KOLLMORGEN

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Digital Servo Amplifier

SERVOSTAR® 300

Assembly, Installation, Setup

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

Edition 12/05
File sr300_e.xxx

Solutions by DANAHER MOTION

Previous versions:

Edition	Remarks
06/04	First edition
04/05	Restart lock -AS-, UL-listing, new pinning for X8, several corrections
04/05a	order numbers 400V types for NA updated
11/05	Chapter 1 updated, ComCoder wiring corrected, Acuro(BISS)-Interface new, max. station address changed to 127, motor choke changed, SynqNet and EtherCat expansion cards added, chapter 6 restructured, order codes restructured
12/05	Feedback section, termination resistors X1/X5, CE section

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

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1 General

1.1 About this manual

This manual describes the SERVO**STAR**® 300 series of digital servo amplifiers (standard version: 1.5A ...10A rated current).

In this manual you can find information about:

● General	Chapter 1
● Technical description	Chapter 2
● Assembly / installation	Chapter 3
● Interfaces	Chapter 4
● Setup	Chapter 5
● Accessories	Chapter 6
● Transport, storage, maintenance and disposal	Chapter 7

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 applications notes, in Acrobat-Reader format on the accompanying CD-ROM (system requirements: WINDOWS, Internet Browser, Acrobat Reader) in different languages.
You can print out this documentation on any standard commercial printer. A printed copy of the documentation is available from us at extra cost.

This manual addresses personnel with the following qualifications:

Transport : only by personnel with knowledge of handling electrostatically sensitive components.
Installation : only by electrically qualified personnel.
Setup : only by qualified personnel with extensive knowledge of electrical engineering and drive technology

1.2 Symbols used in this manual

	danger to personnel from electricity and its effects			general warning general instructions mechanical hazard
⇨ p.	see page (cross-reference)		●	special emphasis

Keys on the panel of the servo amplifier :	
▲	**press once** : move up one menu item, increase number by one **press twice in rapid succession**: increase number by ten
▼	**press once**: move down one menu item, decrease number by one **press twice in rapid succession**: decrease number by ten
▲ ▼	**hold right key pressed, and then press left key as well**: to enter a number, “Return” function

1.3 Abbreviations used in this manual

The abbreviations used in this manual are explained in the table below.

Abbrev.	Meaning
AGND	Analog ground
AS	Restart lock, option
BTB/RTO	Ready to operate
CAN	Fieldbus (CANopen)
CE	Communité Europeenne
CLK	Clock signal
COM	Serial interface for a PC-AT
DGND	Digital ground (for 24V and digital I/O)
DIN	German Institute for Industrial Standards
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EN	European Standard
ESD	Electrostatic discharge
IEC	International Electrotechnical Commission
IGBT	Insulated-gate bipolar transistor
INC	Incremental interface
ISO	International Organization for Standardization
LED	Light-emitting diode
MB	Megabyte
NI	Zero pulse
PC	Personal computer
PELV	Protected low voltage
PLC	Programmable logic controller
PWM	Pulse-width modulation
RAM	Volatile memory
RBallast / R_{BR}	Ballast resistor (= regen resistor)
RBext	External regen resistor
RBint	Internal regen resistor
RES	Resolver
ROD	digital encoder
S1	continuous operation
S3	Intermittent operation
SRAM	Static RAM
SSI	Synchronous serial interface
UL	Underwriters Laboratories
V AC	Alternating voltage
V DC	DC voltage
VDE	Society of German Electrical Technicians

2 Technical description

2.1 Safety Instructions

- **Only properly qualified personnel are permitted to perform activities such as transport, installation, setup and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, setup and operation of the product, and who have the appropriate qualifications for their job. Qualified personnel must know and observe:**
  IEC 364 and CENELEC HD 384 or DIN VDE 0100
  IEC-Report 664 or DIN VDE 0110
  National Accident Prevention Regulations or BGV A3
- **Read this documentation before carrying out installation and setup. Incorrect handling of the servo amplifier can lead to personal injury or material damage. It is vital that you keep to the technical data and information on connection requirements (on the nameplate and in the documentation).**
- **The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.**
- **The servo amplifiers contain electrostatically sensitive components that may be damaged by incorrect handling. Ground yourself before touching the servo amplifier, by touching any unpainted metal surface that is itself grounded. Avoid contact with highly insulating materials such as artificial fabrics or plastic film. Place the servo amplifier on a conductive surface.**
- **Do not open the units. Keep all covers and control cabinet doors closed during operation. Otherwise there are deadly hazards, with the risk of death, severe danger to health, or material damage.**
- **Servo amplifiers may have uncovered live parts during operation, depending on their degree of enclosure protection. Control and power connections may be live, even when the motor is not rotating.**
- **Servo amplifiers may have hot surfaces during operation. Temperatures may rise to above 80°C (176°F).**
- **Never undo the electrical connections to the servo amplifier while it is live. In unfavorable circumstances this may cause electrical arcing with damage to contacts and danger to persons.**
- **After disconnecting the servo amplifier, wait at least five minutes before touching live sections of the equipment, such as contacts, or undoing any connections. Capacitors can still have dangerous voltages present up to five minutes after switching off the supply voltages. To be sure, measure the voltage in the DC bus link circuit and wait until it has fallen below 40V.**

2.2 Use as directed

Servo amplifiers are components that are built into electrical plant or machines, and can only be operated as integral components of such plant or machines.

The manufacturer of the machine must generate a hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Servo amplifiers in the SERVOSTAR 300 series can be supplied from 3-phase grounded (earthed) industrial supply networks (TN-system, TT-system with grounded neutral point, no more than 5000A symmetrical rated current at 230V or 480V$^{+10\%}$).
The servo amplifiers must not be operated directly on non-grounded supply networks or on asymmetrically grounded supplies with a voltage >230V. Connection to other types of supply networks (with an additional isolating transformer) is described on p. 16.

Periodic overvoltages between phases (L1, L2, L3) and the housing of the servo amplifier must not exceed 1000V crest.

In accordance with EN 61800, voltage spikes (< 50µs) between phases must not exceed 1000V. Voltage spikes (< 50µs) between a phase and the housing must not exceed 2000V.

If the servo amplifiers are used in residential areas, in business/commercial areas, or in small industrial operations, then additional filter measures must be implemented by the user.

The SERVOSTAR 300 family of servo amplifiers is **exclusively** intended for driving suitable brushless synchronous servomotors and asynchronous motors 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 produced by the servo amplifier.

The servo amplifiers must **only** be operated in a closed control cabinet, taking into account the ambient conditions defined on page 21. Ventilation or cooling may be necessary to keep the temperature within the cabinet below 40°C.

Use only copper conductors for wiring. The conductor cross-sections can be derived from the standard EN 60204 (alternatively for AWG cross-sections: NEC Table 310-16, 60°C or 75°C column).

We only guarantee the conformance of the servo system with the standards cited on p.11 if the components (servo amplifier, motor, cables etc.) are those supplied by us.

Restart lock for personnel safety

The servo amplifier has an integrated personnel safe restart lock, which meets the requirements of safety category 3 according to EN 954-1.

The conceptual examination of the function "safe stop" (called restart lock AS in the following) was accomplished by the BG-Institute for Occupational Safety and Health and the classification in category 3 according to EN 954-1 was confirmed.

Please consider the specifications on page 61 when you use this function

2.3 European Directives and Standards

Servo amplifiers are 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 (98/37/EC), the EC EMC Directive (89/336/EEC) and the EC Low Voltage Directive 73/23/EEC.

Standards to be applied for conformance with the EC Machinery Directive (98/37/EC):
EN 60204-1 (Safety and Electrical Equipment in Machines)
EN 292 (Safety of Machines)

The manufacturer of the machine must generate a hazard analysis for the machine, and must implement appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Standards to be applied for conformance with the EC Low Voltage Directive (73/23/EEC):
EN 60204-1 (Safety and Electrical Equipment in Machines)
EN 50178 (Electronic Equipment in Power Installations)
EN 60439-1 (Low Voltage Switchgear Combinations)

Standards to be applied for conformance with the EC EMC Directive (89/336/EEC):

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

The manufacturer of the machine/plant is responsible for ensuring that it meets the limits required by the EMC regulations. Advice on the correct installation for EMC (such as shielding, grounding, treatment of connectors and cable layout) can be found in this documentation.

The machine/plant manufacturer must check whether other standards or EC Directives must be applied to the machine/plant.

2.4 CE conformance

Conformance with the EC EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of servo amplifiers within the European Community. Product standard EN 61800-3 is applied to ensure conformance with the EMC Directive. The Declaration of Conformity form can be found on our website (download area).

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 ≤ 10m).

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

With a motor cable length from 10m onwards, the servo amplifier meets the requirement to the category C3.

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. The standard EN 50178 is applied to ensure conformance with the Low Voltage Directive.

2.5 Conformance with UL and cUL

This servo amplifier is listed under UL file number **E217428**.

UL (cUL)-certified servo amplifiers (Underwriters Laboratories Inc.) fulfil the relevant U.S. and Canadian standard (in this case UL 840 and UL 508C).

This standard describes the fulfilment 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. and Canadian standard is determined by an independent UL (cUL) 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 (cUL)-certification of the equipment.

UL 508C

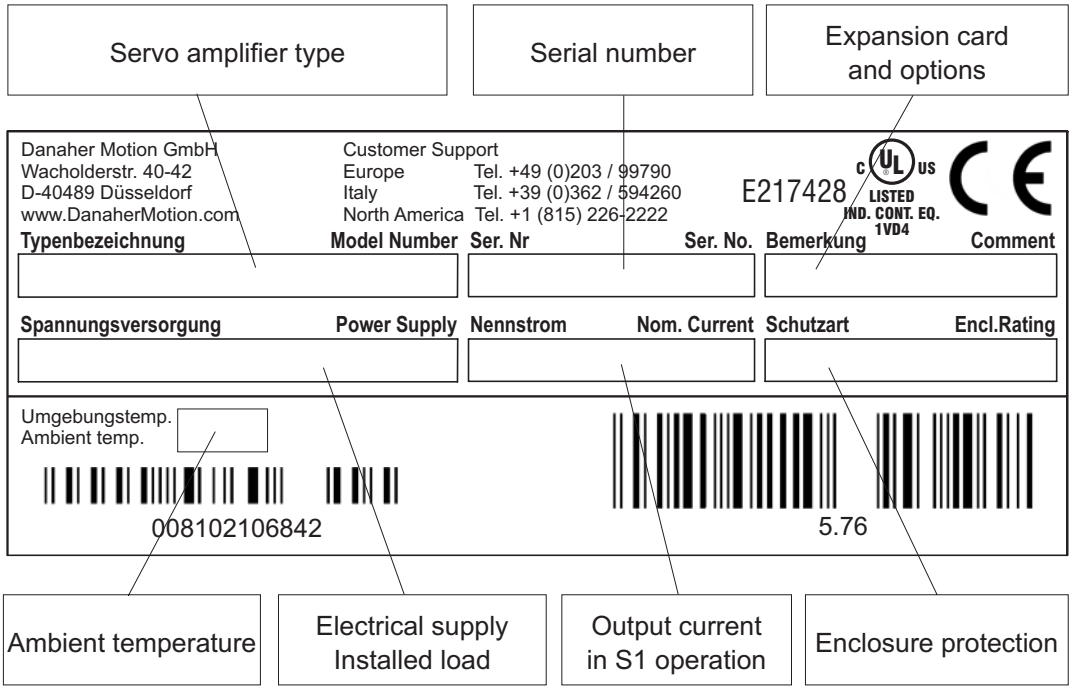
UL 508C describes the fulfilment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire being caused by such equipment.

