: 192.168.00.XX
CAN (CiA 402)	-	■	ID34023 Instance 0	1 ≤ ID34023 ≤ 65535 1 ≤ S1 ≤ 250[2)]
FSoE	-	■	ID33201	See document Supplement to the Safety Manual 2013/18 when using iC / iX / iDT with Functional Safety, Part no. 204604

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

7.5.1 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.

7.5.2 VARAN: Automatic addressing

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

7.5.3 EtherCAT and FSoE: Addressing by DIP switch S1

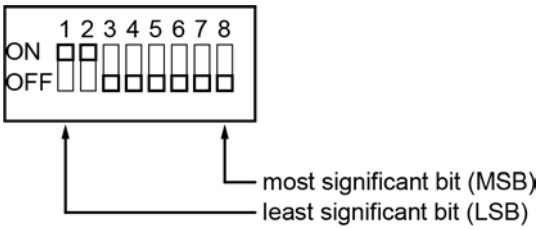
NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1). Ensure that no objects fall into the housing when working on the open housing. Foreign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

By means of the DIP switch, the EtherCAT and FSoE address of the controller will be set **simultaneously**.

FSoE addressing:
See document Safety manual; functional safety, Part no. 203446

The address setting by DIP switch is prior to addresses via parameter ID34023 'BUS address participant'.
The value, set in the DIP switch will be written to parameter ID34023.

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.

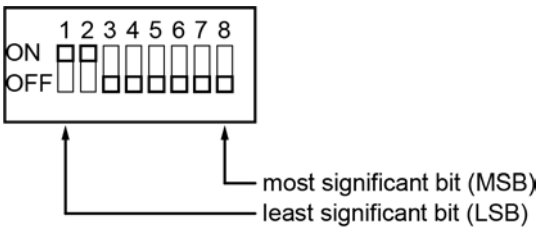
Consequence of addressing

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

7.5.4 SERCOS III: 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). 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

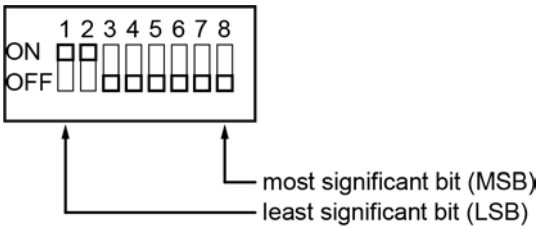
The set address (X) is adopted in the IP address: 192.168.0.X

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

7.5.5 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). 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.

7.5.6 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'.)

7.5.7 FSoE: Addressing by parameter ID33201 'Safety address'

FSoE addressing:
See document: Safety manual; functional safety, Part no. 203446.

7.5.8 CAN (CiA 402): Addressing by parameter ID34023 'BUS address participant'

If the DIP switch S1 is set to 0, the address can be set by parameter ID34023.
The setting of the parameter can be done by means of software AIPEX PRO via the CAN 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'.)

8 Maintenance - Service - Repair

8.1 Service notes

Diligent regular inspections and maintenance help to detect malfunctions early and remedy them before consequential damage occurs. If malfunctions, unusual loads or conditions occur that might negatively affect the drive system, e.g. overload, short circuit or mechanical damage, the components of the drive system have to be checked immediately.

The intervals for maintenance tasks are very dependent on the local conditions at the location where the drive system is in use, e.g. dirt, load, how frequently it is switched on, etc.

Valid for all device types:

- Regularly check connectors and connection cables for damage, and replace if required. Do not make provisional repairs to the connection lines. If any damage is visible on the sheathing, no matter how small, immediately shut down the system and renew the cables.
- Defective AMK components must be sent to AMK to be assessed and repaired. The opening of and any modifications to devices by personnel not authorised by AMK is prohibited and will result in the loss of the warranty. In these cases, AMK is not liable for any ensuing damage.

Valid for iC / iX:

- The devices are maintenance-free.
- If necessary, just clean the surfaces with a duster and a slightly damp cloth with neutral soap. Do not use any spraying agent.

Valid for iDT:

- Excessive dirt, dust or chips can adversely affect the function of the motors and, in extreme cases, even lead to failure. The motor housing is used for heat emission during operation. Insufficient heat emission reduces the bearing life time and can lead to excessive temperature shutdowns. If necessary, only clean the surfaces with compressed air and a slightly damp cloth with neutral soap. Do not use any spraying agent. No moisture may penetrate the motor.
- Motor bearings should be replaced once the nominal bearing life time has been reached (40,000 hours) or when running noise occurs. We recommend having AMK perform the bearing replacement.
- The following table gives a general overview of the maintenance measures and intervals. The measures and the specified intervals have to be adapted to the respective conditions and supplemented as necessary.

