AKD® Central Power Supply

Installation Manual

CE   RoHS✓

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	KCM X4 and Ready contacts added, KCM switch-on sequence, STO section updated

Hardware Revision (HR)

AKD-N	AKD-C	Firmware	WorkBench	Remarks
A	A	from 1.11	from 1.11	AKD-C Start revision

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)

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

Printed in Germany

1 Table of Contents

2 General

2.1   About this Manual

This manual, *AKD-C Installation Manual* ("Instructions Manual" according to EC Machinery Directive 2006/42/EC), describes the AKD-C (Central Power Supply) and includes information needed to safely install decentral drive system with an AKD-C and several AKD-N drives. A digital version of this manual (pdf format) is available on the DVD included with your device. 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.
- *AKD-N Installation Manual*: describes the AKD-N series of drives for Kollmorgen decentralized drive system and includes information needed for safe assembling and installation of the drives.
- *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	Communité Européenne
COM	Serial interface for a personal computer
DCOM	Communication line for digital inputs
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMC	Electromagnetic compatibility
KAS	Kollmorgen Automation Suite
KAS IDE	Setup software (Kollmorgen Automation Suite Integrated Development Environment) used for AKD PDMM drives
LED	Light-emitting diode
LSB	Low significant byte (or bit)
MSB	Main significant byte (or bit)
NI	Zero pulse
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)
R_{Brake}/R_B	Regen resistor (also called a brake resistor)
RBext	External regen resistor
RBint	Internal regen resistor
RCD	Residual current device
RES	Resolver
ROD	Incremental encoder (A quad B)
SELV	Safety Extra Low Voltage
STO	Safe torque off
VAC	Volts, alternating current
VDC	Volts, direct current

2.6 Standards Used

Standard	Content
ISO 4762	Hexagon socket head cap screws
ISO 11898	Road vehicles — Controller area network (CAN)
ISO 12100	Safety of machinery: Basic concepts, general principles for design
ISO 13849	Safety of machinery: Safety-related parts of control systems
IEC 60085	Electrical insulation - Thermal evaluation and designation Maintenance
IEC 60204	Safety of Machinery: Electrical equipment of machinery
IEC 60364	Low-voltage electrical installations
IEC 60439	Low-Voltage Switchgear and Controlgear Assemblies
IEC 60529	International protection rating (IP code)
IEC 60664	Insulation coordination for equipment within low-voltage systems
IEC 60721	Classification of environmental conditions
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61131	Programmable controllers
IEC 61491	Electrical equipment of industrial machines – Serial data link for real-time communications between controls and drives.
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61800	Adjustable speed electrical power drive systems
IEC 62061	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 82079	Preparation of instructions for use - Structuring, content and presentation
UL 840	UL Standard for Safety for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
UL 508C	UL Standard for Safety Power Conversion Equipment

ANSI - American National Standard Institute, Inc.

IEC - International Electrotechnical Commission

ISO - International Organization for Standardization

UL - Underwriters Laboratories

3 Safety

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 device can cause harm to people or damage to property. The operator of systems using the AKD-C must require that all personnel who work with the system read and understand the manual before using the device.

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 devices 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 for one AKD-N 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 drive technology 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 devices contain electrostatically sensitive components which may be damaged by incorrect handling. Electrostatically discharge your body before touching the device. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the device on a conductive surface.

Earthing!

It is vital that you ensure that the device is safely earthed to the PE (protective earth) busbar in the switch cabinet. 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.

Residual current protective or monitoring devices!

AKD-C with AKD-N can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of AKD-C.

High voltages!

The equipment produces high electric voltages up to 900V. Do not open or touch the equipment during operation. Keep all covers closed.

During operation, AKD-C may have uncovered live sections, according to their level of enclosure protection. Wait at least seven minutes after disconnecting the product from the supply voltages (mains supply and 24V supply) 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 all power supply sources. Always measure the voltage in the DC bus link at connector X14 and wait until the voltage is below 60 V before handling components.

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

Never modify the product!

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

3.2 Use as Directed

The AKD-C series power supplies are exclusively intended for operating AKD-N series drives within a decentralized drive system.

AKD-C 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 devices 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 Decentral drive system

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

Assembling

AKD-C devices must only be operated in environments suitable for the ambient conditions defined on ➜ p. 27. Observe the information given in the *Decentralized System Projecting Guide*.

Wiring

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

Power supply

AKD-C must be powered from a 3 phase industrial supply network
(not more than 200 kA symmetrical rated current at 400 V and 480 V).

Auxiliary voltage supply, Standby power

Standby power for the drive strings must only be used for supplying the AKD-N electronics.
24 VDC supply unit must accord to PELV/SELV (EN 60204-1) requirements.

Safe torque off

The Safe Torque Off (STO) functionality is in the certification process. As long as the function is not safety certified, it should not be used as safety function according to ISO 13849.

Review the section "Use as Directed" in the STO chapter (➜ p. 34) before using this safety function (SIL2, PLd, category 3 according to ISO 13849).
24 VDC supply unit for global 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 external regen resistor contacts.
- in applications with any short circuits to the DC-Bus link 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-C 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-C01007	125 x 410 x 295	5

3.4.2 Transport

Transport the AKD-C 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 devices contain electrostatically sensitive components that can be damaged by incorrect handling. Electrostatically discharge yourself before touching the device. Avoid contact with highly insulating materials, such as artificial fabrics and plastic films. Place the device 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-C 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 device does not require maintenance. Opening the device voids the warranty.

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

- Casing: Clean with isopropanol or similar cleaning solution.
- Protective grill on fan: Clean with a dry brush.

NOTICE Do not immerse or spray the device .

3.4.5 Uninstalling

If a drive must be uninstalled (such as for replacement), remove the device 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 AKD-C from all power supply sources 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 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.
4. Uninstall. Remove the AKD-C.

3.4.6 Repair and disposal

Only the manufacturer can repair the AKD-C. Opening the device voids the warranty. Uninstall the device as described in "Uninstalling" (➔ p. 18), then send the device 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	KOLLMORGEN Europe GmbH
201 West Rock Road	Pempelfurtstr. 1
Radford, VA 24141	D-40880 Ratingen

4   Approvals

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 or on page "Approvals" in the Kollmorgen Product WIKI.

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 devices 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-C01007 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-C01007 meet the noise immunity requirements to the 2nd environmental category (industrial environment). For noise emission theAKD-C01007 meet the requirement to a product of the Category C2.

| 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

See *AKD-N Installation Manual* for detailed information. Certification in process.

5 Package

5.1 Package Supplied

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

- AKD-C
- Printed copy of *AKD-C Installation Manual*
- DVD containing the setup software, WorkBench, and all product documentation in digital format.
- Mating connectors X12, X13, X14, X15, X16
- Two connector covers M23

NOTE   The M23 connector covers are required for protecting X2 of the last AKD-N in the strings.

Accessories Sold Separately

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

- Hybrid cables for connection to first AKD-N
- External regen resistor
- EtherCAT cable to the network
- Power cable, control wires

5.2 Nameplate

The nameplate depicted below is attached to the side of the device.

5.3   Part Number Scheme

The part number is identical to the order code.
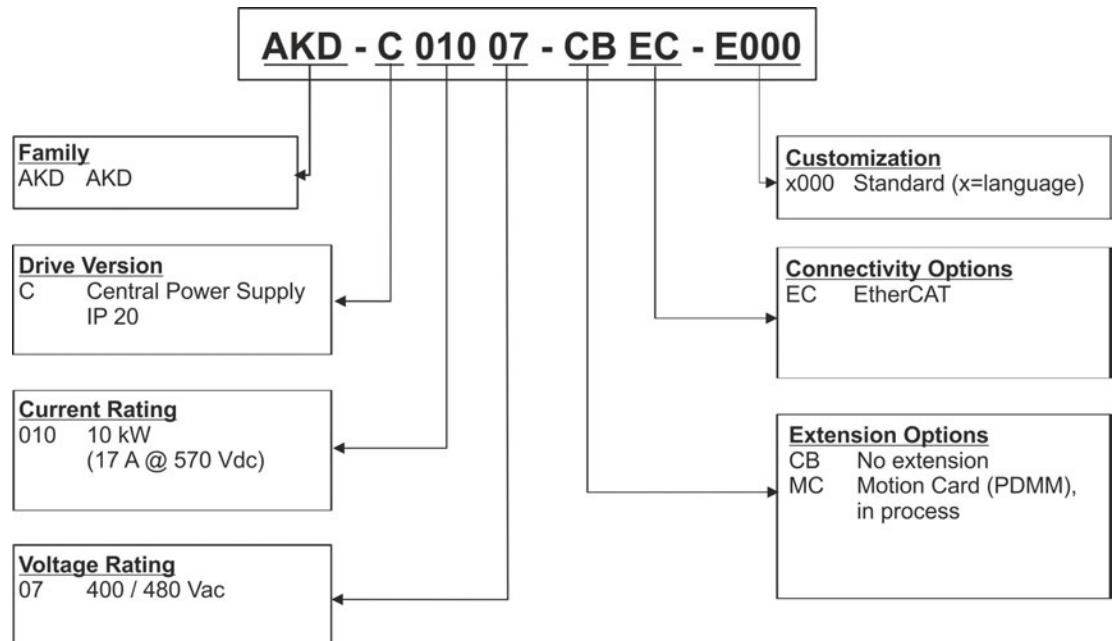
Customization code includes language version of printed material and customer specials.

6 Technical description and data

6.1 The AKD-C Central Power Supply

Available AKD versions

Variant	Description	Power	Connectivity
AKD-C01007-CBEC	Central Power supply without extension.	10 kW	EtherCAT, Ethernet/IP

Standard features

- Supply voltage range 400 V to 480 V ±10%.
- Mains EMC filter and 24 V EMC filter integrated.
- EtherCAT bus onboard.
- TCP/IP service channel 100 Mbit/s onboard.
- Safe Torque Off (STO) according to IEC 62061 SIL 2 onboard.
- Supports up to 16 AKD-N drives.

Power section

- Three phase supply, maximum voltage range 360 to 528 V, 47 to 65 Hz.
- B6 bridge rectifier, integral soft-start circuit.
- Fusing to be provided by the user.
- Shielding star point close to the device.
- DC power split to two connectors (strings) for up to 16 drives.
- DC power voltage range 565 to 680 VDC, DC bus output current max 17 A.
- Standby DC power voltage 55 VDC ±10% (generated from 24 VDC voltage supply)
- Regen circuit for all connected AKD-N.
- Built-in regen resistor, external regen resistor or capacitor module if required.

Integrated safety

- Appropriate insulation/creepage distances and electrical isolation for safe electrical separation, per IEC 61800-5-1, between the power input/DC bus connections and the signal electronics.
- Soft-start, overvoltage detection, short-circuit protection, phase-failure monitoring.
- Temperature monitoring.
- SIL 2 safe torque off in accordance with IEC 62061 , ➜ p. 34.

Supply voltage 24V DC (electronic supply and standby voltage)

- From an external, safety approved 24 V ±10% power supply, minimum 480 W.
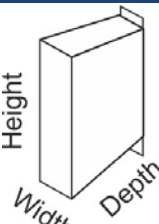
Operation and parameter setting

- Using the setup software WorkBench for setup via TCP/IP.

Inputs/Outputs

- 1 programmable digital output (➜ p. 69)
- 1 fault relay output (➜ p. 70)
- 1 Enable input (➜ p. 68)
- 2 STO inputs (one per string) (➜ p. 34)
- 2 STO status outputs (one per string) (➜ p. 34)
- Service Interface (➜ p. 72)
- EtherCAT Interface (➜ p. 71)

6.2 Mechanical Data

Mechanical data	Units	AKD-C01007-x
Weight	kg	3.8
Height front	mm	290
Height back	mm	329
Width	mm	80
Depth, without connectors	mm	198
Depth, with connectors	mm	231

6.3 Electrical Data

Electrical data	Units	Value
Rated supply voltage	V~	3 x 400 V to 3 x 480 V, ±10%
Rated supply input frequency	Hz	50 Hz to 60 Hz, ±10%
Rated input power		
at 3x400 V	kVA	9.2
at 3x480 V	kVA	11
Rated input current at 3x400/480 V	A	14
Permitted switch on/off frequency	1/h	30
Max. inrush current	A	5
Rated DC bus link voltage (Bus Turn on Delay 3ph 1 sec)	V=	565 to 680
Standby DC power voltage	V=	55 ±10%
Continuous total output current	A=	17
Peak total output current (for 1 s, ± 3%)	A=	34
Continuous output power		
at 3x400 V	kVA	9.2
at 3x480 V	kVA	11
Peak output power (for 1 s)		
at 3x400 V	kVA	18.4
at 3x480 V	kVA	22
Technical data for regen circuit	—	➜ p. 31
Thermal dissipation at 24V standby		
No AKD-N (min)	W	8.6
16 AKD-N (max)	W	40
Thermal dissipation at rated current (without regen power)	W	125
Noise emission (low speed / high speed fan)	dB(A)	40 / 60
Aux. voltage supply (PELV)	V=	24 V (±10%, check voltage drop)
Aux. voltage supply current	A=	14
Aux. voltage inrush current	A=	16
Protection class	-	IP20

6.4 Fusing

US fuses: Class RK5 or CC or J, 600 VAC 200 kA, time-delay. The fuse must be UL and CSA listed, UL recognized is not sufficient.

EU fuses: types gRL or gG, 400 V/500 V, time-delay

Fuse holders: Combined with the standard fuse blocks, finger safe fuse holders must be used according to IEC 60529.

Examples:
Bussmann: CH Series Modular Fuse Holders, fuse size 0 to 30A class J, 3 poles: CH30J3
Ferraz: Ultrasafe Fuse holders, fuse size 0 to 30A class J, 3 poles: US3J3I

6.4.1 External power supply fusing

	Ampere rating	UL Region	CE Region
External AC power supply fusing	20A (Time-Delay)	in process	example: Siba type gRL/gG, D02, 20A
External 24 VDC supply fusing	15A (Time-Delay)	in process	example: Siba type in process

6.4.2 External regen resistor fusing

	Ampere rating	UL Region	CE Region
AKD-C01007	25A	in process	example: Siba type in process

6.5 Ambient Conditions, Ventilation, and Mounting Position

Storage	➜ p. 17
Transport	➜ p. 17
Ambient temperature in operation	0 to +40 °C under rated conditions +40 to +55 °C with continuous current derating 4 % per Kelvin
Humidity in operation	Relative humidity 5 to 85%, no condensation, class 3K3
Site altitude	Up to 1000 meters above mean sea level without restriction 1,000 to 2,000 meters above mean sea level with power derating 1.5%/100 m
Pollution level	Pollution level 2 as per IEC 60664-1
Vibrations	Class 3M1 according to IEC 60721-3-3
Environmental area	Cabinet IP 54 according to IEC 60529
Mounting position	Vertical
Ventilation	Built-in fan
NOTICE	The device shuts down in case of excessively high temperature in the control cabinet. Make sure sufficient forced ventilation is supplied within the control cabinet.

6.6   Grounding System

There are several ground networks in the drive:

DCOM	common line for digital inputs on I/O connector X15
GND	24 V supply
STO-GND	STO input
0 V	internal digital ground, service channel

6.7   Signal Inputs/Outputs

Interface	Electrical Data
Enable input	- 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 - update rate 250 µs - galvanic isolation for 250 VDC
Digital output	- as per IEC61131-2 type 1 - max. 30 VDC, 100 mA - short circuit proof - galvanic isolation for 250 VDC
Relay output	- max. 30 VDC, 1A - max. 42 VAC, 1 A - time open/close 10ms - isolation 400 VDC contact/coil
STO-Enable inputs	- ON: 18 VDC to 30 VDC, 210 mA +10 mA per AKD-N - OFF: 0 VDC to 12 VDC, < 50 mA - galvanic isolation for 250 VDC
STO-Status outputs	- as per IEC61131-2 type 1 - max. 30 VDC, 100 mA - galvanic isolation for 250 VDC

6.8 Connectors

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

Connector	Type	Max. Cross Section[1]	Current[2]	Voltage[3]
Motion Bus X10, X11	RJ45	0,5 mm², 21 awg	1 A	<100 V
Power X12	Terminal Connector, 4 poles	10 mm², 8 awg	30 A	600 V
Aux. voltage X13	Terminal Connector, 2 poles	2.5 mm², 12 awg	16 A	250 V
DC bus, Regen X14	Terminal Connector, 4 poles	10 mm², 8 awg	30 A	600 V
Control signals X15	Terminal Connector, 6 poles	1 mm², 18 awg	12 A	250 V
STO signals X16	Terminal Connector, 6 poles	1 mm², 18 awg	12 A	250 V
Service Port X18	RJ45	0,5 mm², 21 awg	1 A	<100 V
DC Power X20A, X21A	Terminal Connector, 3 poles	10 mm², 8 awg	30 A	600 V
Local Fieldbus In/Out X20B, X21B	Mini I/O connector, 8 poles	0.34 mm², 22 awg	0.5 A	30 V

[1]single-line connection
[2]single-line connection with recommended conductor cross section (➜ p. 29)
[3]rated voltage with pollution level 2

6.9 Recommended Tightening Torques

Connector	Tightening Torque/Nm
X13, X15, X16	0.2 to 0.25
X12, X14, X20A, X21A	0.7 to 0.8
PE bolt	1.7

See "Conformance with UL/cUL" (➜ p. 20) for in-lbs values.

6.10 Cable Requirements

The table below describes the recommended interface cross sections and cable requirements in accordance with IEC 60204. 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 loss system warranty, if you use hybrid, motor or feedback cables from a manufacturer other than Kollmorgen.

Hybrid cable from	Cable type*	Hybrid cable to	Cross section
AKD-C X20A/X20B String 1	CCNCN1-025	AKD-N X1, hybrid	3 x 2.5 mm² 4 x 0.25 mm²
AKD-C X21A/X21B String 2	CCNCN1-025	AKD-N X1, hybrid	3 x 2.5 mm² 4 x 0.25 mm²

* Followed by length coding. Contact your Kollmorgen sales representative.

