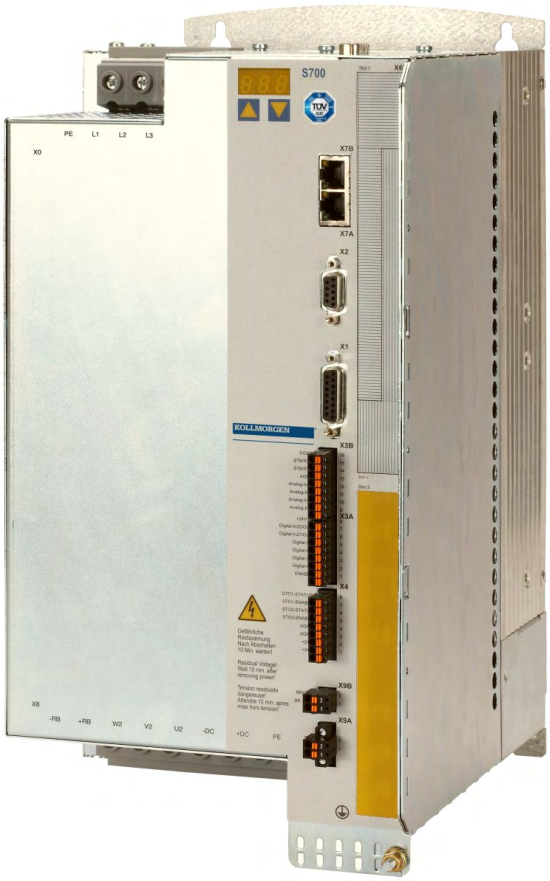
S700

Digital Servo Amplifier S748x2...S772x2 (STO dual channel)

Instructions Manual



Edition: July 2019,
Translation of the original document
Valid for Hardware Revision 02.30

For safe and proper use, follow these instructions.
Keep them for future reference.

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IND. CONT. EQ.
1VD4

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Record of Document Revisions

Revision	Remarks
...	Table with lifecycle information of this document see (➜ # 165)
02/2017	X6 Pin 1 corrected (no 5V output), warning notes, handling separate chapter, single cable connection new, SFD3/Hiperface DSL new
11/2018	Connector X1 corrected (male->female), HR table updated, layout of the warning notes updated, user expertise updated, new readers note on cover page, Wiki replaced by KDN
07/2019	CE Conformity (RoHS), dc bus link (examples), layout updates

Hardware Revision (HR)

Hardware Rev.	Firmware Rev.	Export classification	Remarks
01.01	5.00 - 5.17	AL-3A225	Starting version (STO and Safety pending)
02.10	5.18 - 5.99	AL-3A225	STO and Safety Cards approved
02.20	5.18_ND0 - 5.99_ND0	-	New data structure
02.30	≥ 6.00_ND0	-	SFD3/DSL support

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2 General

2.1 About this manual

This manual describes the S748-S772 series of digital servo amplifiers (standard version: 48A ...72A rated current). S701 to S724 amplifiers are described in an additional manuals.

A more detailed description of the expansion cards that are currently available and the digital connection to automation systems can be found, together with our application notes, in Acrobat-Reader format on the accompanying CD-ROM (system requirements:

WINDOWS, Internet Browser, Acrobat Reader) in different languages.

Technical data and dimensional drawings of accessories such as cables, brake resistors, mains supplies, etc., can be found in the accessories manual.

This documentation (PDF) can be printed out on any standard commercial printer.

More background information can be found in our "Kollmorgen Developer Network" kdn.kollmorgen.com.

2.2 Using the PDF Format

This document includes several features for ease of navigation

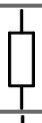
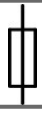
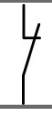
Cross References	Table of contents and index include active cross references.
Table of contents and index	Lines are active cross references. Click on the line and the appropriate page is accessed.
Page/chapter numbers in the text	Page/chapter numbers with cross references are active links.

2.3 Symbols Used

Warning Symbols

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 danger from hot surface.
	Warning of danger from suspended loads.
	Warning of danger from automatic start.

Drawing symbols

Symbol	Description	Symbol	Description
	Signal ground		Diode
	Chassis ground		Relay
	Protective earth		Relay switch off delayed
	Resistor		Normally open contact
	Fuse		Normally closed contact

2.4 Standards used

Standard	Content
ISO 4762	Hexagon socket head cap screws
ISO 12100	Safety of machinery: Basic concepts, general principles for design
ISO 13849	Safety of machinery: Safety-related parts of control systems (former EN 954)
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	Protection categories by housing (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
UL 508C	UL Standard for Safety Power Conversion Equipment

IEC: International Electrotechnical Commission
ISO: International Organization for Standardization
UL: Underwriters Laboratories

2.5 Abbreviations Used

Abbrev.	Meaning
(➜ # xx)	See page xx. Example (➜ # 53): see page 53.
AGND	Analog ground
BTB/RTO	Ready to operate
CAN	Fieldbus (CANopen)
CLK	Clock signal
COM	Serial interface for a PC-AT
DGND	Digital ground
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
ESD	Electrostatic discharge
F-SMA	Fiber Optic Cable connector according to IEC 60874-2
INC	Incremental Interface
LED	Light-emitting diode
MB	Megabyte
NI	Zero pulse
PC	Personal computer
PELV	Protected low voltage
PL	Performance Level
PLC	Programmable logic controller
PWM	Pulse width modultation
RAM	Volatile memory
RB	Brake (regen) resistor
RBext	External brake resistor
RBint	Internal brake resistor
RES	Resolver
ROD	A quad B encoder
SDI	Safe direction
SIL	Safety Integrity Level
SIL CL	Safety Integrity Level Claim Limit
SLI	Safe limited increments
SLP	Safe limited position
SLS	Safe limited speed
SOS	Safe operating stop
SRAM	Static RAM
SS1	Safe stop
SS2	Safe operational stop
SSI	Synchronous serial interface
SSR	Safe speed range
STO	Safe Torque Off
V AC	AC voltage
V DC	DC voltage
VDE	Verein deutscher Elektrotechniker

3 Safety

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

3.1 You should pay attention to this

Specialist staff required!

Only properly qualified personnel are permitted to perform such tasks as transport, installation and setup. Qualified specialist staff are persons with expertise in transport, installation, assembly, commissioning and operation of electrotechnical equipment.

- Transport, storage, unpacking: only by personnel with knowledge of handling electrostatically sensitive components.
- Mechanical installation: only by personnel with mechanical expertise.
- Electrical installation: only by personnel with expertise in electrical engineering.
- Basic tests / setup: only by personnel with expertise in electrical engineering and drive technology.

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

Read the documentation!

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

Check Hardware Revision!

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

Pay attention to the technical data!

Adhere to the technical data and the specifications on connection conditions. If permissible voltage values or current values are exceeded, the devices can be damaged. 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.

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.

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.

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 AENA 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.

Hot surface!



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

Earthing!



It is vital that you ensure that the drive is safely earthed to the PE (protective earth) 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.

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, S700 may have uncovered live sections, according to their level of enclosure protection.

Lethal danger exists at live parts of the device. Built-in protection measures such as insulation or shielding may not be removed. Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with switched off mains supply, and secured against restart.

Never undo any electrical connections to the S700 while it is live. There is a danger of electrical arcing with damage to contacts and personal injury. Wait at least 10 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.

Always measure the voltage in the DC bus link and wait until the voltage is below 50 V before handling components.

Functional Safety

The STO safety implementation on the S700 is certified. The assessment of the safety functions according to EN13849 or EN 62061 must finally be done by the user.

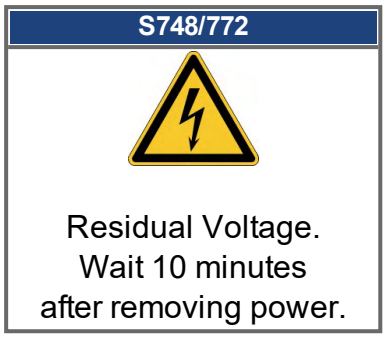
Reinforced Insulation

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

Never modify the drive!

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

3.2 Warning notes placed on the product



NOTICE If these signs are damaged, they must be replaced immediately.

3.3 Use as Directed

The servo amplifiers are components which are built into electrical equipment or machines, and can only be used as integral components of such equipment. If the servo amplifiers are used in residential areas, or in business or commercial premises, then additional filter measures must be implemented by the user.

Cabinet and Wiring

- The servo amplifiers **may only** be operated in a closed switchgear cabinet, taking into account the ambient conditions (➜ # 32) and the dimensions (➜ # 54). Ventilation or cooling may be necessary to prevent enclosure ambient from exceeding 40°C (104°F).
- Use only copper wire. Wire size may be determined from EN 60204 (or table 310-16 of the NEC 60°C or 75°C column for AWG size).

Power supply

- Servo amplifiers in the S700 series can be supplied from 1-phase or 3-phase grounded (earthed) industrial supply networks (TN-system, TT-system with grounded neutral point, no more than 42kA symmetrical rated current).
- S7480/S7720: In case of mains voltage asymmetry >3% a mains choke must be used.
- Periodic overvoltages between outer conductor (L1, L2, L3) and housing of the servo amplifier may not exceed 1000V (peak value). Transient overvoltages (< 50µs) between the outer conductors may not exceed 1000V. Transient overvoltages (< 50µs) between outer conductors and housing may not exceed 2000V.

For the cases of DC input power for single and group installations

NOTE S700 has not been evaluated by Kollmorgen, UL, or TÜV for replacing AC mains input with DC input - for either single or group installations.

DC installations must be reviewed and evaluated by the user for branch circuit protection*, wire size, wire voltage rating, fuse protection, system dielectric requirements, overvoltage and input** current rating.

In case of DC supplied drives the built-in EMC filter will not work. The user is responsible to keep the conducted emissions and the immunity of the drive within the required noise levels.

*Special care must be taken in branch circuit design with mixed rating drives to avoid the smaller drives becoming the effective ‘fuse’ rather than the circuit protective fuse.

**The power supply system design must ensure inrush current protection by limiting input current during power up. DC supply polarity must be properly wired. Improper polarity of DC power will damage the drive and void warranty.

Motors

- The S700 family of servo amplifiers is **only** intended to drive specific brushless synchronous servomotors, with closed-loop control of torque, speed and/or position. The rated voltage of the motors must be at least as high as the DC bus link voltage of the servo amplifier.

Functional Safety

- Consider the specific "use as directed" information (➜ # 41) when you use the safety function STO.
- To achieve PL e or SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback signal from the safety control.
- Observe the user documentation for safety cards S1-2(S3) / S2-2(S4) when you use a safety expansion card.

3.4 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 use of the servo amplifier in the following environments is prohibited:

- potentially explosive areas,
- environments with corrosive and/or electrically conductive acids, alkaline solutions, oils, vapors, dusts,
- directly on non-grounded supply networks or on asymmetrically grounded supplies with a voltage >240V,
- ships or offshore applications.

Commissioning the servo amplifier is prohibited if the machine in which it was installed,

- does not meet the requirements of the EC Machinery Directive,
- does not comply with the EMC Directive,
- does not comply with the Low Voltage Directive.

The control of holding brakes by the S700 alone may not be used in applications, where functional safety is to be ensured with the brake.

4 Product life cycle handling

4.1 Transport

- Only by qualified personnel in the manufacturer's original recyclable packaging
- Avoid shocks
- Temperature: –25 to +70°C, max. 20K/h rate of change, class 2K3 acc. to EN61800-2, EN60721-3-1
- Humidity: max. 95% relative humidity, no condensation, class 2K3 acc. to EN61800-2, EN60721-3-1
- If the packaging is damaged, check the unit for visible damage. In this case, inform the shipper and the manufacturer.

NOTICE The servo amplifiers contain electrostatically sensitive components which can be damaged by incorrect handling. Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.). Place the servo amplifier on a conductive surface.

4.2 Packaging

The S700 packaging consists of recyclable cardboard with inserts.

- Dimensions S748/S772: (HxWxD) 390x600x400 mm
- Labeling : nameplate outside at the box

4.3 Storage

- Storage only in the manufacturer's original recyclable packaging
  Max. stacking height S748...S772: 3 cartons
- Storage temperature: -25 to +55°C, max. rate of change 20K/h, class 1K4 acc. to EN61800-2, EN60721-3-1
- Storage humidity: 5 ... 95% relative humidity, no condensation, class 1K3 acc. to EN61800-2, EN60721-3-1
- Storage duration: Less than 1 year without restriction.
  More than 1 year: capacitors must be re-formed before setting up and operating the servo amplifier. To do this, remove all electrical connections and apply single-phase 230V AC for about 30 minutes to the terminals L1 / L2.

4.4 Decommissioning

NOTICE Only professional staff who are qualified in electrical engineering are allowed to decommission parts of the system.

DANGER: Lethal Voltages!
There is a danger of serious personal injury or death by electrical shock or electrical arcing.

- Switch off the main switch of the switchgear cabinet.
- Secure the system against restarting.
- Block the main switch.
- Wait at least 10 minutes after disconnecting.

4.5 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.

NOTICE Do not immerse or spray the device. Avoid that liquid enters the device.

To clean the device exterior:

1. Decommission the device (see chapter 4.4 "Decommissioning").
2. Casing: Clean with isopropanol or similar cleaning solution.
   Caution : Highly Flammable! Risk of injury by explosion and fire.
   - Observe the safety notes given on the cleaning liquid package.
   - Wait at least 30 minutes after cleaning before putting the device back into operation.
3. Protective grill on fan: Clean with a dry brush.

4.6 Disassembly

NOTICE Only professional staff who are qualified in electrical engineering are allowed to disassemble parts of the system.

1. Decommission the device (see chapter 4.4 "Decommissioning").
2. Check temperature.
   CAUTION: High Temperature! Risk of minor burns. During operation, the heat sink of the drive may reach temperatures above 80 °C (176 °F). Before touching the device, check the temperature and wait until it has cooled below 40 °C (104 °F).
3. Remove the connectors. Disconnect the potential earth connection last.
4. Demount: loosen the fastening screws. Remove the device.

4.7 System Repair

NOTICE Only professional staff who are qualified in electrical engineering are allowed to exchange parts of the drive system.

CAUTION: Automatic Start! During replacement work a combination of hazards and multiple episodes may occur.

- Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with use of prescribed personal safety equipment.

Exchange of the device

Only the manufacturer can repair the device. Opening the device voids the warranty.

1. Decommission the device (see chapter 4.4 "Decommissioning").
2. Demount the device (see chapter 4.6 "Disassembly").
3. Send the device to the manufacturer.
4. Install a new device as described in this manual.
5. Setup the system as described in this manual.

Exchange of other drive system parts

If parts of the drive system (for example cables) must be replaced, proceed as follows:

1. Decommission the device (see chapter 4.4 "Decommissioning").
2. Exchange the parts.
3. Check all connections for correct fastening.
4. Setup the system as described in this manual.

4.8 Disposal

NOTICE To dispose the unit properly, contact a certified electronic scrap disposal merchant.

In accordance with the WEEE-2012/19/EC guideline and similar, the manufacturer accepts returns of old devices and accessories for professional disposal. Transport costs are the responsibility of the sender.

Contact Kollmorgen and clarify the logistics.

5 Approvals

Certificates (CE, functional safety) can be found at the Kollmorgen Website.

5.1 Conformance with UL

The servo amplifiers are listed under UL file number **E217428**.

UL-certified servo amplifiers (Underwriters Laboratories Inc.) fulfil the relevant U.S. standards (in this case UL 840 and UL 508C). The UL certification relates only to the mechanical and electrical construction design of the device. This standard describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire, electric shock, or injury to persons, being caused by such equipment. The technical conformance with the U.S. standard is determined by an independent UL inspector through the type testing and regular checkups. Apart from the notes on installation and safety in the documentation, the customer does not have to observe any other points in direct connection with the UL-certification of the equipment.

UL 508C: UL 508C describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire being caused by such equipment.

UL 840: UL 840 describes the fulfillment by design of air and insulation creepage spacings for electrical equipment and printed circuit boards.

UL Markings

- Use 60°C or 75°C copper wire only.
- Tightening torque for field wiring terminals:
  X0 8-2 AWG, TQ Lb In. 40.
  X8 8-2 AWG, TQ Lb In. 40.
- Use in a pollution degree 2 environment.
- These devices provide solid state motor overload protection at 130% of full load current.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
- These devices are not provided with motor over-temperature sensing.
- Suitable for use on a circuit capable of delivering not more than 42kA rms symmetrical amperes for a max. voltage of 480 Vac.
- Supply circuit protection:

Model	Fuse class	Rating Voltage/SCCR	Max. Fuse Rating
S7480	RK5, CC, J, T	600VAC 200kA	60A
S7720	RK5, CC, J, T	600VAC 200kA	80A

- For use on a solidly grounded wye source only.

5.2 CE conformance

The servo amplifiers 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 you will be responsible for carrying out new measurements to ensure conformance with regulatory requirements.

Kollmorgen declares the conformity of the products S748 and S772 with the following directives

- EC Machinery Directive 2006/42
- EC EMC Directive 2014/30/EC
- EC Low Voltage Directive 2014/35/EC

Concerning noise immunity the servo amplifier meets the requirements to the 2nd environmental category (industrial environment). For noise emission the amplifier meets the requirement to a product of the category C2 (motor cable up to 10 m). With a motor cable length from 10 m onwards, the servo amplifier meets the requirement to the category C3.

NOTICE This product can cause high-frequency interferences in non industrial environments which can require measures for interference suppression.

5.2.1 European Directives and Standards for the machine builder

Servo amplifiers are safety components that are intended to be incorporated into electrical plant and machines for industrial use. When the servo amplifiers are built into machines or plant, the amplifier must not be used until it has been established that the machine or equipment fulfills the requirements of the

- EC Machinery Directive (2006/42/EC)
- EC EMC Directive (2014/30/EC)
- EC Low Voltage Directive (2014/35/EC)

Standards to be applied for conformance with EC Machinery Directive (2006/42/EC)

- IEC 60204-1 (Safety and Electrical Equipment in Machines)
- ISO 12100 (Safety of Machines)

NOTICE The manufacturer of the machine must generate a risk assessment for the machine, and must implement appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.
The machine manufacturer must check whether other standards or EC Directives must be applied to the machine.

Standards to be applied for conformance with EC Low Voltage Directive(2014/35/EC)

- IEC 60204-1 (Safety and Electrical Equipment in Machines)
- IEC 60439-1 (Low-voltage switchgear and controller assemblies)

Standards to be applied for conformance with EC EMC Directive (2014/30/EC)

- IEC 61000-6-1 / 2 (Interference Immunity in Residential & Industrial Areas)
- IEC 61000-6-3 / 4 (Interference Generation in Residential & Industrial Areas)

The manufacturer of the machine is responsible for ensuring that it meets the limits required by the EMC regulations. Advice on the correct installation for EMC can be found in this documentation.

We only guarantee the conformance of the servo system with the standards cited in this chapter if the components (motor, cables, chokes etc.) are those supplied by us.

5.2.2 Functional Safety Conformance according to EC Machinery Directive

STO (Safe Torque Off)

The S700 servo amplifier offers a two channel STO function (**S**afe **T**orque **O**ff). The function blocks the trigger pulses of the power transistors (pulse inhibitor).

The STO safety concept is certified by the TÜV. The safety circuit concept for realizing the safety function "Safe Torque Off" in the servo amplifiers S700 is suited for SIL CL3 according to IEC 62061 and PLe according to ISO 13849-1. The subsystems (servo amplifiers) are totally described for safety technics with the characteristic data SIL CL, PFHD and TM.

Device	Operation mode	EN 13849-1	EN 62061	PFHD [1/h]	TM [Year]
STO1/2 Enable	single channel	PLd, Cat.3	SIL CL 2	7.05E-08	20
STO1-Enable+ STO2-Enable	dual channel	PLd, Cat.3	SIL CL 2	7.05E-08	20
STO1-Enable+ STO2-Enable+ STO-Status	dual channel + periodical testing	PLe, Cat.4	SIL CL 3	1.38E-09	20

SIL2 / PLd solutions can be implemented with single-channel or dual-channel control with simple safety switching devices.
SIL3 / PLe solutions requires a safety control that periodically tests the safe switching of the pulse inhibitor by analyzing the feedback signal.

Expansion card "Safety 2-2" (S4)

This expansion card (Basic version) includes various safety functions for the safe operation of drive shafts. All functions fulfill the safety requirements **SIL CL2** according to IEC 62061 respectively performance level **PLd** according to ISO 13849-1. The functional safety is certified by the TÜV. Safety characteristic data are listed in the Instructions Manual of the expansion card.

Expansion card "Safety 1-2" (S3)

This expansion card (full version) includes several safety functions. All functions fulfill the safety requirements **SIL CL3** acc. to IEC 62061 respectively performance level **PLe** acc. to ISO 13849-1. The functional safety is certified by the TÜV. Safety characteristic data are listed in the Instructions Manual of the expansion card.

5.3 Conformance with RoHS

The device is manufactured in conformance with RoHS Directive 2011/65/EC with delegated directive 2015/863/EC for installation into a machine.

5.4 Conformance with REACH

EU Regulation no. 1907/2006 deals with the registration, evaluation, authorization and restriction of chemical substances 1 (abbreviated to "REACH").

The device does not contain any substances (CMR substances, PBTsubstances, vPvB substances and similar hazardous substances stipulated in individual cases based on scientific criteria) above 0.1 mass percent per product that are included on the candidate list.

5.5 Conformance with EAC

EAC is the abbreviation for Eurasian Conformity. The mark is used in the states of the Eurasian Customs Union (Russia, Belarus, Kazakhstan) similar to the European CE mark.

Kollmorgen declares, that the device has passed all required conformity procedures in a member state of the Eurasian Customs Union, and that the device meets all technical requirements requested in the member states of the Eurasian Customs Union:

- Low voltage (TP TC 020/2011)
- Electromagnetic Compatibility (TP TC 004/2011)

Contact: Intelisys LLC. , Bakuninskaya Str. d 14, Building 10, RU-105005 Moskau

6 Package

6.1 Package supplied

When an amplifier from the S700 series is ordered (order numbers (➜ # 159)), the following is supplied:

- Servo amplifier S700 with shielding plate and shield clamps
- Product Safety Guide S700 (printed)
- Online documentation and setup software on CD-ROM
- Mating connectors X3A, X3B, X4, X9A, X9B

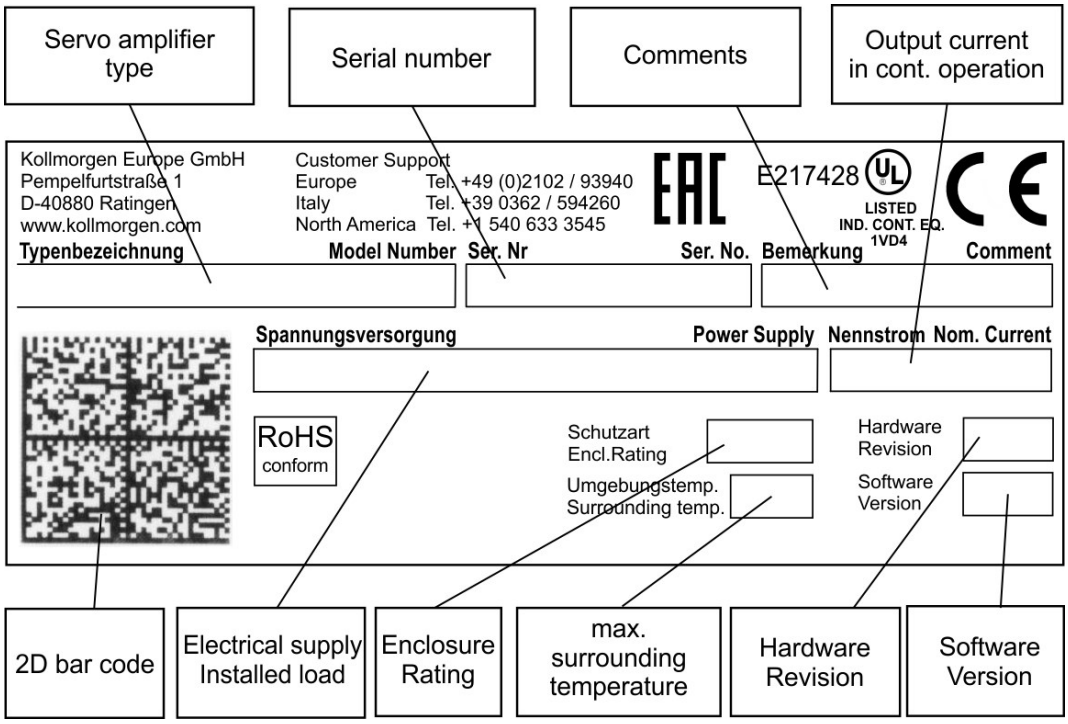
NOTE The mating SubD connectors are not part of the package!

Accessories : (must be ordered separately, if required; description see accessories manual)

- Hybrid motor cable (prefabricated) for single cable connection
- Motor cable as a cut-off length
- Feedback cable (prefabricated)
  or both feedback connectors separately, with the feedback cable as a cut-off length
- External brake resistor BAS(U)
- Communication cable to the PC (➜ # 104) for setting parameters from a PC
- Power cable, control cables, fieldbus cables (as cut-off lengths)
- Mains choke if mains voltage is more than 3% asymmetrical

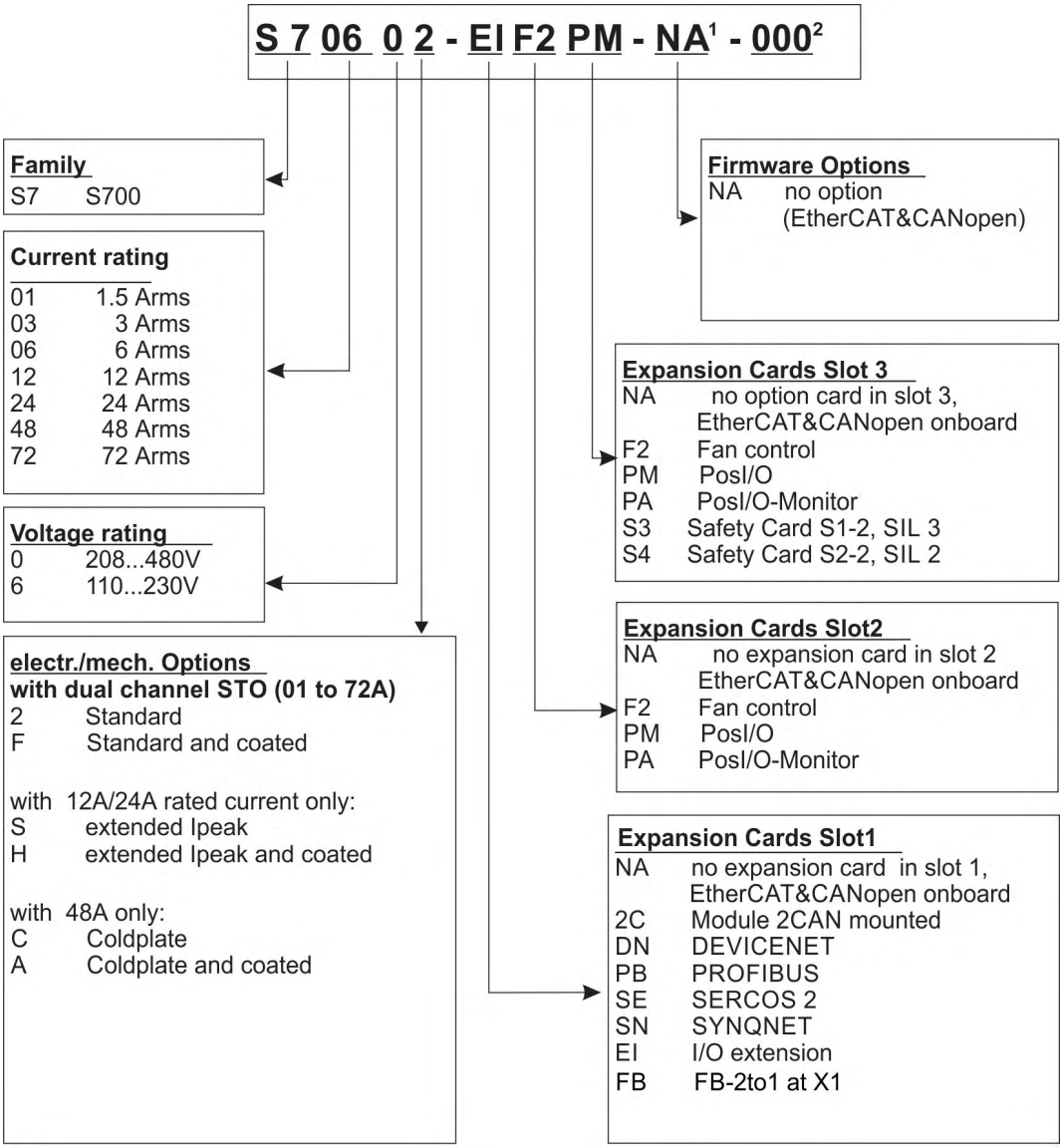
6.2 Nameplate

The nameplate is attached to the side of the servo amplifier. The information described below is printed in the individual fields. Picture similar to the original nameplate.



6.3 Part number scheme

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



1 is void with standard
2 is void with standard, additional coding defines customer specific specials.

Example 1: S77202-EIF2PM-NA-000

S7	S700
72	72A rated current
0	208...480V rated voltage
2	no electr./mech. option
EI	I/O expansion card in Slot 1
F2	Expansion card Controlled Fan in Slot 2
PM	PosI/O expansion card in Slot 3
NA	Standard (EtherCAT&CANopen onboard)
000	no customer specific specials

Example 2: S7480C-EIF2S4-NA-000

S7	S700
48	48A rated current
0	208...480V rated voltage
C	Coldplate
EI	I/O expansion card in Slot 1
F2	Expansion card Controlled Fan in Slot 2
S4	Safety Card S2-2 in Slot 3
NA	Standard (EtherCAT&CANopen onboard)
000	no customer specific specials

7 Technical description

7.1 The S700 family of digital servo amplifiers

Standard version

- Large supply voltage range: 3 x 208V$_{-10\%}$ … 480V$^{+10\%}$
  (with mains voltage below 300V set parameters NONBTB=3 and VBUSBAL=1)
- Overvoltage category III acc. to IEC 61800-5-1
- CANopen on board
- EtherCAT on board
- RS232 and 24V pulse direction interface on board
- Resolver-, Encoder-, AquadB Encoder-, ComCoder- evaluation on board
- Position controller on board
- Safe Stop STO on board (up to SIL CL3, PLe)
- 3 front side slots for expansion cards
- Memory Card slot on board
- Synchronous servomotors, linear motors, asynchronous motors and DC motors can be used

Power section

- Directly on grounded mains supply, 3x208V-10% … 3x480V+10%, 50/60Hz
  (with mains voltage below 300V set parameters NONBTB=3 and VBUSBAL=1)
- TN-network or TT-network with grounded neutral point, 42kA max. symmetrical current
- rating, connection to other supply types only via isolating transformer (➜ # 68)
- B6 bridge rectifier, integral supply filter and soft-start circuit
- Single-phase supply operation possible (e.g. for setup)
- Fusing (e.g. fusible cutout):
  to be provided by the user
- Shielding: All shielding connections are made directly on the amplifier
- Output stage: IGBT module with floating current measurement
- Brake circuit: With dynamic distribution of the generated power between several amplifiers on the same DC bus link circuit. External brake resistors if required.
- DC bus link voltage: 260...900 V DC, can be connected in parallel.
- Interference suppression filters are integrated for the electrical supply feed and the 24 V auxiliary supply voltage (with motor cable 10 m for C2 as per IEC 61800-3, with motor cable > 10 m for C3 as per IEC 61800-3).

Integrated safety

- Appropriate insulation and creepage distances and electrical isolation ensure safe electrical separation, as per IEC 61800-5-1, between the power input / motor connections and the signal electronics.
- Soft-start, overvoltage detection, short-circuit protection, phase-failure monitoring.
- Temperature monitoring of the servo amplifier and motor (if our motors and prefabricated cables are used).
- Safe stop (up to SILCL3 acc. to IEC 62061, PLe acc. to ISO13849-1), (➜ # 41)
- Slot for safety card with more safety functions for the safe drive operation, (➜ # 153)

Auxiliary supply voltage 24V DC

- Electrically isolated, internal fusing, from an external 24V DC power supply unit.
- Separate 24V supply input for internal electronic supply
- Separate 24V supply input for motor holding brake supply
- Separate 24V supply input for digital outputs

Operation and parameter setting

- With our user-friendly setup software DRIVEGUI.EXE, for setup via the serial interface of a PC.
- If no PC is available: direct operation by two keys on the servo amplifier and a 3-character LED display.
- Fully programmable via RS232 interface.
- Read and write access to parameter records and firmware via smartcard.

Completely digital control

- Digital current controller (space vector, pulse-width modulation, 62.5 µs)
- Adjustable digital speed controller (62.5 µs)
- Integrated position controller, with adaptation possibilities for all applications (250 µs, optionally 125 µs)
- Integrated 24V step/direction interface for connecting a servomotor to a stepper controller

Inputs and Outputs

- programmable analog inputs (➜ # 99)
- programmable analog inputs (➜ # 100)
- 2 programmable digital inputs/outputs (direction selectable) (➜ # 100)
- Programmable logical combinations of digital signal
- 1 input Enable (➜ # 100)
- 2 inputs STO Enable (➜ # 101)
- 2 STO-Status Outputs (➜ # 102)

Expansions

Slot 1

Expansion cards in slot 1 can be combined with F2 Option in slot 2. More combinations of slot 1 and slot 2 expansion cards are not possible.

- I/O-14/08 expansion card, (➜ # 127)
- PROFIBUS expansion card, (➜ # 130)
- sercos® II expansion card, (➜ # 131)
- DeviceNet expansion card, (➜ # 133)
- SynqNet expansion card, (➜ # 136)
- FB-2to1 expansion card, (➜ # 138)
- -2CAN- expansion module, separated connectors for CAN bus and RS232, (➜ # 140)

Slot 2

- PosI/O expansion card,(➜ # 143)
- PosI/O-Monitor expansion card, (➜ # 143)
- F2 Option, controlled fan, later insertion not possible,(➜ # 152), can be combined with expansion cards in slot 1.

Slot 3

- PosI/O expansion card, (➜ # 152)
- PosI/O-Monitor expansion card, (➜ # 152)
- F2 Option, controlled fan, later insertion not possible, (➜ # 152)
- Safety expansion card (S3) S1-2 (SIL CL3), (➜ # 155)
- Safety expansion card (S4) S2-2 (SIL CL2), (➜ # 153)

Several third-party expansion cards (ModBus, LightBus, FIP-IO etc. please contact the manufacturer for further information)

Macro programming

More information can be found in our KDN Makro-Programming.

- 62.5µs / 250µs / 1ms / 4ms / 16ms / IDLE / IRQ
- 128 kByte memory
- IEC 61131 structured text
- 400 easy instructions every 62.5 µs
- CAN objects for multi axis control

7.2 Technical data

7.2.1 Rated data

Electrical data	DIM	S74802	S77202
Rated supply voltage (grounded supply. phase to phase) (L1.L2.L3)	V~	3 x 208V-10% … 3 x 480V+10%. 50/60 Hz	
Rated input power for cont. operation	kVA	35	50
Permitted switch on/off frequency	1/h	30	
Auxiliary voltage supply	—	(➜ # 31)	
Maximum DC bus link voltage	V=	900	
Rated output current (rms value, 3%)			
at 3x208V	Arms	48	72
at 3x230V	Arms	48	72
at 3x400V	Arms	48	72
at 3x480V	Arms	48	72
Peak output current (for max. 5s. ± 3%)	Arms	96	140
Switching frequency of output stage	kHz	8	
- at reduced current (50%)	kHz	16	
Voltage rise speed dU/dt, (measured without connected motor, (➜ # 73))			
at 3x208V	kV/µs	2.1	
at 3x230V	kV/µs	2.3	
at 3x400V	kV/µs	4.0	
at 3x480V	kV/µs	4.8	
Technical data for brake circuit	—	(➜ # 35)	
Threshold for overvoltage switch-off	VDC	(➜ # 35)	
Motor inductance min. at 3x208V	mH	0.38	0.26
Motor inductance min. at 3x230V	mH	0.42	0.29
Motor inductance min. at 3x400V	mH	0.74	0.51
Motor inductance min. at 3x480V	mH	0.88	0.61
Motor inductance max.	mH	Consult our support	
Form factor of the output current (rated conditions, min. load inductance)	—	1.01	
Bandwidth of current controller	kHz	> 1.2 (up to 5)	
Residual voltage drop at rated current	V	6	
Thermal dissipation, output stage disabled	W	24	
Thermal dissipation at rated current (without brake dissipation)			
at 3x230V	W	555	855
at 3x400V	W	635	1005
at 3x480V	W	685	1135
Noise emission max.	dB(A)	62	68
Mechanical data			
Weight	kg	13	
Weight Coldplate Version (S7480C, S7480A)	kg	10.4	-
Height, without/with connectors & shielding plate	mm	386/505	
Width	mm	190	
Depth, without/with connectors	mm	244/285	

* In case of mains voltage below 300V, set parameters NONBTB=3 and VBUSBAL=1.

7.2.2 Inputs, outputs, aux. voltage supply

Interface	electr. data
Analog inputs 1 and 2 Max. common-mode voltage	±10 V ±10 V
Digital control inputs	as per EN 61131-2 Typ1. max. 30 VDC. 15 mA
Digital control outputs	as per EN 61131-2 Typ1. max. 30 VDC. 100 mA
BTB/RTO output, relay contacts	max. 30 VDC. max 42 VAC, 500 mA
24V-IO for digital outputs	20 V ... 30 V
Auxiliary supply voltage PELV, PELV	
- Electronics (with fan, no option card)	24 V (-0% +15%), 2A
- Motor brake, min./max.output current	24 V (-0% +15%), 0.15 A / 3 A

7.2.3 Connectors

Connector	Type	max. cross section*1	permiss. current *2	permiss. voltage*3
X0 Mains	Terminals	35 mm²	125 A	1000 V
X1 Encoder input	SubD15pol. (female)	0.5 mm²	1 A	<100 V
X2 Resolver input	SubD 9pol. (female)	0.5 mm²	1 A	<100 V
X3A, X3B Control signals	Mini-Combicon connector	1.5 mm²	4 A	160 V
X4 Aux. voltage, STO	Mini-Combicon connector	1.5 mm²	4 A	160 V
X5 (optional) Encoder Emulation, ROD/SSI	SubD 9pol. (male)	0.5 mm²	1 A	<100 V
X6 PC interface, CAN	SubD 9pol. (male)	0.5 mm²	1 A	<100 V
X7A,B EtherNET	RJ45 connector	FTP CAT.5, 26AWGx4P as per EN50173		
X8 DC Bus link, Motor, Brake Resistor	Terminals	35 mm²	125 A	1000 V
X9A,B Motor brake	Mini-Combicon connector	1.5 mm²	4 A	160 V

*1 single-line connection
*2 single-line connection with recommended conductor cross section (➜ # 33)
*3 rated voltage with pollution level 2

7.2.4 Recommended tightening torques

Connector	Tightening torque
X0 with up to 25mm² wire	2.5 Nm
X0 with 35mm² wire	4.5 Nm
X3A,B	Cage clamps
X4	Cage clamps
X8 with up to 25mm² wire	2.5 Nm
X8 with 35mm² wire	4.5 Nm
X9A	Cage clamps, Mounting flange: 0,5 Nm
Grounding bolt	3.5 Nm

7.2.5 Fusing

Internal fusing, wire fuse or electronic

Circuit	S748 / S772
24V Electronics	4 A
24V Motor brake	4 A
Brake resistor	electronic

External fusing

Fusible cutouts or similar	S748	S772
AC supply $F_{N1/2/3}$	60 A*	80 A*
24V Electronics $F_{H1/2}$	8 A**	8 A**
24V Brake $F_{H3/4}$	8 A**	8 A**
Brake resistor $F_{B1/2}$	100 A***	100 A***

* EU fuses: types gRL or gL, 400V/500V
US fuses: class RK5 or CC or J or T, 600VAC 200kA, time-delay
** e.g. wire fuses or micro fuse or Automatic Circuit Brakers
*** EU fuses: Bussmann HLS, 690V/100A
US fuses: Bussmann FWP-xxA22F, Size 22x58mm, UL approved for 500Vdc

Tips and detailed information can be found in the "KDN".

7.2.6 Ambient Conditions, Ventilation, and Mounting Position

Storage, hints	(➜ # 18)
Transport, hints	(➜ # 18)
Surrounding air temperature in operation	0 to +40°C (32 to 104°F) at rated data +40 to +55°C (113 to 131°F) with power derating 2.5% / K
Humidity in operation	rel. humidity 85%, no condensation, class 3K3
Site altitude	up to 1000m a.m.s.l. without restriction 1000 — 2500m a.m.s.l. with power derating 1.5%/100m
Pollution level	Pollution level 2 to EN 60664-1
Vibrations	Class 3M1 according to IEC 60721-3-3
Enclosure protection	IP 20 according to EN60529
Mounting position	generally vertical (➜ # 56)
Ventilation	built-on/built-in fan (optionally controlled, option F2)
NOTICE	The servo amplifier shuts down (F01 and F13 (➜ # 123), motor has no torque) in case of excessively high temperature in the control cabinet. Make sure that there is sufficient forced ventilation within the switchgear cabinet.

Kollmorgen requirements for servo amplifiers with Coldplate:

Flatness of the mounting (cooling) plate: ≤ 25 µm / 100 mm

Mains voltage	Max. thermal resistance	Max. allowed temperature at center of coldplate
230 V	0.063 K/W	75 °C
400 V	0.055 K/W	75 °C
480 V	0.051 K/W	75 °C

NOTICE The cooling plate temperature must not be more than 10 K below the environment temperature. With a difference of more than 10 K there is a risk of condensation. Condensation may destroy the electronics of the servo amplifier.

7.2.7 Conductor cross-sections

Recommendations for cables (material and construction (➜ # 63).
Following IEC 60204 (B2), we recommend for **single-axis systems**:

Interface	Cross section		Techn. requirements
AC connection	S748: S772:	16 mm² 25 mm²	600 V, 80°C
DC bus link	S748: S772:	25 mm² 25 mm²	1000 V, 80°C, shielded for lengths >0.50 m
Brake resistor	S748: S772:	35 mm² 35 mm²	1000 V, 80°C, shielded for lengths >0.50 m
Motor cables	S748: S772:	16 mm² 25 mm²	600 V, 80°C, shielded, capacitance <150 pF/m
Resolver, motor thermal control, max.100m*	4x2x0.25 mm²		twisted pairs, shielded, C<120 pF/m
Encode, rmotor thermal control, max. 50m*	7x2x0.25 mm²		twisted pairs, shielded, C<120 pF/m
ComCoder, motor thermal control, max. 25m	8x2x0.25 mm²		twisted pairs, shielded, C<120 pF/m
Setpoints, AGND, max 30m	0.25 mm²		twisted pairs, shielded
Control signals, BTB, DGND, max. 30m	0.5 mm²		
Holding brake (motor)	min. 0.75 mm²		600 V, 80°C, shielded, **check voltage drop**
+24 V electronics, max 30m	max. 1.5 mm²		**check voltage drop**
+24 V motor brake, max 30m	max. 1.5 mm²		**check voltage drop**
NOTICE	For multi-axis systems, observe the specific operating conditions for your system. To reach functional safety with the max. permitted cable length, observe cable requirements (➜ # 63)		

* Kollmorgen North America supplies cables up to 39 meters, Europe up to max. length

7.3 Motor holding brake

A 24 V holding brake in the motor can be controlled directly by the amplifier. A special 24 V supply voltage (X9B) is used. Brakes with up to 3 A can be controlled directly.



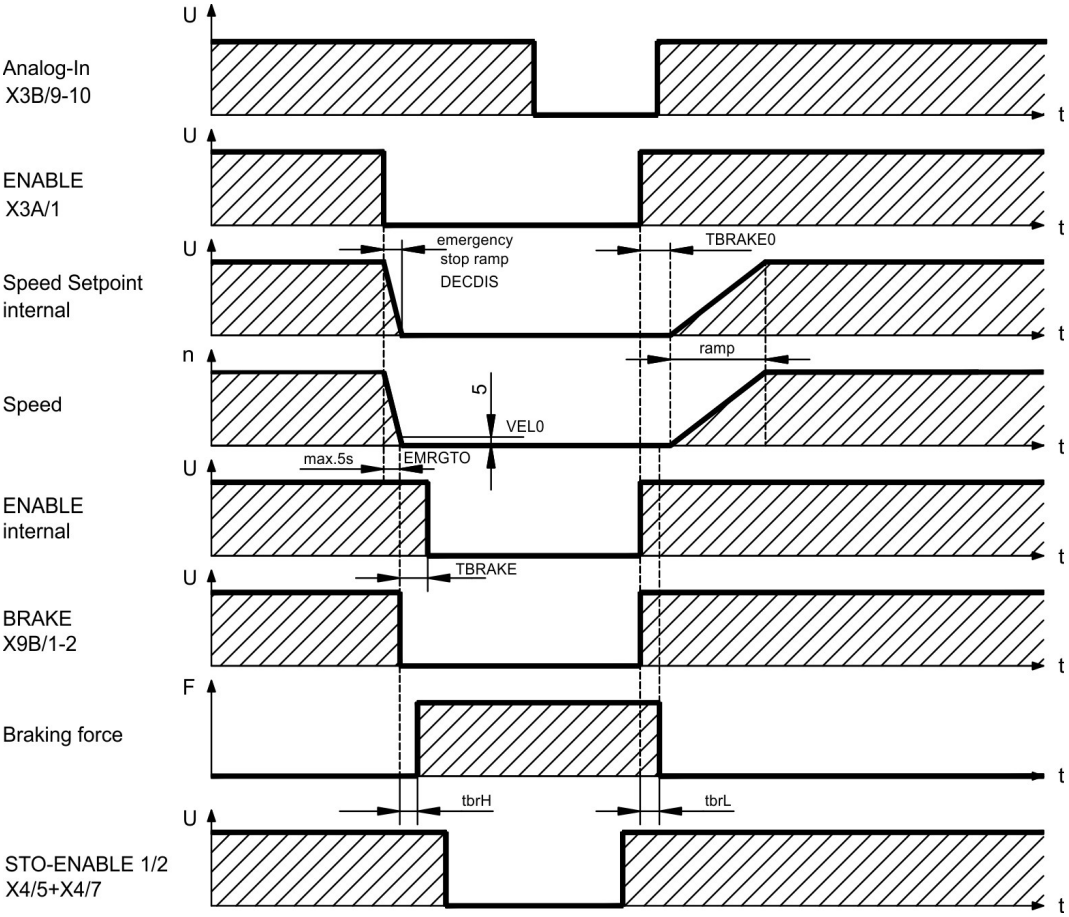
⚠CAUTION No functional safety!

Danger by falling load (in case of suspended load, vertical axes). An additional mechanical brake is required for functional safety, which must be safely operated, e.g. via the Safety Card S1-2 (➜ # 155).

NOTICE

The brake only works with sufficient voltage level (➜ # 31). Check voltage drop, measure the voltage at brake input and check brake function (brake and no brake).

The brake function must be enabled through the BRAKE setting (screen page: Motor). In the diagram below you can see the timing and functional relationships between the ENABLE signal, speed setpoint, speed and braking force. All values can be adjusted with parameters, the values in the diagram are default values.



During the internal ENABLE delay time of 100 ms (DECDIS), the speed setpoint of the servo amplifier is internally driven down along an adjustable ramp to 0V. The output for the brake is switched on when the speed has reached 5 rpm (VELO), at the latest after 5 s (EMRGTO). The release delay time (tbrH) and the engage delay time (tbrL) of the holding brake that is built into the motor are different for the various types of motor (see motor manual), the matching data are loaded from the motor database when the motor is selected. A description of the interface can be found on page (➜ # 73).

7.4 LED display

A 3-character LED-Display indicates the status of the amplifier after switching on the 24 V supply (➜ # 121). When the keys on the front panel are used, the parameter and function numbers are shown, as well as the numbers for any errors and warnings that may occur (➜ # 123).

7.5 Grounding system

AGND - analog inputs, internal analog ground
DGND - 24V-IO, digital inputs and digital outputs, optically isolated.
GND - internal digital ground, encoder Emulation, RS232, CAN
XGND - 24V supply, STO Enable, ventilator
BRGND - 24V motor brake supply

7.6 Dynamic braking (brake circuit)

During braking with the aid of the motor, energy is fed back into the servo amplifier. This generated energy is dissipated as heat in the brake resistor. The brake resistor is switched in by the brake circuit. The setup software can be used to adapt the brake circuit (thresholds) according to the electrical supply voltage. Our customer service can help you with the calculation of the brake power that is necessary for your system. A simple method is described in the "KDN". A description of the interface can be found on page (➜ # 71).

Functional description:

1.- Individual amplifiers, **not coupled** through the DC bus link circuit (DC+, DC-)

When the energy fed back from the motor has an average or peak power that exceeds the preset level for the brake power rating, then the servo amplifier generates the warning “n02 brake power exceeded” and the brake circuit is switched off. The next internal check of the DC bus link voltage (after a few milliseconds) detects an overvoltage and the output stage is switched off, showing the error message “Overvoltage F02” (➜ # 123).
The BTB/RTO contact (terminals X3B/14,15) will be opened at the same time (➜ # 102).

2.- Several servo amplifiers **coupled** through the DC bus link (DC+, DC-)

Using the built-in brake circuit, several amplifiers of the same series can be operated off a common DC bus link (observe (➜ # 70)), without requiring any additional measures. 90% of the **combined power** of all amplifiers is always available for peak and continuous power. The switch-off on overvoltage takes place as described under 1. (above) for the amplifier that has the lowest switch-off threshold (resulting from tolerances).

Technical data of the brake circuits depend on the amplifiers type and the mains voltage situation (VBUSBAL).

Technical Data		VBUSBAL: Supply voltage			
Rated data	DIM	1:230 V	2:400 V	3:480 V	4*:480 V
Switch-on threshold of brake circuit	V	400	720	840	790
Overvoltage F02	V	455	800	900	900
Pulse brake power	kW	16	50	70	70
External brake resistor (RBe), S748	Ohm	15			
External brake resistor (RBe), S772	Ohm	10			
Continuous brake power (RBe)	kW	8			

* Kollmorgen recommends setting VBUSBAL=4 in case of 480 V mains supply, with this setting the optimized calculation method is used.

NOTE Suitable external brake resistors can be found in our accessories manual.

7.7 Switch-on and switch-off behavior

This chapter describes the switch-on and switch-off behavior of the S700 and the steps required to achieve operational stopping or emergency stop behavior that complies with standards.

NOTE The servo amplifier's 24 V supply must remain constant.

The ASCII commands ACTFAULT (error response, also depends on the specific error, see ERRCODE) and STOPMODE (Enable signal response) dictate how the drive will behave.

ACTFAULT & STOPMODE	Behavior: (see also ASCII reference in the Online Help of the setup software)
0	Motor coasts to a standstill in an uncontrolled manner
1 (default)	Motor is braked in a controlled manner

Behavior during a power failure

The servo amplifiers use an integrated circuit to detect if one or more input phases (power supply feed) fail. The behavior of the servo amplifier is set using the setup software: Under "**Response to Loss of Input Phase**" (PMODE) on the **Basic Setup** screen, select:

Error message if the servo amplifier is to bring the drive to a standstill: Error message F19 is output if an input phase is missing. The servo amplifier is disabled and the BTB contact opens. Where the factory setting is unchanged (ACTFAULT=1), the motor is braked using the set "EMERGENCY STOP RAMP".

- **Warning** if the higher-level control system is to bring the drive to a standstill: Warning n05 is output if an input phase is missing, and the motor current is limited to 4 A. The servo amplifier is not disabled. The higher-level control system can now selectively end the current cycle or start bringing the drive to a standstill. Therefore, the error message "MAINS BTB, F16" is output on a digital
- **Error message** if the servo amplifier is to bring the drive to a standstill: Error message F19 is output if an input phase is missing. The servo amplifier is disabled and the BTB contact opens. Where the factory setting is unchanged (ACTFAULT=1), the motor is braked using the set "EMERGENCY STOP RAMP".

Behavior when undervoltage threshold is reached

If the undervoltage threshold is undershot in the DC bus link (the threshold value depends on the type of servo amplifier), the error message "UNDERVOLTAGE, F05" is displayed. The drive response depends on the ACTFAULT and STOPMODE setting.

Behavior with enabled "holding brake" function

Servo amplifiers with an enabled holding brake function have a special procedure for switching off the output stage (➜ # 34). Removing the ENABLE signal triggers electrical braking.

As with all electronic circuits, the general rule applies that there is a possibility of the internal "holding brake" module failing. Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, e.g. via the Safety Card S1-2.