UL 840

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

2.6 Nameplate

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



2.7 Instrument description

2.7.1 Package supplied

When you order an amplifier from the SERVOSTAR 300 series (order numbers ⇨ p.101), you will receive:

— SERVOSTAR 3xx
— mating connectors X0, X3, X4, X8, X9 (only with SERVOSTAR 303-310)

The mating SubD connectors are not part of the package!

— Assembly, Installation and Setup instructions
— Online documentation on CD-ROM
— Setup software DRIVEGUI.EXE on CD-ROM

Accessories : (must be ordered separately, if required)

— synchronous servomotor (linear or rotary)
— motor cable (prefabricated), or both power connectors separately, with the motor cable as a cut-off length
— feedback cable (prefabricated)
or both feedback connectors separately, with the feedback cable as a cut-off length
— motor choke 3YLNxx (⇨ p.93), for motor cables longer than 25 meters
— external regen resistor (⇨ p.92)
— communication cable to the PC (⇨ p.59) for setting parameters from a PC
— power cable, control cables, fieldbus cables (as cut-off lengths)

2.7.2 The SERVOSTAR 300 family of digital servo amplifiers

Standard version

- Two voltage classes with large nominal voltage range
  1 x 110V$_{-10\%}$ ... 3 x 230V$^{+10\%}$ (SERVOSTAR 303-310, S3xx6)
  3 x 208V$_{-10\%}$ ... 3 x 480V$^{+10\%}$ (SERVOSTAR 341-346, S3xx0)
- Instrument width 70 mm
- Shielding connection directly on the servo amplifier
- Two analog inputs
- Integrated CANopen (default: 500 kBaud), for integration in CAN-bus systems and for setting parameters for several drives via the PC interface of one of the amplifiers
- Slot for an expansion card
- Integrated RS232, integrated pulse direction interface
- Integrated restart lock -AS- for personnel safety, ⇨ p. 61

Power section

- Directly on grounded 3-phase supply, 110V$_{-10\%}$ or 230V$_{-10\%}$ up to 480V$^{+10\%}$ TN-network or TT-network with grounded neutral point, 5000 A max. symmetrical current rating, connection to other supply types only via isolating transformer, ⇨ p. 16
- 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
- Regen circuit with dynamic distribution of the regenerated power between several amplifiers on the same DC bus link circuit. Internal regen resistor as standard, external regen resistors if required.
- DC bus link voltage 135 … 450 V DC or 260 … 900 V DC, can be connected in parallel
- Interference suppression filters are integrated for the electrical supply feed and the 24V auxiliary supply voltage (with motor cable ≤ 10m for general availability as per EN 61800-3, with motor cable < 10m for 2nd environmental category as per EN 61800-3,)

Integrated safety

- Appropriate insulation/creepage distances and electrical isolation ensure safe electrical separation, as per EN 50178, 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)

Auxiliary supply voltage 24V DC

- Electrically isolated, internal fusing, from an external 24V DC power supply unit with, for instance, isolating transformer or uninterruptible power supply

Operation and parameter setting

- With our user-friendly setup software, 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

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)
- Integrated step/direction interface for connecting a servomotor to a stepper controller
- Evaluation of resolver signals and sine-cosine signals of high-resolution encoders
- Encoder emulation (incremental, compatible with A quad B or SSI)

Comfort functions

- 2 programmable analog inputs
- 4 programmable digital inputs
- 2 programmable digital outputs
- programmable logical combinations of digital signals

Expansions

- I/O-14/08 expansion card, ⇨ p.76
- PROFIBUS DP expansion card, ⇨ p.79
- SERCOS expansion card, ⇨ p.80
- DeviceNet expansion card, ⇨ p.82
- EtherCat expansion card, ⇨ p. 85
- SynqNet expansion card, ⇨ p. 86
- -2CAN- expansion module, separated connectors for CAN-bus and RS232, ⇨ p.84
- For third-party expansion cards (ModBus, LightBus, FIP-IO etc.) please contact the manufacturer for further information

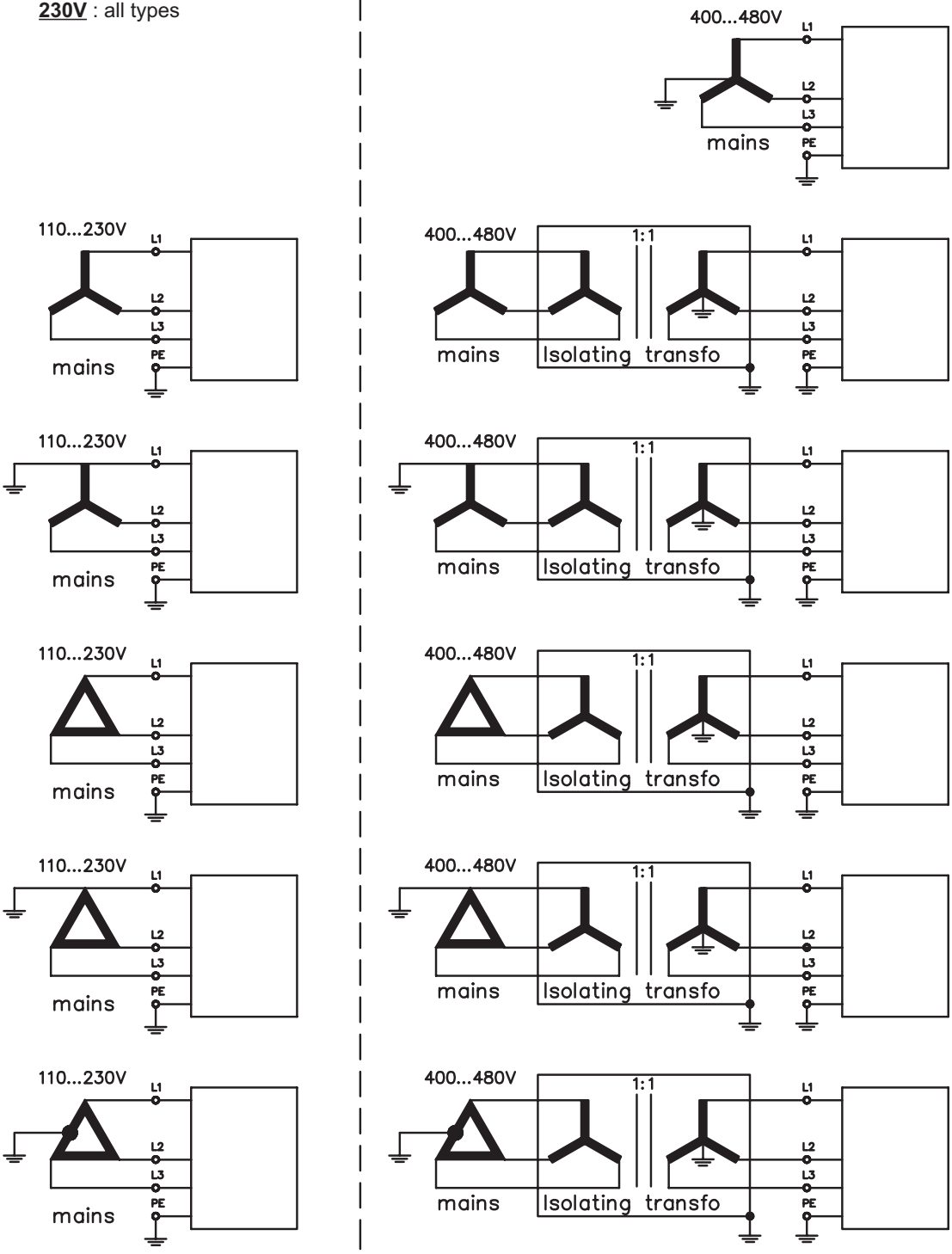
2.8 Connection to various electrical supply networks

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

An isolating transformer is always required for 400 … 480V networks that are asymmetrically grounded or not grounded.

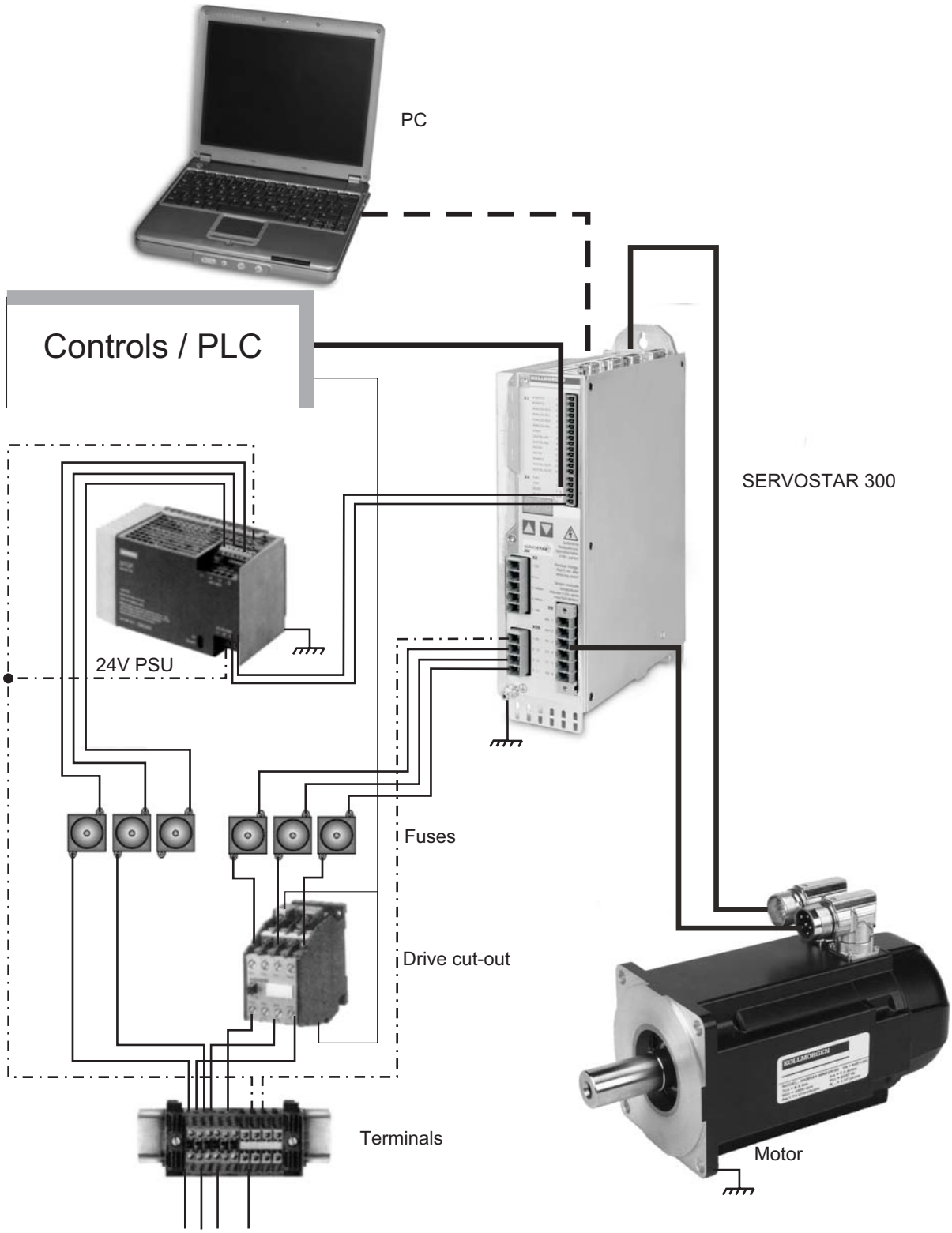
110V : SERVOSTAR 303-310*
230V : all types

