

AKD[®] Near Servo Drive

Installation Manual



Edition: C, December 2014
Valid for AKD-N, Hardware Revision B
Part Number 903-200018-00
Original Document



Keep all manuals as a product component during the life span of the product.
Pass all manuals to future users and owners of the product.

KOLLMORGEN

Because Motion Matters™

Record of document revisions

Revision	Remarks
A, 11/2013	First edition
B, 05/2014	STO section updated
C, 12/2014	Patents updated, typos corrected, HR changed acc. to export control

Hardware Revision (HR)

AKD-N	AKD-C	Firmware/ WorkBench	Export Classification	Remarks
A	A	from 1.11	3A225	AKD-C and AKD-N start revisions
B	A	from 1.13	-	AKD-N Hardware Revision for export classification traceability purposes

Trademarks

- AKD is a registered trademark of Kollmorgen Corporation
- EnDat is a registered trademark of Dr. Johannes Heidenhain GmbH
- EtherCAT is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH
- HIPERFACE is a registered trademark of Max Stegmann GmbH
- Windows is a registered trademark of Microsoft Corporation

Current patents

- US Patent 5.162.798 (used in control card R/D)
- US Patent 5.646.496 (used in control card R/D and 1 Vp-p feedback interface)
- US Patent 6.118.241 (used in control card simple dynamic braking)
- US Patent 8.154.228 (Dynamic Braking For Electric Motors)
- US Patent 8.214.063 (Auto-tune of a Control System Based on Frequency Response)
- US Patent 8.566.415 (Safe Torque Off over network wiring)

Patents referring to fieldbus functions are listed in the matching fieldbus manual.

Technical changes which improve the performance of the device may be made without prior notice!

Printed in Germany

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2.1 About this Manual

This manual, *AKD-N Installation Manual* ("Instructions Manual" according to EC Machinery Directive 2006/42/EC), describes the AKD-N series of digital drives and includes information needed to safely install an AKD-N. A digital version of this manual (pdf format) is available on the DVD included with your drive. Manual updates can be downloaded from the Kollmorgen website (www.kollmorgen.com).

Additional documents include the following:

- *Decentralized System Projecting Guide*: describes how to build a decentralized drive system with AKD-C and AKD-N. It provides tips for system topology, cooling, and maximizing the system performance. This document is expected to be published in April 2015.
- *AKD-C Installation Manual*: describes the AKD-C series of intelligent power supply for Kollmorgen decentralized drive system and includes information needed for safe assembling, installation and system setup.
- *Decentralized System User Guide*: describes how to use your drive in common applications. It also provides tips for maximizing your system performance. The *User Guide* includes the *Parameter and Command Reference Guide* which provides documentation for the parameters and commands used to program the AKD-N.
- *EtherCAT Communication*: describes how to use your system in EtherCAT applications.
- *Accessories Manual*. It provides documentation for accessories like cables and regen resistors used with AKD-C and AKD-N. Regional variants of this manual exist.

2.2 Using the PDF Format

This document includes several features for ease of navigation

Cross References	Table of contents and index include active cross references.
Table of contents and index	Lines are active cross references. Click on the line and the appropriate page is accessed.
Page/chapter numbers in the text	Page/chapter numbers with cross references are active links.







2.3 Notes for the Printed Edition (paper version)

A printed version of the manual is enclosed with each product. For environmental reasons, the document was reduced in size and printed on DIN A5.

NOTE

Should you experience difficulties reading the font size of the scaled-down printed version, you can print and use the PDF version in DIN A4 format 1:1. You can find the PDF version on the DVD accompanying the product and on the Kollmorgen website.

2.4 Symbols Used

Symbol	Indication
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates situations which, if not avoided, could result in property damage.
NOTE	This symbol indicates important notes.
	Warning of a danger (general). The type of danger is specified by the text next to the symbol.
	Warning of danger from electricity and its effects.
	Warning of suspended loads.

2.5 Abbreviations Used

Abbreviation	Meaning
CE	Communauté Européenne
EMC	Electromagnetic compatibility
LED	Light-emitting diode
OSSD	Output signals Switching Device
PC	Personal computer
PE	Protective earth
PELV	Protective extra low voltage
PLC	Programmable logic control
PWM	Pulse-width modulation
RAM	Random access memory (volatile memory)
ROD	Incremental encoder (A quad B)
Rth	Specific thermal resistance
SELV	Safety Extra Low Voltage
STO	Safe torque off
VAC	Volts, alternating current
VDC	Volts, direct current

3 Safety

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3.1 You should pay attention to this

This section helps you to recognize and avoid dangers to people and objects.

Read the documentation!

Read the available documentation before installation and commissioning. Improper handling of the drive can cause harm to people or damage to property. The operator of systems using the AKD-N must require that all personnel who work with the drive read and understand the manual before using the drive.

Check Hardware Revision!

Check the Hardware Revision Number of the product (see product label). This number is the link between your product and the manual. The product Hardware Revision Number must match the Hardware Revision Number on the cover page of the manual.

Pay attention to the technical data!

Adhere to the technical data and the specifications on connection conditions (rating plate and documentation). If permissible voltage values or current values are exceeded, the drives can be damaged.

Perform a risk assessment!

The manufacturer of the machine must generate a risk assessment for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property. Additional requirements on specialist staff may also result from the risk assessment.

Automatic Restart!

The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting.

Risk of death or serious injury for humans working in the machine.

If the parameter DRV.ENDEFAULT is set to 1, then place a warning sign to the machine (Warning: Automatic Restart at Power On) and ensure, that power on is not possible, while humans are in a dangerous zone of the machine. In case of using an undervoltage protection device, you must observe EN 60204-1:2006 chapter 7.5 .



Specialist staff required!

Only properly qualified personnel are permitted to perform such tasks as transport, assembly, setup and maintenance. Qualified specialist staff are persons who are familiar with the transport, installation, assembly, commissioning and operation of drives and who bring their relevant minimum qualifications to bear on their duties:

- Transport: only by personnel with knowledge of handling electrostatically sensitive components.
- Unpacking: only by electrically qualified personnel.
- Installation: only by electrically qualified personnel.
- Basic tests / Setup: only by qualified personnel with knowledge of electrical engineering and drive technology

The qualified personnel must know and observe ISO 12100 / IEC 60364 / IEC 60664 and national accident prevention regulations.

Observe electrostatically sensitive components!

The drives contain electrostatically sensitive components which may be damaged by incorrect handling. Electrostatically discharge your body before touching the drive. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the drive on a conductive surface.



Hot surface!

Drives may have hot surfaces during operation. The housing can reach temperatures above 80°C. Risk of minor burns! Measure the temperature, and wait until the housing has cooled down below 40 °C before touching it.



Earthing!

It is vital that you ensure that the drive is safely earthed to the PE (protective earth) system in the machine. Risk of electric shock. Without low-resistance earthing no personal protection can be guaranteed.



Leakage Current!

Since the leakage current to PE is more than 3.5 mA, in compliance with IEC61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section >10 mm² must be used. Deviating measures according to regional standards might be possible.



High voltages!

The equipment produces high electric voltages up to 900 V. Do not open or touch the equipment during operation. Keep all covers closed. The built-in LED does **not** safely indicate the real voltage level.

During operation, drives may have uncovered live sections, according to their level of enclosure protection. Wait at least seven minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (such as contacts) or removing any connections.

Capacitors can have dangerous voltages present up to seven minutes after switching off the supply power. Always measure the voltage in the DC bus link at connector X14 at AKD-C and wait until the voltage is below 60 V before handling components.

Never undo any electrical connections to the drive while it is live. There is a danger of electrical arcing with damage to contacts and personal injury.

Reinforced Insulation

Thermal sensors, motor holding brakes and feedback systems built into the connected motor must have reinforced insulation (according to IEC61800-5-1) against system components with power voltage, according to the required application test voltage. All Kollmorgen components meet these requirements.

Never modify the drive!

It is not allowed to modify the drive without permission by the manufacturer. Opening the housing causes loss of warranty.

3.2 Use as Directed

The AKD-N family of drives is exclusively intended for driving suitable synchronous servomotors with closed-loop control of torque, speed, and/or position.

Drives are components that are built into electrical plants or machines and can only be operated as integral components of these plants or machines. The manufacturer of the machine must generate a risk assessment for the machine.

When the drives are built into machines or plant, the drive must not be used until it has been established that the machine or plant fulfills the requirements of the regional directives.

Kollmorgen Decentralized Drive System

AKD-N series drives must only be operated in a motion system with components from Kollmorgen. Required additional Kollmorgen components are the intelligent power supply AKD-C, CCx series of hybrid cables, motor power and feedback cables, servomotors.

Assembling

AKD-N drives must only be operated in environments suitable for the ambient conditions defined on → p. 24. Optional finned heat sink may be necessary to keep the drive flange temperature below 85 °C.

Wiring

Use only Kollmorgen CCx series of hybrid cables for connecting AKD-N and AKD-C devices.

Power supply

AKD-N series drives must be powered by AKD-C intelligent power supplies with DC voltage from 55 VDC up to 800 VDC.

Motor voltage rating

The rated voltage of the motors must be at least as high as the DC bus link voltage divided by $\sqrt{2}$ produced by the drive ($U_{nMotor} \geq U_{DC}/\sqrt{2}$).

Safe torque off

Review the section "Use as Directed" in the STO chapter (→ p. 36) before using this safety function (SIL2, PLd, category 3 according to ISO 13849).

The 24 VDC supply unit for local STO supply must accord to PELV/SELV (EN 60204-1) requirements.

3.3 Prohibited Use

Other use than that described in chapter "Use as directed" is not intended and can lead to personnel injuries and equipment damage.

The device may not be used

- with a machine that does not comply with appropriate national directives or standards,
- for driving elevators,
- in applications with continuous, operational short circuits to the motor power contacts.

The use of the device in the following environments is also prohibited:

- potentially explosive areas
- environments with corrosive and/or electrically conductive acids, alkaline solutions, oils, vapors, dusts
- ships or offshore applications

Wiring the system with hybrid cables from other manufacturers than Kollmorgen is not allowed. Changing Kollmorgen cables or connectors is not allowed.

3.4 Handling

3.4.1 Packaging

The AKD-N packaging consists of recyclable cardboard with inserts and a label on the outside of the box.

Model	Package Dimensions (mm) HxWxL	Total Weight (kg)
AKD-N00307	120 x 295 x 370	3.2
AKD-N00607	120 x 295 x 370	3.2

3.4.2 Transport

Transport the AKD-N in accordance with IEC 61800-2 as follows:

- Transport only by qualified personnel in the manufacturer's original recyclable packaging.
- Avoid shocks while transporting.
- Store at or below maximum stacking height of 8 cartons
- Transport only within specified temperature ranges: -25 to +70 °C, max. rate of change 20 K/hour, class 2K3.
- Transport only within specified humidity: maximum 95% relative humidity, no condensation, class 2K3.

NOTICE

The drives contain electrostatically sensitive components that can be damaged by incorrect handling. Electrostatically discharge yourself before touching the drive. Avoid contact with highly insulating materials, such as artificial fabrics and plastic films. Place the drive on a conductive surface.

If the packaging is damaged, check the unit for visible damage. Inform the shipper and the manufacturer of any damage to the package or product.

3.4.3 Storage

Store the AKD-N in accordance with IEC 61800-2 as follows:

- Store only in the manufacturer's original recyclable packaging.
- Store at or below maximum stacking height of 8 cartons
- Store only within specified temperature ranges: -25 to +55 °C, max. rate of change 20 K/hour, class 1K4.
- Storage only within specified humidity: 5 to 95% relative humidity, no condensation, class 1K3.

3.4.4 Maintenance and cleaning

The drive does not require maintenance. Opening the drive voids the warranty.

The inside of the unit can only be cleaned by the manufacturer. To clean the drive exterior:

- Casing: Clean with isopropanol or similar cleaning solution.
- Cooling fins: Clean with a dry brush.

3.4.5 Uninstalling

If a drive must be uninstalled (such as for replacement), remove the drive as follows:

1. Switch off the main switch of the switchgear cabinet and the fuses that supply the system.



WARNING

Contacts can still have dangerous voltage present up to seven minutes after switching off mains voltage. Risk of electrical shock! Wait at least seven minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (e.g. contacts) or undoing any connections. Always measure the voltage in the DC bus link at connector X14 at AKD-C and wait until the voltage is below 60 V before handling components.

2. Remove the connectors. Disconnect the potential earth connection last.
3. Check temperature.



CAUTION

During operation, the heat sink of the drive may reach temperatures above 80 °C (176 °F). Risk of minor burns. Before touching the device, check the temperature and wait until it has cooled below 40 °C (104 °F).

4. Uninstall. Remove the AKD-N.

3.4.6 Repair and disposal

Only the manufacturer can repair the drive. Opening the device voids the warranty. Uninstall the drive as described in "Uninstalling" (→ p. 15), then send the drive in the original packaging to the manufacturer (see table below). Transport costs are the responsibility of the senders.

In accordance with the WEEE-2002/96/EC-Guidelines and similar, the manufacturer accepts returns of old devices and accessories for professional disposal. Transport costs are the responsibility of the sender. Send the devices to the manufacturer addresses shown in the table below.

USA	Europe
Kollmorgen 201 West Rock Road Radford, VA 24141	KOLLMORGEN Europe GmbH Pempelfurtstr. 1 D-40880 Ratingen

4 Approvals

4.1 Conformance with UL/cUL	17
4.2 Conformance with EC Low Voltage and EMC Directives	17
4.3 Conformance with EC Machinery Directive, Functional Safety	17

4.1 Conformance with UL/cUL

Planned.

4.2 Conformance with EC Low Voltage and EMC Directives

CE Declarations of Conformity can be found on the Kollmorgen website.

Conformance with the EC EMC Directive 2004/108/EC and the Low Voltage Directive 2006/95/EC is mandatory for the supply of drives within the European Community.

The drives have been tested by an authorized testing laboratory in a defined configuration, using the system components that are described in this documentation. Any divergence from the configuration and installation described in this documentation means that the user will be responsible for carrying out new measurements to ensure conformance with regulatory requirements.

Kollmorgen declares the conformity of the product series AKD-Nzzz07 with the following directives:

- EC Directive 2006/95/EC, low voltage
Used harmonized standard EN61800-5-1 (2007)
- EC Directive 2004/108/EC, electromagnetic compatibility
Used harmonized standard EN 61800-3 (2004)

The AKD-Nzzz07 meet the noise immunity requirements to the 2nd environmental category (industrial environment). For noise emission the AKD-Nzzz07 meet the requirement to a product of the Category C2 (motor cable up to 5 m).

NOTICE

These devices can cause high-frequency interferences in non industrial environments and may require measures for interference suppression (such as additional external EMC filters).

4.3 Conformance with EC Machinery Directive, Functional Safety

Conformance with the EC Machinery Directive 2006/42/EC is mandatory for the supply of safety components within the European Community.

Safe Torque Off (STO) string type

Certification in process.

Safe Torque Off (STO) single drive type

Certification in process.

5 Package

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5.1 Package Supplied

When a drive from the AKD-N series is ordered, the following items are included in the drive package:

- AKD-N
- Printed copy of *AKD-N Installation Manual*
- DVD containing the setup software, WorkBench, and all product documentation in digital format.
- Two connector covers M12 (for unused X3 and X6)

NOTE

The mating connectors are not included in the package.

The M23 connector cover for protecting X2 of the last AKD-N in a string is part of delivery of the AKD-C package.






Accessories Sold Separately

Accessories must be ordered separately if required; refer to your regional accessories manual:

- Heatsink 40 mm or 50 mm
- Heat conducting film
- Motor cable, feedback cable
- Hybrid cable for connection to next AKD-N
- Cable for digital I/O connection
- Cable for local STO connection (AKD-N-DS only)
- Cable for tertiary fieldbus (AKD-N-DF only)

5.2 Nameplate

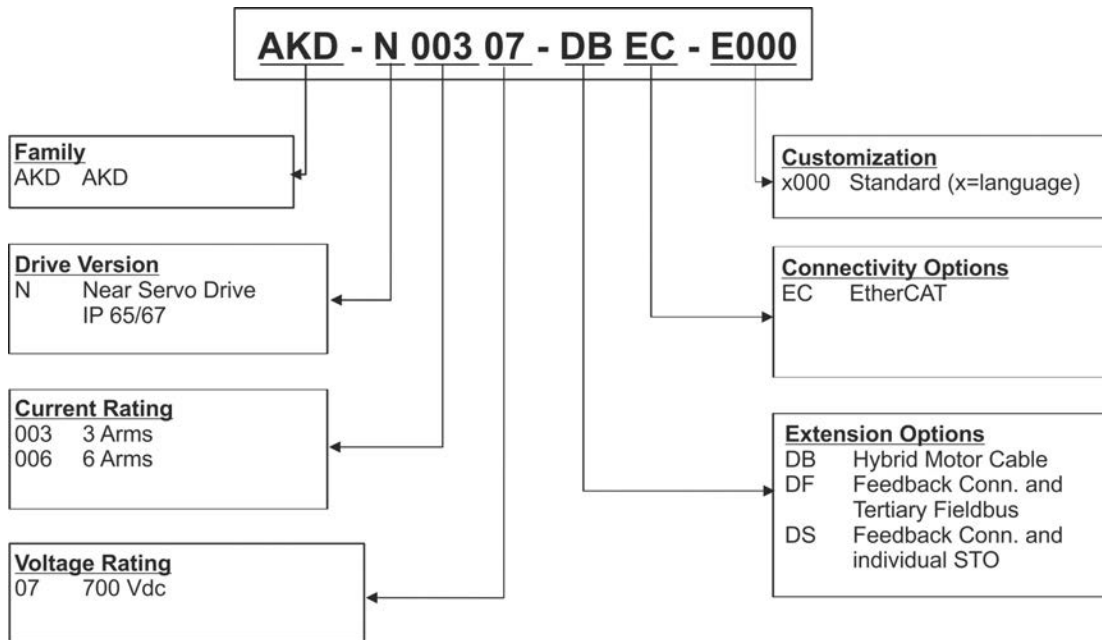
The nameplate depicted below is attached to the side of the drive, sample data entries are for a 6 A type.