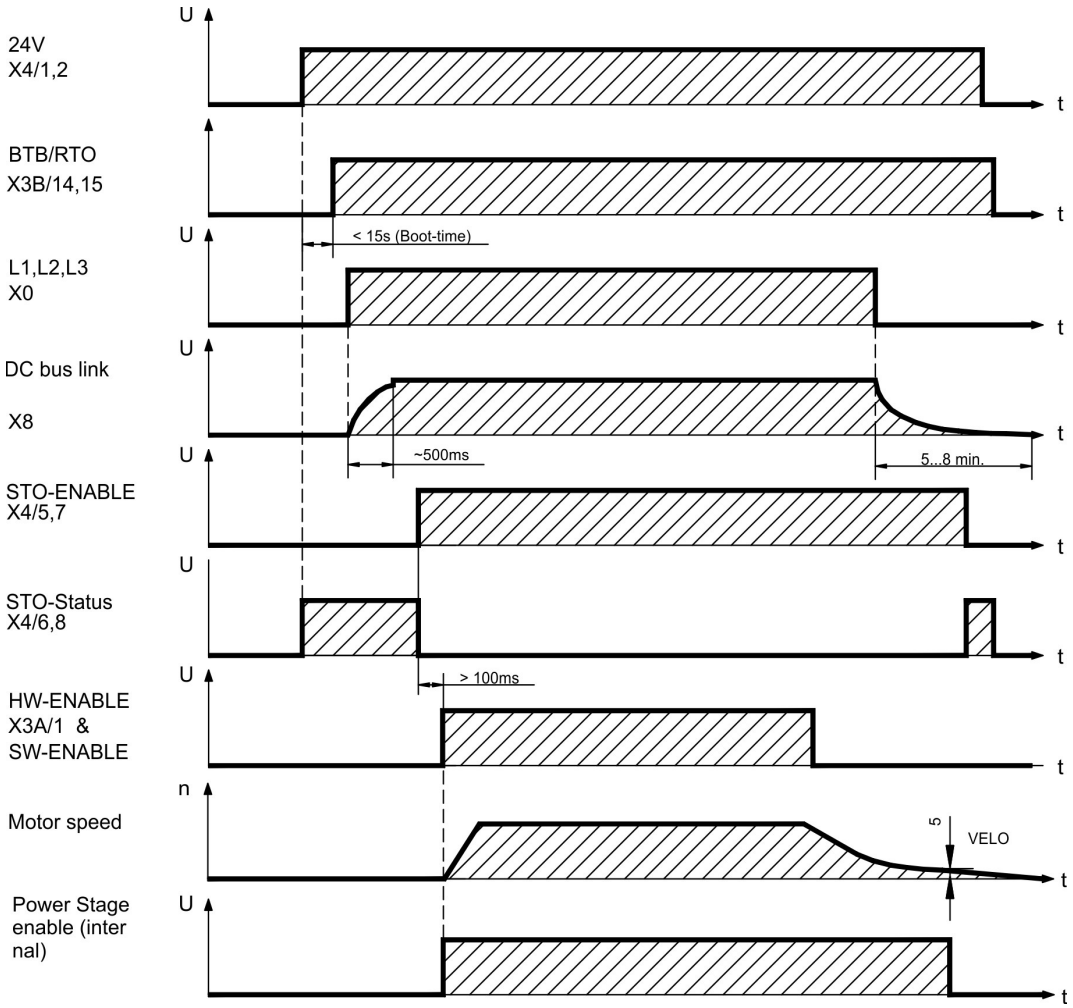
Behavior of the safety function STO

With the functional safe restart lock STO, the drive can be secured on standstill using its internal electronics so that even when power is being supplied, the drive shaft is protected against unintentional restart. The chapter "Safety function STO" describes how to use the STO function. See (➜ # 41) onwards.

7.7.1 Behavior in standard operation

The behavior of the servo amplifier always depends on the current setting of a number of different parameters (e.g., ACTFAULT, VBUSMIN, VELO, STOPMODE, see Online Help).

The diagram below illustrates the correct functional sequence for switching the servo amplifier on and off.



Devices which are equipped with a selected “Brake” function use a special sequence for switching off the output stage(➜ # 34).

The built-in safety function STO can be used to switch off the drive, so that functional safety is ensured at the drive shaft (➜ # 41) .

NOTE In case of a built-in safety card, wait for the Ready Acknowledge (X30 Pin 16) of the safety card before enabling the servo amplifier again.

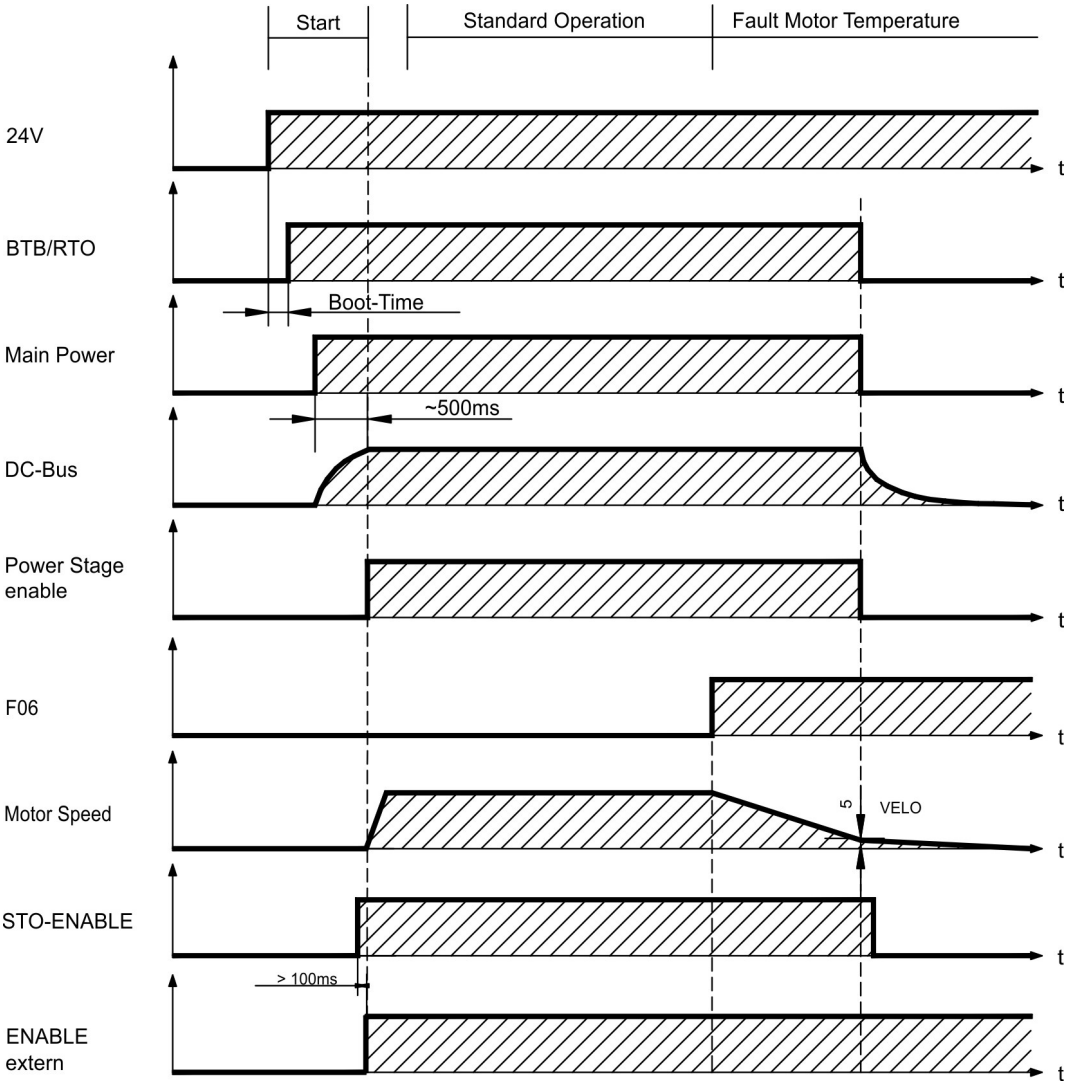
7.7.2 Behavior in the event of an error (with standard setting)

The behavior of the servo amplifier always depends on the current setting of a number of different parameters (e.g., ACTFAULT, VBUSMIN, VELO, STOPMODE, see Online Help).

⚠CAUTION Uncontrolled coasting!

Some faults (see ERRCODE) force the output stage to switch-off immediately, independent from the ACTFAULT setting. Danger of injury by uncontrolled coasting of the load. An additional mechanical brake is required for functional safety, which must be safely operated.

The diagram shows the startup procedure and the procedure that the internal control system follows in the event of motor overtemperature, assuming that the standard parameter settings apply. Fault F06 does not switch-off the output stage immediately, with ACTFAULT=1 a controlled emergency brake is started first.



(F06 = error messages "Motor Temperature")

Even if there is no intervention from an external control system (in the example, the ENABLE signal remains active), the motor is immediately braked using the emergency stop ramp if the error is detected and assuming that no changes have been made to the factory setting (ACTFAULT=1).

NOTE In case of a built-in safety card, wait for the Ready Acknowledge (X30 Pin 16) of the safety card before enabling the servo amplifier again.

7.8 Stop-, Emergency Stop-, Emergency Off Function to IEC 60204

With the functional safe, certified function STO (➜ # 41) the drive can be secured on stand-still (torque-free) using its internal electronics so that even when power is being supplied, the drive shaft is protected against unintentional restart (up to SIL CL3 according to IEC 62061, PLe according to ISO 13849-1).

With built-in “Safety” expansion card, more safe drive functions in accordance with IEC 61508 are provided (➜ # 153).

The parameters “STOPMODE” and “ACTFAULT” must be set to 1 in order to implement the stop and emergency stop categories. If necessary, change the parameters via the terminal screen of the setup software and store the data in the EEPROM.

Examples for implementation can be found in the KDN on page Stop and Emergency Stop Function.

7.8.1 Stop

The Stop function is used to shut down the machine in normal operation. The Stop functions are defined by IEC 60204.

Category 0: Shut-down by immediate switching-off of the energy supply to the drive machinery (i.e. an uncontrolled shut-down); this can be done with the built-in STO functionality (➜ # 41) .

Category 1: A controlled shut-down , whereby the energy supply to the drive machinery is maintained to perform the shut-down, and the energy supply is only interrupted when the shut-down has been completed;

Category 2: A controlled shut-down, whereby the energy supply to the drive machinery is maintained.

The Stop Category must be determined by a risk evaluation of the machine. In addition, suitable means must be provided to guarantee a reliable shut-down.

Category 0 and Category 1 Stops must be operable independently of the operating mode, whereby a Category 0 Stop must have priority. Stop functions must be implemented by disconnection of the appropriate circuitry, and have priority over assigned start functions.

If necessary, provision must be made for the connection of protective devices and lock-outs. If applicable, the Stop function must signal its status to the control logic. A reset of the Stop function must not create a hazardous situation.

Examples for implementation can be found in the KDN on page Stop and Emergency Stop Function.

7.8.2 Emergency Stop

The Emergency Stop function is used for the **fastest possible shutdown** of the machine in a dangerous situation. The Emergency Stop function is defined by IEC 60204. Principles of emergency stop devices and functional aspects are defined in ISO 13850.

The Emergency Stop function will be triggered by the manual actions of a single person. It must be fully functional and available at all times. The user must understand instantly how to operate this mechanism (without consulting references or instructions).

NOTE The Stop Category for the Emergency Stop must be determined by a risk evaluation of the machine.

In addition to the requirements for stop, the Emergency Stop must fulfil the following requirements:

- Emergency Stop must have priority over all other functions and controls in all operating modes.
- The energy supply to any drive machinery that could cause dangerous situations must be switched off as fast as possible, without causing any further hazards (Stop Category 0) or must be controlled in such a way, that any movement that causes danger, is stopped as fast as possible (Stop Category 1).
- The reset must not initiate a restart.

Examples for implementation can be found in the KDN on page Stop and Emergency Stop Function.

7.8.3 Emergency Off

The Emergency Off function is used to switch-off the electrical power supply of the machine. This is done to prevent users from any risk from electrical energy (for example electrical impact). Functional aspects for Emergency Off are defined in IEC 60364-5-53.

The Emergency Off function will be triggered by the manual actions of a single person.

NOTE The result of a risk evaluation of the machine determines the necessity for an Emergency Off function.

Emergency Off is done by switching off the supply energy by electro-mechanical switching devices. This results in a category 0 stop. If this stop category is not possible in the application, then the Emergency Off function must be replaced by other measures (for example by protection against direct touching).

7.9 Safety function STO

A frequently required application task is the safe torque off and the protection of personnel against unintentioned restarting of drives. The S700 servo amplifier offers, even in the basic version, a two channel STO function (Safe Torque Off). The function blocks the trigger pulses of the power transistors (pulse inhibitor).

Advantages of the safety function STO:

- the DC bus link remains charged up, since the mains supply line remains active
- only low voltages are switched, so there is no contact wear
- very little wiring is required
- single or dual channel control possible
- SIL2 or SIL3 solutions possible

The STO safety function corresponds to stop category 0 (uncontrolled stopping) acc. to EN 60204-1. The safety function STO can be operated from external safety switch gears (relays), from a safe external control (semiconductor output or driven contact) or from the built-in safety card S1-2 (➜ # 155) or S2-2 (➜ # 153).

NOTE

SIL2 / PLd solutions can be implemented with single-channel or dual-channel control with simple safety switching devices.

A SIL3 / PLe solution requires a safety control that periodically tests the safe switching of the pulse inhibitor by analyzing the feedback (status) signal.

7.9.1 Safety characteristic data

The subsystems (servo amplifiers) are totally described for safety technics with the characteristic data SIL CL, PFHD and TM..

Unit	Operation Mode	EN 13849-1	EN 62061	PFHD [1/h]	TM [Years]
STO1/2 Enable	single channel	PLd, Cat.3	SIL CL 2	7.05E-08	20
STO1-Enable+ STO2-Enable	dual channel	PLd, Cat.3	SIL CL 2	7.05E-08	20
STO1-Enable+ STO2-Enable+ STO-Status	dual channel + periodical testing	PLe, Cat.4	SIL CL 3	1.38E-09	20

7.9.2 Safety notes



⚠WARNING **High electrical voltage!**

Risk of electric shock! The function STO does not provide an electrical separation from the power output. If access to the motor power terminals is necessary,

- disconnect the servo amplifier from mains supply,
- consider the discharging time of the intermediate circuit.



⚠WARNING **No Brake Power!**

Serious injury could result when a suspended load is not properly blocked. The servo amplifier cannot hold a vertical load when STO is active.

- Add a safe mechanical blocking (for instance, a motor-holding brake).



⚠CAUTION **Uncontrolled movement!**

Danger of personal injury. If STO is engaged during operation by separating input STO1-Enable and STO2-Enable from 24 VDC, the motor runs down out of control and the servo amplifier displays the error F27. There is no possibility of braking the drive controlled.

- Brake the drive in a controlled way first and then separate the STO inputs from +24VDC time-delayed.

NOTICE

In case of single channel control:
If the STO is automatically activated by a control system, then make sure that the output of the control is supervised for possible malfunction. This can be used to prevent a faulty output from unintentionally activating the function STO. Since STO is used in a single- channel system, erroneous engaging will not be recognized.

NOTICE

Controlled braking:
Keep to the following functional sequence when the drive must be braked in a controlled manner:

1. Brake the drive in a controlled manner (velocity setpoint = 0V)
2. When speed = 0 rpm, disable the servo amplifier (enable = 0V)
3. If there is a suspended load, block the drive mechanically
4. Activate STO (STO1-Enable and STO2-Enable = 0V)

7.9.3 Use as directed

The STO function is exclusively intended to provide functional safety, by preventing the restart of a system.

- To achieve this functional safety, the wiring of the safety circuits must meet the safety requirements of IEC60204, ISO12100, IEC62061 respectively ISO13849-1.
- In case of single channel control: if STO is automatically activated by a control system, then make sure that the output of the control is monitored for possible malfunction.
- To achieve PL e or SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback signal from the safety control (➜ # 51).

7.9.4 Prohibited Use STO

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 by the personnel, and secured (main switch).
- Emergency-Off situations: the mains contactor must be switched off (by the emergency-Off button).

7.9.5 Enclosure

Since the servo amplifier meets enclosure IP20, you must select the enclosure ensuring a safe operation of the servo amplifier referring to the enclosure. The enclosure must meet IP54 at least.

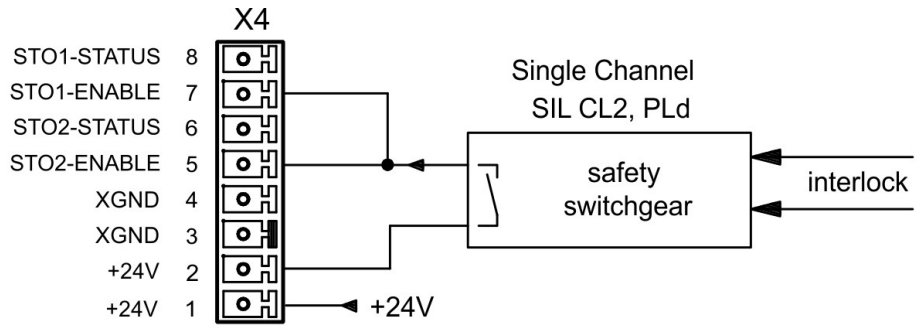
7.9.6 Wiring

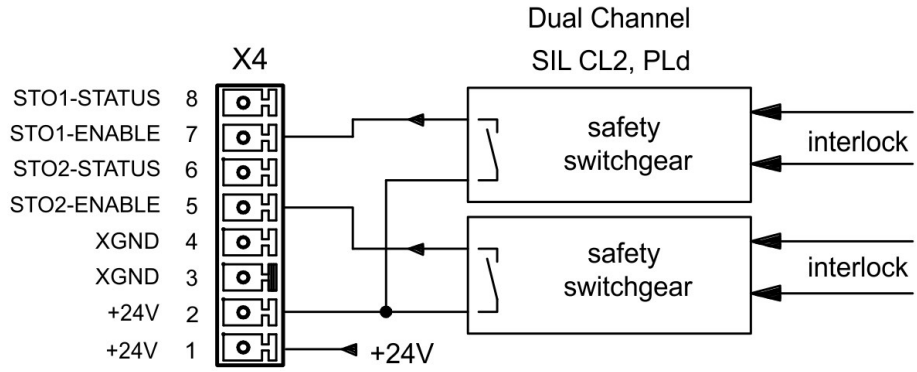
When using STO wiring leads outside the control cabinet, the cables must be laid durably (firmly), protected from outside damage (e.g. laying in a cable duct), in different sheathed cables or protected individually by grounding connection.
Wiring remaining within the demanded enclosure must meet the requirements of the standard IEC 60204-1.

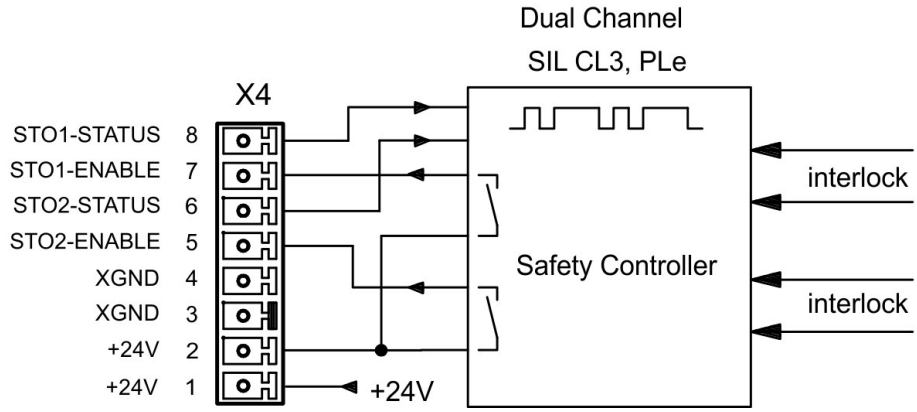
7.9.7 Technical data

STO1-Enable and STO2-Enable	Data
Input voltage	20 V..30 V
Input current	33 mA – 40 mA (Ieff)
Peak current	100 mA (Is)
Response time (falling edge at STO input until energy supply to motor is interrupted)	STO1: 1 ms STO2: 2 ms

7.9.8 Pinout







NOTE To achieve PLe / SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the status signal from a safety control.

7.9.9 Functional description

In case of use of the STO function the inputs STO1- Enable and STO2-Enable must be connected to the exits of a security control or a safety relay, which meets at least to the requirements of the SIL CL2 according to IEC 62061 and PLd according to ISO 13849-1 (see diagrams from (➜ # 47)).

Possible states of the servo amplifier in connection with STO:

STO1-ENABLE STO2-ENABLE	ENABLE	Display	Motor has torque	SIL CL2 or 3 safety
0V	0V	-S-	no	yes
0V	+24V	F27	no	yes
+24V	0V	normal status e.g. 06	no	no
+24V	+24V	normal status e.g. E06	yes	no

SIL2/PLd Single Channel Control

With the single-channel control of the STO (SIL2/PLd) safety function, both switch-off paths STO1-Enable and STO2-Enable are switched by one output of a safety switching device (e.g. safety relay), see example (➜ # 47).

In case of single channel usage of STO, erroneous engaging will not be recognized. Therefore the output of the control must be supervised for possible malfunction.

SIL2/PLd Dual Channel Control

With the dual-channel control of the STO (SIL2/PLd) safety function, the switch-off paths STO1-Enable and STO2-Enable are switched separately by two outputs of a safety switching device (e.g. safety relay), see example (➜ # 48).

SIL3/PLe Dual Channel Control

With the dual-channel control of the STO safety function, the switch-off paths STO1-Enable and STO2-Enable are switched separately by two outputs of a safety control, see example (➜ # 49).

To achieve PL e or SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback (status) signal from the safety control (➜ # 51).

NOTICE

When wiring the STO inputs within an enclosure it must be paid attention to the fact that the used cables and the enclosure meet the requirements of IEC 60204-1.

If the wiring leads outside the demanded enclosure, the cables must be laid durably (firmly), and protected from outside damage (➜ # 43).

NOTE

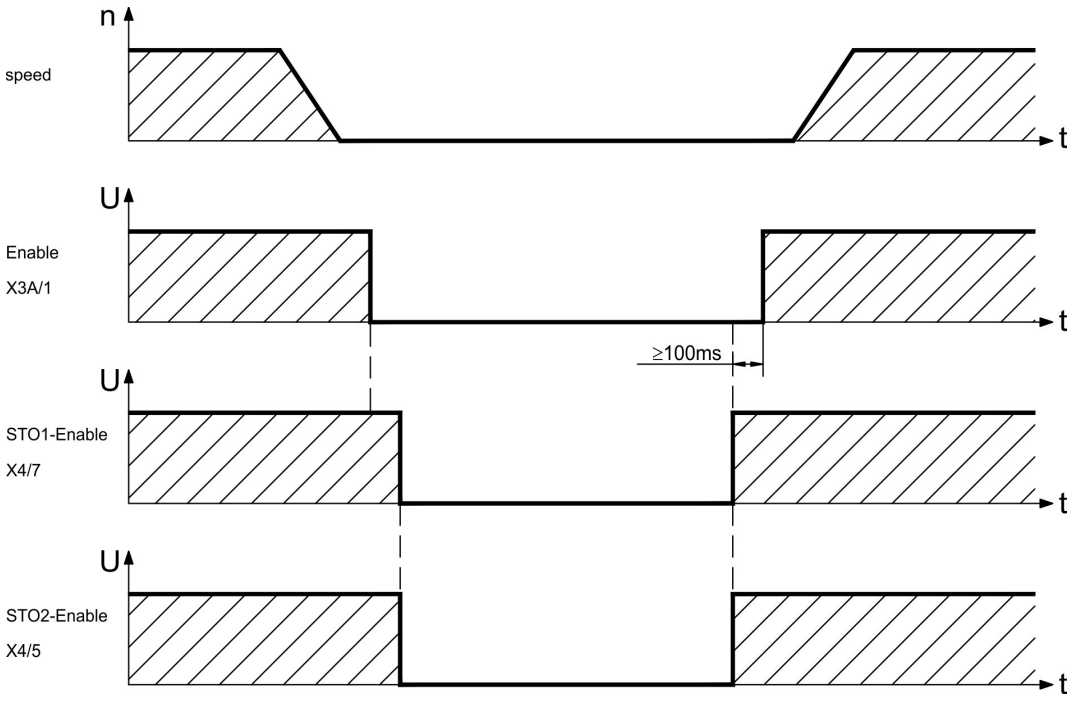
If STO function is not needed in the application, then the inputs STO1-ENABLE and STO2-ENABLE must be connected directly with +24VDC. STO is passed by now and cannot be used. Now the servo amplifier is not a safety component referring to the EC Machine Directive.

7.9.9.1 Safe operation sequence

If a controlled braking before the use of STO is necessary, the drive must be braked and the inputs STO1-ENABLE and STO2-Enable have to be separated from +24 VDC time-delayed.

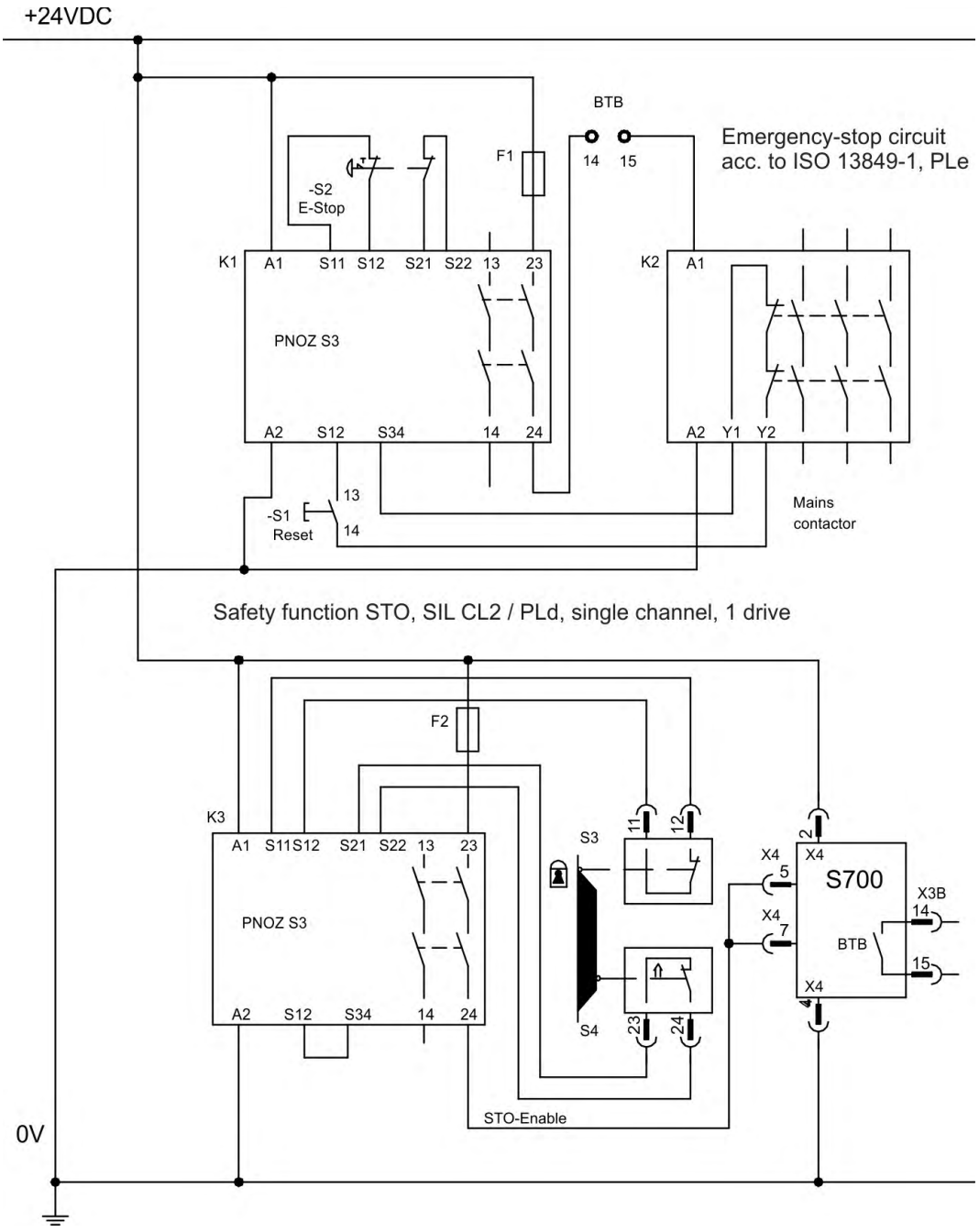
1. Brake the drive in a controlled manner (speed setpoint = 0V)
2. When speed = 0 rpm, disable the servo amplifier (enable = 0V)
3. If there is a suspended load, block the drive mechanically
4. Activate STO (STO1-Enable and STO2-Enable = 0V)

The diagram shows how STO should be used to ensure a safe stop of the drive and error free operation of the servo amplifier.



7.9.9.2 Control circuit single channel SIL2/PLd (example)

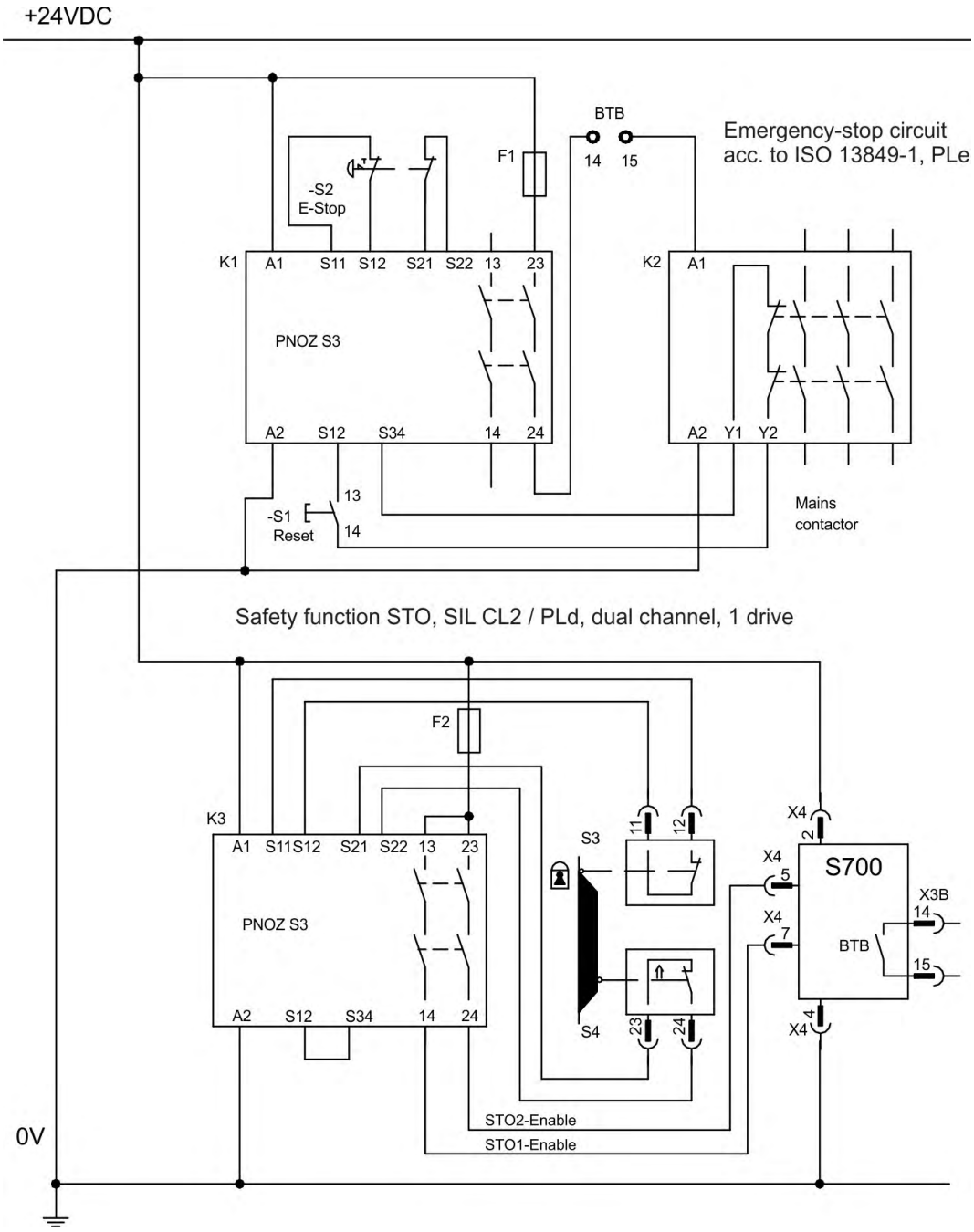
The example shows a circuit diagram with one axis connected to an emergency stop circuit. The STO of the drives is switched by a protective screen. A single channel switch-off is used. The safety switch gears used in the example are manufactured by Pilz and fulfill at least the PLd acc. to ISO 13849-1. Further information to the safety switch gears is available from Pilz. The use of safety switch gears of other manufacturers is possible, if these also fulfill the SIL CL2 according to IEC 62061 and PLd according to ISO 13849-1.



NOTE Consider the wiring instructions (➜ # 43).

7.9.9.3 Control circuit dual channel SIL2/PLd (example)

The example shows a circuit diagram with one axis connected to an emergency stop circuit. The STO of the drives is switched by a protective screen. A dual channel switch-off is used. The safety switch gears used in the example are manufactured by Pilz and fulfill at least the PLd acc. to ISO 13849-1. Further information to the safety switch gears is available from Pilz. The use of safety switch gears of other manufacturers is possible, if these also fulfill the SIL CL2 according to IEC 62061 and PLd according to ISO 13849-1.

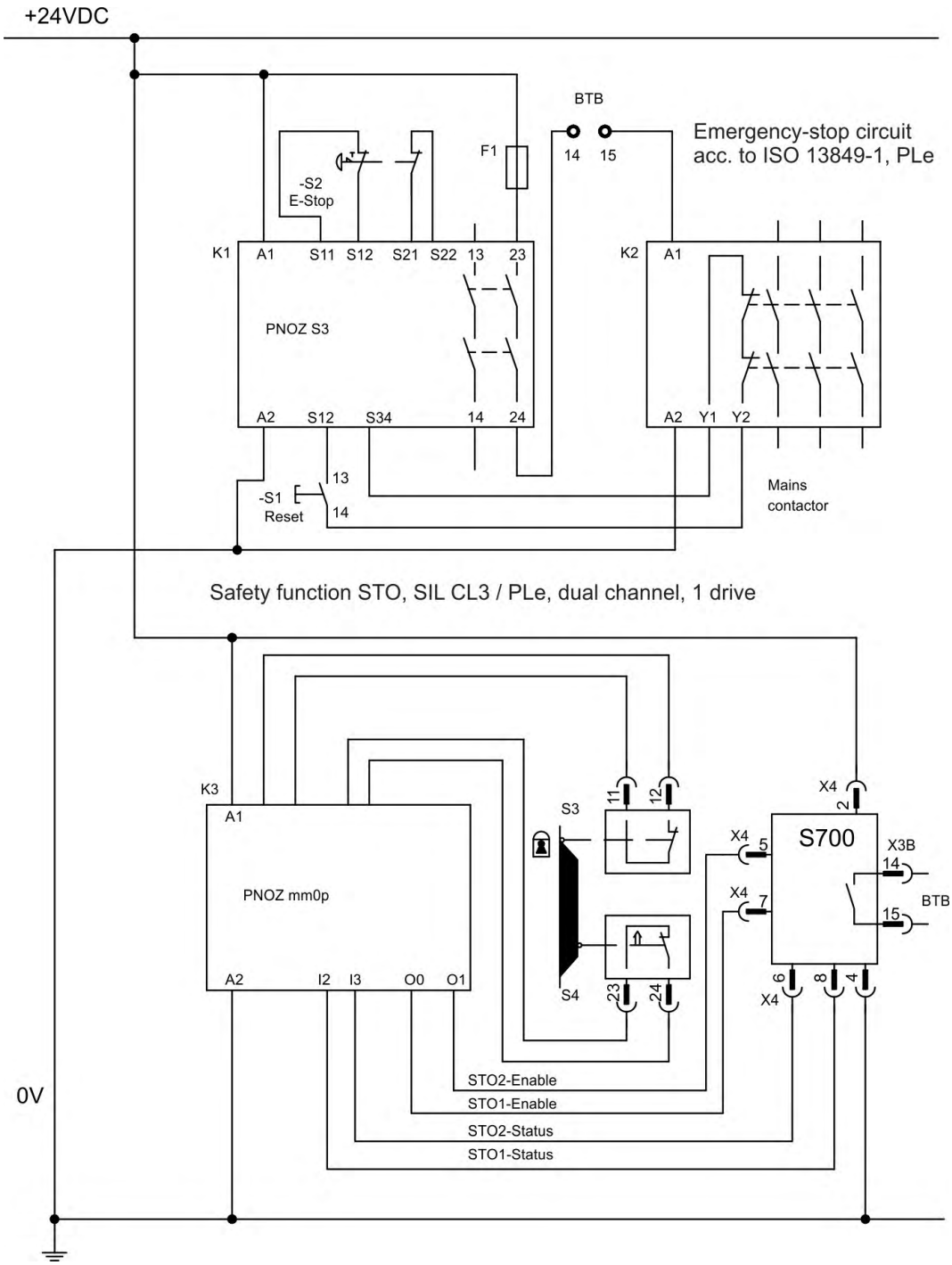


NOTE Consider the wiring instructions (➜ #43).

7.9.9.4 Control circuit dual channel SIL3/PLe (example)

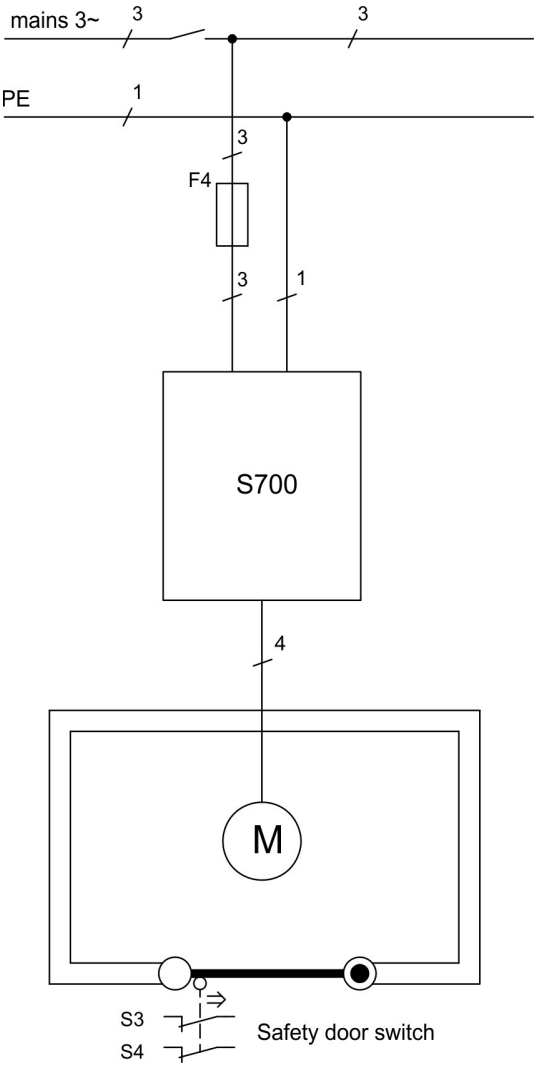
The example shows a circuit diagram with one axis connected to an emergency stop circuit. The STO of the drives is switched by a protective screen. A dual channel switch-off is used. The safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback in the safety control.

The safety controller used in the example is manufactured by Pilz and fulfills at least the PLe acc. to ISO 13849-1. Further information to the safety controllers are available from Pilz. The use of safety controlelrs of other manufacturers is possible, if these also fulfill the SIL CL3 according to IEC 62061 and PLe according to ISO 13849-1.



NOTE Consider the wiring instructions (➜ # 43)

7.9.9.5 Mains supply circuit (example)



7.9.10 Functional test

7.9.10.1 SIngle or Dual Channel control, SIL CL2 / PLd

NOTICE

With initial starting and after each interference into the wiring of the drive or after exchange of one or several components of the drive the function of STO must be tested.

1. Method:

1. Stop drive, with setpoint 0V, keep servo amplifier enabled (Enable=24V).
   DANGER: Do not enter hazardous area!
2. Activate STO1-Enable and STO2-Enable e.g. by opening protective screen (voltage at X4/7=0V and X4/5=0V).

Correct behavior: the BTB/RTO contact opens, the net contactor releases and the servo amplifier displays error F27.

2. Method:

1. Stop all drives, with setpoint 0V, disable servo amplifier (Enable=0V).
2. Activate STO1-Enable and STO2-Enable e.g. by opening protective screen (voltage at X4/7=0V and X4/5=0V).

Correct behavior: the servo amplifier displays **-S-**.

7.9.10.2 SIL CL3 / PLe Dual Channel control

NOTICE

To achieve PLe / SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback signal from a safety control:

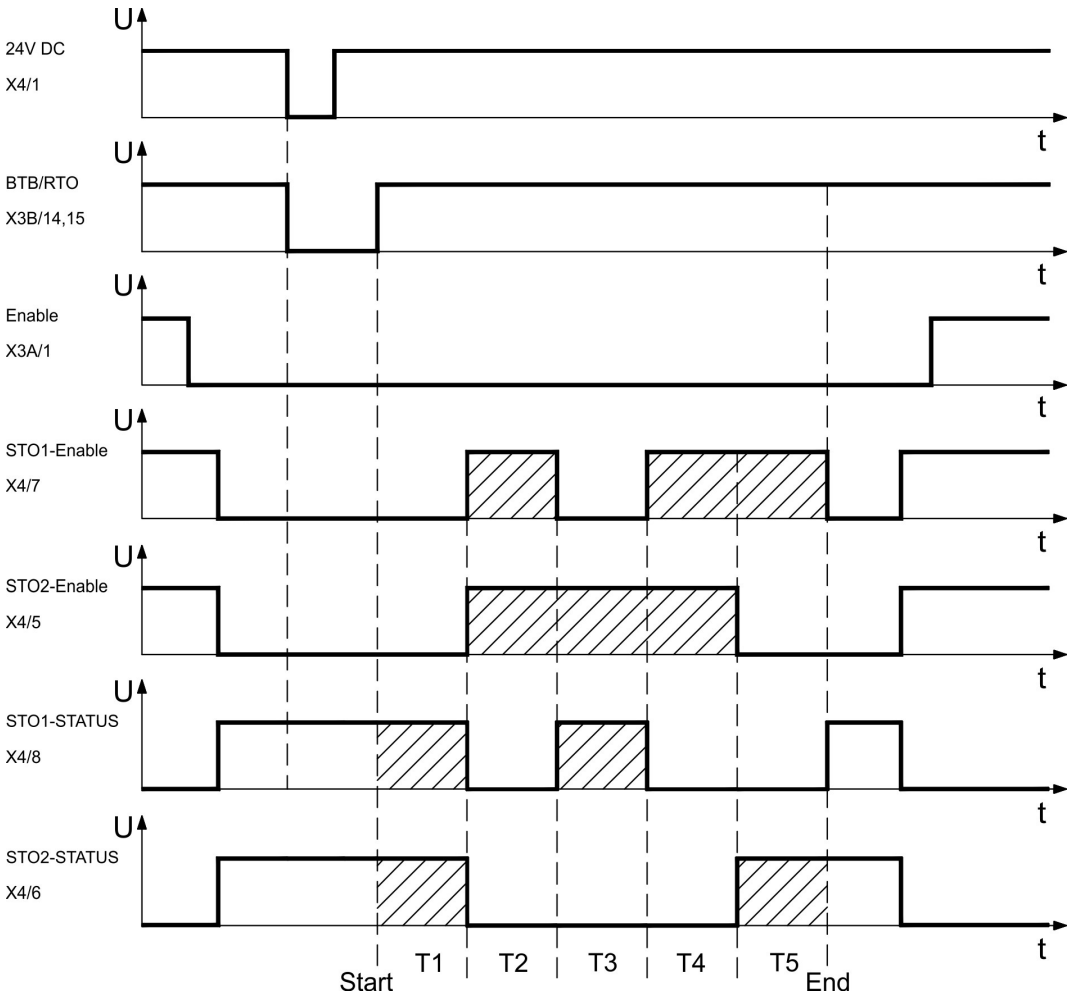
- At the start of a system
- At the restart after triggering a protective device
- At least every 8 hours by the operator.

The inputs STO1-ENABLE and STO2-ENABLE are switched in turns according to a defined test sequence. The switching states of the pulse inhibitor are available at the status outputs of the S748/772 and are analyzed by a safety control.

The test sequence for the functional test of the safe pulse inhibitor must be performed as shown in the following time chart.

Prerequisites for the start of the test sequence:

- Operational readiness BTB/RTO = “1"
- Enable signal ENABLE = “0"
- STO1-ENABLE and STO2-ENABLE = “0"



Legend:

STO1-ENABLE: digital input, 1st switch-off path
STO1-STATUS: digital output, switching state of pulse inhibitor 1st switch-off path
Start: Start of test sequence
STO2-ENABLE: digital input, 2nd switch-off path
STO2-STATUS: digital output, switching state of pulse inhibitor 2nd switch-off path
T1 bis T5: Test sequence
End: End of test sequence

7.10 Shock-hazard Protection

7.10.1 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. As a rule of thumb, the following assumption can be made for leakage current on our low capacitance cables at a mains voltage of 400 V, depending on the clock frequency of the output stage:
I_{leak} = **n x 20 mA + L x 1 mA/m** at 8 kHz clock frequency at the output stage
I_{leak} = **n x 20 mA + L x 2 mA/m** at a 16 kHz clock frequency at the output stage
(where Ileak=leakage current, n=number of drives, L=length of motor cable)
At other mains voltage ratings, the leakage current varies in proportion to the voltage.

Example:
2 x drives + a 25m motor cable at a clock frequency of 8 kHz:
2 x 20 mA + 25 m x 1 mA/m = 65 mA leakage current.

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. Use the PE terminal and the PE connection screws in order to fulfill this requirement.

The following measures can be used to minimize leakage currents:

- Reduce the length of the engine cable.
- Use low-capacity cables (➜ # 63).
- Remove external EMC filters (radio-interference suppressors are integrated).

7.10.2 Residual current protective device (RCD)

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 S700 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. Refer to the chapter above for the rule of thumb for determining the leakage current. Rated residual currents in the RCDs:

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

NOTE Recommendation: In order to protect against direct contact (with motor cables shorter than 5 m) Kollmorgen recommends that each drive be protected individually using a 30 mA RCD which is sensitive to all currents.

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

7.10.3 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 S700 can also be operated via an isolating transformer (schematic connection (➜ # 68)). 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.

8 Mechanical Installation

8.1 Important Notes



⚠CAUTION High EMC Voltage Level!

Risk of electrical shock, if the servo amplifier (or the motor) is not properly EMC-grounded.

- Do not use painted (i.e. non-conductive) mounting plates.
- In unfavourable circumstances, use copper mesh tape between the earthing bolts and earth potential to deflect currents.

NOTICE Protect the servo amplifier 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 servo amplifier will switch itself off in case of overheating. Ensure that there is an adequate flow of cool, filtered air into the bottom of the control cabinet, or use a heat exchanger (➜ # 32).

NOTICE Do not mount devices that produce magnetic fields directly beside the servo amplifier. Strong magnetic fields can directly affect internal components. Mount devices which produce magnetic field with distance to the servo amplifier and/or shield the magnetic fields.

8.2 Guide to Mechanical Installation

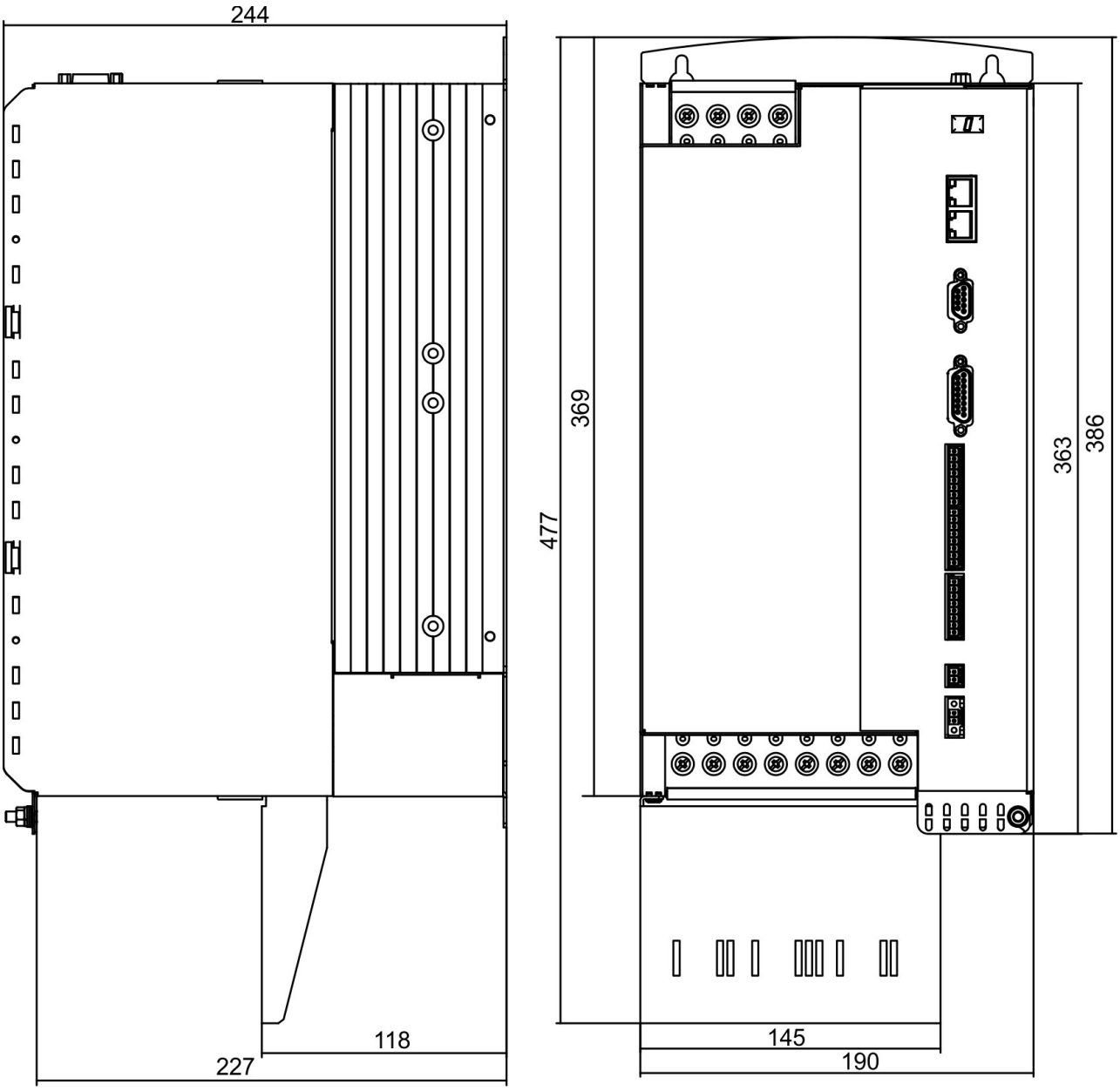
The following notes should assist you to carry out the mechanical installation in a sensible sequence, without overlooking anything important.

Site	• Mount in a closed switchgear cabinet (➜ # 32). • The site must be free from conductive or corrosive materials. • For the mounting position in the cabinet refer to (➜ # 56).
Ventilation	• Check that the ventilation of the servo amplifier is unimpeded and keep within the permitted ambient temperature (➜ # 32). • Keep the required space clear above and below the servo amplifier (➜ # 56).
Assembly	• Assemble the servo amplifier and power supply, filter and choke close together on the conductive, **grounded** mounting plate in the cabinet.
Grounding Shielding	• EMC-compliant (EMI) shielding and grounding (➜ # 67). • Earth (ground) the mounting plate, motor housing and CNC-GND of the controls. Notes on connection techniques (➜ # 62).

8.3 Dimensions

8.3.1 Device with heat sink

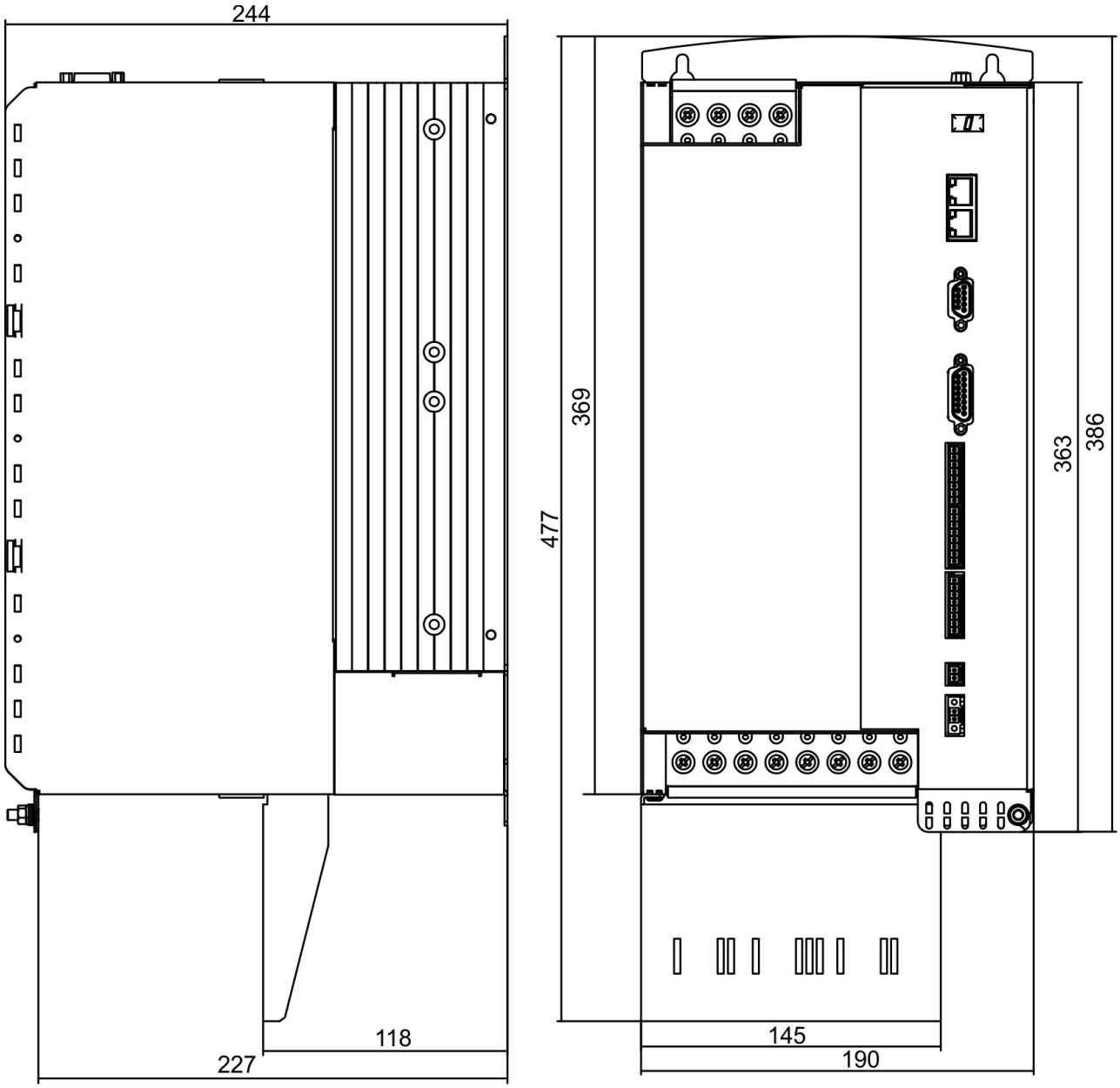
Material: four M5 hexagon socket screws to ISO 4762



8.3.2 Device with Coldplate

NOTICE These devices are not UL listed and are not EAC and Safety certified.