400V / 480V : SERVOSTAR 341-346*



* Order code reference see p. 101

2.9 Components of a servo system



2.10 Technical data

2.10.1 Technical data for 110/230 V (types S3_ _6_)

		SERVOSTAR		
Rated data	**DIM**	**303**	**306**	**310**
Order Code	—	S30361	S30661	S31061
Rated supply voltage (grounded supply, phase to phase)	V~	1 x 110V$_{-10\%}$ … 1 x 230V$^{+10\%}$ 3 x 110V$_{-10\%}$ … 3 x 230V$^{+10\%}$ 50/60 Hz		
Rated input power for S1 operation	kVA	1.1	2,4	4
Max. DC bus link voltage	V=	450		
Rated output current (rms value, ± 3%)				
at 1x110V	Arms	3	3	3
at 3x115V	Arms	3,5	8	10
at 3x230V	Arms	3	6	10
at 1x230/240V	Arms	3	4	4
Peak output current (rated current x 2 for approx. 5s, ± 3%)				
at 1x110V	Arms	5	5	5
at 3x115V	Arms	9	15	20
at 3x230V	Arms	9	15	20
at 1x230/240V	Arms	9	9	9
Switching frequency of the output stage	kHz	8 (16*)		
Technical data for regen circuit	—	⇨ p.23		
Threshold for overvoltage switch-off	VDC	235 / 455		
Motor inductance min.				
at 1x110V	mH	3,7	3,7	3,7
at 3x115V	mH	2,1	1,3	1,0
at 3x230V	mH	4,3	2,6	1,9
at 1x230/240V	mH	4,3	4,3	4,3
Motor inductance max.	mH	Consult our customer support		
Form factor of the output current (rated conditions, min. load inductance)	—	1.01		
Bandwidth of current controller	kHz	> 1.2		
Residual voltage drop at rated current	V	4		
Thermal dissipation, output stage disabled	W	12		
Thermal dissipation at rated current (incl. PSU losses, without regen dissipation)	W	35	60	90
Mechanical				
Weight	kg	approx. 2,6		
Height, without connectors	mm	275	279	
Width	mm	70		
Depth, without connectors	mm	171		
Depth, with connectors	mm	< 200		

* at reduced current

2.10.2 Technical data for 400/480 V (types S3_ _0_)

		SERVOSTAR		
Rated data	**DIM**	**341**	**343**	**346**
Order Code	—	S30101	S30301	S30601
Rated supply voltage (grounded supply, phase to phase)	V~	3 x 208V$_{-10\%}$ … 480V$^{+10\%}$, 50/60 Hz		
Rated input power for S1 operation	kVA	1.2	2,5	5
Max. DC bus link voltage	V=	900		
Rated output current (rms value, ± 3%)				
at 3x208V	Arms	2	5	6
at 3x230V	Arms	2	5	6
at 3x400V	Arms	1,5	4	6
at 3x480V	Arms	1,5	3	6
Peak output current (max. approx. 5s, ± 3%)				
at 3x208V	Arms	4,5	7,5	12
at 3x230V	Arms	4,5	7,5	12
at 3x400V	Arms	4,5	7,5	12
at 3x480V	Arms	4,5	7,5	12
Switching frequency of the output stage	kHz	8 (16*)		
Technical data for regen circuit	—	⇨ p.23		
Threshold for overvoltage switch-off	VDC	455 / 800 / 900		
Motor inductance min.				
at 3x208V	mH	7,7	4,6	2,9
at 3x230V	mH	8,5	5,1	3,2
at 3x400V	mH	14,8	8,9	5,6
at 3x480V	mH	17,8	10,7	6,7
Motor inductance max.	mH	Consult our customer support		
Form factor of the output current (rated conditions, min. load inductance)	—	1.01		
Bandwidth of subordinate current controller	kHz	> 1.2		
Residual voltage drop at rated current	V	5		
Thermal dissipation, output stage disabled	W	12		
Thermal dissipation at rated current (incl. PSU losses, without regen dissipation)	W	40	60	90
Mechanical				
Weight	kg	approx. 2,7		
Height, without connectors	mm	275	278	
Width	mm	70		
Depth, without connectors	mm	171		
Depth, with connectors	mm	< 235		

* at reduced current

2.10.3 Inputs / outputs

Analog inputs 1, 2 (resolution 14/12 bit)	V	±10
Max. common-mode voltage	V	±10
Input resistance to AGND	kΩ	20
Digital control inputs	V	as per EN 61131-2 Type 1, max. 30VDC
Digital control outputs, active high	V	open Emitter, max. 30VDC, 10mA
BTB/RTO output, relay contacts	V	DC max. 30, AC max 42
	mA	500
Auxiliary supply voltage, electrically isolated, without brake/fan	V	20 - 30
	A	1
Auxiliary supply voltage, electrically isolated, with brake/fan (check voltage drop !)	V	24 (-0% +15%)
	A	2.5
Max. output current to brake	A	1.5
Connection technology		
Control signals	—	Combicon connector
Power signals	—	Combicon connector
Resolver input	—	SubD 9-pin (socket)
Incremental encoder input	—	SubD 15-pin. (socket)
PC interface, CAN	—	SubD 9-pin (plug)
Encoder emulation, ROD/SSI	—	SubD 9-pin (plug)

2.10.4 Recommended tightening torques

Connector	Tightening torque
X0, X8, X9	0,5..0,6 Nm
Grounding bolt	3.5 Nm

2.10.5 Fusing

2.10.5.1 Internal fusing

Circuit	Internal fuse
Auxiliary voltage 24V	3.15 A (slow)
Regen resistor	electronic

2.10.5.2 External fusing

Wire fuses or similar		SERVOSTAR 303*, 341*, 343*	SERVOSTAR 306*, 310*, 346*
AC supply feed	$F_{N1/2/3}$ (X0/1; 2; 3)	6 AT (FRx-6)	10 AT (FRx-10)
24V feed	$F_{H1/2}$	max. 8 AF (FRx-12)	
Regen resistor	$F_{B1/2}$ (X8/2; 4)	6 AT (FRS-6)	6 AT (FRS-6)

x = S or S-R for 480V applications x = N or N-R for 230V applications

* order code reference see p. 101

2.10.6 Permissible ambient temperatures, ventilation, mounting position

Storage hints	⇨ p.95
Transport hints	⇨ p.95
Supply voltage tolerances	
Supply input	303-310*: 1x110V$_{-10\%}$ …1x230V$^{+10\%}$, 50/60 Hz 3x110V$_{-10\%}$ …3x230V$^{+10\%}$, 50/60 Hz 341-346*: 3x208V$_{-10\%}$ - 3x 480V$^{+10\%}$, 50/60 Hz
Auxiliary supply	
without brake and fan	20 V DC ... 30 V DC
with brake or fan	24 V DC (-0% +15%)
Ambient temperature in operation	0...+40°C under rated conditions +40...+55°C with power derating 2.5% / °C
Humidity in operation	rel. humidity 85%, no condensation
Site altitude	up to 1000 meters a.m.s.l. without restriction 1000…2500 meters a.m.s.l. with power derating 1.5% / 100meters
Pollution level	Pollution level 2 as per IEC 60664-1, 2.5.1
Enclosure protection	IP 20
Mounting position	vertical ⇨ p.29
Ventilation 1 A and 3 A types	**natural convection**
all other types	**built-on fan**
Make sure that there is sufficient forced ventilation within the control cabinet.	

* order code reference see p. 101

2.10.7 Conductor cross-sections

Observe the technical data for cables on page 35.
Following EN 60204, we recommend for **single-axis systems**:

AC connection	1.5 mm²	600V, 105°C
DC bus link Regen resistor	1.5 mm²	1000V, 105°C, shielded for lengths >20cm
Motor cables up to 25 m*	1 - 1.5 mm²	600V, 105°C, shielded, capacitance <150pF/meter
Motor cables 25m to 50 m*, with motor choke 3YLNxx	1 mm²	600V,105°C, shielded, capacitance <150pF/meter
Resolver, motor thermostat	4x2x0,25 mm² twisted pairs, shielded, max.100m*, capacitance <120pF/m	
Encoder, motor thermostat	7x2x0.25 mm² twisted pairs, shielded, max.50m*, capacitance <120pF/m	
Setpoints, AGND	0.25 mm² , twisted pairs, shielded	
Control signals, BTB, DGND	0.5 mm²	
Holding brake (motor)	min. 0.75 mm², 600V, 105°C, shielded, check voltage drop	
+24 V / DGND	max. 2.5 mm², check voltage drop	
For multi-axis systems, observe the specific operating conditions for your system		

* Danaher Motion North America supplies cables up to 39 meters
Danaher Motion Europe supplies cables up to max. length

2.10.8 LED display

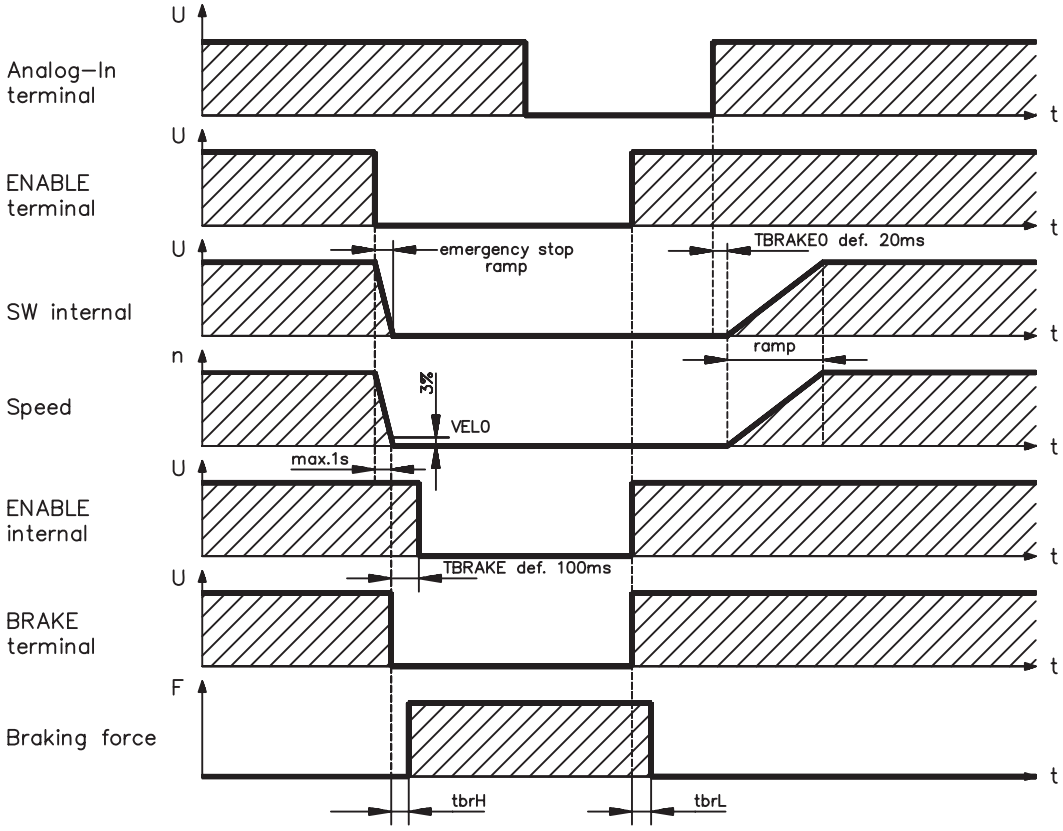
A 3-character LED display indicates the status of the amplifier after switching on the 24V supply (⇨ p.71). When the keys on the front panel are used, the parameter and function numbers are shown, as well as the numbers for any errors that may occur (⇨ p.72).