KOLLMORGEN		Customer Support: North America: +1 (540) 633-3400 Europe: +49 (0) 2102-9394-0 Italy: +39 (0) 362-594260	HW Rev: B 
Pempelfurtstr. 1 40880 Ratingen Germany		Model No: AKD-N00307-DBEC-D000 	
Serial No: R-1241-00006 			
MAC Address: 00-23-1B-00-70-3C			
	INPUT	OUTPUT	
Voltage	560-670 Vdc	0-480 Vac	
Frequency	-	0-800 Hz	
Phase	-	3 Ph	
FL Current	4 A dc	3 Arms	
Power	2.3 KVA	-	
Enclosure Protection Rating:		IP 67	

Before use, refer to CD for installation and safety information.
Assembled in Germany Patents Pending www.kollmorgen.com

5.3 Part Number Scheme

Use for part number scheme for product identification only, not for the order process, because not all combinations of features are possible, always.



Customization code includes language version of printed material and customer specials.

6 Technical description and data

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6.1 The AKD-N Family of Digital Drives

Available AKD-N versions

Variant (short)	Description	Current	Connectivity
AKD-N-DB	Hybrid DC power and fieldbus connection. Hybrid motor power and feedback connection.	3 to 6 A	EtherCAT, I/O
AKD-N-DF	Hybrid DC power and fieldbus connection. Hybrid or dual line motor power and feedback connection. Local tertiary fieldbus interface.	3 to 6 A	EtherCAT, I/O, Local Fieldbus
AKD-N-DS	Hybrid DC power and fieldbus connection. Hybrid or dual line motor power and feedback connection. Local drive STO input.	3 to 6 A	EtherCAT, I/O, Local STO

Standard features

- Supply voltage range 55 VDC to 800 VDC
- Motion bus onboard.
- SFD, Hipurface DSL, Comcoder, ENDAT 2.1 & 2.2, BiSS, HIPERFACE, 1Vp-p Sin-Cos encoders, incremental encoders support onboard.
- Safe Torque Off (STO) according to IEC 62061 SIL 2 onboard.
- Use with synchronous servomotors, linear motors, and induction machines.

Power section

- DC power supply, voltage range 55 VDC to 800 VDC.
- Output stage IGBT module with floating current measurement.

Integrated safety

- Appropriate insulation/creepage distances and electrical isolation for safe electrical separation, per IEC 61800-5-1, between the power input/motor connections and the signal electronics.
- Temperature monitoring of the drive and motor.
- Motor overload protection: foldback mechanism
- SIL 2 safe torque off in accordance with IEC 62061

Operation and parameter setting

- Using the setup software WorkBench for system setup via TCP/IP connected to X18 of the intelligent power supply AKD-C.

Full digital control

- Digital current controller (670 ns)
- Adjustable digital velocity controller (62.5 μ s)
- Software option position controller (250 μ s)

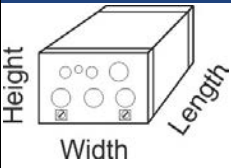
Inputs/Outputs

- 3 programmable digital inputs → p. 54
- 1 programmable digital outputs → p. 54

Extensions

- Optional Feedback Connector X5 and Local fieldbus port X6, drive variant "DF", → p. 61
- Optional Feedback Connector X5 and Local STO input X6, drive variant "DS", → p. 61

6.2 Mechanical Data

		Mechanical data	Units	AKD -N00307	AKD -N00607
	Weight		kg	1.6	
	Height		mm	75	
	Width		mm	130	
	Length, housing		mm	201	
	Length, with connectors and mounting clamps		mm	247	

6.3 Electrical Data

Electrical data	Units	AKD-N00307	AKD-N00607
Rated supply voltage	V=	560 to 680	
Standby supply voltage	V=	55	
Rated input power for continuous operation	kVA	1.5	3
Rated input current	A	2.8	5.5
Permitted switch on/off frequency	1/h	30	
Continuous output current (± 3%):			
Optimum cooling situation (cold plate size definition fulfilled)	Arms	3 ¹⁾	6 ²⁾
Free convection cooling, unmounted	Arms	1.8	1.7
Continuous output power:			
Optimum cooling situation (cold plate size definition fulfilled)	kVA	1.3	2.6
Free convection cooling, unmounted	kVA	0.8	0.7
Peak output current (for 5 s, ± 3%)	Arms	9	18
Peak output power (for 1 s)	kW	2.6	5.2
Motor inductance min.	mH	6.3	3.2
Motor inductance max.	mH	600	300
Thermal dissipation, output stage disable	W	max. 6	max. 6
Thermal dissipation at rated current	W	37	71
Efficiency factor	%	97	97
Technical data for regen circuit	—	→ p. 27	
Motor holding brake current	A	max. 0.9	max. 1.2

¹⁾ cold plate: (LxWxT) 240x240x10, surrounding temperature: 40°C, supply voltage: 680V

²⁾ cold plate: (LxWxT) 500x500x10, surrounding temperature: 40°C, supply voltage: 680V

6.4 Performance Data

Performance Data	Units	AKD N00307	AKD- N00607
Switching frequency of output stage	kHz	10	8
Voltage rise speed dU/dt	kV/μs	7.2	
Bandwidth of current controller	kHz	2.5	
Bandwidth of velocity controller (scalable)	Hz	0 to 750	
Bandwidth of position controller (scalable)	Hz	1 to 250	

6.5 Ambient Conditions, Ventilation, and Mounting Position

Storage	→ p. 14
Transport	→ p. 14
Ambient temperature in operation	-10 °C to +40 °C under rated conditions +40 °C to +55 °C with continuous current derating 4 % per Kelvin
Humidity in operation	Relative humidity 5 to 95%, no condensation, class 3K4
Site altitude	Up to 1000 meters above mean sea level without restriction 1,000 to 2,000 meters above mean sea level with current derating 1.5%/100 m
Pollution level	Pollution level 3 as per IEC 60664-1
Vibrations	Class 3M5 according to IEC 60721-3-2
Environmental area	IP65/IP67 according to IEC 60529, UL Type 4x
Mounting position	All orientations allowed, observe preferred position, → p. 45
Cold plate size	Aluminum cold plate minimum size: AKD-N00307: 350x350x10 mm AKD-N00607: 500x500x10 mm The drive operates to full ratings, if the mounting surface for the cold plate is between -10°C and +85°C and the ambient air temperature is between -10°C and +40°C.
Ventilation	Free air convection

6.6 Inputs/Outputs

Interface	Electrical Data
Digital inputs (X3)	<ul style="list-style-type: none"> • as per IEC61131-2 type 1 • ON: 15 VDC to 30 VDC, 2 mA to 15 mA • OFF: -3 VDC to 5 VDC, < 1 mA • galvanic isolation for 30 VDC • 2 high speed inputs: update rate 2 µs • 1 standard input: update rate 250 µs
Digital outputs (X3)	<ul style="list-style-type: none"> • as per IEC61131-2 type 1 • max. 30 VDC, 100 mA • short circuit proof • galvanic isolation for 30 VDC • Update rate 250 µs
STO input (option DS)	<ul style="list-style-type: none"> • ON: 18 VDC to 30 VDC, 50 mA to 100 mA • OFF: 0 VDC to 12 VDC, < 50 mA • galvanic isolation for 60 VDC
STO outputs (X3, option DS)	<ul style="list-style-type: none"> • as per IEC61131-2 type 1 • max. 30 VDC, 100 mA • short circuit proof • galvanic isolation for 30 VDC • Update rate 62.5 µs

6.7 Connectors

Given voltage and current data are the lowest values allowed by UL and CE.

Connector	Type	Max. Cross Section	Current	Voltage*
Hybrid IN, X1	Hybrid Connector (male), 7 poles	4 x 0.34mm ² , 22 awg 3 x 2.5 mm ² , 14 awg	0.5 A 18 A	30 V 850 V
Hybrid OUT, X2	Hybrid Connector (female), 7 poles	4 x 0.34mm ² , 22 awg 3 x 2.5 mm ² , 14 awg	0.5 A 18 A	30 V 850 V
Digital I/O, X3	Connector (female), 8 poles	8 x 0.34 mm ² , 22 awg	2 A	30 V
Motor, X4	Connector (female), 8 poles	4 x 2.5 mm ² , 14 awg 4 x 1.0 mm ² , 18 awg	15 A 10 A	630 V 30 V
Feedback X5	Connector (male), 17 poles	17 x 0.75 mm ² , 20 awg	3.6 A	63 V
STO/Fieldbus, X6	Connector (female), 4 poles	4 x 0.34 mm ² , 22 awg	1 A	50 V

* Rated voltage with pollution level 2, use Kollmorgen cables only.

6.8 Cable Requirements

For information on the chemical, mechanical, and electrical characteristics of the cables please refer to the accessories manual or contact customer support.

NOTE

Use Kollmorgen hybrid, motor, and feedback cables only. You will lose system warranty, if you use hybrid, motor or feedback cables from a manufacturer other than Kollmorgen.

Cable from	Cable type	Cable to	Cross section
AKD-C X20/X21	CCNCN1-025 ¹⁾	AKD-N X1, hybrid	3 x 2.5 mm ² 4 x 0.25 mm ²
AKD-N X2	CCNNN1-025 ¹⁾	AKD-N X1, hybrid	3 x 2.5 mm ² 4 x 0.25 mm ²
AKD-N X3	Phoenix SAC-8P-M12MS ²⁾	Digital I/O	8 x 0.25 mm ²
AKD-N-DB/DS/DF X4	CCJNA1-015 ¹⁾	Motor Power with brake and Hiperface DSL feedback, hybrid	4 x 1.5 mm ² 2 x 0.75 mm ² 2 x 0.34 mm ²
AKD-N-DS/DF X4	CM0NA1-015 ¹⁾	Motor Power without brake	4 x 1.5 mm ²
AKD-N-DS/DF X4	CM1NA1-015 ¹⁾	Motor Power with brake	4 x 1.5 mm ² 2 x 0.75 mm ²
AKD-N-DS/DF X5	CFSNA1-002 ¹⁾	Motor Feedback SFD	4 x 2 x 0.25 mm ²
AKD-N-DS/DF X5	CFCNA1-002 ¹⁾	Motor Feedback Comcoder	7 x 2 x 0.25 mm ²
AKD-N-DS/DF X5	CFENA1-002 ¹⁾	Motor Feedback EnDat/BiSS	7 x 2 x 0.25 mm ²
AKD-N-DS/DF X5	CFHNA1-002 ¹⁾	Motor Feedback Hiperface	7 x 2 x 0.25 mm ²
AKD-N-DF X6	Phoenix NBC-MSD/5,0-93E ²⁾	Tertiary Fieldbus	2 x 2 x 0.14 mm ²
AKD-N-DS X6	Phoenix SAC-4P-M12MS ²⁾	Single Drive STO switch	4 x 0.34 mm ²

¹⁾ Followed by length coding. Contact your Kollmorgen sales representative.

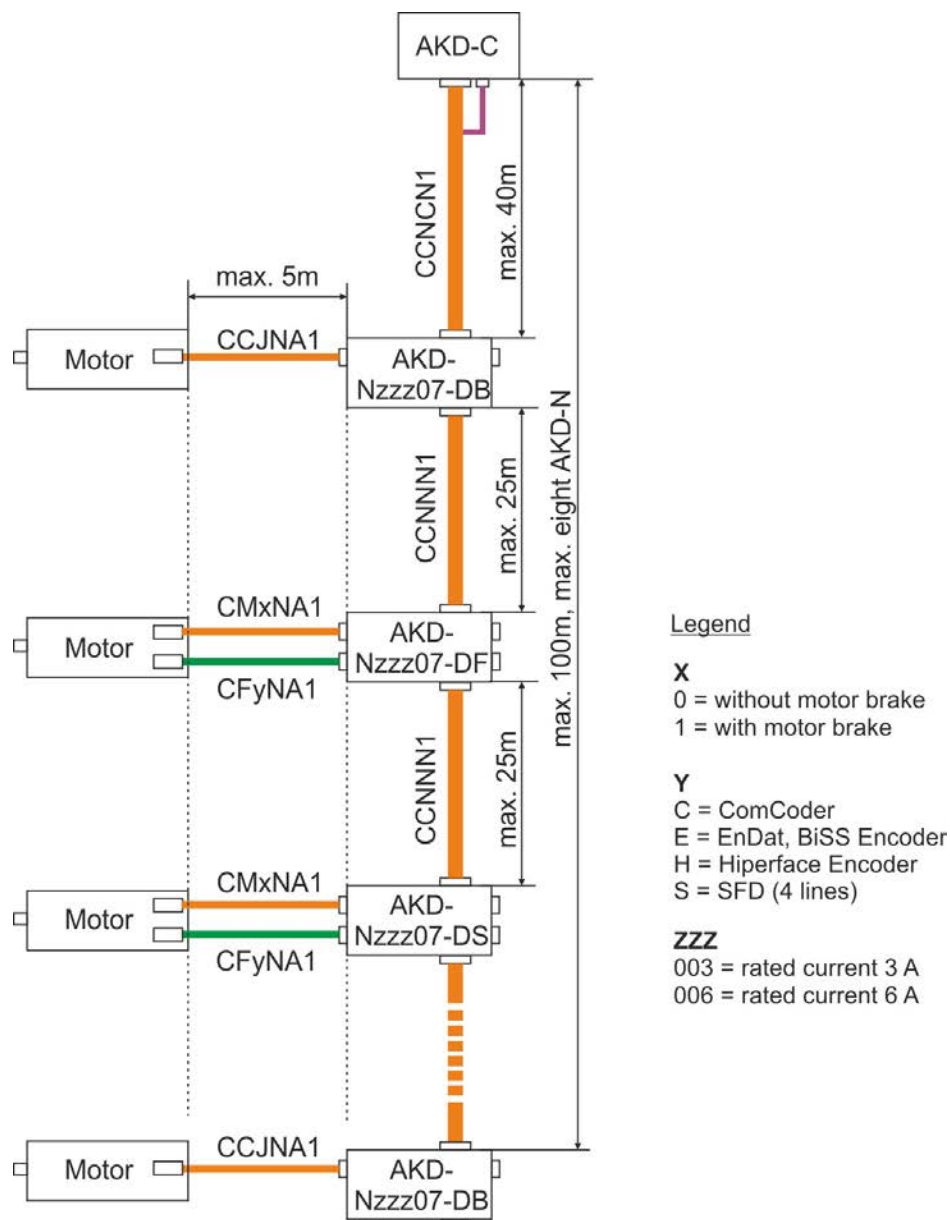
²⁾ Example, similar cables are available from other distributors.

6.9 Cable length definition

NOTE

AKD-C offers two separate strings to connect up to 8 AKD-N to each of them. Maximum total cable length for each string is 100 m. For system topology information refer to → p. 49

Cable Type	Cable usage	Available Length (m)	Max. Length (m)
CCNCN1	AKD-C to AKD-N, hybrid	3, 6, 12, 24, 36	40
CCNNN1	AKD-N to AKD-N, hybrid	0.25, 0.5, ... , 2.0 (steps 0.25m up to 2m) 2.5, 3.0, ... , 25 (steps 0.5m up to 25m)	25
CCJNA1	AKD-N to Motor, hybrid	0.2, 0.3, ... , 1.0 (steps 0.1m up to 1m) 1.25, 1.5, ... , 2.0 (steps 0.25m up to 2m)	5
CMxNA1	AKD-N to Motor Power	0.2, 0.3, ... , 1.0 (steps 0.1m up to 1m) 1.25, 1.5, ... , 2.0 (steps 0.25m up to 2m)	5
CFyNA1	AKD-N to Motor Feedback	0.2, 0.3, ... , 1.0 (steps 0.1m up to 1m) 1.25, 1.5, ... , 2.0 (steps 0.25m up to 2m)	5



6.10 Dynamic Braking

Dynamic braking is a method to slow down a servo system by dissipating the mechanical energy driven by the motor back EMF. The AKD-N has a built in advanced dynamic braking mode which operates fully in hardware. When activated, the drive shorts the motor terminals in phase with the back EMF (q axis) but continues to operate the non-force producing current loop (d-axis) with 0 current. This forces all of the dynamic braking current to be stopping current and insures the fastest stopping/amp of motor terminal current.

- When current is not being limited, the mechanical energy is being dissipated in the motor resistance.
- When current is being limited, energy is returned to the drive bus capacitors.
- The drive also limits the maximum dynamic braking motor terminal current via the *DRV.DBILIMIT* parameter to insure that the drive, motor, and customer load do not see excessive currents/forces.

Whether and how the AKD-N uses dynamic braking depends on (*DRV.DISMODE*).

6.11 Regen circuit

When the amount of returned energy builds the bus capacitor voltage up enough the AKD-C activates the regen circuit to start dumping the returned energy in the regen resistor (also called regenerative or brake resistor). The AKD-C has an internal regen resistor is resistor, an additional external one can be connected to X14.

External regen resistors are described in the regional *AKD Accessories Manual*.

6.11.1 Functional description

When the amount of returned energy builds the bus capacitor voltage up enough the AKD-C activates the brake chopper to start dumping the returned energy in the regen resistor at the AKD-C (internally or connected to terminal X14).

90% of the combined power of all the coupled drives is always available for peak and continuous power.

Switch-off on over voltage

The drive that has the lowest switch-off threshold (resulting from tolerances) reports an over-voltage fault if the DC bus threshold is exceeded. The drive power stage is disabled and the load coasts to a stop with the fault message "F501 Bus Over voltage". The AKD-C fault relay contact (terminals X15/5-6) is opened due to this fault.