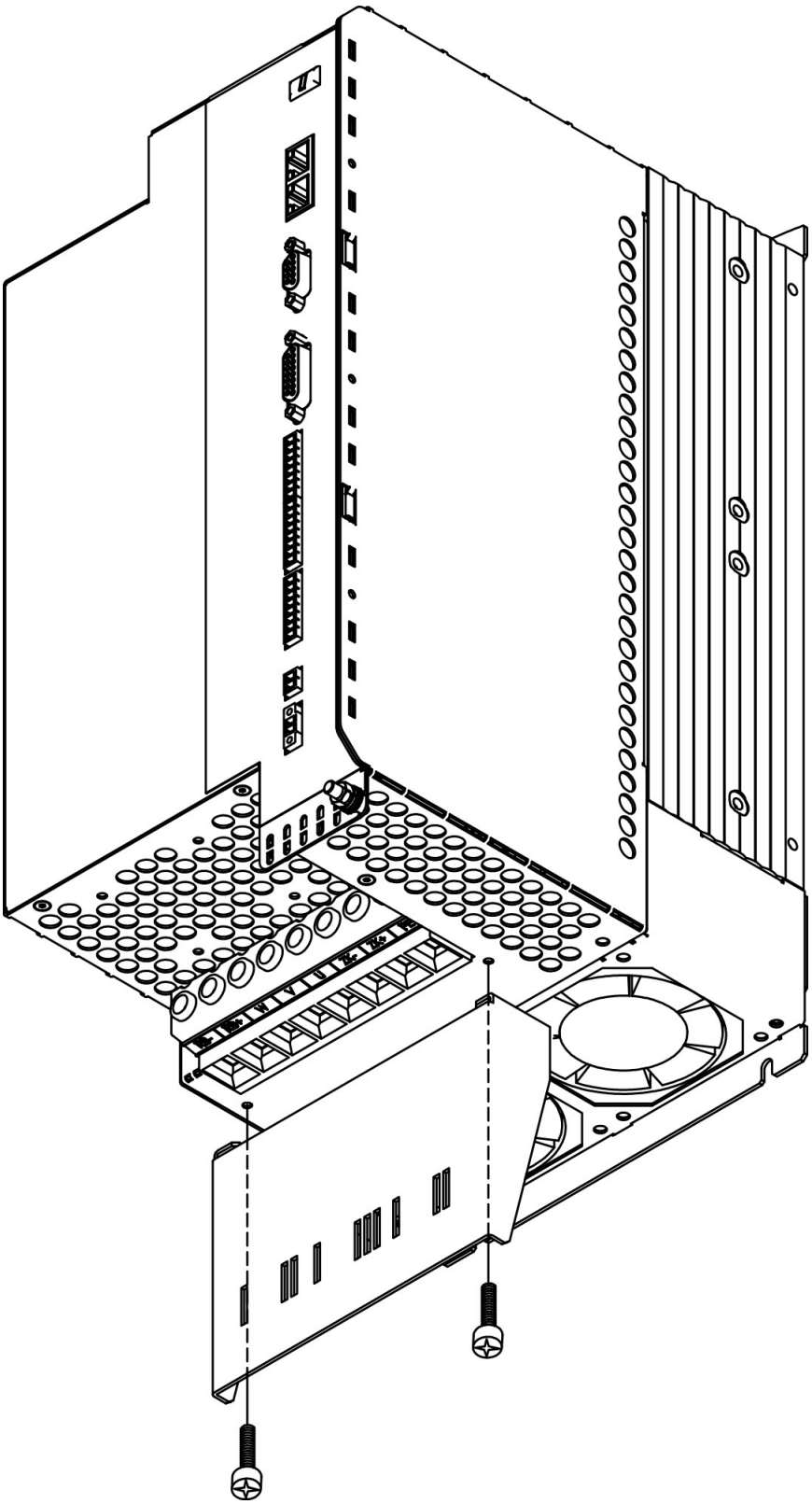
Material: six M5 hexagon socket screws to ISO 4762



8.4 Assembly

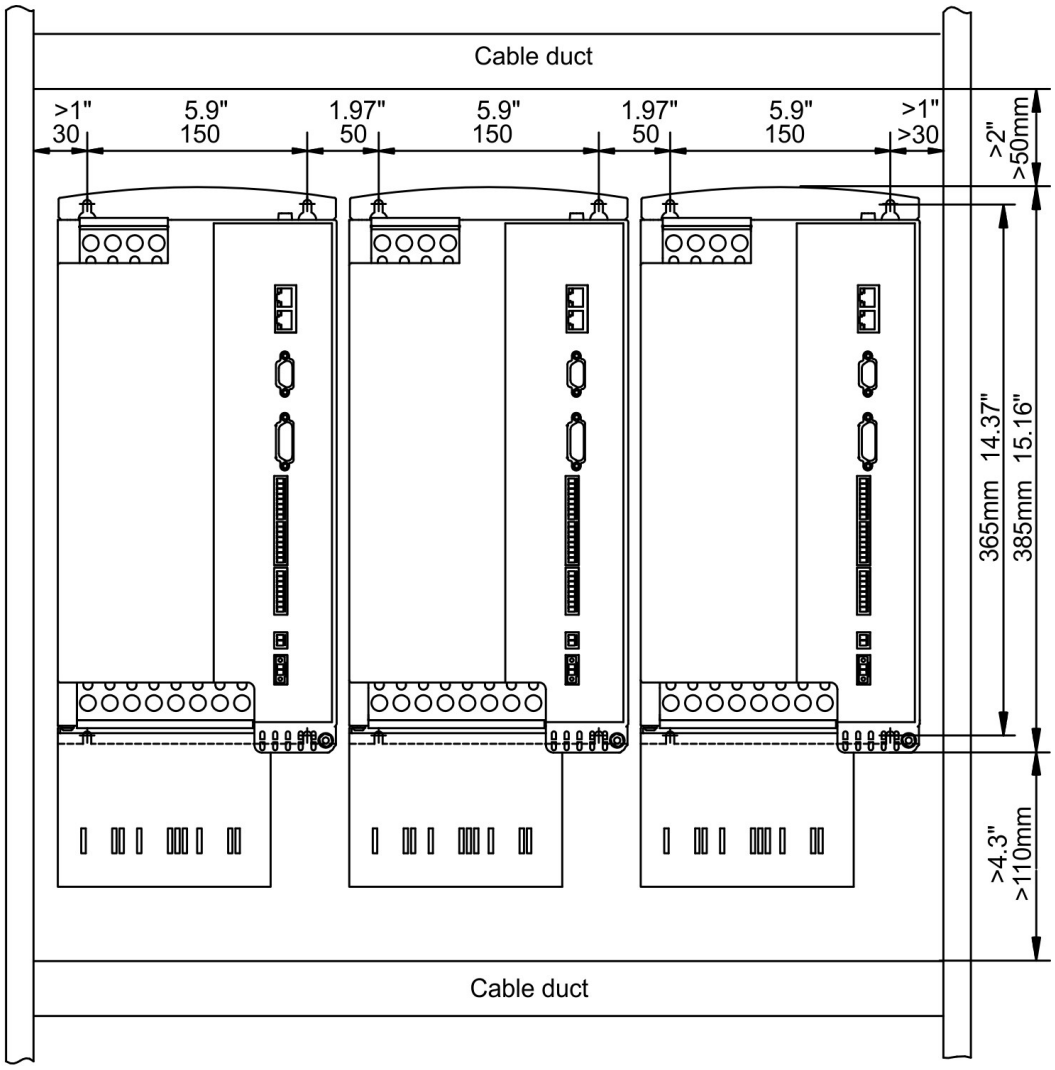
8.4.1 Mounting the shielding plate

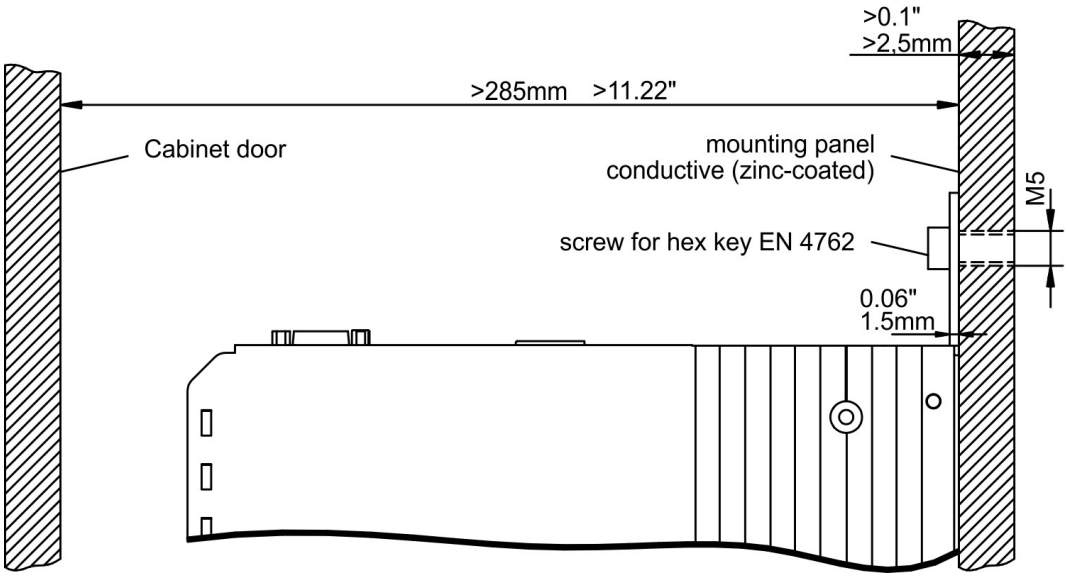
Material: unscrew existing screws and re-use them
Tool required : standard screw driver (cross)



8.4.2 Backplane mounting - devices with heat sink

Material: five M5 hexagon socket screws to ISO 4762
Tool required : 4 mm Allen key



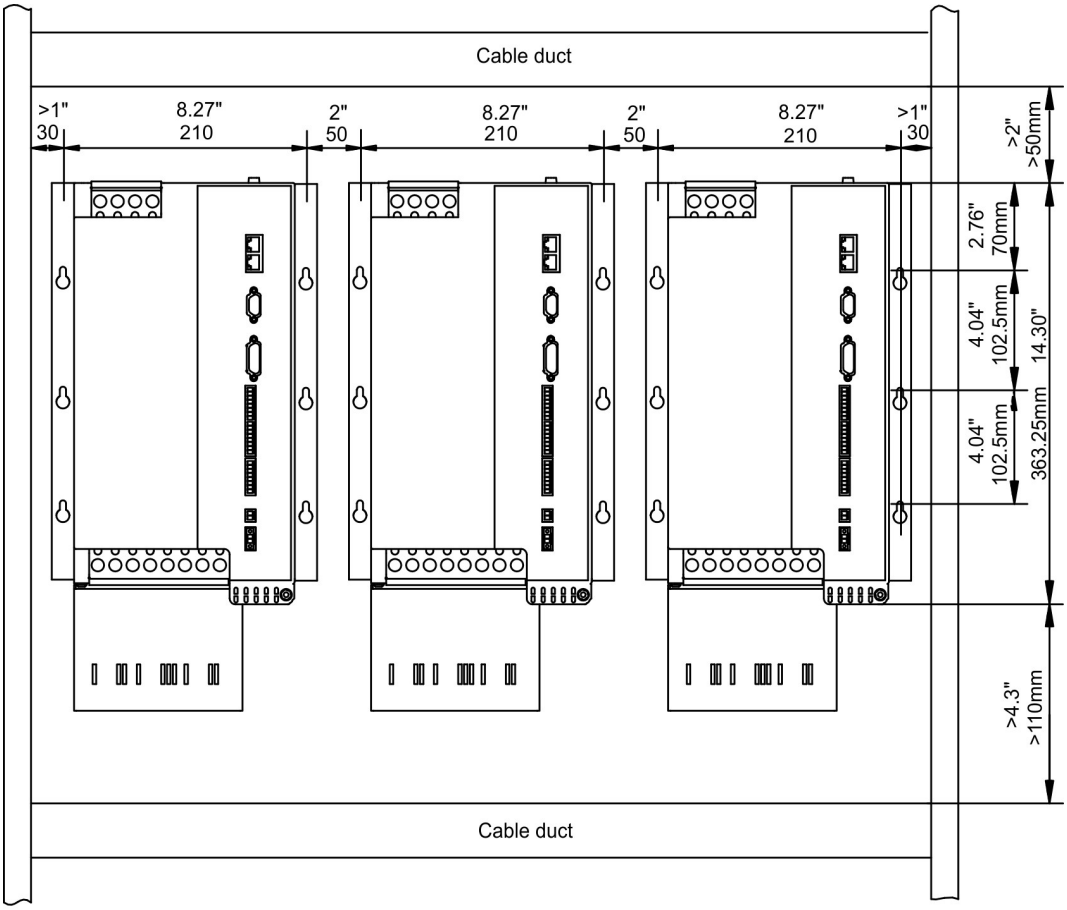


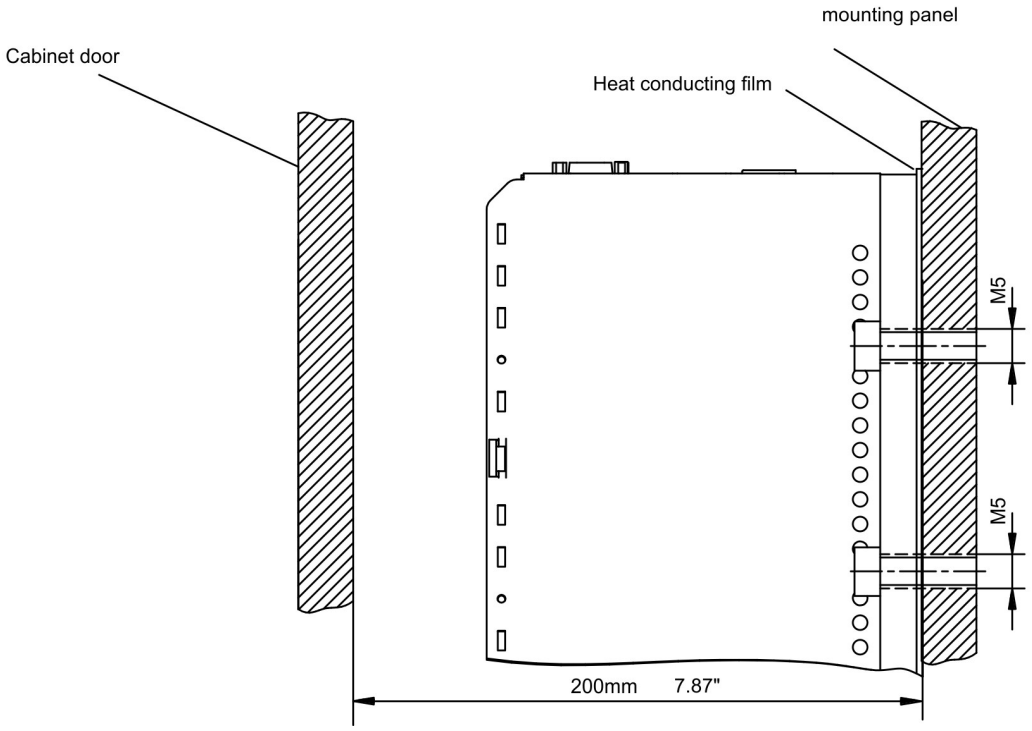
8.4.3 Backplane mounting - devices with Coldplate

NOTICE These devices are not UL listed and are not EAC and Safety certified.

Material: six M5 hexagon socket screws to ISO 4762

Ambient requirements see (➜ # 32), mounting plate flatness:≤ 25 µm / 100 mm
Heat conducting film to increase the heat conduction, e.g. Kunze KU-CG20.
Tool required : 4 mm Allen key





9 Electrical Installation

9.1 Important Notes



DANGER High Voltage up to 900 V!

There is a danger of serious personal injury or death by electrical shock or electrical arcing. Capacitors can still have dangerous voltages present up to 10 minutes after switching off the supply power. Control and power connections can still be live, even if the motor is not rotating.

- Only install and wire the equipment when it is not live.
- Make sure that the cabinet is safely disconnected (for instance, with a lock-out and warning signs).
- Never remove electrical connections to the drive while it is live.
- Wait at least 10 minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (e.g. contacts) or undoing any connections.
- To be sure, measure the voltage in the DC bus link and wait until it has fallen below 50 V.

NOTICE Wrong mains voltage, unsuitable motor or wrong wiring will damage the amplifier.
Check the combination of servo amplifier and motor. Compare the rated voltage and current of the units. Implement the wiring according to the connection diagram (➜ # 61)
Make sure that the maximum permissible rated voltage at the terminals L1, L2, L3 or +DC, –DC is not exceeded by more than 10% even in the most unfavorable circumstances (see IEC 60204-1).

NOTICE Excessively high external fusing will endanger cables and devices. The fusing of the voltage supply must be installed by the user, best values (➜ # 32). Hints for use of Residual-current circuit breakers (FI), (➜ # 52).

NOTICE The servo amplifier's status must be monitored by the PLC to acknowledge critical situations. Wire the BTB/RTO contact in series into the emergency off circuit of the installation. The emergency off circuit must operate the supply contactor.

9.2 Guide to electrical installation

NOTICE Correct wiring is the basis for reliable functioning of the servo system. Route power and control cables separately. We recommend a distance of at least 200 mm. This improves the interference immunity. If a motor power cable is used that includes cores for brake control, the brake control cores must be separately shielded. Ground the shielding at both ends. Ground all shielding with large areas (low impedance), with metalized connector housings or shield connection clamps wherever possible. Notes on connection techniques (➜ # 62).

NOTICE Feedback lines may not be extended, since thereby the shielding would be interrupted and the signal processing could be disturbed. Lines between servo amplifiers and filter or external brake resistor must be shielded. Install all power cables with an adequate cross-section, as per IEC 60204 to reach max. cable length (➜ # 63).

The following notes should assist you to carry out the electrical installation in a sensible sequence, without overlooking anything important.

Cable selection	• Select cables according to EN 60204, (➜ # 33).
Grounding Shielding	• EMC-compliant (EMI) shielding and grounding, (➜ # 67). • Earth (ground) the mounting plate, motor housing and CNC-GND of the controls (➜ # 62).
Wiring	Route power leads and control cables separately. Wire the BTB/RTO contact in series into the emergency off circuit of the system. 1. Connect the digital control inputs to the servo amplifier. 2. Connect up AGND (also if fieldbuses are used). 3. Connect the analog setpoint, if required. 4. Connect up the feedback unit (resolver and/or encoder). 5. Connect the encoder emulation, if required. 6. Connect the expansion card (➜ # 126). 7. Connect the motor cables, connect shielding at both ends. 8. Connect motor-holding brake, connect shielding at both ends. 9. Connect the external brake resistor (with fusing). 10. Connect aux. supply (for max. permissible voltage values (➜ # 31)). 11. Connect main power supply (for max. permissible voltage values (➜ # 31), hints for use of residual-current circuit breakers (FI) (➜ # 52) 12. Connect PC (➜ # 104).
Final check	• Final check of the implementation of the wiring, according to the wiring diagrams which have been used.

9.3 Wiring

The installation procedure is described as an example. A different procedure may be appropriate or necessary, depending on the application of the equipments. We provide further know-how through training courses (on request).



DANGER **High voltage up to 900V!**

There is a danger of electrical arcing with damage to contacts and serious personal injury.

- Only install and wire up the equipment when it is not live, i.e. 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).

NOTE

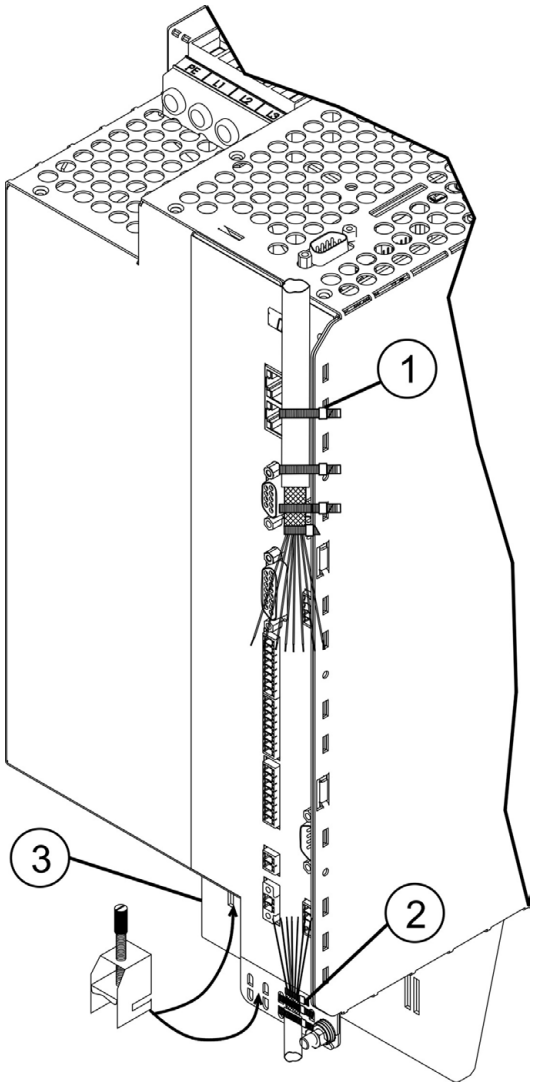
The ground symbol  , which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest feasible surface area between the unit indicated and the mounting plate in the control cabinet.

This connection is for the effective grounding of HF interference, and must not be confused with the PE-symbol  (PE = protective earth, safety measure as per IEC 60204).

Use the following connection diagrams:

Overview:	(➜ # 67)
Safe Torque Off STO:	(➜ # 44)
Voltage supply:	(➜ # 68)
Motor:	(➜ # 73)
Feedback:	(➜ # 74)
Electronic Gearing and Master Slave:	(➜ # 94)
Pulse-Direction:	(➜ # 95)
Master-Slave :	(➜ # 96)
Digital and analog inputs and outputs:	(➜ # 99)
RS232 / PC connection:	(➜ # 104)
CANopen Interface:	(➜ # 105)
EtherNet Interface:	(➜ # 106)
Expansion cards for slot 1:	
I/O-14/08:	(➜ # 127)
PROFIBUS:	(➜ # 130)
sercos® II:	(➜ # 131)
DeviceNet:	(➜ # 133)
SynqNet:	(➜ # 136)
FB-2to1:	(➜ # 138)
-2CAN-:	(➜ # 140)
Expansion cards for slot 2:	
PosI/O & PosI/O-Monitor:	(➜ # 143)
Expansion cards for slot 3:	
PosI/O & PosI/O-Monitor:	(➜ # 152)
Safety Cards:	(➜ # 153)

9.3.1 Shielding connection to the front panel



Remove the outside shroud of the cable and the shielding braid on the desired core length.
Secure the cores with a cable tie.

Remove the outside shroud of the line on a length from for instance 30 mm without damaging the shielding braid.

Strip all wires and fit wire end ferrules.

Use cable ties to attach the cable to the side (1) or bottom (2) shroud of the servo amplifier, securing the braided shield of the cable to the shroud of the servo amplifier with a cable tie.

Alternatively you can use shield connection terminal clamps (see accessories manual). These hook into the bottom shroud and ensure optimum contact between the shield and the shroud.

Wire the plug-in terminal blocks as shown in the connection diagram.

The motor cable shield is connected via a shield connection clamp to the bottom shielding plate (3). Clamp and shielding plate are part of delivery.

9.3.2 Technical data for connecting cables

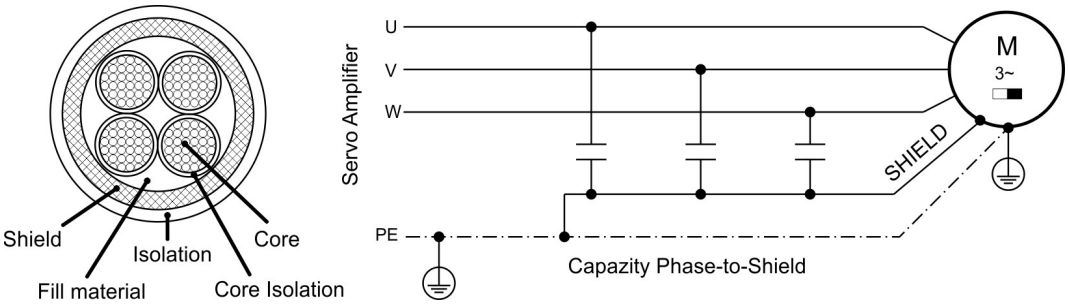
For further information on the chemical, mechanical and electrical characteristics of the cables please refer to the accessories manual or contact our customer service.

NOTE Observe the rules in the section "Conductor cross-sections" (➜ # 33). To reach the max. permitted cable length, you must use cable material that matches the capacitance requirements listed below.

Capacitance (core to shield)

Motor cable less than 150 pF/m
Feedback cable less than 120 pF/m

Example: Motor cable:



Technical data

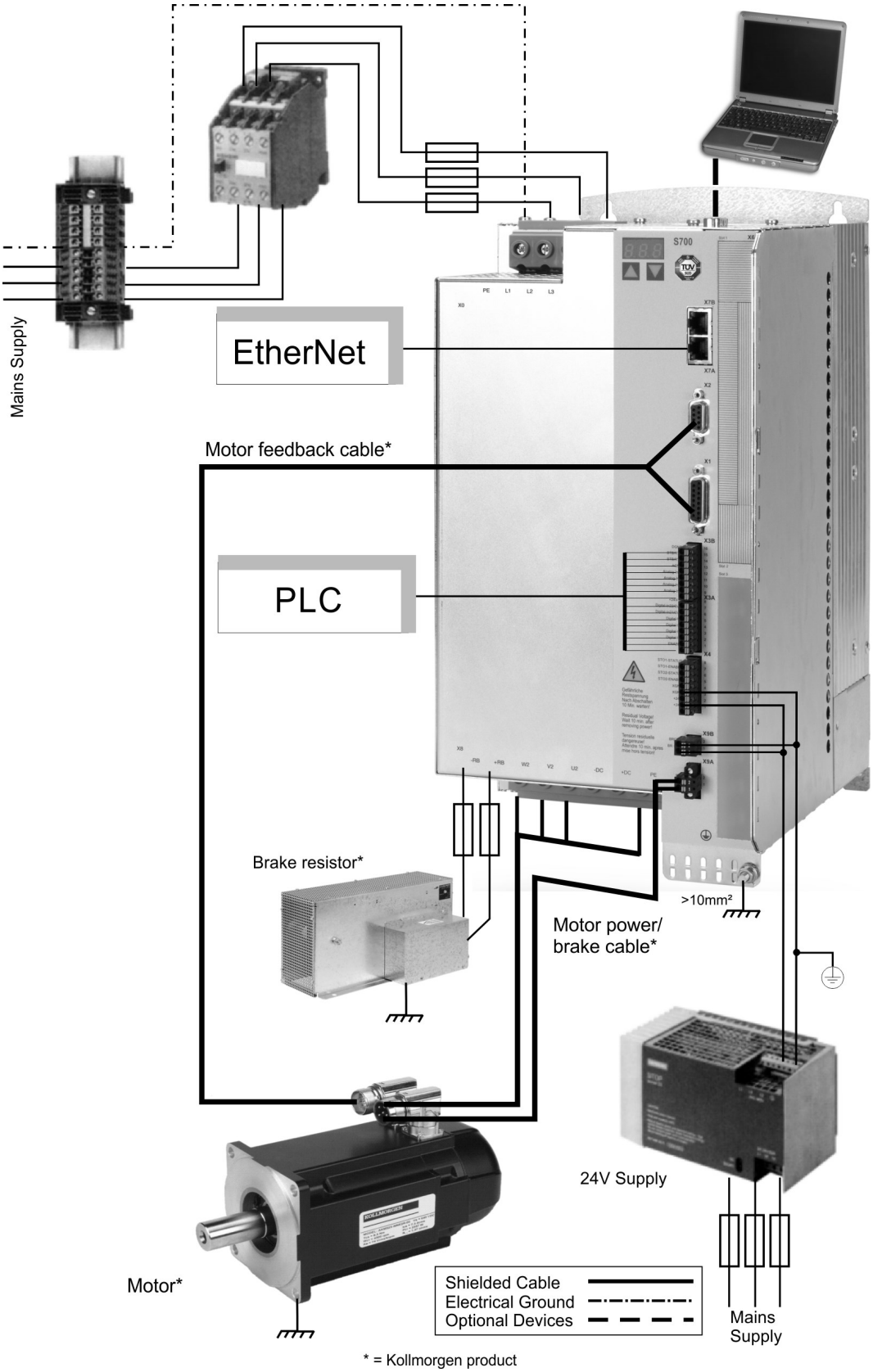
For a detailed description of Kollmorgen cable types and how to assemble them, please refer to the accessories manual.

Chokes

NOTE With motor cables longer than 25m the use of a motor choke 3YLN may be necessary depending on the system. Contact our customer support.

If mains voltage is more than 3% asymmetrical, a mains choke 3L with 2% uk must be used. See Accessories Manual.

9.4 Components of a servo system

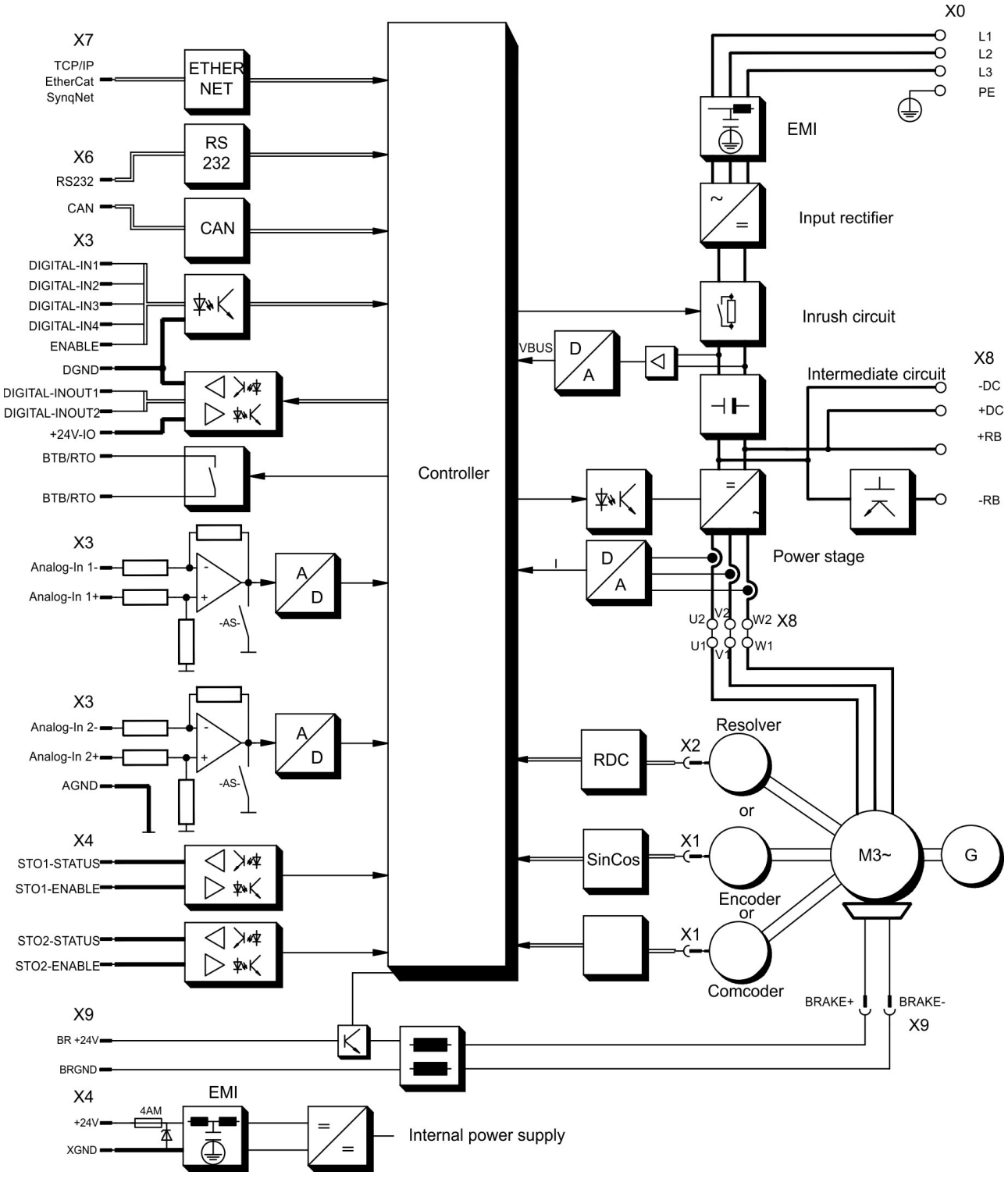


* = Kollmorgen product

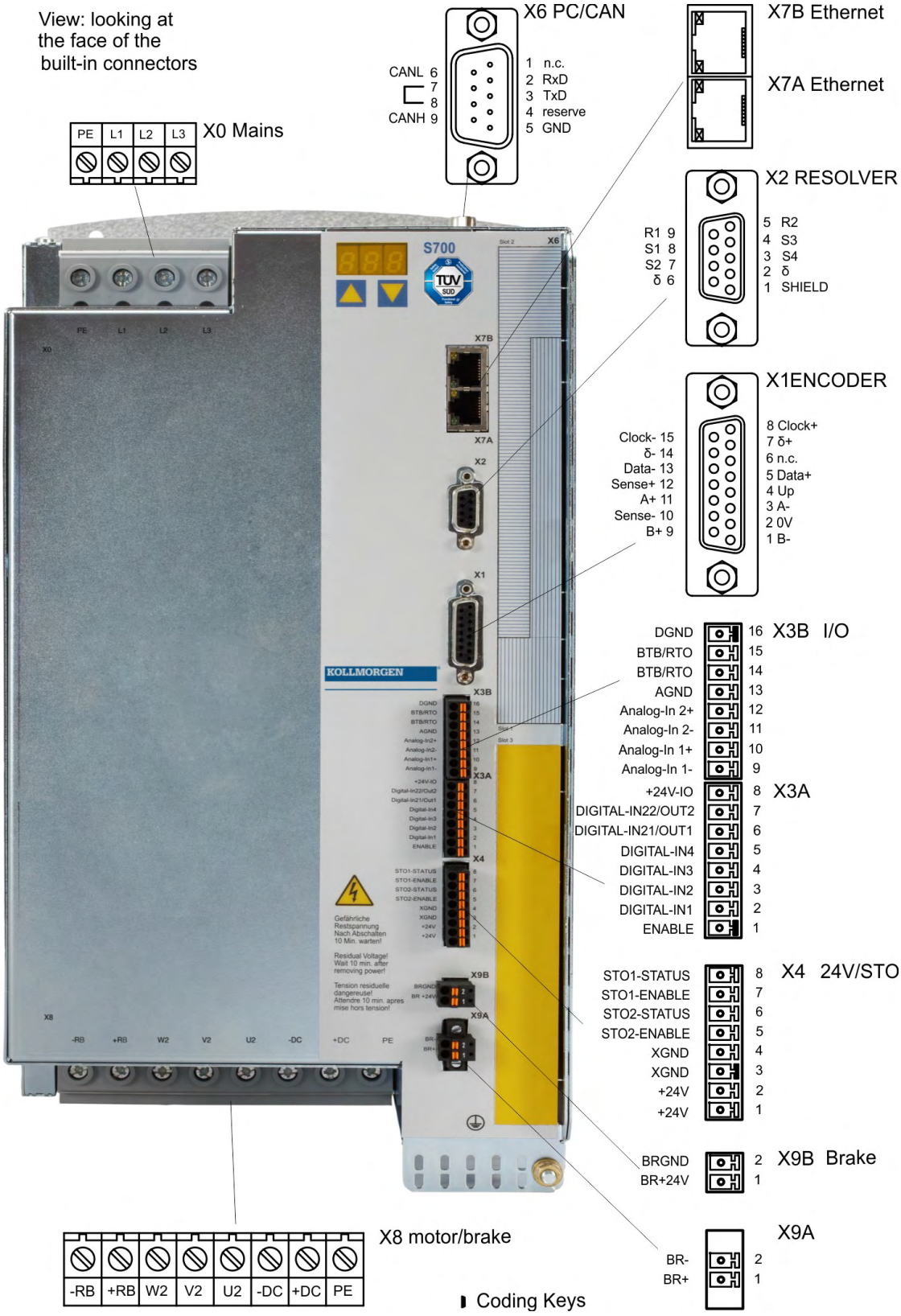
NOTE Cables drawn bold are shielded. Electrical ground is drawn with dash-dotted lines. Optional devices are connected with dashed lines to the servo amplifier. The required accessories are described in our accessories manual. STO function is deactivated in the example.

9.5 Block diagram

The block diagram below just provides an overview.

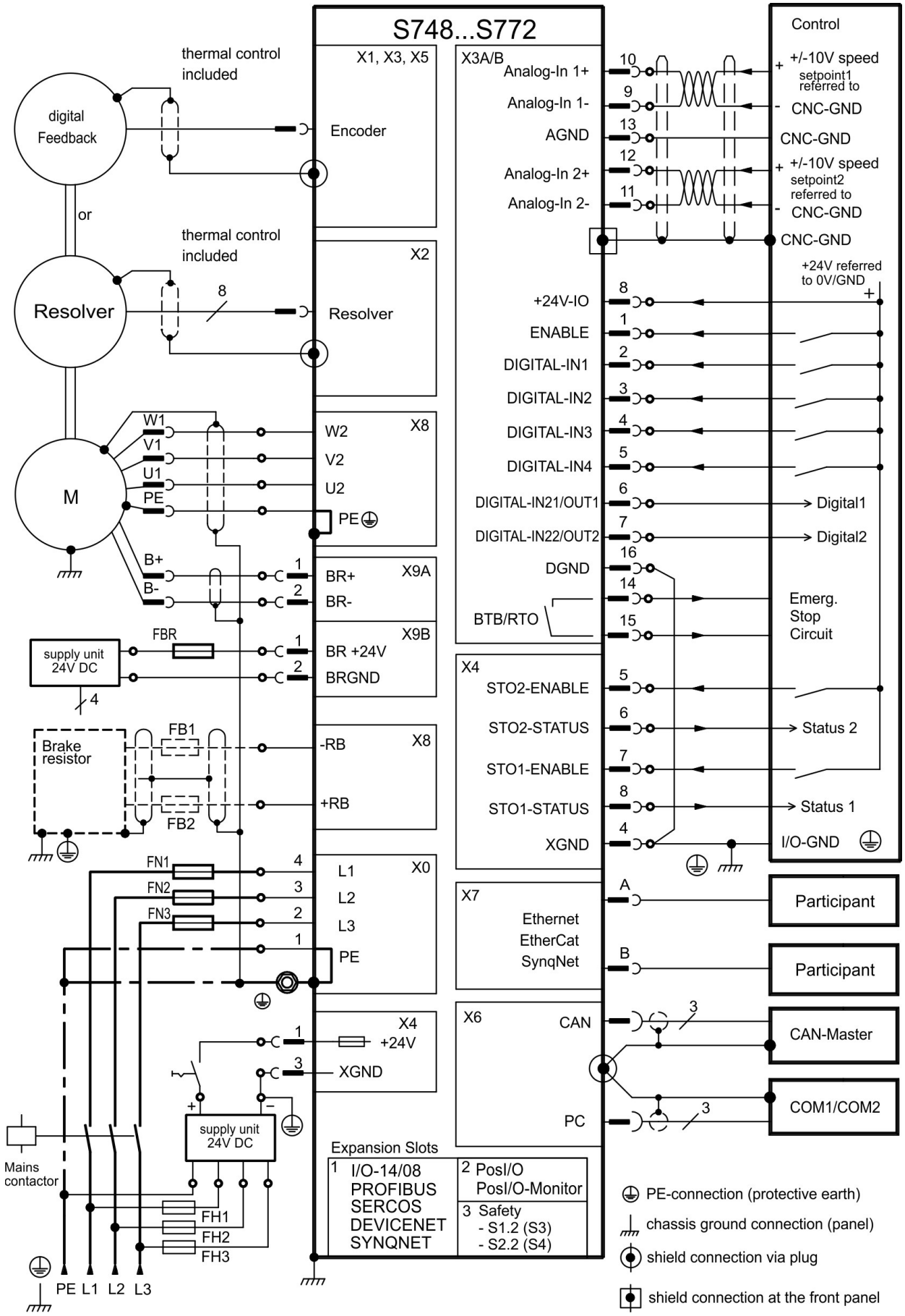


9.6 Connector assignments



9.7 Connection diagram (Overview)

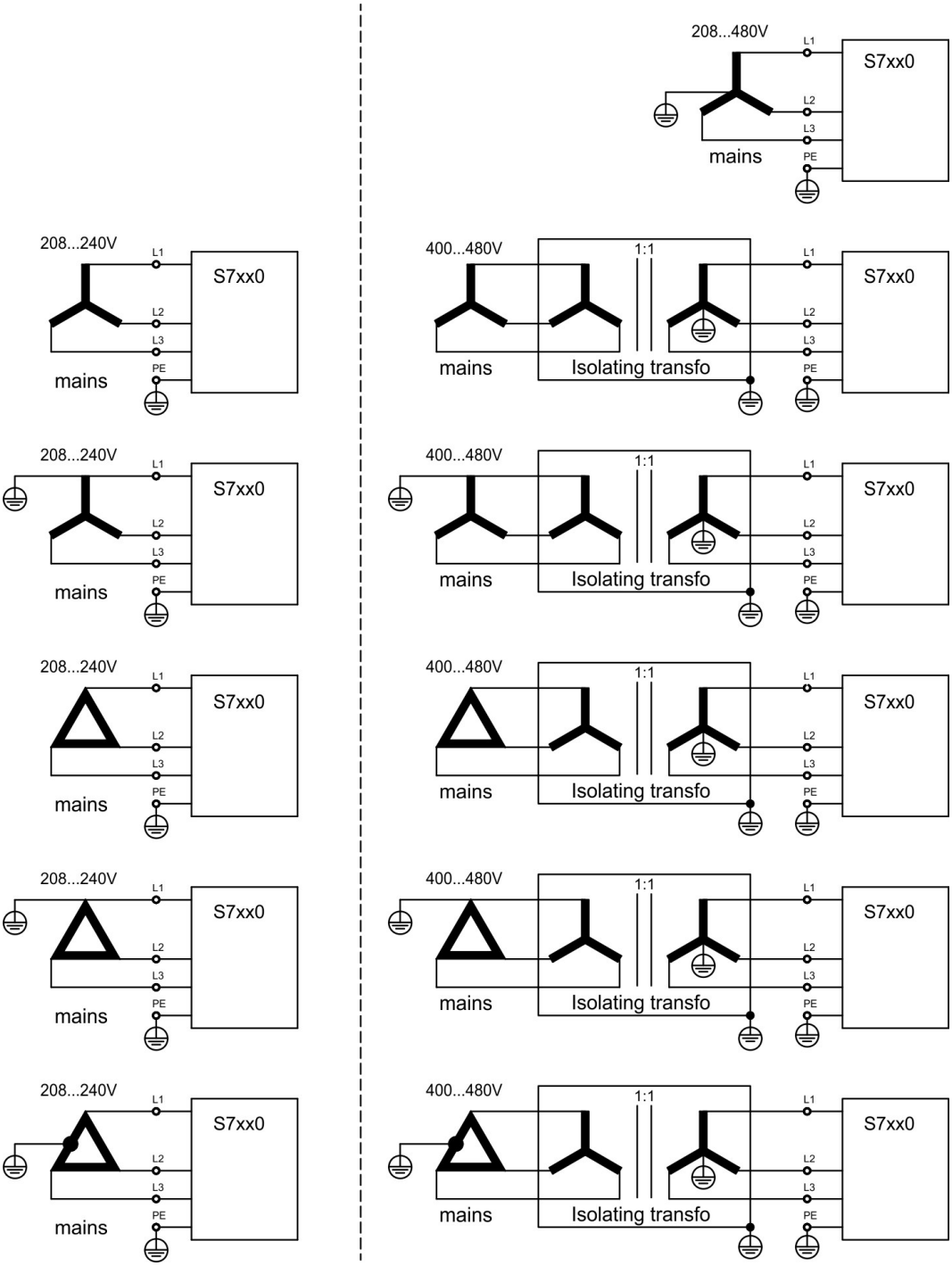
Reference Safety Instructions (➜ # 13) and Use As Direct (➜ # 16) !



9.8 Voltage supply

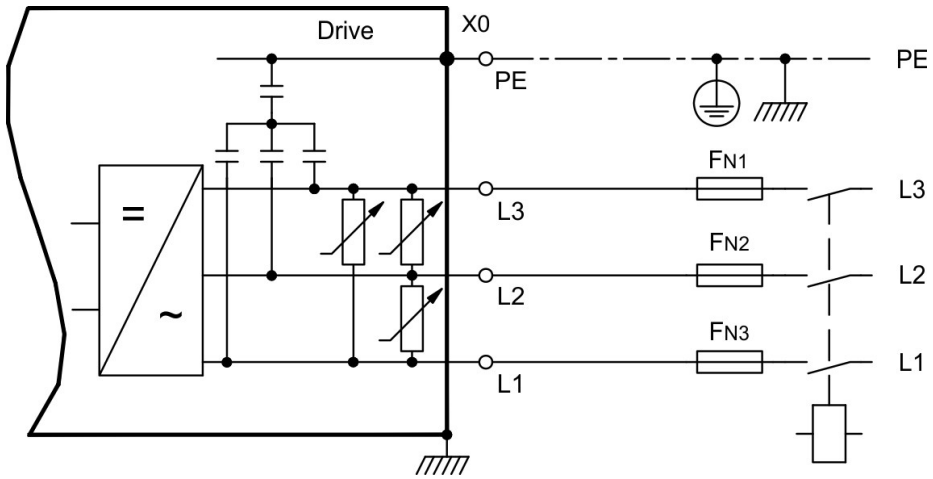
9.8.1 Connection to various mains supply networks

NOTICE An isolating transformer is required for 400V to 480V networks that are asymmetrically grounded or not grounded as shown below.

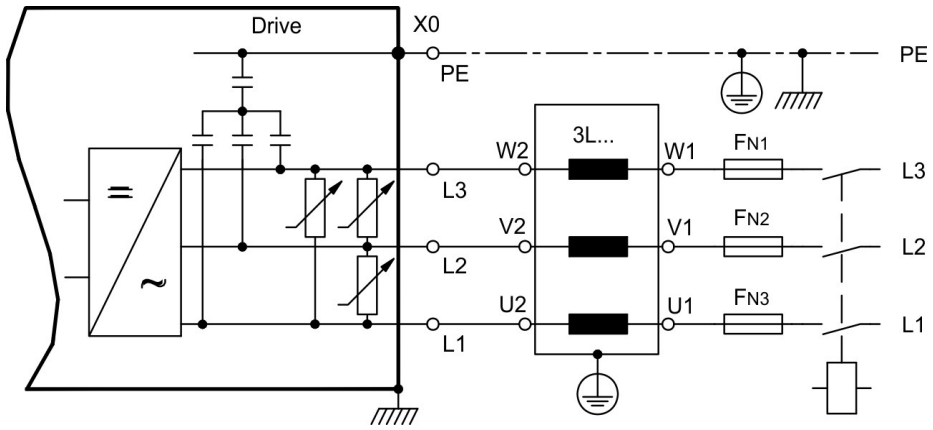


9.8.2 Mains supply connection (X0)

- Directly to 3-phase supply network, filter is integrated, supply networks (➜ # 68) (with mains voltage below 300V set parameters NONBTB=3 and VBUSBAL=1)
- Fusing (e.g. fusible cut-outs) to be provided by the user (➜ # 32)
- Screw driver for plus-minus-screws (Combiprofile Slotted/Pozidriv) size 2

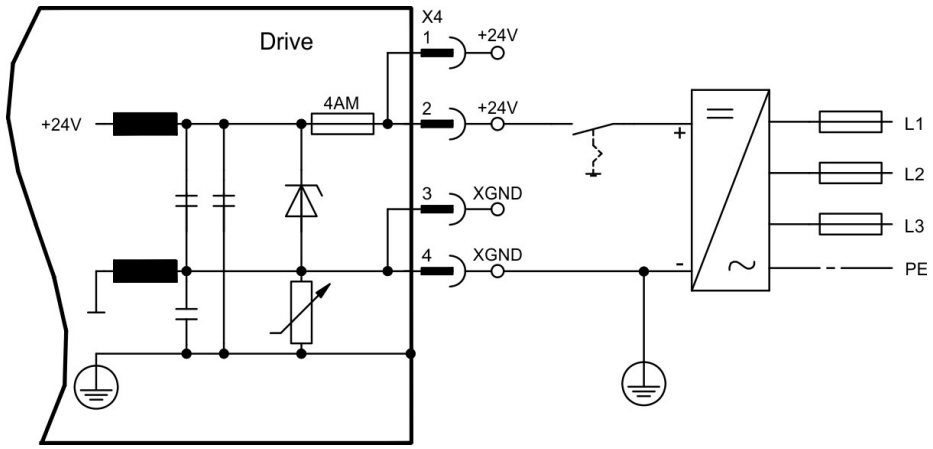


NOTICE If mains voltage is more than 3% asymmetrical, a mains choke 3L with 2% uk must be used. See Accessories Manual. For EMC reasons the choke should be mounted electrically isolated to the cabinet.



9.8.3 24V auxiliary supply (X4)

- External 24V DC power supply, electrically isolated, e.g. via an isolating transformer
- Required current rating (➜ # 31)
- Integrated EMC filter for the 24V auxiliary supply



9.9 DC bus link (X8)

Terminals X8/-DC and X8/+RBe. Can be connected in parallel, whereby the brake power is divided between all the amplifiers that are connected to the same DC bus link circuit.

- Screw driver for plus-minus-screws (Combiprofile Slotted/Pozidriv) size 2

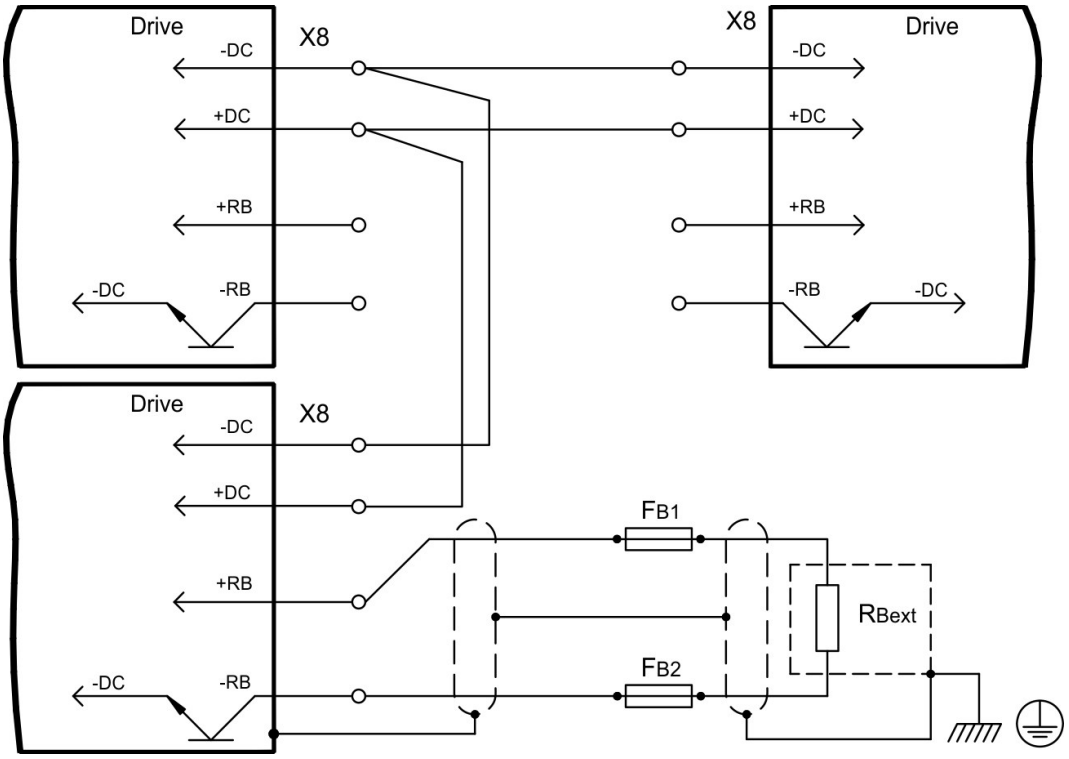
In case of mains supply from the same mains (identical mains supply voltage) three servo amplifiers S748/772 may be connected by the DC bus link.

NOTICE

- The servo amplifiers can be destroyed, if DC bus link voltages are different. Only servo amplifiers with mains supply from the same mains (identical mains supply voltage) may be connected by the DC bus link.
- VBUSBAL must be identical with all devices on the same DC bus.
- The sum of the rated currents for all of the servo amplifiers connected in parallel to an S748/772 must not exceed 96 Arms (140 Apeak).
  Examples: S748-S748-S748 oder S772-S748 oder S772-S772
- Use unshielded single cores with a max. length of 500mm (cross reference see (➜ # 33)); use shielded cables for longer lengths.
- Servo amplifiers working generatively very often, should be placed beside amplifiers, which need energy. That reduces current flow on longer distances.