2.11 Grounding system

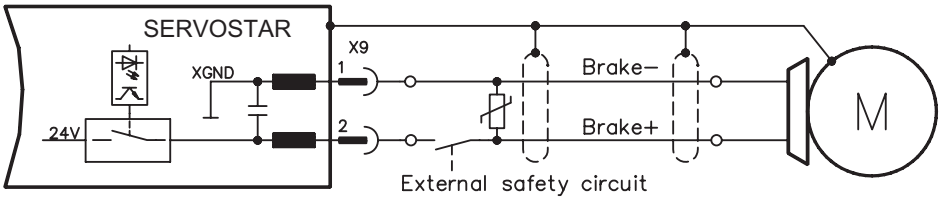
AGND — analog inputs, internal analog ground, encoder emulation, RS232, CAN
DGND — digital inputs/outputs and the 24V supply, optically isolated.

2.12 Control circuit for motor-holding brake

A 24V / max.1.5A holding brake in the motor can be controlled directly by the servo amplifier. **This function does not ensure personnel safety!** The brake function must be enabled through the BRAKE parameter (screen page: Motor, setting: WITH). In the diagram below you can see the timing and functional relationships between the ENABLE signal, speed setpoint, speed and braking force.



During the internal ENABLE delay time of 100ms, the speed setpoint of the servo amplifier is internally driven down an adjustable ramp to 0V. The output for the brake is switched on when the speed has fallen to 3% of the preset final speed, at the latest after 1 second.
The rise (f_{brH}) and fall (f_{brL}) times of the holding brake that is built into the motor are different for the various types of motor (see motor manual). A description of the interface can be found on page 42. Operation of the brake in a manner that provides personnel safety requires an additional “make” contact in the brake circuit, and a suppressor device, such as a varistor, for the brake circuit. Recommended circuit:



2.13 Regen circuit

During braking with the aid of the motor, energy is fed back into the servo amplifier. This regenerative energy (hence the term “regen” circuit) is dissipated as heat in the regen resistor. The regen resistor is switched in by the regen circuit.

The setup software can be used to adapt the regen circuit (thresholds) according to the electrical supply voltage.

Our customer service can help you with the calculation of the regen power that is necessary for your system.

A description of the interface can be found on page 42.

Functional description:

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

If the energy fed back from the motor has an average or peak power that exceeds the preset level for the regen power rating, then the servo amplifier generates the warning “n02 regen power exceeded” and the regen circuit is switched off.

The next internal check of the DC bus link voltage (after a few milliseconds) detects an overvoltage and the servo amplifier is switched off, with the error message “Overvoltage F02” (⇨ p.72).

The BTB/RTO contact (terminals X3/2,3) will be opened at the same time (⇨p.52)

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

Thanks to the built-in regen circuit, several amplifiers (even with different current ratings) can be operated off a common DC bus link, without requiring any additional measures.

The **combined (peak and continuos) power** of all amplifiers is always available. 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 regen circuits dependent on the amplifiers type and the mains voltage situation see table on the next page.

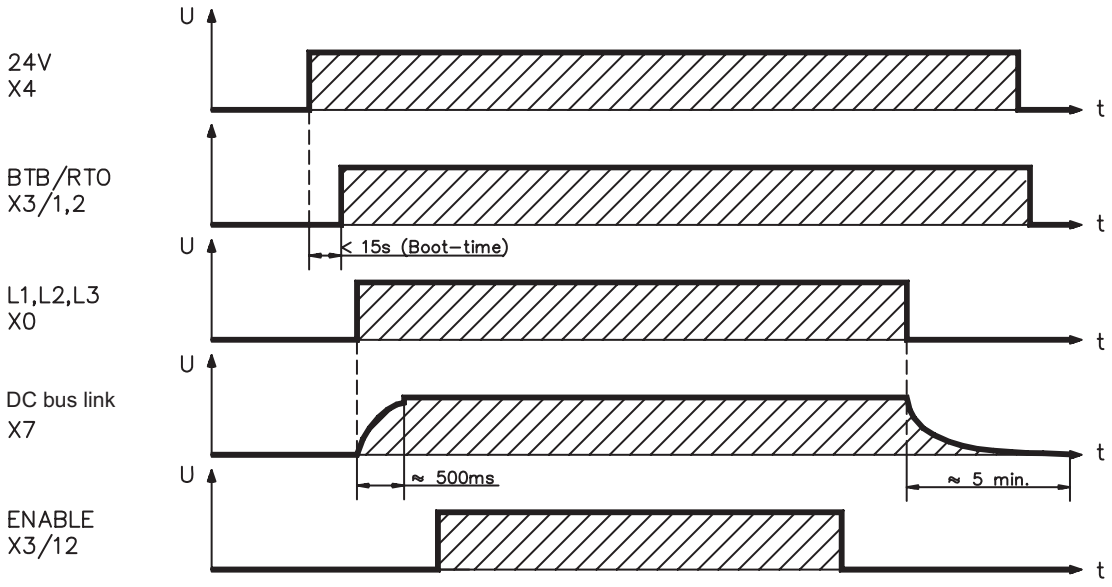
Technical Data:

Regen circuit			Supply voltage			
	Rated data	**Dim.**	**110 V**	**230 V**	**400 V**	**480 V**
303 (S30361)	Switch-on (upper) threshold of regen circuit	V	200	400		
	Overvoltage F02	V	235	455		
	Regen resistor (internal)	Ohm	66	66		
	Continuous power in regen circuit (RBint)	W	20	20		
	Pulse power in regen circuit (RBint max. 1s)	kW	0,75	3	—	
	Regen resistor (external)*	Ohm	66	66		
	Continuous power in regen circuit (RBext) max.	kW	0,3	0,3		
	Pulse power in regen circuit (RBext max. 1s)	kW	0,75	3		
306 / 310 (S30661/S31061)	Switch-on (upper) threshold of regen circuit	V	200	400		
	Overvoltage F02	V	235	455		
	Regen resistor (internal)	Ohm	66	66		
	Continuous power in regen circuit (RBint)	W	50	50		
	Pulse power in regen circuit (RBint max. 1s)	kW	0,75	3	—	
	Regen resistor (external)*	Ohm	66	66		
	Continuous power in regen circuit (RBext) max.	kW	1	1		
	Pulse power in regen circuit (RBext max. 1s)	kW	0,75	3		
341 (S30101)	Switch-on (upper) threshold of regen circuit	V		400	720	840
	Overvoltage F02	V		455	800	900
	Regen resistor (internal)	Ohm		91	91	91
	Continuous power in regen circuit (RBint)	W		20	20	20
	Pulse power in regen circuit (RBint max. 1s)	kW	—	2,1	7	9
	Regen resistor (external)*	Ohm		91	91	91
	Continuous power in regen circuit (RBext) max.	kW		0,3	0,3	0,3
	Pulse power in regen circuit (RBext max. 1s)	kW		2,1	7	9
343 / 346 (S30301/S30601)	Switch-on (upper) threshold of regen circuit	V		400	720	840
	Overvoltage F02	V		455	800	900
	Regen resistor (internal)	Ohm		91	91	91
	Continuous power in regen circuit (RBint)	W		50	50	50
	Pulse power in regen circuit (RBint max. 1s)	kW	—	2,1	7	9
	Regen resistor (external)*	Ohm		91	91	91
	Continuous power in regen circuit (RBext) max.	kW		1,0	1,0	1,0
	Pulse power in regen circuit (RBext max. 1s)	kW		2,1	7	9

* Partially other resistance values are possible. Please ask our customer support.

2.14 Switch-on and switch-off behavior

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



2.14.1 Stop function as per EN 60204 (VDE 0113)

If a fault occurs (⇨ p.72) then the output stage of the servo amplifier is switched off and the BTB/RTO contact is opened. In addition, a global error signal can be generated at one of the digital outputs (terminals X3/16 and X3/17) – see online help for the setup software. These signals can be used by the higher-level control system to finish the current PLC cycle or to shut down the drive (with additional brake or similar).

Devices with activated (holding-)“Brake” function use a special sequence for switching off the output stage (⇨ p.22).

The “Stop” functions are defined in EN 60204 (VDE 0113), Paras. 9.2.2, 9.2.5.3.

There are three categories of stop functions:

- Category 0: Shutdown by an immediate switch-off of the energy supply to the drive machinery (i.e an uncontrolled shutdown);
- Category 1: A controlled shutdown, during which the supply of energy to the drive machinery is maintained as long as shutdown is being carried out, and only interrupted when standstill has been reached;
- Category 2: A controlled shutdown, during which the supply of energy to the drive machinery is maintained.

Every machine must be equipped with a Category 0 stop function. Stop functions to Categories 1 and/or 2 must be provided if the safety of functional requirements of the machine make them necessary.

You can find further information and implementation examples in the Application Note “Stop and Emergency Stop Functions”.

2.14.2 Emergency Stop strategies

The Emergency Stop function is defined in EN 60204 (VDE 0113), Para. 9.2.5.4.

Implementation of the Emergency Stop function :
Wiring recommendation can be found in the Application Note “Stop and Emergency Stop Functions".

Category 0:

The controller enable is switched to “disable”, the electrical supply is disconnected.

The drive must be held by an electromechanical holding device (brake).

In multi-axis systems with a coupled DC bus link, the motor cable must also be disconnected by a changeover switch (a contactor, such as the Siemens 3RT1516-1BB40) and short-circuited by resistors connected in a star configuration.

Category 1:

If hazardous conditions can result from an Emergency Stop switch-off with an uncontrolled run-down, the drive can be switched off after a controlled shutdown. Stop Category 1 permits electromotoric (i.e. regenerative) braking with a switch-off when zero speed has been reached. Safe shutdown can be achieved if the loss of the electrical supply is not evaluated as a fault and the control system takes over the disabling of the servo amplifier.
In normal circumstances, only the supply power is switched off in a safe manner. The 24V auxiliary supply remains switched on.