6.11.2 Technical data

Technical data are listed in the *AKD -C Installation Manual*.

6.12 LED Codes

The built-in LED indicates the status of the drive after the 24 V supply for AKD-C is switched on. If the AKD-C service connection to the PC or to the PAC doesn't work, then the LED is the only way to get information.



DANGER

The built-in LED does not safely indicate the real voltage level. If connectors are unplugged or contacts are touched, there is a danger of electrical arcing with damage to contacts and serious personal injury. Always measure the voltage in the DC bus link at connector X14 at AKD-C and wait until the voltage is below 60 V before handling any component in the decentral servo system.

The LED delivers information with three colors (red, green, yellow) and blink frequency. Specialist can analyze the blink frequency, more information to that can be found in the WorkBench online help.

Basic information

Color	Remarks
Green	Enabled and running
blink green/orange	Enabled and running with warning
blink orange	Safe bus voltage
blink red/orange/green	Fault

6.13 Switch-On and Switch-Off Behavior

Behavior of “holding brake” function

Drives with an enabled holding brake function have a special timing for switching on and off the output stage. Events that remove the DRV.ACTIVE signal trigger the holding brake to apply. As with all electronic circuits, the general rule applies that there is a possibility of the internal holding brake module failing.

Functional safety, for example with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

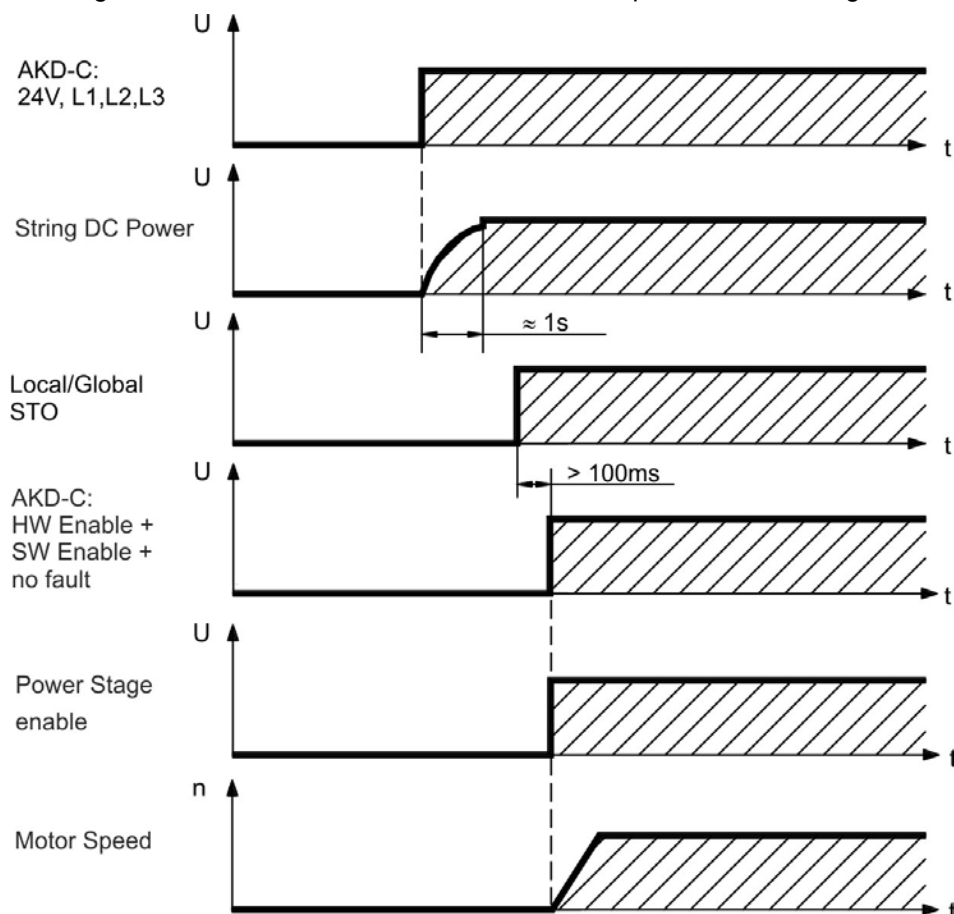
If velocity drops below threshold $CS.VTHRESH$ or timeout occurs during a stop procedure, the brake is applied. Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake immediately after faults or Hardware Disable.

Safety function STO

With the functional safe function STO, the drive can be secured on standstill using its internal electronics so that even when power is being supplied, the drive shaft is protected against unintentional restart. The chapter “Safe Torque Off (STO)” describes how to use the STO function (→ p. 36).

6.13.1 Switch-on behavior in standard operation

The diagram below illustrates the correct functional sequence for switching the drive on.



6.13.2 Switch-off behavior

NOTE

The AKD-C 24 V supply must remain constant. Hardware Enable input disables all AKD-N power stages immediately. Configured Digital Inputs and fieldbus commands can be used to perform controlled stops.

The control functions Stop, Emergency Stop and Emergency Off are defined by IEC 60204. Notes for safety aspects of these functions can be found in ISO 13849 and IEC 62061.

NOTE

The parameter DRV.DISMODE must be set to 2 to implement the different stop categories. Consult the *AKD-N User Guide* for configuring the parameter.



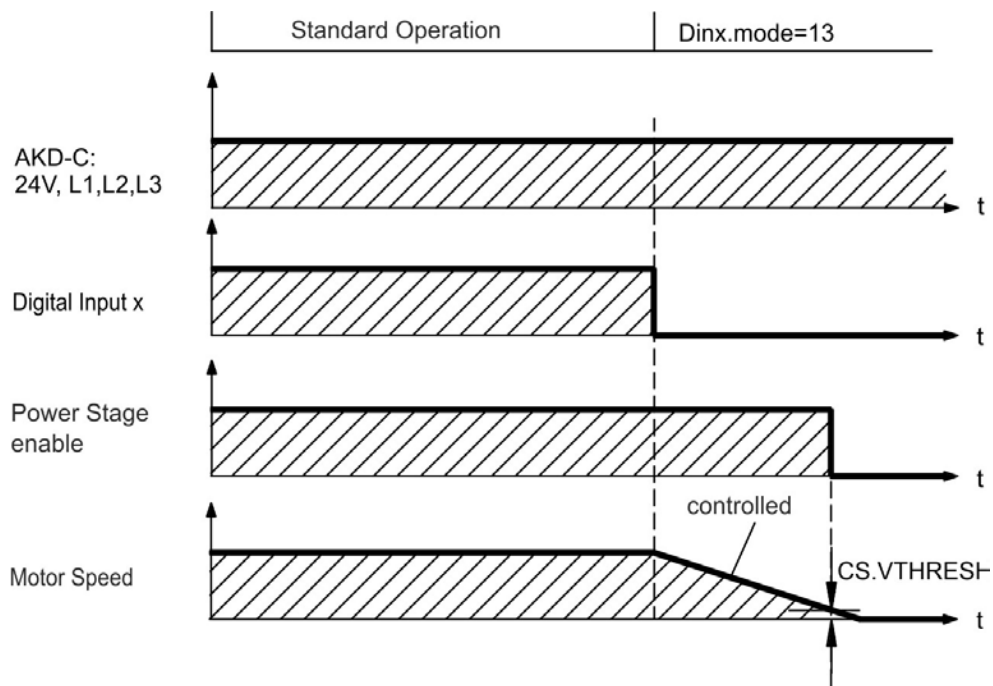
WARNING

With vertical load the load could fall. Serious injury could result when the load is not properly blocked. Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake immediately after faults or Hardware Disable.

6.13.2.1 Switch-off behavior using a digital input (controlled stop)

This is a category 2 stop according to IEC 60204. A digital input can be configured to bring the motor to a controlled stop and then disable the drive and apply the holding brake (if present). See the *AKD-N User Guide* for information on configuring Digital Inputs.

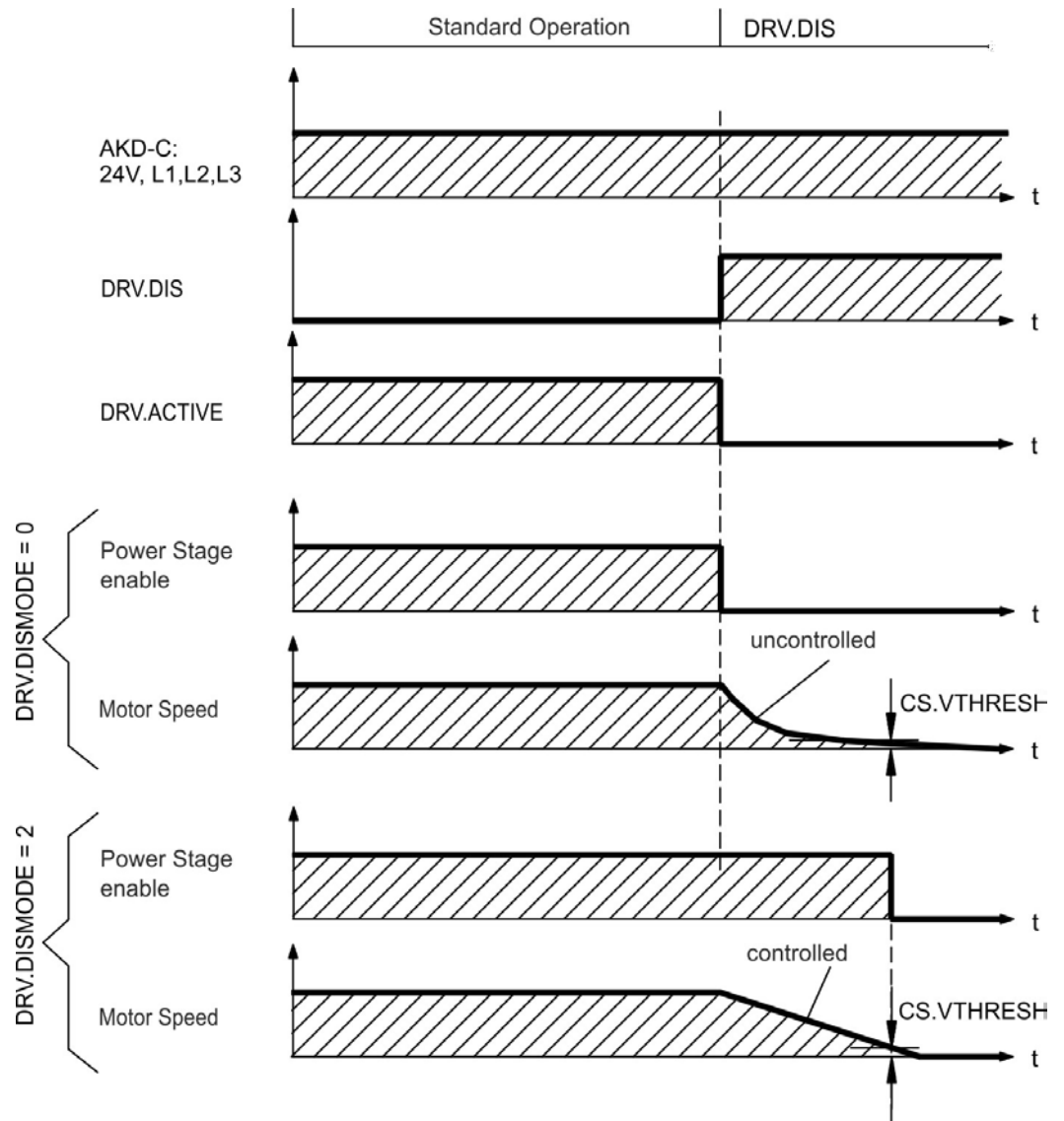


If velocity drops below threshold *CS.VTHRESH* or timeout occurs brake is applied.

6.13.2.2 Switch-off behavior using the DRV.DIS command

The enable/disable button in WorkBench issues a *drv.dis* command internally to the drive. See *AKD-N User Guide* for configuring inputs and software commands. Sometimes this enable signal is called "Software Enable" (SW-Enable).

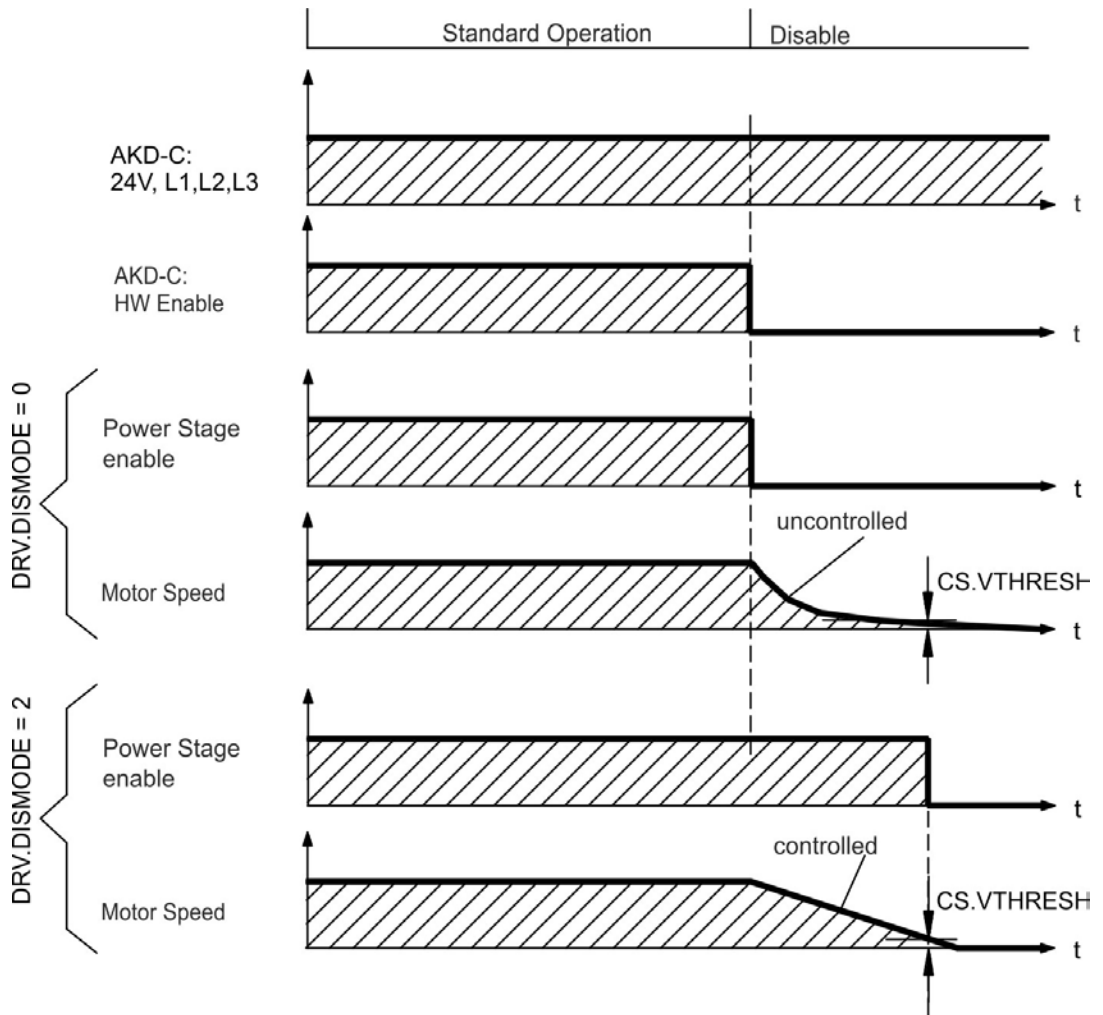
DRV.DISMODE 0	Disable axis immediately, if velocity drops below threshold <i>CS.VTHRESH</i> or timeout occurs brake is applied. Category 0 stop according to IEC 60204 (→ p. 36).
DRV.DISMODE 2	Use controlled stop to disable drive, if velocity drops below threshold <i>CS.VTHRESH</i> or timeout occurs brake is applied. Category 1 stop according to IEC 60204 (→ p. 36).



If velocity drops below threshold *CS.VTHRESH* or timeout occurs brake is applied.

6.13.2.3 Switch-off behavior using HW Enable input on AKD-C (uncontrolled stop)

This is a category 0 stop according to IEC 60204. The hardware enable input disables the AKD-N power stage immediately.