Fusing information are explained in detail in the KDN on page "DC Bus link in parallel".

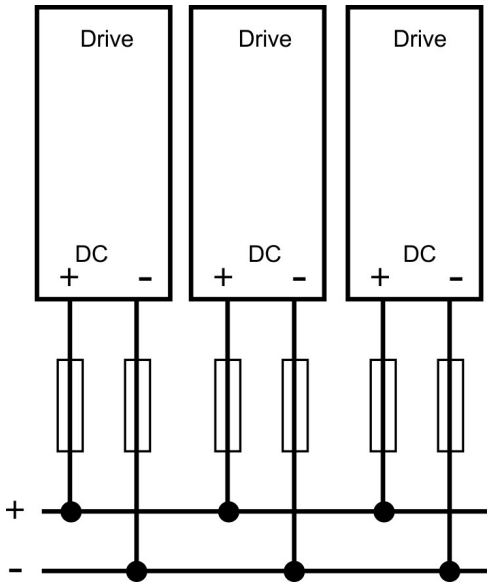
Wiring example with external brake resistor



9.9.1 DC Bus topology

Without intermediate circuit fuses, other devices can become damaged or destroyed if, for example, a device fails due to an internal short circuit. If a device fails due to a short-circuit, only its intermediate fuses are tripped and the rest of the network continues uninterrupted. Fuses cannot avoid damage by current peaks completely. The solid busbars can conduct large currents.

Fuse types see (➜ # 32). More information can be found in the "KDN".



9.9.2 External brake resistor (X8)

An external brake resistor can be connected to X8 (-RB, +RB).

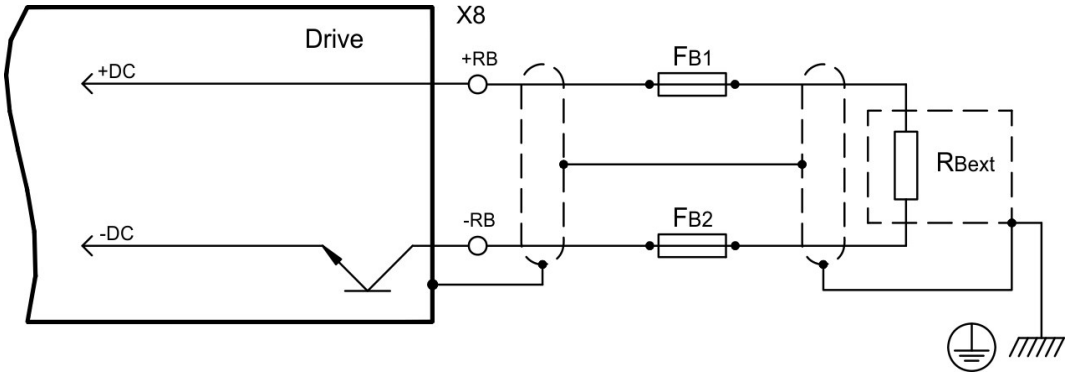


Fuse types (➜ # 32).

Brake circuit and technical data: (➜ # 34).

If you want to link the DC bus with neighbored S748/772 servo amplifiers, see connection example in chapter "DC Bus link".

- Screw driver for plus-minus-screws (Combiprofile Slotted/Pozidriv) size 2



9.9.3 Capacitor Module KCM (X8)



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

Dimensions (HxWxD) : 300x100x201 mm

KCM-S	**S**aves energy: The energy stored in the capacitor module during regenerative 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 can be connected to S7010 ... S7480 devices (mains supply voltage 400/480V). Information for mounting, installation and setup can be found in the KCM Instructions Manual and in KDN.

Technical Data of KCM Modules

Type	Storage capacity [Ws]	Rated supply voltage [V=]	Peak supply voltage [V=]	Mains [kW]	Protection class	Inception voltage [V=]	Weight [kg]
KCM-S200	1600	max. 850 VDC	max. 950VDC (30s in 6min)	18	IP20	ermittelt	6.9
KCM-P200	2000					470 VDC	6.9
KCM-E200	2000					-	4.1
KCM-E400	4000					-	6.2



DANGER **High DC voltage up to 900 V!**

There is a danger of serious personal injury or death by electrical shock or electrical arcing. It can take over an hour for the modules to self-discharge.

- Switch off (disconnect) the line voltage. You must only work on the connections when the system is disconnected.
- 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 50V between the DC+/DC- terminals or to ground, wait some minutes and measure again or discharge the modules as described in the KCM instructions manual.

9.10 Motor connection

9.10.1 Motor power connection (X8)

The S748/772 drive is able to protect the connected motor from overloading, if the parameters are set correctly and the thermal protection sensor is connected and supervised. With Kollmorgen motors the valid data are automatically set by the internal motor database. With motors from other manufacturers the data from the nameplate must be entered to the referring fields in the motor view of the setup software DriveGUI.

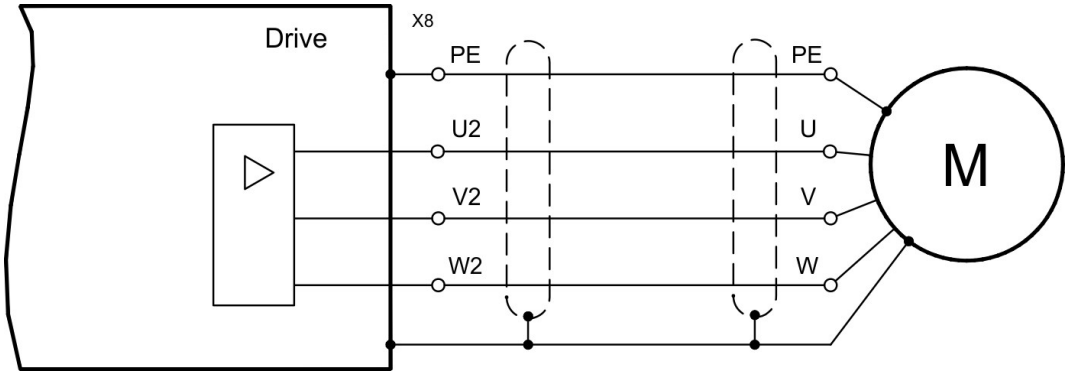
Together with the motor supply cable and motor winding, the power output of the servo amplifier forms an oscillating circuit. Characteristics such as cable capacity, cable length, motor inductance, frequency and voltage rise speed (see Technical Data, (➜ # 30)) determine the maximum voltage in the system.

NOTICE The dynamic voltage rise can lead to a reduction in the motor's operating life and, on unsuitable motors, to flash overs in the motor winding.

- Only install motors with insulation class F (acc. to IEC 60085) or above
- Only install cables that meet the requirements on (➜ # 33) and (➜ # 63).

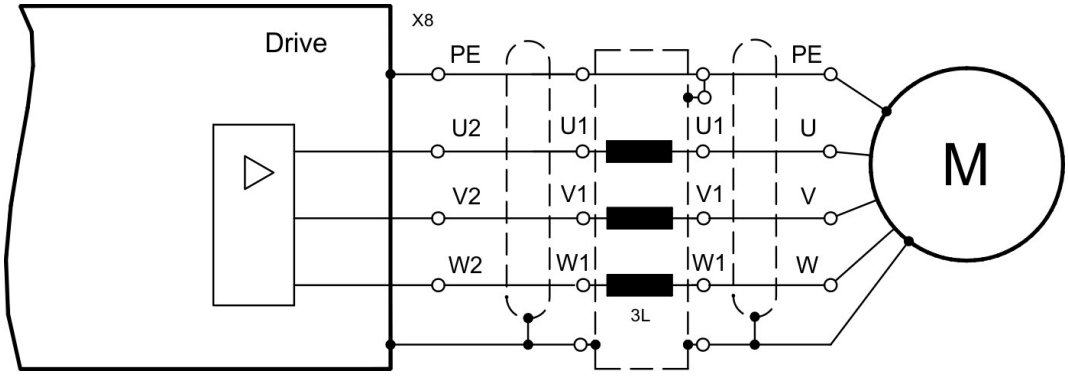
Use screw driver for plus-minus-screws (Combiprofile Slotted/Pozidriv) size 2.

Standard applications up to 25m cable length



Application with cable length >25m and special conditions

NOTICE With long motor cables overvoltage may endanger the motor winding. For cable lengths above 25m a motor choke 3YLN may be wired into the motor cable, close to the amplifier. Contact our customer support.



9.10.2 Motor holding brake connection (X8, X9)

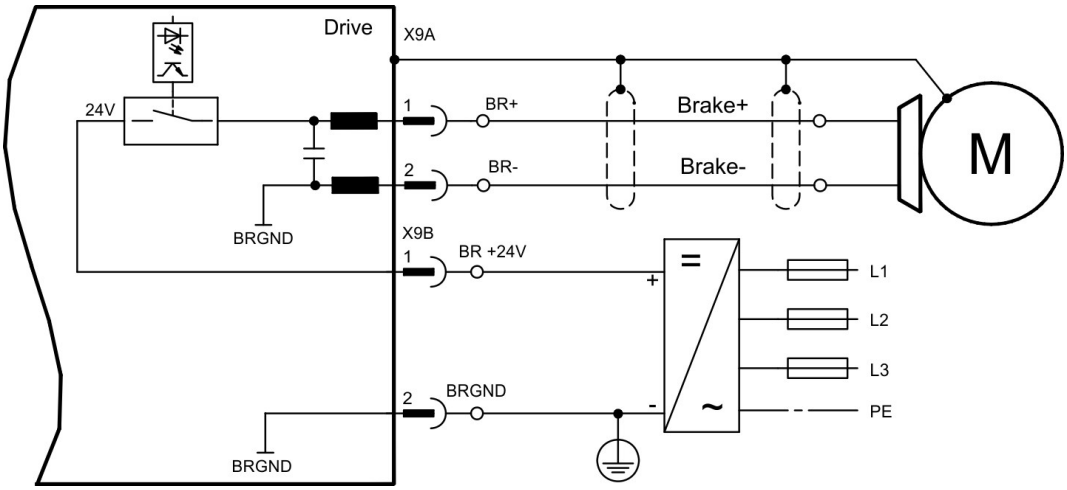
The motor holding brake can be controller by the servo amplifier. An external 24V supply voltage delivers the required electrical power for the connected brake.



⚠CAUTION No functional safety!

Serious injury could result when a suspended load is not properly blocked.

- An additional mechanical brake is required for functional safety, which must be safely operated, e.g. via the Safety Card S1-2 (➜ # 155).



Observe the requirements to auxiliary voltage supply (➜ # 31).

9.11 Feedback systems

Every closed servo system will normally require at least one feedback device for sending actual values from the motor to the servo drive. Depending on the type of feedback device used, information will be fed back to the servo amplifier using digital or analog means. Up to three feedback devices can be used at the same time. S700 supports the most common types of feedbacks whose functions must be assigned with the parameters

FBTYPE	DRIVEGUI.EXE screen page FEEDBACK, primary Feedback (➜ # 75)
EXTPOS	Screen page POSITION CONTROLLER, secondary position (➜ # 75)
GEARMODE	Screen page ELECTRONIC GEARING, encoder control (➜ # 94)

in the setup software. Scaling and other settings must always be made here.

For a detailed description of the ASCII parameters, please refer to the DRIVEGUI.EXE Online-Help.

9.12 Primary and secondary feedback types

This chapter provides an overview of the supported feedback types, their corresponding parameters and a reference to the relevant connection diagram in each case.

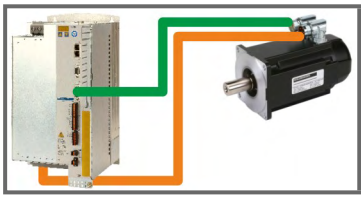
Single Cable connection (Power and Feedback in one cable)



Hybrid cables on request.

Feedback type	Connector	Wiring	primary FBTYPE	secondary EXTPOS
SFD3	X1	(➜ # 76)	36	-
HIPERFACE DSL	X1	(➜ # 77)	35	-

Dual cable connection (Power and Feedback separated)



Motor cables and Feedback cables see Accessories Manual

Feedback type	Connector	Wiring	primary FBTYPE	secondary EXTPOS
Resolver	X2	(➜ # 78)	0	-
SinCos Encoder BiSS (B) analog	X1	(➜ # 79)	23, 24	-
Encoder BiSS (B, C[2])) digital	X1	(➜ # 80)	20, 22,33	11, 12
SinCos Encoder ENDAT 2.1	X1	(➜ # 81)	4, 21	8
Encoder ENDAT 2.2	X1	(➜ # 82)	32, 34	13
SinCos Encoder HIPERFACE	X1	(➜ # 83)	2	9
SinCos Encoder SSI (linear)	X1	(➜ # 84)	26[1)]	-
SinCos Encoder without data channel	X1	(➜ # 85)	1, 3, 7, 8	6, 7
SinCos Encoder + Hall	X1	(➜ # 86)	5, 6	-
ROD* 5V without zero, 1.5MHz	X1	(➜ # 87)	30, 31	30
ROD* 5V with zero, 350kHz	X1	(➜ # 88)	17, 27	10
ROD* 5V with zero + Hallgeber	X1	(➜ # 89)	15	-
ROD* 24V without zero	X3	(➜ # 90)	12, 16	2
ROD* 24V without zero + Hallgeber	X3/X1	(➜ # 91)	14	-
SSI	X1	(➜ # 92)	25[1)]	25[1)]
Hall	X1	(➜ # 93)	11	-
Step/Direction 24V	X3	(➜ # 95)	-	1
Sensorless (without Feedback)	-	-	10	-
with expansion card "PosI/O" or "PosI/O-Monitor"				
ROD* 5V with zero	X5	(➜ # 144)	13[1)], 19[1)]	3
ROD* 5V with zero + Hall	X5/X1	(➜ # 145)	18	-
SSI	X5	(➜ # 146)	9[1)]	5[1)]
SinCos Encoder SSI (linear)	X5/X1	(➜ # 147)	28	-
Step/Direction 5V	X5	(➜ # 148)	-	4

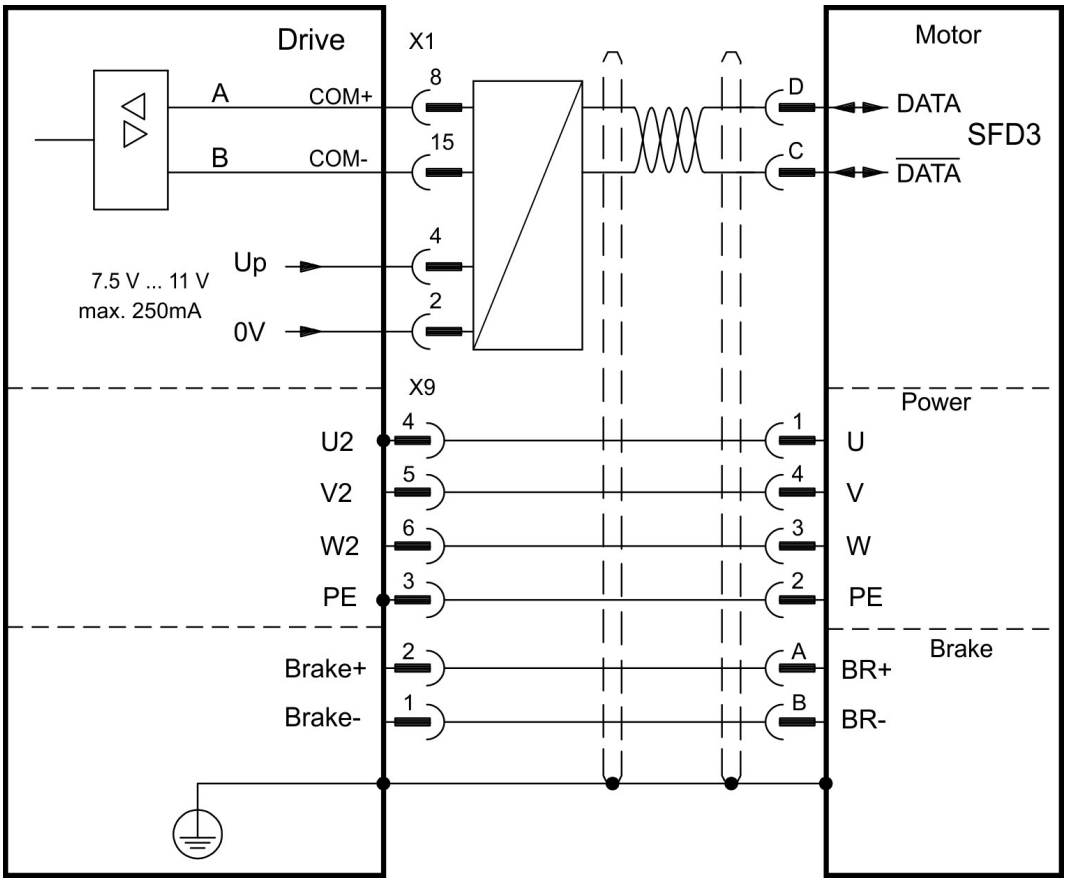
* * ROD is an abbreviation for “incremental encoder”.
1) Switch on the encoder supply voltage on X1: set ENCVON to 1
2) BiSS C support for Renishaw encoders, Hengstler encoders are not supported.

NOTE The expansion card FB2to1 (➜ # 138) enables simultaneous connection of a digital primary feedback and of an analog secondary feedback to the connector X1.

9.12.1 SFD3 (X1), single cable connection

Connection of the Kollmorgen feedback system SFD3 (primary, (➜ # 74)). SFD3 can be used only with the special Kollmorgen hybrid cable) (on request).

Maximum cable length 25 m.
FBTYPE: 36

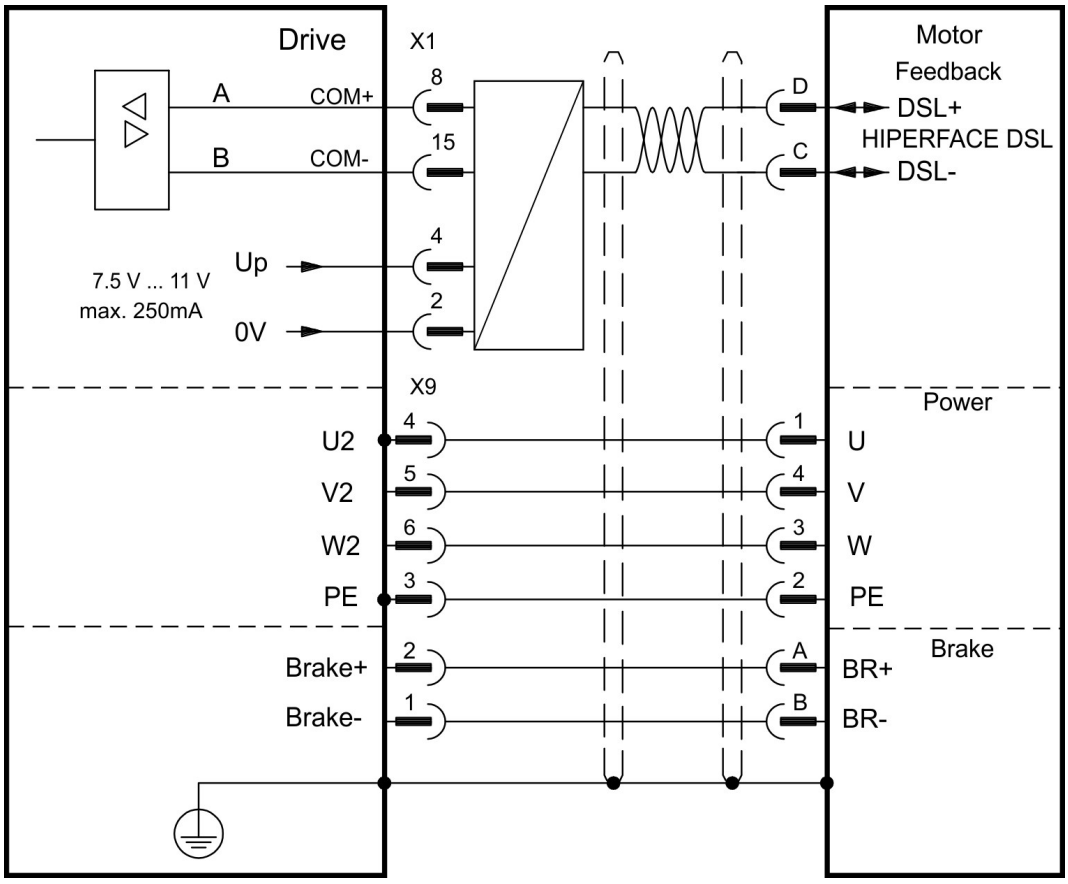


The pin assignment shown on the motor side relates to the AKM motors (connector code D).

9.12.2 HIPERFACE DSL (X1), single cable connection

Connection of HIPERFACE DSL feedback (primary, (➜ # 74)). HIPERFACE DSL can be used only with the special Kollmorgen hybrid cable) (on request).

Maximum cable length 25 m.
FBTYPE: 35



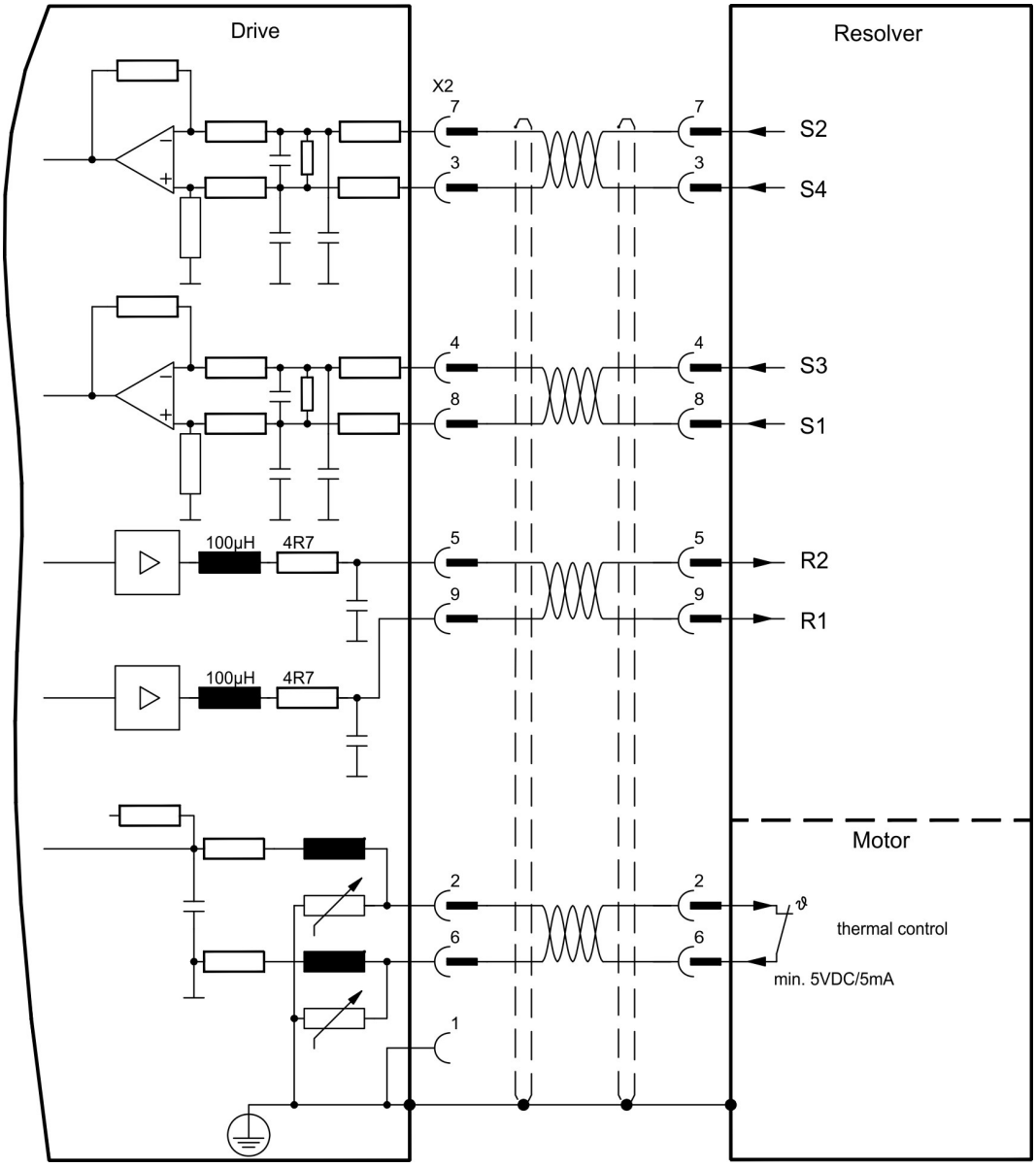
The pin assignment shown on the motor side relates to the AKM motors (connector code D).

9.12.3 Resolver (X2)

Connection of a Resolver (2 to 36-poles) as a feedback system (primary, (➜ # 74)). The thermal control in the motor is connected via the resolver cable to X2 and evaluated there.

If cable lengths of more than 100 m are planned, please consult our customer service.

FBTYPE: 0



The pin assignment shown on the motor side relates to the AKM motors (connector code D).

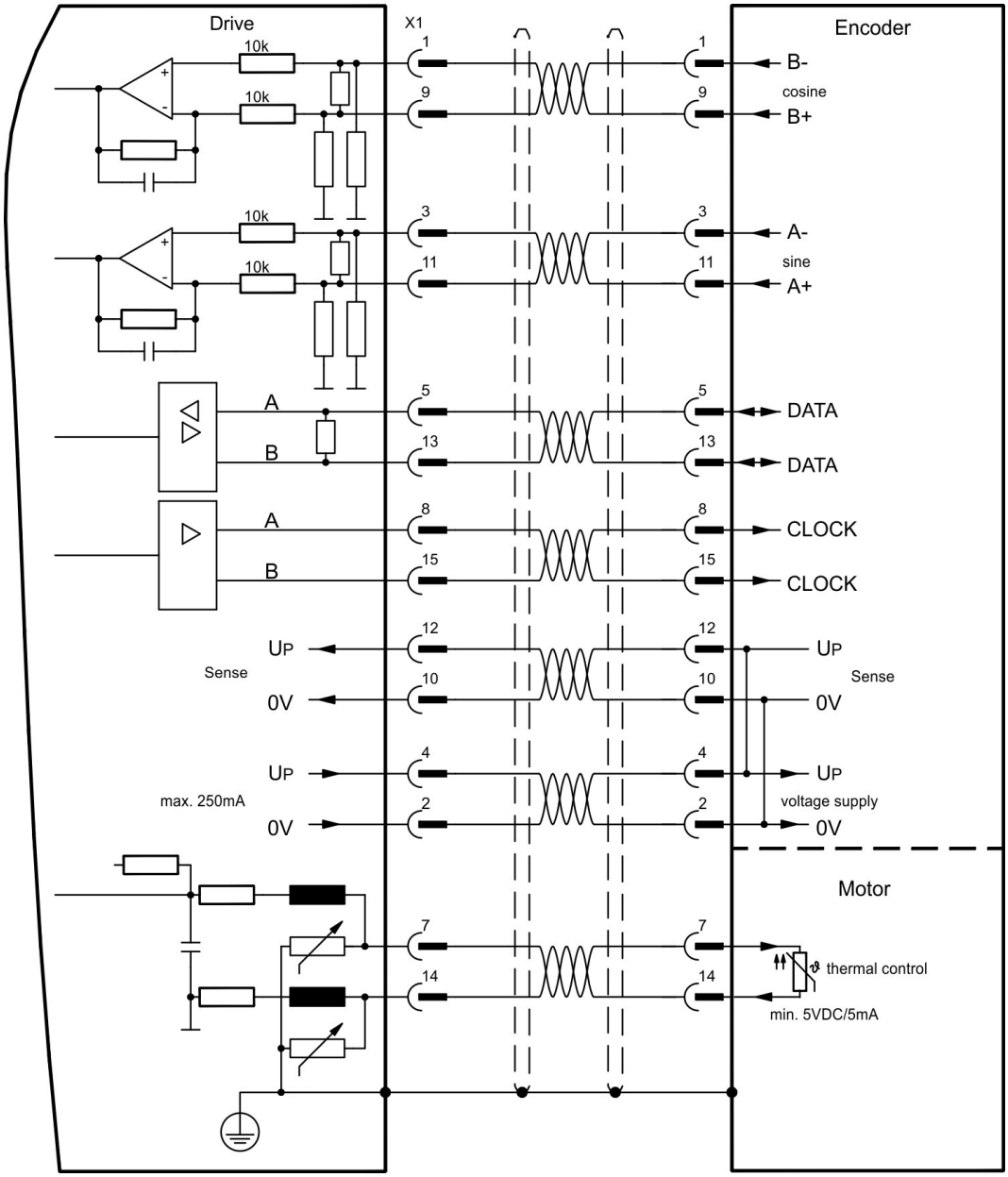
9.12.4 Sine Encoder with BiSS analog (X1)

Wiring of a single-turn or multi-turn sine-cosine encoder with BiSS interface as a feedback system (primary and secondary, (➜ # 74)).

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	Up
5V analog (BiSS B)	23	-	-	5V +/-5%
12V analog (BiSS B)	24	-	-	7.5...11V



The pin assignment shown on the motor side relates to the AKM motors.

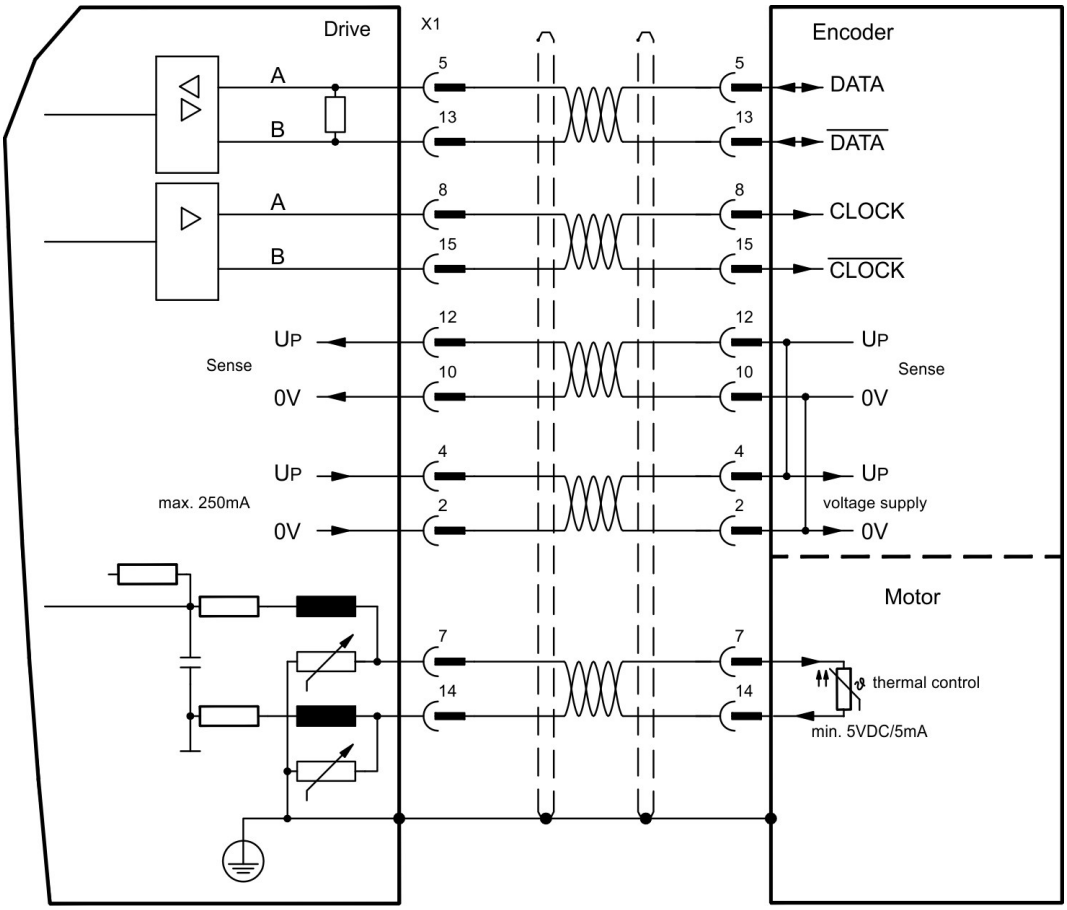
9.12.5 Encoder with BiSS digital (X1)

Wiring of a single-turn or multi-turn digital encoder with BiSS interface as a feedback system (primary and secondary, (➜ # 74)).

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit: 1,5MHz

Type	FBTYPE	EXTPOS	GEARMODE	Up
5V digital (BiSS B)	20	11	11	5V +/-5%
12V digital (BiSS B)	22	11	11	7,5...11V
5V digital (BiSS C, Renishaw)	33	12	12	5V +/-5%



The pin assignment shown on the motor side relates to the AKM motors.

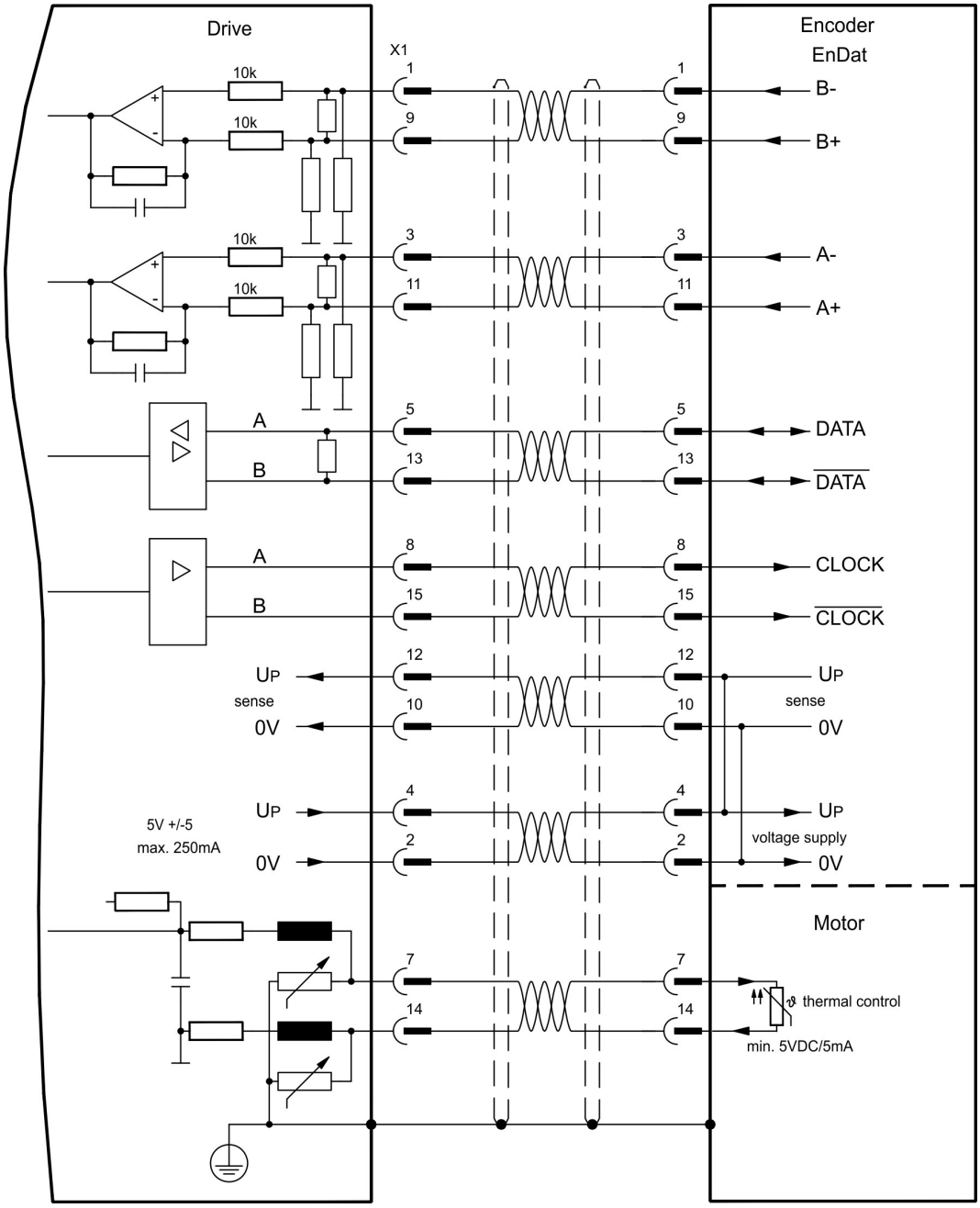
9.12.6 Sine Encoder with EnDat 2.1 (X1)

Wiring of a single-turn or multi-turn sine-cosine encoder with EnDat 2.1 interface as a feedback system (primary and secondary, (➜ # 74)). Preferred types are the optical encoder ECN1313 / EQN1325 and the inductive encoder ECI 1118/1319 or EQI 1130/1331.

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
ENDAT 2.1	4	8	8
ENDAT 2.1 + Wake&Shake	21	8	8



The pin assignment shown on the motor side relates to the AKM motors.

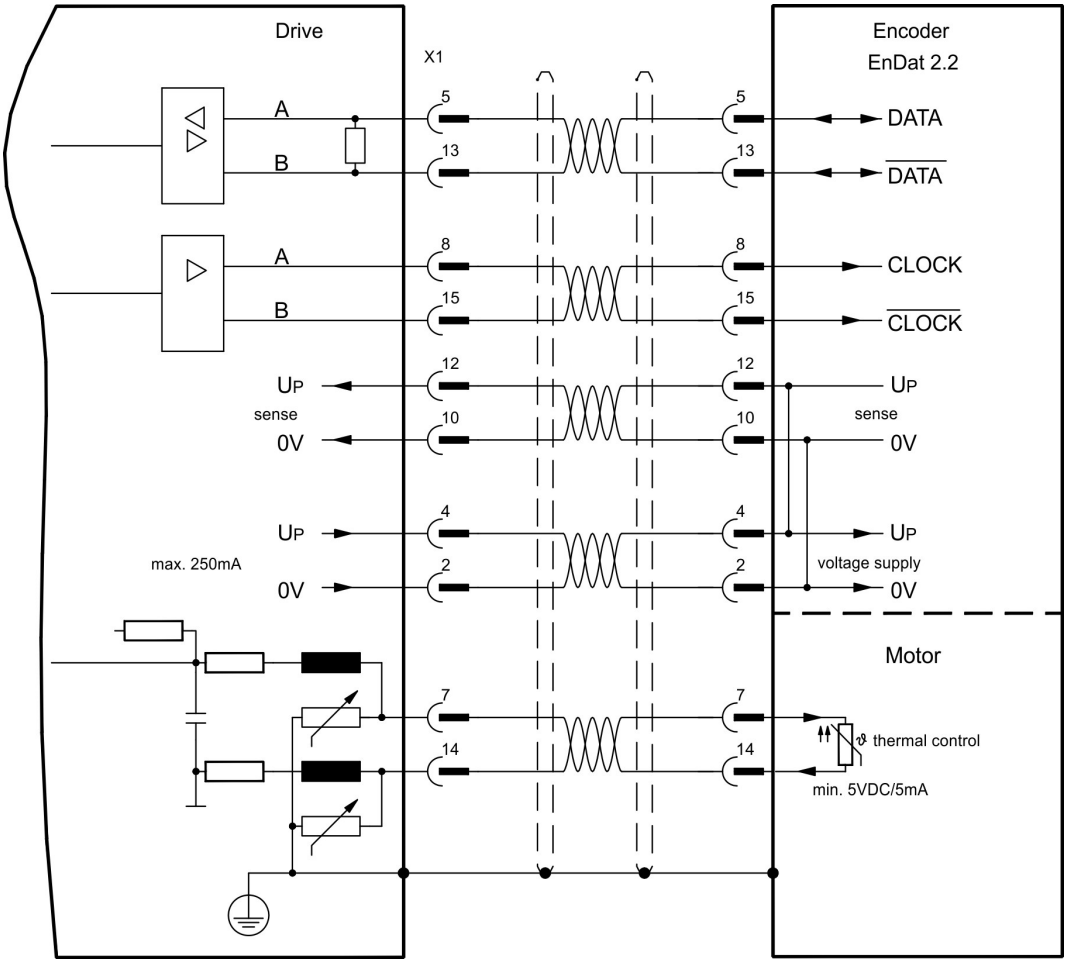
9.12.7 Encoder with EnDat 2.2 (X1)

Wiring of a single-turn or multi-turn encoder with EnDat 2.2 interface as a feedback system (primary, (➜ # 74)). The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable.

If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit: 1,5MHz

Type	FBTYPE	EXTPOS	GEARMODE	Up
5V ENDAT 2.2	32	13	13	5V +/-5%
12V ENDAT 2.2	34	13	13	7,5...11V



The pin assignment shown on the motor side relates to the AKM motors.

9.12.8 Sine Encoder with HIPERFACE (X1)

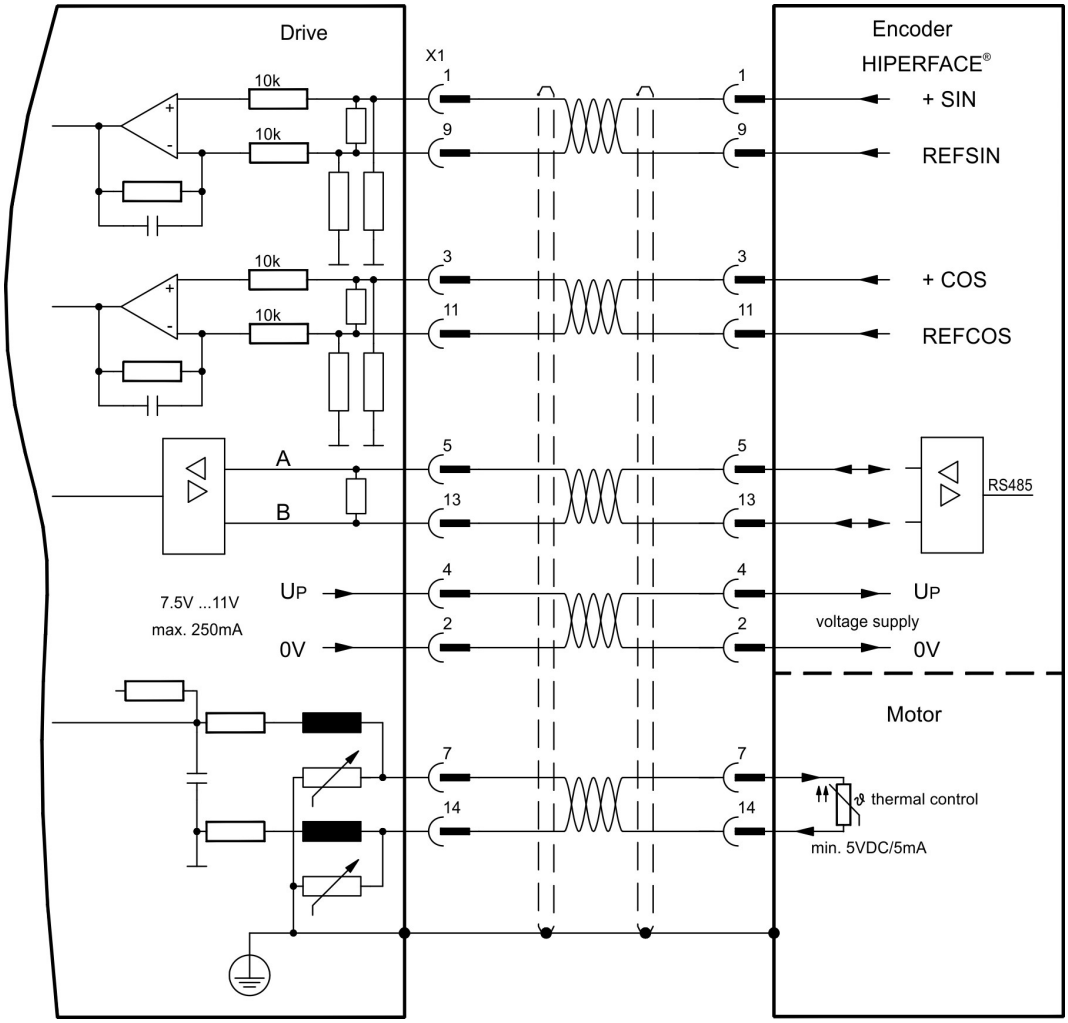
Wiring of a single-turn or multi-turn sine-cosine encoder with HIPERFACE interface as a feedback system (primary and secondary, (➜ # 74)).

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable.

If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
HIPERFACE	2	9	9



The pin assignment shown on the motor side relates to the AKM motors.

9.12.9 Sine Encoder with SSI (X1)

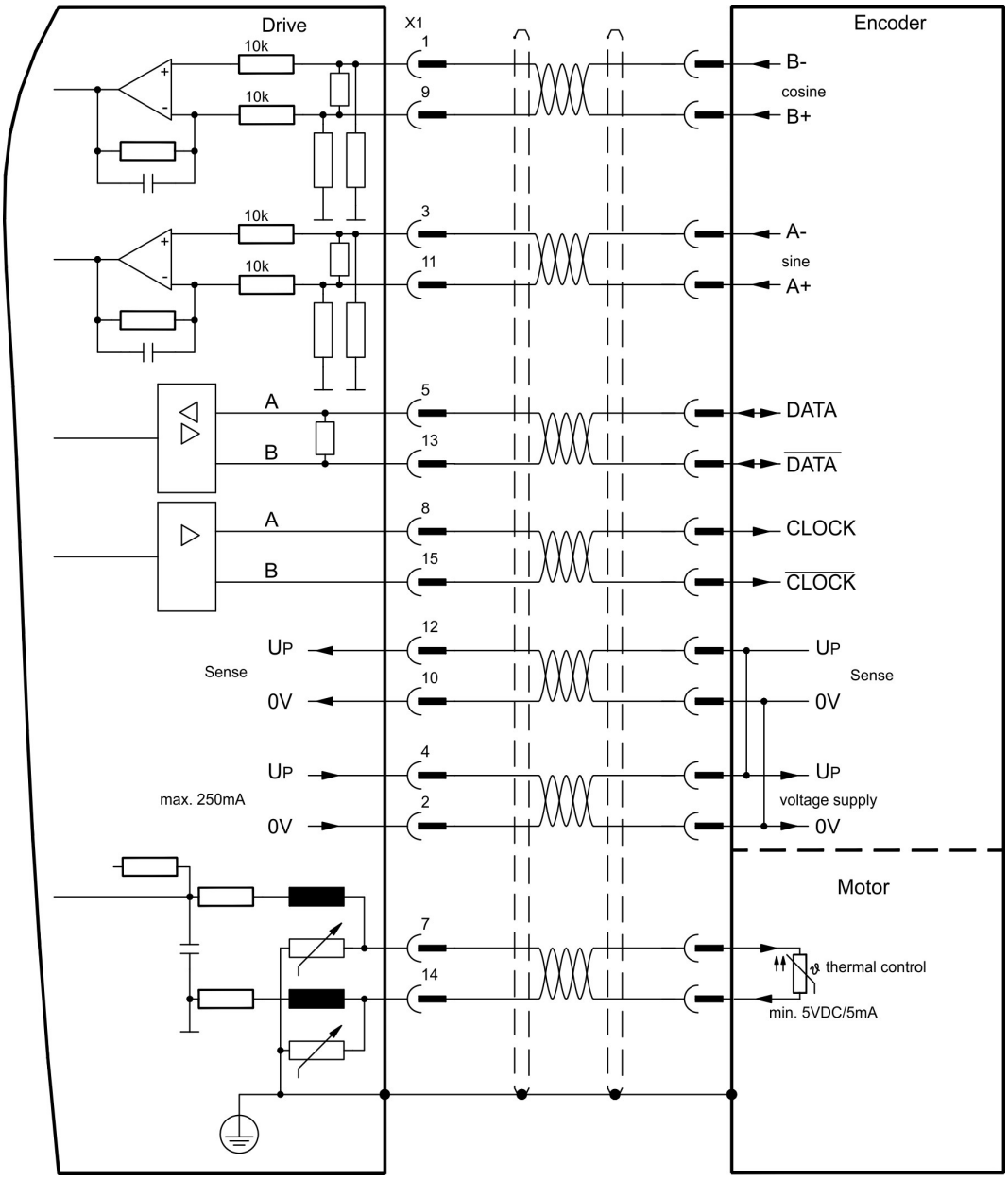
Wiring of sine-cosine encoder with SSI interface as a linear feedback system (primary, (➜ # 74)).

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
SinCos SSI 5V linear	26	-	-

Switch on supply voltage for the encoder at X1: set ENCVON to 1.



9.12.10 Sine Encoder without data channel (X1)

Wiring of a sine-cosine encoder without data channel as a feedback (primary and secondary, (➜ # 74)). Every time the 24V auxiliary voltage is switched on, the amplifier needs start-up information for the position controller (parameter value MPHASE). Depending on the feedback type either wake&shake is executed or the value for MPHASE is read out of the amplifier's EEPROM.



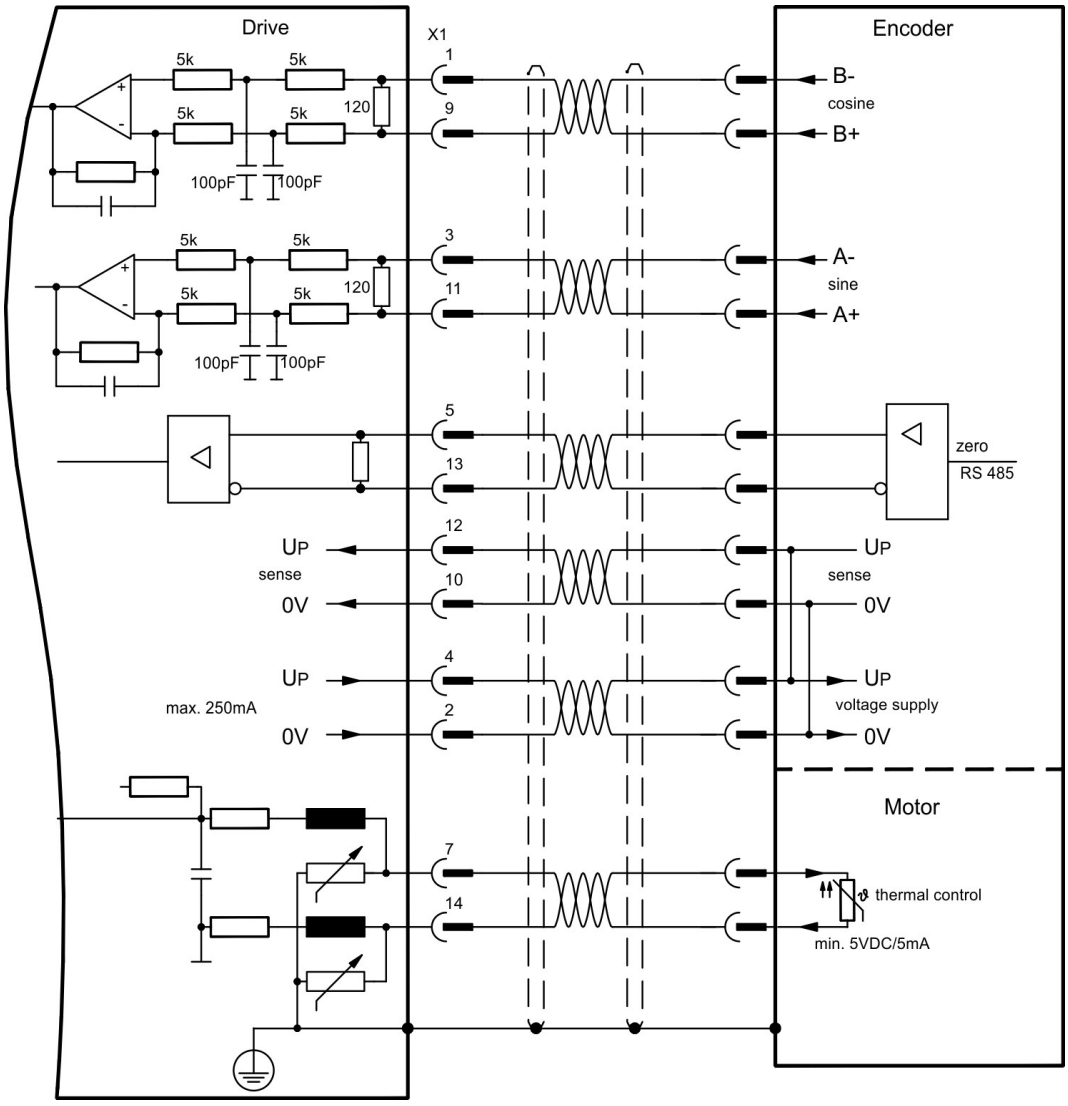
⚠WARNING Vertical load can fall!

With vertical load the load could fall during wake&shake, because the brake is not active and torque is not sufficient to hold the load.

- Don't use wake&shake with vertical load (hanging load).