3 Installation

3.1 Important notes

- 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.
- 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 on page 31.
- 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 EN 60204-1 Section 4.3.1). An excessive voltage on these terminals can lead to destruction of the regen circuit and the servo amplifier.
- The fusing of the AC supply input and 24V supply must be installed by the user (⇨ p.20).
- Take care that the servo amplifier and motor are properly grounded.
  Do **not** use painted (i.e. non-conductive) mounting plates.
- Route power and control cables separately. We recommend a distance of at least 200mm. This improves the interference immunity required by EMC regulations.
  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 (⇨ p.32).
- Ground all shielding with large areas (low impedance), with metalized connector housings or shield connection clamps wherever possible. Notes on connection techniques can be found on page 34.
- Feedback lines may not be extended, since thereby the shielding would be interrupted and the signal processing could be disturbed.
- Lines between amplifiers and external regen resistor must be shielded.
- Install all power cables with an adequate cross-section, as per EN 60204 (⇨ p.21) and use the requested cable material (⇨ p. 35) to reach max. cable length.
- Wire the BTB/RTO contact in series into the safety circuit of the installation. The safety circuit must operate the supply contactor. This is the only way to ensure monitoring of the servo amplifier.
- Ensure that there is an adequate flow of cool, filtered air into the bottom of the control cabinet, or use a heat exchanger. Please refer to page 21.
- It is permissible to use the setup software to alter the settings of the servo amplifier. **Any other alterations will invalidate the warranty.**

Never disconnect the electrical connections to the servo amplifier while it is live. In unfavorable circumstances this could cause destruction of the electronics. Residual charges in the capacitors can have dangerous levels up to 300 seconds after switching off the electrical supply. Measure the bus voltage on the DC bus link (+DC/-DC) and wait until the voltage has fallen below 40V.
Control and power connections can still be live, even if the motor is not rotating.

3.2 Guide to installation and wiring

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

Site

In a closed control cabinet. Please refer to page 21.
The site must be free from conductive or corrosive materials.
For the mounting position in the cabinet ⇨ p.29.

Ventilation

Check that the ventilation of the servo amplifier is unimpeded, and keep within the permitted ambient temperature ⇨ p.21.
Keep the required space clear above and below the servo amplifier ⇨ p.29.

Assembly

Assemble the servo amplifier and power supply close together, on the conductive, **grounded** mounting plate in the cabinet.

Cable selection

Select cables in accordance with EN 60204 ⇨ p.21.

Grounding Shielding

For EMC-compliant shielding and grounding ⇨ p.32.
Ground the mounting plate, motor housing and CNC-GND of the control system.
Notes on connection techniques can be found on page 34.

Wiring

Route power leads and control cables separately.
Wire the BTB/RTO contact in series into the safety circuit of the system.

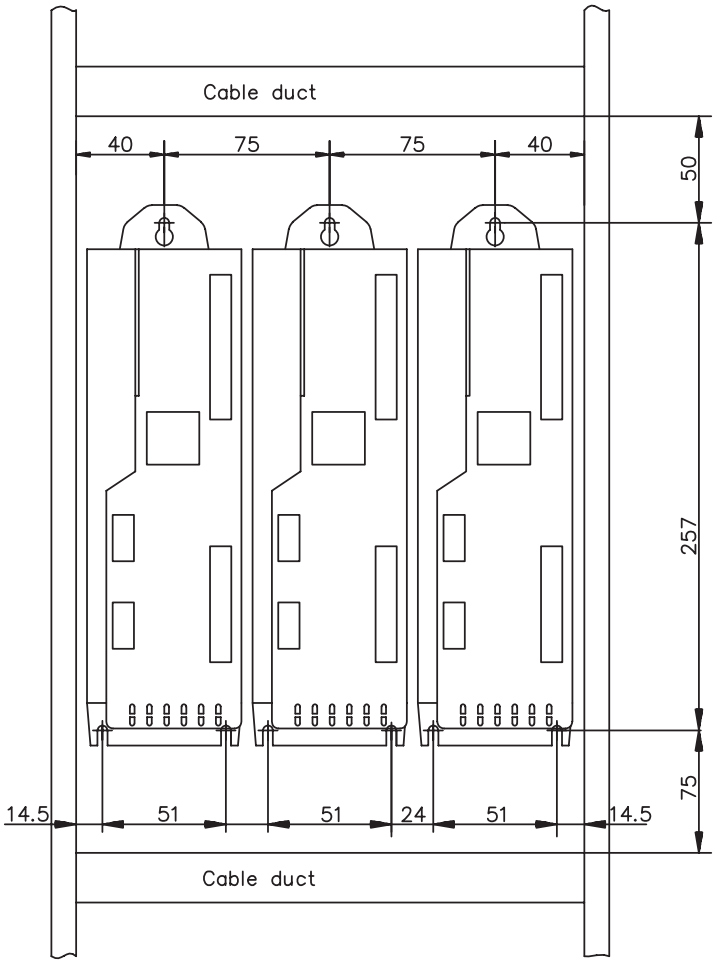
— Connect the digital control inputs and outputs.
— Connect up AGND (also if fieldbuses are used).
— Connect the analog input source, if required.
— Connect the feedback device.
— Connect the encoder emulation, if required.
— Connect the expansion card
(see corresponding notes from page 75 on).
— Connect the motor cable
Connect shielding to EMC connectors (shield connection) at both ends. Use the motor choke (3YLNxx) if cable > 25 meters.
— Connect motor-holding brake, connect shielding to EMC connector/shield connection at both ends.
— If required, connect the external regen resistor (with fusing).
— Connect the auxiliary supply
(maximum permissible voltage values ⇨ p.21).
— Connect the main electrical supply
(maximum permissible voltage values ⇨ p.21).
— Connect the PC (⇨ p.59).

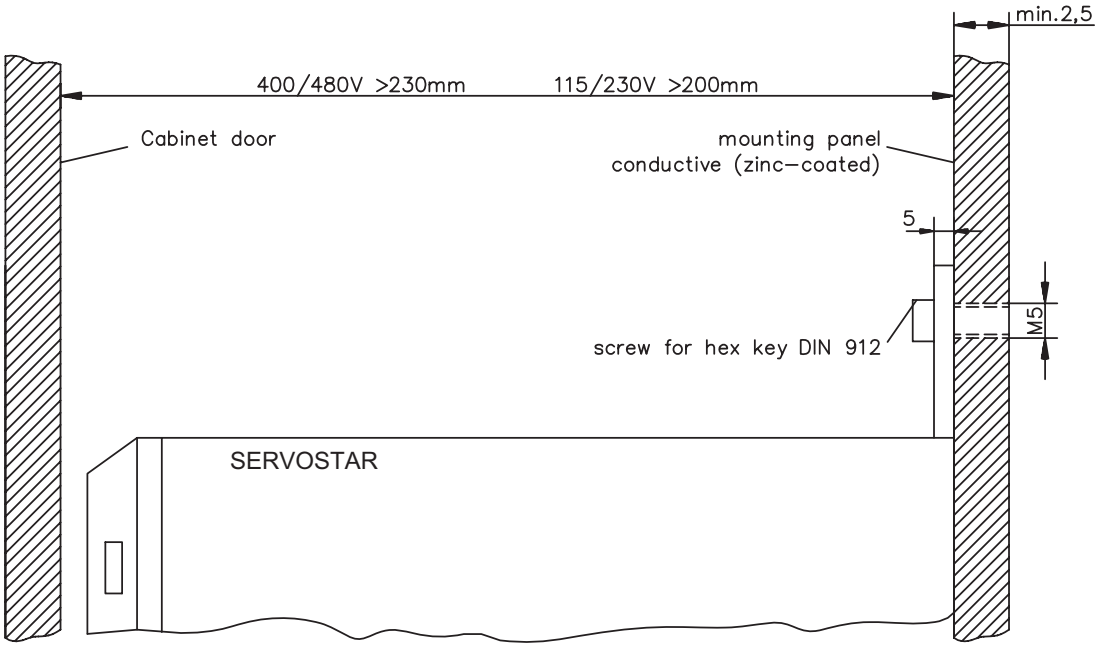
Final check

— Final check of the implementation of the wiring against the wiring diagrams that have been used.

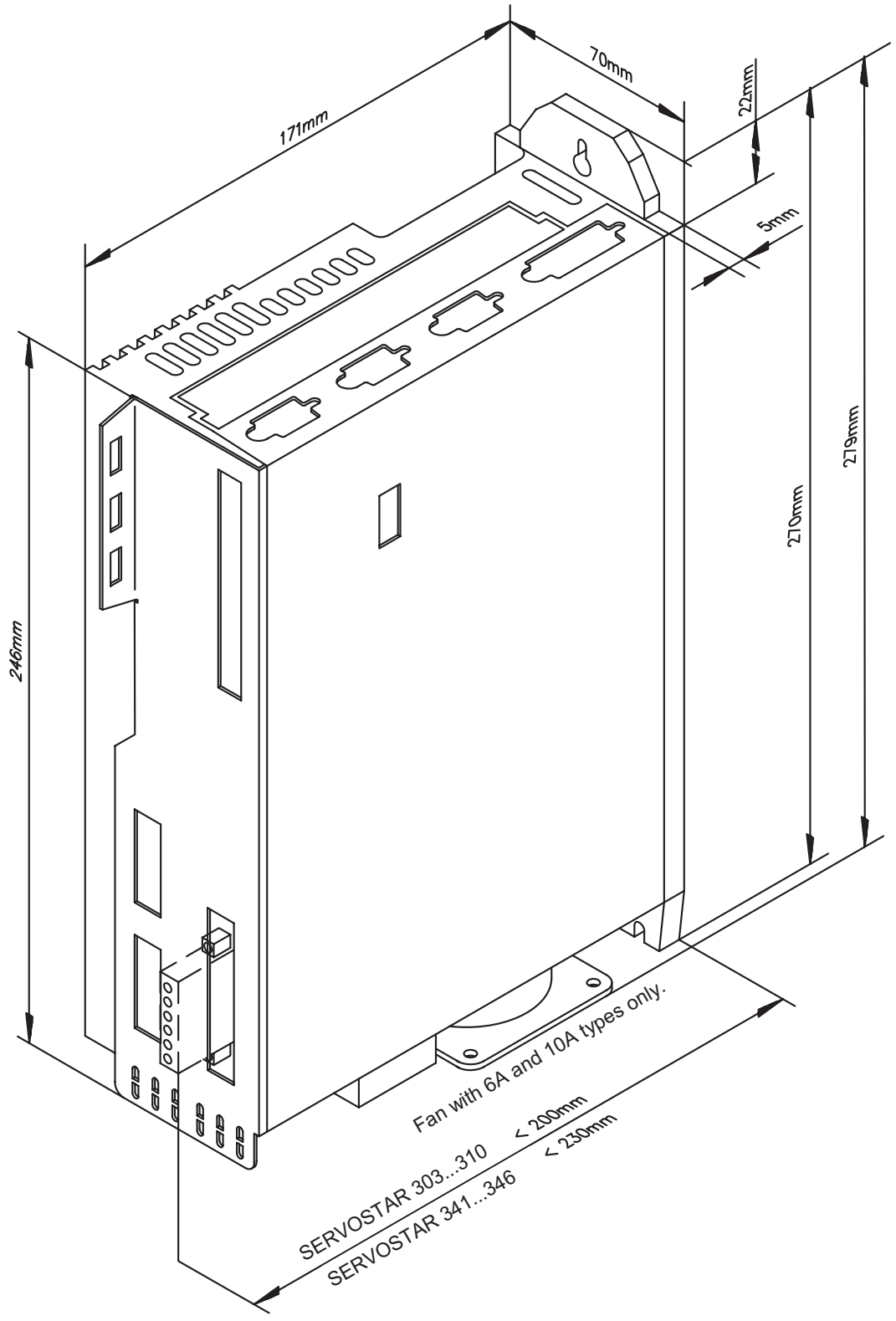
3.3 Assembly

Material: 3 x M5 hexagon socket screws to DIN 912
Tool required : 4 mm Allen key
All dimensions in mm.