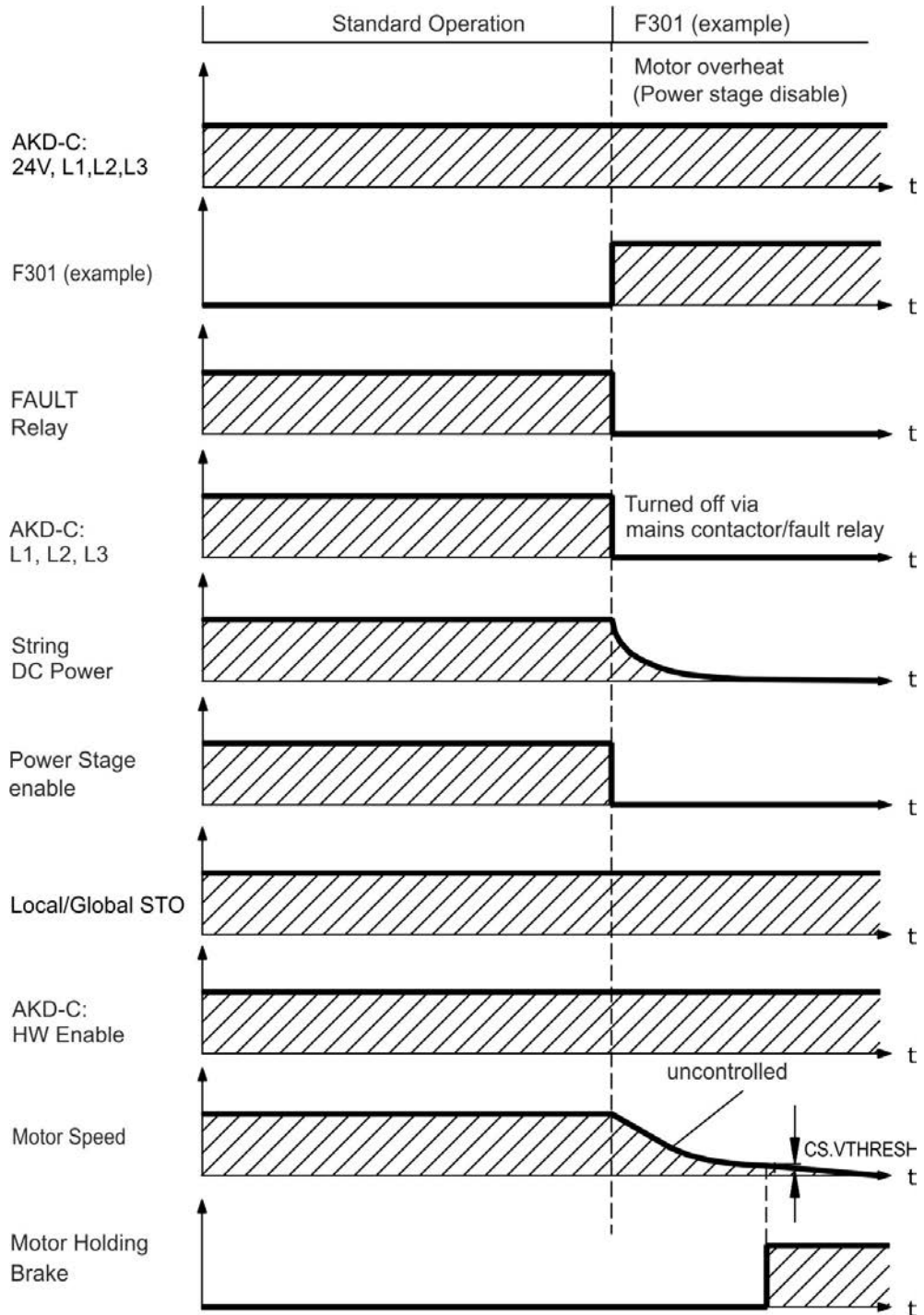
If velocity drops below threshold $CS.VTHRESH$ or timeout occurs the motor holding brake is applied. Set parameter `MOTOR.BRAKEIMM` to 1 with vertical axes, to apply the motor holding brake immediately after Hardware Disable.

6.13.2.4 Switch-off behavior in the event of a fault

The behavior of the drive always depends on the fault type and the setting of a number of different parameters (DRV.DISMODE, VBUS.UVFTHRESH, CS.VTHRESH, and others; see the *AKD-N User Guide* or WorkBench help for more details). See the *Drive Fault and Warning Messages and Remedies* section of the *AKD-N User Guide* for a table describing the specific behavior of each fault. The following pages show examples for the possible fault behaviors.

Switch-off behavior for faults that cause an immediate power stage disable

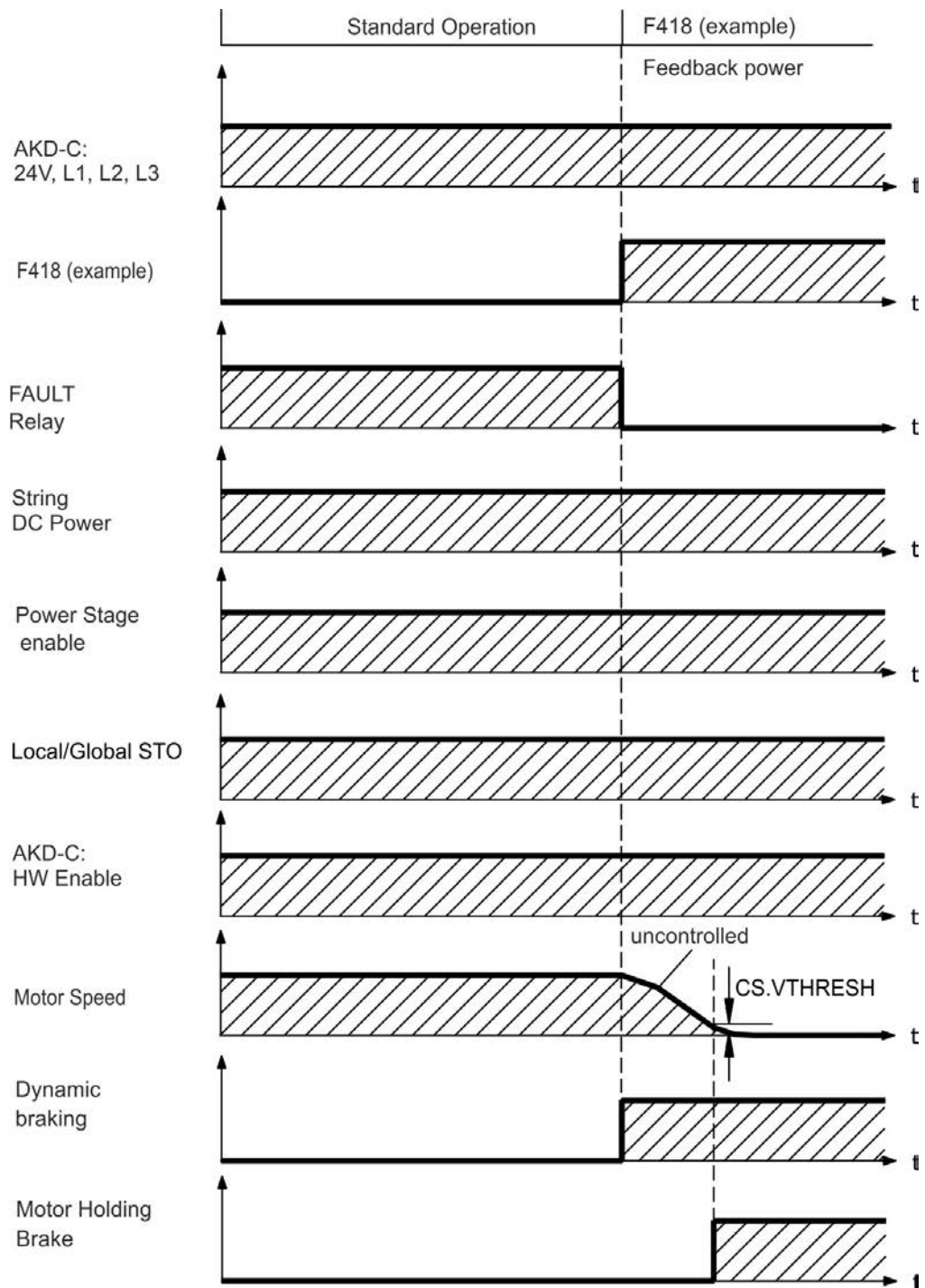
This is a category 0 stop according to IEC 60204.



If velocity drops below threshold $CS.VTHRESH$ or timeout occurs the motor holding brake is applied. Set parameter `MOTOR.BRAKEIMM` to 1 with vertical axes, to apply the motor holding brake immediately after faults.

Switch-off behavior for faults that cause dynamic braking

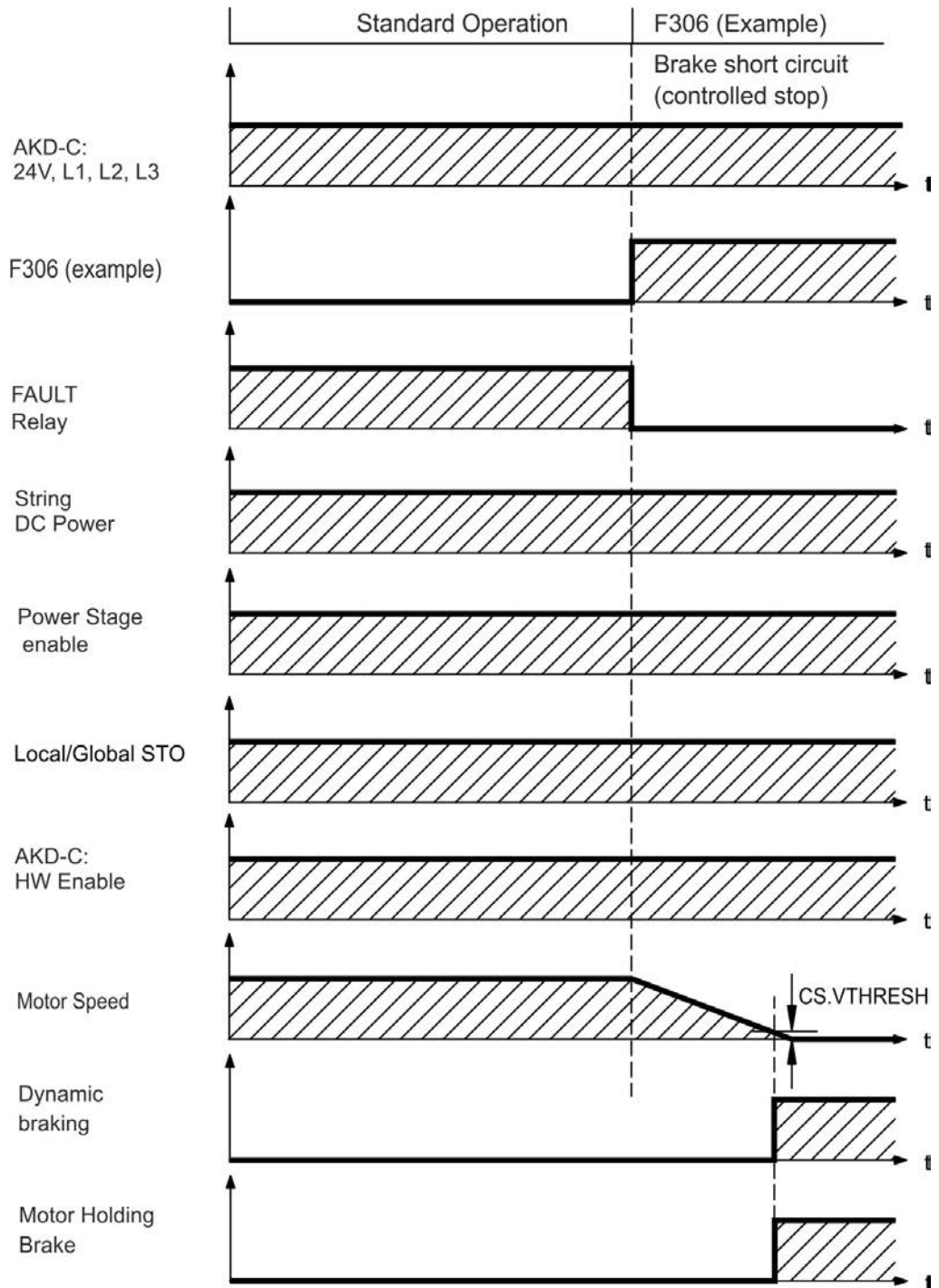
This is a category 0 stop according to IEC 60204.



If velocity drops below threshold $CS.VTHRESH$ or timeout occurs brake is applied .

Switch-off behavior for faults that cause a controlled stop

This is a category 1 stop according to IEC 60204.



If velocity drops below threshold $CS.VTHRESH$ or timeout occurs brake is applied .

6.14 Safe Torque Off (STO)

The STO functionality of AKD-N with option "DB" or "DF" is controlled by the AKD-C smart power supply via the specific string, where the AKD-N is connected to. This STO topology is called "*Global STO*" or "*String STO*".

AKD-N drives with option "DS" offer an additional connector X6 with a digital STO-Enable input. This STO functionality is called "Local STO". These drive variants cannot be safety controlled by the global STO functionality.

6.14.1 Global STO, control via AKD-C

Connector X16 on the AKD-C offers access to all STO (Safe Torque Off) signals of the decentral drive system powered by this AKD-C. There is one STO-Enable input and one STO-Status output for each DC Power string.

The global STO function is described in the *AKD-C Installation Manual*. Application examples can be found in the *Decentralized System Projecting Guide*.

NOTE

The global STO function uses the following devices: AKD-C, AKD-N without option "DS", Kollmorgen hybrid connection cable.

NOTE

In case of using an AKD-N with option "DS" (local STO input), the global STO-Enable signal will have not influence to this specific drive. The local STO-Status of this drive nevertheless is monitored in the string STO-Status.

6.14.2 Local STO, control via digital input on AKD-N-DS

Option "DS" on the AKD-N offers local STO-Enable functionality. There is one STO-Enable input on X6 and one STO-Status output on X3 for the drive. The STO-Status outputs on X3 are available only with AKD-N drives with option "DS".

6.14.3 Safety characteristic data

The subsystems are described with the following characteristics:

Device	Operation Mode	ISO 13849-1	IEC 62061	PFH [1/h]	T _M [Years]	SFF [%]
STO	STO single channel	PL d, CAT 3	SIL 2	i.p.	i.p.	i.p.

NOTICE

A very unlikely but possible event can happen, if within a very short time 2 not adjacent IGBTs will have a short circuit. In such case a movement of maximum an angle of 120° (electrical) can happen. This effect can only happen if the drive is in the function STO. If the total failure rate of the IGBT is 120 fit normally for such short circuit 60 fit will be valid (50:50 model). By such event 2 specific IGBTs have to fail at same time. The calculation shows a probability of $1.5 \cdot 10^{-15}$ per hour (without common cause failure). Even if the STO function will be issued for a whole year, this event will only happen every 100 Billion years.

6.14.4 Response Time

Global STO

The delay from falling edge at global STO Enable input until energy supply to the motors is interrupted, depends on the number of connected AKD-N to the string. Maximum reaction time is 10 ms. The more AKD-N are connected to the string, the shorter is the reaction time.

Local STO

The delay from falling edge at local STO Enable input until energy supply to the motor is interrupted is maximum 10 ms.

6.14.5 Use as directed

The STO function is exclusively intended to provide a functional safe torque off of the drive. To achieve this functional safety, the wiring of the safety circuits must meet the safety requirements of IEC 60204, ISO 12100 and ISO 13849.

If the local STO function is in use, then the input STO must be connected to the exit of a safety control or a safety relay, which at least meets the requirements of PLd, CAT 3 according to ISO 13849.

The 24 VDC supply unit for local STO supply must accord to PELV/SELV (EN 60204-1) requirements.

6.14.6 Prohibited use

The STO function must not be used if the drive is to be made inactive for the following reasons:

- Cleaning, maintenance and repair operations, long inoperative periods. In such cases, the entire system should be disconnected from the supply and secured (main switch).
- Emergency-Off situations. In an Emergency-Off situation, the main contactor is switched off (by the Emergency-Off button).
- Wiring the system with hybrid cables from other manufacturers than Kollmorgen is not allowed.
- Changing cables or connectors is not allowed.
- Do not use STO Status signals for functional safety.

6.14.7 Enclosure, wiring

Observe the required ambient conditions as described in chapter "Ambient Conditions, Ventilation, and Mounting Position" (→ p. 24). The AKD-N can be used in an environment that meets IP67.

The cables must be laid durably (firmly), protected from outside damage (for example, by laying the cable in a duct), placed in different sheathed cables, or protected individually by grounding connection.

Wiring must meet the requirements of the standard IEC 60204-1.

6.14.8 Local STO safety instructions



WARNING

The drive cannot hold a vertical load when STO is active. Serious injury could result when load is not properly blocked. Drives with a suspended load must have an additional safe mechanical blocking (for instance, by a motor-holding brake).

The drives have not to be used for driving elevators.



CAUTION

In case of a specific double fault within a very short time (see → p. 36) a single movement of maximum an angle of 120° (electrical) can happen. This effect can only happen if the drive is in the function STO.

Even if the STO function will be issued for a whole year, this event will only happen every 100 Billion years.



CAUTION

The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting. Risk of death or serious injury for humans working in the machine.

If the parameter DRV.ENDEFAULT is set to 1, then place a warning sign to the machine (Warning: Automatic Restart at Power On) and ensure, that power on is not possible, while humans are in a dangerous zone of the machine. In case of using an undervoltage protection device, you must observe EN 60204-1:2006 chapter 7.5 .



CAUTION

The STO function does not provide an electrical separation from the power output. There is a danger of electrical shock and personnel injury. If access to the motor power terminals is necessary, the drive must be disconnected from AKD-C considering the DC Bus discharging time.

NOTICE

If the safety function STO is automatically activated by a control system, then make sure that the output of the control is monitored for possible malfunction. The monitoring can be used to prevent a faulty output from unintentionally activating the STO function. Since the local STO function is a single-channel system, erroneous engaging will not be recognized.

NOTICE

It is not possible to perform a controlled brake if the drive controlled STO-Enable is off. If controlled braking before the use of the STO function is necessary, the drive must be braked and the input STO must be separated time-delayed from +24 V .

NOTE

The STO Status signals are informal and not relevant for functional safety.