The thermal control in the motor is connected via the encoder cable to X1. If lead lengths of more than 50 m are planned, please consult our customer service. Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	Up	Remarks
SinCos 5V	1	6	6	5V +/-5%	MPHASE from EEPROM
SinCos 12V	3	7	7	7.5...11V	MPHASE from EEPROM
SinCos 5V	7	6	6	5V +/-5%	MPHASE wake & shake
SinCos 12V	8	7	7	7.5...11V	MPHASE wake & shake



9.12.11 Sine Encoder with Hall (X1)

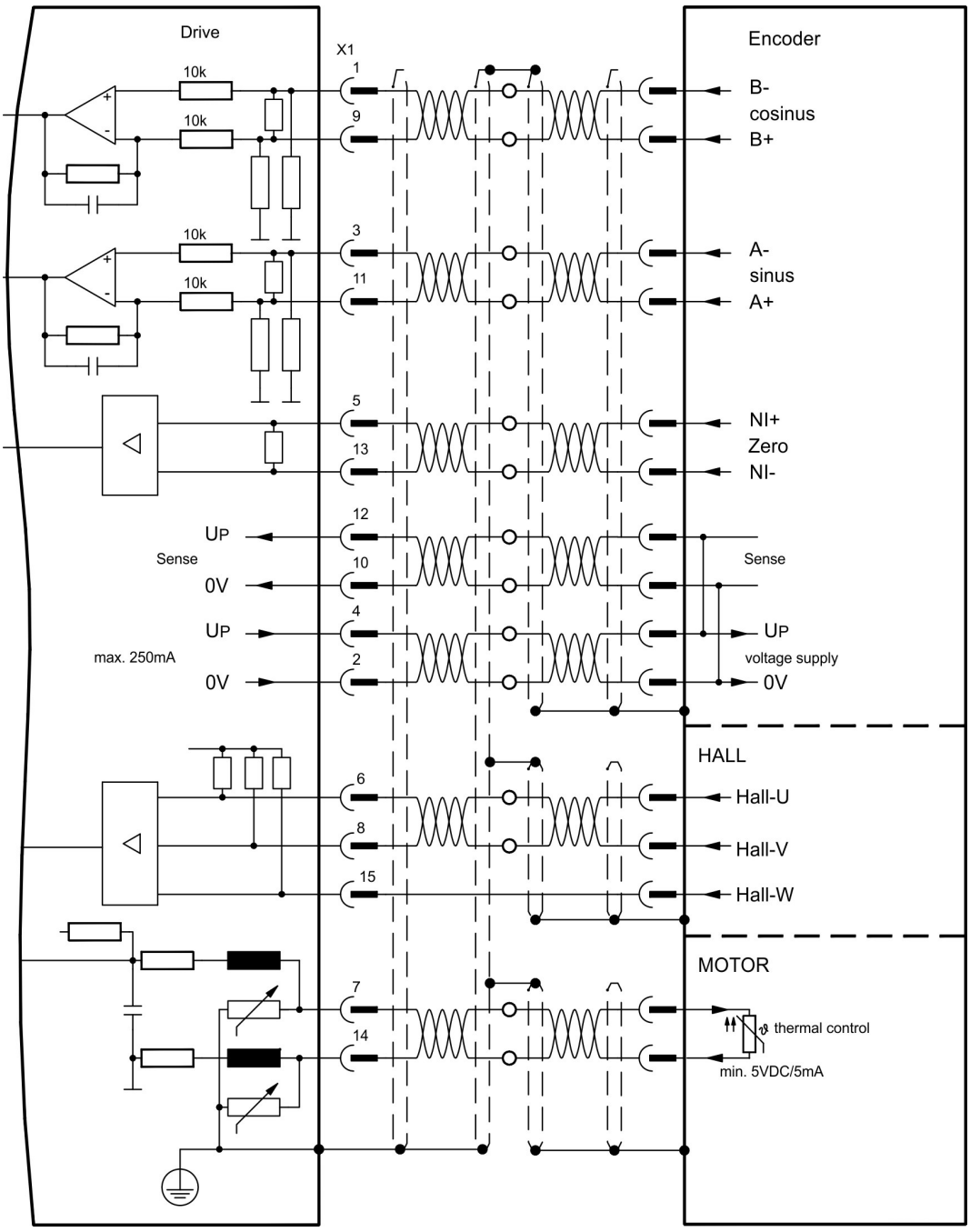
Feedback devices (incremental or sine-cosine), which don't deliver an absolute information for commutation, can be used as complete feedback system combined with an additional Hall encoder (primary, (➜ # 74)) .

The thermal control in the motor is connected to X1 and evaluated there.

All signals are connected to X1 and evaluated there. If cable lengths of more than 25 m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	Up
SinCos 5V mit Hall	5	-	-	5V +/-5%
SinCos 12V mit Hall	6	-	-	7.5...11V



9.12.12 ROD (AquadB) 5V, 1.5MHz (X1)

Wiring of a 5V incremental encoder (ROD, AquadB) as a feedback (primary or secondary, (➜ # 74)). Every time the 24V auxiliary voltage is switched on, the amplifier need start-up information for the position controller (parameter value MPHASE). Depending on the setting of FBTYPE a wake&shake is executed or the value for MPHASE is taken out of the servo amplifier's EEPROM.



⚠WARNING Vertical load can fall!

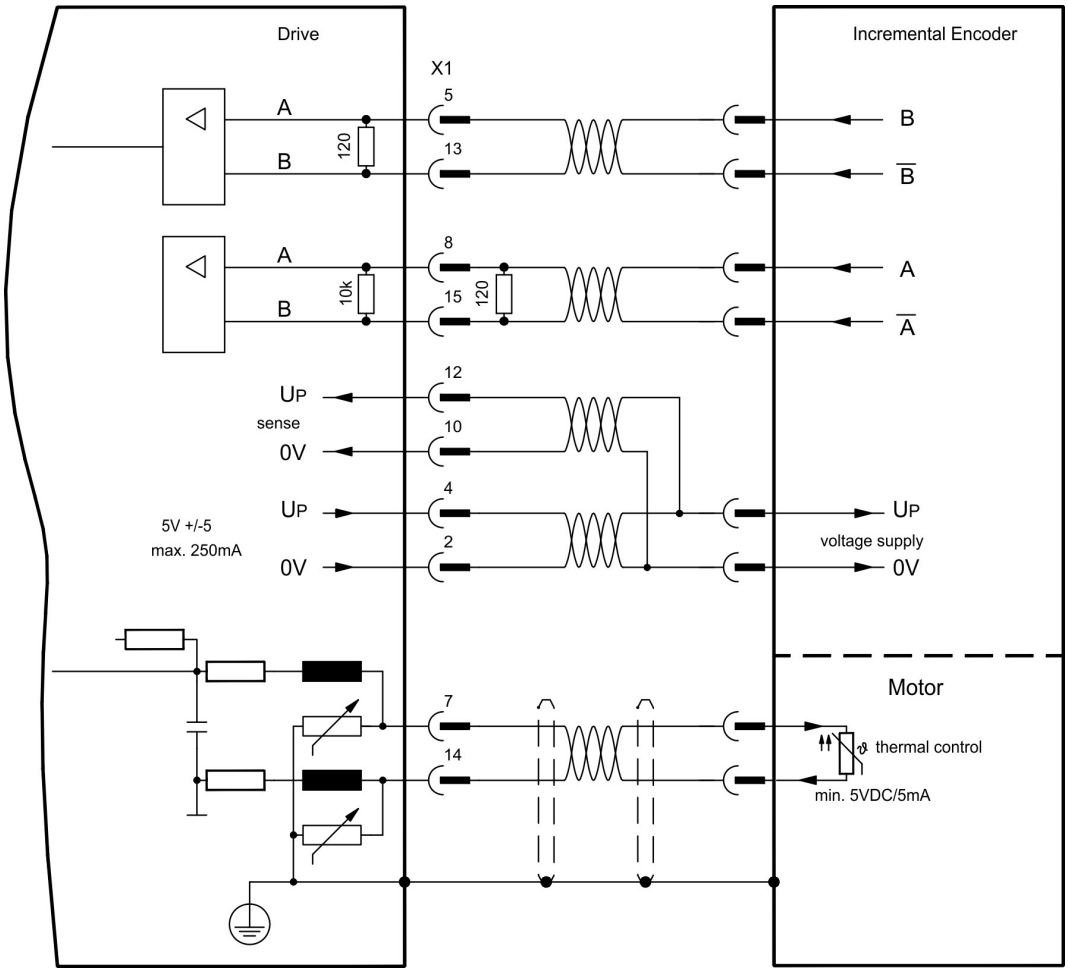
With vertical load the load could fall during wake&shake, because the brake is not active and torque is not sufficient to hold the load.

- Don't use wake&shake with vertical load (hanging load).

The thermal control in the motor is connected via the encoder cable to X1. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit (A, B): 1,5MHz

Type	FBTYPE	EXTPOS	GEARMODE	Remarks
AquadB 5V	31	30	30	MPHASE from EEPROM
AquadB 5V	30	30	30	MPHASE with wake & shake



9.12.13 ROD (AquadB) 5V, 350kHz (X1)

Wiring of a 5V incremental encoder (ROD, AquadB) as a feedback (primary or secondary, (➜ # 74)). Every time the 24V auxiliary voltage is switched on, the amplifier need start-up information for the position controller (parameter value MPHASE). Depending on the setting of FBTYPE a wake&shake is executed or the value for MPHASE is taken out of the servo amplifier's EEPROM.



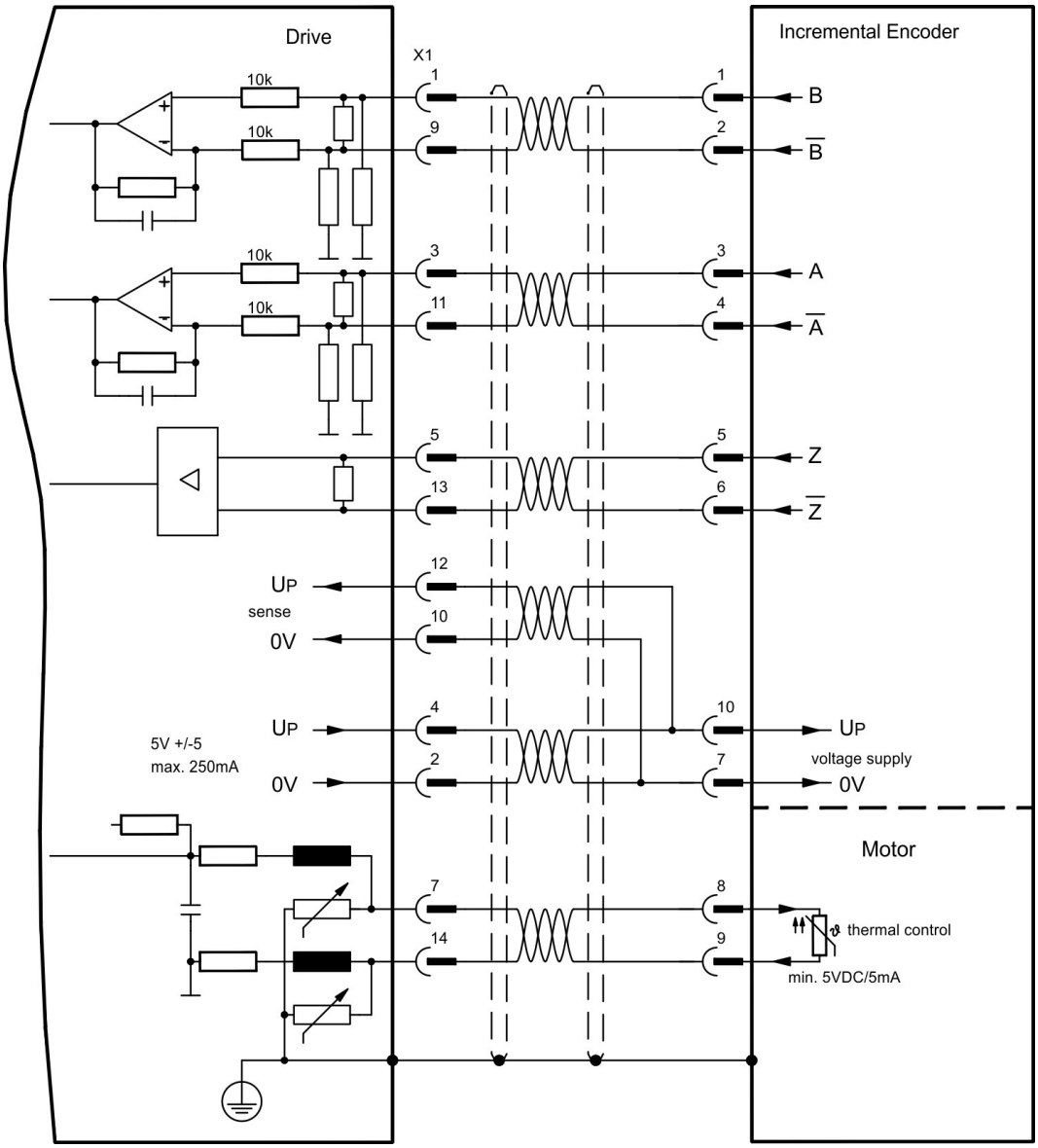
⚠WARNING Vertical load can fall!

With vertical load the load could fall during wake&shake, because the brake is not active and torque is not sufficient to hold the load.

- Don't use wake&shake with vertical load (hanging load).

The thermal control in the motor is connected to X1. If lead lengths of more than 50 m are planned, please consult our customer service. Frequency limit (A, B): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	Remarks
AquadB 5V	27	10	10	MPHASE from EEPROM
AquadB 5V	17	10	10	MPHASE with wake & shake



The pin assignment shown on the motor side relates to the AKM motors.

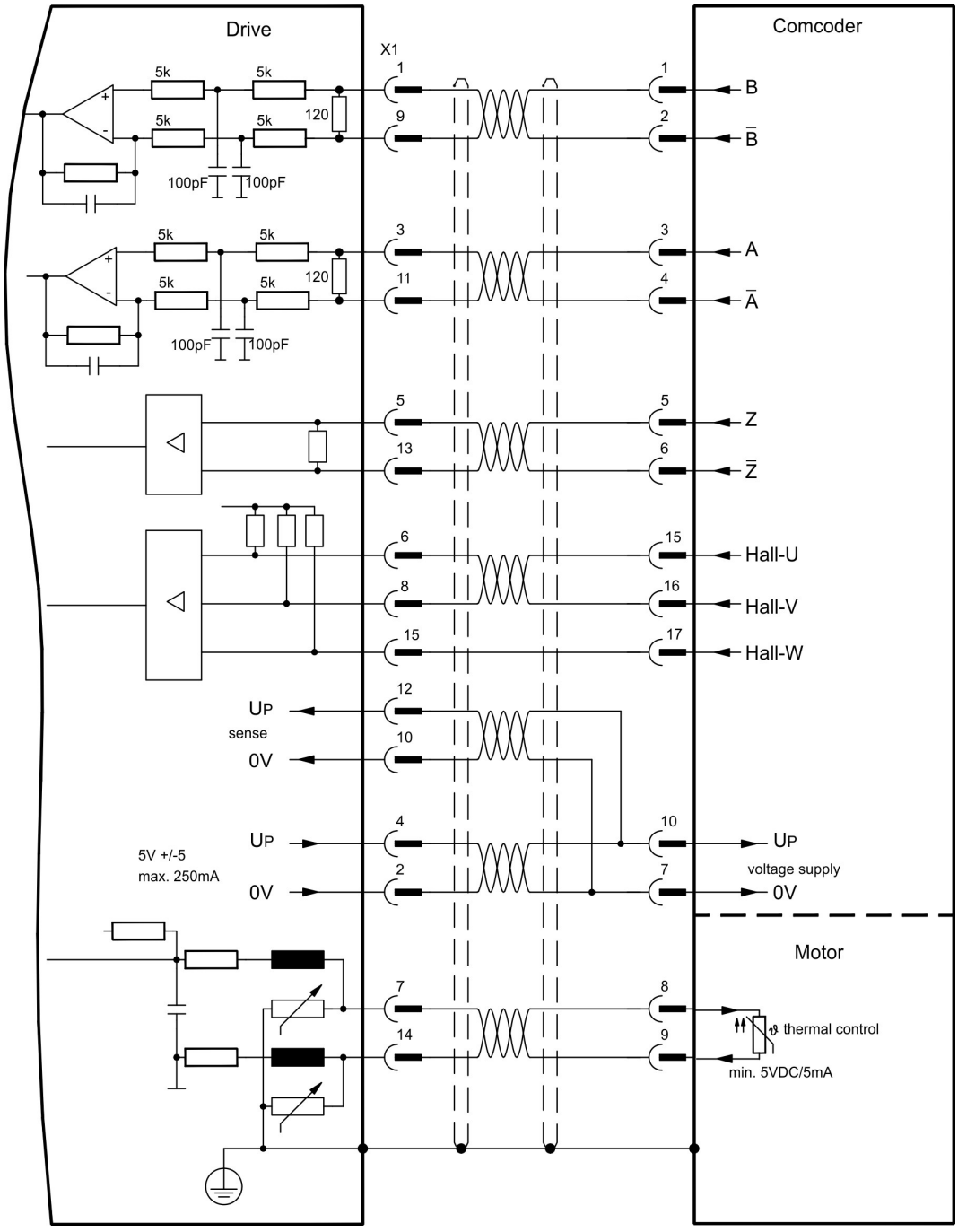
9.12.14 ROD (AquadB) 5V, 350kHz with Hall (X1)

Wiring of a ComCoder as a feedback unit (primary, (➜ # 74)). For the commutation hall sensors are used and for the resolution an incremental encoder.

The thermal control in the motor is connected to X1 and evaluated there. With our ComCoder cable all signals are connected correctly. If cable lengths of more than 25 m are planned, please consult our customer service. With separate feedback devices (Encoder and Hall are two devices) the wiring must be done similar to (➜ # 86), but the amplifier's pinout is identical to the wiring diagram shown below.

Frequency limit (A,B): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
AquadB 5V + Hall	15	-	-



The pin assignment shown on the motor side relates to the AKM motors.

9.12.15 ROD (AquadB) 24V (X3)

Wiring of a 24V incremental encoder (ROD AquadB) as a feedback system (primary or secondary, (➜ #74)). This uses the digital inputs DIGITAL-IN 1 and 2 on connector X3.

Every time the 24V auxiliary voltage is switched on, the amplifier need start-up information for the position controller (parameter value MPHASE). Depending on the setting of FBTYPE a wake&shake is executed or the value for MPHASE is taken out of the servo amplifier's EEPROM.



⚠WARNING Vertical load can fall!

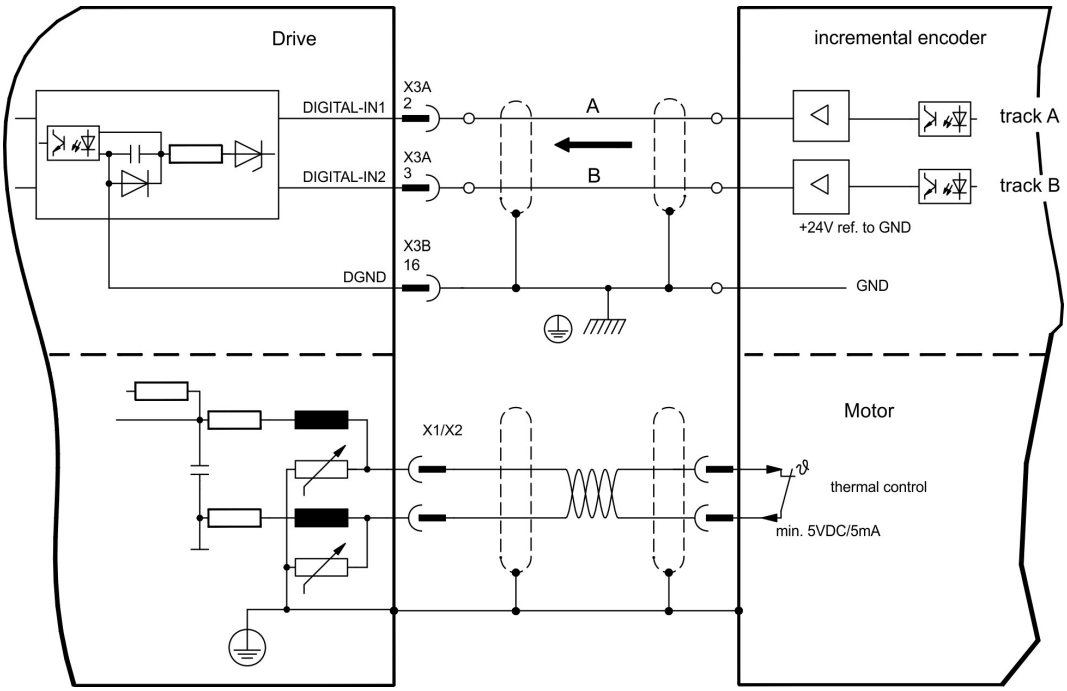
With vertical load the load could fall during wake&shake, because the brake is not active and torque is not sufficient to hold the load.

- Don't use wake&shake with vertical load (hanging load).

The thermal control in the motor is connected to X1 or X2. If cable lengths of more than 25 m are planned, please consult our customer service.

Frequency limit: 100 kHz, transition time tv ≤ 0.1µs

Type	FBTYPE	EXTPOS	GEARMODE	Remarks
AquadB 24V	12	2	2	MPHASE from EEPROM
AquadB 24V	16	2	2	MPHASE with wake & shake



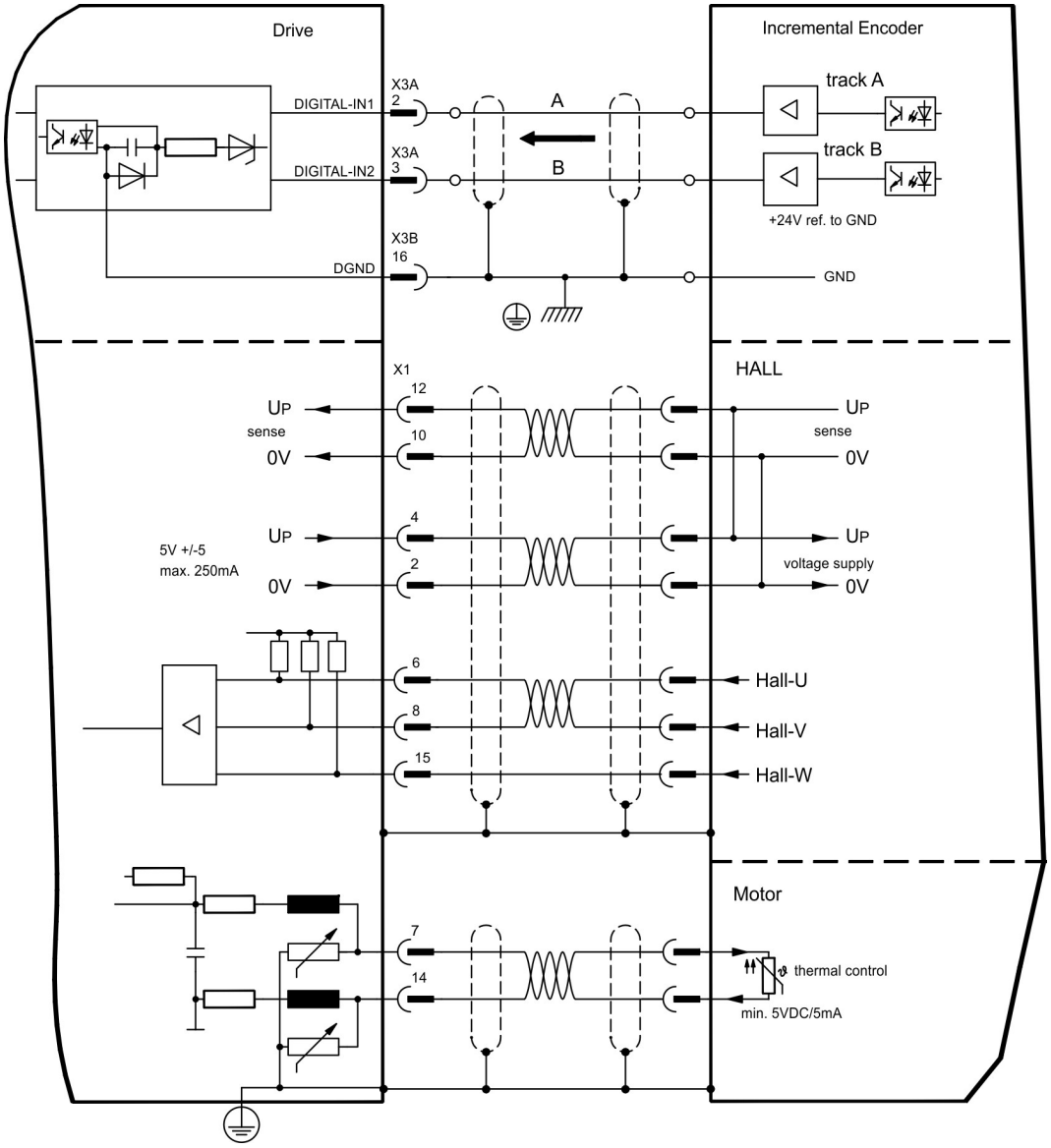
9.12.16 ROD (AquadB) 24V with Hall (X3, X1)

Wiring of a 24V incremental encoder (ROD, AquadB) and Hall sensors as a feedback unit (primary, (➜ # 74)). For the commutation hall sensors are used and for the resolution an incremental encoder.

The thermal control in the motor is connected to X1 and evaluated there. If cable lengths of more than 25 m are planned, please consult our customer service.

Frequency limit X3: 100 kHz, X1: 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
AquadB 24V + Hall	14	-	-



9.12.17 SSI absolute Encoder (X1)

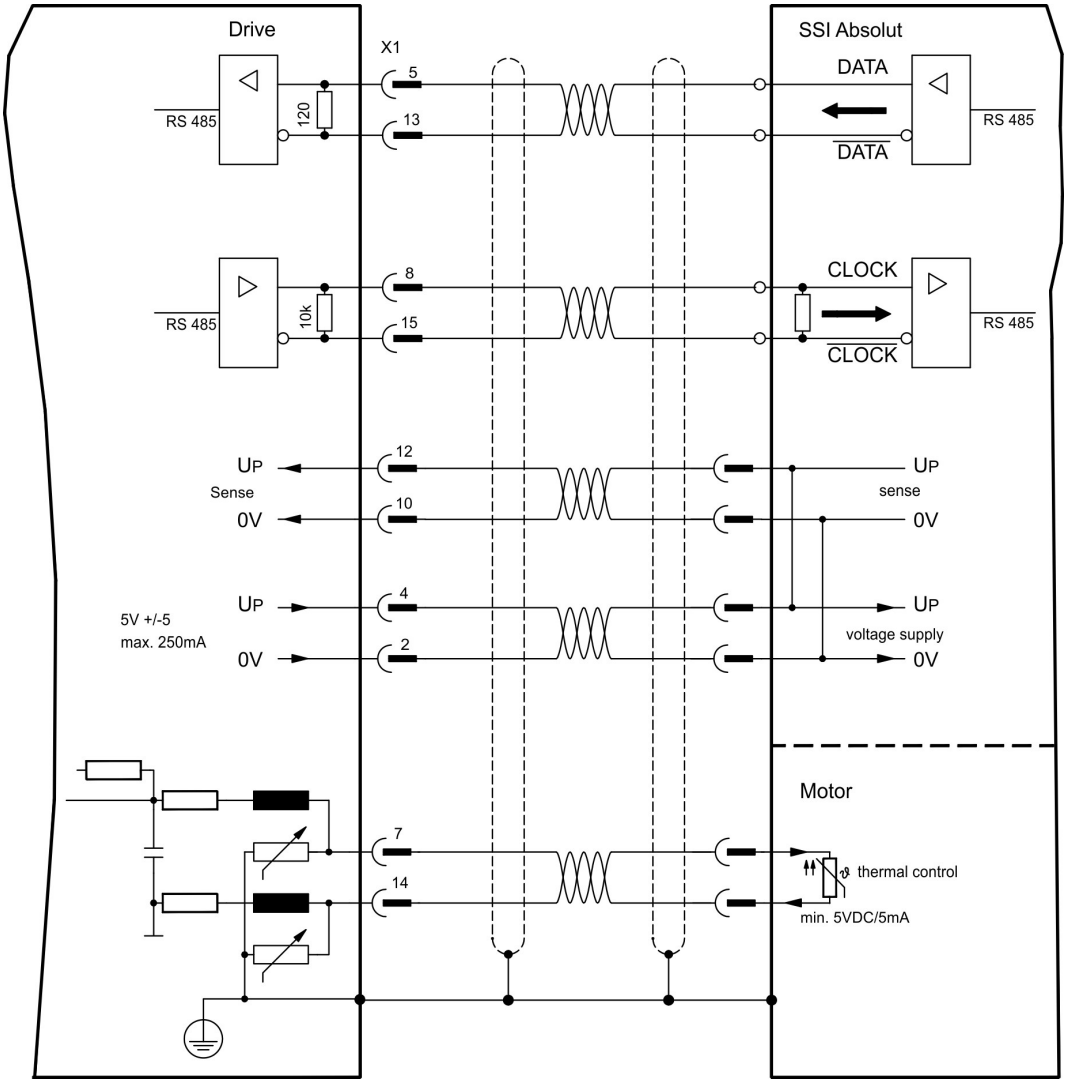
Wiring of a synchronous serial absolute-encoder as a feedback system (primary or secondary, (➜ # 74)). The signal sequence can be read in Gray code or in Binary (standard) code. The thermal control in the motor is connected to X1 and evaluated there. If cable lengths of more than 50 m are planned, please consult our customer service.

Frequency limit: 1.5MHz
Resolution/turn: max. 16 Bit
Turns: max. 16 Bit

Anschluss eines synchron seriellen Multiturn-Absolutgebers als Rückführeinheit (primär oder

Gebertyp	FBTYPE	EXTPOS	GEARMODE
SSI	25	25	25

Versorgungsspannung des Gebers auf X1 einschalten: ENCVON auf 1 setzen.



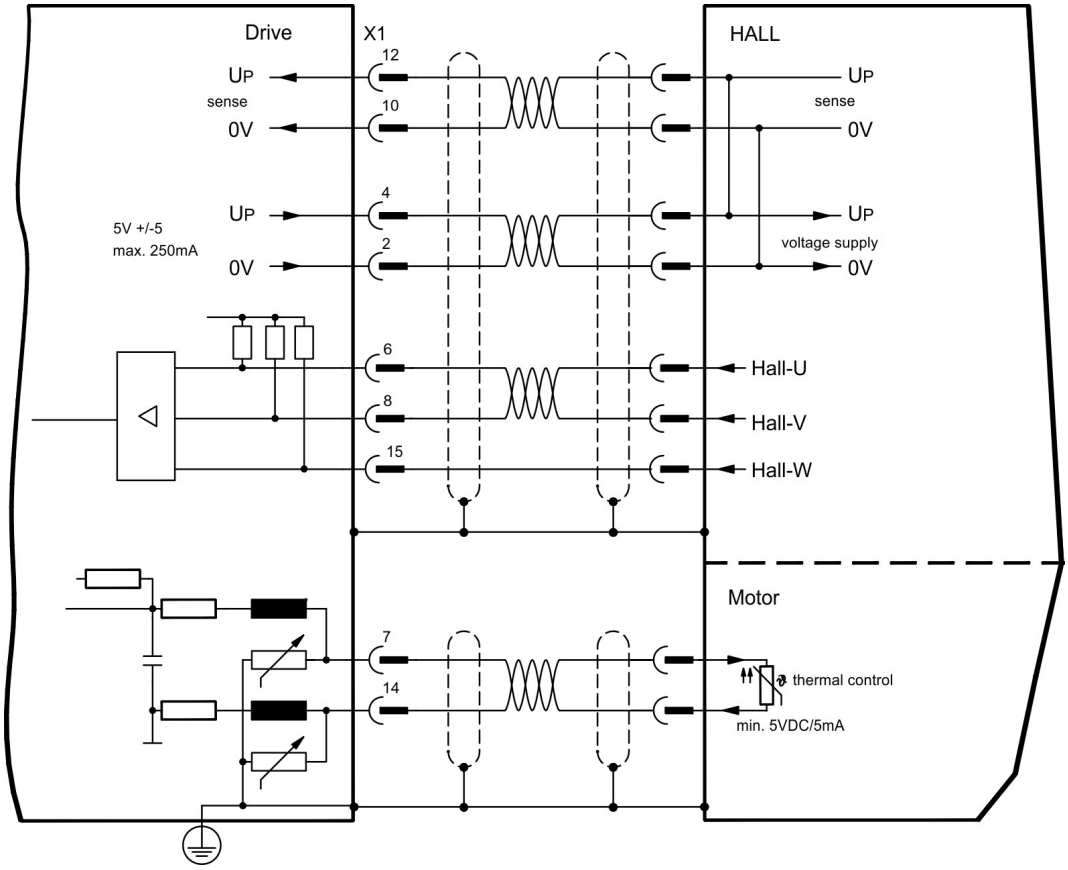
9.12.18 Hall sensors (X1)

Wiring of Hall sensors as a feedback unit (primary, (➜ # 74)).

The thermal control in the motor is connected to X1 and evaluated there. If cable lengths of more than 25 m are planned, please consult our customer service.

Frequency limit: 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE
Hall	11	-	-



9.13 Electronic Gearing, Master-Slave operation

In the case of the “electronic gearing” functionality (see setup software and description of GEARMODE parameter), the servo amplifier is controlled by a secondary feedback device as a slave.

It is possible to set up master/slave systems, use an external encoder as a setpoint encoder or connect the amplifier to a stepper motor control.

The amplifier is parameterized using the setup software (electronic gearing, parameter GEARMODE).

The resolution (number of pulses per revolution) can be adjusted.

NOTE

If input X1 is used without the X1 power supply (pins 2, 4, 10, 12), e.g. master-slave operation with other servoamplifiers, the monitoring of this power supply must be switched off in order to prevent error message F04 from appearing. To do this, you must change Bit 20 of the DRVCNFG2 parameter (see ASCII object reference in the online help).

9.13.1 Encoder control types

The following types of external encoder can be used for control:

S700 controlled by	Frequency limit	Connector	Wiring diagram	GEARMODE
Encoder BiSS digital	1,5 MHz	X1	(➜ # 80)	11, 12
SinCos Encoder ENDAT 2.1	350 kHz	X1	(➜ # 81)	8
Encoder ENDAT 2.2	1,5 MHz	X1	(➜ # 82)	13
SinCos Encoder HIPERFACE	350 kHz	X1	(➜ # 83)	9
SinCos Encoder without data channel	350 kHz	X1	(➜ # 85)	6, 7
ROD* (AquadB) 5V	1,5 MHz	X1	(➜ # 87)	30
ROD* (AquadB) 5V	350 kHz	X1	(➜ # 88)	10
ROD* (AquadB) 24V	100 kHz	X3	(➜ # 90)	2
SSI 5V	1,5 MHz	X1	(➜ # 92)	25
Step/direction 5V	1,5 MHz	X1	(➜ # 95)	27
Step/direction 24V	100 kHz	X3	(➜ # 95)	1

With a "PosI/O" or "PosI/O-Monitor" expansion card in slot 2 or 3 ((➜ # 143) ff), the following encoder types can be used:

S700 controlled by	Frequency limit	Connector	Wiring diagram	GEARMODE
SSI 5V	1,5 MHz	X5	(➜ # 146)	5
ROD* (AquadB) 5V	1,5 MHz	X5	(➜ # 148)	3
Step/direction 5V	1,5 MHz	X5	(➜ # 148)	4

* ROD is an abbreviation for incremental encoder

9.13.2 Connection to stepper motor controllers (step and direction)

You can connect the servo amplifier to a third-party stepper-motor controller. Parameter setting for the slave amplifier is carried out with the aid of the setup software (electronic gearing). The number of steps can be adjusted, so that the servo amplifier can be adapted to match the step-direction signals of any stepper controller. Various monitoring signals can be generated.

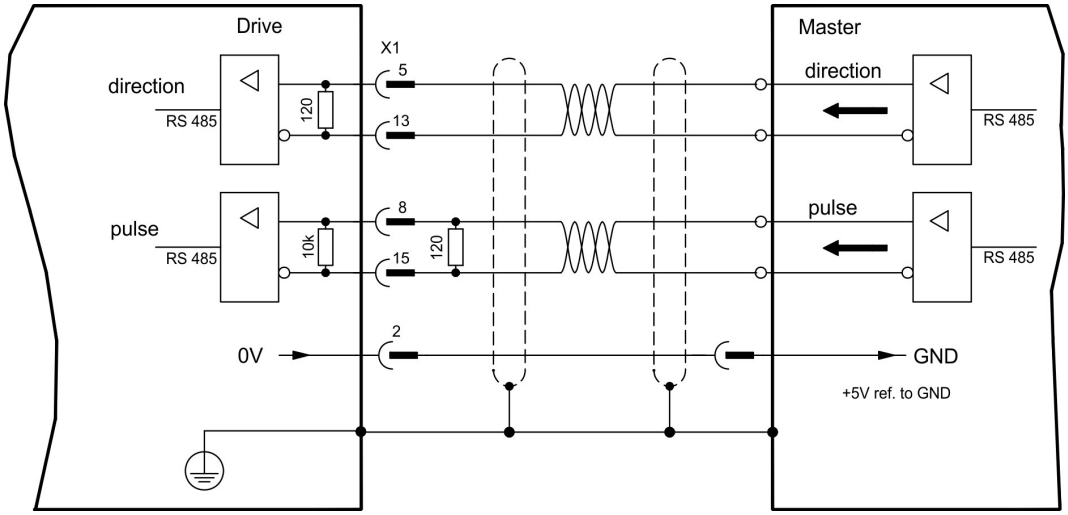
NOTE Using an A quad B encoder provides better EMC noise immunity.

9.13.2.1 Step / Direction with 5 V signal level (X1)

Wiring of the servo amplifier (SubD connector X1) to a stepper-motor controller with a 5V signal level.

Frequency limit: 1.5 MHz

Control	GEARMODE
Step/direction 5V	27

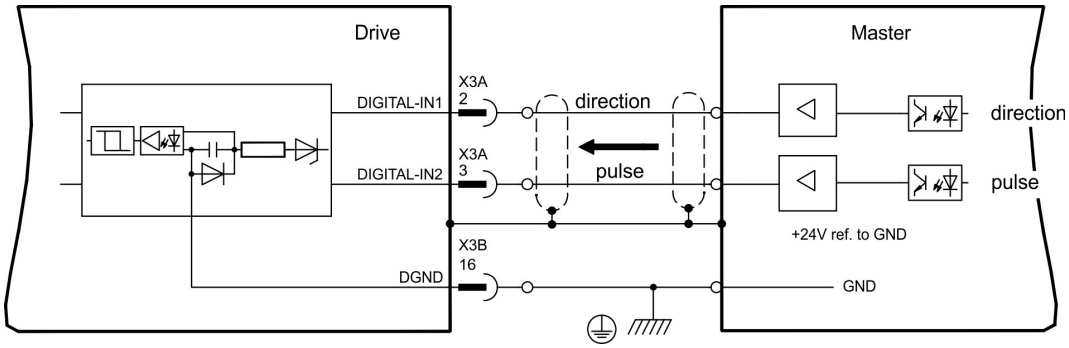


9.13.2.2 Step / Direction with 24 V signal level (X3)

Wiring of the servo amplifier to a stepper-motor controller with a 24 V signal level. The digital inputs DIGITAL-IN 1 and 2 on connector X3 are used.

Frequency limit: 100 kHz

Control	GEARMODE
Step/direction 24V	1



9.13.3 Master-Slave operation

9.13.3.1 Connection to an S700 master, 5V signal level (X1)

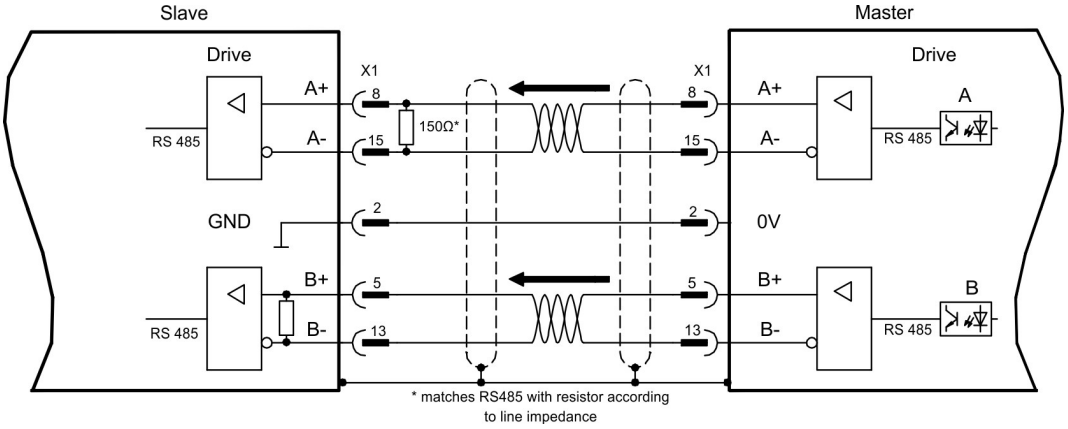
You can link two S700 amplifiers together in master-slave operation. One slave amplifier can be controlled by the master, via the encoder output X1 (➜ # 97).

Master: position output to X1 (screen page "Encoder emulation")
Slave: screen page "Electronic gearing" (GEARMODE)

Frequency limit: 1.5 MHz

Example for Master-Slave operation with two S700 amplifiers:

Slave GEARMODE: 30 **Master ENCMODE:9**



If using SSI emulation, then the master must be set to ENCMODE 10 and the slave to GEARMODE 25.

9.13.3.2 Connection to an S700 Master, 5V signal level (X5)

If an expansion card PosI/O or PosI/O-Monitor (➜ # 143) is built-in, you can use the encoder emulation via X5.

With this interface up to 16 Slaves can be connected to one Master, because no internal termination resistors are built-in with X5. Wiring (➜ # 148).

9.14 Encoder Emulation, position output

9.14.1 Incremental encoder output - A quad B (X1)

Fast incremental encoder interface. Select encoder function ROD (A Quad B) Encoder ("Encoder Emulation" screen page). The servo amplifier calculates the motor shaft position from the cyclic- absolute signals of the resolver or encoder, generating incremental- encoder compatible pulses from this information. Pulse outputs on the SubD connector X1 are 2 signals, A and B, with 90° phase difference (i.e. in quadrature, hence the alternative term "A quad B" output), with a zero pulse.

The resolution (before multiplication) can be set:

Encoder function (ENCMODE)	Feedback system (FBTYPE)	Resolution (ENCOUT)	Zero pulse (NI)
9, ROD => X1	0, Resolver	32...4096	once per turn (only at A=B=1)
	>0, Encoder	256...524288 (2^8 ... 2^{19})	

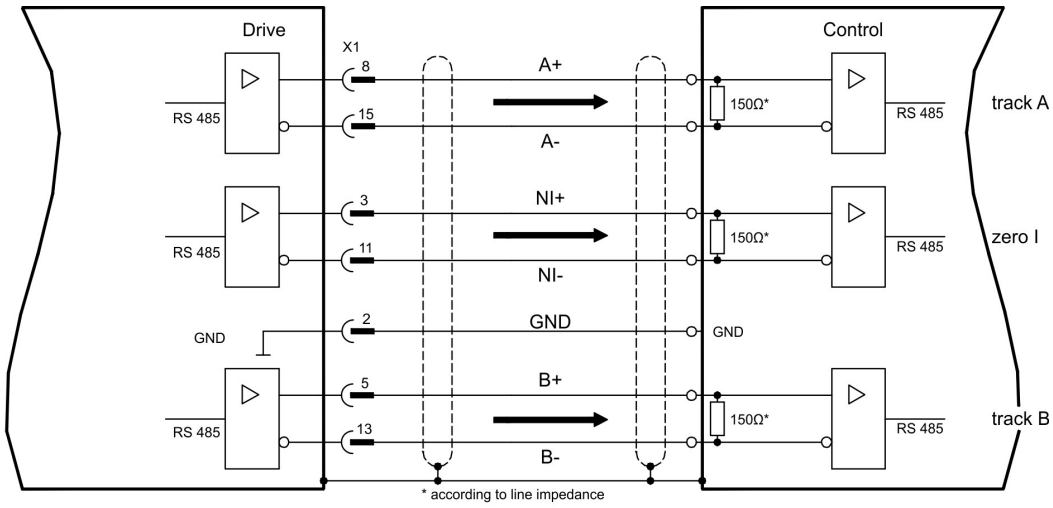
NOTE With built in safety card only binary resolutions up to 2^{12} are possible.

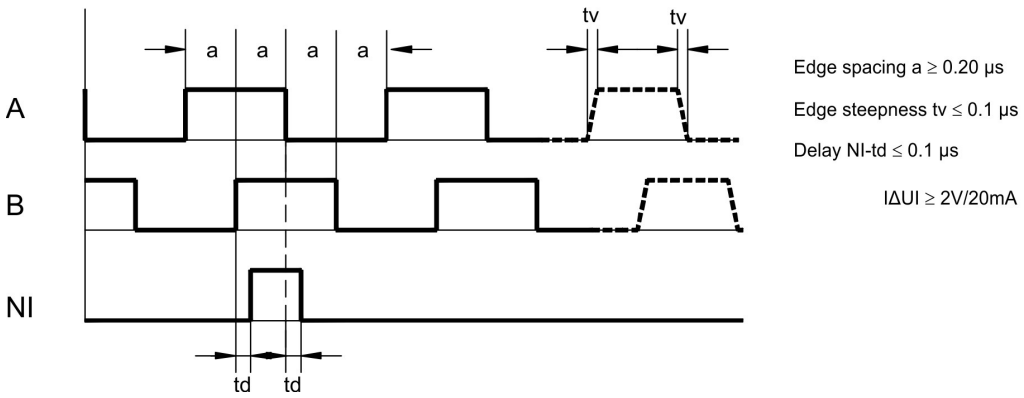
Use the NI-OFFSET parameter to adjust + save the zero pulse position within one mechanical turn. The drivers operate off an internal supply voltage.

NOTE The maximum permissible cable length is 100 meters.

Connections and signals for the incremental encoder interface :

Default count direction: UP when the motor shaft is rotating clockwise (looking at the shaft's end)





9.14.2 SSI encoder output (X1)

SSI interface (synchronous serial absolute-encoder emulation). Select encoder function SSI ("Encoder Emulation" screen page, ENCMODE 10). The servo amplifier calculates the motor shaft position from the cyclic-absolute signals of the resolver or encoder. From this information a SSI date (Stegmann patent specification DE 3445617C2) is provided. Max 32 bits are transferred.

The leading data bit contains the number of revolutions and are selectable from 12 to 16 bits. The following max. 16 bits contain the resolution and are not variable.

The following table shows the allocation of the SSI date depending upon selected number of revolutions:

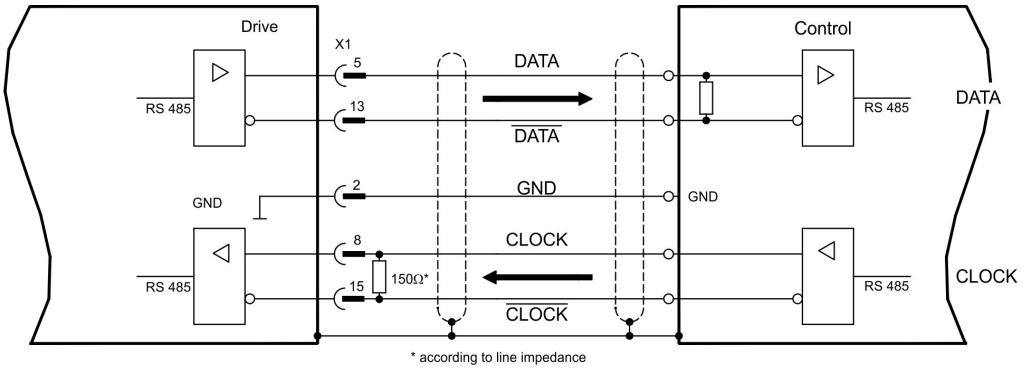
Revolution															Resolution (variable)															
SSIREVOL																														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
		13	12	11	10	9	8	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			12	11	10	9	8	7	6	5	4	3	2	1	0																
				11	10	9	8	7	6	5	4	3	2	1	0																

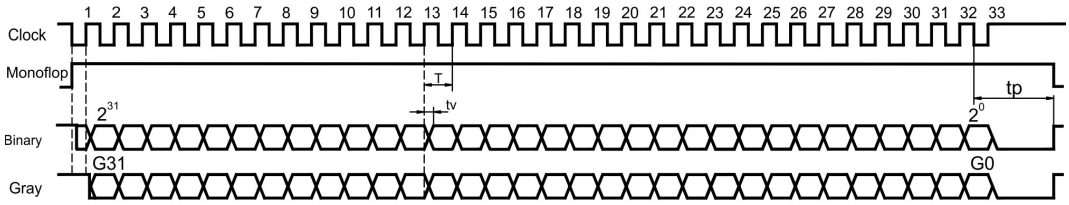
The signal sequence can be output in **Gray** code or in **Binary** (standard) code. The servo amplifier can be adjusted to the clock frequency of your SSI-evaluation with the setup software.

The drivers operate off an internal supply voltage.

Connection and signals for the SSI interface :

Default count direction: UP when the motor shaft is rotating clockwise (looking at the end of the motor shaft)





Switch over time Data tv ≤ 300nsec
Period T = 600 ns
Time Out tp = 3µs/13µs (SSITOUT)

Output IΔUI ≥ 2V/20mA
Input IΔUI ≥ 0.3V

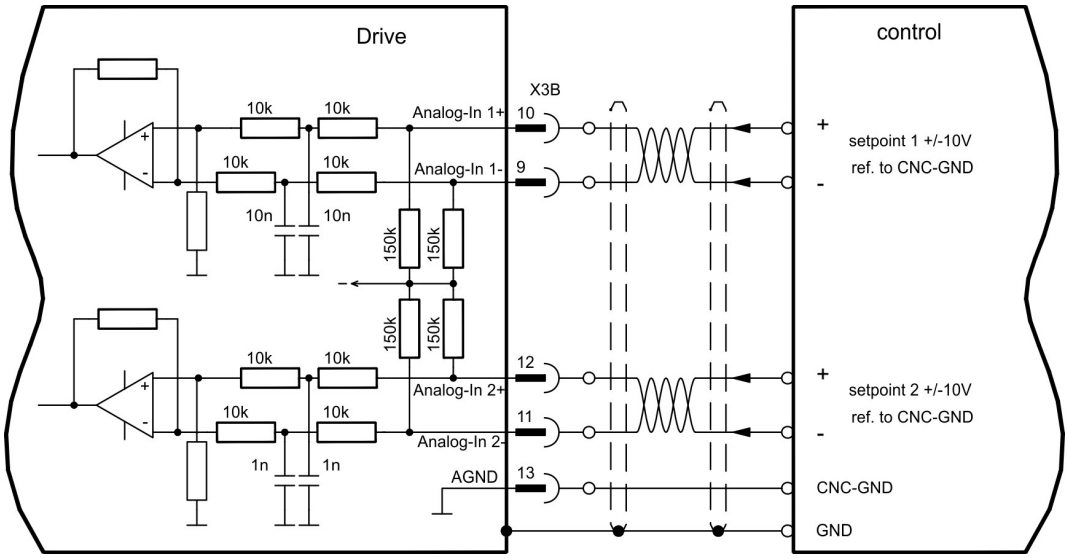
9.15 Digital and analog inputs and outputs

9.15.1 Analog Inputs (X3B)

The servo amplifier is fitted with two programmable differential inputs for analog setpoints. AGND (X3B/13) must always be joined to control GND as a ground reference.

Technical characteristics

- Differential-input voltage max. ± 10 V
- Ground reference AGND, terminal X3B/13
- Input resistance 150 k
- Common-mode voltage range for both inputs ± 10 V
- Update rate 62.5 µs



Analog-In 1 input (terminals X3B/10-X3B/9)

Differential input voltage max. ± 10 V, resolution 16 Bit (accuracy 13 Bit), scalable.
Standard setting: speed setpoint

Analog-In 2 input (terminals X3B/12-X3B/11)

Differential input voltage max. ± 10 V, resolution 16 Bit (accuracy 13 Bit), scalable.
Standard setting: torque setpoint

Application examples for setpoint input Analog-In 2:

- adjustable external current limit
- reduced-sensitivity input for setup or jog operation
- pre-control, override

If an input was freshly assigned to a pre-programmed function, then the data set must be saved in the EEPROM of the servo amplifier and a reset has to be carried out (with the amplifier setup software for example).

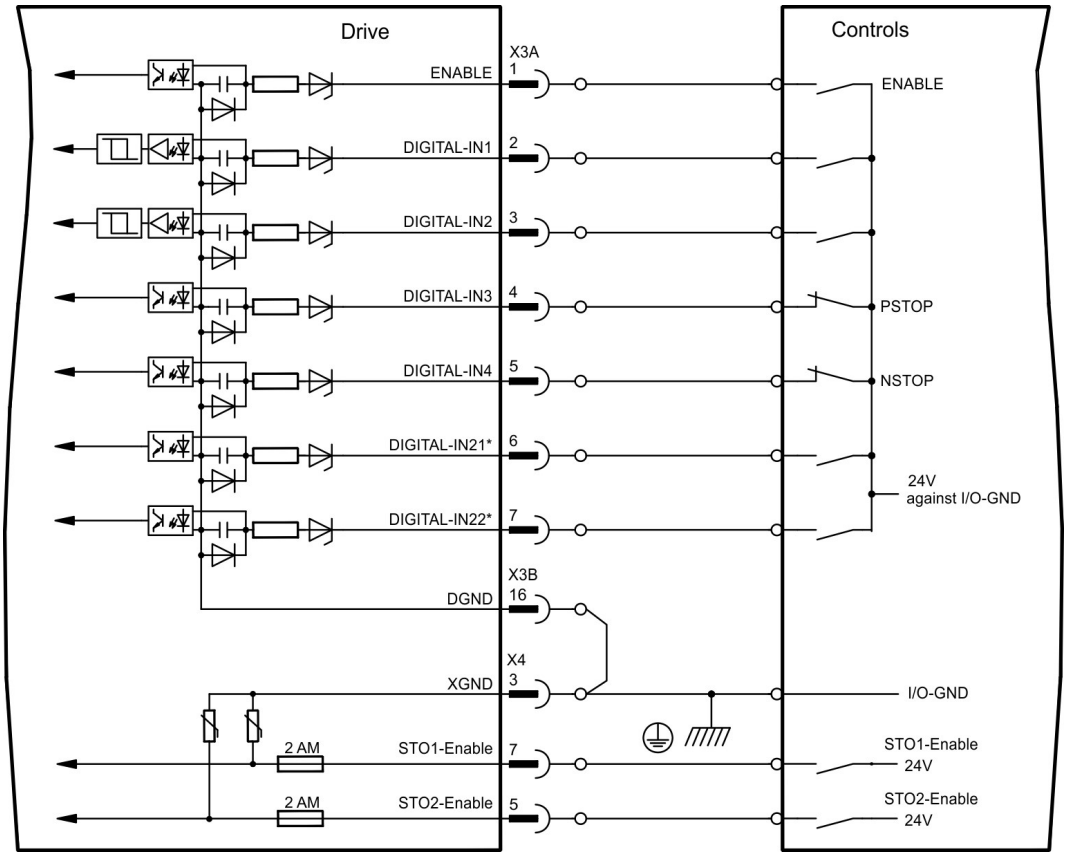
Defining the direction of rotation

Standard setting : clockwise rotation of the motor shaft (looking at the shaft end)

- Positive voltage between terminal X3B/10 (+) and terminal X3B/9 (-) or
- Positive voltage between terminal X3B/12 (+) and terminal X3B/11 (-)

To reverse the direction of rotation, swap the connections to terminals X3B/10-X3B/9 or X3B/12-X3B/11 respectively, or change the COUNT DIRECTION parameter in the “Feedback” screen page.