Interface	Cross Section	Cable Requirements
X12, AC connection	4.0 mm² (12 awg)	600 V, minimum 75°C
X13, +24 V/GND, max 30 m	2.5 mm² (14 awg)	single line
X14, DC bus link, regen resistor	4.0 mm² (12 awg)	1000 V, minimum 75°C, shielded for lengths >0.20 m
X15, Digital I/Os, max. 30 m	0.5 mm² (21 awg)	single line
X16, STO Signals, max. 30 m	0.5 mm² (21 awg)	single line

6.11 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. 51

Cable Type	Cable usage	Available Length (m)	Max. Length (m)
CCNCN1	AKD-C to AKD-N, hybrid	3, 6, 12, 24, 36	40
Ethernet Cable	AKD-C to AKD-C	on request	100
Ethernet Cable	AKD-C to Personal Computer or Switch	on request	100
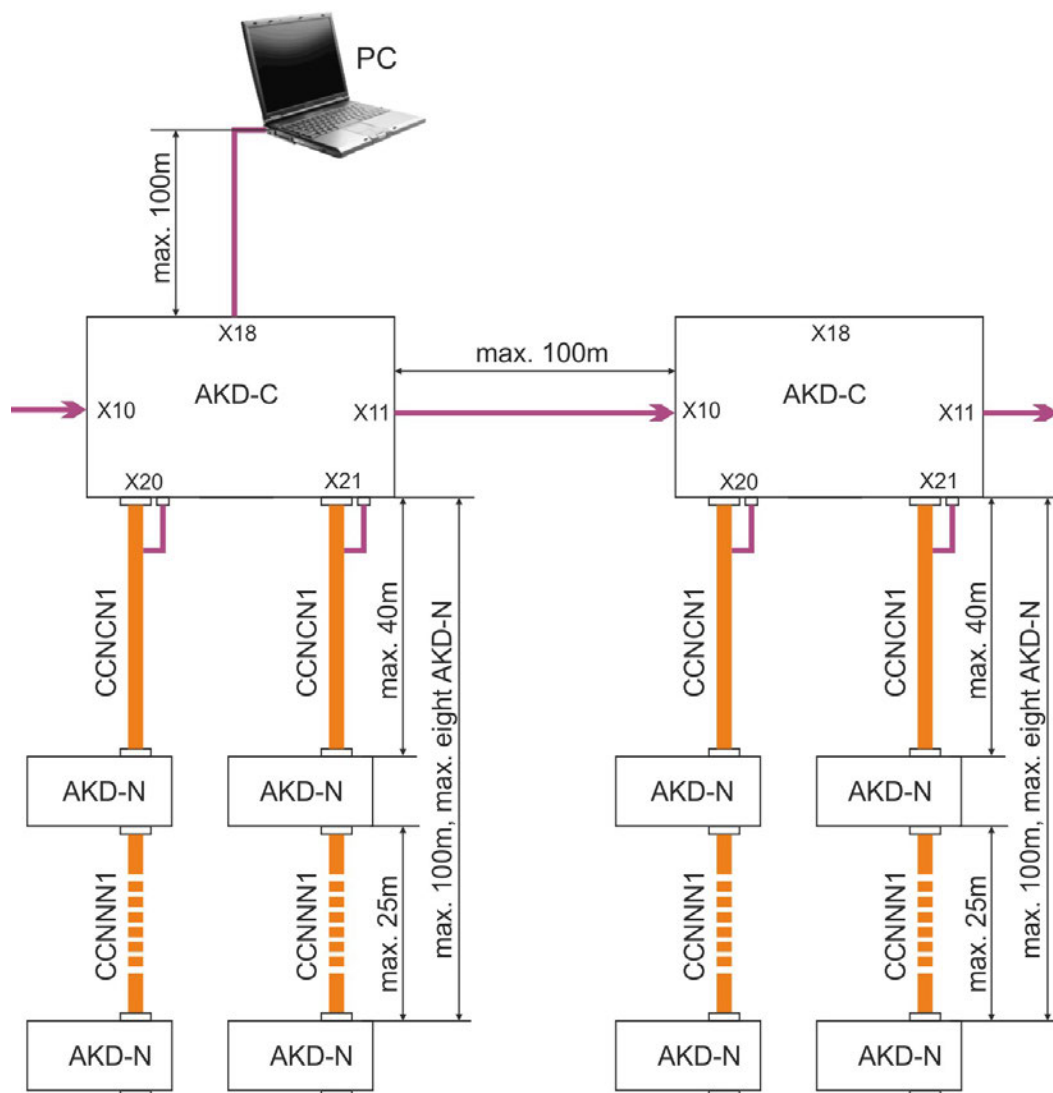
6.12 Dynamic Braking

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 drives have 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 AKD-C 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 uses dynamic braking depends on (*DRV.DISMODE*).

6.13 Regen circuit

When the amount of returned energyfrom the AKD-N 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, an additional external one can be connected to X14.

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

6.13.1 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.

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" (➜ p. 82). The AKD-C fault relay contact (terminals X15/5-6) is opened due to this fault.

6.13.2 Technical data

NOTE   Observe the regeneration time (some minutes) after full load with peak regen power.

Rated data	Units	400 V	480 V
Switch-on threshold of regen circuit (nominal)	V	760	760
Overvoltage limit	V	840	840
Maximum regen duty cycle	%	15*	15*
Internal regen resistor	Ohm	33	33
Continuous power, internal resistor	W	100	100
Peak regen power, internal resistor (0.5s)	kW	17.5	17.5
External regen resistor	Ohm	33	33
Maximum continuous regen power, external resistor	kW	1.5	1.5
Peak regen power, external (1s)	kW	17.5	17.5
Absorption energy in capacitors (+/- 20%)	Ws	21	7
DC Bus Capacitance (nominal)	µF	585	585

* depends on connected regen resistor power

6.14   Switch-On and Switch-Off Behavior

6.14.1 Switch-on behavior in standard operation

The diagram below illustrates the correct functional sequence for switching the System on.
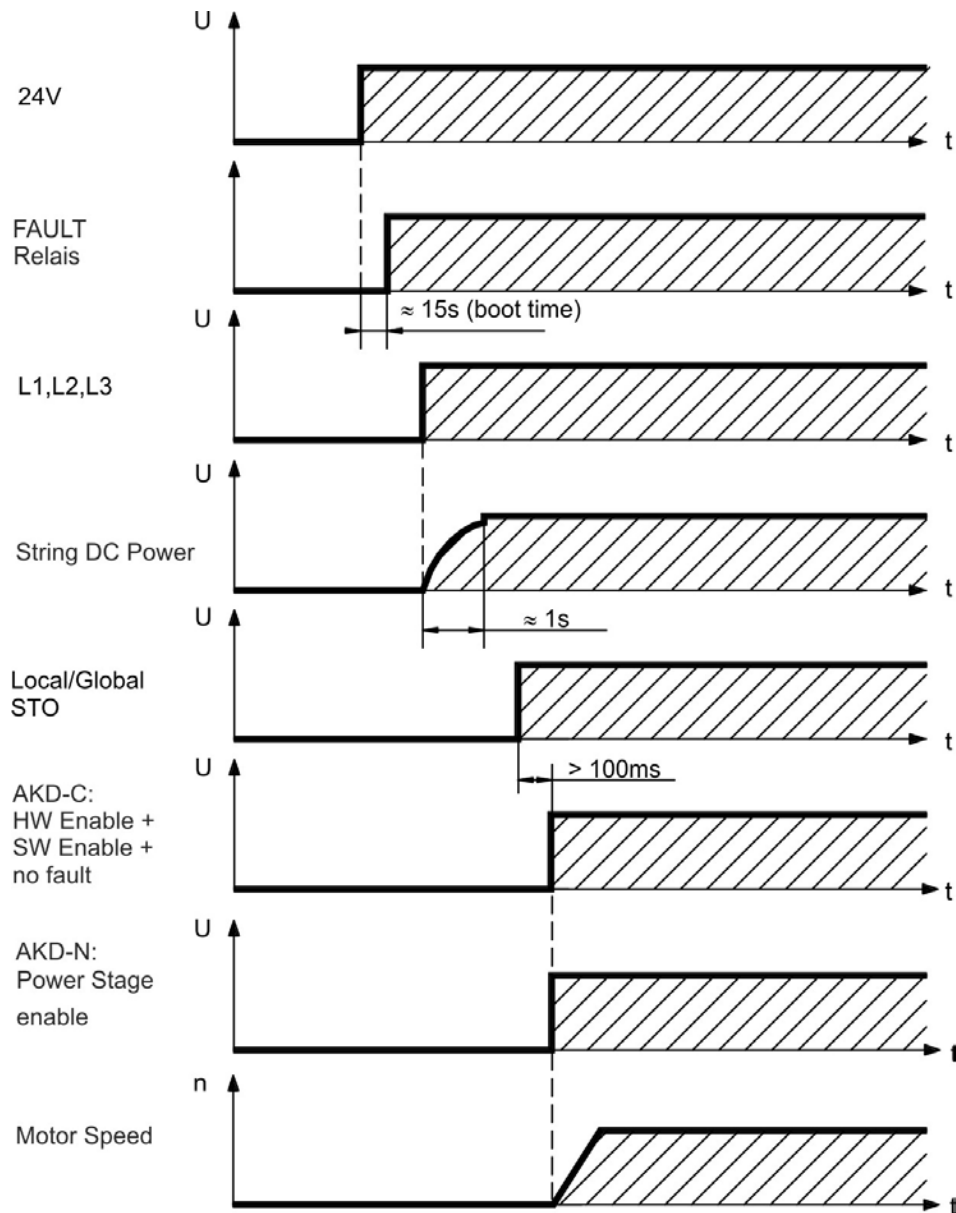
6.14.2 Switch-off process, standard operation

NOTE Hardware Enable input disables all AKD-N power stages immediately. Refer to the *AKD-N Installation Manual* for drive switch-off behaviour depending on different operational situations and parameter settings.

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.
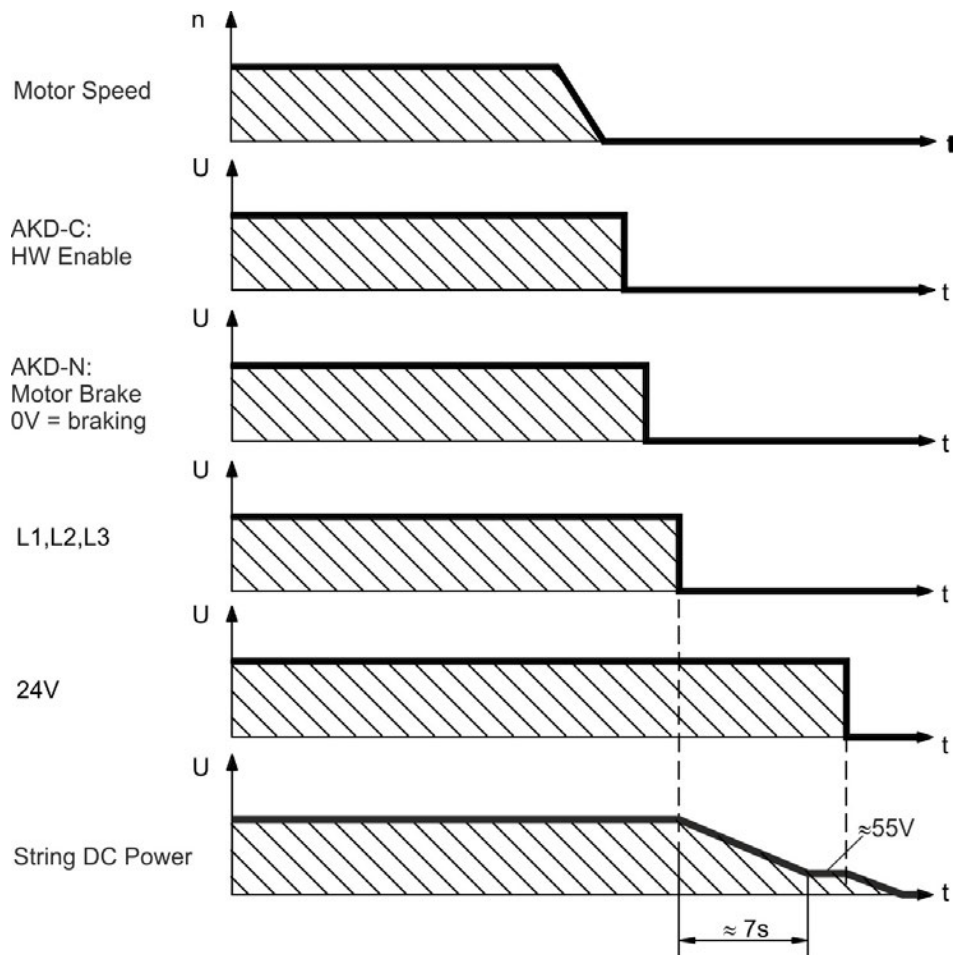
6.15 Global Safe Torque Off (STO)

`NOTE`   Certification of functional safety is in process.

6.15.1 General information

Connector X16 offers access to all STO (Safe Torque Off) relevant signals of the decentral drive system powered by this AKD-C .

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

There is one STO-Enable input and one STO-Status output for each DC Power string. STO-Enable 1 does affect string 1 only. STO-Enable 2 does affect string 2 only.

The string STO input releases the power output stage of all AKD-N (without option DS) connected to the string as long as a 24 V signal is applied to this input. If the STO input goes open-circuit, then power will no longer be supplied to the connected motors, and the drives will lose all torque and coast to a stop.

`NOTE`   In case of using an AKD-N with option "DS" (local STO input), the global STO signal will have not influence to this specific drive. The local STO input on the AKD-N has no influence to the global STO as well. The local STO functionality is described in the AKD-N installation manual.
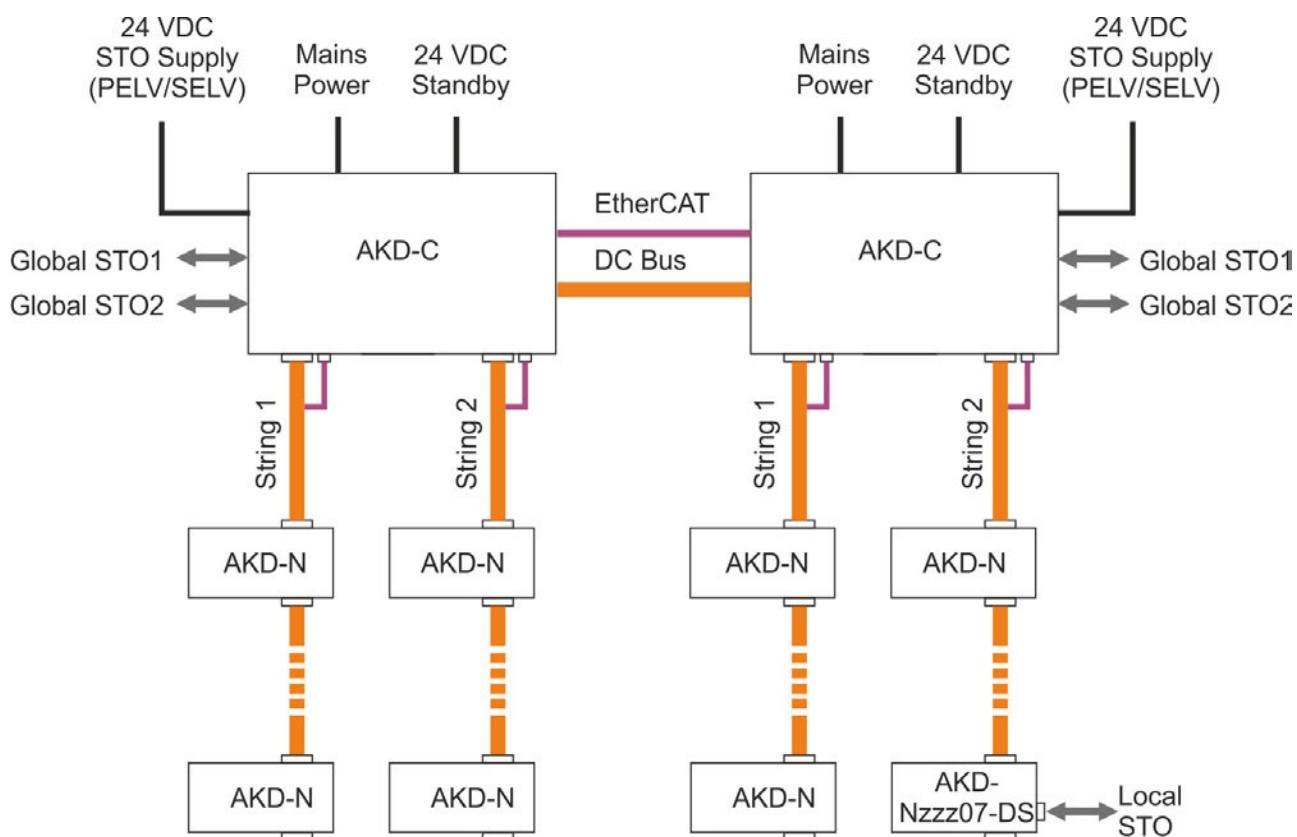
The STO safety implementation on the AKD is certified. The safety circuit implementation used for the safety function "Safe Torque Off" in the drive is suited for SIL 2 according to IEC 62061 and PLd / CAT3 according to ISO 13849-1.

Application examples can be found in the *Decentralized System Projecting Guide*.

6.15.2 Safety characteristic data

The subsystems are described with the following characteristic data:

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	0	20	100

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 $1.5 * 10^{-15}$ 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.

6.15.3 Response Time

The delay from falling edge at global STO Enable input until energy supply to the motor 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.

6.15.4 Use as directed

The STO function is exclusively intended to provide a functional safe torque off of the motion system. 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 global STO function is in use, then the inputs STO-Enable 1/2 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.

6.15.5 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.

6.15.6 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 must not be used for driving elevators.

CAUTION

In case of a specific double fault within a very short time (see ➜ p. 35) 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 for one AKD-N 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 the mains 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 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.

6.15.7 Enclosure, wiring

Observe the required ambient conditions as described in chapter "Ambient Conditions, Ventilation, and Mounting Position" (➜ p. 27).