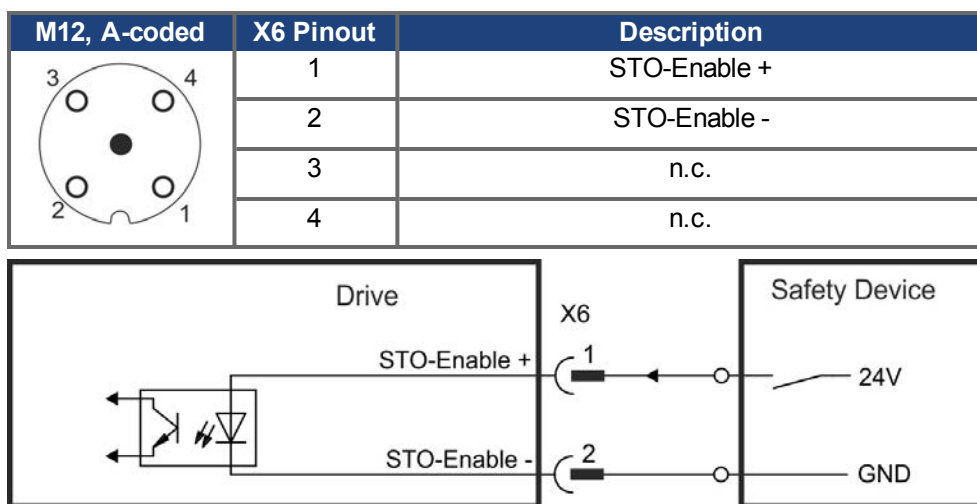
6.14.9 Technical data and pinout local STO

NOTE

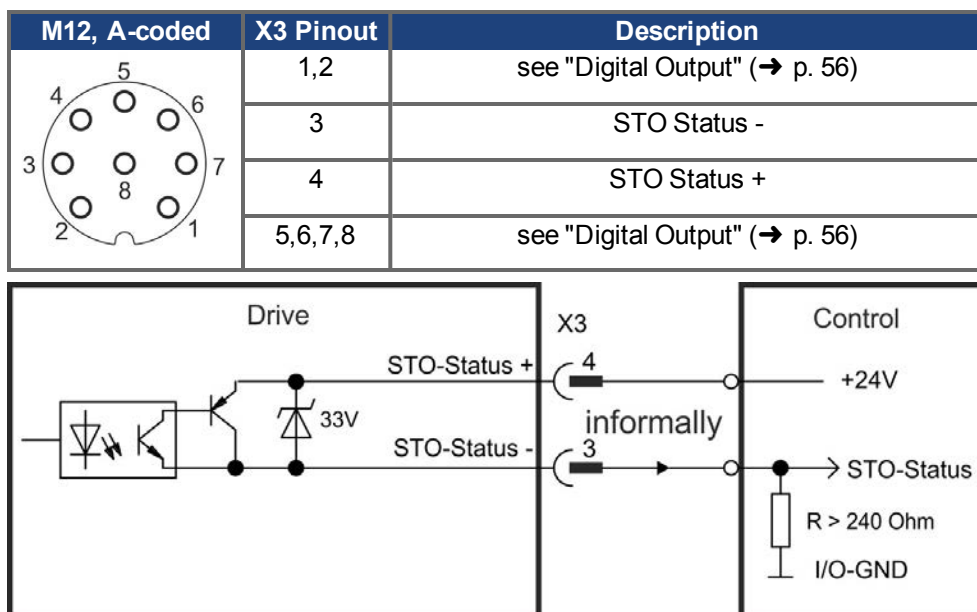
The local STO input is not compatible with IEC 61131-2.

STO-Enable input	<ul style="list-style-type: none"> • Input does not match IEC61131-2 • ON: 18 VDC to 30 VDC, 100 mA • OFF: 0 VDC to 12 VDC, < 50 mA • Galvanic isolation for 250 VDC • Tolerated OSSD pulse duration 0.3 ms
STO-Status outputs	<ul style="list-style-type: none"> • As per IEC61131-2 type 1 • Max. 30 VDC, 100 mA • Galvanic isolation for 250 VDC
24 VDC Power supply	<ul style="list-style-type: none"> • PELV/SELV acc. to EN 60204-1 • Output 24 VDC +/-10%

Wiring diagram local STO-Enable



Wiring diagram local STO-Status



6.14.10 Functional description local STO

With AKD-N with option DS, an additional digital input (STO) releases the power output stage of the drive as long as a 24 V signal is applied to this input. When the local STO function (Safe Torque Off) is not needed, then the input STO must be connected directly to +24 VDC. The function is then bypassed and cannot be used.

NOTE The global STO signal will have no influence to this drive. The local STO input on the AKD-N has no influence to the global STO as well.

Local STO-Enable	String HW Enable	Local STO-Status	Safety acc. to SIL2	Drive can produce Torque
0 V	no	high	yes	no
0 V	yes	high	yes	no
+24 V	no	low	no	no
+24 V	yes	low	no	yes

When STO function is engaged during operation by separating input STO-Enable from 24 V, the connected motor slows down without control.

NOTICE Use the following functional sequence when the STO function is used:

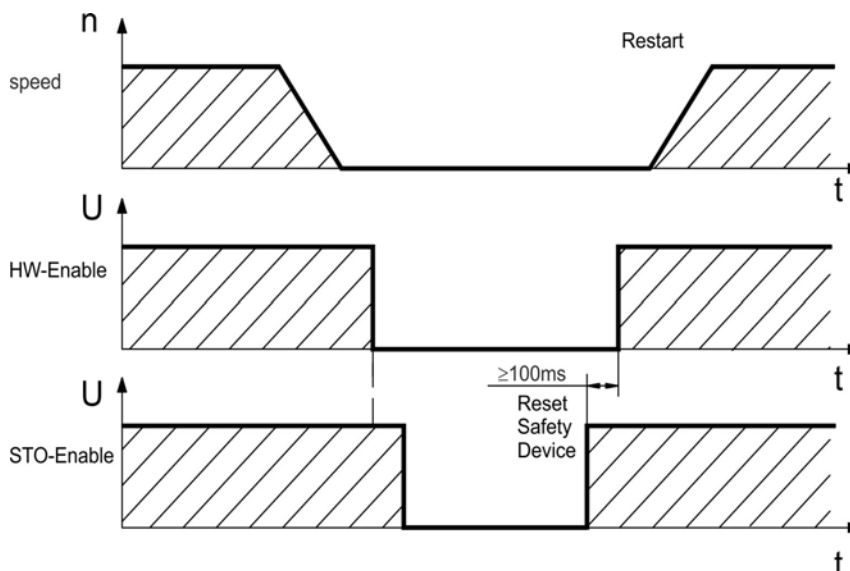
1. Brake the drive in a controlled manner (speed setpoint = 0 V).
2. When speed = 0 rpm, disable the drive (enable = 0 V).
3. If a suspended load is present, block the drive mechanically.
4. Activate the STO function.

NOTE It is not possible to perform a controlled brake if the drive STO-Enable is off. If controlled braking prior to the use of the STO function is necessary, the drive must be braked first and the input STO must be separated from +24 V time-delayed.

6.14.10.1 Signal diagram (sequence)

The diagram below shows how to use STO function for a safe drive stop and fault free operation of the drive. This sequence is valid for local and global STO functionality.

1. Brake the drive in a controlled manner (speed setpoint = 0 V).
2. When speed = 0 rpm, disable the drive (Enable = 0 V).
3. Activate the STO function (local STO-Enable = 0 V)
4. For restart you must reset the safety device.



6.14.11 Functional test

NOTICE

You must test the safe torque off function after initial start of the drive, after each interference into the wiring of the drive, or after exchange of one or several components of the drive.

6.14.11.1 Global STO

First Method:

1. Stop drives in the string with setpoint 0 V. Keep drives enabled.
DANGER: Do not enter hazardous area!
2. Activate the global STO function for example by opening protective screen of the string, where the drives are connected (voltage at AKD-C X16/6 or X16/8 0V).
3. The AKD-C fault contact opens, the corresponding string STO-Status message (X16/1 or X16/2) changes the voltage level, the drives lose torque and slow down to zero speed without control.

Second Method:

1. Stop all drives in the string with setpoint 0 V, disable the string.
2. Activate the global STO function, for example, by opening protective screen (voltage at AKD-C X16/6 or X16/8 0V)
3. The corresponding string STO-Status message (X16/1 or X16/2) changes the voltage level, the string cannot be enabled.

6.14.11.2 Local STO

First Method:

1. Stop the drive with setpoint 0 V. Keep drive enabled.
DANGER: Do not enter hazardous area!
2. Activate the local STO function for example by opening protective screen of the drive, (voltage at AKD-N X6/1 0V).
3. The drive lose torque and slows down to zero speed without control.

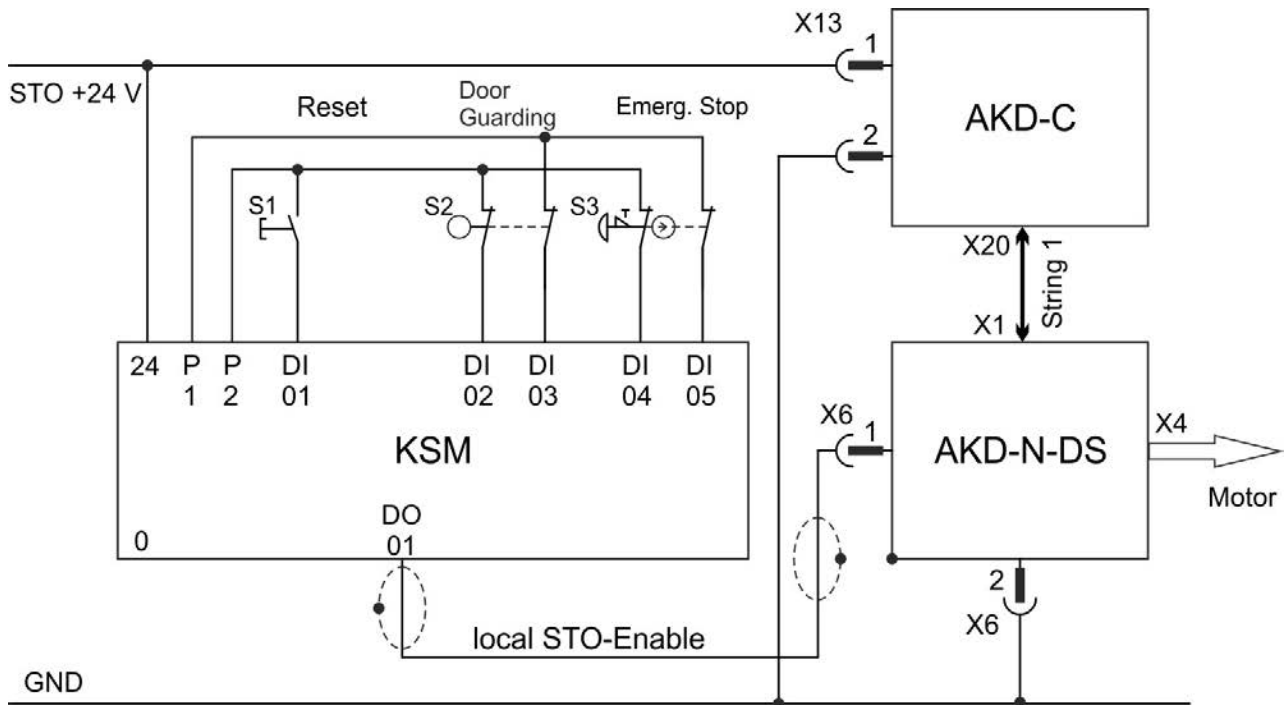
Second Method:

1. Stop the drive with setpoint 0 V, disable drive.
2. Activate the STO function, for example, by opening protective screen (voltage at AKD-N X6/1 0V)
3. The drive cannot be enabled.

6.14.11.3 Local STO application example

The sample application below shows door guarding and emergency stop, controlled by Kollmorgen KSM safety module to switch the local STO-Enable input of an AKD-N-DS drive according to SIL2, PLd.

For detailed application examples refer to the *Decentralized System Projecting Guide*.



Refer to the KSM safety modules documentation for pinout and functionality of the Kollmorgen KSM Modules. These documents can be downloaded from the Kollmorgen website.

7 Mechanical Installation

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7.2 Temperature Management	44
7.3 Mechanical Drawings	45

7.1 Important Notes



CAUTION

There is a danger of electrical shock by high EMC level which could result in injury, if the drive (or the motor) is not properly EMC-grounded.



CAUTION

AKD-N Drives may have hot surfaces during operation. The housing can reach temperatures above 80°C. Risk of minor burns! Measure the temperature, and wait until the housing has cooled down below 40°C before touching it.

Ensure free space of minimum 50 mm to all sides of the drive.

NOTICE

Protect the drive from impermissible stresses. In particular, do not let any components become bent or any insulation distances altered during transport and handling. Avoid contact with electronic components and contacts.

NOTICE

The drive will switch itself off in case of overheating. Ensure that the mounting space matches the requirements (→ p. 24).

NOTICE

Do not mount devices that produce magnetic fields directly beside the drive. Strong magnetic fields can directly affect internal components. Install devices which produce magnetic field with distance to the drives and/or shield the magnetic fields.

NOTE

An optimized thermal strategy is mandatory for AKD-N performance. Observe the information given in the *Decentralized System Projecting Guide* and in chapter "Temperature Management" (→ p. 44)

7.2 Temperature Management

The possible continuous output current and output power depends on the cooling situation for the AKD-N. For a detailed calculation of temperature behavior of the decentralized drive system based on the special machinery architecture, please contact the Kollmorgen customer support.

Optimum cooling situation to reach rated power:

Cold plate requirements with 40°C surrounding temperature at 680 VDC supply voltage:

- AKD-N 3 A : 240 mm x 240 mm x 10 mm
- AKD-N 6 A : 500 mm x 500 mm x 10 mm

For a rough overview the three level rating below may help.

1. Optimum cooling situation
Cold plate size definition fulfilled, no additional heat sink required
2. Medium cooling situation
Example: 65% cooling plate available
Use the optional small heat sink (40 mm height) to reach optimum situation
3. Bad cooling situation
Example: 50% cooling plate available
Use the optional big heat sink (50 mm height) to reach optimum situation.

The heat sink variants are described in the regional accessories manual.

7.3 Mechanical Drawings

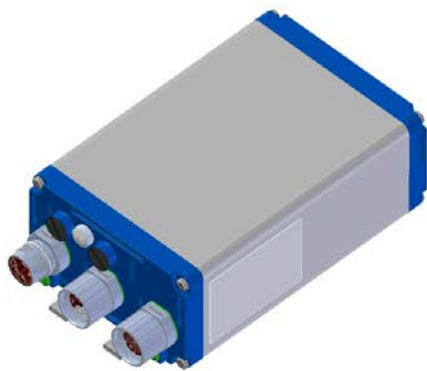
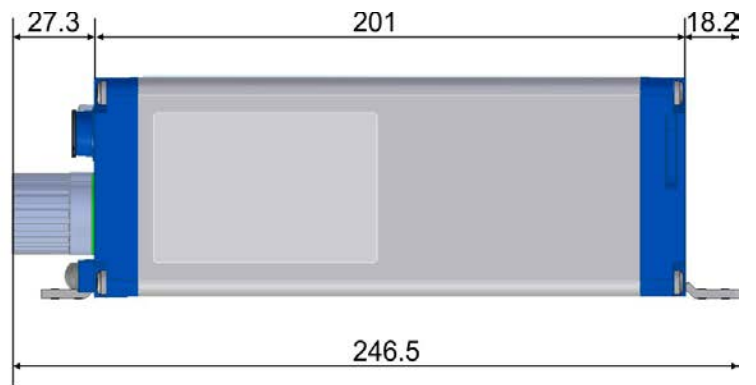
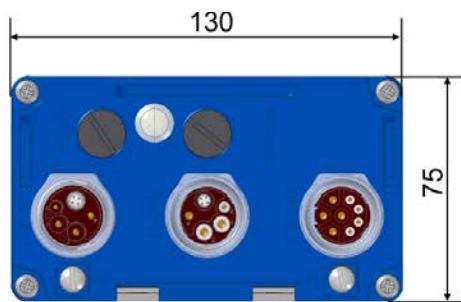
7.3.1 Dimensions AKD-N, preferred mounting

Material:

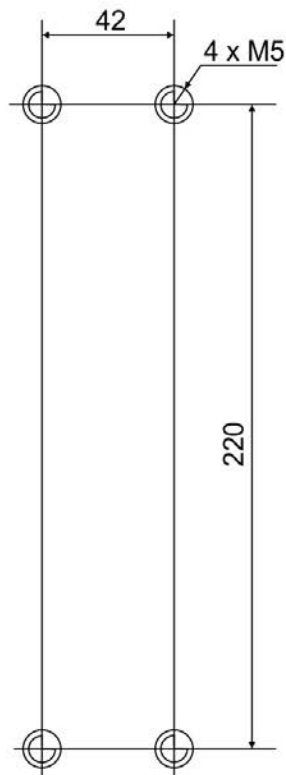
- Four mounting clamps (part of delivery)
- Four M5 hexagon socket screws to ISO 4762, use 4 mm T-handle Allen key
- Heat conducting film (order code 849-373000-04)

NOTE

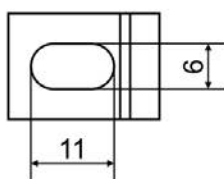
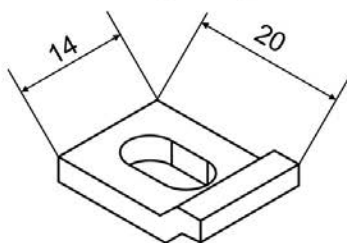
Ensure free space of minimum 50 mm to all sides of the AKD-N.