Measures	Maintenance interval
Cleaning the surfaces	Directly dependent on the degree of soiling; heavy soiling interferes with the proper heat dissipation of the components.
Visual inspections, e.g. of the housing, cable, connections, leaks	
Exchanging the bearings	If the motor is run with the rated data, we recommend exchanging the bearings after 40,000 operating hours. If the bearing is subjected to axial and radial forces, the service life is reduced as shown by the characteristic curve on the motor data sheet. In vertical installation position, the grease service life stated in the data sheet is reduced by half.
Exchanging the radial shaft seal rings	Parallel to the bearing change, every 40,000 h
Relubrication intervals	You can find a reference value for the relubrication intervals of the axial bearings on the motor/motor data sheet. The relubrication intervals heavily depend on the motion profile actually traversed and the cycle times. The B-side bearing is lubricated for life and needs no maintenance.
Replacing the encoder belt, if applicable	20,000 h
Lubrication change, performed by AMK	If motors were in storage for more than 2 years, we recommend a lubrication change.

Valid for devices with fan:

- Dependent on the degree of pollution of the cooling air, fans and cooling fins must be cleaned regularly by means of compressed air.

8.2 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

8.2.1 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 or a local digital output. 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 24B and 0B 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.

8.3 Firmware update

NOTICE	
	Firmware Download Due to download a firmware, application-specific parameter settings are overwritten and become invalid! **Steps to prevent:** • BEFORE you download a new firmware, please make really sure that application-specific data is saved as backup.

By means of the AMK PC software ATF, the firmware is transmitted to the connected device via the Ethernet interface X85 or CAN interface X136. A firmware update is only possible with a point to point connection between the PC and the device!

The handling the ATF software is described in the Software description ATF - AMK Tool Flasher, Part no. 203771

A new flash memory with mirrored memory is supported up from device internal software monitor version 2.00:

The monitor version can be read out from ID30 'Software version' instance 2.

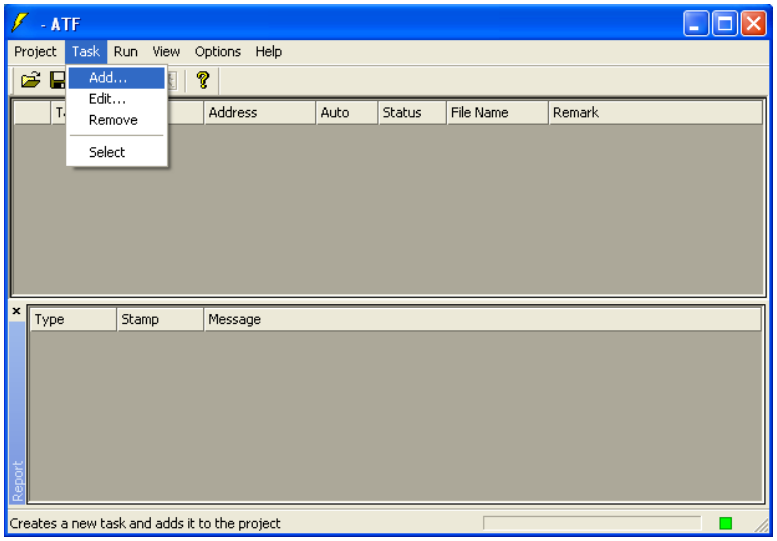
If the device is switched on for the first time after a firmware update, the new firmware will be plausibility checked and copied into the mirror memory. This procedure takes approximately 15 seconds time and is displayed by the status LED.