The AKD-C (IP 20) must be mounted in an IP54 cabinet to ensure pollution level 2 according to IEC 60664-1. Connector X16 (STO signals) ensures requirements of pollution level 3 according to IEC 60664-1.

The AKD-N can be used in an environment that meet IP67.

If you are wiring leads that are outside the specified enclosure (IP54), 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 remaining within the specified enclosure must meet the requirements of the standard IEC 60204-1.
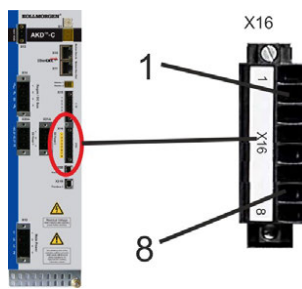
6.15.8 Technical data and connection

NOTE | The global STO inputs are not compatible with IEC 61131-2. Connector X16 (STO signals) ensures requirements of pollution level 3 according to IEC 60664-1.

STO-Enable inputs	• inputs do not match IEC61131-2 • galvanic isolation for 250 VDC • OFF: 0 VDC to 12 VDC, < 50 mA • ON: 18 VDC to 30 VDC, 210 mA +10 mA per AKD-N • tolerated OSSD pulse duration 0.3 ms
STO-Status outputs	• as per IEC61131-2 type 1 • max. 30 VDC, 100 mA • galvanic isolation for 250 VDC
STO 24 VDC supply	• PELV/SELV acc. to EN 60204-1 • Output 24 VDC +/-10% • Current 5 A (full system STO supply)

Pinout connector X16 STO Signals

Pin	Signal	Description
1	STO-Status 1	STO-Status message string 1
2	STO-Status 2	STO-Status message string 2
3	+24	STO +24 VDC supply
4, 5	GND	STO GND
6	STO-Enable 1	STO Enable string 1
7	GND	STO GND
8	STO-Enable 2	STO Enable string 2

Wiring diagram STO Signals
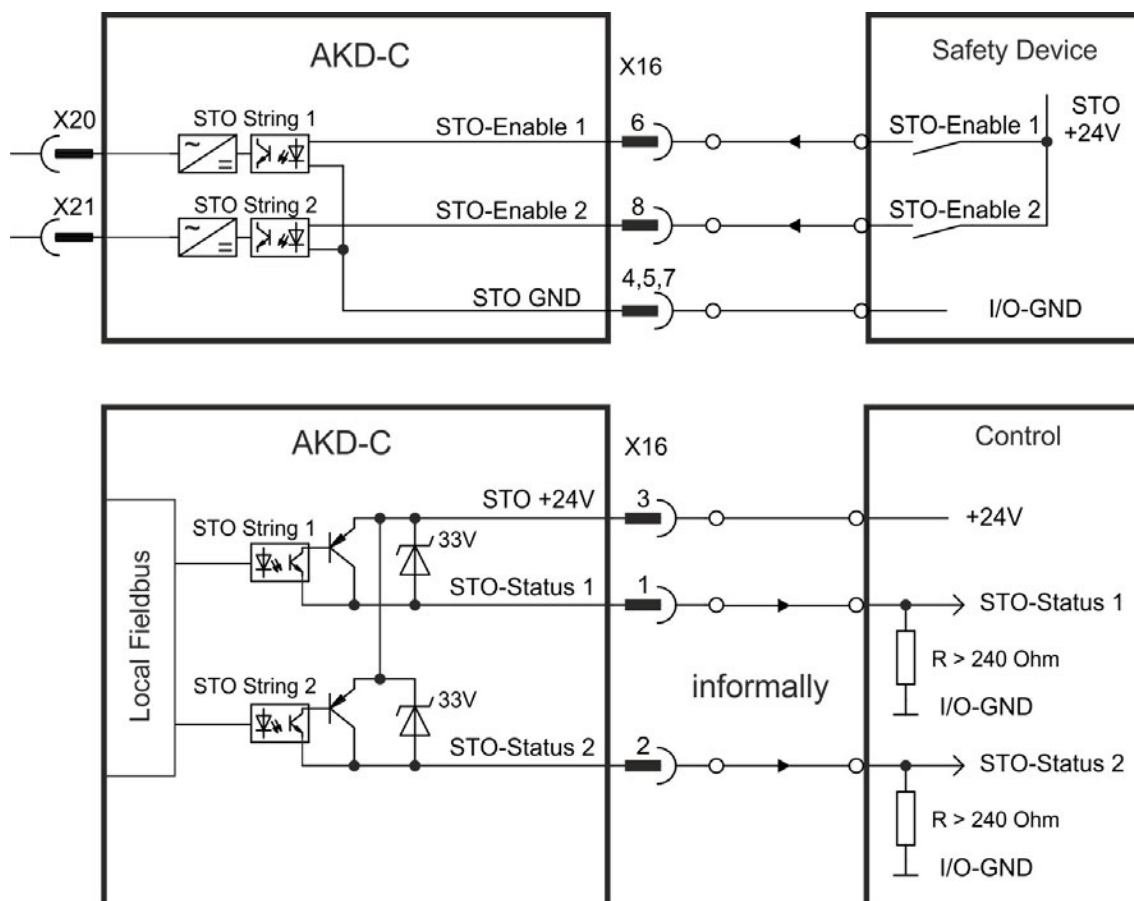
6.15.9 Functional description

There is one STO-Enable input and one STO-Status output for each string. The string STO-Enable input releases the power output stage of all AKD-N (without option DS) connected to the string as long as a 24 VDC signal is applied to this input. When STO function is engaged during operation by separating STO-Enable from 24 V, the drives (without option DS) connected to the string slow down without control.

When the global STO function (Safe Torque Off) is not needed, then the inputs STO-Enable 1/2 must be connected directly to +24 VDC. The function is then bypassed and cannot be used in the machinery safety concept.

NOTE
In case of using an AKD-N with option "DS" (local STO input) in the string, then the string STO-Enable signal will have no influence to this specific drive. The local STO-Status of this drive nevertheless is monitored in the string STO-Status.

NOTE
The string STO-Status output at the AKD-C is a logical OR of all STO-Status of the drives connected to that respective string. STO-Status is high:
- during system boot (power up), or
- if the string STO-Enable input is 0V, or
- if the communication with one of the connected drives is lost, or
- if no drive is connected to the string, or
- if the local fieldbus doesn't work.

Possible states of the drives connected to the string referring to the global STO function:

String STO-Enable	String HW Enable	String STO-Status	Safety acc. to SIL2	AKD-N on String 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

NOTICE
Use the following functional sequence when the STO function is used:
1. Brake the drives in a controlled manner (speed setpoint = 0 V).
2. When drives speed = 0 rpm, disable the string (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 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.

NOTE
When wiring the input STO within one enclosure, the cables and the enclosure must meet the requirements of IEC 60204-1. If you are wiring leads outside the specified enclosure, then the cables must be laid durably and protected from outside damage.

6.15.9.1 Signal diagram (sequence)

The diagram below shows how to use global STO function for a safe drive stop and fault free operation of the drives connected to one of the strings.

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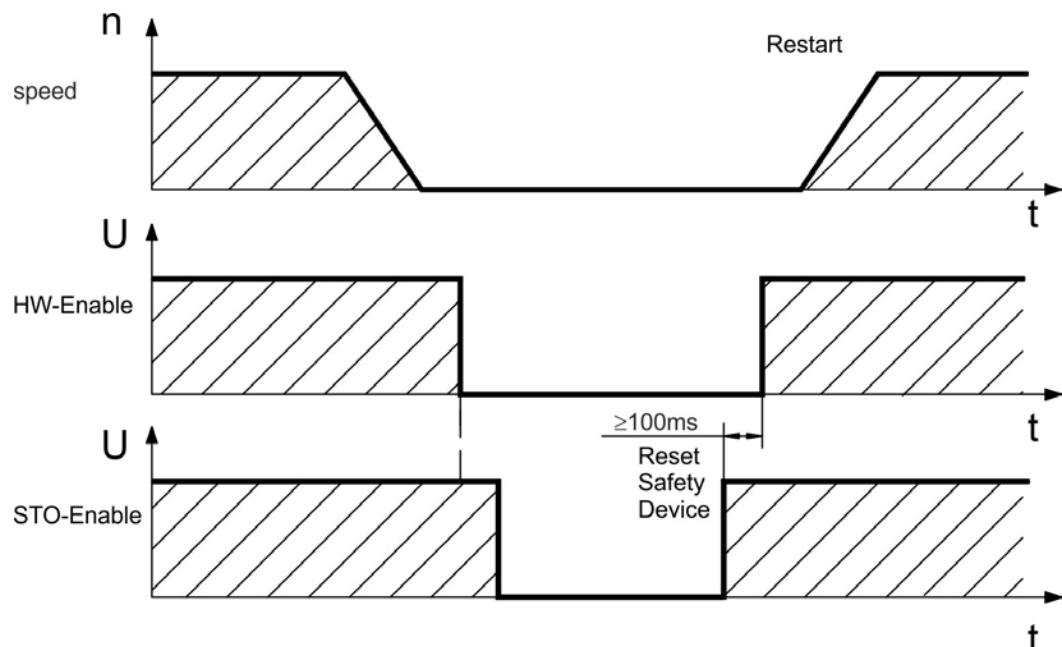
6.15.9.2 Functional test

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.

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.

6.15.9.3 Global STO application example

The sample application below shows door guarding and emergency stop, controlled by Kollmorgen KSM safety module to switch the global STO-Enable inputs of an AKD-C device to SIL2, PLd. Both drive strings are switched independently.

For detailled application examples refer to the *Decentralized System Projecting Guide*.
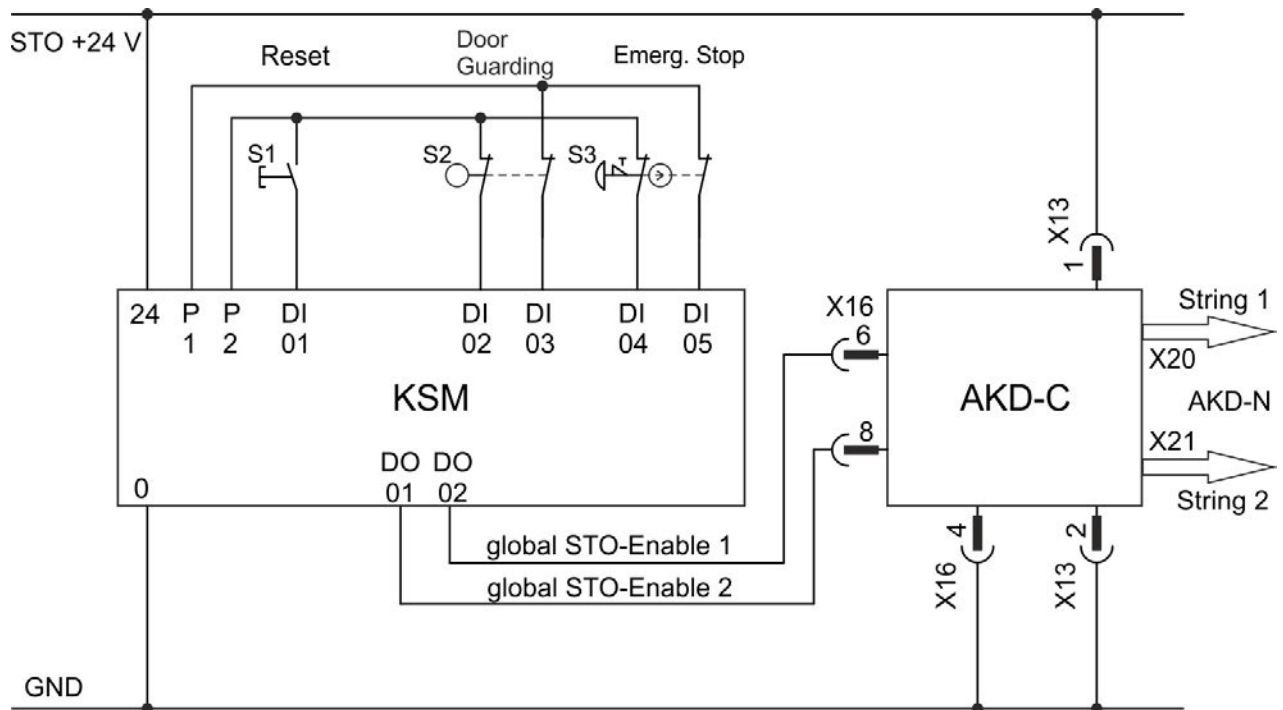
Refer to the KSM safety modules documentation for pinout and functionality of the Kollmorgen KSM Modules. These documents can be downloaded from the Kollmorgen website.

6.16 Shock-hazard Protection

6.16.1 Leakage current

Leakage current via the PE conductor results from the combination of equipment and cable leakage currents. The leakage current frequency pattern includes a number of frequencies, whereby the residual-current circuit breakers definitively evaluate the 50 Hz current. For this reason, the leakage current cannot be measured using a conventional multimeter.

NOTE 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

6.16.2 Residual current protective device (RCD)

NOTE AKD-C with AKD-N can cause a d.c. current in the protective earthing conductor. Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection in case of direct or indirect contact, only an RCD or RCM of Type B is allowed on the supply side of AKD-C.

In conformity with IEC 60364-4-41 – Regulations for installation and IEC 60204 – Electrical equipment of machinery, residual current protective devices (RCDs) can be used provided the requisite regulations are complied with.

The AKD-C is a 3-phase system with a B6 bridge. Therefore, RCDs which are sensitive to all currents must be used in order to detect any DC fault current.

Rated residual currents in the RCDs:

10 to 30 mA	Protection against "indirect contact" (personal fire protection) for stationary and mobile equipment, as well as for "direct contact".
50 to 300 mA	Protection against "indirect contact" (personal fire protection) for stationary equipment

If you use a selective RCD, the more intelligent evaluation process will prevent spurious tripping of the RCD.

6.16.3 Isolating transformers

When protection against indirect contact is absolutely essential despite a higher leakage current, or when an alternative form of shock-hazard protection is sought, the AKD can also be operated via an isolating transformer (schematic connection ➜ p. 56). A ground-leakage monitor can be used to monitor for short circuits.

NOTE Keep the length of wiring between the transformer and the drive as short as possible.

6.17 LED Display
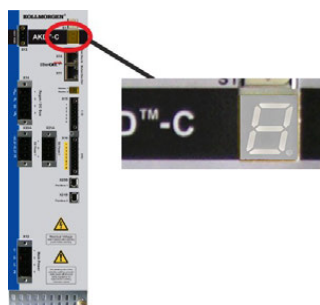
The LED seven-segment display indicates the status of the drive after the 24 V supply is switched on. If the service connection to the PC or to the PAC doesn't work, then the LED display is the only way to get information.AKD fault codes or warning codes are displayed constantly if present. Fault messages are coded with "F" or "E", warnings are coded with "n". The IP address can be flashed across the LED display if the B1 button is pressed.

The local fieldbus status LEDs are described in "Local Fieldbus (X20B, X21B)" (➜ p. 66).

7   Mechanical Installation

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.

NOTICE Protect the device 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 device will switch itself off in case of overheating. Ensure that the mounting space matches the requirements ("Ambient Conditions, Ventilation, and Mounting Position" (➜ p. 27)).
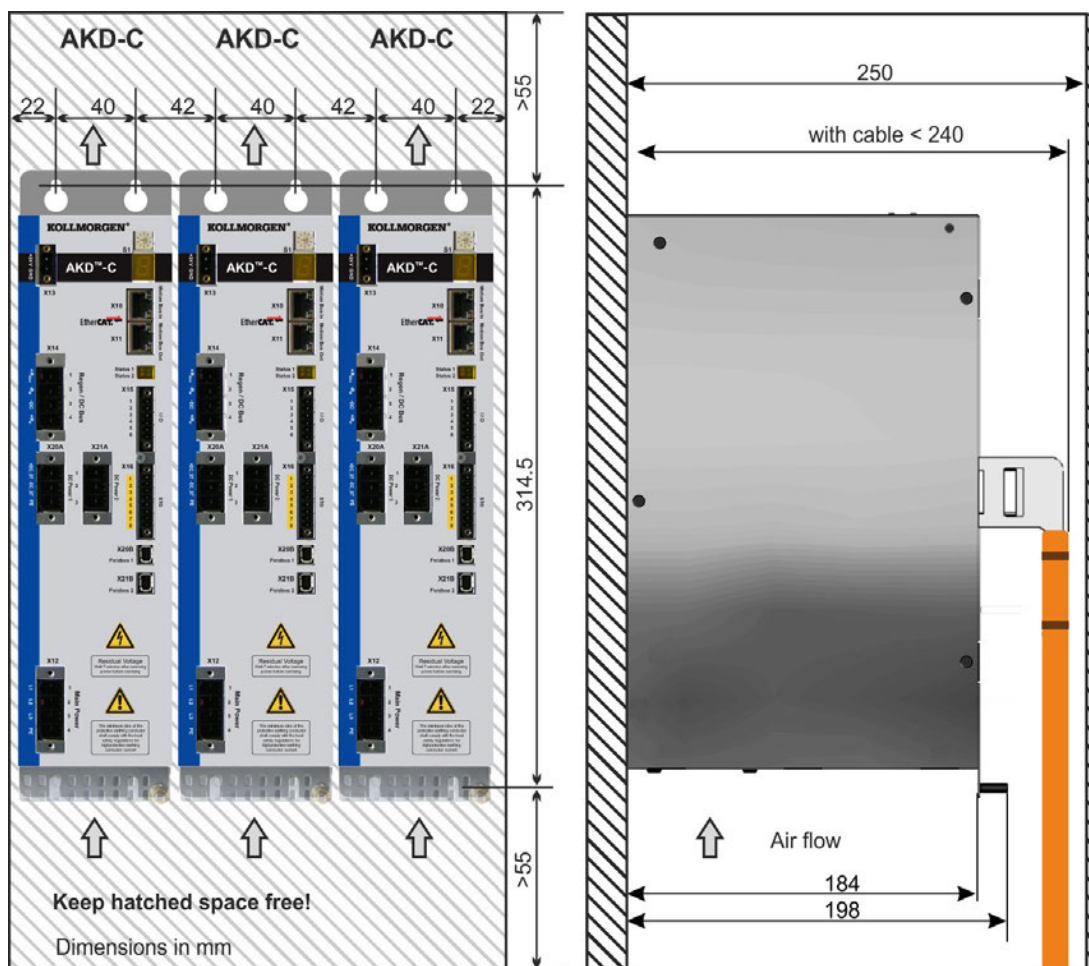
NOTICE Do not mount devices that produce magnetic fields directly beside the drive. Strong magnetic fields can directly affect internal components. Install devices which produce magnetic field with distance to the AKD-C and/or shield the magnetic fields.