Drill plan, preferred mounting



4 Mounting Clamps



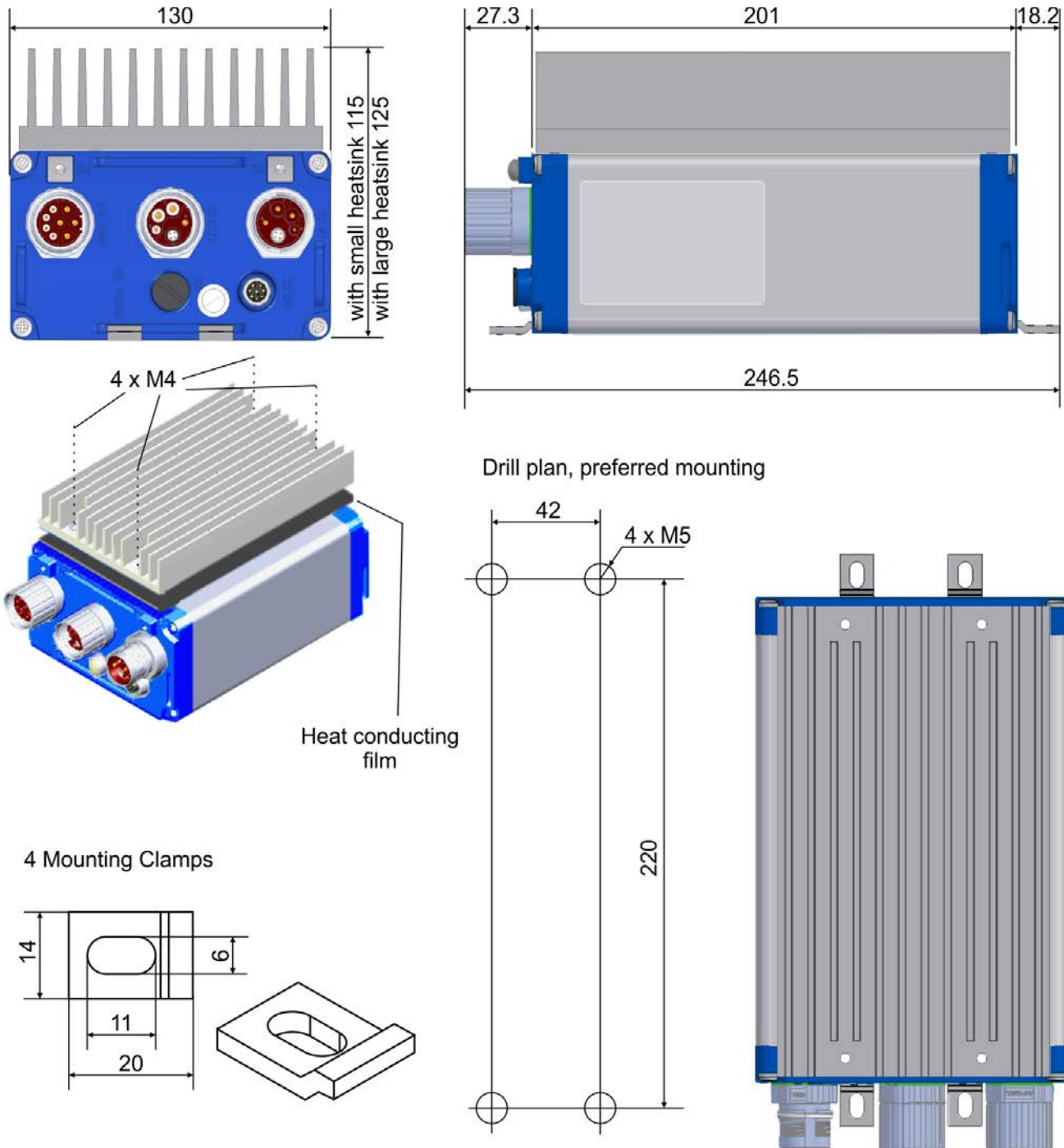
7.3.2 Dimensions AKD-N with optional heat sink, preferred mounting

Material:

- Four mounting clamps (part of delivery)
- Four M5 hexagon socket screws to ISO 4762, use 4 mm T-handle Allen key
- Four M4x16 hexagon socket screws to ISO 4762 (part of delivery), use 3 mm T-handle Allen key
- Heat conducting film (order code 849-373000-04)
- Heat sink 40 mm (option, see regional Accessories Manual)
- Heat sink 50 mm (option, see regional Accessories Manual)

NOTE

Ensure free space of minimum 50 mm to all sides of the AKD-N.



8 Electrical Installation

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8.1 Important Notes



DANGER

Never remove electrical connections to the drive while it is live. There is a danger of electrical arcing with damage to contacts and serious personal injury. Capacitors can still have dangerous voltages present up to 7 minutes after switching off the supply power. Always measure the voltage in the DC bus link at connector X14 at AKD-C and wait until the voltage is below 60 V before handling components. Control and power connections can still be live, even if the motor is not rotating. The built-in LED does **not** indicate the real voltage level.



CAUTION

Since the leakage current to PE is more than 3.5 mA, in compliance with IEC 61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section $>10 \text{ mm}^2$ must be used. There is a danger of electrical shock with possible personal injury. Deviating measures according to regional standards might be possible.

NOTICE

Wrong DC Bus link voltage, unsuitable motor or wrong wiring will damage the drive. Check the combination of drive and motor. Compare the rated voltage and current of the units. Implement the wiring according to the connection diagrams: → p. 51.

It is permissible to use the setup software to alter the settings of the drive. Any other alterations will invalidate the warranty.

8.2 Guide to Electrical Installation

Install the drive electrical system as follows:

1. Select cables (→ p. 25.) in accordance with the planned system topology (→ p. 49).
2. Install grounding (PE) and ground the drive.
Ground the mounting plate, motor housing and CNC-GND of the control system.
3. Wire the drive:

NOTICE

The connectors are close to each other on the drive. To ensure simple handling, observe the connector mounting sequence: X2 - X1 - X4 - X5 - X3 - X6

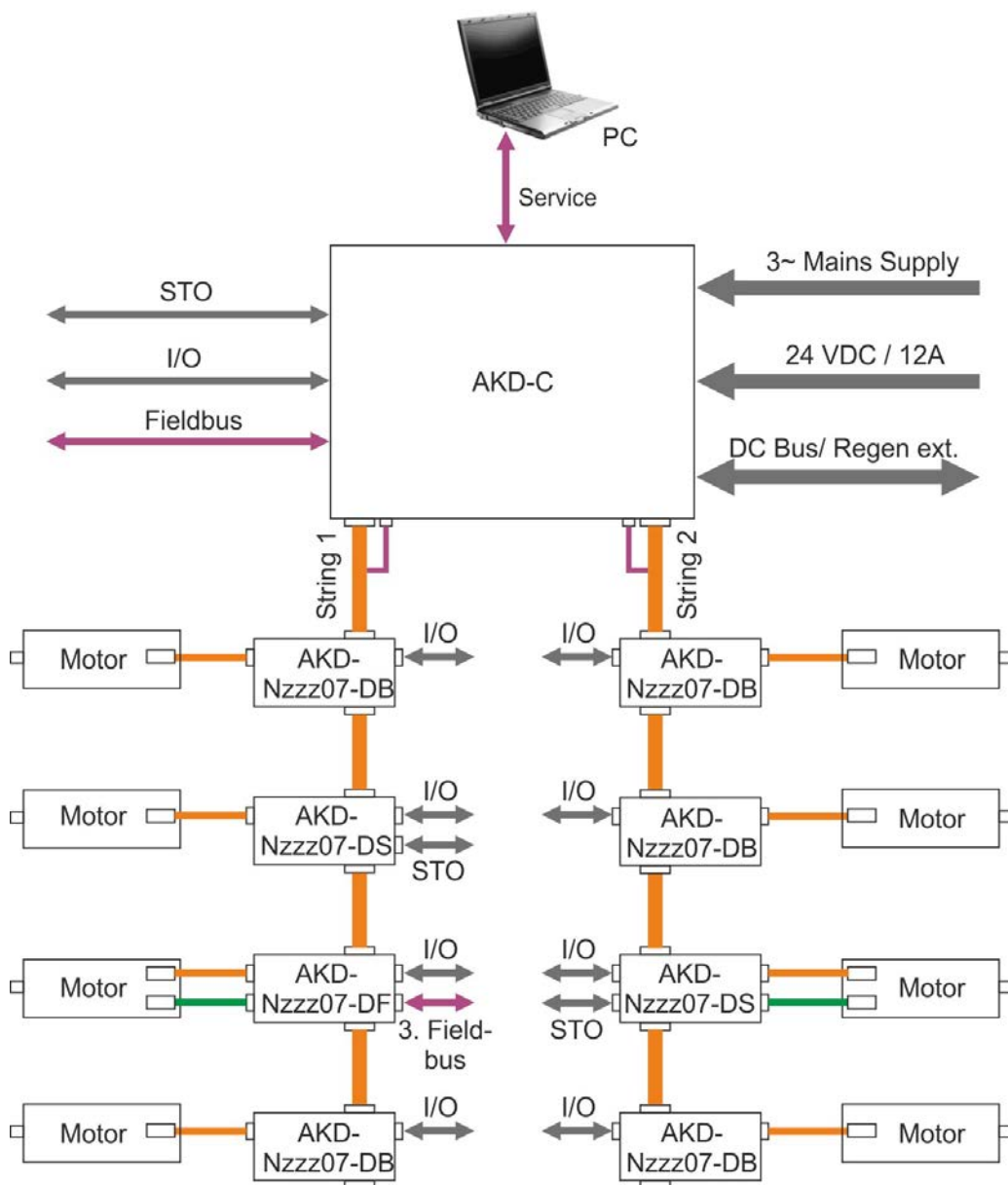
- Connect the hybrid power cable between AKD-C X20 or X21 and AKD-N X1, max. length 40 m.
 - Connect the hybrid power cables between the AKD-N drives X1/X2, max. length 25 m.
 - Dual line connection:
Connect the motor cable to X4, max. length 5 m.
Connect the feedback device to X5, max. length 5 m.
 - Single line connection:
Connect the hybrid motor cable to X4, max. length 5 m.
4. Check the wiring against the planned system topology diagrams (→ p. 49).

8.3 System Topology of a Decentralized Servo System

8.3.1 System limits

String length:	maximum 100 m total cable length per string
Number of AKD-N:	maximum 8 per string observe total power/current restrictions described in the <i>Decentralized System Projecting Guide</i>
Sum of output current of string 1 and string 2:	17 A, calculate coincidence factor of the axes
Standby Power:	Standby power is limited to 260 W at 24 V for both strings. This power must supply all AKD-N (8 W each) and the remaining power can be used for motor holding brakes.

8.3.2 Example



8.4 Wiring



DANGER

There is a danger of electrical arcing which can cause serious personnel injury. Only install and wire the equipment when it is not live, that is, when neither the electrical supply nor the 24 V auxiliary voltage nor the supply voltages of any other connected equipment is switched on.

Make sure that the cabinet is safely disconnected (for instance, with a lock-out and warning signs). The individual voltages are switched on for the first time during setup.

The built-in LED does **not** safely indicate the real voltage level. Always measure the voltage in the DC bus link at connector X14 at AKD-C and wait until the voltage is below 60 V before handling any component in the decentral servo system.

NOTICE

Only professional staff who are qualified in electrical engineering are allowed to install the drive. Wires with color green with one or more yellow stripes must not be used other than for protective earth (PE) wiring.

NOTE

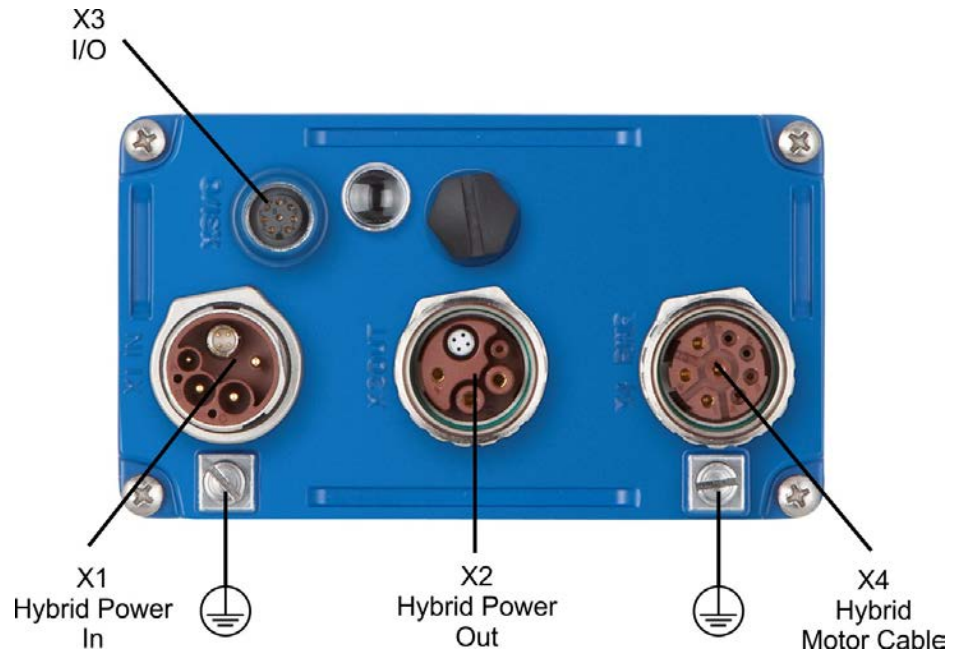
The ground symbol, which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest feasible surface area between the unit indicated and the mounting plate in the control cabinet. This connection is for the effective grounding of HF interference, and must not be confused with the PE-symbol (PE = protective earth, safety measure as per IEC 60204).

Use the following connection diagrams:

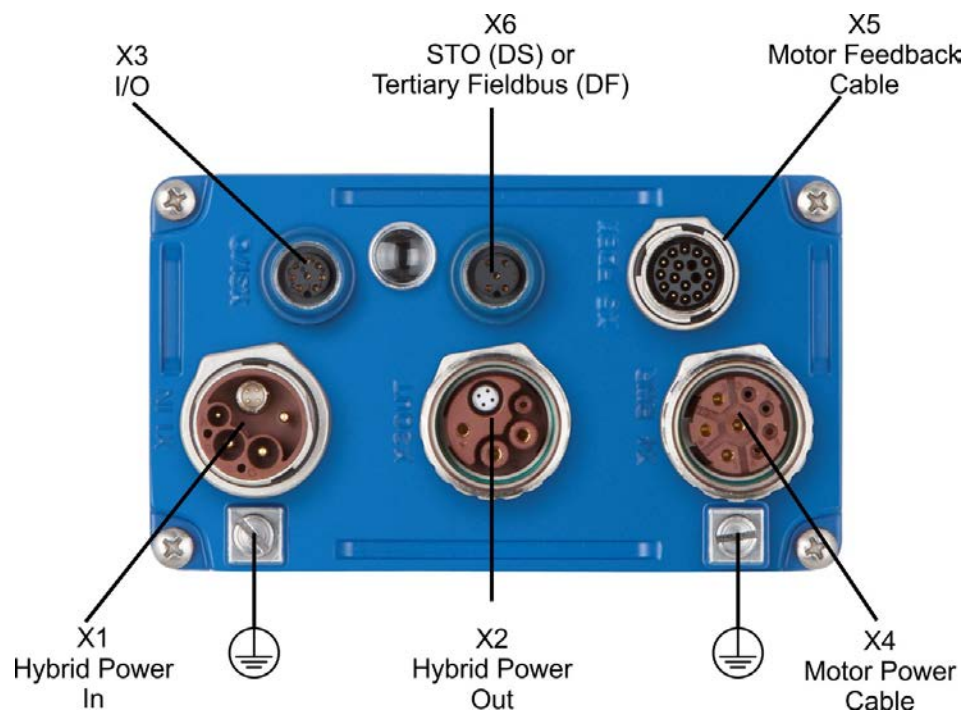
Overview AKD-N variant DB	→ p. 52
Overview AKD-N variant DS/DF	→ p. 53
DC power and Fieldbus connection	→ p. 54
Digital inputs and outputs	→ p. 54
Motor Power	→ p. 57
Motor Brake	→ p. 58
Motor Feedback	→ p. 59
Tertiary motion bus interface	→ p. 61
Local STO	→ p. 61