Highlights of the new flash with mirrored memory:

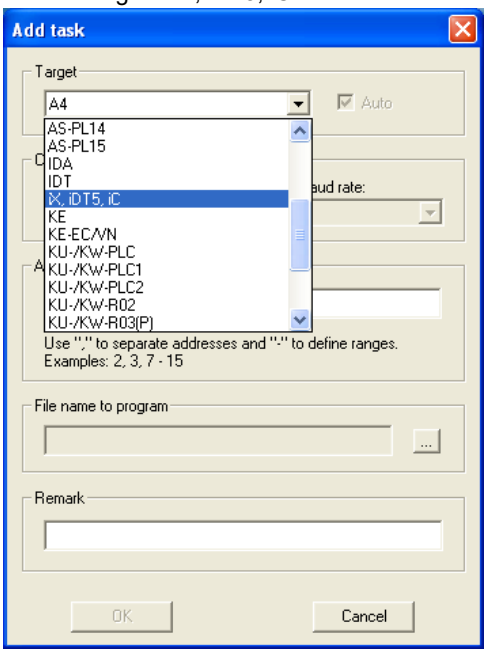
- The memory provides a valid firmware at any time
- Possibly appearing errors during firmware update procedure will have no effect to the backup in the mirrored memory, because the backup of a new firmware into the mirrored memory will be done by the monitor not before firmware update is ready followed by a restart and checksum check.
- The backup of the firmware in the mirrored memory is automatically done by the device internal software monitor (from version 2.00)

8.3.1 Update via Ethernet interface X85

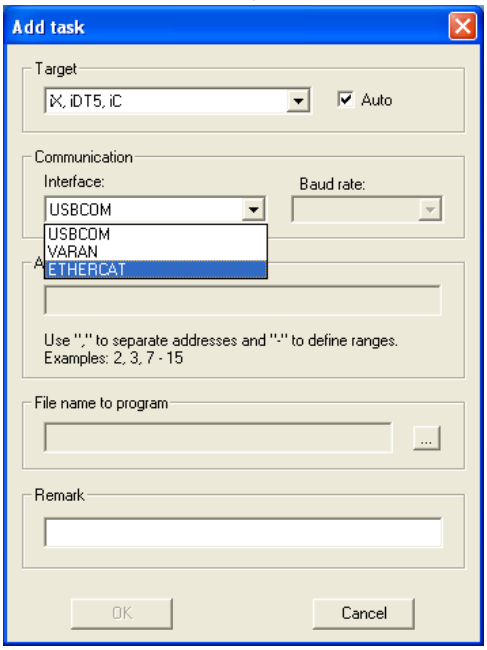
1. Establish a point to point connection between your PC and the Ethernet interface X85.
   (Siehe 'Point to point connection for devices with an EtherCAT interface' auf Seite 78.)
   OR
   Establish a connection between your PC and the EtherCAT PLC controller
   (Siehe 'Connection between PC and an EtherCAT controller (with connected iX, iC, iDT network)' auf Seite 80.)
2. Start the AMK Tool Flasher (ATF).
3. Select 'Task' -> 'Add...'



a. Select 'Target' >iX, iDT5, iC<



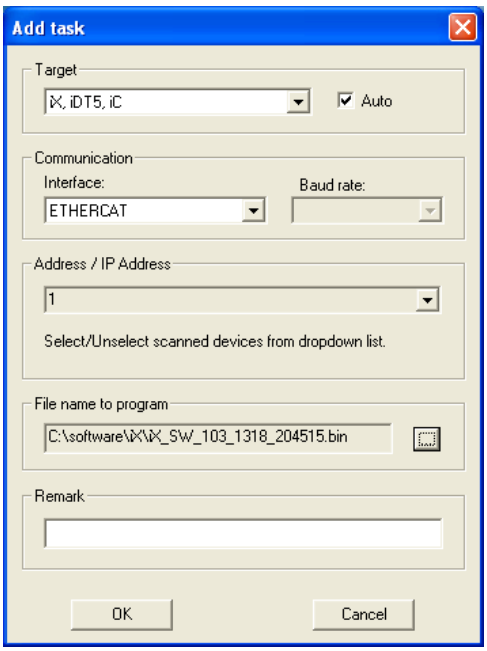
b. Select 'Communication', 'Interface' -> >ETHERCAT<



The following message appears:
'Please wait' - 'Scanning for EtherCAT devices'
Subsequently, 'Address / IP Address' shows the addresses of the connected devices.
If you are connected to several devices, all detected addresses are shown. You can select from a list the devices you want to flash.

c. By 'File name to program', you select the firmware version.