7.2 Dimension Drawing
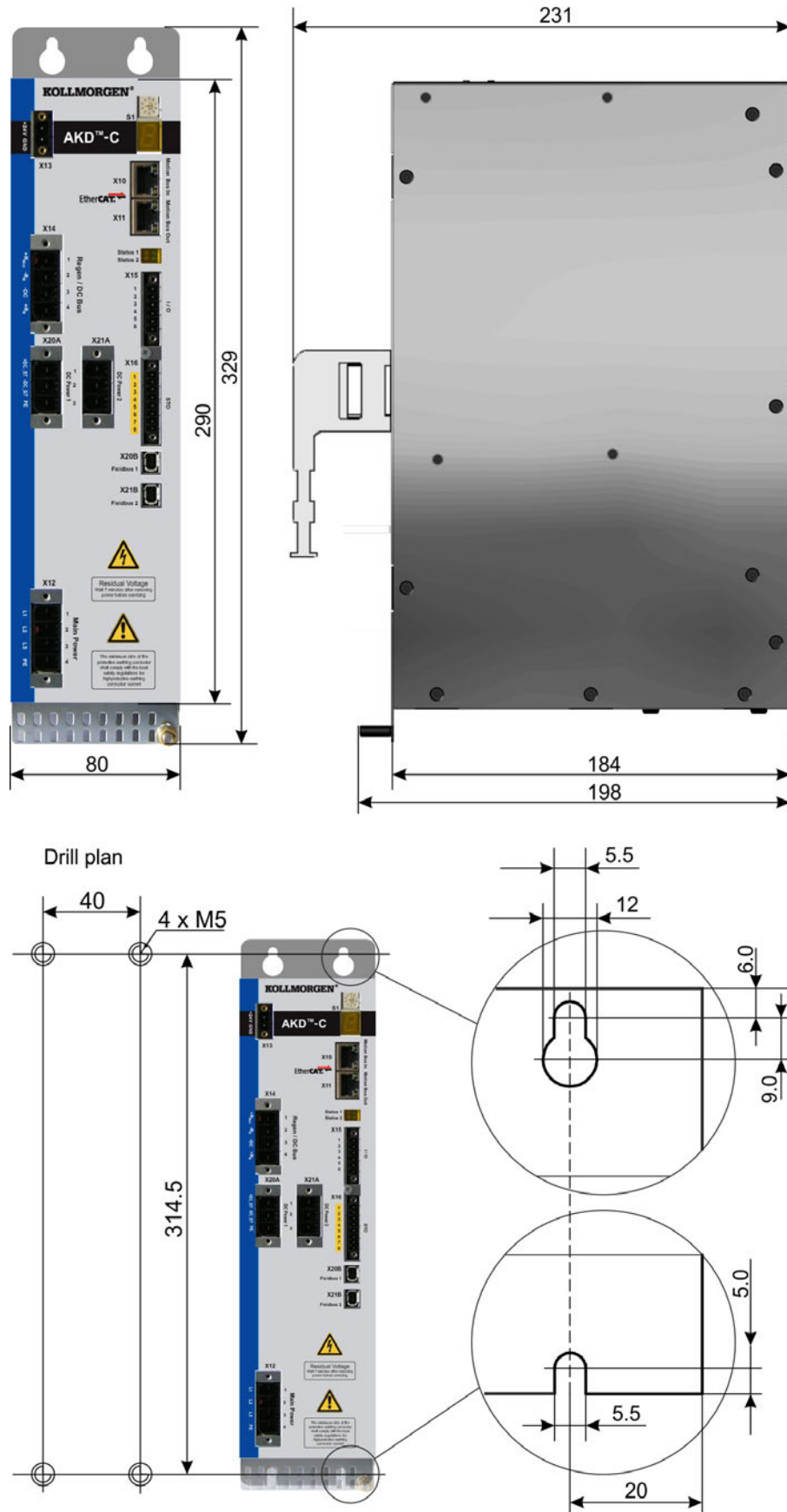
7.3   Mounting Example

Mounting material: Four M5 hexagon socket screws to ISO 4762, 4 mm T-handle Allen key.

8 Electrical Installation

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 all power supply sources. Always measure the voltage in the DC bus link at connector X14 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.

> ⚠ **CAUTION**
> 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. 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 system components. 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. 54.

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

8.2 Guide to Electrical Installation

Install the electrical system as follows:

1. Select cables in accordance with IEC 60204 (➜ p. 29.) and the system topology (➜ p. 51).
2. Install shielding and ground the AKD-C.
   Ground the mounting plate and CNC-GND of the control system.
3. Wire the device.
   - Wire the FAULT contact in series into the emergency stop circuit of the system.
   - If required, connect the external regen resistor (with fusing).
   - Connect the required AKD-N drives to string 1 or string 2.
   - Connect the Enable input and the digital output, if required.
   - Connect the STO inputs and STO status outputs for the used strings (➜ p. 34).
   - Connect the auxiliary supply (maximum permissible voltage values see electrical data (➜ p. 26).
   - Connect the main electrical supply.
     Check maximum permitted voltage value (➜ p. 26). Check proper use of residual-current circuit breakers (RCD, ➜ p. 42)
   - Connect the PC (➜ p. 72) for setting up the drive system.
4. Check the wiring against the wiring diagrams and observe the system topology limits (➜ p. 51).

8.3 EMI Noise Reduction

8.3.1 Recommendations for EMI noise reduction

The following guidelines will help you to reduce problems with electrical noise in your application.

- Ensure good connections between the cabinet components.
  Connect the back panel and cabinet door to the cabinet body using several conductive braids. Never rely on hinges or mounting bolts for ground connections. Provide an electrical connection across the entire back surface of the AKD-C panel. Electrically-conductive panels such as aluminum or galvanized steel are preferred. For painted and other coated metal panels, remove all coating behind the drive.
- Ensure good ground connection.
  Connect from cabinet to proper earth ground. Ground leads should be the same gauge as the leads to main power or one gauge smaller.
- Use Kollmorgen cables.
  Experience has shown that customers who use Kollmorgen's cables have far fewer problems than customers who build cables.
  Route power and control cables separately, Kollmorgenrecommends a distance of at least 200 mm to improve interference immunity.
- Ground the shielding at both ends.
  Ground all shielding with large areas (low impedance), with metalized connector housings or shield connection clamps wherever possible. For cables entering a cabinet, connect shields on all 360° of the cable. Never connect a simple "pigtail".
- Splice cables properly.
  If you need to divide cables, use connectors with metal backshells. Ensure that both shells connect along the full 360° of the shields. No portion of the cabling should be unshielded. Never divide a cable across a terminal stripe
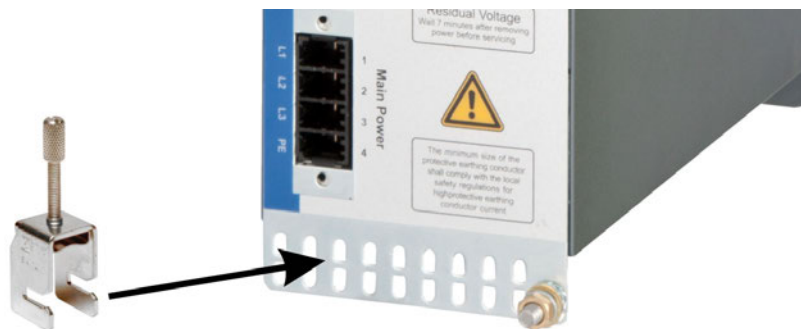
8.3.2 Shielding connection to the drive

8.3.2.1 Shield connection clamps for X12, X13, X14, X15, X16

Shield connection clamps (see accessories manual) are used for connecting cable shields for X12, X13, X14, X15, X16.

**NOTE** Usually wiring to these connectors must not be shielded.

We recommend using Phoenix Contact SK14 shield clamps with clamp range of 6 to 13mm. The clamps hook into the grounding plate and ensure optimum contact between the shield and the grounding plate.

8.3.2.2 Ethernet connectors X10, X11, X18

The shield of Ethernet cables is connected via the connectors to the housing.

8.3.2.3 DC power connector X20A, X21A (cable CCNCN1)

Connection for the DC power by mating connector with strain relief.
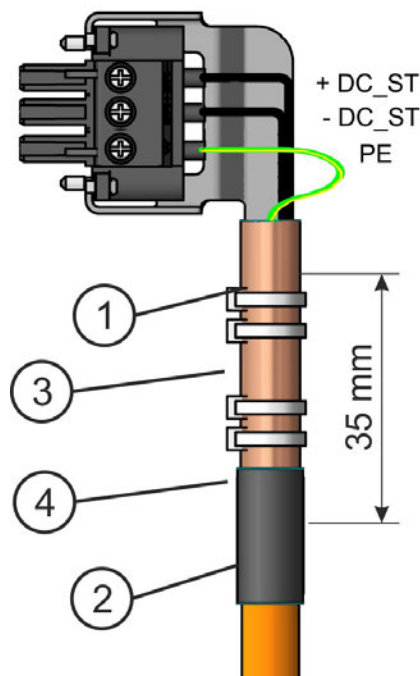
Strip the external cable sheath to a length of approx. 100 mm, taking care not to damage the braided shield. Push the braided shield (1) back over the cable and secure with a rubber sleeve (2) or shrink sleeve.

Shorten all the wires apart from the protective earth (PE) wire (green/yellow) by about 20 mm so that the PE wire is now the longest wire. Strip all wires and fit wire end ferrules.

Secure the braided shield of the cable to the shroud with a cable tie (3) and use a second tie (4) to fasten the cable.

Wire the connector as shown in the connection diagram. Plug in the connector to the socket on the front of the AKD-C.

Screw the connector in place. This ensures that there is conductive contact over a large surface area between the braided shield and the front panel.

### 8.3.2.4 Local fieldbus connectors X20B, X21B (cable CCNCN1)

The shield of local fieldbus cables is connected via the connector to the housing.

## 8.4 System Topology of a Decentralized Servo System

8.4.1 System limits

String length:	maximum 100 m total cable length per string
Number of AKD-N:	maximum 8 per string, total maximum 16 observe total power/current restrictions described in the *Decentralized System Projecting Guide*
Number of AKD-C:	limited by fieldbus protocol
Sum of output current of string 1 and string 2:	17 A, use coincidence factor of the axes for optimization
Standby total power:	Total standby power is limited to 260 W at 24 V.
Service Interface X18	Ethernet TCP/IP, 100 Mbit/s

8.4.2 Example for one AKD-C
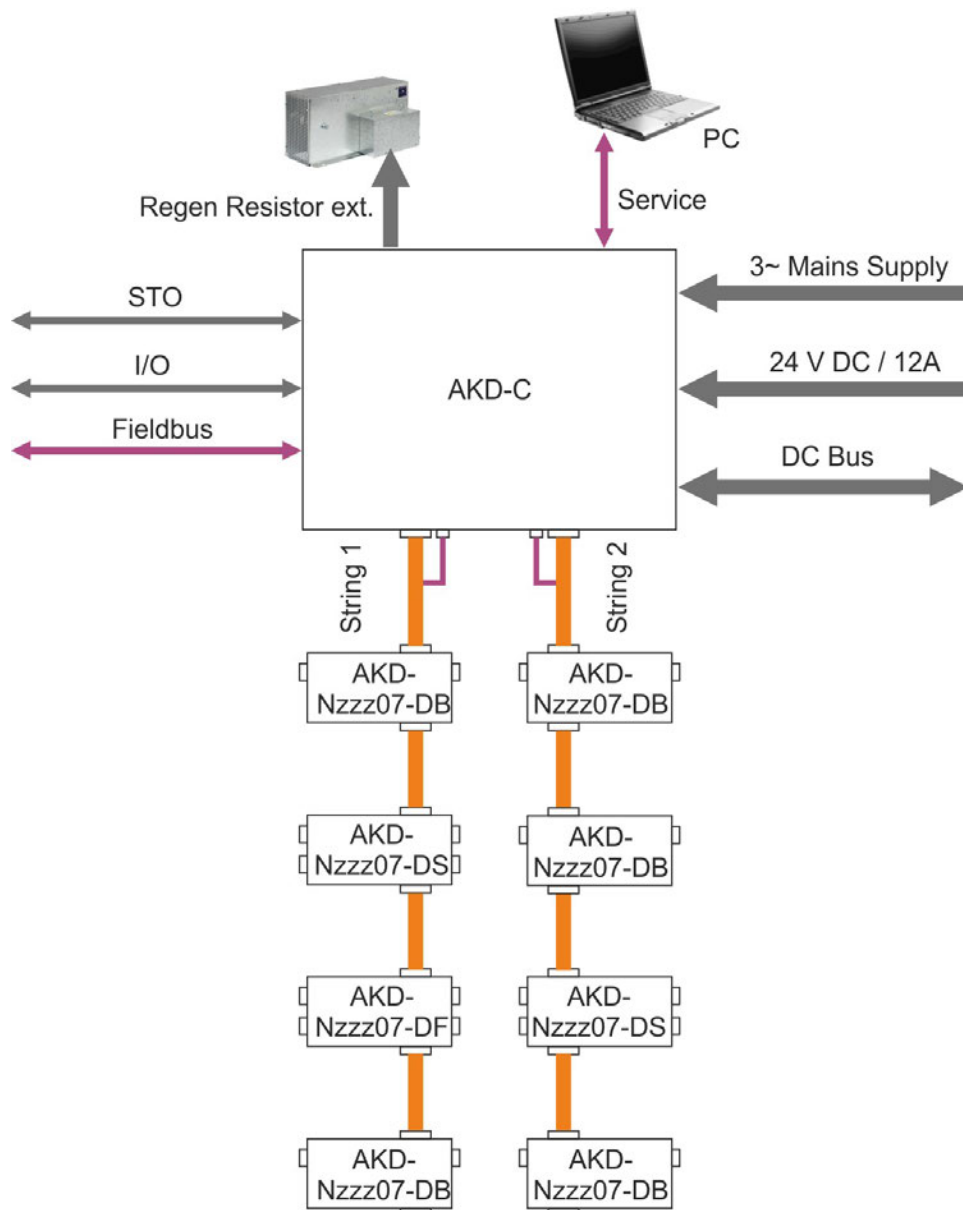
8.4.3 Example for several AKD-C
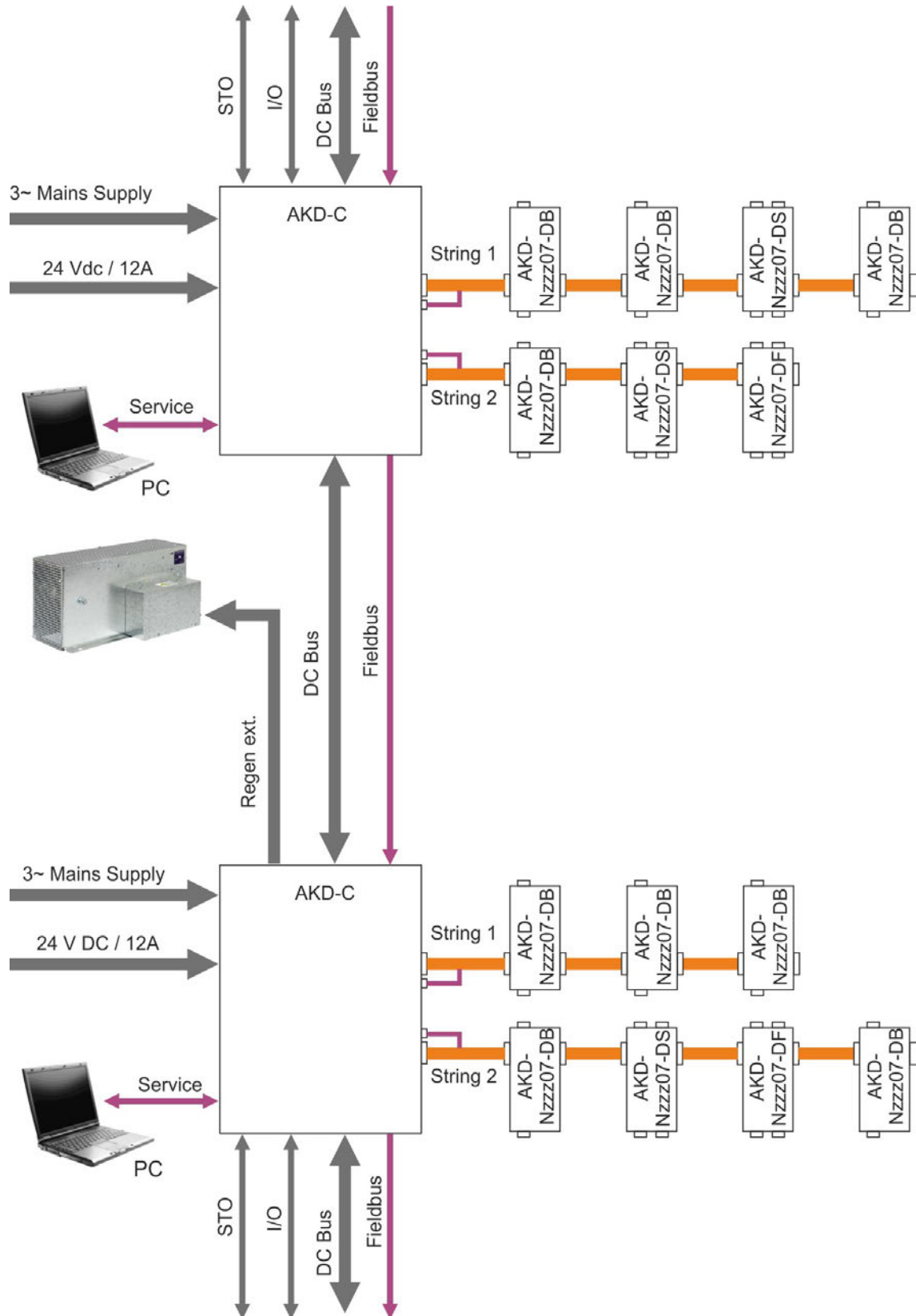
8.5 Wiring

> **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.