8.5 Connection Overview

8.5.1 Connector assignment AKD-Nzzz07-DB

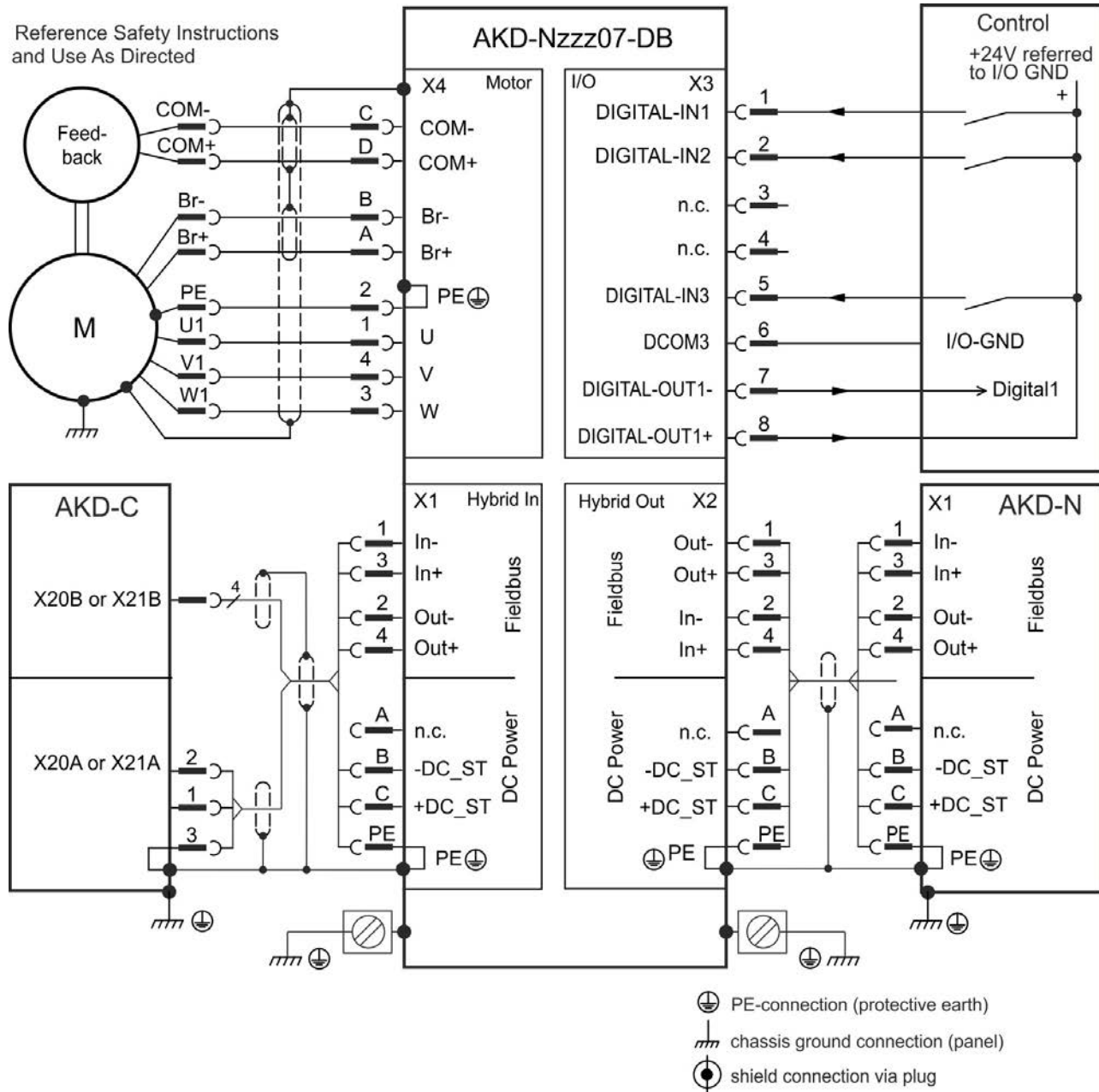


8.5.2 Connector assignment AKD-Nzzz07-DF/DS



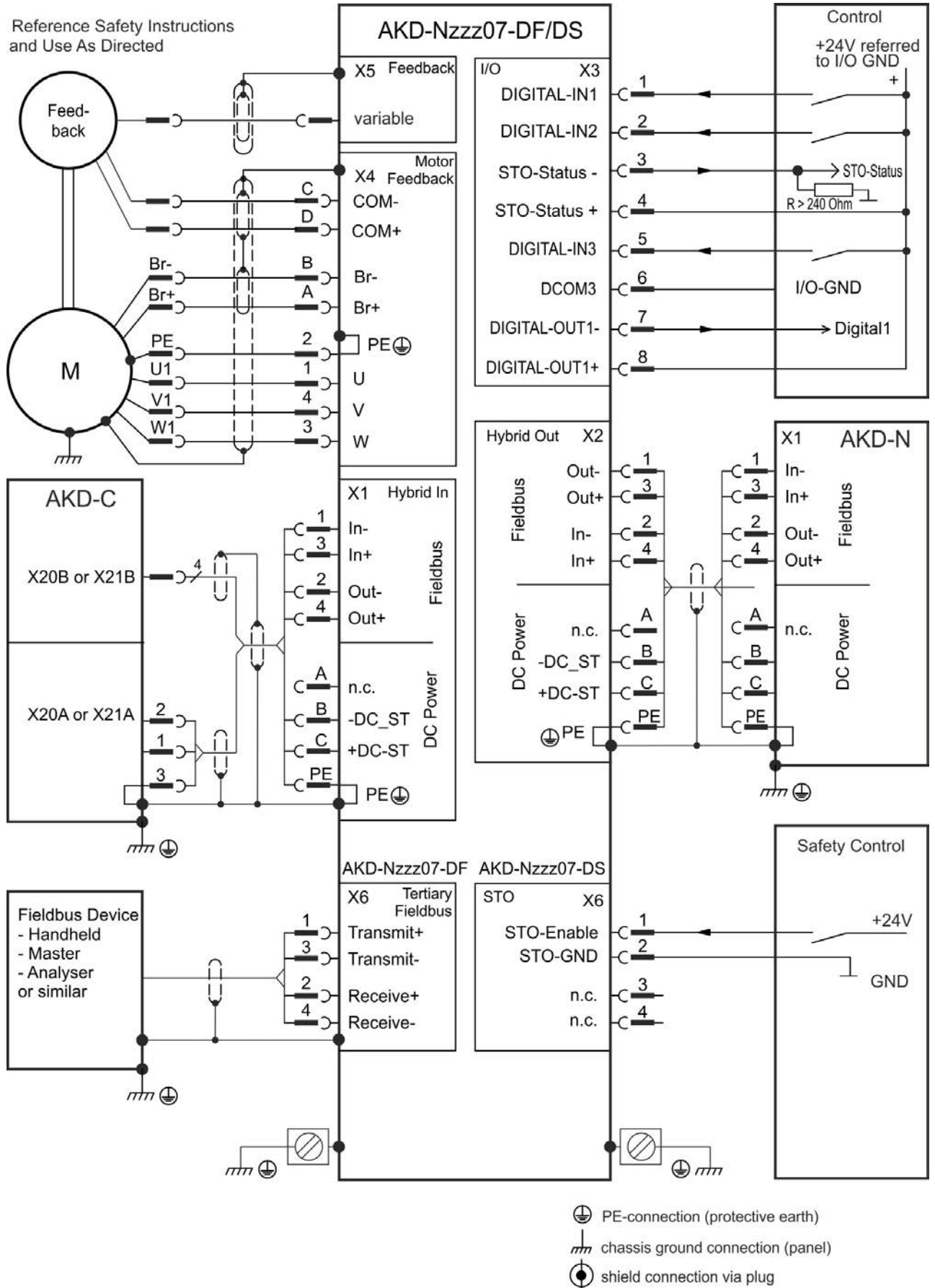
8.5.3 Connection diagram AKD-Nzzz07-DB

Reference Safety Instructions and Use As Directed

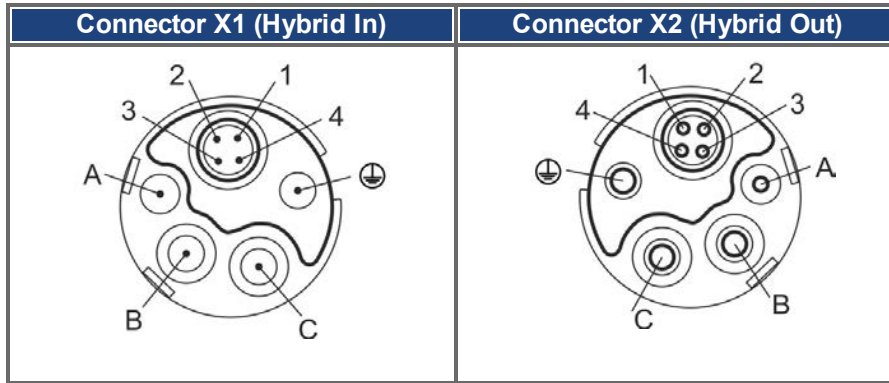


8.5.4 Connection diagram AKD-Nzzz07-DF/DS

Reference Safety Instructions and Use As Directed



8.6 Hybrid Connection (X1, X2)



Pinout

Pin	Usage X1	Usage X2
A	not connected	not connected
B	-DC_ST	-DC_ST
C	+DC_ST	+DC_ST
PE	PE	PE
1	Receive -	Transmit -
2	Transmit -	Receive -
3	Receive +	Transmit+
4	Transmit +	Receive +

8.7 I/O Connection (X3)

M12, A-coded	X3	Description	Abbreviation	Function
	1	Digital Input 1	DIGITAL-IN 1	Programmable
	2	Digital Input 2	DIGITAL-IN 2	Programmable
	3*	STO-Status -	STO-Status -	local STO-Status
	4*	STO-Status +	STO-Status +	local STO-Status
	5	Digital Input 3	DIGITAL-IN 3	Programmable
	6	Digital Common	DCOM3	Common line for pins 1, 2, 5
	7	Digital Output 1-	DIGITAL-OUT1-	Programmable
	8	Digital Output 1+	DIGITAL-OUT1+	Programmable

* STO-Status signals are available for AKD-N with option "DS" only.

The DCOM3 line should be connected to the 0V of the I/O supply when using sensors of type "Source" with digital inputs.

The DCOM3 line should be connected to the 24V of the I/O supply when using sensors of type "Sink" with digital inputs.

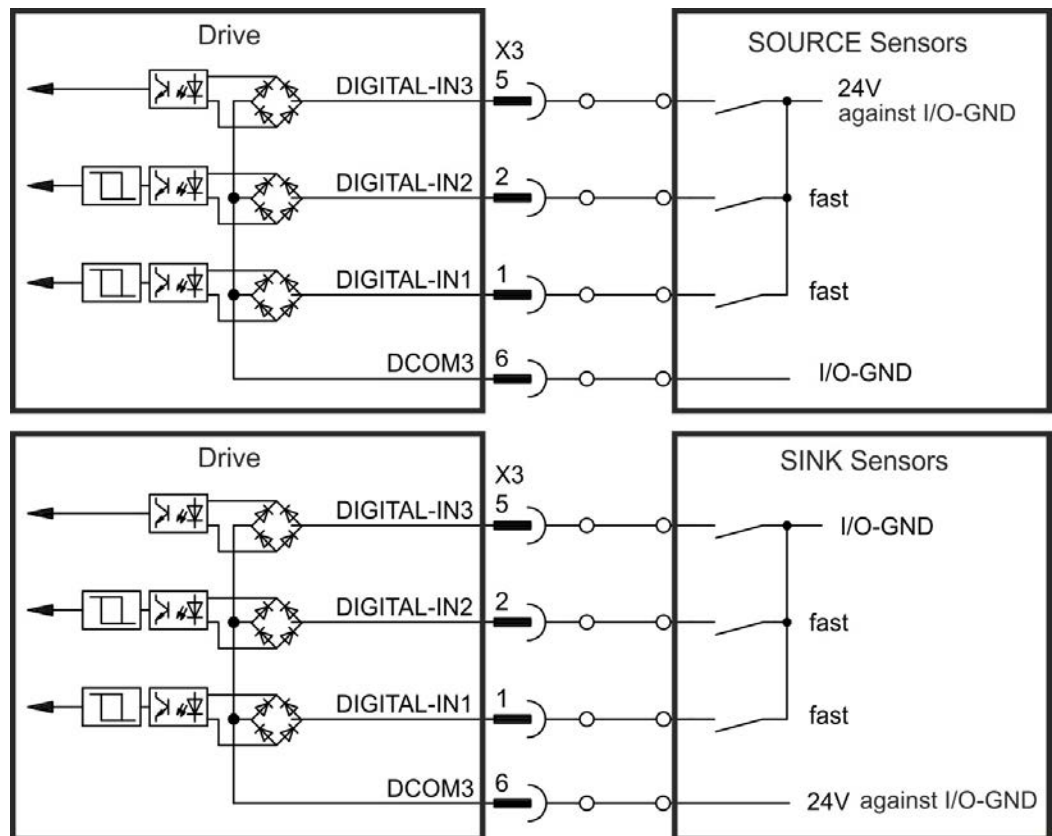
8.7.1 Digital Inputs

The drive provides 3 digital inputs. These can be used to initiate pre-programmed functions that are stored in the drive. A list of these pre-programmed functions is included in the WorkBench. If an input is programmed, it must be saved to the drive. By default, all inputs are not programmed (off). For more information refer to the setup software.

NOTE

Depending on the selected function, the inputs are high or low active. The inputs can be used with switched +24 V (source type) or switched GND (sink type).

Digital Input Wiring Diagram:



Digital Inputs 1 and 2

These inputs are particularly fast and are therefore suitable for latch functions, for example.

Technical characteristics:

- Floating, reference common line is DCOM3
- Sink or Source type sensors possible
- High: 15 to 30 V / 2 to 15 mA , Low: -3 to +5 V / <1 mA
- Update rate: Hardware 2 μ s

Digital Input 3

Choose the function you require in WorkBench.

Technical characteristics:

- Floating, reference common line is DCOM3
- Sink or Source type sensors possible
- High: 15 to 30 V / 2 to 15 mA , Low: -3 to +5 V / <1 mA
- Update rate: Software 250 μ s

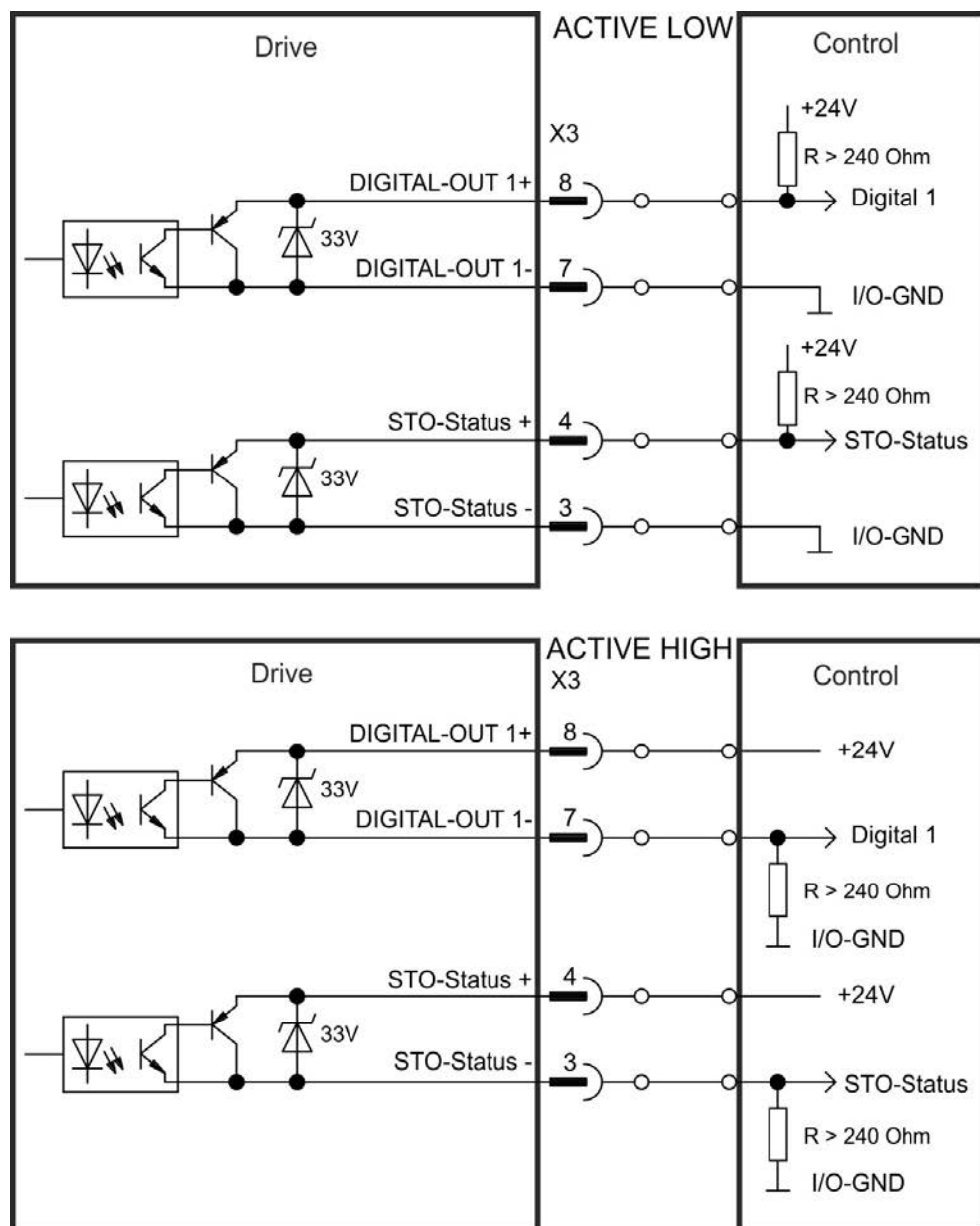
8.7.2 Digital Output

The drive supplies one programmable digital output and the permanent STO-Status output for drives with "DS" option. For the programmable output choose the required function in the setup software. Messages from pre-programmed functions stored in the drive can be output here. A list of these pre-programmed functions can be found in the setup software. If an output is to be assigned to a pre-programmed function, then the parameter set must be saved in the drive. By default, the output is not programmed (off). For more information refer to the setup software.

Technical characteristics:

- STO-Status signal is available for AKD-N with option "DS" only.
- 24 V , 20 VDC to 30 VDC
- All digital outputs are floating, max. 100 mA
- Can be wired as active low or active high (see examples below)
- Update rate: 250 μ s

Wiring diagram:



8.8 Motor Power Connection (X4)

Together with the motor supply cable and motor winding, the power output of the drive forms an oscillating circuit. Characteristics such as cable capacity, cable length, motor inductance, and frequency determine the maximum voltage in the system.

The AKD-N drive is able to protect the connected motor from overloading, if the parameters are set correctly and the thermal protection sensor is connected and supervised. With Kollmorgen motors the valid data are automatically set by the internal motor database. With motors from other manufacturers the data from the nameplate must be entered to the referring fields in the motor view of the Kollmorgen setup software WorkBench.

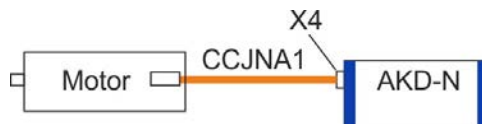
NOTICE

The dynamic voltage rise can lead to a reduction in the motor operating life and, on unsuitable motors, to flashovers in the motor winding.

- Only install motors with insulation class F (acc. to IEC60085) or above.
- Only install Kollmorgen cables that meet the requirements → p. 25.

8.8.1 Connector X4 AKD-Nzzz07-DB/DS/DF, hybrid, single line

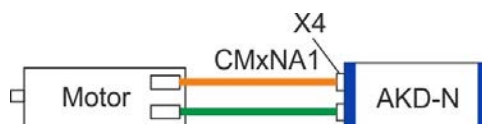
Motors with single line connection (motor power lines, motor holding brake lines and motor feedback lines combined in one hybrid cable) can be connected to X4 of the AKD-Nzzz07-DB or -DS variants.