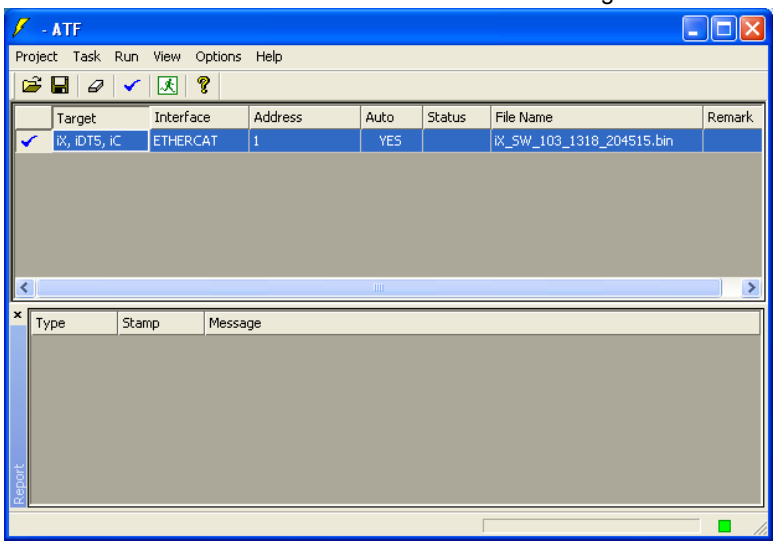
NOTICE	
Material Damage!	**Non-compatible firmware type will destroy the processor!** If you select a non-compatible firmware type to update a decentralized drive, the processor will be destroyed. The device must be replaced. **Steps to prevent:** • Make sure to select the correct firmware type. The designation of the firmware for decentralized drives is **iX_SW**_vvv_yyww_nnnnnn.bin (vvv - version; yyww - year and week; nnnnnn - Part no.) Siehe 'Imprint' auf Seite 2.



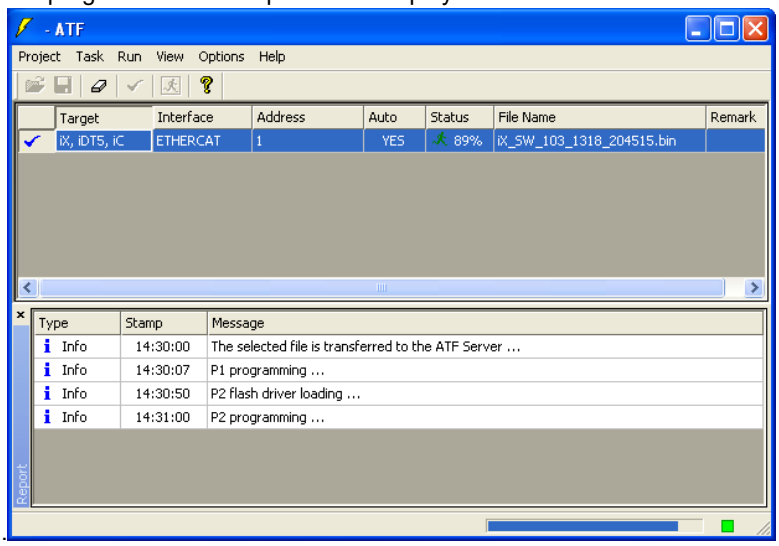
d. Confirm your inputs with **'OK'**.

4. The new-defined task is shown.

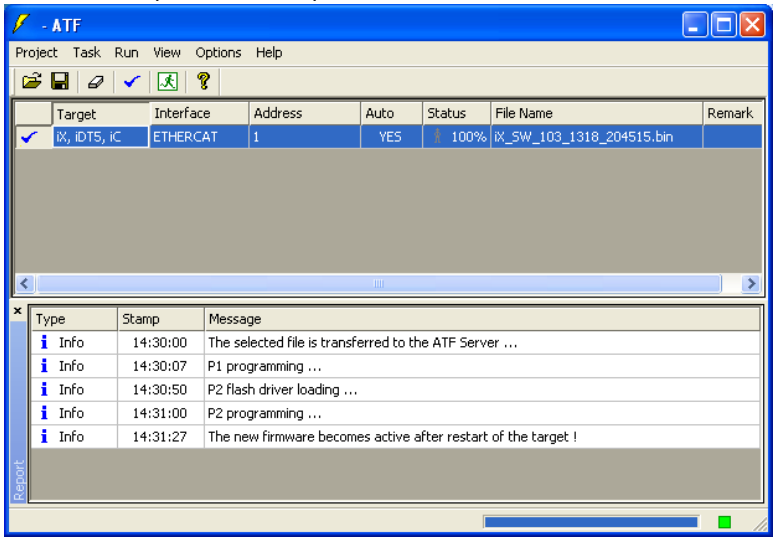
The mark ✓ indicates which task is selected for flashing.