3.3.1 Dimensions



3.4 Wiring

Only professional staff who are qualified in electrical engineering are allowed to install the servo amplifier.

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).

Warning !
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.
Take care that the cabinet is safely disconnected (with a lock-out, warning signs etc.). The individual voltages will be switched on for the first time during setup.

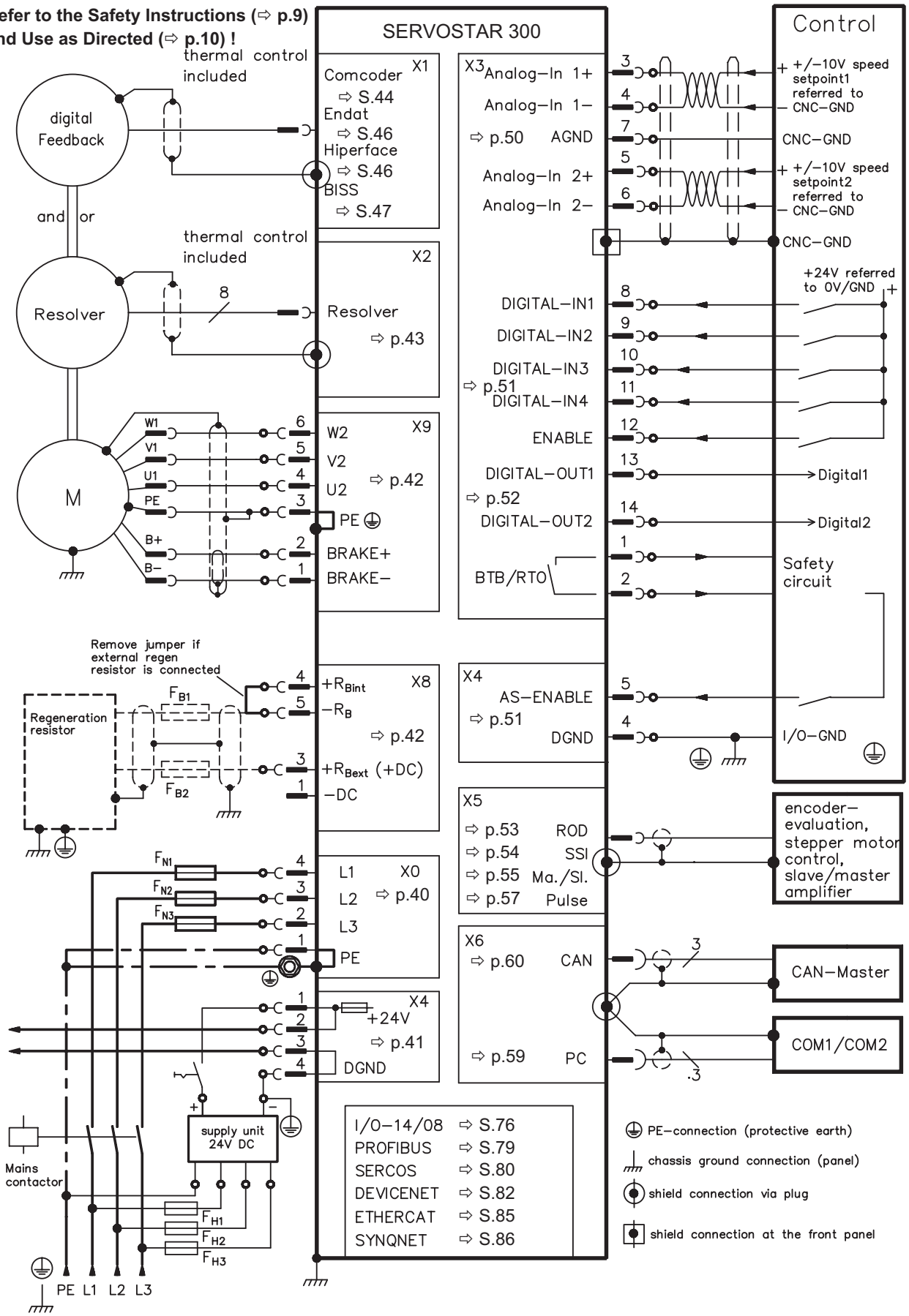
Note !

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 EN 60204).

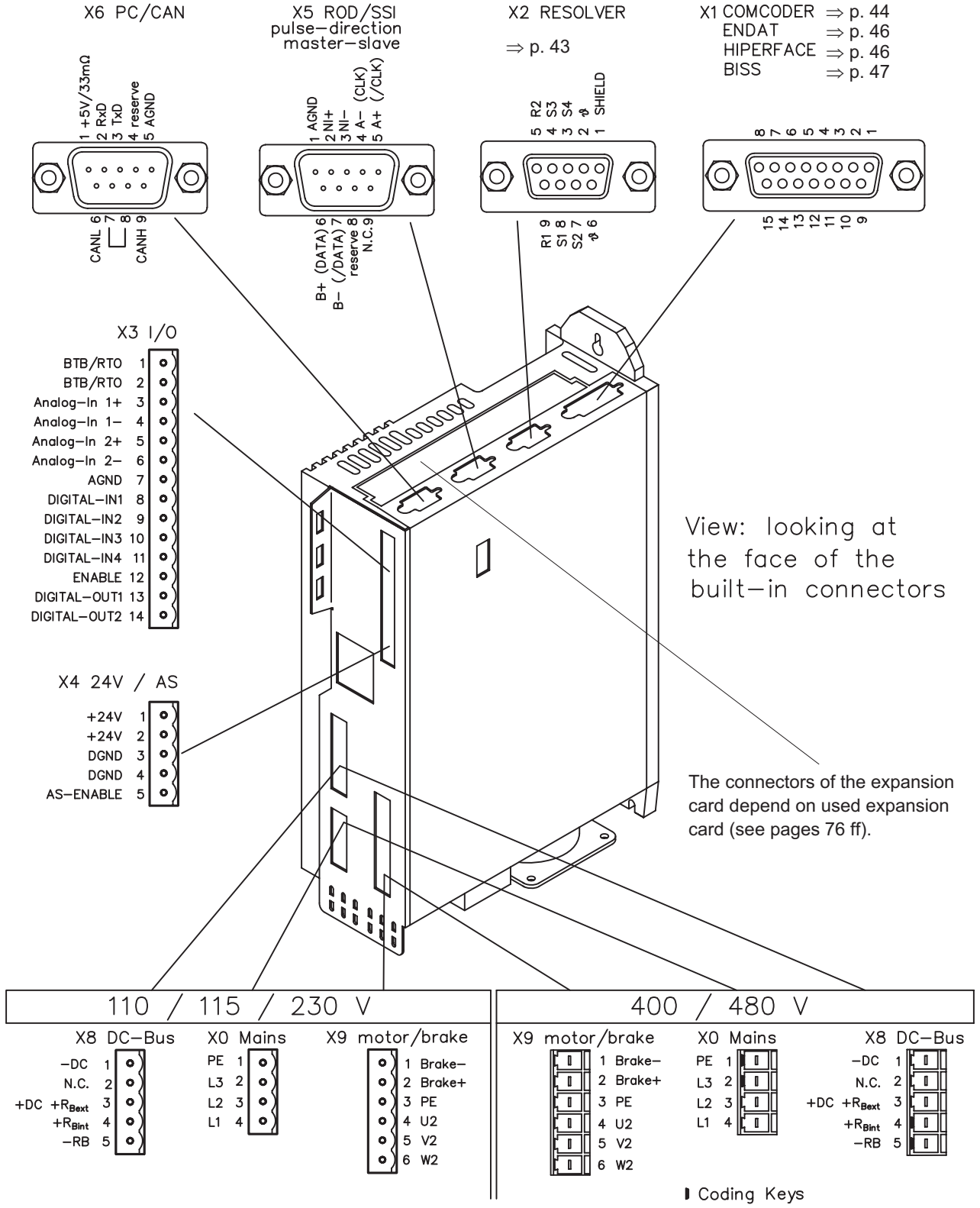
Use the following connection diagrams :

3.4.1 Connection diagram

Refer to the Safety Instructions (⇨ p.9) and Use as Directed (⇨ p.10) !

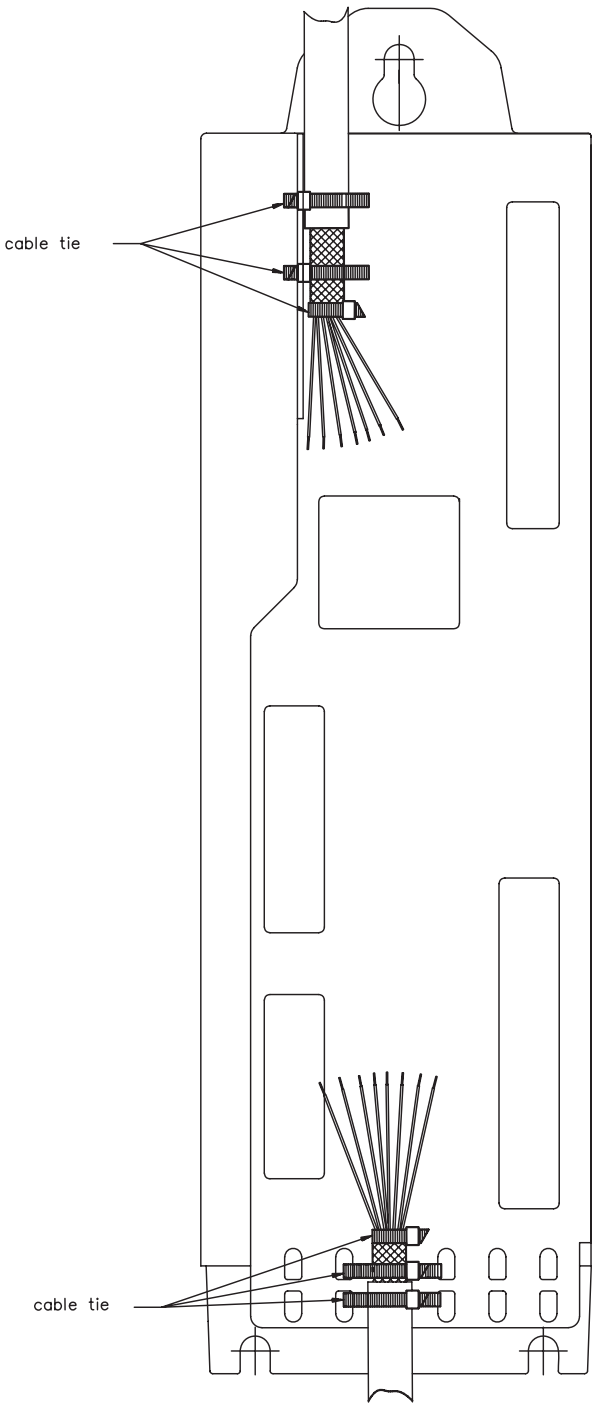


3.4.2 Connector assignments



3.4.3 Notes on connection technology

3.4.3.1 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 30mm without damaging the shielding braid.

Pull a cable tie by the slot in the shielding rail on the front panel of the servo amplifier.

Press the shielding of the cable firmly against the front panel with the cable tie.

3.4.3.2 Technical data for connecting cables

Further information on the chemical, mechanical and electrical characteristics of the cables can be obtained from our customer service.