NOTICE Only professional staff who are qualified in electrical engineering are allowed to install the decentral drive system. 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 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).

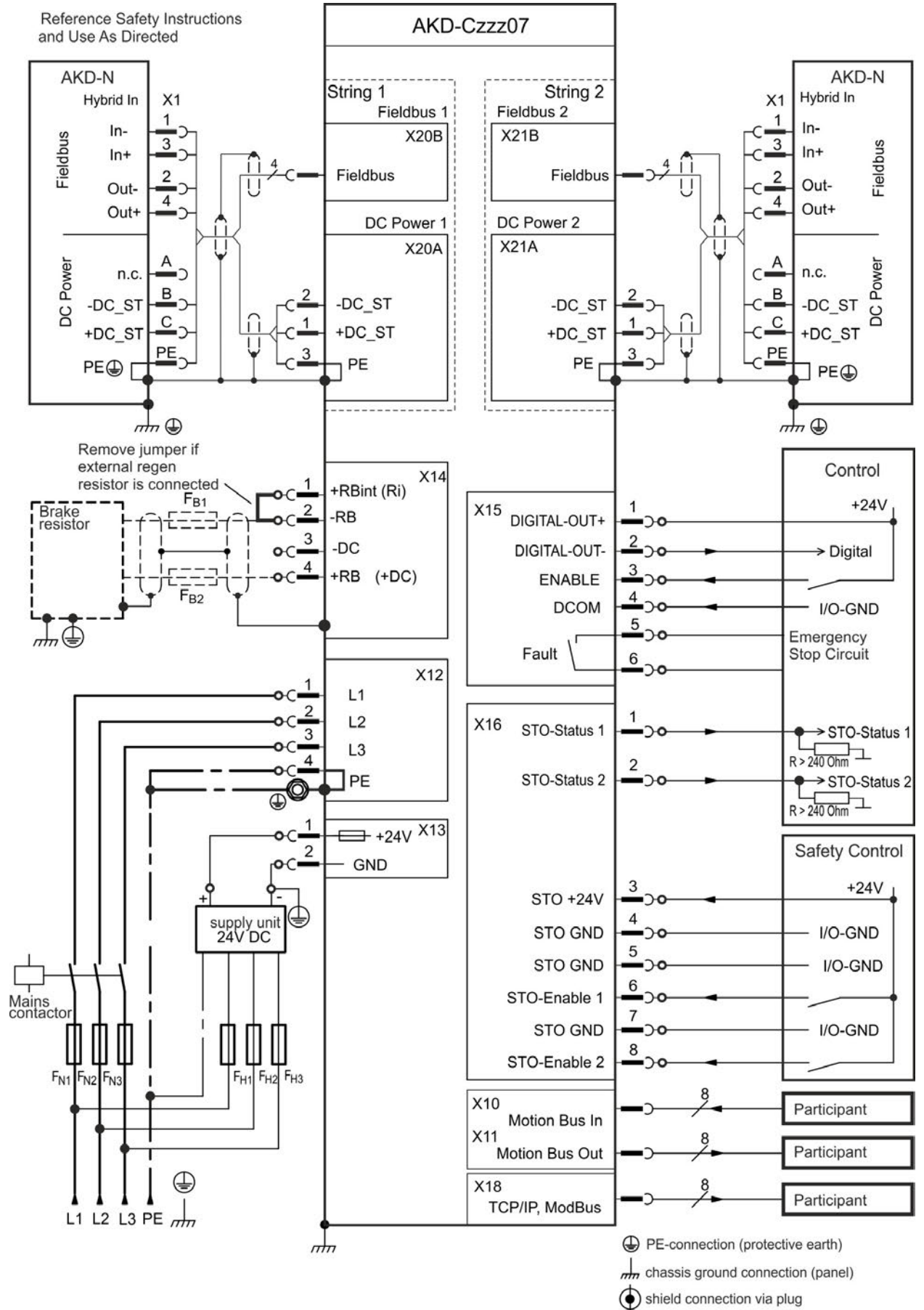Use the following connection diagrams:

8.6 Connection Overview

8.6.1 Connector assignment
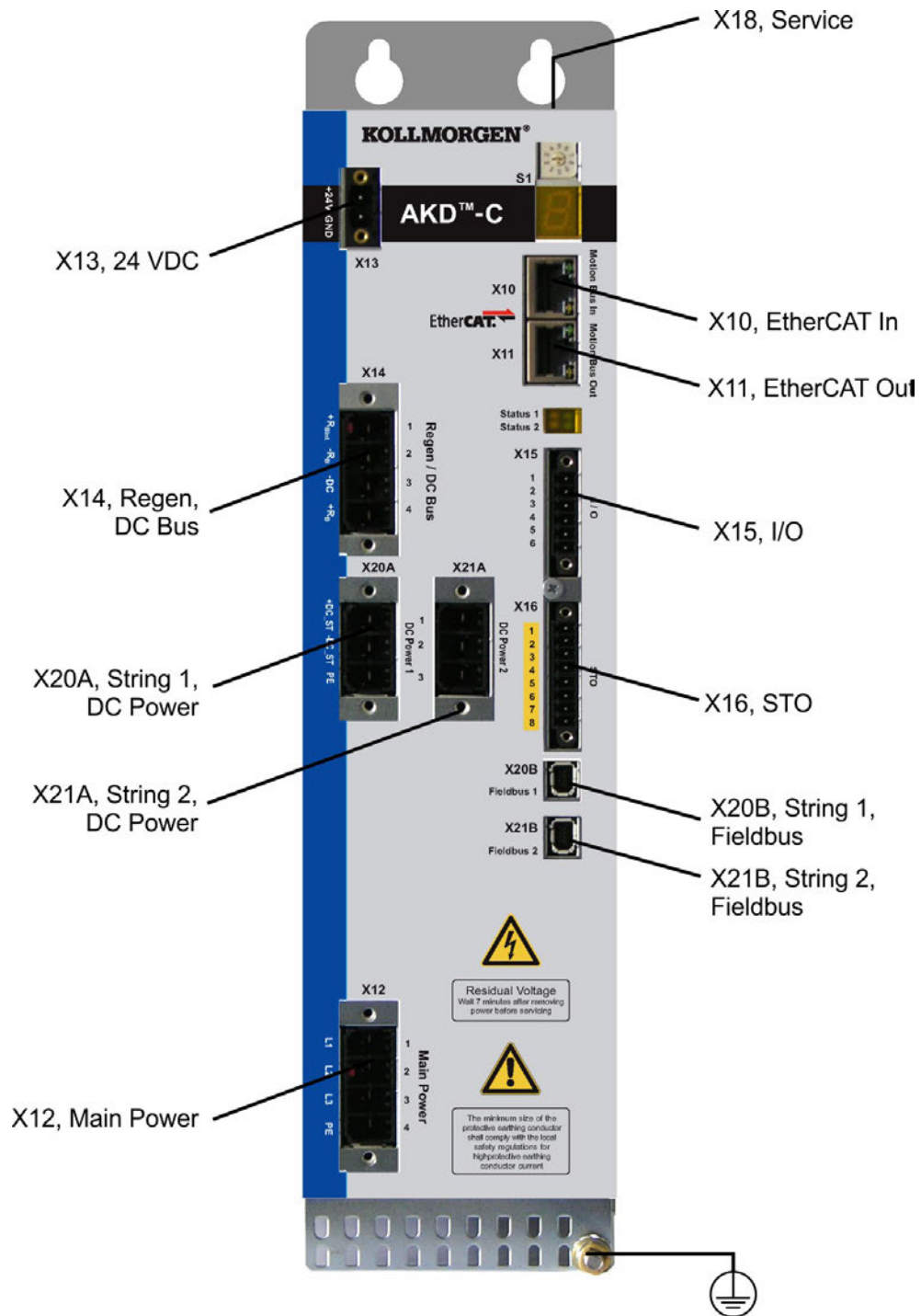
8.6.2 Connection diagram

8.7 Electrical Supply Connection

8.7.1 Connection to various mains supply networks

This page illustrates all the possible connection variations for different electrical supply networks.

> **WARNING**
>
> There is a danger of electrical shock with serious personnel injury if the device is not properly grounded. An isolating transformer is required for 120V/240V networks to get a minimum voltage of 400 V -10%.
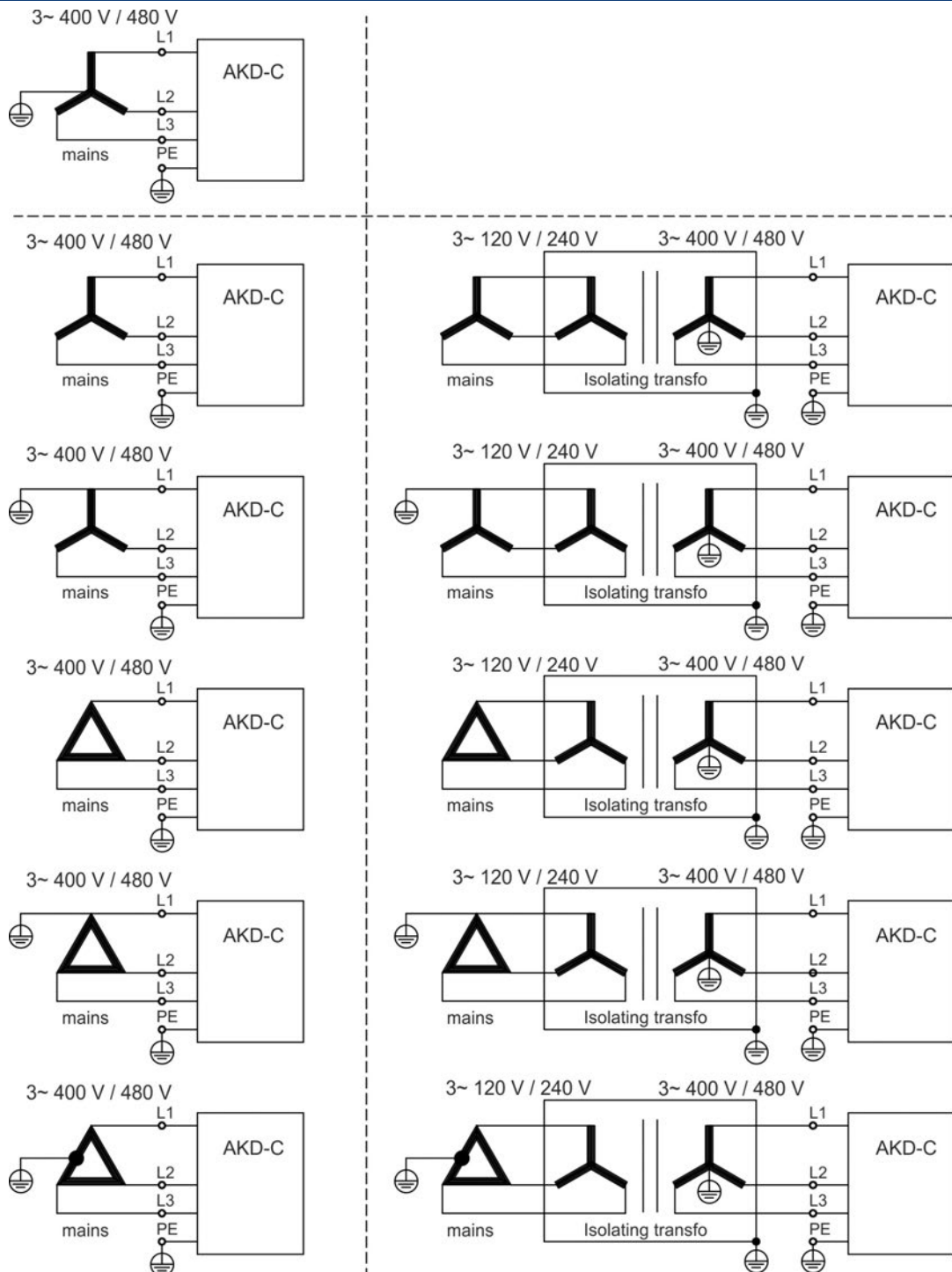
8.7.2 Mains supply connection (X12)

8.7.2.1 Three phase connection

- Directly to 3-phase supply network, supply networks ➜ p. 56
- Fusing (such as fusible cut-outs) to be provided by the user ➜ p. 27.
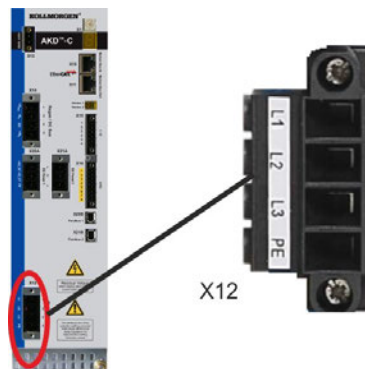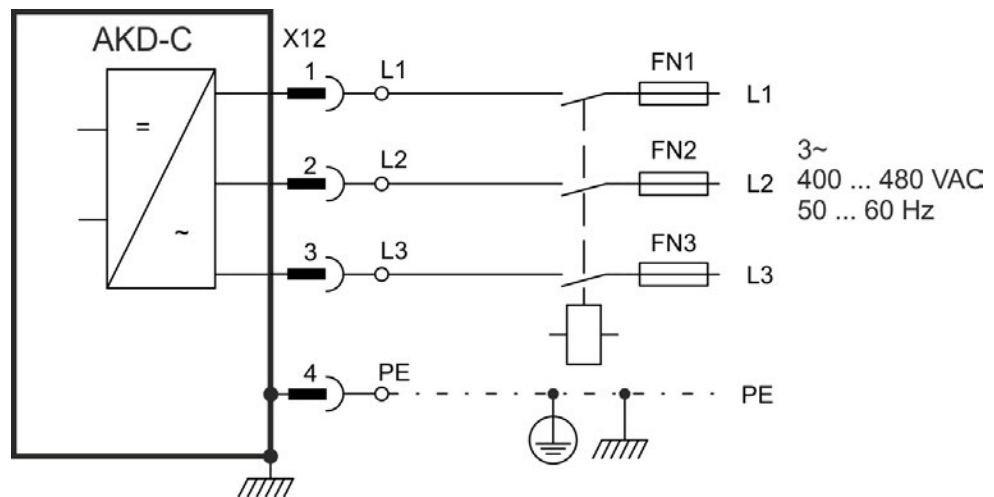
Pin	Signal	Description
1	L1	Line 1
2	L2	Line 2
3	L3	Line 3
4	PE	Protective Earth

### 8.7.3 24 VDC supply voltage (X13)

The following diagram describes external 24 VDC power supply, electrically isolated, for example, via an isolating transformer. The required current rating depends on the use of motor brake and number of connected AKD-N drives.

The 24 VDC voltage is internally split into a control supply to power the AKD-C electronics and a supply voltage to power the connected AKD-N drives in case of switched off AC mains power.