5. By  , the flash task is started.
   The progress of the flash process is displayed.



6. After the flash process is completed, the device must be switched off and on



7. Remove the connections between your PC and the decentralized drive, and re-establish the field bus connection.

8.4 Repair

Repairs and all work in which the devices have to be opened must be carried out by AMK and authorized by AMK persons exclusively. Inform AMK on the equipment failure and send the unit to us for inspection and repair.

9 Accessories

9.1 Options

Real-time Ethernet

Designation	AMK part no.	Description	iC	iX	iDT
O-SECS	O823	EtherCAT (SoE) Slave	x	x	x
O-SECC	O948	EtherCAT (CoE)	x	x	x
O-SVNS	O824	VARAN (SoV) Slave	x	x	x
O-SS3S	O949	SERCOS III Slave	-	-	x

9.2 PC software and converter

Designation	AMK part no.	Description
CD software AIPEX PRO	O907	CD with PC software AIPEX PRO V3.x and ATF
USB / CAN converter	O755	Connection between PC and devices with CAN (DSP 402) interface Consists of: 1 x AMK part no. 200808 converter USB / CAN 1 x AMK part no. 46786 adapter cable (2 x Sub-D 9P) 1 x AMK part no. O780 circuit board AP-CI6 complete 1 x AMK part no. 201110 bus terminating plug M12 1 x AMK part no. 29240 bus terminating plug 6P (Fire wire) 1 x AMK part no. 201108 CAN cable ACC2000 length of 2 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded 1 x AMK part no. 29543 cable IEEE 1394 (2 x Fire wire)
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
Device description file for CANopen controller (CiA 402) iXS_vvv_jjww.eds	-	This file is part of the AIPEX PRO software but you can also get it separately from AMK

9.3 Cable for power connection [X1A] and transmission iC to iX / iDT5

Designation	AMK part no.	Description
Power cable 2.5 mm^2	19376	Length of y m[1)], M23 socket, straight, open cable end

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

Contact assignment

Pin	Wire	Signal
⏚	green/yellow	PE
1	L1 / U	UZP
4	L2 / V	-
3	L3 /W	UZN
A	white/5	24V
B	brown/6	0V
C	green/7	24B

Pin	Wire	Signal
D	yellow/8	0B

9.4 Cable for transmitting the connection [X1B]

Designation	AMK part no.	Description
Looping 2.5 mm^2	47390	Length of y m[1)], M23 pin, straight, M23 socket, straight

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

9.5 Cable for I/O interface [X04]

Designation	AMK part no.	Description
I/O cable EA500	202054	Length of 0.5 m, M12 connector pin angled at 90°, open cable end, 8-pole
I/O cable EA2000	202674	Length of 2 m, M12 connector pin angled at 90°, open cable end, 8-pole
I/O cable EA5000	201731	Length of 5 m, M12 connector pin angled at 90°, open cable end, 8-pole
I/O cable EA10000	202281	Length of 10 m, M12 connector pin angled at 90 °, open cable end, 8-pole

Contact assignment

Pin	Wire colour
1	white
2	brown
3	green
4	yellow
5	grey
6	pink
7	blue
8	red

9.6 Cable for encoder connection [X05]

Designation	AMK part no.	Description
Encoder cable E, F, P, Q, I encoder (CM3)	403118	Length of y m[1)], pin for CM3 design and M23 socket on the motor side for E, F, P, Q, I encoder
Encoder cable S, T, U, V encoder (CM3)	403182	Length of y m[1)], pin for CM3 design and M23 socket on the motor side for S, T, U, V encoder

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

9.7 Cable for the motor connection [X06]

Designation	AMK part no.	Description
Motor cable (CM3)	403122	Length of y m[1)], socket for CM3 design and M23 socket on the motor side

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

9.8 Cable for EtherCAT connector [X85] and [X86]

Designation	AMK part no.	Description
EtherCAT RJ45 / M12 pin	203502	2 m, 4-pole
EtherCAT RJ45 / M12 pin	204265	5 m, 4-pole
EtherCAT RJ45 / M12 pin	203974	10 m, 4-pole

Designation	AMK part no.	Description
EtherCAT 2 x M12 pin	203503	0.3 m, 4-pole
EtherCAT 2 x M12 pin	203500	1 m, 4-pole
EtherCAT 2 x M12 pin	203501	2 m, 4-pole
EtherCAT 2 x M12 pin	203973	5 m, 4-pole
EtherCAT 2 x M12 pin	204266	10 m, 4-pole