Observe the rules in the section "Conductor cross-sections" on page 21. To reach the max. permitted cable length, you must use cable material that matches the capacitance requirements listed below.

Insulation material

Sheathing - PUR (polyurethane, code 11Y)
Core insulation - PETP (polyesteraphthalate, code 12Y)

Capacitance

Motor cable - less than 150 pF/m
Resolver/Encoder cable - less than 120 pF/m

Technical data

— The brackets in the core definition indicate the shielding.
— All cables are suitable for use as trailing cables.
— The technical data refer to use as moveable cables.
Operating life : 1 million bending cycles

Cores [mm²]	max. length [m]	Use for	Core identi-fication	Operating temp. range [°C]	Outside diameter [mm]	Bending radius [mm]
(4x1.0)	50*	motor power	number	-30 / +80	10	100
(4x1.5)	50*	motor power	number	-30 / +80	10.5	105
(4x1.0+(2x0.75))	50*	motor power + brake	color	-30 / +80	10.5	100
(4x1.5+(2x0.75))	50*	motor power + brake	number	-30 / +80	11.5	120
(4x(2x0.25))	100*	Resolver	color	-30 / +80	6.9	70
(7x(2x0.25))	50*	Encoder	color	-30 / +80	7.7	80

* Danaher Motion North America supplies cables up to 39 meters
Danaher Motion Europe supplies cables up to max. length.
Motor cables longer than 25m only with motor choke 3YLNxx

3.5 Setup software

3.5.1 General

This chapter describes the installation of the setup software DRIVEGUI.EXE for the SERVOSTAR 300 digital servo amplifiers.

We offer training and familiarization courses on request.

3.5.1.1 Use as directed

The setup software is intended to be used for altering and saving the operating parameters for the SERVOSTAR 300 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 7 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.

3.5.1.2 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, see p.59). The setup software provides the communication between the PC and SERVOSTAR 300.

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 interface modules (expansion cards) which may be 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 (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.

3.5.1.3 Hardware requirements

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!**) (⇨ p.59).

Connect / 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® I or comparable
Operating system	:	WINDOWS 2000 / XP
Graphics adapter	:	Windows compatible, color
Drives	:	hard disk with at least 10 MB free space CD-ROM drive
Interface	:	one free serial interface (COM1: bis COM10:)

3.5.1.4 Operating systems

WINDOWS 2000 / XP

DRIVEGUI.EXE will run under WINDOWS 2000 and WINDOWS XP.

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

Unix, Linux

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

3.5.2 Installation under WINDOWS 2000 / XP

On the CD-ROM you can find an installation program, which makes it easy to install the setup software on your PC.

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:\start.exe** (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 SERVOSTAR 300 (⇨ p.59).

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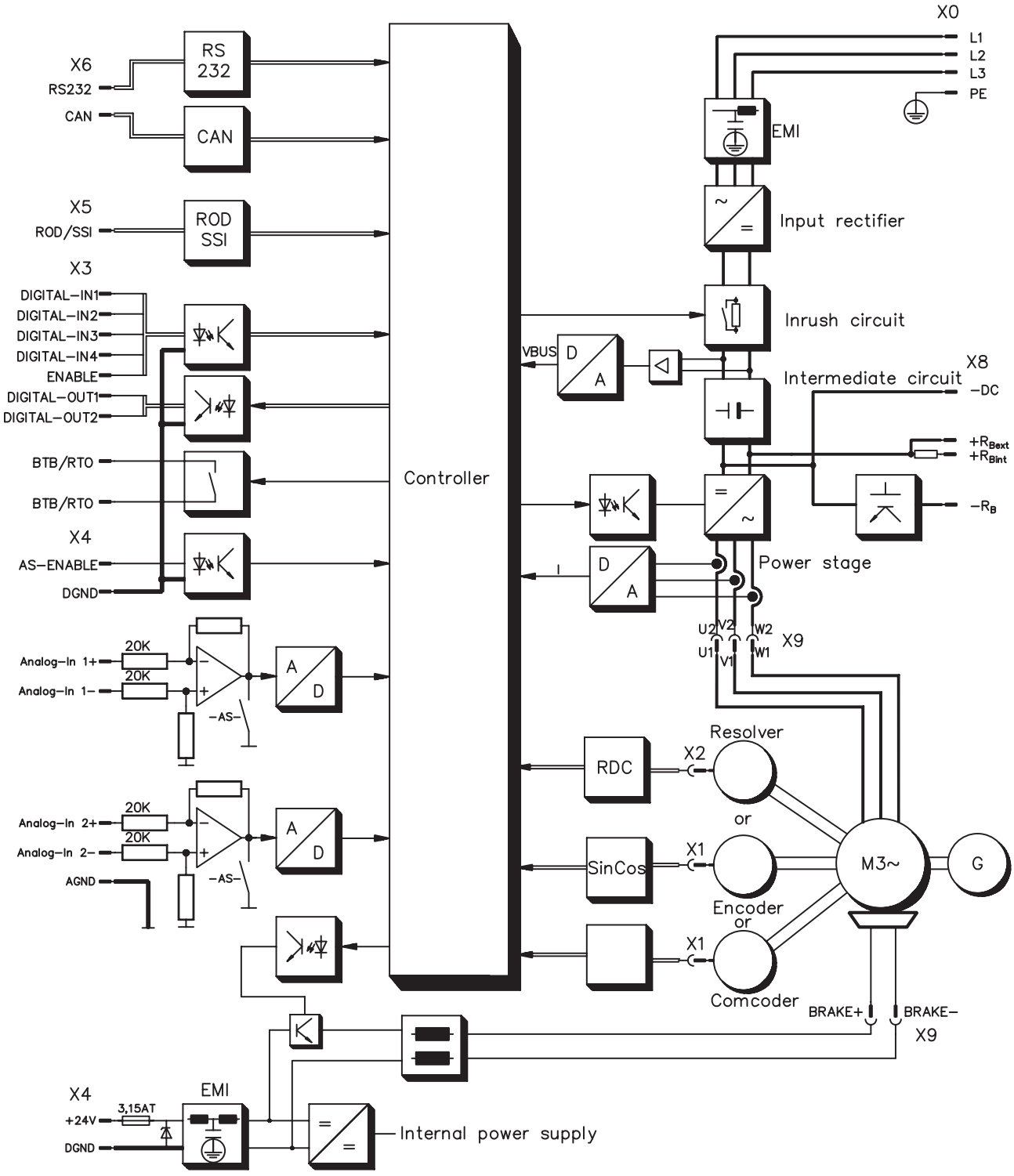
4 Interfaces

All the important interfaces are presented in this chapter. The precise position of the connectors and terminals can be seen on page 33. The block diagram below just provides an overview.

4.1 Block diagram

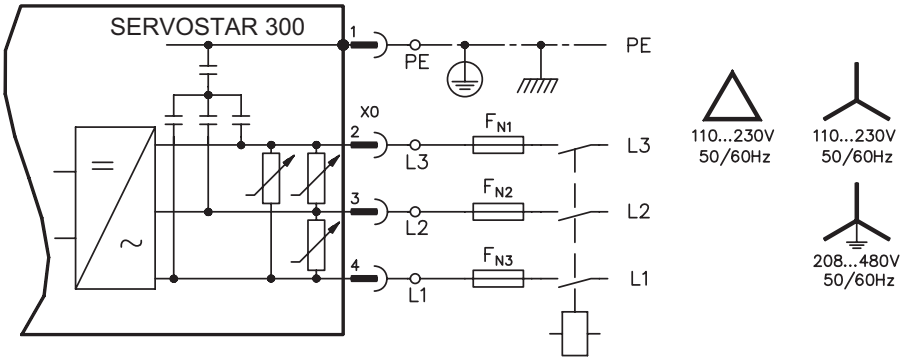


4.2 Electrical supply

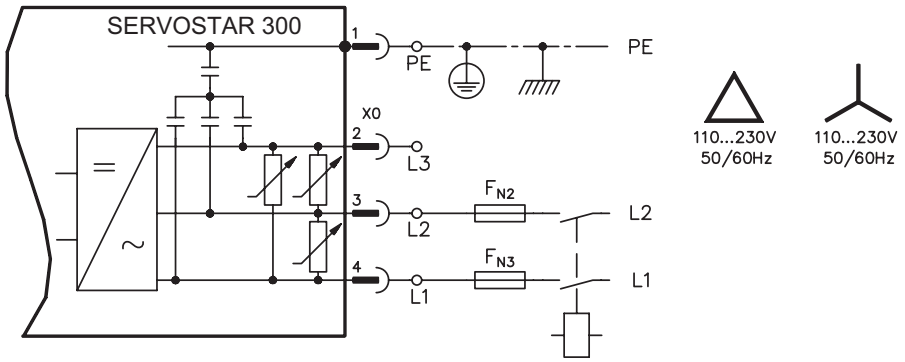
4.2.1 Mains electrical supply connection (X0)

4.2.1.1 Three phase

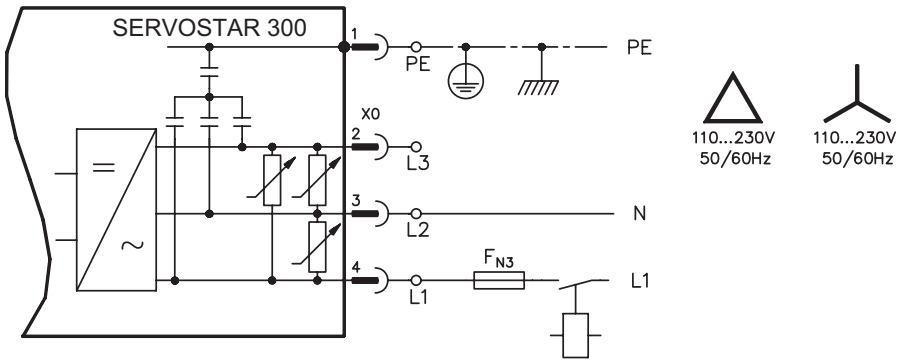
— Directly to 3-phase supply network, filter is integrated
— Fusing (e.g. fusible cut-outs) to be provided by the user ⇨ p.20



4.2.1.2 Single phase without neutral



4.2.1.3 Single phase with neutral

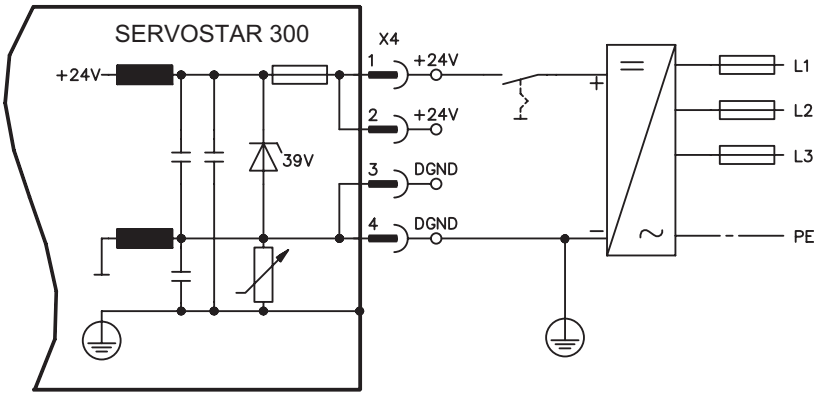


4.2.2 24V auxiliary supply (X4)

— External 24V DC power supply, electrically isolated, e.g. via an isolating transformer