	X4	Signal	Description
<p>The diagram shows a circular terminal block with four pins labeled 1, 2, 3, and 4. Pin 1 is connected to 'U', pin 2 to 'PE', pin 3 to 'W', and pin 4 to 'V'. There are also labels A, B, C, and D around the perimeter of the terminal block.</p>	A, B, C, D	...	Feedback (→ p. 59), Brake (→ p. 58)
	1	U	Motor phase U
	2	PE	Protective earth (motor housing)
	3	W	Motor phase W
	4	V	Motor phase V

8.8.2 Connector X4 AKD-Nzzz07-DF/DS, dual line

Motors with dual line connection (motor power lines and motor holding brake lines in one cable, motor feedback lines in a separate cable) can be connected to X4 and X5 of the AKD-Nzzz07-DF and -DS variants.



	X4	Signal	Description
<p>The diagram shows a circular terminal block with four pins labeled 1, 2, 3, and 4. Pin 1 is connected to 'U', pin 2 to 'PE', pin 3 to 'W', and pin 4 to 'V'. There are also labels A, B, C, and D around the perimeter of the terminal block.</p>	A, B, C, D	...	Brake (→ p. 58)
	1	U	Motor phase U
	2	PE	Protective earth (motor housing)
	3	W	Motor phase W
	4	V	Motor phase V

8.9 Motor Brake Connection (X4)

A 24 V holding brake in the motor can be controlled directly by the drive. The brake only works with sufficient 24 V voltage level. Check voltage drop, measure the voltage at brake input and check brake function (brake and no brake). Maximum current for the motor brake is 1 A with AKD-N00307 and 1.5 A with AKD-N00607.

NOTE

The stand-by power supply from AKD-C limits the number of brakes in the system. Observe the projecting hints for system topology and limits in the *Projecting Guide*.

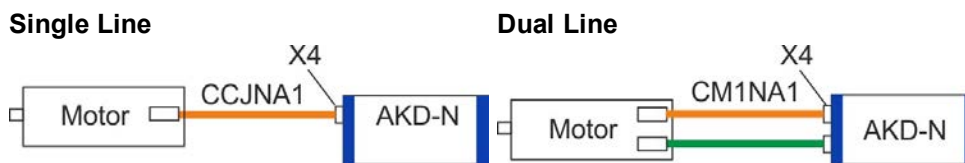


CAUTION

This function does not ensure functional safety. Functional safety requires and additional, external mechanical brake, operated by a safety controller. Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the brake immediately after faults or Hardware Disable.

The brake function must be enabled and configured with parameter using WorkBench, for details refer to the online help.

Single line hybrid cable and dual line motor power cable use two lines for motor holding brake connection.



	X4	Signal	Description
	A	+BR	Motor holding brake, positive
	B	-BR	Motor holding brake, negative
	C, D	...	Single Line: Feedback (→ p. 59) Dual Line: unused
	1,2,3,4	...	Motor power (→ p. 57)

8.10 Motor Feedback Connection (X4, X5)

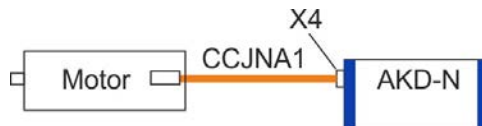
Every closed servo system normally requires at least one feedback device for sending actual values from the motor to the drive. Depending on the type of feedback device used, information will be fed back to the drive using digital or analog means.

AKD-N supports the most common types of feedback device. Feedback functions are assigned with parameters in WorkBench, the setup software. Scaling and other settings are also performed in WorkBench. For a detailed description of the parameters, please refer to the WorkBench online help.

Motors with single line connection (motor power lines, motor holding brake lines and motor feedback lines combined in one hybrid cable) can be connected to X4 of the AKD-Nzzz07-DB or -DS variants.

Motors with dual line connection (motor power lines and motor holding brake lines in one cable, motor feedback lines in a separate cable) can be connected to X4 and X5 of the AKD-Nzzz07-DF and -DS variants.

8.10.1 Connector X4 AKD-Nzzz07-DB/DS/DF, hybrid, single line

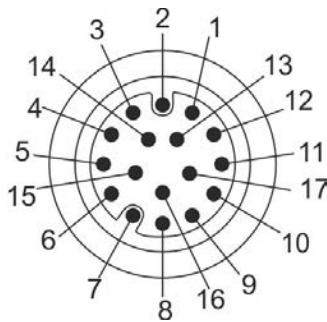
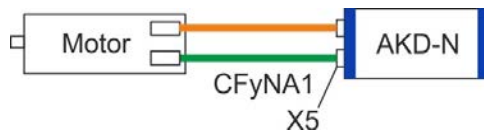


	X4	Signal	Description
	A,B	...	Brake (→ p. 58)
	C	COM-	Feedback, negative
	D	COM+	Feedback, positive
	1,2,3,4	...	Motor power (→ p. 57)

NOTE

Support for SFD3 and Hiperface DSL feedback systems.

8.10.2 Connector X5 AKD-Nzzz07-DF/DS, dual line



X5	SFD (4 lines)	BiSS B (analog)	BiSS C (digital)	EnDAT 2.1	EnDAT 2.2	Hiper- face	Sine Enc. +Hall	Incr. Enc. +Hall
1	-	-	-	-	-	-	Hall U	Hall U
2	-	CLK+	CLK+	CLK+	CLK+	-	Hall V	Hall V
3	-	CLK-	CLK-	CLK-	CLK-	-	Hall W	Hall W
4	-	-	-	-	-	*1	-	-
5	-	-	-	-	-	*1	-	-
6	COM+	DAT+	DAT+	DAT+	DAT+	DAT+	Zero+	Zero+
7	COM-	DAT-	DAT-	DAT-	DAT-	DAT-	Zero-	Zero-
8	-	Thermal control (+)						
9	-	Thermal control (-)						
10	+5 V	+5 V	+5 V	+5 V	+5 V	+8 to +9 V	+5 V	+5 V
11	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V
12	-	A+	-	A+	-	SIN+	A+	A+
13	-	A-	-	A-	-	SIN-	A-	A-
14	-	B+	-	B+	-	COS+	B+	B+
15	-	B-	-	B-	-	COS-	B-	B-
16								
17								

CLK = CLOCK, DAT = DATA

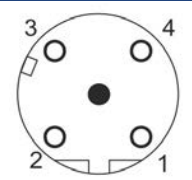
BiSS Mode C interface from Renishaw (model Resolute RA26B)

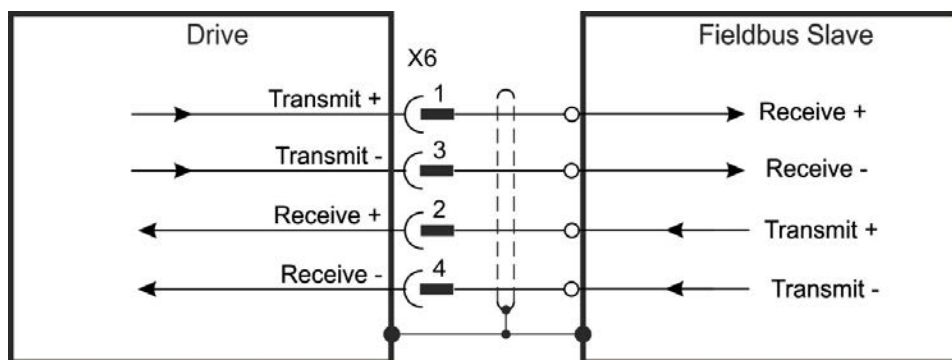
Hiperface *1=pins 4 and 5 externally connected

8.11 Optional Connector (X6)

8.11.1 Pinout AKD-Nzzz07-DF

The additional connector X6 with AKD-N-DF device variants allows connection to fieldbus slave devices that are controlled by the system master.

M12, D-coded	X6	Description
	1	Transmit +
	2	Receive+
	3	Transmit -
	4	Receive-

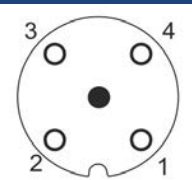


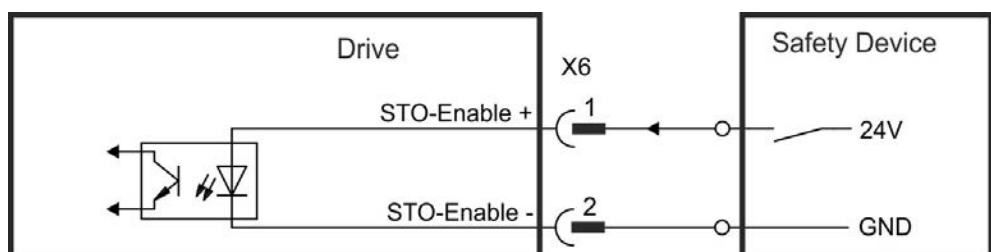
8.11.2 Pinout AKD-Nzzz07-DS

An additional digital input (STO-Enable) releases the power output stage of the drive as long as a 24 V signal is applied to this input. The local STO-Enable input is galvanically isolated and need external 24 VDC supply (PELV/SELF).

For detailed description of STO interface and functionality refer to "Safe Torque Off (STO)" (→ p. 36).

Wiring diagram local STO-Enable

M12, A-coded	X6	Description
	1	STO-Enable +
	2	STO-Enable -
	3	n.c.
	4	n.c.



9 Setup

9.1 Important Notes	63
9.2 Setup software WorkBench	64
9.3 Initial System Test	65
9.4 Fault and Warning Messages	66

9.1 Important Notes

NOTE

Before testing and setup, the manufacturer of the machine must generate a risk assessment for the machine and take appropriate measures so that unforeseen movements cannot cause injury or damage to any person or property.

Only professional personnel with extensive knowledge in the fields of electrical engineering and drive technology are allowed to test and set up the drive.



DANGER

The equipment produces potentially lethal voltages up to 900 V. Risk of electrical shock.

Check that all connection components that are live in operation are safely protected against bodily contact.

Never remove the electrical connections to the drive while it is live.

Capacitors can still have dangerous residual charges up to 7 minutes after switching off the supply voltage.



WARNING

The drive might restart automatically after power on, depending on the parameter setting. Risk of death or serious injury for humans working in the machine. If parameter DRV.ENDEFAULT is set to 1, then place a warning sign to the machine (Warning: Automatic Restart at Power On) and ensure, that power on is not possible, while humans are in a dangerous zone of the machine.



CAUTION

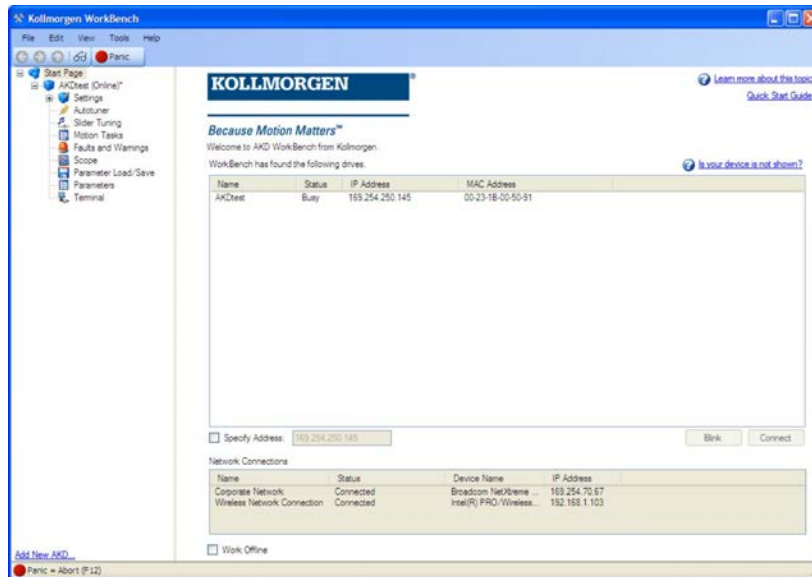
The heat sink of the drive can reach temperatures up to 80°C in operation. Risk of light burns. Check the heat sink temperature before handling the drive. Wait until the heat sink has cooled down to 40 °C before touching it.

NOTE

Additional information on setting up the equipment:

- Programming parameters and control loop behavior are described in the online help of the setup software.
- Kollmorgen can provide training courses for the decentral drive system upon request.

9.2 Setup software WorkBench



The setup software WorkBench for AKD-N and AKD-C devices is intended to be used for altering and saving the operating parameters for the decentral drive system. The attached device can be set up with the help of this software, and during this procedure the drive can be controlled directly by the service functions.

You can find the setup software on the accompanying DVD and in the download area of the Kollmorgen website.

Kollmorgen offers training and familiarization courses on request.

NOTE

Only professional personnel who have the relevant expertise (→ p. 11) are permitted to carry out online parameter setting for a drive that is running. Sets of data that have been stored on data media are not safe against unintended alteration by other persons. Unexpected move could be the result if you use unchecked data. After loading a set of data you must therefore always check all parameters before enabling the drive.

For most applications, you can use a PC and WorkBench (the drive setup software) to set up the operating conditions and parameters for your drive. The PC is connected to the AKD-C by an Ethernet cable (see *AKD-C Installation Manual*). The setup software provides the communication between the PC, the AKD-C and the AKD-N.

NOTE

With WorkBench every drive that is connected to the same AKD-C as the PC is visible, and controllable

You can select a drive out of the list, alter parameters, and instantly observe the effect on the drive, since there is a continuous (online) connection to the drive. You can also read important actual values from the selected drive, which are displayed on the monitor of the PC (oscilloscope functions).

You can save sets of data on data media (archiving) and load them into other drives or use them for backup. You can also print out the data sets.

9.3 Initial System Test

9.3.1 Unpacking, mounting, and wiring

- Unpack the drive and accessories. Observe the safety instructions in the documentation.
- Mount the drive (→ p. 43ff).
- Connect the AKD-N via the hybrid cables to the AKD-C (→ p. 47ff).
- Connect Motor (→ p. 57) and feedback (→ p. 59) (single line or dual line connection depending on motor and AKD-N version).
- Make sure you have on hand the following information about the drive components:
 - rated mains supply voltage
 - motor type (motor data, if the motor type is not listed in the motor database)
 - feedback unit built into the motor (type, poles/lines/protocol)
 - moment of inertia of the load
- Connect a PC with the installed WorkBench setup software to the AKD-C connector X18. See *AKD-C Installation Manual* for more information.

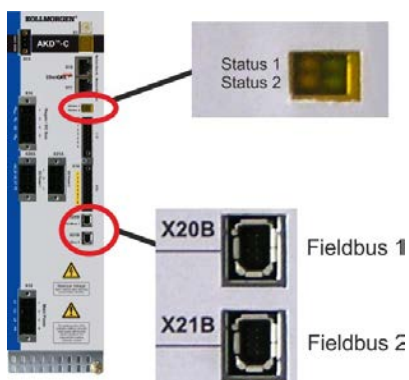
9.3.2 Set IP address

The Node address can be set with the WorkBench setup software or via the used fieldbus.

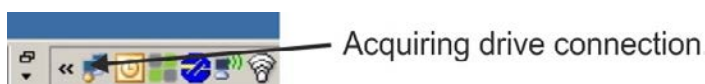
9.3.3 Confirm connections

Switch on 24 VDC logic power for the system through the AKD-C X13 connector (mains supply voltage is not needed for communications).

Confirm that the link LEDs on the AKD-C are both illuminated.



While the PC is connecting, your statusbar will show the following acquiring icon:



Wait for this icon to change to the limited functionality icon (this process can take up to one minute).



Although Windows displays this limited functionality icon for the drive connection, the PC can communicate fully with the drive. Using WorkBench, you can now configure the drive through this connection.

9.3.4 Install and start WorkBench

WorkBench installs automatically from the DVD included with the drive. WorkBench is also available on the Kollmorgen Web site: www.kollmorgen.com.

Once installation is complete, click the WorkBench icon to start the program. WorkBench will show a list of all the drives that it can find connected to the AKD-C. Select the drive you wish to configure and then click **Next**.

If multiple drives are detected, a drive can be uniquely identified using one of the following methods:

1. The MAC address of the drive. This address is printed on the sticker on the side of the drive.
2. The name of the drive. The drive name is set using WorkBench. A new drive defaults to "No_Name."
3. Blinking the display. Select a drive and click **Blink** to force the LED of the drive to blink on and off for 20 seconds.

9.3.5 Enable the drive using the setup wizard

Once a connection to the drive has been established, the AKD Overview screen appears. Your drive appears in the navigation area on the left of the screen. Right click on your drive name and select **Setup Wizard** from the drop-down menu. The Setup Wizard guides you through the initial drive configuration, which includes a simple test motion.

After completing the Setup Wizard, your drive should be enabled. If the drive is not enabled, check the following:

1. The hardware enable (HW) for the drive strings must be in the enabled state (pin 3 on AKD-C X15 connector).
2. The software enable (SW) must be in the enabled state. Activate using the **Enable/Disable** button on the upper toolbar on WorkBench or in the Overview screen.
3. No faults may be present (click the **Clear Fault** button on the upper tool bar to clear any faults).

The status of HW enable, SW enable, and Faults is displayed in the lower toolbar of the WorkBench software. The drive is connected if the lower right corner shows **Online**.

You can now use the Settings View in WorkBench to complete advanced configuration of your drive.

9.4 Fault and Warning Messages

When a fault occurs, the AKD-C fault relay is opened, the output stage is switched off (motor loses all torque), or the load is dynamically braked. If a warning is issued prior to the fault, the warning has the same number as the associated fault. Warnings do not trip the power stage of the drive or fault relay output.

Within a string several drives might show warnings or faults. All actual faults and warnings can be monitored with the WorkBench setup software via the AKD-C service interface or with the used motion controller software connected via the AKD-C motion bus interface.

NOTE

More information about fault messages, remedy and clearing faults can be found in the WorkBench online help.

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Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

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