9.15.2 Digital Inputs (X3A, X3B, X4)



* * DIGITAL-IN 21 and 22 must be defined as inputs using the setup software (“Digital I/O” screen page).

9.15.2.1 Connector X3A, X3B

Input ENABLE

- PLC compatible (IEC 61131-2 type 1), floating, reference ground is DGND
- High: 15...30 V / 2...15 mA , Low: -3...5 V / <1mA
- Update rate: Software: 250 µs

The output stage of the servo amplifier is enabled by applying the ENABLE signal (Terminal X3A/1, active high). Enable is possible only if inputs STOx-Enable have a 24 V signal (➜ # 41) ff). In the disabled state (low signal) 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 (“Basic Setup” screen page of the DRIVEGUI.EXE setup software).

Programmable digital inputs X3:

You can use the digital inputs X3A/2 to X3A/7 to initiate pre-programmed functions that are stored in the servo amplifier. A list of these pre-programmed functions can be found on the “Digital I/O” screen page of our setup software.
If an input was freshly assigned to a pre-programmed function, then the data set must be saved in the EEPROM of the servo amplifier and a reset has to be carried out (with the amplifier setup software for example).

Digital Inputs DIGITAL-IN 1 and 2 (X3A/2, X3A/3):

These inputs are particularly fast and are therefore suitable for latch functions or for high-speed feedback signals, for example.

- PLC compatible (IEC 61131-2 type 1), floating, reference ground is DGND
- High: 15...30 V / 2...15 mA , Low: -3...5 V / <1mA
- Update rate: Hardware: 2µs

Digital Inputs DIGITAL-IN 3 and 4 (X3A/4, X3A/5):

The PSTOP and NSTOP limit switch evaluation functions, for instance, can be assigned to these inputs. Choose the function you require in the setup software ("Digital I/O" screen page).

- PLC compatible (IEC 61131-2 type 1), floating, reference ground is DGND
- High: 15...30 V / 2...15 mA, Low: -3...5 V / <1mA
- Update rate: Software: 250 µs

Digital Inputs DIGITAL-IN21 and 22 (X3A/6, X3A/7):

Pins 6 and 7 on X3A can be used as either inputs or outputs. Choose the function you require in the setup software ("Digital I/O" screen page).

- PLC compatible (IEC 61131-2 type 1), floating, reference ground is DGNDD
- High: 15...30 V / 2...15 mA, Low: -3...5 V / <1mA
- Update rate: Software: 250 µs

NOTE Depending on the selected function the inputs are high or low active.

9.15.2.2 Connector X4

You can thus achieve a restart lock-out for functional safety by using the STO1-Enable and STO2-Enable inputs in conjunction with an external safety circuit.

Input STO1-ENABLE (X4/7) and STO2-Enable (X4/5)

- Floating, reference ground is XGND
- 20V...30V / 33mA...45mA

NOTE These inputs are not compatible with EN 61131-2.

These additional digital inputs releases the power output stage of the amplifier as long as a 24 V signal is applied to these inputs. If the STO inputs go open-circuit, then power will no longer be supplied to the motor, **the drive will lose all torque and coast down to a stop.**

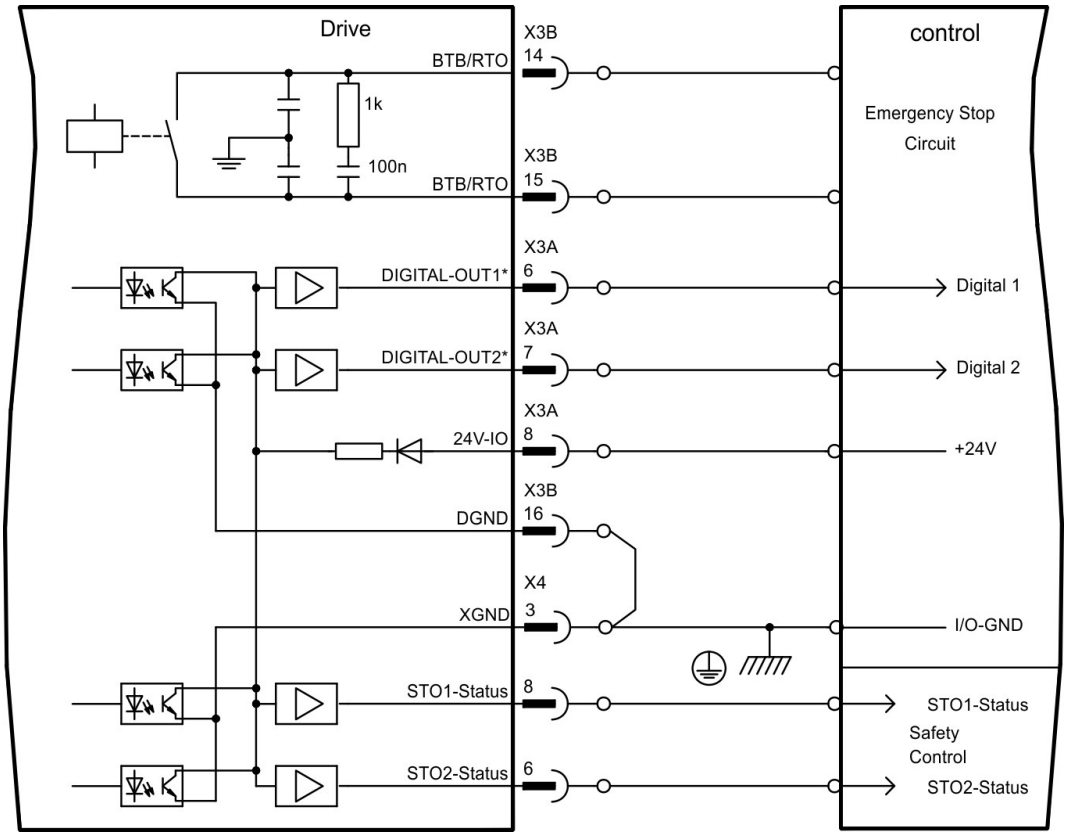
NOTICE Failsafe braking of the drive, if required, must be provided by means of an additional mechanical brake, since electrical braking by the drive is no longer possible.

You can find further information and connection examples (➜ # 43)ff.

9.15.3 Digital Outputs (X3A, X3B, X4)

Technical characteristics

- Power supply at terminals X3A/8 (24V-IO) and X3B/16 (DGND)
- All digital outputs are floating
- 24V-IO : 20V DC ... 30V DC
  DIGITAL-OUT1/2 : PLC compatible (IEC 61131-2 type 1), max. 100mA
  STO1/2-Status : PLC compatible (IEC 61131-2 type 1), max. 100mA
  BTB/RTO : Relay output, max. 30V DC or 42V AC, 0.5A
- Update rate : 250 µs



* DIGITAL-OUT 1/2 must be defined as outputs using the setup software (“Digital I/O” screen page).

9.15.3.1 Connectors X3A, X3B

Ready-to-operate contact BTB/RTO (X3B/14, X3B/15)

Operational readiness (terminals X3B/14 and X3B/15) is signaled by a **floating** relay contact. The contact is **closed** when the servo amplifier is ready for operation, and the signal is **not** influenced by the enable signal, the I²t-limit, or the brake threshold.

NOTE

All faults cause the BTB/RTO contact to open and the output stage to be switched off (if the BTB/RTO contact is open, the output stage is inhibited -> no power output). Error messages are listed on page (➜ # 123).

Programmable digital outputs DIGITAL-OUT 1 and 2 (X3A/6, X3A/7):

Pins 6 and 7 on X3A can be used as either inputs or outputs. Choose the function you require in the setup software (OxMODE). The outputs are floating outputs, so the 24 V switching voltage must be provided by an external supply.

If they are programmed as digital outputs, messages from pre-programmed functions stored in the servo amplifier can be output here. A list of these pre-programmed functions can be found on the “I/O digital” screen page of our setup software DRIVEGUI.EXE.

If an output is to be freshly assigned to a pre-programmed function, then the parameter set must be saved in the EEPROM of the servo amplifier and a reset has to be carried out (with the amplifier setup software for example).

9.15.3.2 Connector X4

Status messages STO1-Status (X4/8) and STO2-Status (X4/6):

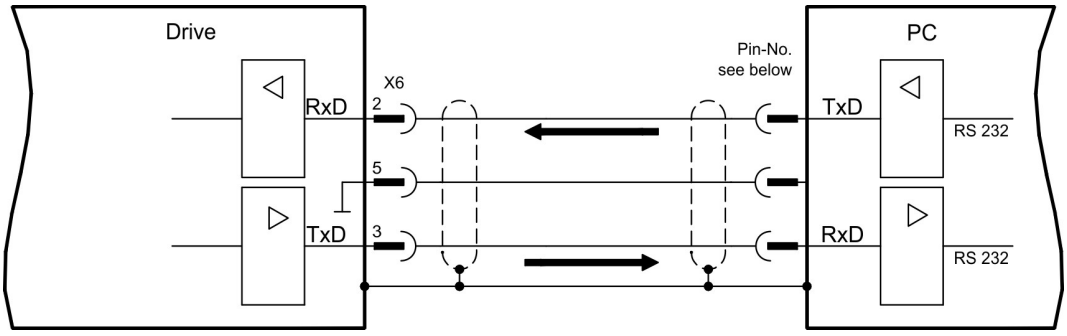
Pin 6 and 8 on X4 report the status of the STO-Enable inputs. The outputs are floating outputs, so the 24 V switching voltage must be provided by an external supply via X3A/8.

9.16 RS232 interface, PC connection (X6)

Operating, position control, and motion-block parameters can be set up by using the setup software on an ordinary commercial PC (➜ # 110).

Connect the PC interface (X6) of the servo amplifier to a serial interface on the PC, **while the power supply to the equipment is switched off.**

NOTE Do not use a null-modem power link cable!



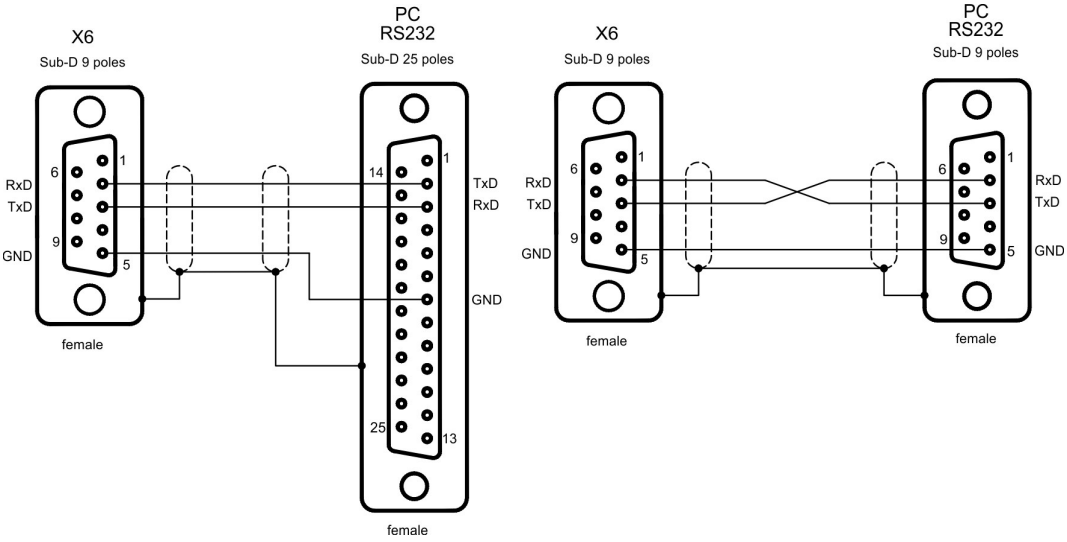
This interface has the same electrical potential as the CANopen interface.

The interface is selected and set up in the setup software. Further notes (➜ # 109).

With the optional expansion module -2CAN- the two interfaces for RS232 and CAN, which otherwise use the same connector X6, are separated onto two connectors (➜ # 140).

Interface cable between the PC and servo amplifiers of the S700 series:

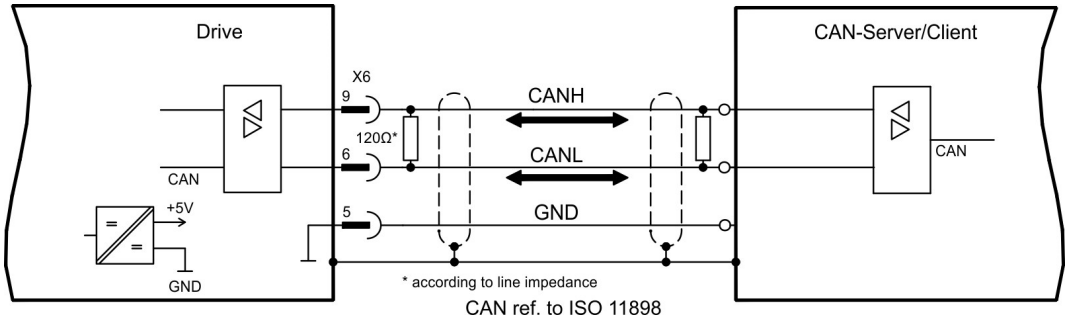
(View : looking at the solder side of the SubD sockets on the cable)



9.17 CAN-bus interface (X6)

The interface for connection to the CAN-bus (default : 500 kBaud). The integrated profile is based on the CANopen DS301 communication profile and the DS402 drive profile. The following functions are available in connection with the position controller: Jogging with variable speed, homing run (zeroing to reference), start motion task, start direct task, digital setpoint provision, data transmission functions and many others. Detailed information can be found in the CANopen manual. The interface is at the same

Detailed information can be found in the CANopen manual. The interface is at the same electrical potential as the RS232 interface. The analog setpoint inputs can still be used. With the optional expansion module -2CAN- the two interfaces for RS232 and CAN, which otherwise use the same connector X6, are separated onto two connectors (➜ # 140).



CAN-bus cable

To meet ISO 11898, a bus cable with a characteristic impedance of 120 Ω should be used. The maximum usable cable length for reliable communication decreases with increasing transmission speed. As a guide, you can use the following values which we have measured, but they are not to be taken as assured limits:

- Characteristic impedance 100-120 Ω
- Cable capacitance max. 60 nF / 1000m
- Lead loop resistance 159.8 Ω / 1000m

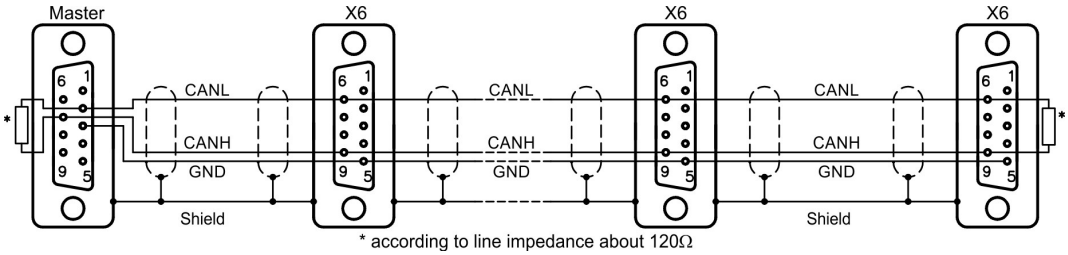
Cable length, depending on the transmission rate (samples)

Baudrate / kBaud	max. cable length / m
1000	10
500	70
250	115

Lower cable capacitance (max. 30 nF / km) and lower lead resistance
(loop resistance, 115Ω / km) make it possible to achieve greater distances.
(Characteristic impedance 150 ± 5Ω => terminating resistor 150 ± 5Ω).

For EMC reasons, the SubD connector housing must fulfill the following requirements:

- metal or metalized housing
- provision for cable shielding connection on the housing, large-area connection



9.18 EtherNet interface (X7)

This interface with its two RJ-45 connectors can be used for communicating with various fieldbus devices depending on the used firmware version:

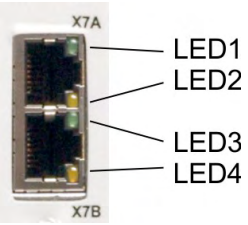
- EtherCAT (Standard, CAN over EtherCAT)

NOTE The interface is deactivated, if a field bus extension card is inserted to an extension slot.

The protocol that has been installed with the firmware must be enabled (ASCII command ETHMODE).

Standard setting: if an EtherCAT connection is detected while booting the servo amplifier, then EtherCAT is activated, otherwise CANopen (➜ # 105) is activated.

With the Download Tool (on the product CDROM and within the download area of our web-site) the different firmware versions can be loaded into the servo amplifier.



The communication status is indicated by the built-in LEDs.

Connector	LED#	Name	Function
X7A	**LED1**	LINK_IN	ON = receive valid (IN port) OFF= not valid, power off or reset.
	LED2	CYCLIC	ON = network cyclic BLINK = network not cyclic OFF = power off or reset
X7B	**LED3**	LINK_OUT	ON = receive valid (OUT port) OFF = not valid, power off or reset
	LED4	REPEATER	ON = repeater on, network cyclic BLINK = repeater on, network not cyclic OFF = repeater off, power off or reset

Pinout

X7A	Signal		X7B	Signal
1	Transmit +		1	Receive +
2	Transmit -		2	Receive -
3	Receive +		3	Transmit +
4	n.c.		4	n.c.
5	n.c.		5	n.c.
6	Receive -		6	Transmit -
7	n.c.		7	n.c.
8	n.c.		8	n.c.

9.19 Memory card



In the top of the servo amplifier there is a card reader for memory cards. The firmware and a full set of parameters (with control buttons and setup software) can be stored on the memory card and reloaded onto the servo amplifier.

MMC and SD cards are supported. This function means that a replacement device or identical shafts in standard production machines can be set up very quickly and easily.

Uploads and Downloads from and to the memory card can be started with the keypad or with the setup software using.

Operating with ASCII commands is described in the KDN on page "Memory Card" beschrieben.

NOTE Always switch off the S700 before inserting or removing the memory card. If an absolute encoder is used, homing must be carried out before the parameters are loaded into a new device.

To download new firmware to an amplifier without a PC connection, proceed as follows:

1. Save the firmware to be programmed onto a memory card under the name “**default.s19**" (S-record format) or ”**default.bin**" (binary format).

2. Disconnect the power to the amplifier (24 V supply OFF) and insert the card in the memory card slot on the amplifier.

3. Press and hold down both operating keys (▲ ▼) and switch on the 24 V supply voltage to the amplifier. “—” appears in the display to indicate that the monitor program has been activated. In case of access problems the drive display shows the letters “CCC”. The interrupted command proceeds after re-insertion of the memory card.

4. Press both operating keys again to start the update process. The progress of the update can be monitored in the display:

- First, the firmware is downloaded from the card to the internal memory.
- During this phase, the display counts from 0 to 100.
- Next, the internal firmware memory is deleted. During this phase, 100 is displayed permanently.
- Once the firmware memory has been deleted, the firmware is written. This phase is indicated in the display by the display counting backwards from 100 to 0.

5. Once programming has been completed, the firmware is started automatically.

The parameter file can also be loaded automatically on a restart. If a parameter file with the name “**default.par**” has already been saved on the memory card, it will be loaded by the firmware at this point. This allows automatic updating of firmware and parameters.

10 Setup

The procedure for setup is described as an example. Depending on the application, a different procedure may be appropriate or necessary. In multi-axis systems, set up each servo amplifier individually.

Before setting up, 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.

10.1 Important notes

NOTICE 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 Lethal Voltage!

There is a danger of serious personal injury or death by electrical shock. Lethal danger exists at live parts of the device.

- Built-in protection measures such as insulation or shielding may not be removed.
- Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with switched off mains supply, and secured against restart.



WARNING Automatic Restart!

Risk of death or serious injury for humans working in the machine. The servo amplifier might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting. If parameter AENA is set to 1,

- then place a warning sign (Warning: Automatic Restart at Power On) to the machine.
- Ensure, that power on is not possible, while humans are in a dangerous zone of the machine.

NOTICE If the servo amplifier has been stored for more than 1 year, it will be necessary to re-form the capacitors in the DC bus link circuit. To do this, disconnect all electrical connections and apply single-phase 208...240 V AC to terminals L1 and L2 of the servo amplifier for about 30 minutes. This will re-form the capacitors.

NOTE The adaptation of parameters and the effects on the control loop behavior are described in the Online Help of the setup software.

The setting up of any expansion card that may be fitted is described in the corresponding manual on the CD-ROM.

We can provide further know-how through training courses (on request).

10.2 Setup software

This chapter describes the installation of the setup software DRIVEGUI.EXE for the S700 digital servo amplifiers.

We offer training and familiarization courses on request.

10.2.1 Use as directed

The setup software is intended to be used for altering and saving the operating parameters for the S700 series of servo amplifiers. The attached servo amplifier can be set up with the help of this software, and during this procedure the drive can be controlled directly by the service functions.

Only professional personnel who have the relevant expertise described on page (➜ # 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. After loading a set of data you must therefore always check all parameters before enabling the servo amplifier.

10.2.2 Software description

The servo amplifiers must be adapted to the requirements of your machine. Usually you will not have to carry out this parameter setting yourself on the amplifier, but on a PC, with the assistance of the setup software. The PC is connected to the servo amplifier by a null-modem cable (serial, (➜ # 104)). The setup software provides the communication between the PC and S700.

You can find the setup software on the accompanying CD-ROM and in the download area of our 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 amplifier. At the same time, important actual values are read out from the amplifier and displayed on the monitor of the PC (oscilloscope functions).

Any expansion cards built into the amplifier are automatically recognized, and the additional parameters which are required for position control or motion-block definition are made available.

You can save sets of data on data media or on the memory card (archiving) and load them again. You can also print out the data sets.

We supply you with motor-specific default sets of data for the most common combinations of servo amplifier and motor. In most applications you will be able to use these default values to get your drive running without any problems.

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

10.2.3 Hardware requirements, operating systems

The PC interface (X6, RS232) of the servo amplifier is connected to the serial interface of the PC by a null-modem cable (not a null-modem link cable!) (➜ # 104).

NOTICE Connect or disconnect the interface cable only when the electrical supply is switched off for both the PC and the servo amplifier.

The interface in the servo amplifier has the same potential level as the CANopen interface.

Minimum requirements for the PC:

Processor:	At least Pentium® II or comparable
Graphics adapter:	Windows compatible, color
Drives:	Hard disk with at least 10 MB free space CD-ROM drive
Interface:	one free serial interface (COM1 … COM10) or USB with an USB->Serial converter

Operating systems WINDOWS 2000, XP, VISTA, 7 / 8 / 10

DRIVEGUI.EXE will run under WINDOWS 2000, XP, VISTA, 7, 8 and 10.

Emergency operation is feasible through an ASCII terminal emulation (without graphical user interface).
Interface settings : 38400 bps, databit 8, no parity, stopbit 1, no flow control

Operating systems Unix, Linux

The functioning of the software has not been tested for WINDOWS running within Unix or Linux.

10.2.4 Installation under WINDOWS

The CD-ROM includes an installation program for the setup software.

Installation

Autostart function activated:
Insert the CD-ROM into a free drive. A window with the start screen opens. There you find a link to the setup software DRIVEGUI.EXE. Click it and follow the instructions.

Autostart function deactivated:
Insert the CD-ROM into a free drive. Click on **START** (task bar), then on **Run**. Enter the program call: **x:\index.htm** (x = correct CD drive letter).
Click **OK** and proceed as described above.

Connection to the serial interface of the PC:

Connect the interface cable to a serial interface on your PC (COM1 to COM10) and to the serial interface of the servo amplifier S700 (➜ # 104).

10.3 Quickstart, initial drive test

10.3.1 Preparation

Unpacking, Mounting and Wiring the Servo Amplifier

1. Unpack servo amplifier and accessories.
2. Observe safety instructions in the manuals.
3. Mount the servo amplifier as described in chapter "Mechanical Installation" (➜ # 53).
4. Wire the servo amplifier as described in chapter "Electrical Installation" (➜ # 59) or apply the minimum wiring for drive testing as described on the next page.
5. Install the software (➜ # 109).
6. You need this information concerning the drive components:
   - Rated mains supply voltage
   - motor type (motor data, if the motor type is not listed in the motor database, see Online-Help
   - feedback unit built into the motor (type, poles, lines, protocol etc.)
   - moment of inertia of the load

Documents

You need access to these documents (located on the product CD-ROM, you can download the latest editions from our website):

- Instruction manual (this manual)
- CANopen Fieldbus Interface Manual
- EtherCAT Fieldbus Interface Manual
- Accessories manual

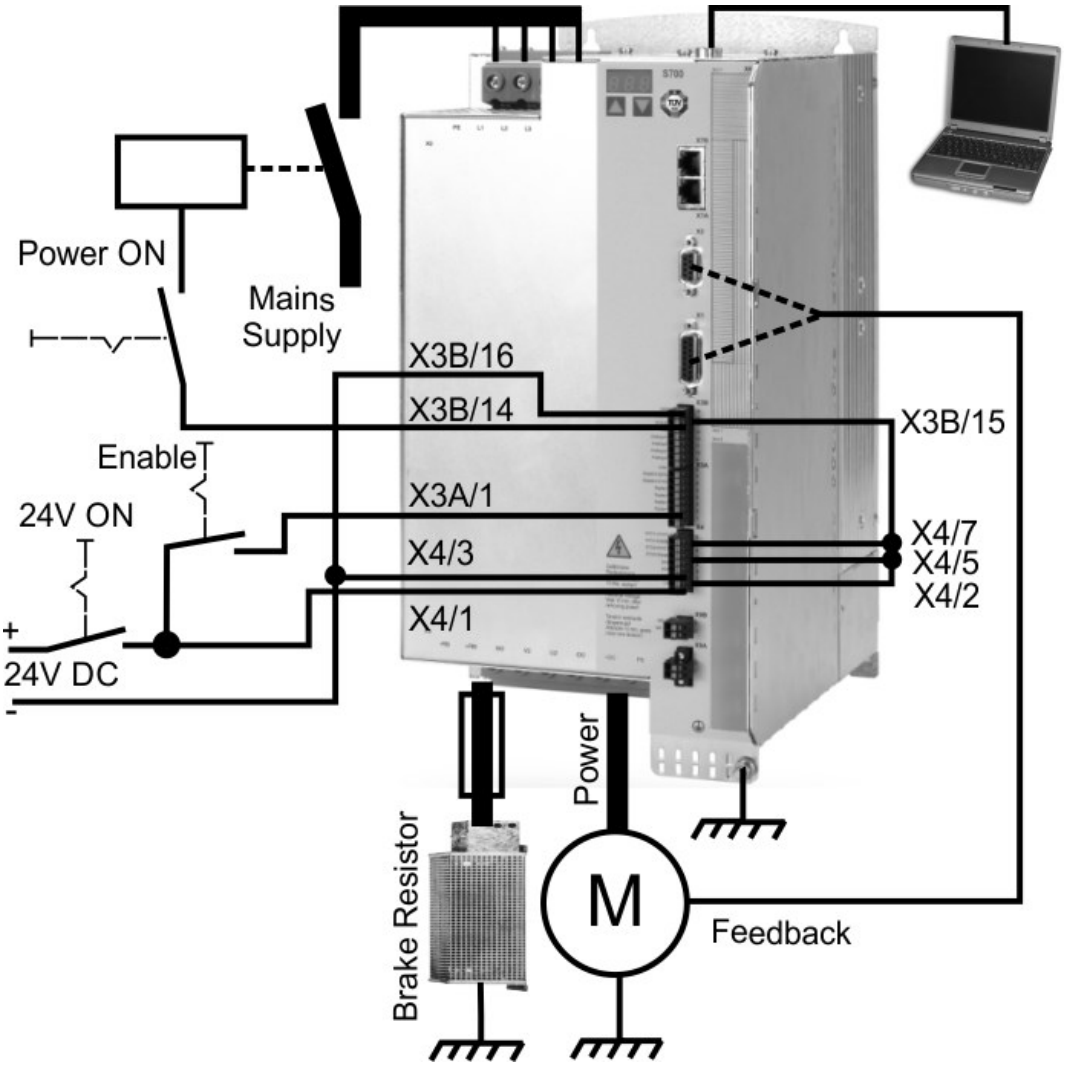
Depending on the installed expansion card you need one of these documents:

- Operating Manual Safety Expansion Card Sx
- PROFIBUS DP Fieldbus Interface Manual
- DeviceNet Fieldbus Interface Manual
- sercos® Fieldbus Interface Manual

You need Acrobat Reader to read the PDFs, an installation link is on every screen of the product CD-ROM.

Minimum Wiring for Drive Test

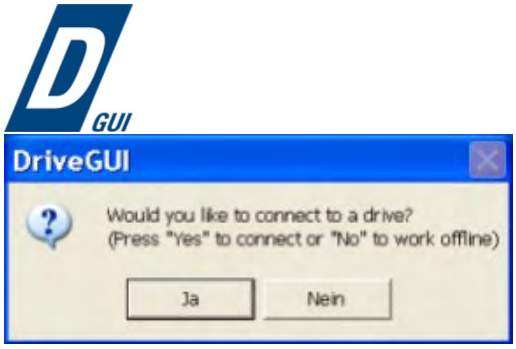
NOTE This wiring does not fulfill any requirements to safety or functionality of your application, it just shows the required wiring for drive testing without load.



10.3.2 Connect

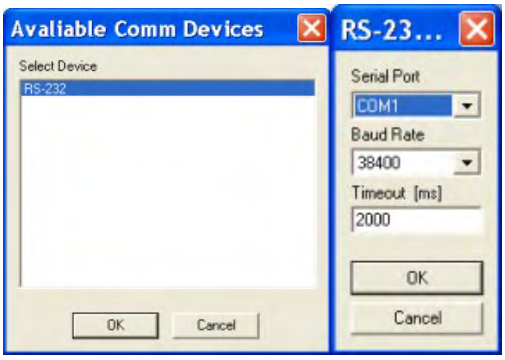
- Connect the interface cable to a serial interface on your PC and to the serial interface X6 of the servo amplifier. USB to serial converter can be used optionally.
- Switch on the 24 V power supply for the servo amplifier.
- Wait about 30 seconds, until the front display of the servo amplifier displays the current class (e.g. 48 for 48 A) anzeigt. If the power supply voltage is switched on, too,leading P is displayed (e.g. P48 for Power, 48 A).

If a fault code (F) or a warning (n) or a status message (./_ / E/S) appears in the display, you will find the description on page (➜ # 123) or (➜ # 124).
If a fault message appears, fix the problem.



Double-Click the DRIVEGUI.EXE icon on your Windows desktop to start the software.
.

You can work offline or online with DRIVEGUI.EXE. Work ONLINE now.



If the communication is started for the first time, you have to setup the communication parameters. Choose the communication system and the interface, where the servo amplifier is connected to. Click OK.

The software tries to communicate with these parameters. If it's not successful, you receive this error message:



Frequent causes:

- wrong interface chosen
- wrong connector chosen at the servo amplifier
- interface is used by another software
- 24 V auxiliary voltage for the servo amplifier not working
- interface cable broken or wrong wiring

Quit the error message. The software starts in the offline mode now, that requires the manual selection of the amplifier's type. Quit this selection by closing the window. Fix the communication problem. Restart the software in Online mode.

If communication works, you see the start screen. Select "Setup Wizard" in the navigation frame.



NOTICE

Make sure, that the amplifier is disabled (Input Enable connector X3A pin 1 must be 0 V or open)!

10.3.3 Important Screen Elements

Help Function

The online help gives detailed information to all parameters the servo amplifier can work with.

Key F1	Starts online help for the actual screen page.
Menu bar Help	Starts online help with the first page.
	Context Help. Click the help symbol first. Then click the function for which you need help.

Tool Bar



	Save to EEPROM, required if you changed parameters.
	Reset, required if you changed configuration parameters.
	Operation Mode, **use "0: Digital Velocity" mode for drive testing.**

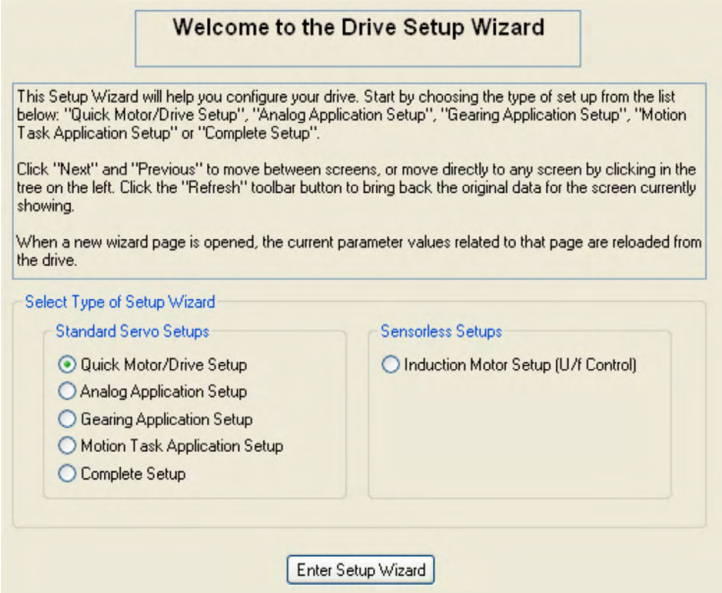
Status Bar



The status bar shows a green Online symbol, indicating that the communication works.

10.3.4 Setup Wizard

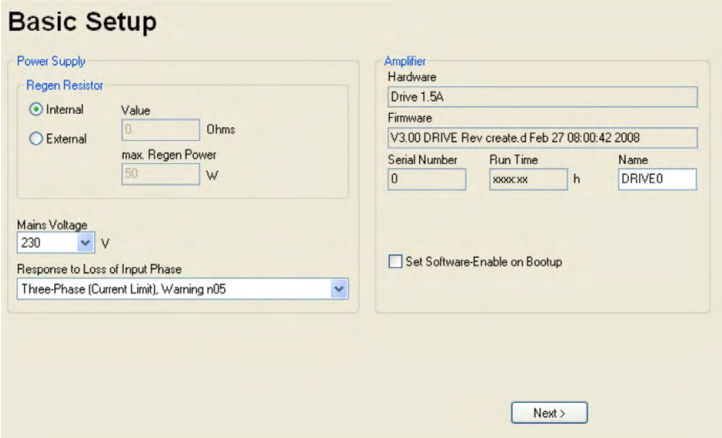
The Setup Wizard leads you through the necessary steps for configuring your servo amplifier. Depending on the selected application, only the active screen pages are necessary.



For a quick setup / drive test, select the setup type "Quick Motor/Drive Setup".

Start the Wizard.

10.3.4.1 Basic Setup



Basic parameters are set here.

Mains Voltage: Select actual mains voltage.

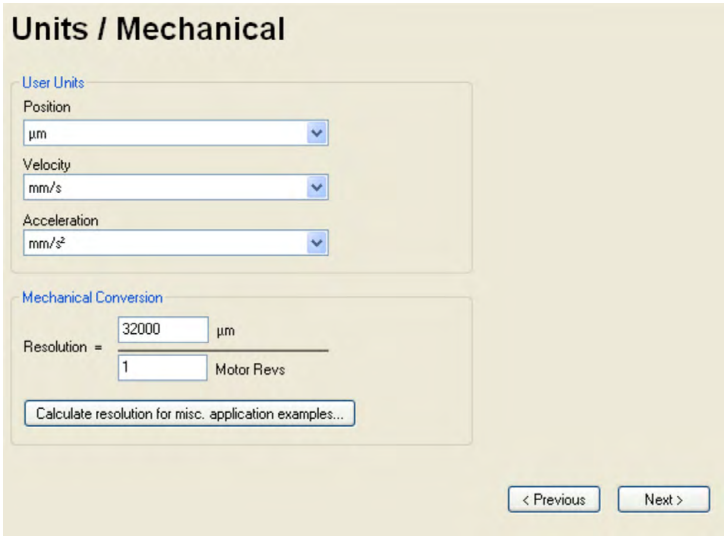
Response to Loss of Input Phase: Select Three-Phase operation. With three-phase operation you can select either warning "n05" or error "F19" in case of phase loss. The reaction "F19" disables the output stage, "n05" is just a message.

Name: You can enter a name for the servo amplifier (up to 8 characters). This simplifies the drive identification in the system.

Set Software Enable on Bootup: Do **not** select this option for the quick test.

Click NEXT.

10.3.4.2 Units/Mechanical



The user units for all input fields in the setup software can be preselected here.

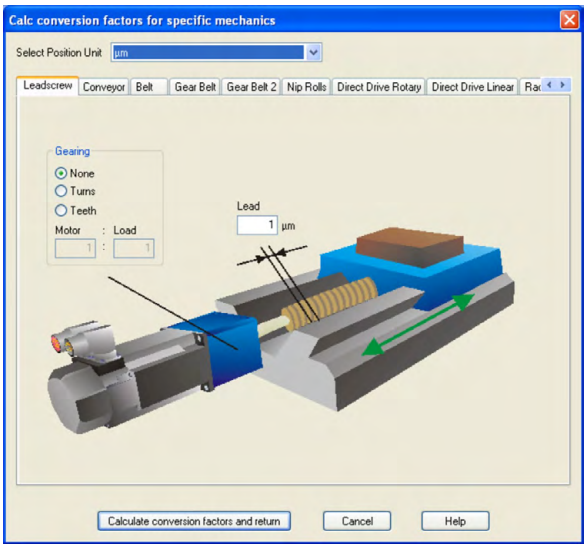
Position, Velocity, Acceleration

Select usable units for your application referring to the moved load.

Mechanical Conversion

The relationship between motor shaft revolution (pole pair pitch with linear motors) and motion distance of the load is specified here. Gear ratio can be calculated here as well. Detailed information can be found in the Online-Help.
Use the tool based on sample applications for calculating the resolution value:

Calculate PGEARI/PGEARO for..." button



If your application does not correspond to any of the listed examples, enter the required parameters directly in the fields on the “Units” screen.

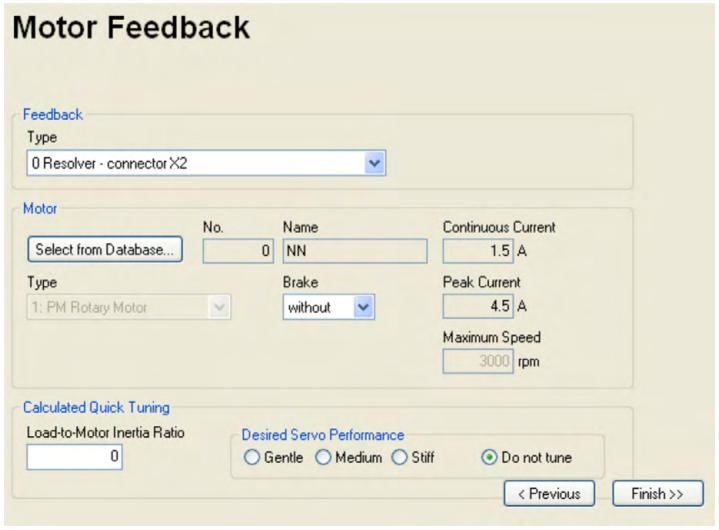
First, select the application that corresponds to your own. Next, set the position unit. Select the position unit that provides you with the required accuracy for your application.

Set the mechanical data for you application now. If a gearhead is flange-mounted on the motor, you must also enter the gearhead data (either the number of teeth or the ratio of the revolutions).

Then click the “Calculate conversion factors and return” button.

Click NEXT.

10.3.4.3 Motor (rotary) and Feedback



Simplified setting of the motor related parameters.

Feedback: Select the feedback system used in the motor.

NOTE

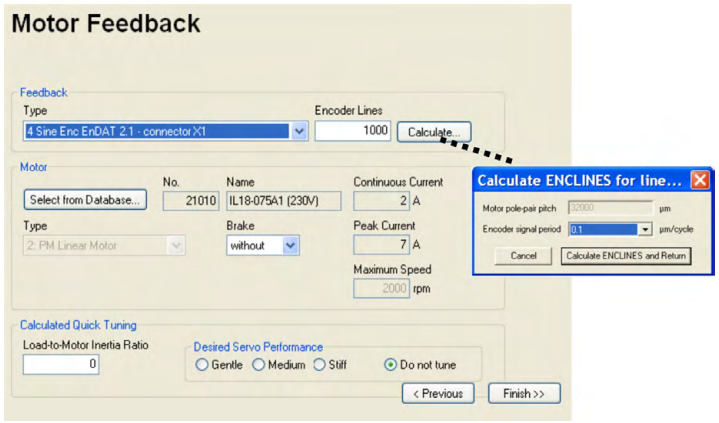
Resolver is fixed to 2 pole in the Quick Motor/Drive Setup.
Change "pole n°" on feedback screen in Complete Setup later, if required.

Motor type: Click the button "Select from Database...".
Open the database file (mdb_ _ _.csv) and select the used motor out of the list. Special motors must be defined in the "Complete Setup".

Brake: If the amplifier shall control a brake, change the Brake parameter to "With"

Calculated quick tuning: If you know the Load-to-motor inertia ratio (0 is for no load), enter the number here and select the desired servo performance. If you don't know the inertia ratio, select "Do not tune". **Click FINISH.**

10.3.4.4 Motor (linear) / Feedback (Encoder)



Simplified setting of the motor related parameters.

Feedback: Select the feedback system used.

Motor type: Click the button "Select from Database..".
Open the database file (mdb_ _ _.csv) and select the used motor. Special motors must be defined in the "Complete Setup".

Encoder Lines (appears with Feedback Type Sine Encoder):
Click "Calculate" and fill in the Encoder signal period.

Brake: If the amplifier shall control a brake, change the Brake parameter to "With"

Calculated quick tuning: If you know the Load-to-motor inertia ratio, enter the number here and select the desired servo performance. Otherwise select "Do not tune".

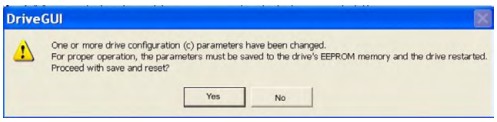
Click FINISH.

10.3.4.5 Save Parameters and Restart

You are going to finish the Setup Wizard and you have changed several basic parameters. Depending on the parameters you changed, two possible reactions will occur now:

Configuration parameters changed

A warning appears, that you have to restart the amplifier, this is called "coldstart".



Click "YES".
The parameters are saved to the amplifier's EEPROM automatically and a reset command restarts the amplifier (takes some seconds).

Other parameters changed

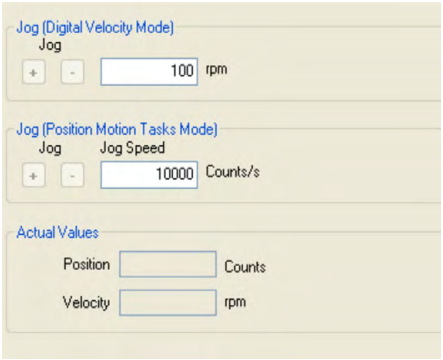
No warning appears. Save the parameters to the EEPROM of the servo amplifier manually by clicking the symbol  in the tool bar. A coldstart of the amplifier is not necessary.
Select the screen "**Motion Service**" in the navigation frame.

10.3.5 Motion Service (Jog Mode)

NOTICE

Be aware that the actual position of the load permits the subsequent moving operations. The axis could move to the hardware limit-switch or the mechanical stop. Make sure that a jerk or a fast acceleration of the load cannot cause any damage. Observe the "safe reduced speed" requirements for your application!

- Switch on the power supply for the drive.
- **STO-Enable**: Apply +24 V to STO1-Enable [X4/5] and to STO2-Enable [X4/7]
- **Hardware-Enable**:Apply +24 V to input Enable [X3A/1]. If STO-Enable is missed or the sequence was wrong, the front display shows  .
- **Software-Enable**: Click the symbol EN in the tool bar.
  Now the front display shows an E and the current class (e.g.  for Enable, 48A).
  Click the symbol DIS to switch off the output stage (disable).



Jog (Digital Velocity Mode):
You can move the drive with constant speed. Enter the desired speed.
The drive moves with the preset speed when the + or - button is pressed. It stops when the button is released.

Actual errors and warnings are listed on the screen "Status". A description of errors and warnings can be found in the Online-Help or on page (➜ # 123) ff.
Now you have setup and tested the basic functions of the drive successfully.

10.3.6 More Setup Screens

NOTICE

Observe the safety instructions in the manuals and in the online help before you change parameters in the additional setup screens.

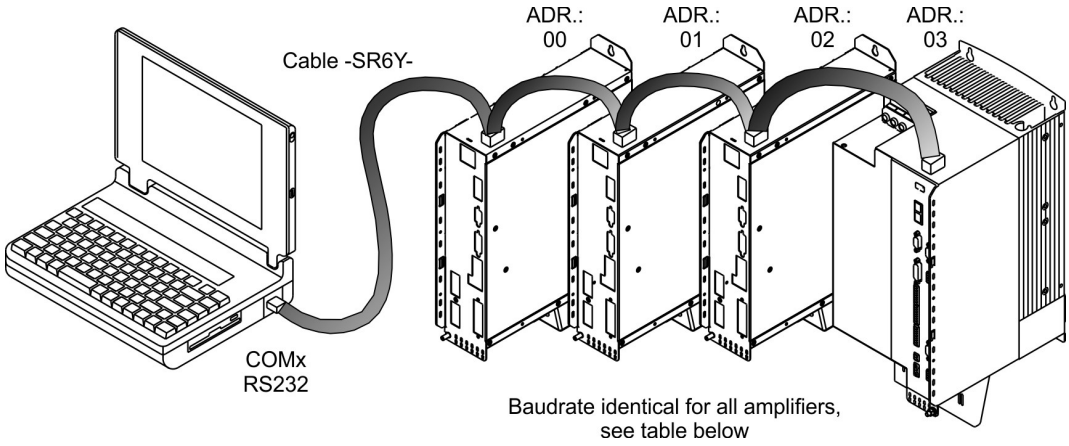
For all setup functions detailed information can be found in the online help system and the integrated command reference.

Select "Complete Setup" in the Setup-Wizard. Now you have access to:

- **CAN- and Feldus settings:** Setup address and baudrate
- **Feedback:** Adjust the used feedback unit
- **Motor:** Adjust the used motor
- **Control Loops:** Current-, Velocity- and Position-Loops can be optimized
- **Position Data:** Adjust the position control for the requirements of your application.
- **Position Registers:** Up to 16 position values in the motion way can be monitored.
- **Electronic Gearing:** If the servo amplifier will follow a setpoint as a slave with a gear ratio, you can select the gearing source here and define the gear ratio.
- **Encoder Emulation:** Select the encoder emulation (position output)
- **Analog I/O:** Setup the analog inputs
- **Digital I/O:** Setup the digital inputs and digital outputs
- **Status (Errors/Warnings):** Displays amplifiers data with history, actual faults and warnings
- **Monitor:** Displays the drive data (actual values)
- **Homing:** Definition and start of homing
- **Motion task:** Definition and start of motion task
- **Oscilloscope:** 4 channel oscilloscope with multiple functionality
- **Bode Plot:** Tool for optimizing the drive
- **Terminal:** Setup the servo amplifier with ASCII commands
- **Expansion Card:** Depending on the built-in expansion card a menu appears
- **Autotuning:** Fast tuning of the velocity controller

10.4 Multi axis system

With a special cable you can connect up to 255 servo amplifiers to your PC: cable type -SR6Y- (for four amplifiers) or -SR6Y6- (for six amplifiers) see Accessories Manual.



With the PC connected to only one amplifiers you can select every amplifier in the system via the set station address with the setup software.

Node address for CAN-bus

You can use the keypad on the front panel to preset the station addresses for the individual amplifiers and the baud rate for communication (➜ # 122). Usually the setup software is used to set all parameters.

Baud rate for CAN-bus

NOTE After changing the station address and baud rate you must turn the 24V auxiliary supply for the servo amplifier off and on again.

Coding of the Baud rate in the LED display:

Coding	Baud rate in kBit/s	Coding	Baud rate in kBit/s
1	10	25	250
2	20	33	333
5	50	50	500
10	100	66	666
12	125	80	800
		100	1000

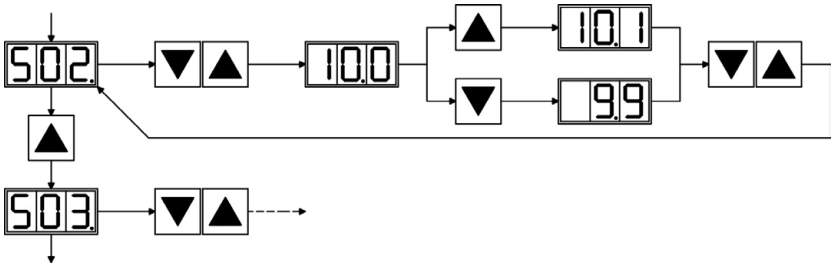
10.5 Keypad operation and LED display

This section illustrates the two possible operating menus and the use of the keys on the front panel. Normally, the S700 only presents the standard menu for your use. If you want to operate the amplifier via the detailed menu, you must keep the right key pressed while switching on the 24V supply.

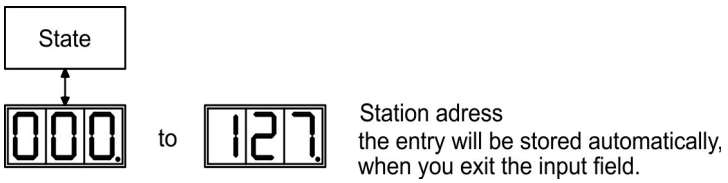
10.5.1 Operation

The two keys can be used to perform the following functions:

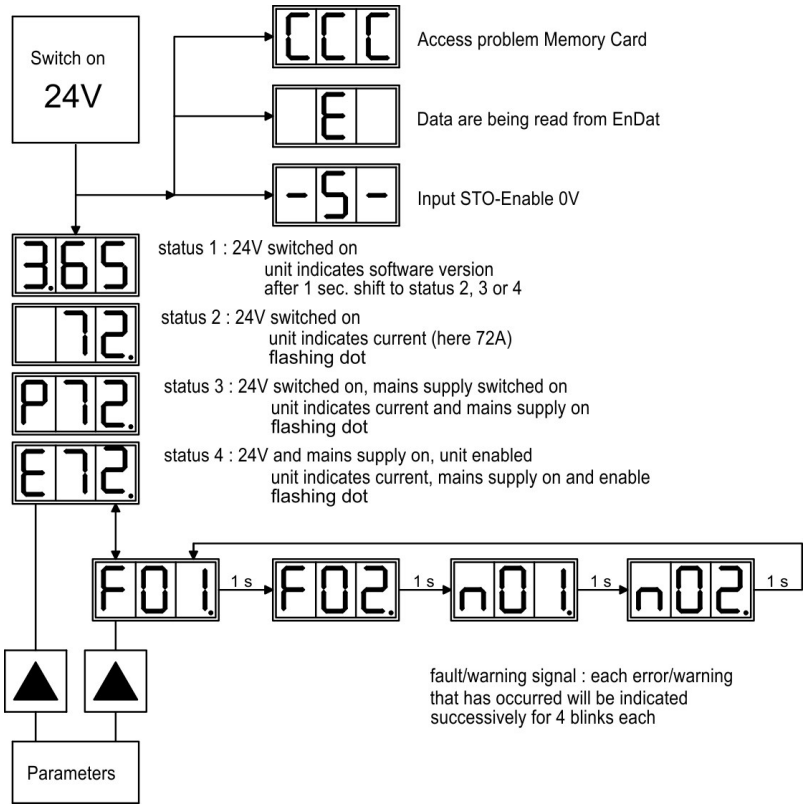
Key symbol	Functions
▲	**press once** : go up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : go down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**press and hold right key, then press left key as well** : enter a number, return function **name**



10.5.2 Status display

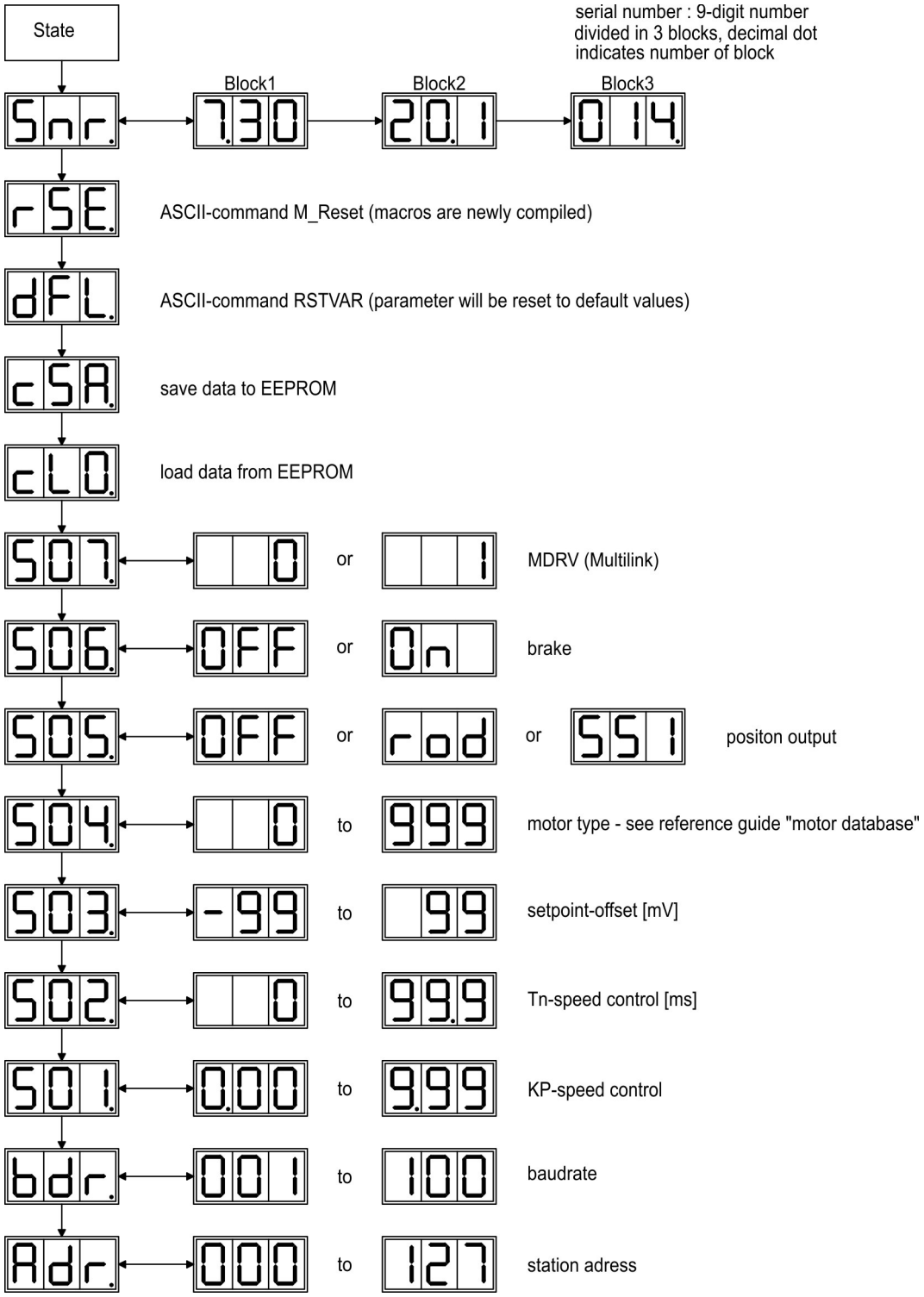


10.5.3 Standard menu structure



10.5.4 Advanced menu structure

NOTE To operate the amplifier via the detailed menu, you must keep the right key pressed while switching on the 24 V supply.