9.9 Cable and terminating plug for CAN BUS connection [X136] and [X137]

Designation	AMK part no.	Description
IDT-ACC500	201107	Length of 0.5 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded
IDT-ACC2000	201108	Length of 2 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded
IDT-ACC5000	201131	Length of 5 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded

Designation	Part no.:	Description
IDT-ACCT	201110	Resistance 2 x 120 ohm, M12 connector pin for X137 connection, straight connector

9.10 Brake resistor

Designation	AMK part no.	Description
AR140	O746	Brake resistor 47 ohm / 140 W

9.11 Cable glands

Designation	AMK part no.	Description
Cable gland M25 x 1.5	100623	Metallic cable gland
Cable gland M25 x 1.5 (EMC)	101005	EMC-compliant cable gland

9.12 Mains choke

Designation	AMK part no.	Description
ALN12	O911	Mains choke 3 x 12 A / 500 V AC
ALN17	O742	Mains choke 3 x 17 A / 500 V AC

9.13 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
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.

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.

- CSA - Certificate of compliance
- 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

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

BI
Digital input

BO
digital output

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

Default
Factory setting

DSP 402
CAN bus Draft Standard Proposal 402 Device Profile (Commanding protocol for drives)

DZR
Speed control

DCavg
Diagnostic coverage average -

E

E/A
In- and outputs

EF
Power output stage enable

EF2
Power output stage enable

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

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

H-encoder
Encoder with Hall sensors (Contains one sine and cosine track per rotation or per pair of poles on linear measuring systems)

Hiperface
Motor encoder interface protocol of the company Sick Stegmann

Hiperface DSL
Motor encoder interface protocol of the company Sick Stegmann

I

iSA
AMKASMART decentralized controller with power supply

iX
AMKASMART decentralized inverter

iC
AMKASMART decentralized inverter with power supply

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

iDT
AMKASMART Servo motors with integrated inverter

i²t
Integral of the squared current over time

IGBT
Power electronic component, e. g. transistor

K

KE
AMKASYN compact power supply with recovery

KES
AMKASYN compact power supply with sinusoidal voltage and current

KP
Proportional gain (speed control, PID controller)

KTY
Type of a temperature sensor

Kv
Position loop factor

KEN
AMKASYN compact power supply without recovery

L

LSB
Least Significant Bit

M

MSB
Most Significant Bit

MTTFd
Mean time to dangerous failure

N

Nenndrehzahl
Nominal speed

NHN
Heights measured above the base height levelReference plane for heights over the sea level for Germany since 1992. The reference plane is located in Germany on the church in Wallenhorst.

NK
Cam switch

NIP
Zero pulse of encoder

P

PELV
Protective Extra Low Voltage

PFH
Probabillity of dangerous failure per hour

PFD
Probability of dangerous failure on demand

PFDavg
Probability of dangerous failure on demand average

PL
Performance Level

Parameter
Identification number acc. to SERCOS standard

P-encoder
Absolute encoder singleturn, EnDAT 2.2 light

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

Q

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

Q-encoder
Absolute encoder multiturn, EnDAT 2.2 light

QEF2
Acknowledgement power output state enable (2 channel) QEF, QEF2 are the mirrored input signals EF, EF2. The state bits can be configured with ID26 'Configuration status bits' for field bus transmission or on a binary output (EF: code 33135, EF2: code 33136)

QEF
Acknowledgement power output state enable (2 channel) QEF, QEF2 are the mirrored input signals EF, EF2. The state bits can be configured with ID26 'Configuration status bits' for field bus transmission or on a binary output (EF: code 33135, EF2: code 33136)

R

RTE
Real-time Ethernet

RO
Read Only

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.

RW
Read Write

S

SIL
Safety Integrity Level

SCCR
Short Circuit Current Rating: Maximum available short-circuit current an device can sustain without the occurrence of damage

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

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

SoE
Servodrive Profile (SERCOS) over EtherCAT (Acc. to IEC 61800-7-300)

SERCOS
Standardized digital interface for communication between controller and field bus participants.

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

Tn
Integral-action time in speed control (PID controller)

Td
Differentiating time in speed control (PID controller)

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

U

UZN
DC bus voltage pole negative

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

UZP
DC bus voltage pole positive

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.

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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

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