NOTE 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.
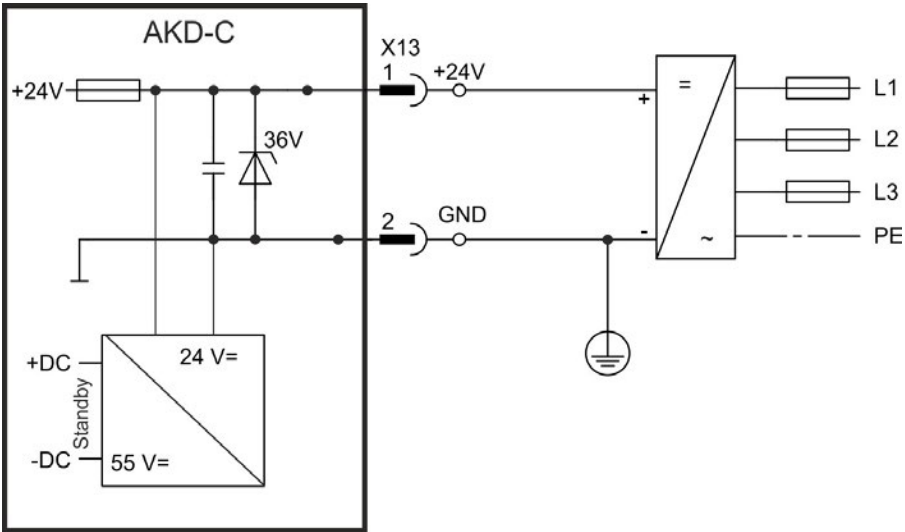
Pin	Signal	Description
1	+24	+24 VDC Auxiliary voltage
2	GND	24V Supply GND

8.8 DC Bus link (X14)

The DC bus link can be connected in parallel so that the regen power is divided between all the AKD-C that are connected to the same DC bus link circuit. Every AKD-C must have it's own power connection to mains voltage, even if the DC bus link is used.

| NOTICE | The devices can be destroyed if DC bus link voltages are different. Only devices with mains supply from the same mains (identical mains phases and voltage) may be connected by the DC bus link. Use unshielded single cores with a maximum length of 200 mm. Use shielded cables for longer lengths. |

| NOTICE | The DC-Bus link circuit +DC/-DC is not short circuit proof. Observe the recommended wire cross section (➜ p. 29). |

Possible DC Bus Link connections

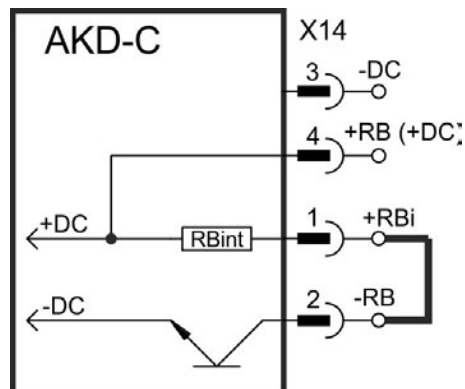| Devices	AKD-xzzz07	KCM	AKD-xzzz06	S3xx / S7xx
AKD-C01007	yes	yes	no	no
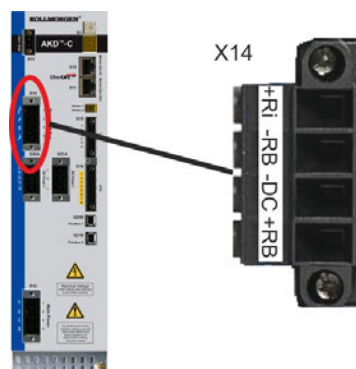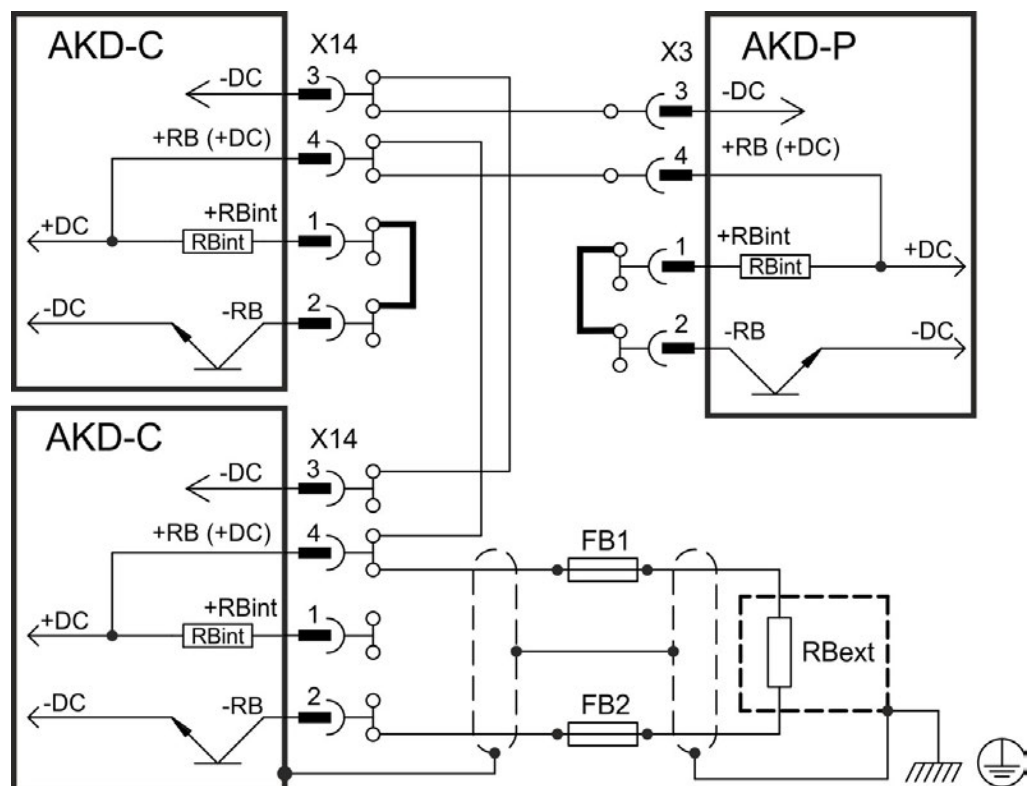
Pin	Signal	Description
3	-DC	DC-Link Bus negative
4	+DC (+RB)	DC-Link Bus positive

8.8.1 Regen resistor (X14)

8.8.1.1 Internal regen resistor

AKD-C has a built-in regen resistor. This internal brake circuit is active with the plugged bridge in mating connector X14 between 1 (+RBi) and 2 (-RB).

8.8.1.2 External regen resistor

For technical data on the brake circuit ➜ p. 31. Fusing (such as fusible cut-outs) to be provided by the user "Fusing" (➜ p. 27).

NOTICE The brake circuit +RB/-RB is short circuit proof. Observe the prohibition of continuous, operational short circuits to the external regen resistor contacts (➜ p. 16).

remove bridge !
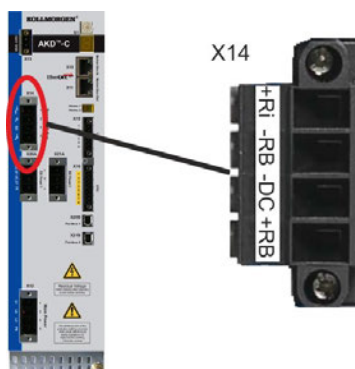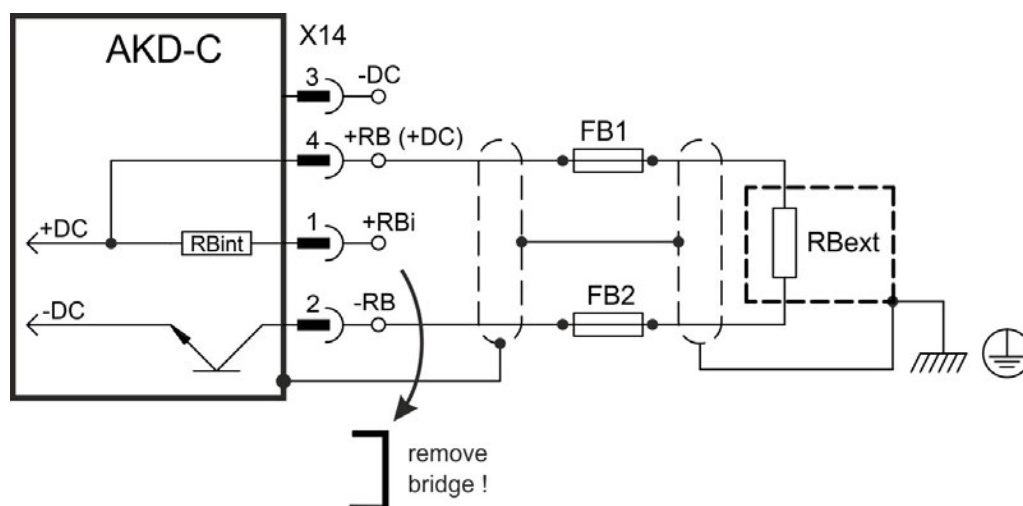
Pin	Signal	Description
2	-RB	External Regen Resistor negative
4	+RB	External Regen Resistor positive

8.8.2 Capacitor Modules (X14)

KCM modules (**K**OLLMORGEN **C**apacitor **M**odules) absorb kinetic energy generated by the motor when it is operating in generator mode. Normally, this energy is dissipated as waste via regen resistors. KCM modules, however, feed the energy they have stored back into the DC Bus link as and when it is required.

Assembly information: see regional accessories manual or KCM instruction manual.

Dimensions (HxWxD) : 300x100x201 mm

KCM-S	**S**aves energy: The energy stored in the capacitor module during generative braking is available the next time acceleration happens. The module's inception voltage is calculated automatically during the first load cycles.
KCM-P	**P**ower in spite of power failure: If the power supply fails, the module provides the servo amplifier with the stored energy that is required to bring the drive to a standstill in a controlled manner (this only applies to the power supply voltage; battery-back the 24 V supply separately).
KCM-E	**E**xpansion module for both applications. Expansion modules are available in two capacitance classes.

NOTE The KCM modules may only be connected to AKD with 400/480 V rated voltage and a maximum rated current of 24 A. Mounting, installation, and setup instructions can be found in the Instructions Manual of the KCM Modules.

DANGER

DC Bus link terminals in servo systems carry high DC voltage of up to 900 V. Touching the terminals while they are carrying voltage is extremely dangerous. Switch off (disconnect) the line voltage. You must only work on the connections when the system is disconnected.

It can take over an hour for the modules to self-discharge. Check the state of charge with a measuring device that is suitable for a DC voltage of up to 1,000 V. When measuring a voltage of over 60 V between the DC+/DC- terminals or to ground, discharge the modules (see "Discharging KCM modules" (➜ p. 64)).

8.8.2.1 Technical Data

| Type	Storage-Capacity [Ws]	Rated Supply Voltage [V DC]	Peak Supply Voltage [V DC]	Power [kW]	Protection Class	Inception Voltage [V DC]	Weight [kg]
KCM-S200	1600	max. 850	max. 950 (30s in 6 min)	18	IP20	evaluated	6.9
KCM-P200	2000					470	6.9
KCM-E200	2000					-	4.1
KCM-E400	4000					-	6.2

8.8.2.2 Example installation with KCM-S and KCM-E

NOTICE	Maximum cable length between AKD-C and KCM: 500mm. The DC+ and DC- lines should always be twisted, maximum cross section is 6mm². Ensure that the polarity is correct, swapping round DC+/DC- will damage the KCM modules.

Create a motion profile that causes the brake chopper to respond.
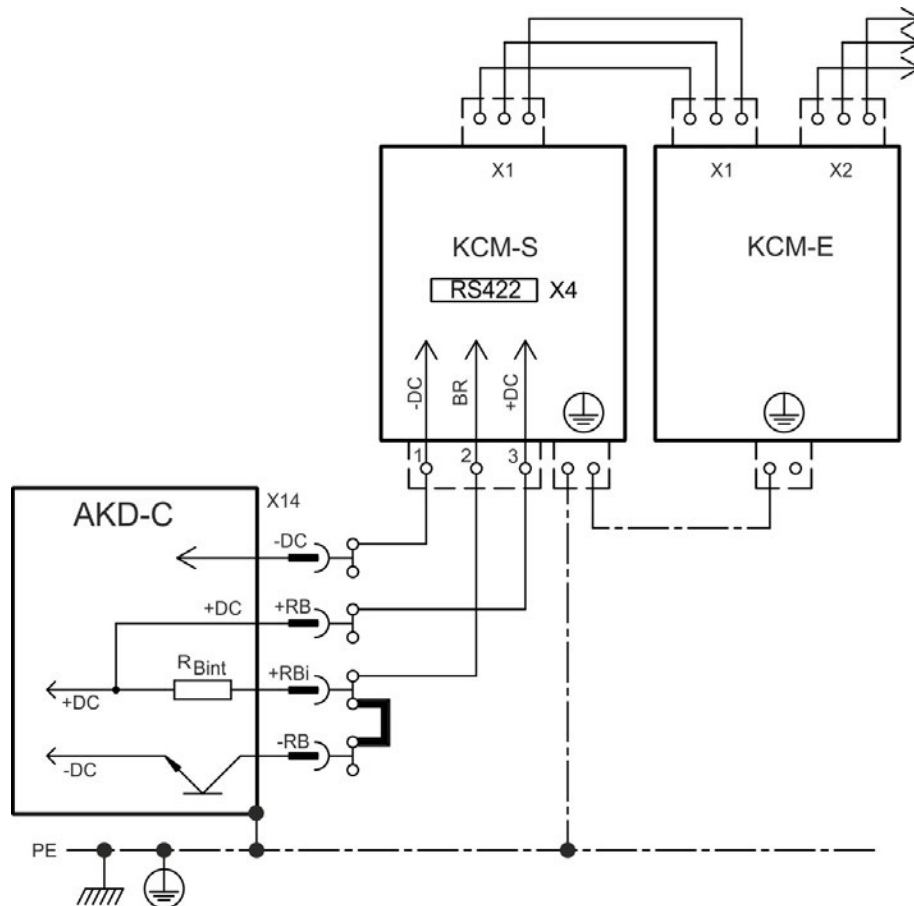
Setup KCM-S and KCM-E

Prerequisite for the following instructions:

- Properly disconnected, grounded system.
- KCM-S: assembled and wired in the switching cabinet. The load that leads to the activation of the brake chopper during braking must be connected.
- KCM-E: assembled and connected to the KCM-S with connection cable (X1) and PE line.
- Discharge aids (plug-in bridge) are removed.

Proceed as instructed below:

1. Switch on the line voltage after the AKD-C has finished the 24V boot process.
2. Enable the AKD and operate the motion profile that causes the brake chopper to respond.
3. The KCM-S determines the chopper threshold and begins to charge; LED (top view) flashes. The energy stored in the capacitor module during generative braking is available the next time acceleration happens.

RS422 interface X4 allows data exchange controlled by a terminal software of your choice. Interface setting: 115200 Baud, 8 Data Bits, 1 Stop Bit, No Parity&Flow Control. The X4 mating connector is in the package. More information is given in the Kollmorgen Product WIKI.

8.8.2.3 Example installation with KCM-P and KCM-E

NOTICE   Maximum cable length between AKD-C and KCM: 500mm. The DC+ and DC- lines should always be twisted, maximum cross section is 6mm². Ensure that the polarity is correct, swapping round DC+/DC- will damage the KCM modules.

The KCM-P starts the charging process at approx. 470 V DC. If the power supply fails, the module provides the DC bus link with the stored energy (this only applies to the power supply voltage; battery-back the 24 V supply separately).
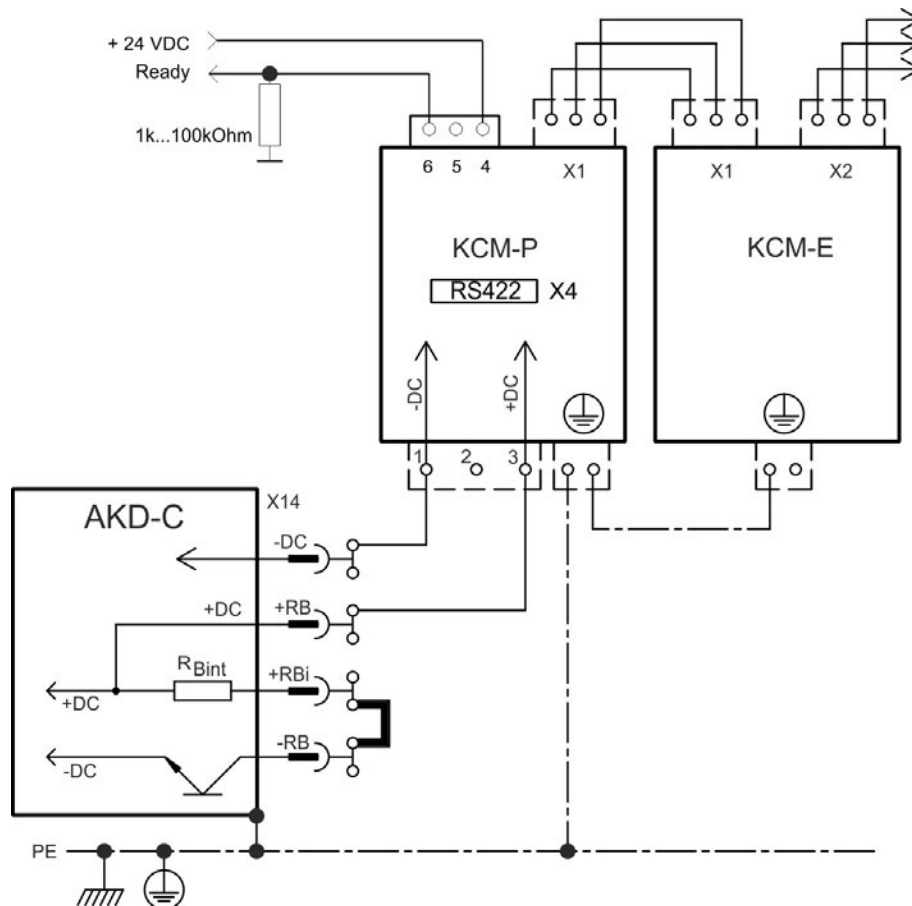
Setup KCM-P and KCM-E

Prerequisite for the following instructions:

- Properly disconnected, grounded system.
- KCM-P: assembled and wired in the switching cabinet. Set AKDundervoltage limit VBUS.UVTHRESH to a value significantly below 470V DC, otherwise AKD will switch-off before KCM-P provides energy to the DC bus link.
- KCM-E: assembled and connected to the KCM-P with connection cable (X1) and PE line.
- Discharge aids (plug-in bridge) are removed.

Proceed as instructed below:

1. Switch on the line voltage after the AKD-C has finished the 24V boot process.
2. The KCM-P begins the charging process at approx. 470 V DC; the LED flashes.

RS422 interface X4 allows data exchange controlled by a terminal software of your choice. Interface setting: 115200 Baud, 8 Data Bits, 1 Stop Bit, No Parity&Flow Control. The X4 mating connector is in the package.

The ready signal reports the ready to operate (high level) status.

More information is given in the Kollmorgen Product WIKI.

8.8.2.4 Discharging KCM modules

The aids supplied with each KCM module (plug-in bridge/connecting cables) allows discharging the modules safely.

| NOTICE |

When the charging LED on top of the modules flashes, the capacitors are charged. Please note, however, that the LED does not allow you to draw a definite conclusion about the state of discharge, as it is not monitored for failures.

DANGER

DC Bus link terminals in servo systems carry high DC voltage of up to 900 V. Touching the terminals while they are carrying voltage is extremely dangerous.

Switch off the line voltage (disconnect the system). You must only work on the connections when the system is disconnected.

Check the state of charge of the capacitors with a measuring device that is suitable for a DC voltage of up to 1,000 V. Wait until the voltage measured between the DC+/DC- terminals or to ground has dropped below 60 V. It can take over an hour for the modules to self-discharge. If you cannot wait for the duration of the self-discharge time, you must force the modules to discharge.

You must follow the procedure described below when forcing the modules to discharge.