10.6 Error messages

Any errors that occur are shown in coded form by an error number in the LED-Display on the front panel. ERRCODE2 shows additional information coded with "ixx" for faults with an asterix "*" in the table below. The servo amplifier reaction depends on the fault and on the setting of parameter ACTFAULT . Faults can be reset by hardware reset of the servo amplifier or depending on the fault (see ERRCODE) by ASCII command CLRFAULT

Number	Designation	Explanation (ASCII Reference ERRCODE)
E or P	Status messages	Status messages, no error (➜ # 121)
. . .	Status message	Updating the startup configuration
-	Status message	Programming mode
- S -	STO-Enable	STO-Enable input is 0V (with disabled drive only)
CCC	Memory Card	Access problems memory card
F01	Heat Sink Temperature	Heat sink temperature too high limit is set by manufacturer to 80°
F02	Overvoltage	Overvoltage in DC bus link limit depends on the electrical supply voltage
F03	Following Error	Message from the position controller
F04*	Feedback	Cable break, short-circuit, short to ground
F05	Undervoltage	Undervoltage in DC bus link, limit is set by manufacturer to 100V
F06	Motor Temperature	Motor temperature too high or temp. sensor defect
F07*	Internal Voltages	Internal amplifier supply voltages are out of tolerance
F08	Overspeed	Motor over-revs, speed is too high
F09	EEPROM	Checksum error
F10	Reserved	Reserved
F11	Motor Brake	Motor cable break, short-circuit, short to ground
F12	Motor Phase	Motor phase missing (cable break or similar)
F13	Ambient Temperature	Ambient temperature too high
F14*	Output Stage	Fault in the power output stage or wrong motor cable or bad cable shielding
F15	I²t max.	I²t maximum value exceeded
F16	Mains BTB/RTO	2 or 3 phases missing in the mains supply feed
F17	A/D Converter	Error in the analog-digital conversion
F18*	Brake Circuit	Brake circuit faulty or incorrect setting
F19	Phase error	Mains phase missed
F20*	Slot Error	Slot error, depends on the type of expansion card, see ASCII object reference, ERRCODE*
F21	Handling Error	Handling error on the expansion card
F22	Reserved	Reserved
F23	CAN Bus Off	Severe CAN bus communication error
F24	Warning	Warning is displayed as fault
F25*	Commutation Error	Commutation error
F26	Limit Switch	Hardware limit switch error on homing move
F27	STO	Operational error with STO, input for STO-Enable and ENABLE have been set at the same time
F28	Fieldbus Error	Fieldbus error, see ASCII object reference, ERRCODE*
F29*	Fieldbus Error	Communication disturbed, see ASCII object reference, ERRCODE*
F30	Emergency Timeout	Timeout emergency stop
F31	Safety Supervision	Safety card error. Error code follows: oXX=error number, iYY=error subindex
F32*	System Error	System software not responding correctly

10.7 Warning messages

Faults which occur, but which do not cause a switch-off of the amplifier output stage (BTB/RTO contact remains closed), are indicated in the LED-Display on the front panel by a coded warning number.

Some warning messages result in a controlled shut-down of the drive (braking by emergency stop ramp). The servo amplifier reaction depends on the warning (see STATCODE).

Number	Designation	Explanation (ASCII Referenz STATCODE)
E/P	Status Messages	Status messages, no error (➜ # 121)
. . .	Status Message	Updating the startup configuration
-	Status Message	Programming mode
- S -	STO-Enable	STO-Enable input is 0V (with disabled drive only)
n01	I²t	I²t threshold exceeded
n02	Brake power	Reached preset electrical brake power limit
n03	S_fault	Exceeded preset following error limit
n04	Response monitoring	Response monitoring (fieldbus) has been activated
n05	Supply phase	Mains supply phase missing
n06	SW limit switch 1	Underrun software limit switch 1
n07	SW limit switch 2	Overrun software limit switch 2
n08	Motion task error	A faulty motion task was started
n09	No reference point	No reference point (Home) set at start of motion task
n10	PSTOP	PSTOP limit-switch activated
n11	NSTOP	NSTOP limit-switch activated
n12	Motor default values loaded	Only for ENDAT/ HIPERFACE: discrepancy between motor number saved in the encoder and the amplifier, motor default values loaded
n13	Expansion card	24V supply of the I/O expansion board is missing
n14	SinCos feedback	SinCos commutation (wake & shake) not completed, will be canceled when amplifier is enabled and wake & shake carried out
n15	Reserve	Reserve
n16	Summarized warning	Summarized warning for n17 to n31
n17	Fielbus Synchronization	CAN sync is not logged in
n18	Multiturn overrun	Max. number of motor turns exceeded
n19	Motion task ramps are limited	Range overflow on motion task data
n20	Invalid motion task	Invalid motion task
n21	PLC program error	For details see PLC code
n22	Max. motor temperatur reached	The user can shut down the process before the temperature eror will interrupt the process immediately
n23	Sin Cos feedback	Warning level reached
n24	Digital I/O	Configuration is not logical
n25...n31	reserved	reserved
n32	Firmware beta version	Firmware is an unreleased beta version

NOTE More information to the messages can be found in the ASCII Object Reference (online help), see parameter STATCODE. Hints for removal can be found in section "Trouble-Shooting" of the online help.

10.8 Trouble shooting

Depending on the conditions in your installation, there may be a wide variety of reasons for the fault. In multi-axis systems there may be further hidden causes of a fault.

NOTICE Eliminate errors and faults in compliance with work safety rules. Troubleshooting only by qualified and trained staff.

NOTE Detailled hints for removal of faults can be found in the online help chapter "Trouble-Shooting". Our customer service can give you further assistance with problems.

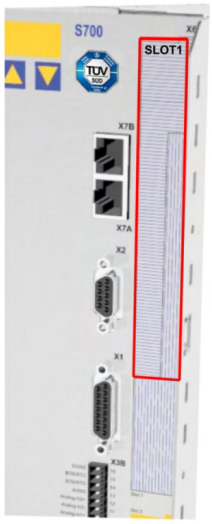
Fault	Possible causes	Measures to remove the cause of the fault
HMI message: communication fault	• wrong cable used • cable plugged into wrong position in servo amplifier or PC • wrong PC interface selected	• use null-modem cable • plug cable into the correct sockets on the servo amplifier and PC • select correct interface
Motor does not rotate	• servo amplifier not enabled • break in setpoint cable • motor phases swapped • brake not released • drive is mechanically blocked • no. of motor poles set incorrectly • feedback set up incorrectly	• apply enable signal • check setpoint cable • correct motor phase sequence • check brake control • check mechanism • set no. of motor poles • set up feedback correctly
Motor oscillates	• gain too high (speed controller) • shielding in feedback cable is broken • AGND not wired up	• reduce Kp (speed controller) • replace feedback cable • join AGND to CNC-GND
Drive reports following error	• I_{rms} or I_{peak} is set to low • setpoint ramp is too long	• increase I_{rms} or I_{peak} (keep within motor limits!) • shorten setpoint ramp +/-
Motor overheating	• I_{rms}/I_{peak} set too high	• reduce I_{rms}/I_{peak}
Drive too soft	• Kp (speed controller) too low • Tn (speed controller) too high • ARLPF / ARHPF too high • ARLP2 too high	• increase Kp (speed controller) • use motor default value for Tn (speed controller) • reduce ARLPF / ARHPF • reduce ARLP2
Drive runs roughly	• Kp (speed controller) too high • Tn (speed controller) too low • ARLPF / ARHPF too low • ARLP2 too low	• reduce Kp (speed controller) • use motor default value for Tn (speed controller) • increase ARLPF / ARHPF • increase ARLP2
Axis drifts at setpoint = 0V	• offset not correctly adjusted for analog setpoint provision • AGND not joined to the CNC-GND of the controls	• adjust setpoint-offset (analog I/O) • join AGND and CNC-GND

11 Expansions

Information about availability and order numbers see (➜ # 159).

11.1 Expansion cards for slot 1

11.1.1 Guide to installation of expansion cards in slot 1



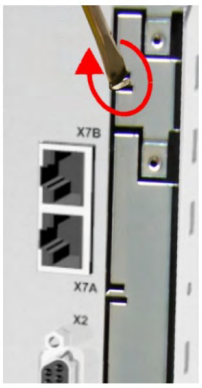
1 - Boundary of SLOT1



2 - Detach the film (at the perforations)



3 - Tear off the film (as far as the mark)



4 - Break the top rib



5 - Break the bottom rib



6 - Pull out the top plate



7 - Pull out the bottom plate



8 - Push in the card



9 - Fasten the screws

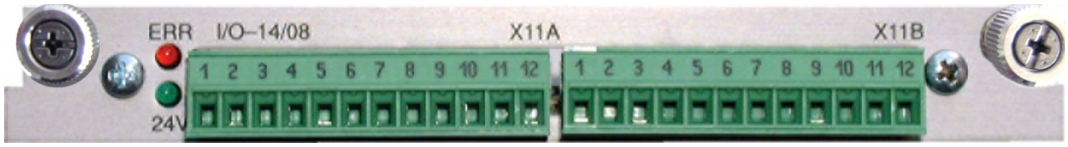
11.1.2 Expansion card -I/O-14/08-

This section describes the additional features that the expansion card -I/O-14/08- provides for the S700. If you ordered the expansion card together with the servo amplifier, then it will be delivered already inserted into the expansion slot of the servo amplifier and screwed in place.

The -I/O-14/08- provides you with 14 additional digital inputs and 8 digital outputs. The functions of the inputs and outputs are adjustable with the setup software.

NOTE The 24V DC voltage must be supplied by an electrically isolated power supply (e.g. with isolating transformer).

The I/Os are used to initiate the motion tasks that are stored in the servo amplifier and to evaluate signals from the integrated position control in the higher-level control system. The functions of the inputs and signal outputs correspond to the functions that can be assigned to the digital I/Os on connector X3. All inputs and outputs are electrically isolated from the servo amplifier by optocouplers.



11.1.2.1 Technical data

Control inputs	24V / 7mA , PLC compatible, IEC 61131
Signal output	24V / max. 500mA , PLC compatiblel, IEC 61131
Supply inputs, to IEC 61131	24V (18...36V) / 100mA plus total current of the outputs (depends on the input wiring of the controls)
Fusing (external)	4 AT
Connectors	MiniCombicon, 12-pin, coded on PIN1 and 12
Cables	Data – up to 50m long : 22 x 0.5 mm², unshielded, Supply – 2 x 1mm², check voltage drop
Waiting time between 2 motion tasks	Depends on the response time of the control system
Addressing time (minimum)	4ms
Starting delay (maximum)	2ms
Response time of digital outputs	max. 10ms

11.1.2.2 LEDs

Two LEDs are mounted next to the terminals on the expansion card. The green LED signals that the 24V auxiliary supply is available for the expansion card. The red LED signals faults in the outputs from the expansion card (overload of switching components, short-circuit).

11.1.2.3 Entering a motion block number (example)

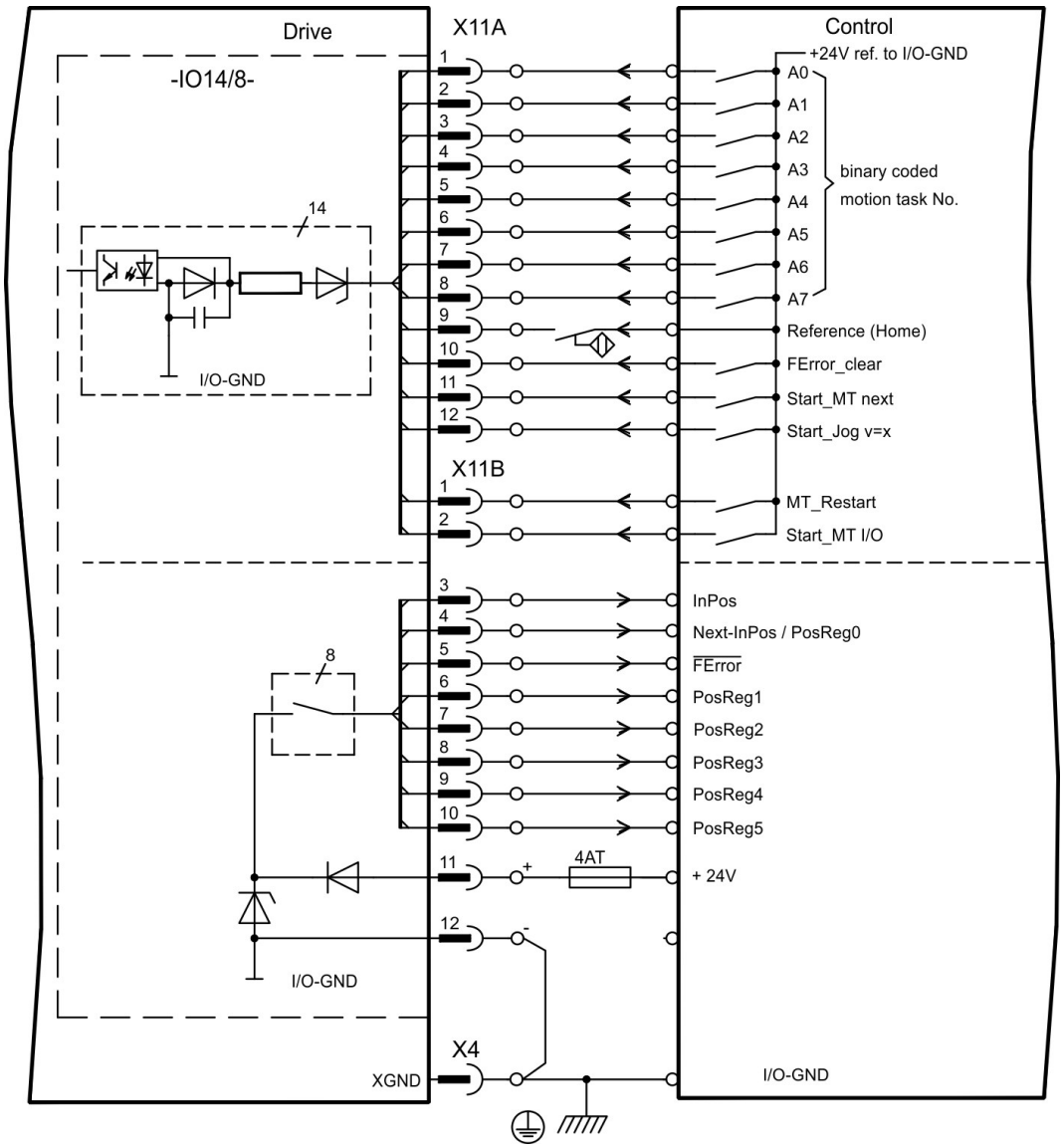
Motion block number	A7	A6	A5	A4	A3	A2	A1	A0
binary 1010 1110	1	0	1	0	1	1	1	0
decimal 174	128	-	32	-	8	4	2	-

11.1.2.4 Connector assignments

The functions are adjustable with the setup software.

Pin	Dir	Default	Description
Connector X11A			
1	In	A0	Motion block number 2^0, LSB
2	In	A1	Motion block number 2^1
3	In	A2	Motion block number 2^2
4	In	A3	Motion block number 2^3
5	In	A4	Motion block number 2^4
6	In	A5	Motion block number 2^5
7	In	A6	Motion block number 2^6
8	In	A7	Motion block number 2^7, MSB
9	In	Reference	Polls the home switch. If a digital input on the base unit is used as a home input, then the input on the expansion card will not be evaluated.
10	In	F_error_clear	Clears the warning of a following error (n03) or the response monitoring (n04)
11	In	F_error_clear	The following task, that is defined in the motion task by “Start with I/O” is started. The target position of the present motion task must be reached before the following task can be started. The next motion block can also be started by an appropriately configured digital input on the base unit.
12	In	Start_Jog v= x	Starts the "Jog Mode" with a defined speed. “x” is the speed saved in the servo amplifier for the function "Jog Mode". A rising edge starts the motion, a falling edge cancels the motion.
Connector X11B			
1	In	MT_Restart	Continues the motion task that was previously interrupted.
2	Out	Start_MT I/O	Starts the motion task that is addressed by A0-A7 (connector X11A/1 to X11A8). If no motion task is addressed, then a homing task is started.
3	Out	InPos	When the target position for a motion task has been reached (the InPosition window), this is signaled by the output of a HIGH signal. **A cable break will not be detected.**
4	Out	Next-InPos	The start of each motion task in an automatically executed sequence of motion tasks is signaled by an inversion of the output signal. The output produces a LOW signal at the start of the first motion task of the sequence. The form of the message can be varied by using ASCII commands.
		PosReg 0	Can be adjusted by ASCII commands only.
5	Out	$\overline{\text{F_error}}$	A LOW signal indicates that the position has gone outside the acceptable following error window.
6	Out	PosReg1	default: SW limit 1, indicated by a HIGH signal
7	Out	PosReg2	default: SW limit 2, indicated by a HIGH signal
8	Out	PosReg3	Can only be adjusted by ASCII commands
9	Out	PosReg4	Can only be adjusted by ASCII commands
10	Out	PosReg5	Can only be adjusted by ASCII commands
11	-	24V DC	Supply voltage for output signals.
12	-	I/O-GND	Digital GND for the control system.

11.1.2.5 Connection diagram (default)

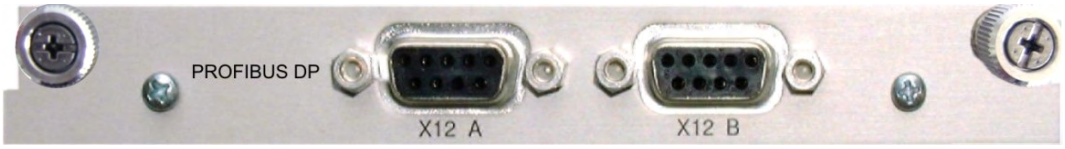


11.1.3 Expansion card -PROFIBUS-

This section describes the PROFIBUS expansion card for the S700. Information on the range of functions and the software protocol can be found in our manual “Communication Profile PROFIBUS DP”.

The PROFIBUS expansion card has two 9-pin SubD sockets wired in parallel.

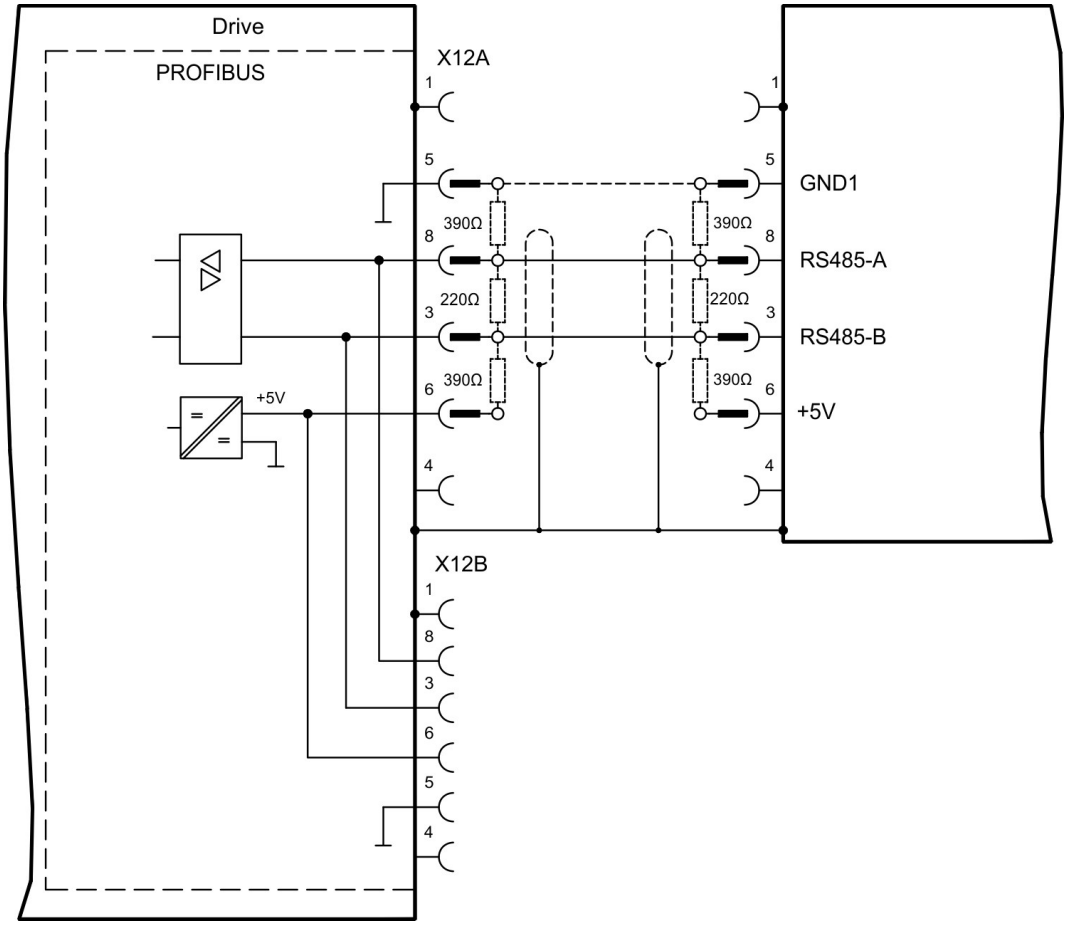
The supply voltage for the expansion card is provided by the servo amplifier.



11.1.3.1 Connection technology

Cable selection, cable routing, shielding, bus connector, bus termination and transmission times are all described in the “Installation Guidelines for PROFIBUS-DP/FMS” from PNO, the PROFIBUS User Organization.

11.1.3.2 Connection diagram



11.1.4 Expansion card -SERCOS-

This section describes the sercos® II expansion card for S700. Information on the range of functions and the software protocol can be found in our manual “IDN Reference Guide sercos®”.



11.1.4.1 LEDs

RT	Indicates whether sercos® telegrams are being correctly received. In the final Communication Phase 4 this LED should flicker, since cyclical telegrams are being received.
TT	Indicates that sercos® telegrams are being transmitted. In the final Communication Phase 4 this LED should flicker, since cyclical telegrams are being transmitted. Check the station addresses for the controls and the servo amplifier if: ● - the LED never lights up in sercos® Phase 1 or ● - the axis cannot be operated, although the RT LED is lighting up cyclically.
ERR	Indicates that sercos® communication is faulty or suffering from interference. If this LED is very bright, then communication is suffering strong interference, or is non-existent. Check the sercos® transmission speed for the controls and the servo amplifier (BAUD RATE) and the fiber-optic connection. If this LED fades or flickers, this indicates a low level of interference for sercos® communication, or the optical transmitting power is not correctly matched to the length of cable. Check the transmitting power of the (physically) previous sercos® station. The transmitting power of the servo amplifier can be adjusted in the setup software DRIVEGUI.EXE on the sercos® screen page, by altering the length parameter for the cable length.

11.1.4.2 Connection technology

For the fiber optic cable connection, only use sercos® components to the sercos® Standard IEC 61491.

Receive data

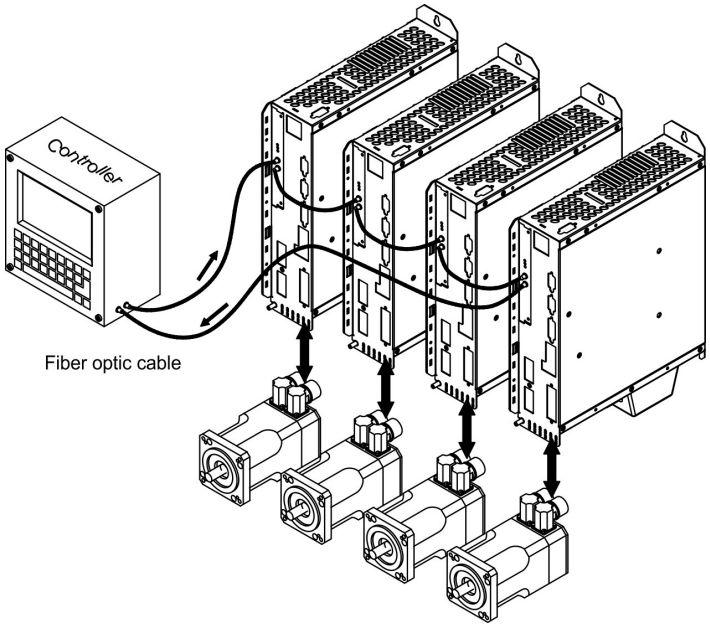
The fiber optic cable carrying receive data for the drive in the ring structure is connected to X13 with an F-SMA connector.

Transmit data

Connect the fiber optic cable for the data output to X14 by F-SMA connector.

11.1.4.3 Connection diagram

Layout of the sercos® bus system in ring topology, with fiber optical cables (schematic).



11.1.4.4 Setup

Modifying the station address

The drive address can be set to a value between 0 and 63. With address 0, the drive is assigned as an amplifier in the sercos® ring. Set the station address with the:

Keys on the front of the servo amplifier

The sercos® address can be modified using the keys on the front of the amplifier (➜ # 120).

Setup software

The address can also be modified in the setup software, “CAN/Fieldbus” screen (please refer to the setup software Online Help). Alternatively, enter the command **ADDR #** in the “Terminal” screen, where # is the new address of the drive.

Modifying the baud rate and optical power

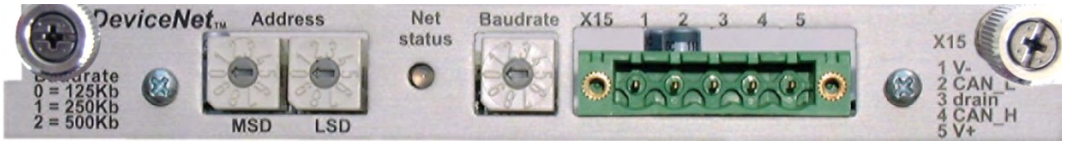
If the baud rate is not set correctly, communication is not possible.
The **SBAUD #** parameter can be used to set the baud rate, where # is the baud rate. If the optical power is not set correctly, errors occur in telegram transmission and the red LED on the drive lights up. During normal communication, the green send and receive LEDs flash, giving the impression that the relevant LED is on.
The **SLEN #** parameter can be used to specify the optical range for a standard 1 mm² glass fibre cable, where # is the length of the cable in meters.

SBAUD		SLEN	
2	2 Mbaud	0 m	Very short connection
4	4 Mbaud	1…< 15 m	Length of the connection with a 1 mm² plastic cable
8	8 Mbaud	15…< 30 m	Length of the connection with a 1 mm² plastic cable
16	16 Mbaud	≥ 30 m	Length of the connection with a 1 mm² plastic cable

The parameters can be modified in the setup software, “SERCOS” screen (please refer to the setup software the Online Help). Alternatively, the commands **SBAUD #** and **SLEN #** can be entered in the “Terminal” screen.

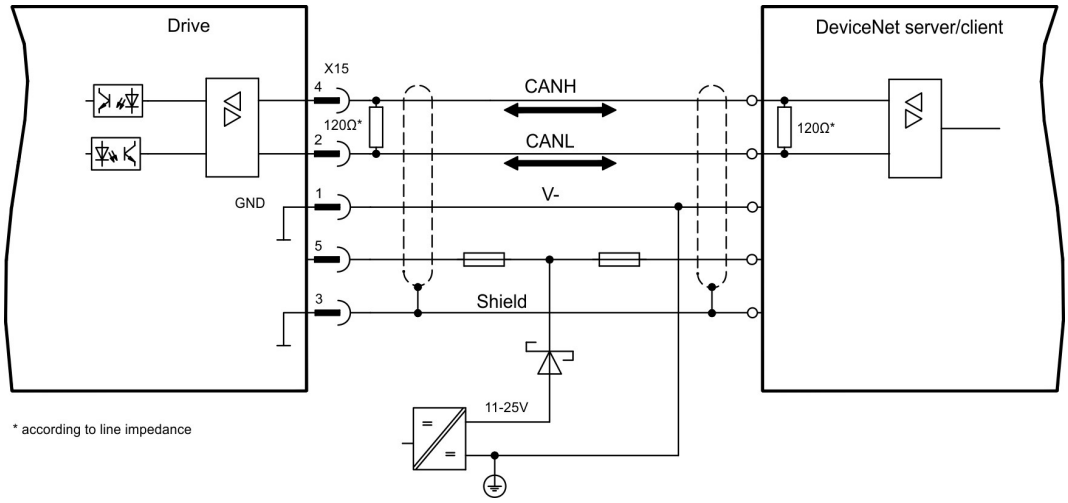
11.1.5 Expansion card - DEVICENET -

This section describes the DeviceNet expansion card for S700. Information on the range of functions and the software protocol can be found in our manual “DeviceNet Communication Profile”.



11.1.5.1 Connection technology, Connection diagram

Cable selection, cable routing, shielding, bus connector, bus termination and transmission times are all described in the “DeviceNet Specification, Volume I, II”, published by ODVA.



11.1.5.2 Combined module status and network status LED

LED	Bedeutung:
off	The device is not online. ● - The device has not yet finished the Dup_MAC_ID test. ● - The device is possibly not yet switched on.
green	The device is operating as normal, is online, and the connections have been established. The device has been assigned to a master.
blinking green	The device is operating as normal, is online, but the connections have not been established. ● - The device has passed the Dup_MAC_ID test and is online, but the connection to other nodes have not been established. ● - This device has not been assigned to a master. ● - Missing, incomplete or wrong configuration.
blinking red	An error that can be cleared and/or at least one I/O connection are in a waiting state.
red	● - An error has occurred that cannot can be cleared; it may be necessary to replace the device. ● - Communication device failure. The device has detected a fault that prevents communication with the network (for instance, a MAC ID appears twice or BUSOFF).

11.1.5.3 Setup

Setting the station address (device address)

The station address for the servo amplifier can be set in three different ways:

- Set the rotary switches at the front of the expansion card to a value between 0 and 63. Each switch represents a decimal figure. For example, to set the address for the drive to 10, set MSD to 1 and LSD to 0.
- Set the rotary switches at the front of the expansion card to a value higher than 63. Now you can set up the station address by using the ASCII commands DNMACID x, SAVE, COLDSTART, whereby “x” stands for the station address.
- Set the rotary switches at the front of the expansion card to a value higher than 63. Now you can set up the station address by using the DeviceNet Object (Class 0x03, Attribute 1). This is normally carried out with the help of a DeviceNet software setup tool. You must save the parameters in non-volatile memory (Class 0x25, Attribute 0x65) and then restart the drive after setting or altering the address.

Setting the transmission speed

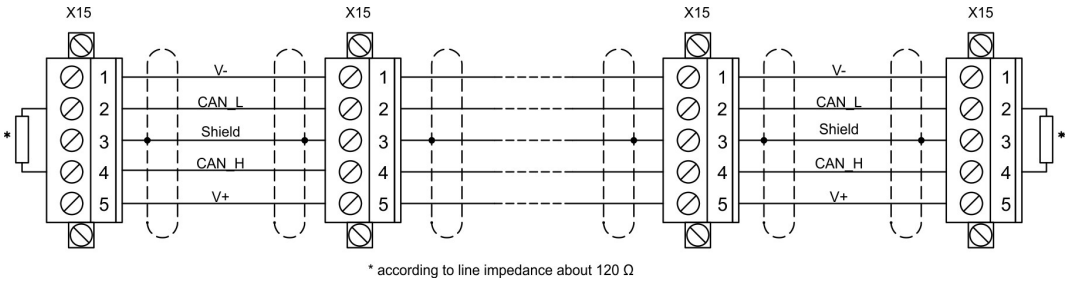
The DeviceNet transmission speed can be set in three different ways:

- Set the rotary switch for Baud rate (at the front of the option card) to a value between 0 and 2. 0 = 125 kbit/s, 1 = 250 kbit/s, 2 = 500 kbit/s.
- Set the rotary switch for Baud rate (at the front of the option card) to a value higher than 2. Now you can set the Baud rate by using the terminal commands DNBAUD x, SAVE, COLDSTART, whereby “x” stands for 125, 250 or 500 .
- Set the rotary switch for Baud rate (at the front of the option card) to a value higher than 2. Now you can set the Baud rate by using the DeviceNet Object (Class 0x03, Attribute 2) to a value between 0 and 2. This is normally carried out with the help of a DeviceNet software setup tool. You must save the parameters in non-volatile memory (Class 0x25, Attribute 0x65) and then restart the drive after altering the baud rate.

11.1.5.4 Bus cable

To meet ISO 11898, a bus cable with a characteristic impedance of 120 Ω should be used. The maximum usable cable length for reliable communication decreases with increasing transmission speed. As a guide, you can use the following values which we have measured, but they are not to be taken as assured limits.

General characteristic	Specification
Bit rates	125 kBit, 250 kBit, 500 kBit
Distance with larger bus connections	500 m at 125 kBaud 250 m at 250 kBaud 100 m at 500 kBaud
Number of nodes	64
Signal environment	CAN
Modulation	Basic bandwidth
Coupling medium	DC-coupled differential transmit/receive operation
Isolation	500 V (option: optocoupler on the transceiver's node side)
Typical differential input impedance (recessive state)	Shunt C = 5pF Shunt R = 25kΩ (power on)
Min. differential input impedance (recessive state)	Shunt C = 24pF + 36 pF/m of the permanently attached stub cable Shunt R = 20kΩ
Absolute max. voltage range	-25 V bis +18 V (CAN_H, CAN_L). The voltages for CAN_H and CAN_L refer to the ground pin of the transceiver. The voltage is higher than that on the V-terminal by the amount of the forward voltage drop of the Schottky diode. This voltage drop must be < 0.6V.



Grounding:

The DeviceNet network must only be grounded at one point, to avoid ground loops.
The circuitry for the physical layer in all devices are referenced to the V-bus signal. The ground connection is made via the power supply for the bus system. The current flowing between V- and ground must not flow through any device other than the power supply.

Bus topology:

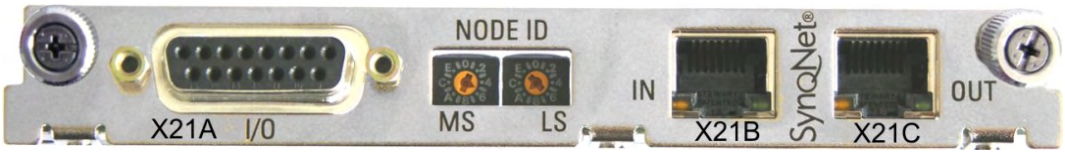
The DeviceNet medium utilizes a linear bus topology. Termination resistors are required at each end of the connecting cable. Stub cables are permitted up to a length of 6 meters, so that at least one node can be connected.

Termination resistors:

DeviceNet requires a termination at each end of the connecting cable.
These resistors must meet the following requirements: 120 Ω, 1% metal-film, ¼ W

11.1.6 Expansion card -SYNQNET-

This section describes the SynqNet expansion card for S700. Information on the range of functions and the software protocol can be found in the SynqNet documentation.



11.1.6.1 NODE ID Switch

With these hexadecimal switches you can set the main and low significant bytes of the Node ID separately. SynqNet does not require an address for correct operation in the network, however in some machines this can be a convenient way of identifying build options to the application program.

11.1.6.2 NODE LED table

LED#	Name	Function
LED1	LINK_IN	ON = receive valid (IN port) OFF= not valid, power off, or reset.
LED2	CYCLIC	ON = network cyclic BLINK = network not cyclic OFF = power off, or reset
LED3	LINK_OUT	ON = receive valid (OUT port) OFF = not valid, power off, or reset
LED4	REPEATER	ON = repeater on, network cyclic BLINK = repeater on, network not cyclic OFF = repeater off, power off, or reset

11.1.6.3 SynqNet Connection, Connector X21B / X21C (RJ-45)

Connection to the SynqNet network via RJ-45 connectors (IN and OUT ports) with integrated LEDs.

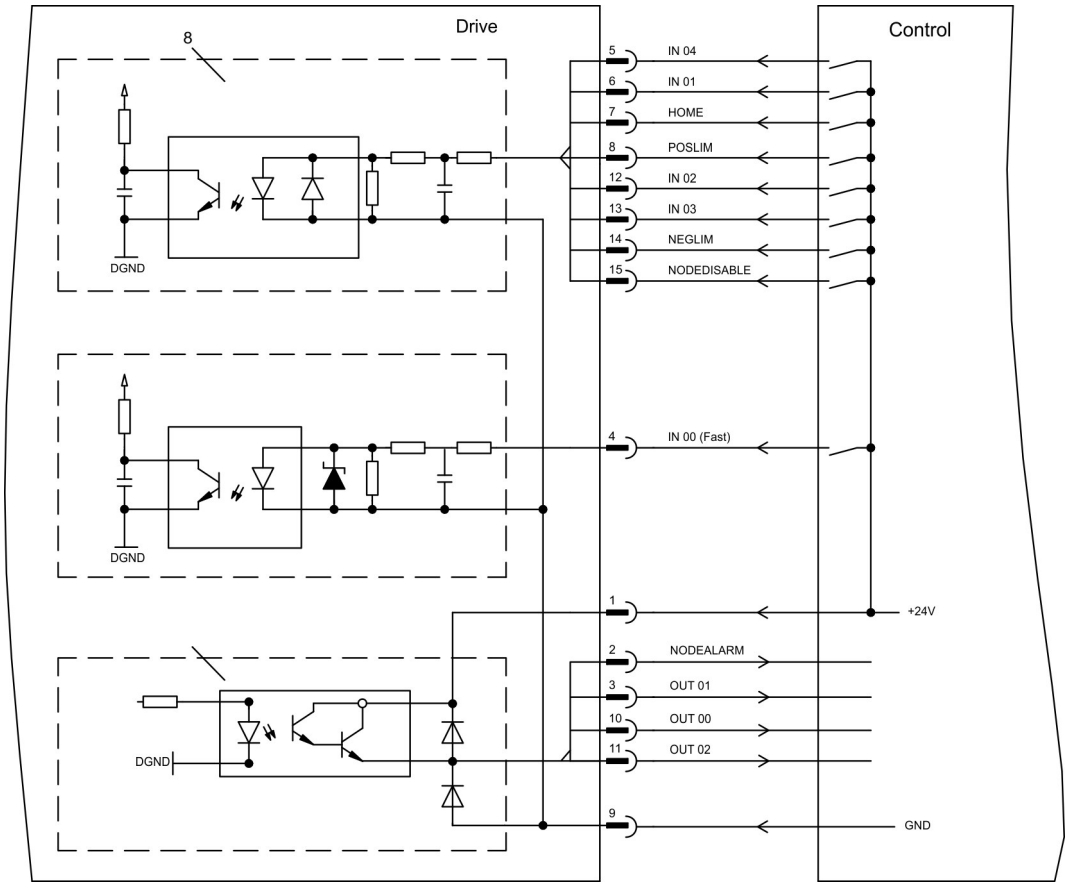
11.1.6.4 Digital inputs and outputs, connector X21A (SubD 15-pin, socket)

Inputs (In): 24V (20…28V), opto-isolated, one high-speed input (Pin 4)

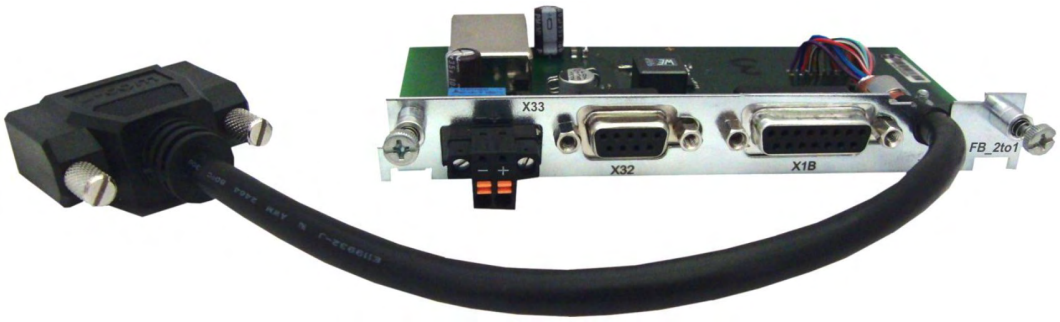
Outputs (Out): 24V, opto-isolated, Darlington driver

Pinout connector X21A (SubD 15 pin)			
Pin	**Type**	**Description**	
1	In	+24V	power supply
2	Out	NODEALARM	indicates a problem with the node
3	Out	OUT_01	digital output
4	In	IN_00 (fast)	capture input (fast)
5	In	IN_04	digital input
6	In	IN_01	digital input
7	In	HOME	reference switch
8	In	POSLIM	limit switch, positive direction
9	In	GND	power supply
10	Out	OUT_00	digital output
11	Out	OUT_02	digital output
12	In	IN_02	digital input
13	In	IN_03	digital input
14	In	NEGLIM	limit switch, negative direction
15	In	NODEDISABLE	disables Node

11.1.6.5 Connection diagram digital inputs and outputs, connector X21A



11.1.7 Expansion card - FB-2to1 -



This chapter describes the Feedback extension card FB-2to1 for the S700. The card enables simultaneous connection of a digital primary and of an analog secondary feedback to the connector X1. The supply of 24V DC auxiliary voltage to X33 is converted on the extension card into a precise 5V DC encoder supply for the secondary feedback.

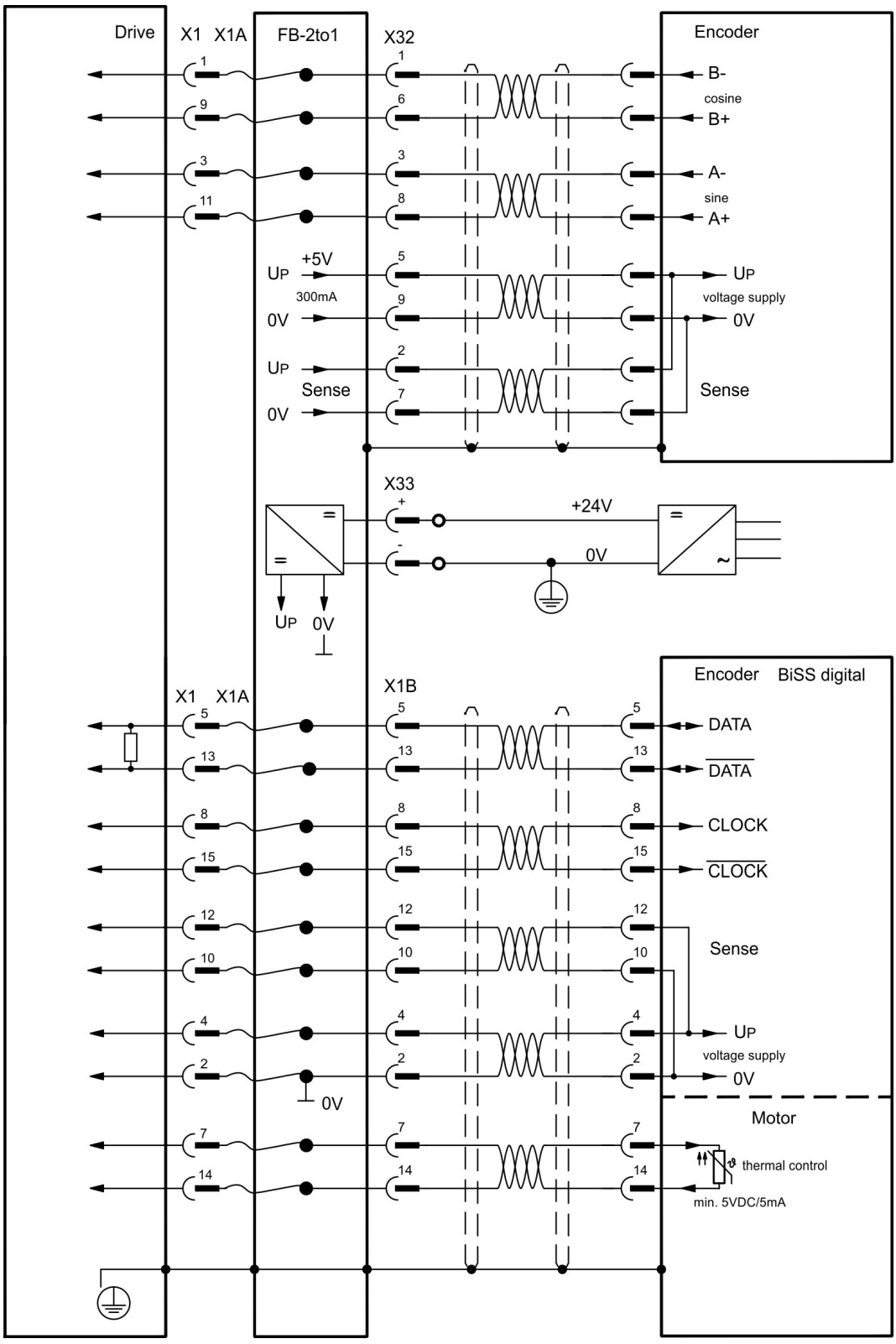


11.1.7.1 Pinout

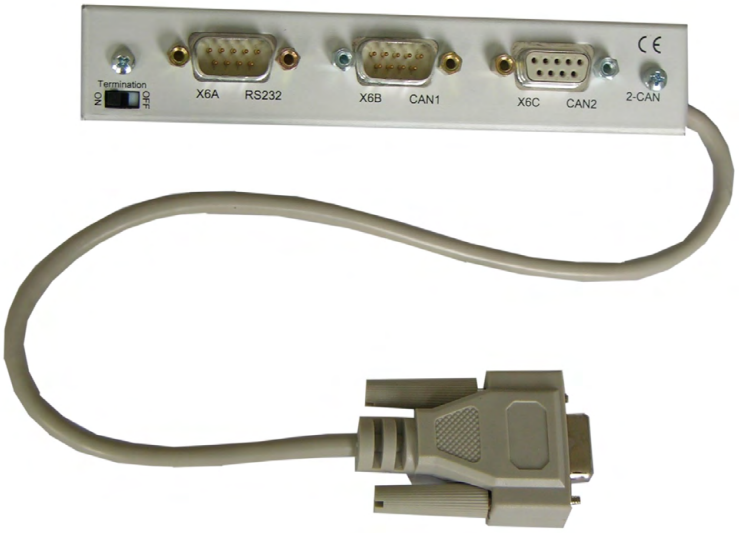
X33	Pinout Combicon Connector
+	+24V DC (20...30V), approx. 500mA
-	GND

X32	Pinout SubD 9 poles (secondary Feedback) SinCos (1V p-p)	X1B	Pinout SubD 15 poles (primary Feedback) EnDat 2.2, BiSS digital, SSI absolute
1	B- (cosine)	1	n.c.
2	SENSE+	2	0V
3	A- (sine)	3	n.c.
4	n.c.	4	+5V DC
5	+5V DC (300mA)	5	DATA
6	B+ (cosine)	6	n.c.
7	SENSE-	7	Temperature Sensor Motor
8	A+ (sine)	8	CLOCK
9	0V	9	n.c.
-	-	10	Sense 0V
-	-	11	n.c.
-	-	12	Sense +5V
-	-	13	$\overline{\text{DATA}}$
-	-	14	Temperature Sensor Motor
-	-	15	$\overline{\text{CLOCK}}$

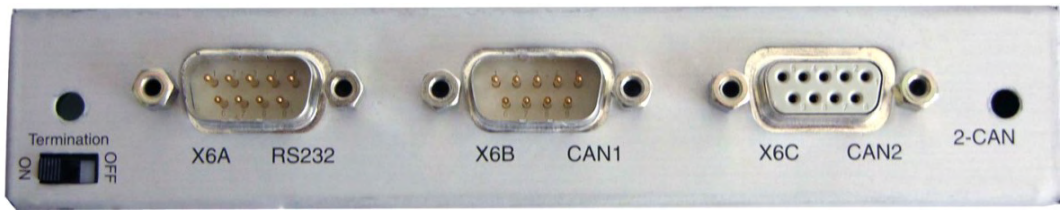
11.1.7.2 Wiring example with BiSS digital (primary) and SinCos (secondary)



11.1.8 Expansion module -2CAN-



2CANConnector X6 of the S700 is assigned to the signals for the RS232 interface and the CAN interface. It is therefore not the standard pin assignment for these interfaces, and a special cable is required to be able to use both interfaces simultaneously. The -2CAN- expansion module provides the interfaces on separate Sub-D connectors. The two CAN connectors are wired in parallel. A termination resistor (120) for the CAN bus can be switched into circuit if the S700 is at the end of the bus.



11.1.8.1 Installation

The modul mu st be placed onto the option slot after levering off the cover of the option slot 1 (➜ # 126):

NOTE

- Screw the distance pieces into the fixing lugs of the option slot.
- Place the expansion module onto the option slot.
- Screw the screws into the threads of the distance pieces.
- Plug the Sub-D9 socket into connector X6 on the S700

11.1.8.2 Connection technology

Standard shielded cables can be used for the RS232 and CAN interfaces.

NOTE

If the servo amplifier is the last device on the CAN bus, then the switch for the bus termination must be set to ON.

Otherwise, the switch must be set to OFF (condition as delivered).

11.1.8.3 Connector assignments

RS232		CAN1=CAN2	
X6A Pin	Signal	X6B=X6C Pin	Signal
1		1	
2	RxD	2	CAN-Low
3	TxD	3	CAN-GND
4		4	
5	GND	5	
6		6	
7		7	CAN-High
8		8	
9		9	

11.1.8.4 Setup of Station Address and Baud Rate

During setup it makes sense to use the keypad on the front panel to preset the station addresses for the individual amplifiers and the Baud rate for communication.

NOTE After changing the station address and baud rate you must turn the 24V auxiliary supply for the servo amplifier off and on again.

Possible ways for setup:

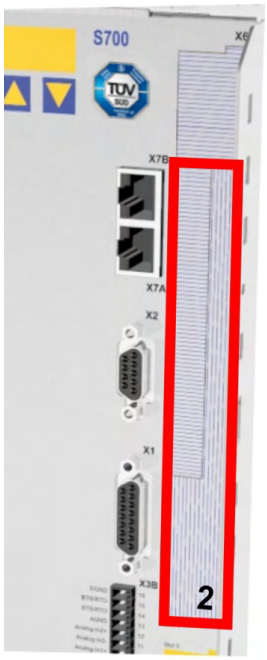
- keypad on the front panel of the servo amplifier
- setup software: screen page “CAN / Fieldbus”
- serial interface with a sequence of ASCII commands:
  ADDR nn => SAVE => COLDSTART (with nn = address)
  CBAUD bb => SAVE => COLDSTART (with bb = baud rate in kBaud)

Coding of the Baud rate in LED display:

Coding	Baud rate in kBit/s	Coding	Baud rate in kBit/s
1	10	25	250
2	20	33	333
5	50	50	500
10	100	66	666
12	125	80	800
		100	1000

11.2 Expansion cards for slot 2

11.2.1 Guide to installation of expansion cards in slot 2



Boundary of SLOT2

The method of installing the expansion card in slot 2 is the same as that described for slot 1 (➜ # 126).

- Remove the lower crosshatched area of the front film (labeled slot 2).
- Lever out the cover plates under the film.
- Push the expansion card into the slot.
- Use the screws provided to fasten the front plate of the expansion card in place.

11.2.2 Option "F2", controlled Fan

To reduce noise emission the servo amplifiers can be ordered with the built-in option card F2. This option cannot be built-in later. The F2 option card fits to slot2 or 3 (see part number scheme on (➜ # 26)).

NOTE Option card F2 can be used combined with a card in slot 1 even if it is plugged to slot 2!