For your own safety, proceed as follows when forcing the modules to discharge:

1. Switch off (disconnect) the line voltage and the 24V voltage.
2. Discharge the modules:
   KCM-S/-P: Insert the plug-in bridge in the screw terminals (black-1 to gray-2) on the base of the modules, wait at least 70 s, leave the plug-in bridge in place (as a means of securing for transport). Remove the plug-in bridge again before recommissioning.
   KCM-E: Bridge the X2/X3 connector with a connecting cable on the top of the module, wait at least 70 s, leave the connecting cable in place (as a means of securing for transport). Detach the connecting cable and reconnect the KCM-E properly before recommissioning.
3. Perform the scheduled task (e.g., cleaning, maintenance, or uninstallation).
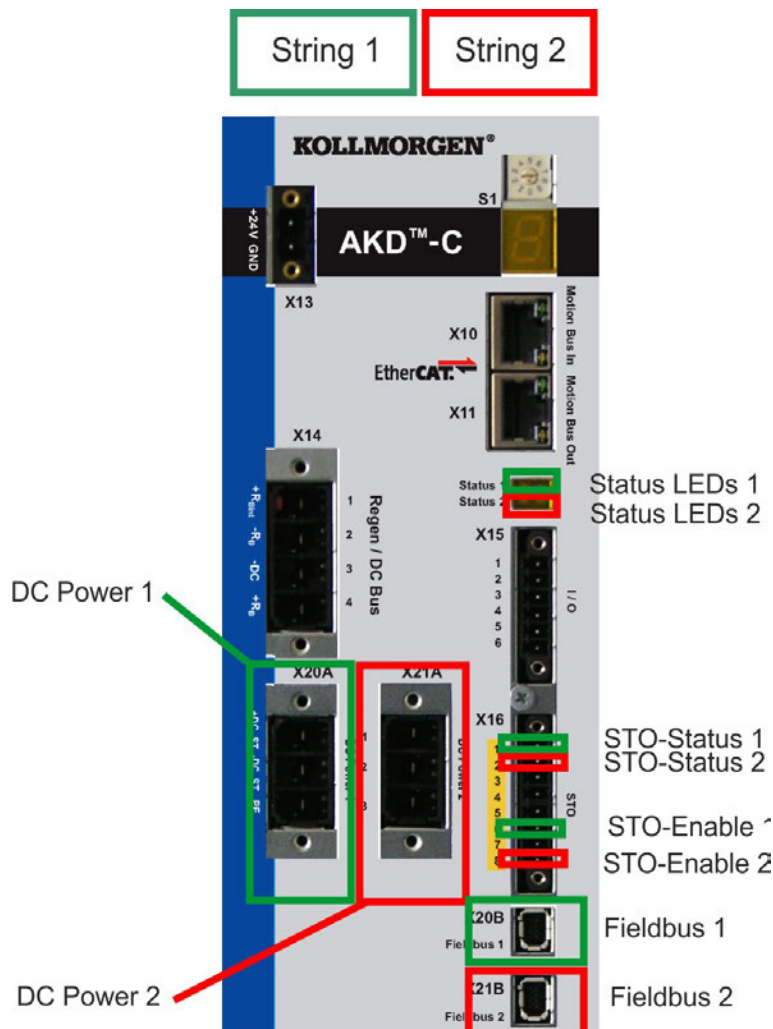
8.9 Drive String Connection

AKD-C support two strings to connect up to 16 AKD-N drives.
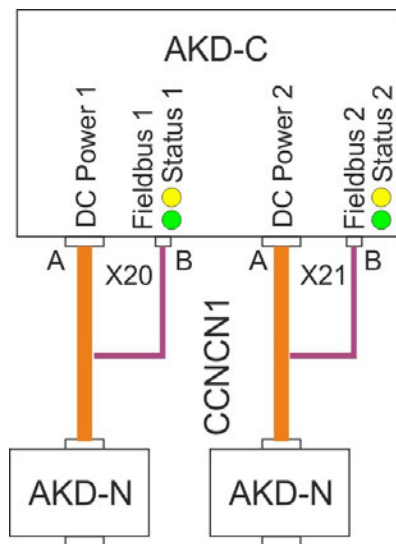
For connecting the first AKD-N to one of the DC strings the Kollmorgen cable type CCNCN1 must be used. This cable is a Y type adapter with one hybrid connector on the AKD-N end and two connectors on the AKD-C end with separate DC power and local fieldbus lines.

8.9.1 String assignment

8.9.2 DC power (X20A, X21A)

The DC power lines supply DC power for up to 8 AKD-N drives in one string. Connection for the DC power must be done by a mating connector with strain relief due to EMC reasons. This connector is configured with the Kollmorgen CCNCN1 cable (➜ p. 29).
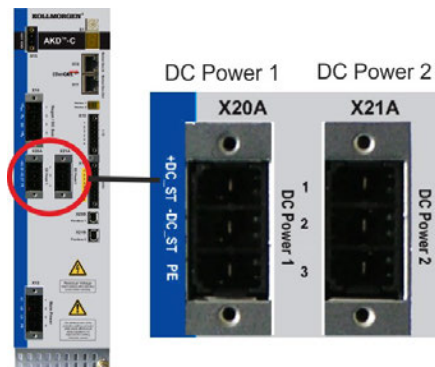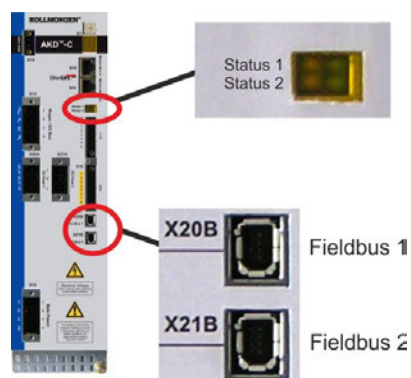
Pin	Signal	Description
1	+DC_ST	DC power positive
2	-DC_ST	DC power negative
3	PE	Protective Earth

8.9.3 Local Fieldbus (X20B, X21B)

Local fieldbus connectors separate for each string enable the AKD-C to communicate with all connected AKD-N via a four line bus medium. This connector is configured with the Kollmorgen CCNCN1 cable (➜ p. 29).

NOTICE

These ports may not be directly connected to standard EtherCAT nodes.
These connectors are type 1 mini I/O, use Kollmorgen cables CCNCN1 only.

Pin	Signal	Description
1	Receive +	Receive +
2	Receive -	Receive -
3	Transmit +	Transmit +
6	Transmit -	Transmit -
4,5,7,8	n.c.	not connected

Status LEDs for the local fieldbus connections

The communication status is indicated by the built-in status LEDs, one pair for each string.

LED	Name	Function
green	IN port Link	ON = active, OFF= not active
yellow	RUN	ON = running, OFF = not running

8.10 I/O Connection

8.10.1 I/O connectors X15 and X16

Digital I/O signals are connected to X15, STO signals are connected to X16.

X15 (I/O)	X16 (STO)
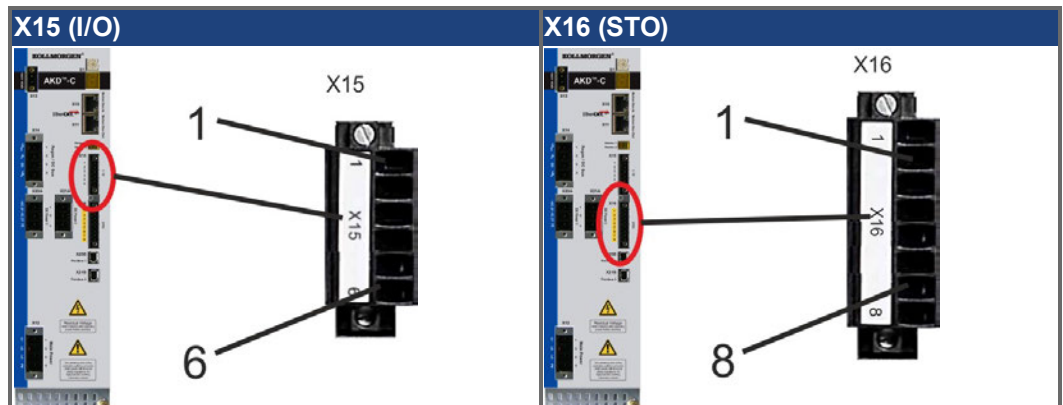
Conn.	Pin	Signal	Abbreviation	Function	Wiring Diagram
X15	1	Digital Output +	DIGITAL-OUT+	Programmable	➔ p. 69
X15	2	Digital Output -	DIGITAL-OUT-		
X15	3	Hardware Enable	Enable	Output stage enable	➔ p. 68
X15	4	Digital Common	DCOM	Common line for X15 pin 1, 2, 3	
X15	5	Fault Relay Output	Fault	Fault Relay Output	➔ p. 70
X15	6	Fault Relay Output	Fault	Fault Relay Output	
X16	1	STO-Status for DC Power String 1	STO-Status 1	Status of STO for string 1	➔ p. 70
X16	2	STO-Status for DC Power String 2	STO-Status 2	Status of STO for string 2	
X16	3	STO +24 VDC	STO +24 V	24 VDC for STO signals	
X16	4	STO GND	STO GND	GND for STO 24 V	
X16	5	STO GND	STO GND	GND for STO 24 V	
X16	6	STO-Enable for DC Power String 1	STO-Enable 1	Switches off torque for drives in string 1	
X16	7	STO GND	STO GND	GND for STO 24 V	
X16	8	STO-Enable for DC Power String 2	STO-Enable 2	Switches off torque for drives in string 2	

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

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

8.10.2 Digital Input (ENABLE, X15)

Digital Input (terminal X15/3) is set to the Hardware Enable function.

Technical characteristics:

- Floating, reference common line is DCOM
- Sink or Source type wiring is possible
- 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 250 VDC
- Update rate: direct connection to hardware (FPGA)

NOTE   The Hardware Enable input and the Software Enable signal (via fieldbus or WorkBench) are serial, that means wiring of Hardware Enable is mandatory.

The output stage of the AKD-N drives, which are connected to the AKD-C are enabled by applying the ENABLE signal (Terminal X15/3). Enable is possible only if the input STO-Enable 1 or 2 (valid for DC power strings 1 or 2) has a 24 V signal (see "Global Safe Torque Off (STO)" on page 34). In the disabled state the connected motor has no torque.

A software enable by means of the setup software is also required (AND link), although this can also be permanently enabled with WorkBench.

The input can be used with switched +24 V (source type) or switched GND (sink type). See diagrams below for typical examples of digital input wiring.

Digital Input Wiring Diagram (Source type connection):
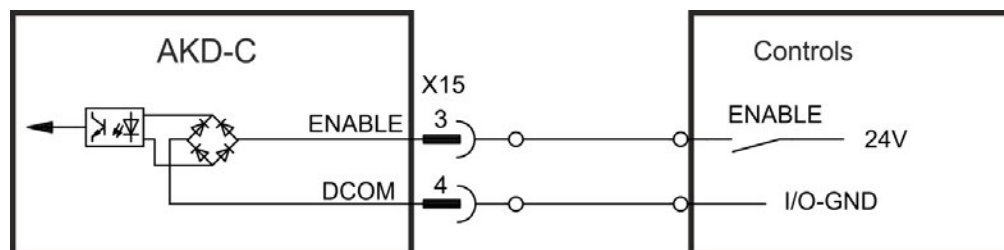
Digital Input Wiring Diagram (Sink type connection):
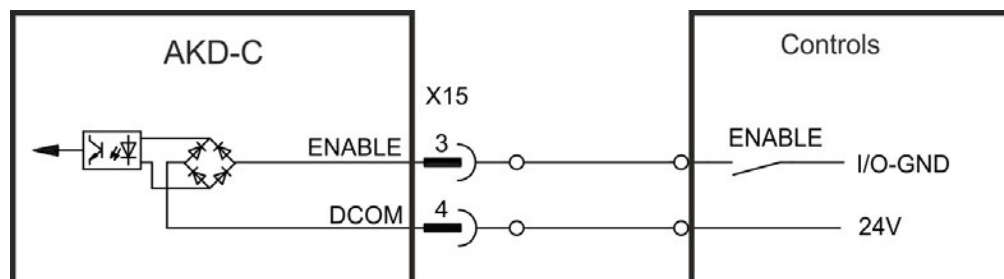
8.10.3 Digital Output (X15)

The drive supplies one digital output (X15/1 to X15/2, ➜ p. 67). Choose the required function in the setup software. Messages from pre-programmed functions stored in the AKD-C can be output here. A list of these pre-programmed functions can be found in the setup software. If the output is to be assigned to a pre-programmed function, then the parameter set must be saved in the AKD-C.

Technical characteristics:

- As per IEC61131-2 type 1
- Floating, max. 30 VDC, 100 mA
- Short circuit proof
- Galvanic isolation for 250 VDC
- Can be wired as active low or active high (see examples below)
- Update rate: 250 µs

Wiring diagram:
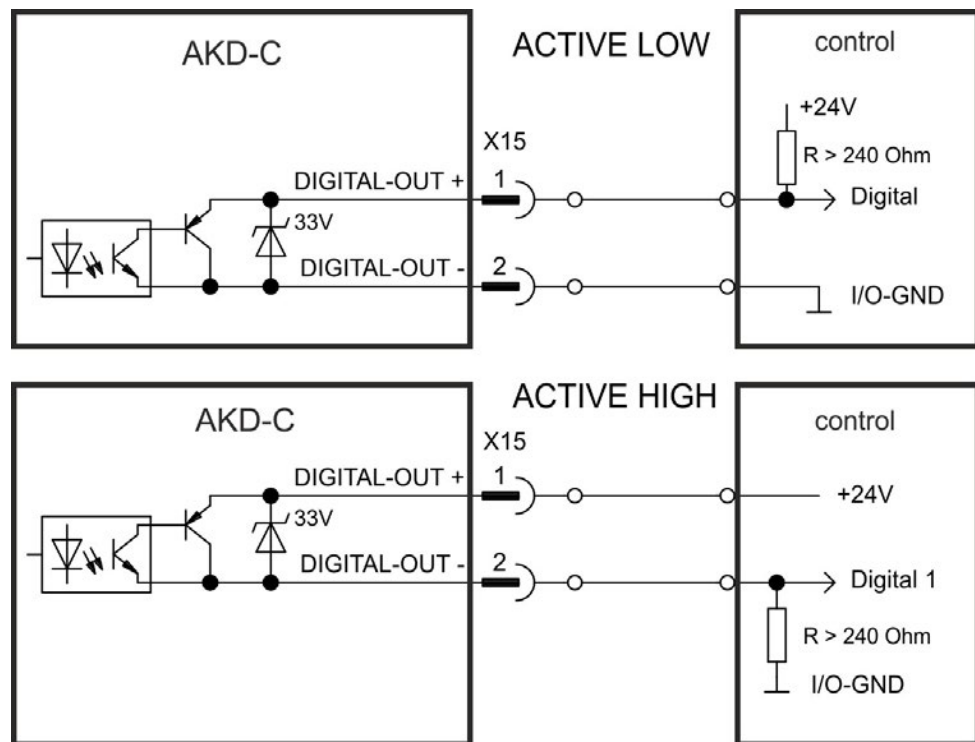
8.10.4 FAULT relay contacts

Operational readiness (terminals X15/5 and X15/6) is signaled by a floating relay contact. The fault relay can be programmed to two modes of operation:

- Contact closed when there is no fault

- Contact closed when there is no fault and the drive is enabled.

The signal is not influenced by the enable signal, the I²t-limit, or the regen threshold.

Technical characteristics:

- FAULT: Relay output, max. 30 VDC or 42 VAC, 1 A
- Time to close: max. 10 ms
- Time to open: max. 10 ms

NOTE All faults cause the FAULT contact to open and the AKD-N output stages to be switched off (if a fault occurs, the internal hardware ready signal is inhibited -> no power output to motors). List of the fault messages: ➜ p. 82.

Wiring diagram:
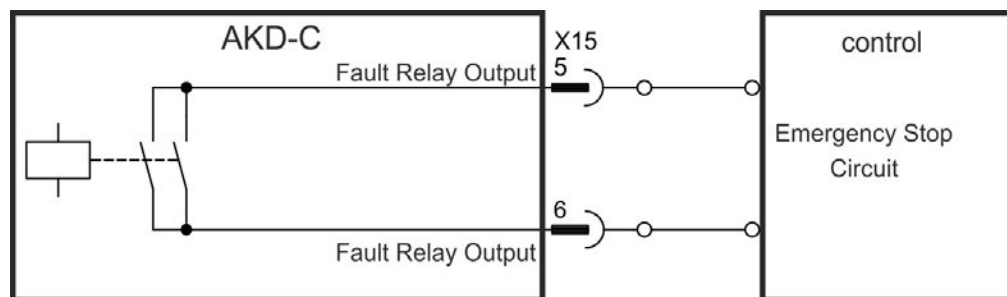
8.10.5 STO signals (X16)

Connector X16 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. All STO signals are galvanically isolated and need external 24 VDC supply (PELV/SELF).

For detailled description of STO interface and functionality refer to "Global Safe Torque Off (STO)" (➜ p. 34).

8.11   Motion Bus Interface (X10/X11)
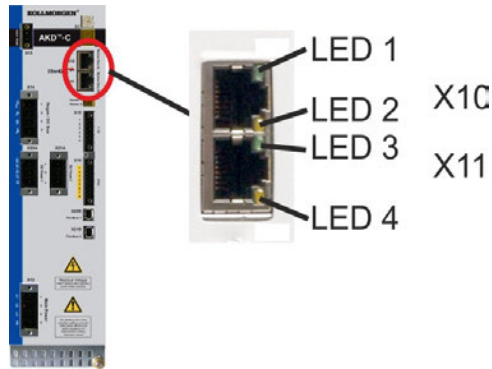
The motion bus interface has RJ-45 connectors and can be used for communication with the EtherCAT master and other AKD-C.

| NOTICE | Do not connect the Ethernet line for the PC or PAC with the set up software to the motion bus interface X10/X11. The set up Ethernet cable must be connected to X18. |

8.11.1 Pinout

Pin	Signal X10	Signal X11
1	Transmit +	Receive+
2	Transmit -	Receive-
3	Receive+	Transmit +
4, 5	n.c.	n.c.
6	Receive-	Transmit -
7, 8	n.c.	n.c.

8.11.2 Bus Protocols

| Protocol	Type	Connectivity Option
EtherCAT	Motion bus	EC

8.11.3 Network configuration

8.11.4 EtherCAT

AKD-C01007-CB**EC** can be connected as slaves to the EtherCAT network (CoE) via RJ-45 connectors X10 (in port) and X11 (out port).The communication status is indicated by the built-in connector LEDs.

Connector	LED#	Name	Function
X10	LED1	IN port Link	ON = active, OFF= not active
	LED2	RUN	ON = running, OFF = not running
X11	LED3	OUT port Link	ON = active, OFF = not active
	LED4	-	-

8.12 Service Interface (X18)

Operating, position control, and motion-block parameters can be set up by using the setup softwareWorkBench on an ordinary commercial PC ("Hardware requirements" (➔ p. 78)).
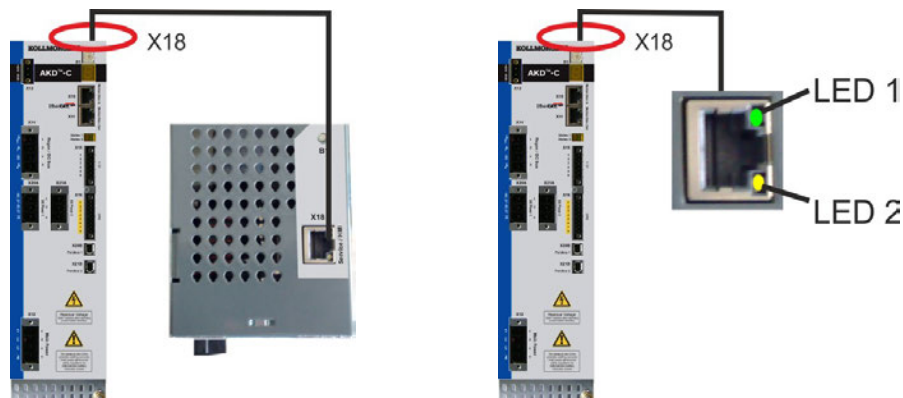
Connect the service interface X18 to an Ethernet interface on the PC directly or via a network switch. The cable can be connected/disconnected to X18 with power on. Confirm that the link LED on the AKD-C (the green LED on the RJ45 connector) and on your PC (or network switch) are both illuminated. If both lights are illuminated, then you have a good electrical connection.

NOTE   The X18 service port of an AKD-C does **not** allow access to AKD-N drives connected to other AKD-C devices.

8.12.1 Pinout

Pin	Signal	Pin	Signal
1	Transmit +	5	n.c.
2	Transmit -	6	Receive-
3	Receive+	7	n.c.
4	n.c.	8	n.c.

8.12.2 Service Bus Protocols

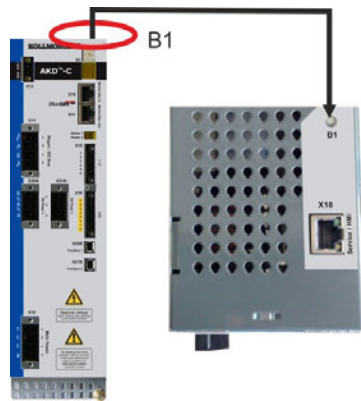| Protocol	Type
Ethernet TCP/IP	Service Bus, 100 Mbit/s

8.12.3 Possible Network Configurations

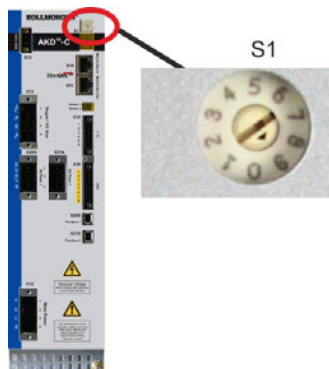NOTE   Network hubs and transfer rate of 10 Mbit/s are not supported.
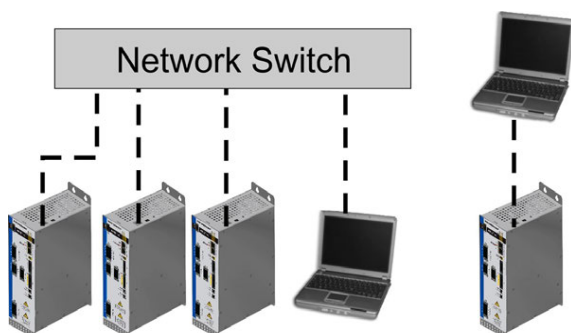
8.13   Pushbutton (B1)

The pushbutton can be used to start predefined functions.

Press short to display the IP address in the LED display

8.14 Rotary Switches (S1), Setting IP address

You can use the rotary switch S1 to set the IP address of the AKD-C. The configured IP address (depending on the current rotary switch S1 position) will be displayed on the 7 segment at Ethernet cable connection time and at power-on, if an Ethernet cable is connected.. If no Ethernet cable is connected, no IP address will be indicated in the display.

By default, the AKD-C utilizes the rotary switch to aquire its IP address. A method of setting the IP address independent of the rotary switch is available. More information is available in the AKD-C User Guide or in the Settings Screen-> Fieldbus-> TCP/IP screen in WorkBench.

S1 Setting	AKD-C IP Address
0	DHCP/AutoIP address. The IP address of the AKD-C is obtained from the DHCP server on your network. If no DHCP server is found the IP addresses is an AutoIP address (it is internally generated following the AutoIP protocol and will be of the form 169.254.x.x).
1 to 9	Static IP Address. The IP address is 192.168.0.n, where n is the number set with the rotary switch. This setting generates addresses in a range from 192.168.0.**1** to 192.168.0.**9**. Example:if S1 is set to 5 – the IP address is 192.168.0.5

NOTE   The PC subnet mask must be set to 255.255.255.0 or 255.255.255.128

Static IP addressing

When connecting the AKD-C directly to a PC, static IP addressing must be used. Set rotary switch S1 to a number from 1 to 9. This setting generates addresses in a range from 192.168.0.**1** to 192.168.0.**9**.
Example: if S1 is set to 5, then the IP address is 192.168.0.5

Dynamic IP addressing (DHCP and Auto-IP)

With S1 set to 0, the device is in DHCP mode. The AKD-C will acquire its IP address from an external DHCP server if present in the network. If a DHCP server is not present, the AKD-C will assume an Automatic Private IP Address of the form 169.254.x.x.

If your PC or PAC is directly connected to the AKD-C , and set to obtain an IP address automatically in the TCP/IP settings, a connection will be established with both devices using compatible automatic generated addresses. It can take up to 60 seconds for a PC to configure an Automatic Private IP Address (169.254.x.x).

Changing the IP address

If the switch is altered while 24 V Logic power is supplied to the AKD-C , you must switch off and then switch on again the 24 V supply voltage. This action will reset the address.

9 Setup

9 Setup

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 power connections to the drive while it is live.

Capacitors can still have dangerous residual charges up to 7 minutes after switching off the supply voltages (24V and mains 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 for one AKD-N 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.


NOTE Additional information on setting up the equipment:

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

9.2   Setup software WorkBench

This chapter describes the installation of the setup software WorkBench for AKD-C and AKD-N drives.

Kollmorgen offers training and familiarization courses on request.
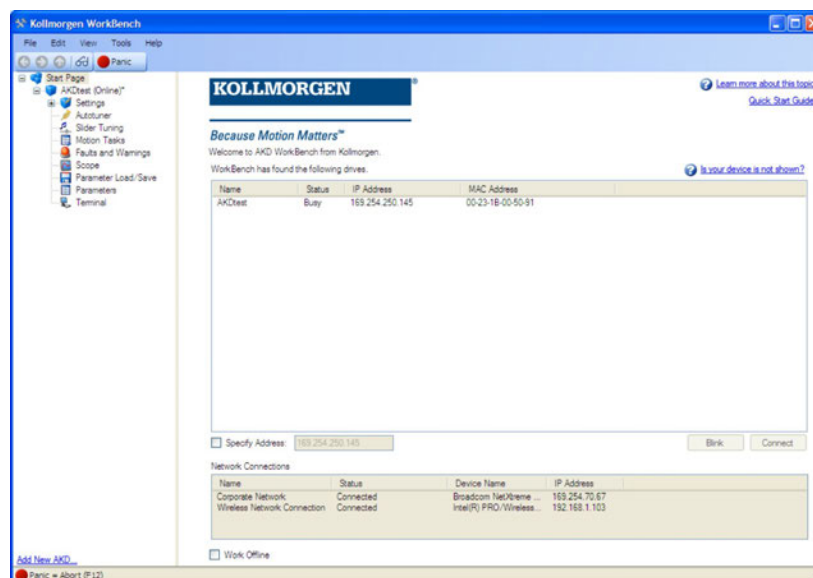
9.2.1 Use as directed

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

Only professional personnel who have the relevant expertise (➜ p. 13) 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.

9.2.2 Software description

Each device must be adapted to the requirements of your machine. For most applications, you can use a PC and WorkBench (the setup software) to set up the operating conditions and parameters. The PC is connected to the AKD-C by an Ethernet cable (➜ p. 72). The setup software provides the communication between the PC and every AKD-N drive connected to this AKD-C. You can find the setup software on the accompanying DVD and in the download area of the Kollmorgen website.

With very little effort you can alter parameters and instantly observe the effect on the drive, since there is a continuous (online) connection to the AKD-C. You can also read important actual values from drives, which are displayed on the monitor of the PC (oscilloscope functions).

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

Most standard feedbacks (SFD, EnDAT 2.2, 2.1, and BiSS) are plug and play compatible. Motor nameplate data is stored in the feedback device and read by the drive automatically at startup. Non-plug and play Kollmorgen motors are stored in WorkBench and can be loaded with one-click using the Motor screen in the WorkBench software.

An extensive online help with integrated description of all variables and functions supports you in each situation.

9.2.3 Hardware requirements

The Service interface (X18, RJ45) is connected to the Ethernet interface of the PC by an Ethernet cable (➜ p. 72).

Minimum requirements for the PC:

Processor: at least Pentium$^®$ II or comparable
Operating system : Windows 2000 or XP or VISTA or 7
Graphics adapter : Windows compatible, color
Data Drives : hard disk with at least 20 MB free space, DVD drive
Interface : one free Ethernet Interface, or a Switch port, 100 Mbit/s

9.2.4 Operating systems

Windows 2000/XP/VISTA/7

WorkBench works with Windows 2000, Windows XP, Windows VISTA and Windows 7

Unix, Linux

The functioning of the software has not been tested for Windows running with Unix or Linux.

### 9.2.5 Installation under Windows 2000/XP/VISTA/7

The DVD includes an installation program for the setup software.

Installation

- Autostart function activated:
  Insert the DVD into a free data drive. A window with the start screen opens. There you find a link to the setup software WorkBench. Click it and follow the instructions.
- Autostart function deactivated:
  Insert the DVD into a free data drive. Click **Start** (task bar), then **Run**. Enter the program call: x:\index.htm (x = correct DVD drive letter).
  Click **OK** and proceed as described above.

Connection to the Ethernet interface of the PC

- Connect the interface cable to an Ethernet interface on your PC or to a Switch and to the service interface X18 of the AKD-C (➔ p. 72).
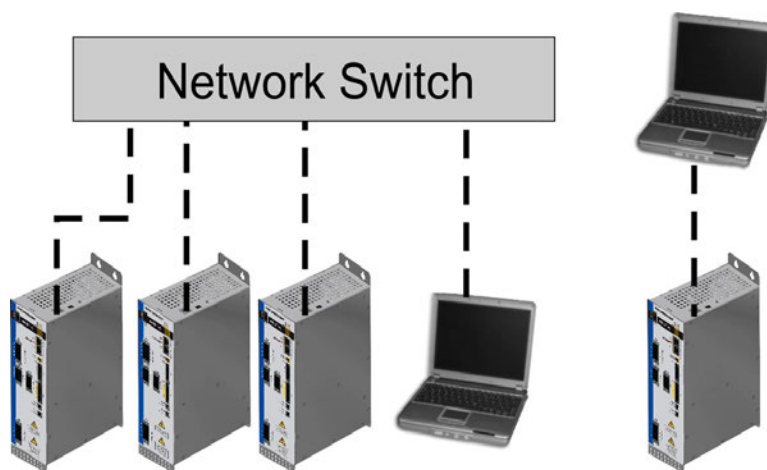
9.3   Initial System Test

9.3.1 Unpacking, mounting, and wiring

- Unpack the AKD-C and accessories. Observe the safety instructions in the documentation.
- Mount the AKD-C (➔ p. 43ff).
- Connect the AKD-N via the hybrid cables to the AKD-C (➔ p. 47ff).
- Connect motors to the connected AKD-N. See *AKD-N Installation Manual* for more information.
- 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 connector X18. See *AKD-C Installation Manual* for more information.
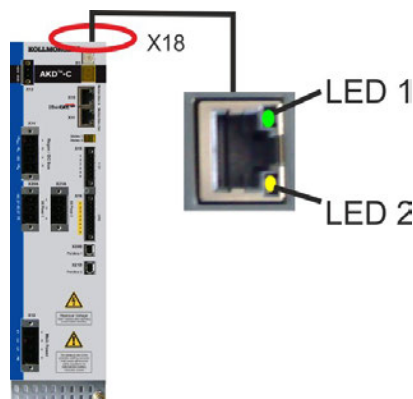
9.3.2 Set IP address

The AKD-C node address can be set with the rotary switch (➔ p. 74), with the WorkBench setup software or via the fieldbus.
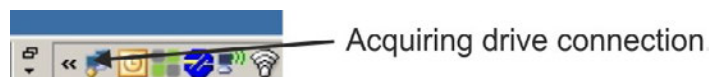
9.3.3 Confirm connections

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 green link LEDs on the AKD-C and on the PC 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 AKD-C you wish to configure and then click **Next**.

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

1. The MAC address of the device. This address is printed on the sticker on the side of the drive.
2. The name of the devices. The device name is set using WorkBench. A new device defaults to "No_Name."
3. Blinking the display. Select a device and click **Blink** to force the display on the front 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 AKD-C has been established, all AKD-N connected to this device are listed. Select one of these drives and 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 of the connected AKD-N are switched off (motors lose all torque), or the load is dynamically braked. The specific behavior depends on the type of fault. The LED display shows the number of the fault that occurred. If a warning is issued prior to the fault, the warning is shown on the LED and has the same number as the associated fault. Warnings do not trip the power stages of the connected AKD-N or fault relay output.
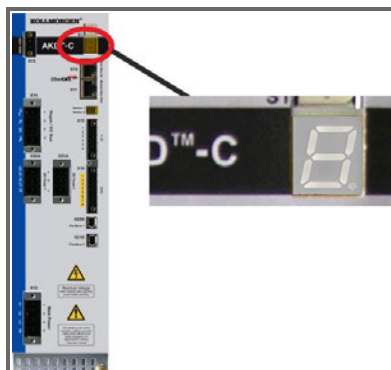
AKD fault codes or warning codes are displayed constantly if present. Fault messages are coded with "F", warnings are coded with "n".

The LED displays the fault or warning number as follows: F-1-0-1-[break] or n-1-0-1-[break]. The highest priority fault is displayed. Multiple faults may be present when a fault condition is occurring. Check the AKD WorkBench Fault Screen or read the status of DRV.FAULTS through the controller or HMI for the entire list of faults.

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

Fault	Message/Warning
F0	Reserved.
F101	Firmware type mismatch.
n101	The FPGA is a lab FPGA.
F102	Resident firmware failed.
n102	Operational FPGA is not a default FPGA.
F103	Resident FPGA failed.
F104	Operational FPGA failed.
F105	Non-volatile memory stamp invalid.
F106	Non-volatile memory data
F125 n125	Synchronization lost
F136	Firmware and FPGA versions are not compatible
F201	Internal RAM failed.
F202	External RAM failed.
F203	Code integrity failed.
F204 to F232	EEPROM failure detected
F234 to F237 n234 to n237	Temperature sensor high.
F240 to F243 n240 to n243	Temperature sensor low.
F501 n501	Bus over voltage.
F503 n503	Bus capacitor overload.
F519	Regen short circuit.
F521 n521	Regen over power.
F523	Bus over voltage FPGA

Fault	Message/Warning
F531	Power stage fault.
F536	Standby power supply fault.
F537	Precharge fault.
F541	AC Input Phase L1 missing
F542	AC Input Phase L2 missing
F543	AC Input Phase L3 missing
F545	Drive String current over peak limit
F546	Drive String current over continuous limit
F561	More than eight AKD-N connected to string 2
F562	More than eight AKD-N connected to string 1
F564	Number of connected AKD-N at string 1 decreased
F565	Number of connected AKD-N at string 2 decreased
F621	Control Board CRC fault.
F623	Power Board CRC fault.
F624	Power Board Watchdog fault.
F625	Power Board Communication fault.
F626	Power Board FPGA not configured.
F627	Control Board Watchdog fault.
F628	Data package on string 1 not received by AKD-C or AKD-N.
F629	Data package on string 2 not received by AKD-C.
F702 n702	Fieldbus communication lost.

9.5 Troubleshooting the AKD-C

Drive problems occur for a variety of reasons, depending on the conditions in your application. The causes of faults in multi-axis systems can be very complex. If you cannot resolve a fault, Kollmorgen customer support can give you further assistance.

NOTE Details on the removal of faults can be found in the WorkBench online help.

This page intentionally left blank.

10 Index

This page intentionally left blank.

About KOLLMORGEN

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.

For assistance with your application needs, visit www.kollmorgen.com or contact us at:

North America	**Europe**	**Asia**
KOLLMORGEN	**KOLLMORGEN Europe GmbH**	**KOLLMORGEN**
203A West Rock Road	Pempelfurtstraße 1	Rm 2205, Scitech Tower, China
Radford, VA 24141 USA	40880 Ratingen, Germany	22 Jianguomen Wai Street
Web: www.kollmorgen.com	**Web:** www.kollmorgen.com	**Web:** www.kollmorgen.com
Mail: support@kollmorgen.com	**Mail:** technik@kollmorgen.com	**Mail:** sales.asia@kollmorgen.com
Tel.: +1 - 540 - 633 - 3545	**Tel.:** +49 - 2102 - 9394 - 0	**Tel.:** +86 - 400 666 1802
Fax: +1 - 540 - 639 - 4162	**Fax:** +49 - 2102 - 9394 - 3155	**Fax:** +86 - 10 6515 0263

KOLLMORGEN ®

Because Motion Matters™