Function

The fan is switched on and off or runs with 50% rated speed depending on temperature. That reduces the average noise emission.

Switching temperature

Monitoring	Fan off	Fan ~50%	Fan on
Ambient temperature	< 55°C	~ 58°C	> 65°C
Heat sink temperature	< 58°C	~ 68°C	> 80°C

11.2.3 Expansion cards "PosI/O" & "PosI/O-Monitor"

The “PosI/O” and "PosI/O-Monitor" expansion card can be pushed into slot 2 or 3. The expansion cards cannot be combined and the use of only one slot in time is allowed.

PosI/O



This expansion card provides an extra SubD connector (X5) with high-speed, bidirectional, digital, 5 V inputs and outputs. The setup software can be used to preset various input and output functions, e.g.:

- Position encoder emulation (ROD- or SSI-compatible)
- Input for high-speed 5 V RS485 signals (electronic gearing, master-slave operation)

PosI/O-Monitor



This expansion card provides the features of the PosI/O card plus an extra connector X3C with analog +/-10V Inputs and Outputs (see chapter "Analog I/O" (➜ # 151)). Functionality can be set with the setup software or with macro functions.

11.2.3.1 Feedback

11.2.3.1.1 ROD (AquadB) 5V (X5, X1)

A 5V incremental encoder (AquadB) can be used as standard motor feedback (primary and secondary, (➜ # 75)). Every time the 24V auxiliary voltage is switched on, the amplifier need start-up information for the position controller (parameter value MPHASE). Depending on the feedback type either wake&shake is executed or the value for MPHASE is read out of the amplifier's EEPROM.



⚠WARNING Vertical load can fall!

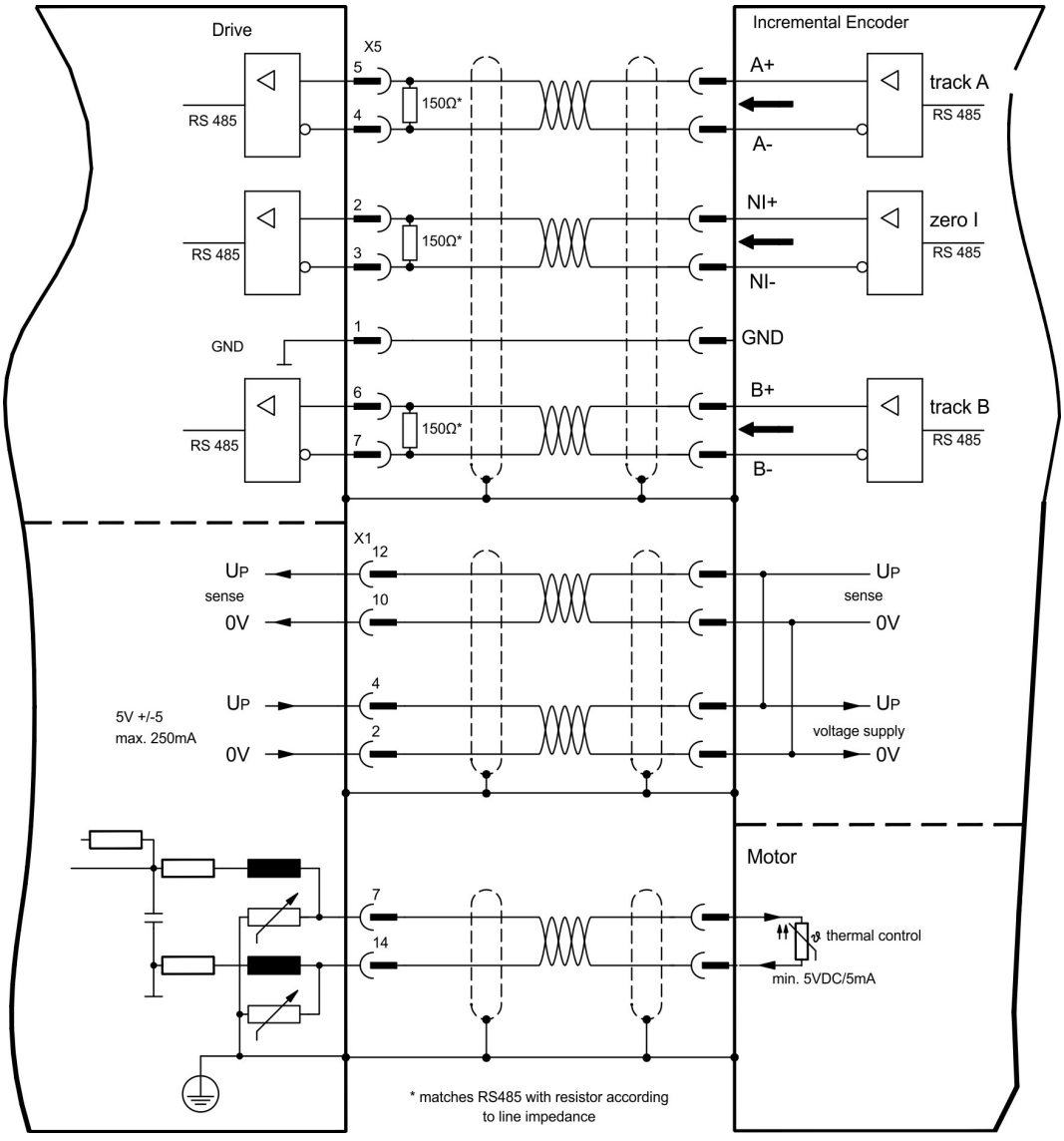
With vertical load the load could fall during wake&shake, because the brake is not active and torque is not sufficient to hold the load.

- Don't use wake&shake with vertical load (hanging load).

The power supply for the encoder and thermal control in the motor is connected to X1. If lead lengths of more than 50 m are planned please consult our customer service.
Frequency limit (A, B, N): 1.5 MHz

Type	FBTYPE	EXTPOS/Gearmode	ENCMODE	Remarks
AquadB 5V	13	3	0	MPHASE from EEPROM
AquadB 5V	19	3	0	MPHASE with wake&shake

Switch on supply voltage for the encoder at X1: set ENCVON to 1



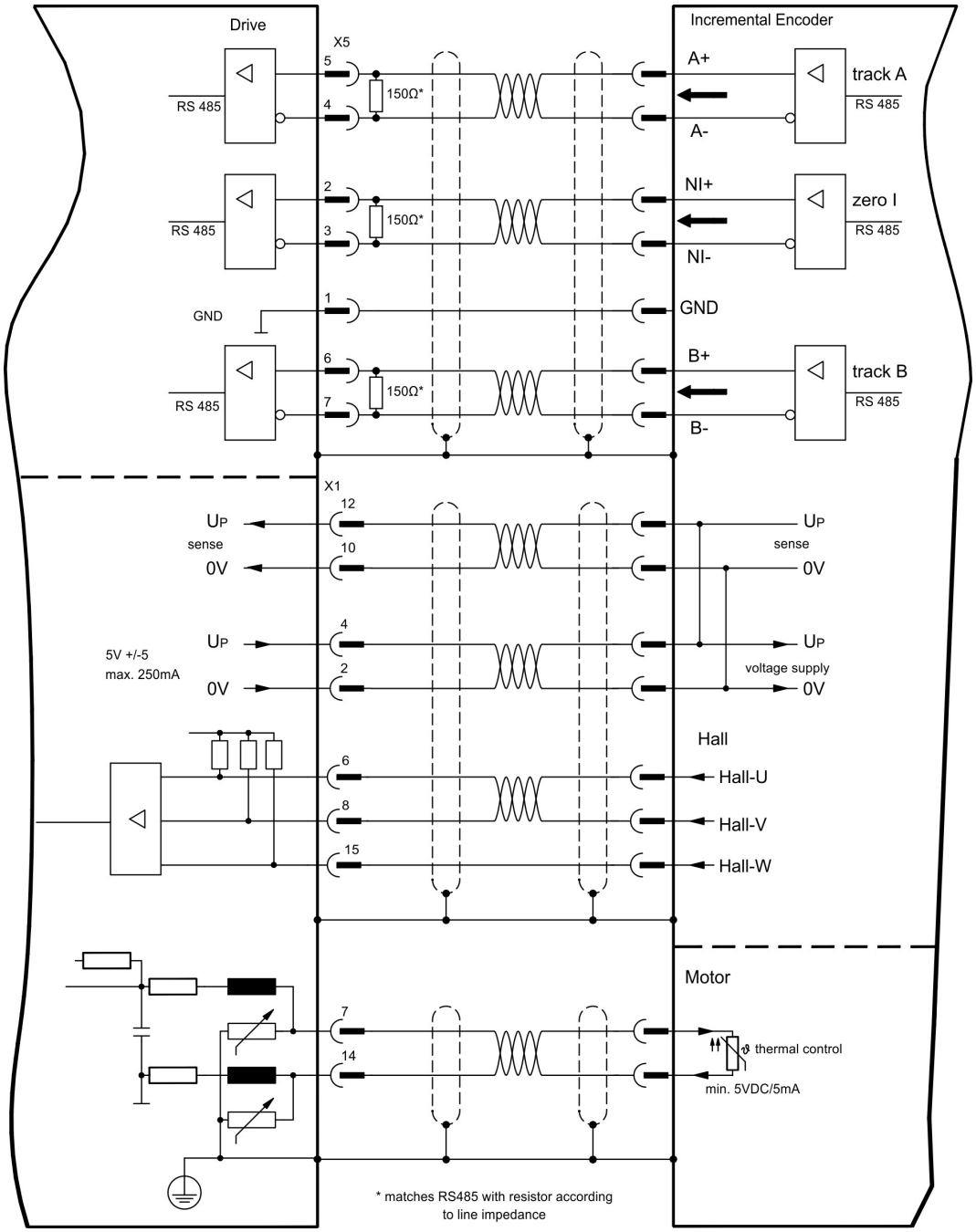
11.2.3.1.2 ROD (AquadB) 5V with Hall (X5, X1)

Wiring of a 5V incremental encoder (ROD, AquadB) with Hall sensors as a feedback unit (primary, (➜ # 75)). For the commutation hall sensors are used and for the resolution an incremental encoder.

The power supply for the encoder and thermal control in the motor is connected to X1 and evaluated there.

If cable lengths of more than 25m are planned, please consult our customer service.
Frequency limit X5: 1.5 MHz, X1: 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	ENCMODE
AquadB 5V with Hall	18	-	-	0



11.2.3.1.3 SSI Encoder (X5, X1)

Wiring of a synchronous serial absolute-encoder as a feedback system (primary or secondary, (➜ # 75)). The signal sequence can be read in Gray code or in Binary (standard) code.

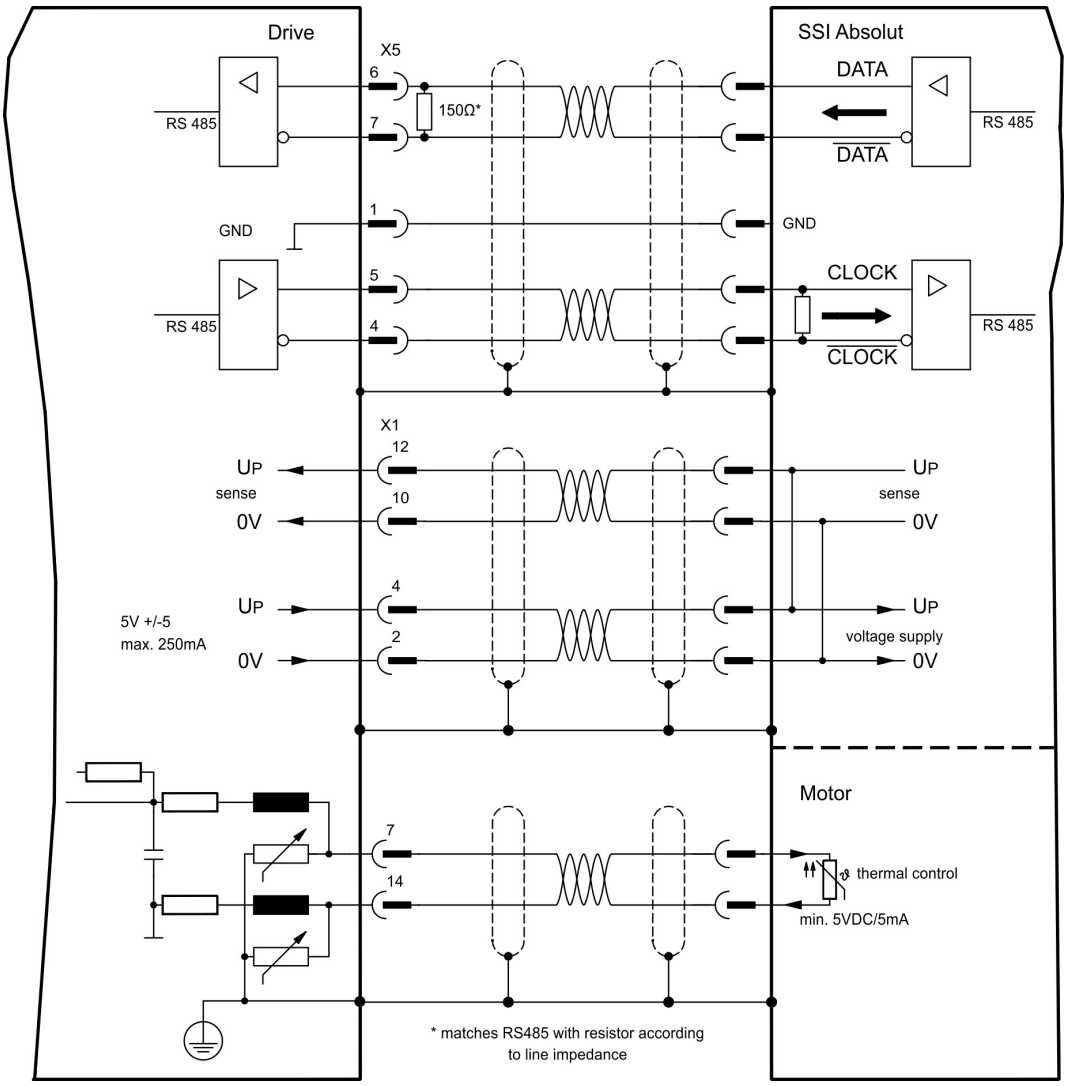
The power supply for the encoder and thermal control in the motor is connected to X1 and evaluated there.

If cable lengths of more than 50m are planned, please consult our customer service.

Frequency limit: 1.5 MHz

Type	FBTYPE	EXTPOS	GEARMODE	ENCMODE
SSI	9	5	5	0

Switch on supply voltage for the encoder at X1: set ENCVON to 1



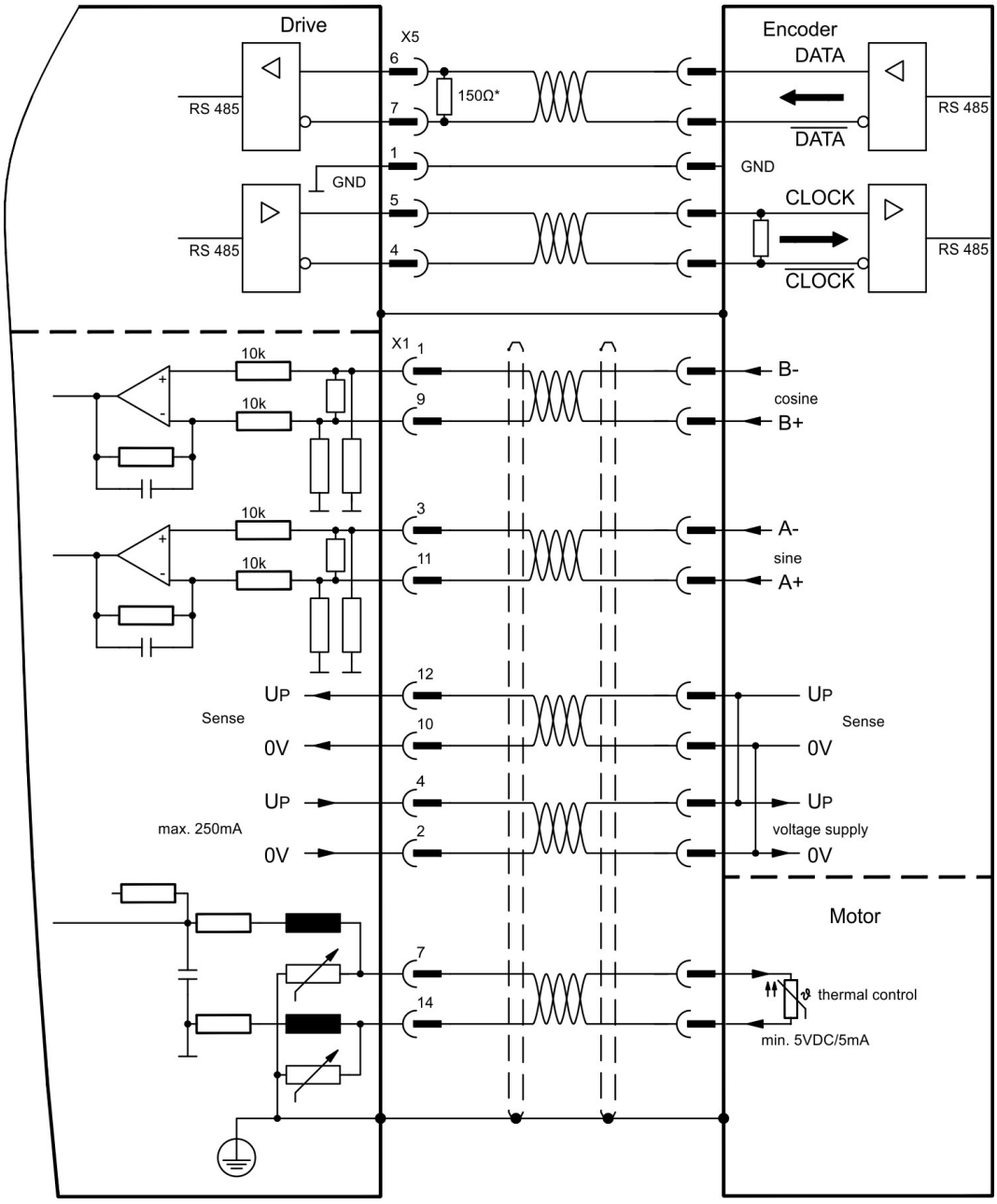
11.2.3.1.4 Sine Encoder with SSI (X5, X1)

Wiring of sine-cosine encoder with SSI interface as a linear feedback system (primary, (➜ # 75)).

The thermal control in the motor is connected via the encoder cable to X1 and evaluated there. All signals are connected using our pre-assembled encoder connection cable. If cable lengths of more than 50m are planned, please consult our customer service.

Frequency limit (sin, cos): 350 kHz

Type	FBTYPE	EXTPOS	GEARMODE	ENCMODE
SinCos SSI 5V linear	28	-	-	0



11.2.3.2 Electronic gearing, Master-Slave operation (X5)

11.2.3.2.1 Connection to a S700 master, 5V signal level (X5)

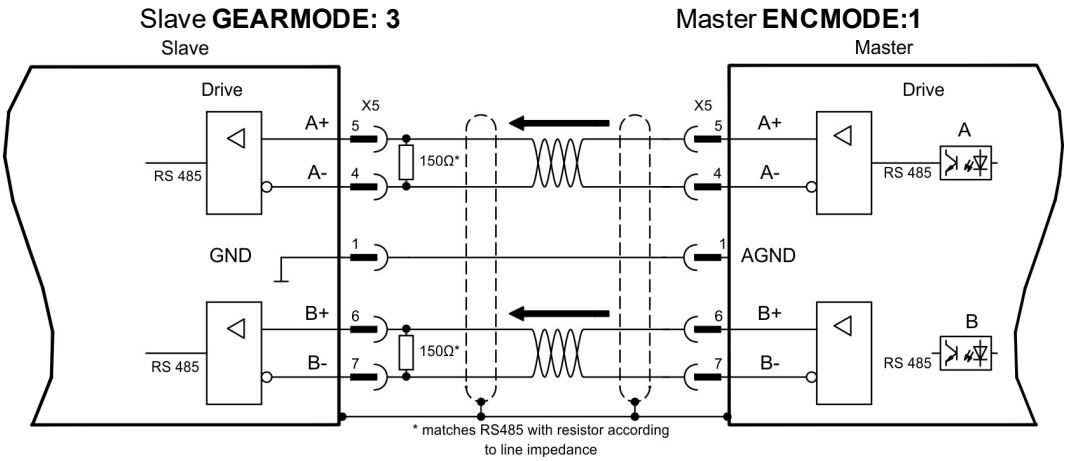
You can link several S700 amplifiers together in master-slave operation. Up to 16 slave amplifiers can be controlled by the master, via the encoder output. The SubD connector X5 is used for this purpose.

Master Setup: position output to X5, screen page "Encoder emulation" (ENCMODE)

Slave Setup: screen page "Electronic gearing" (GEARMODE)

Frequency limit at X5: 1,5 MHz

Example for Master-Slave operation with two S700 amplifiers, ROD emulation is used:



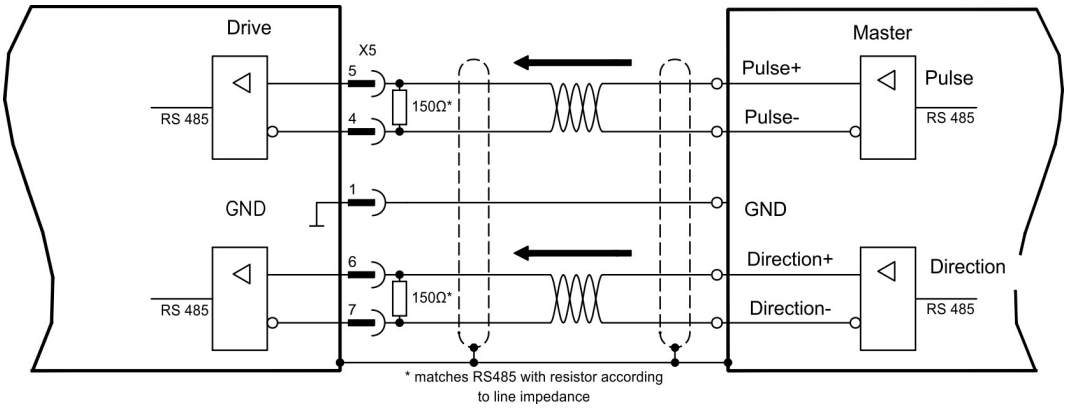
If SSI emulation is used, the master ENCMODE must be set to 2 and the slave GEARMODE to 5.

11.2.3.2.2 Connection to stepper motor controllers with 5 V signal level (X5)

Wiring of the servo amplifier (SubD connector X5) to a stepper-motor controller with a 5 V signal level.

Frequency limit: 1,5 MHz

Type	FBTYPE	EXTPOS	GEARMODE
Step/Direction 5V	-	-	4



11.2.3.3 Encoder-Emulation (X5)

11.2.3.3.1 Incremental encoder output - A quad B (X5)

Fast incremental encoder interface. Select encoder function ROD (A Quad B) Encoder ("Encoder Emulation" screen page). The servo amplifier calculates the motor shaft position from the cyclic- absolute signals of the resolver or encoder, generating incremental- encoder compatible pulses from this information. Pulse outputs on the SubD connector X5 are 2 signals, A and B, with 90° phase difference (i.e. in quadrature, hence the alternative term "A quad B" output), with a zero pulse.

The resolution (before multiplication) can be set by the RESOLUTION function:

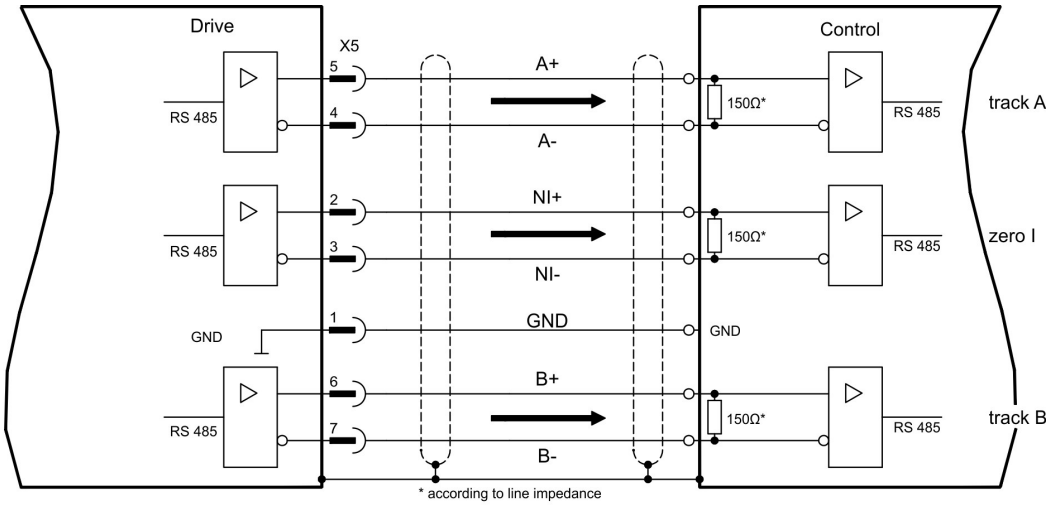
Encoder function (ENCMODE)	Feedback (FBTYPE)	Resolution (ENCOUT)	Zero pulse
1, ROD	0, Resolver	32...4096	once per turn (only at A=B=1)
	>0, Encoder	256...524288 (2^8 … 2^{19})	once per turn (only at A=B=1)
3, ROD interpolation	Encoder	2^4...2^7 (multiplication) TTL line x encoder resolution	encoder signal passed through from X1 to X5

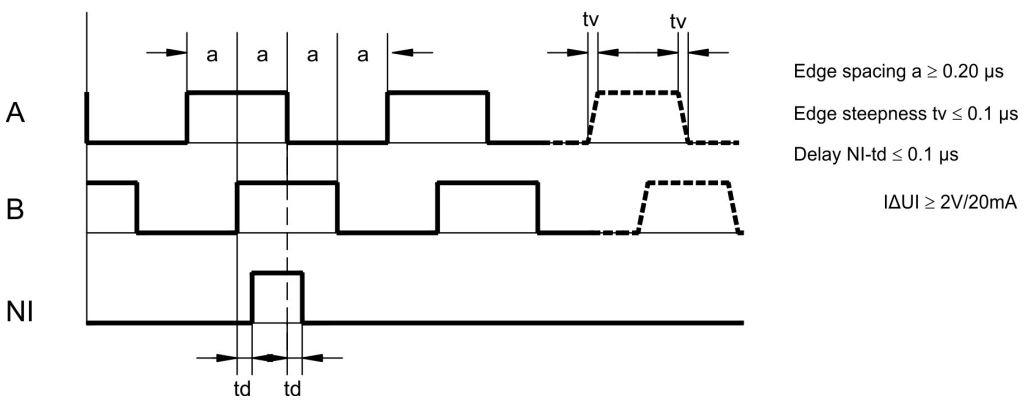
With built in safety card only binary resolutions up to 2^{12} are possible. Use the NI-OFFSET parameter to adjust + save the zero pulse position within one mechanical turn. The drivers operate off an internal supply voltage.

NOTE The maximum permissible cable length is 100 meters.

Connections and signals for the incremental encoder interface :

Default count direction: UP when the motor shaft is rotating clockwise (view at shaft's end)





11.2.3.3.2 SSI encoder output (X5)

SSI interface (synchronous serial absolute-encoder emulation). Select encoder function SSI (“Encoder Emulation” screen page, ENCMODE 2). The servo amplifier calculates the motor shaft position from the cyclic-absolute signals of the resolver or encoder. From this information a SSI date (Stegmann patent specification DE 3445617C2) is provided. Max 32 bits are transferred. The leading data bit contains the number of revolutions and are selectable from 12 to 16 bits. The following max. 16 bits contain the resolution and are not variable.

Die führenden Datenbit bilden die Anzahl der Umdrehungen ab und sind wählbar von 12 bis 16 Bit. Die darauf folgenden max. 16 Bit bilden die Auflösung ab und sind nicht veränderbar.

The following table shows the allocation of the SSI date depending upon selected number of revolutions:

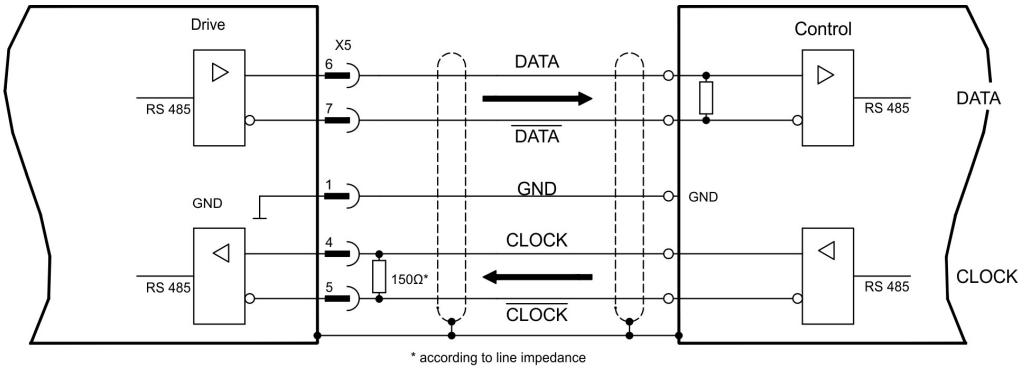
Revolution															Resolution (variable)															
SSIREVOL																														
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0															
		13	12	11	10	9	8	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			12	11	10	9	8	7	6	5	4	3	2	1	0																
				11	10	9	8	7	6	5	4	3	2	1	0																

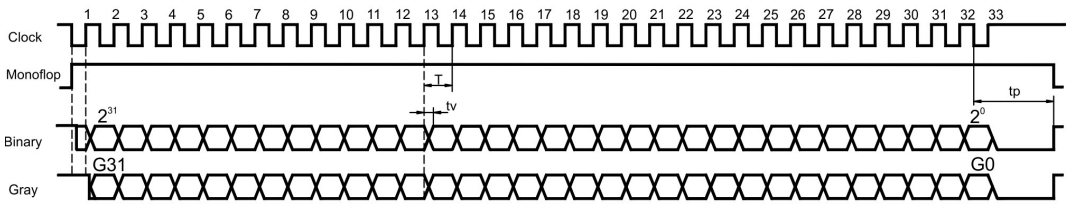
The signal sequence can be output in **Gray** code or in **Binary** (standard) code. The servo amplifier can be adjusted to the clock frequency of your SSI-evaluation with the setup software.

The drivers operate off an internal supply voltage.

Connection and signals for the SSI interface:

Default count direction: UP when the motor shaft is rotating clockwise (view at shaft's end)





Switch over time Data tv ≤ 300nsec

Period T = 600 ns

Time Out tp = 3µs/13µs (SSITOUT)

Output	IΔUI ≥ 2V/20mA
Input	IΔUI ≥ 0.3V

11.2.3.4 Analoge Inputs and Outputs

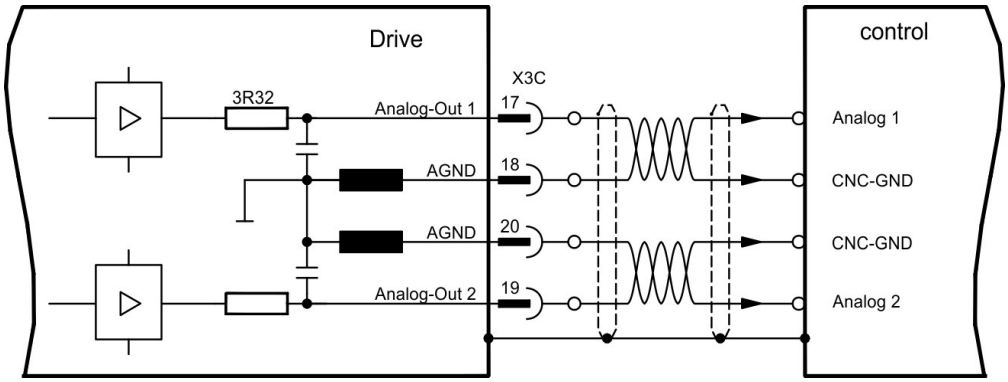
The expansion card "**PosI/O-Monitor**" adds analog inputs and outputs to the servo amplifier were pre-programmed signals can be assigned to. A listing of these pre-programmed functions can be found on the screen page "Analog I/O" of the setup software.

11.2.3.4.1 Analog Outputs ANALOG-OUT 1 and 2

You can use terminals X3C/17 (Analog-Out 1) respectively X3C/19 (Analog-Out 2) to deliver analog values converted from internal digital values (e.g. tachometer voltage).

Technical characteristics

- Reference ground is Analog-GND (AGND, terminal X3C/18 and X3C/20)
- Specification according to EN 61131-2 table 11
- Output voltage ±10 V
- Resolution: 0,38 mV, 16 Bit, Update rate 250 µs

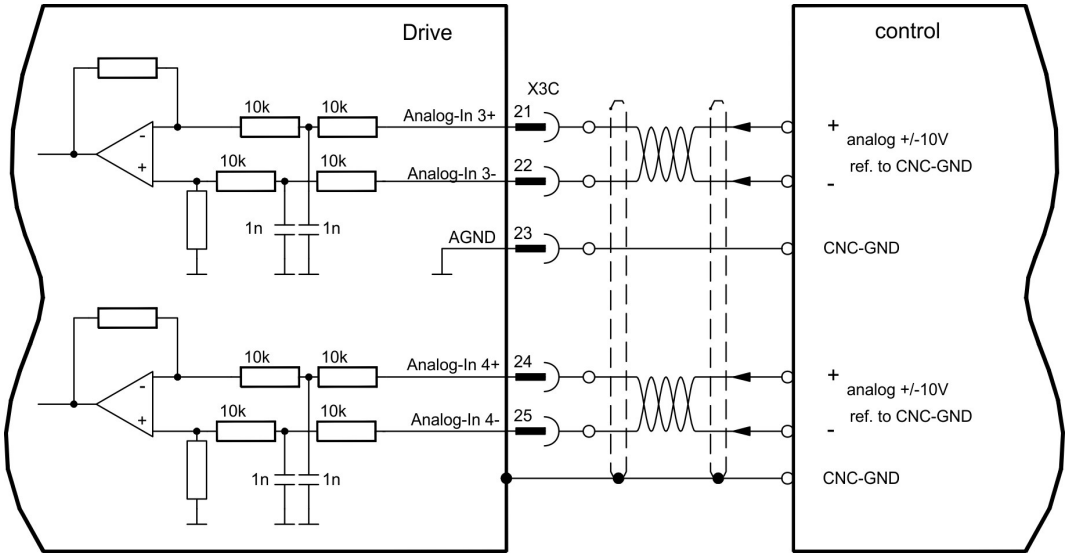


11.2.3.4.2 Analog Inputs ANALOG-IN 3 and 4

You can use terminals X3C/21-X3C/22 (Analog-In 3) respectively terminals X3C/24-X3C/25 (Analog-In 4) with several pre-programmed functions.

Technical characteristics

- Differential input voltage max. ±10 V
- Resolution 1.25 mV, 16 bits, scalable
- Ground reference AGND, terminal X3C/23
- Input resistance 20 kΩ
- Common-mode voltage range for both inputs ± 10 V
- Update rate 62.5 µs



11.3 Expansion cards for slot 3

11.3.1 Guide to installation of expansion cards in slot 3



Boundary of SLOT3

The method of installing the expansion card in slot 3 is the same as that described for slot 1 (➜ # 126).

- Remove the area of the front film colored yellow (labeled slot 3).
- Lever out the cover plates under the film.
- Remove the small PCB (STO Bridge) which is plugged into slot. Use suitable pliers.
- Push the expansion card into the slot.
- Use the screws provided to fasten the front plate of the expansion card in place.

11.3.2 Option "F2", controlled Fan

To reduce noise emission the servo amplifiers can be ordered with the built-in option card F2. This option cannot be built-in later. The F2 option card fits to slot2 or 3 (see part number scheme on (➜ # 26)).

NOTE Option card F2 can be used combined with a card in slot 1 even if it is plugged to slot 2!

Function

The fan is switched on and off or runs with 50% rated speed depending on temperature. That reduces the average noise emission.

Switching temperature

Monitoring	Fan off	Fan ~50%	Fan on
Ambient temperature	< 55°C	~ 58°C	> 65°C
Heat sink temperature	< 58°C	~ 68°C	> 80°C

11.3.3 Expansion cards "PosI/O" & "PosI/O-Monitor"

The “PosI/O” and "PosI/O-Monitor" expansion cards can be pushed into slot 2 or 3. The expansion cards cannot be combined and the use of only one slot in time is allowed.

Detailed description of the interfaces (➜ # 143).

11.3.4 Expansion card "Safety 2-2" (S4)

This expansion card (Basic version) includes various safety functions for the safe operation of drive shafts. Rotatory synchronous motors are allowed when using this safety card. All functions fulfill the safety requirements **SIL CL2** according to IEC 62061 respectively performance level **PLd** according to ISO 13849-1.



NOTE The safety card restricts feedback capability of the drive (refer to Safety Card Operation Manual or to the KDN).

11.3.4.1 Safe drive functions S2-2

The safety functions are activated using the digital inputs on the expansion card. The following functions are available:

Safe Torque Off (STO)

With the STO function, the power supply to the motor is interrupted safely directly in the drive. This corresponds to an uncontrolled braking in accordance with IEC 60204-1, category 0.

Safe Stop 1 (SS1)

With the SS1 function, the drive is stopped by controlled braking and then the power supply to the motor is interrupted safely. This corresponds to an uncontrolled braking in accordance with IEC 60204-1, category 1.

Safe Stop 2 (SS2)

With the SS2 function, the drive is stopped by controlled braking and then remains at a controlled standstill (SOS). This corresponds to a controlled braking in accordance with IEC 60204-1, category 2.

Safe Operating Stop (SOS)

The SOS function monitors the stop position reached and prevents any deviation outside a defined range.

Safely Limited Speed (SLS)

The SLS function monitors the drive to ensure that it maintains a defined speed.

Safe Limited Increments (SLI)

The SLI function monitors that the drive maintains a relative position.

Safe Speed Range (SSR)

The SSR function checks the current speed of the drive against maximum and minimum limiting values.

Safe Direction (SDI)

The SDI function ensures that the drive can only move in one (defined) direction.

11.3.4.2 Safety Notes S2-2

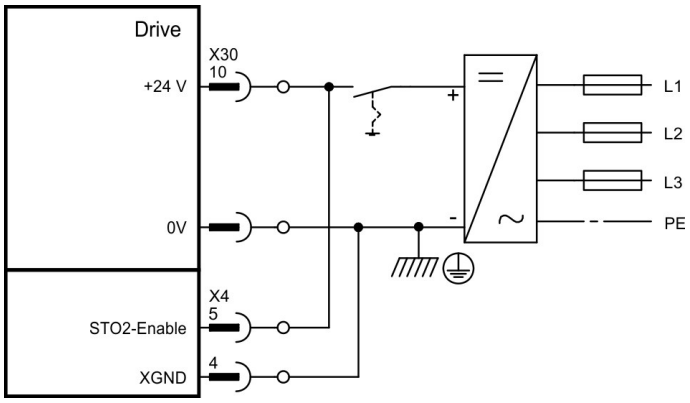
Comply with the operating instructions for the safety card. You can find the operating instructions on the CD-ROM provided with the product or on the Kollmorgen website.

11.3.4.3 Wiring supply voltage 24 V for digital outputs

NOTICE

Input X4/5 "STO2-Enable" must be connected to +24V DC and must not be used as additional STO input!

Input STO1-Enable [X4/7] must not be connected.



11.3.4.4 Safe inputs and outputs S2-2

NOTICE

Inputs X30/1 SS1_Activate and X30/20 Reset must always be connected. Only tested outputs from a safety control system may be connected to all inputs on X30.

X30	Pin	I/O	Description
SS1 Activate	1	I	Activates function SS1
I0	2	I	Programmable, activate safety function X
I1	3	I	Programmable, activate safety function X
I2	4	I	Programmable, activate safety function X
STO Acknowledge	5	O	Status: STO activated
O0	6	O	Programmable, status: safety function X activated
O1	7	O	Programmable, status: safety function X activated
O2	8	O	Programmable, status: safety function X activated
O3	9	O	Programmable, status: safety function X activated
24V Supply	10	-	24V supply of digital outputs
n.c.	11	-	n.c.
I3	12	I	Programmable, activate safety function X
I4	13	I	Programmable, activate safety function X
I5	14	I	Programmable, activate safety function X
I6	15	I	Programmable, activate safety function X
Ready	16	O	Message "Safety card is ready to operate"
n.c.	17	O	n.c.
n.c.	18	O	n.c.
n.c.	19	O	n.c.
Reset	20	I	Input for Reset
0V Supply	21	-	0V supply of digital outputs
0V Supply	22	-	0V supply of digital outputs

11.3.5 Expansion card "Safety 1-2" (S3)

This expansion card includes all available safety functions. Rotatory synchronous motors are allowed when using this safety card. All functions fulfill the safety requirements **SIL CL3** acc. to IEC 62061 respectively performance level **PLe** acc. to ISO 13849-1.



NOTE The safety card restricts feedback capability of the drive (refer to Safety Card Operation Manual or to the KDN).

11.3.5.1 SSafe drive functions S1-2

The safety functions are activated using the digital inputs on the expansion card. The following functions are available:

Safe Torque Off (STO)
With the STO function, the power supply to the motor is interrupted safely directly in the drive. This corresponds to an uncontrolled braking in accordance with IEC 60204-1,cat.0.

Safe Stop 1 (SS1)
With the SS1 function, the drive is stopped by controlled braking and then the power supply to the motor is interrupted safely. This corresponds to an uncontrolled braking in accordance with IEC 60204-1, cat.1.

Safe Stop 2 (SS2)
With the SS2 function, the drive is stopped by controlled braking and then remains at a controlled standstill (SOS). This corresponds to a controlled braking in accordance with IEC 60204-1, cat.2.

Safe Operating Stop (SOS)
The SOS function monitors the stop position reached and prevents any deviation outside a defined range.

Safely Limited Speed (SLS)
The SLS function monitors the drive to ensure that it maintains a defined speed.

Safe Limited Increments (SLI)
The SLI function monitors that the drive maintains a relative position.

Safe Limited Position (SLP)
The SLP function monitors that the drive maintains an absolute position.

Safe Speed Range (SSR)
The SSR function checks the current speed of the drive against maximum and minimum limiting values.

Safe Direction (SDI)
The SDI function ensures that the drive can only move in one (defined) direction.

Safe Brake Control (SBC)
An external mechanical brake can be controlled by the 2 poles output "SBC+/SBC" of the safety card. SBC will become active with STO.

Safe Brake Test (SBT)
The safety function SBT can be used for testing the external mechanical brake and the internal motor holding brake.

11.3.5.2 Safety NotesS1-2

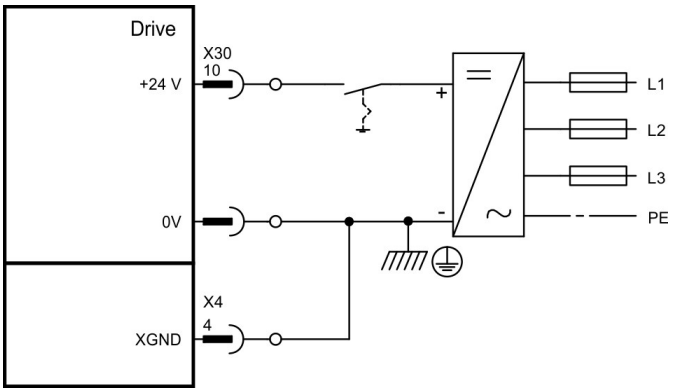
Comply with the operating instructions for the safety card. You can find the operating instructions on the CD-ROM provided with the product or on the website.

11.3.5.3 External encoder S1-2

Incremental encoder (TTL) or encoder with SSI signals can be connected to X31. Supply voltage for the external encoder must be connectoed to X30/11 (+) and X30/22 (-).

X31 Pin	Incremental Encoder (TTL)	SSI Encoder	X31 Pin	Incremental Encoder (TTL)	SSI Encoder
1	Channel A+	Clock +	6	Channel A-	Clock-
2	Channel B+	Data +	7	Channel B-	Data-
3	Reference Z+	n.c.	8	Reference Z-	n.c.
4	U+	U+	9	0 V	0 V
5	n.c.	n.c.			

11.3.5.4 Wiring supply voltage 24 V for digital outputs S1-2



Input STO1-Enable [X4/7] must not be connected.

11.3.5.5 Safe inputs and outputs S1-2

NOTICE

Inputs X30/1 SS1_Activate and X30/20 SS1_SIL3/Reset must always be connected.
Only tested outputs from a safety control system may be connected to all inputs on X30.

X30	Pin	I/O	Description
SS1 Activate	1	I	Activates function SS1
I0	2	I	Programmable, activate safety function X
I1	3	I	Programmable, activate safety function X
I2	4	I	Programmable, activate safety function X
STO Acknowledge	5	O	Status: STO activated
O0	6	O	Programmable, status: safety function X activated
O1	7	O	Programmable, status: safety function X activated
O2	8	O	Programmable, status: safety function X activated
O3	9	O	Programmable, status: safety function X activated
24V Supply	10	-	24V supply of digital outputs
Encoder Supply	11	-	Versorgungsspannung für externen Geber
I3	12	I	Programmable, activate safety function X
I4	13	I	Programmable, activate safety function X
I5	14	I	Programmable, activate safety function X
I6	15	I	Programmable, activate safety function X
Ready Acknowledge	16	O	Message "Safety card is ready to operate"
SBC+	17	O	Control external brake +
SBC-	18	O	Control external brake -
STO SIL CL3	19	O	Output single
SS1 SIL CL3/Reset	20	I	Input for SIL CL3 and Reset
0V Supply	21	-	0V supply of digital outputs
0V Encoder Supply	22	-	0V supply of external encoder

12 Appendix

12.1 Glossary

B	Brake circuit	Converts generative energy fed back by the motor during braking (generated energy) to heat.
C	Clock	Clock signal
	Common-mode voltage	The maximum amplitude of a disturbance (on both inputs) which a differential input can eliminate
	Counts	Internal count pulses, 1 pulse = 1 / 2^{20} $turn^{-1}$
	Continuous power of brake circuit	Mean power that can be dissipated in the brake circuit
	Current controller	Regulates the difference between the current setpoint and the actual value to 0 Output : power output voltage
D	DC bus link	Rectified and smoothed power voltage
	Disable	Removal of the ENABLE signal
E	Earth short	electrical connection between a phase and the protective earth (PE)
	Enable	Enable signal for the servo amplifier, Hardware-Enable with 24V signal to X3, Software-Enable command by setup Software, fieldbus or permanently set. Both are required for enabling the amplifier.
	ENABLE	Enable signal for the servo amplifier (+24 V)
F	Fieldbus interface	CANopen, PROFIBUS, SERCOS etc.
	Final speed (limit speed)	Maximum value for the speed normalization at ±10 V
G	GRAY-code	Special format for representing binary numbers
H	Holding brake	Brake in the motor, that can only be used when the motor is at standstill
I	I^2t threshold	Monitoring of the r.m.s. current that is actually required
	Input drift	Temperature and age-dependent alteration of an analog input
	Incremental encoder interface	Position signaling by 2 signals with 90° phase difference (i.e. in quadrature), is not an absolute position output
	Ipeak, peak current	The effective value of the peak current
	Irms, effective current	The r.m.s. value of the continuous current
K	Kp, P-gain	Proportional gain of a control loop
L	Limit speed (final speed)	Maximum value for speed normalization at ±10 V
	Limit switch	Switch limiting the traverse path of the machine; implemented as n.c. (break) contact
M	Machine	The complete assembly of all connected parts or devices, of which at least one is movable
	Motion block	Data packet with all the position control parameters which are required for a motion task
	Multi-axis system	Machine with several independently driven axes
N	Natural convection	Free movement of air for cooling
O	Optocoupler	Optical connection between two electrically independent systems

P	P-controller	Control loop with purely proportional behavior
	Phase shift	Compensation for the lag between the electromagnetic and magnetic fields in the motor
	PI-controller	Control loop with proportional and differential behavior
	Position controller	Regulates the difference between the position setpoint and the actual position to 0 Output: speed setpoint
	Potential isolation	electrically decoupled, electrical isolation
	Power contactor	System protection device with phase monitoring
	Pulse power of the brake circuit	Maximum power which can be dissipated in the brake circuit
R	Reset	New start of the microprocessor
	Resolver to Digital converter	Conversion of the analog resolver signals into digital information
	Reversing mode	Operation with a periodic change of direction
	Ring core	Ferrite rings for interference suppression
	ROD-interface	Incremental position output
S	Servo amplifier	Control device for regulating the speed, torque and position of a servomotor
	Setpoint ramps	Limits for the rate of change of the speed setpoint
	Short-circuit	here: electrically conductive connection between two phases
	Speed controller	Regulates the difference between the speed setpoint and the actual value to 0 Output : current setpoint
	SSI-interface	Cyclically absolute, serial position output
	Supply filter	Device to divert interference on the power supply cables to PE
	Tachometer voltage	Voltage proportional to the actual speed
	Thermal control	Temperature-sensitive device built into the motor winding (usually PTC)
	Tn, I-integration time	Integral component of a control loop
Z	Zero pulse	Output once per turn from incremental encoder, used to zero the machine

12.2 Order codes

The order numbers of accessories such as cables, brake resistors, mains supplies, etc., can be found in the accessories manual (CDROM or website).

12.2.1 Servo amplifiers

Article (standard version)*	EU order code	US order code
Servo amplifier S74802	S74802-NANANA	
Servo amplifier S77202	S77202-NANANA	

*= Standard: with heat sink, CANopen and EtherCAT onboard, dual channel STO, no expansion card. See "Part number scheme" (➜ # 26).

Article (standard version with F2 option built Slot 2)	EU order code	US order code
Servo amplifier S74802-NAF2NA	S74802-NAF2NA	
Servo amplifier S77202-NAF2NA	S77202-NAF2NA	

Article (standard version with F2 option built Slot 3)	EU order code	US order code
Servo amplifier S74802-NANAF2	S74802-NANAF2	
Servo amplifier S77202-NANAF2	S77202-NANAF2	

12.2.2 Memory Card

Article	EU order code	US order code
Industrial Memory Card (can remain in the drive)	DE-201257	not available

12.2.3 Expansion cards

12.2.3.1 Covers for Option Slots

Article	EU order code	US order code
Slot Covers (1x Slot1, 1x Slot2 or 3)	DE-201295	DE-201295

12.2.3.2 Slot 1

Article	EU order code	US order code
Expansion Card DeviceNet	DE-103571	OPT-DN
Expansion Card PROFIBUS DP	DE-106712	OPT-PB3
Expansion Card SERCOS	DE-90879	OPT-SE
Expansion Card I/0-14/08	DE-90057	OPT-EI
Expansion Card SynqNet	DE-200073	OPT-SN
Expansion Card FB-2to1	DE-201664	not available
Expansion module 2CAN	DE-201076	OPT-CB

12.2.3.3 Slot 2

Article	EU order code	US order code
Expansion Card PosI/O	DE-200881	OPT-E1
Expansion Card PosI/O-Monitor	DE-201294	OPT-PA

12.2.3.4 Slot 3

Article	EU order code	US order code
Expansion Card PosI/O	DE-200881	OPT-E1
Expansion Card PosI/O-Monitor	DE-201294	OPT-PA
Expansion Card Safety 1-2, SIL CL3	DE-201873	OPT-S3
Expansion Card Safety 2-2, SIL CL2	DE-201874	OPT-S4
STO Bridge (instead of Safety Card)	DE-200566	OPT-BR

12.2.4 Mating connectors

Article	EU order code	US order code
Mating connectors X3A	DE-200447	CON-S7X3A
Mating connectors X3B	DE-200448	CON-S7X3B
Mating connectors X3C	DE-200957	CON-S7X3C
Mating connectors X4	DE-201241	CON-S7X4
Mating connectors X9A	DE-201194	CON-S7X9A
Mating connectors X9B	DE-201193	CON-S7X9B

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14 Record of Document Revisions

Revision	Remarks
07/2009	First edition
09/2009	Repair, disposal, standards, directives, GOST-R
11/2009	Safety expansion cards S1/S2, UL listed, FAN option card F2
09/2011	Part number scheme, safety approved, emergency Stop examples moved to WIKI, S1/S2 cards updated, new DriveGUI icon, bridge DGND-GND (dig-I/O) changed, notes holding brake, climatic classes, WIKI links updated, 2CAN module, company data, encoder emulation X1, BiSS-C
06/2012	Expansion card FB-2to1 new, Stop/Emergency Stop/Emergency Off updated
07/2013	Feedback - ENCVON note, FBTYPE 34, CE declaration of conformity, formal improvements, BiSS C Renishaw, according to IEC 82079, safety cards S1/S2 replaced by S3/S4, diagram "Behavior in the event of an error" updated.
08/2013	Correction S4 safety card (SLP not possible)
11/2013	Hint automatic restart, fault table, switch off behaviour in case of faults, VBUSBAL=4
05/2014	Warning symbols updated, SSI emulation timing updated, safe to touch voltage 40V->60V
07/2014	Wiring thermo sensor updated (Feedback)
12/2014	Note drive feedback restrictions with Safety Cards, CE declaration of conformity removed, GOST-R removed, Safety certificates removed, HWR, export classification
02/2015	EAC certification, nameplate with EAC sign, coldplate version new
12/2015	Functional Safety certification expanded, safety chapter typo: discharge time corrected, fax form removed, use as directed extended, safe to touch voltage 60V->50V, fuse FB1/2 to 100A, LVD 2014/35/EC, EMCD 2014/30/EC
02/2017	X6 Pin 1 corrected (no 5V output), warning notes, handling separate chapter, single cable connection new, SFD3/Hiperface DSL new
11/2018	Connector X1 corrected (male->female), HR table updated, layout of the warning notes updated, user expertise updated, new readers note on cover page, Wiki replaced by KDN
07/2019	CE Conformity (RoHS), dc bus link (examples), layout updates

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