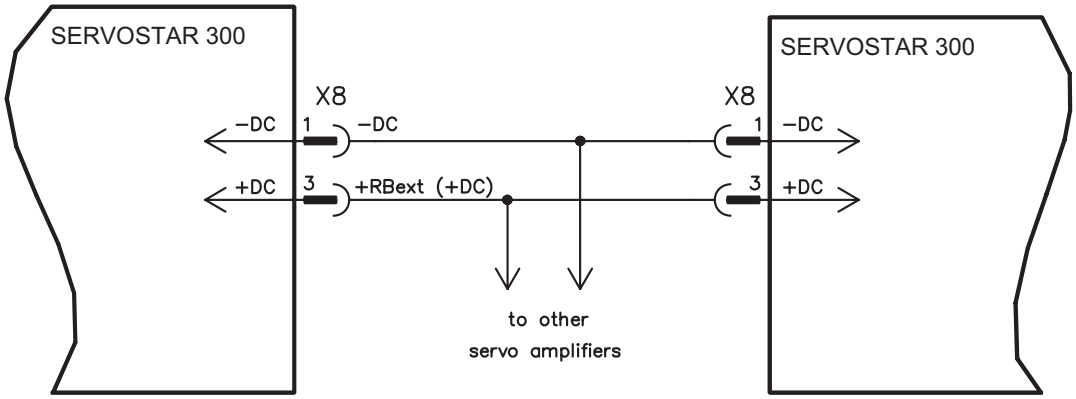
— Required current rating ⇨ p.18

— Integrated EMC filter for the 24V auxiliary supply



4.2.3 DC bus link (X8)

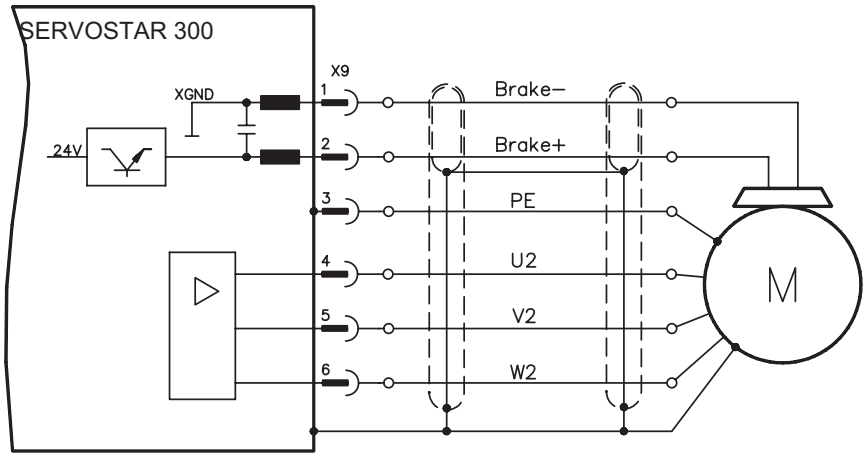
Terminals X8/1 (-DC) and X8/3 (+RBext). Can be connected in parallel, whereby the regen power is divided between all the amplifiers that are connected to the same DC bus link circuit.



Only servo amplifiers with mains supply from the same mains (identical mains supply voltage) may be connected by the DC bus link.

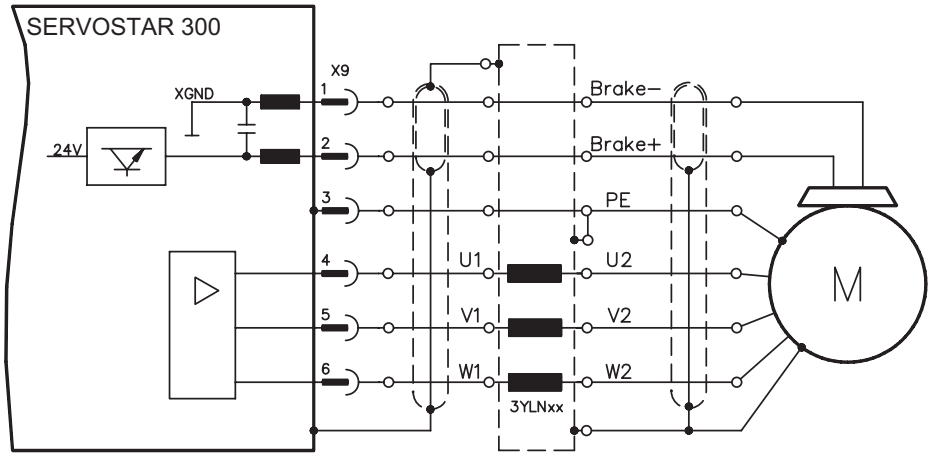
4.3 Motor connection with brake (X9)

Cable length ≤ 25 meters



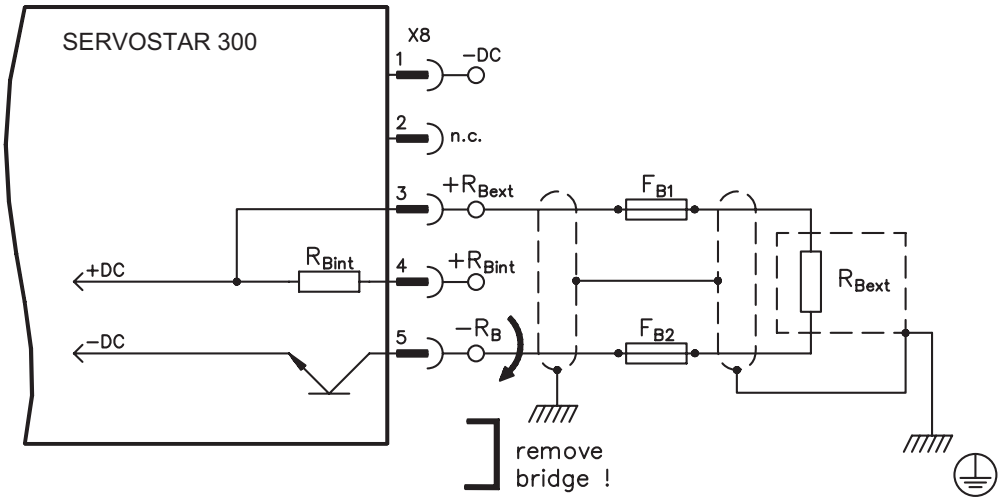
Cable length >25 meters

For cable lengths above 25m up to max. 50m, the motor choke 3YLNxx (⇨ S.93) must be wired into the motor cable, close to the amplifier.



4.4 External regen resistor (X8)

Remove the plug-in link between the terminals X8/5 (-R_B) and X8/4 (+R_{bint}).

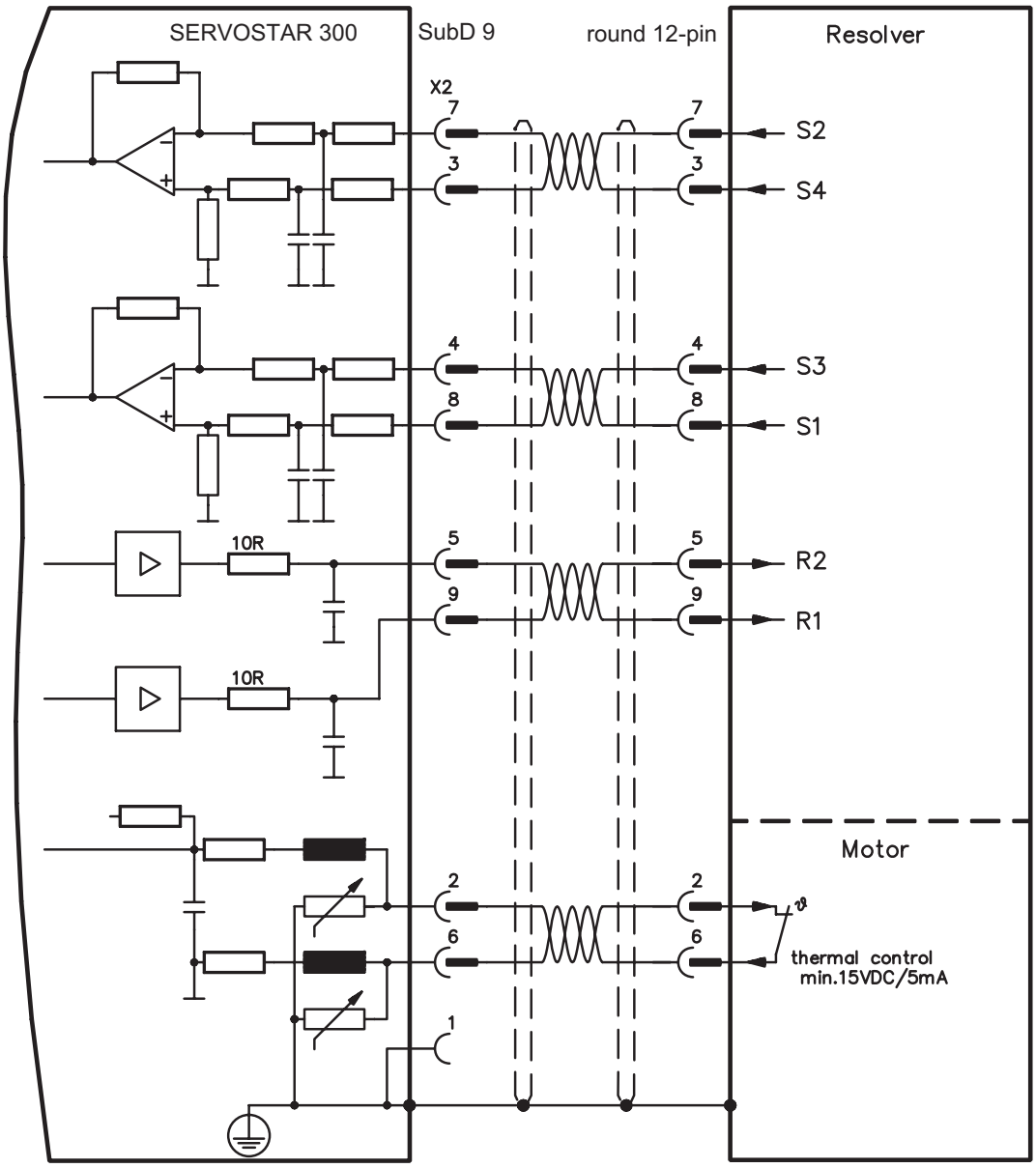


4.5 Feedback

Feedback system	Conn.	See	Remarks
Resolver	X2	p. 43	2 to 36 poles
ComCoder	X1	p. 44	A, B, zero, Hall
Incremental or sine Encoder with Hall	X1	p. 45	A, B, zero, Hall or Sine, Cosine, zero, Hall
Encoder with EnDat/HIPERFACE	X1	p. 46	Sine, cosine, clock, data
ACURO Encoder	X1	p. 47	Data (BISS)
Encoder without Data channel	X1	p. 49	Sine, cosine, zero
Incremental encoder (A quad B)	X5	p. 48	A, B, zero

4.5.1 Resolver (X2)

Our rotatory servomotors are fitted as standard with 2-pole hollow-shaft resolvers. It is possible to connect resolvers with 2 to 36 poles to SERVOSTAR 300. The thermostat contact in the motor is connected via the resolver cable to X2 and evaluated there.
If cable lengths of more than 100 meters are planned, please contact our customer service.



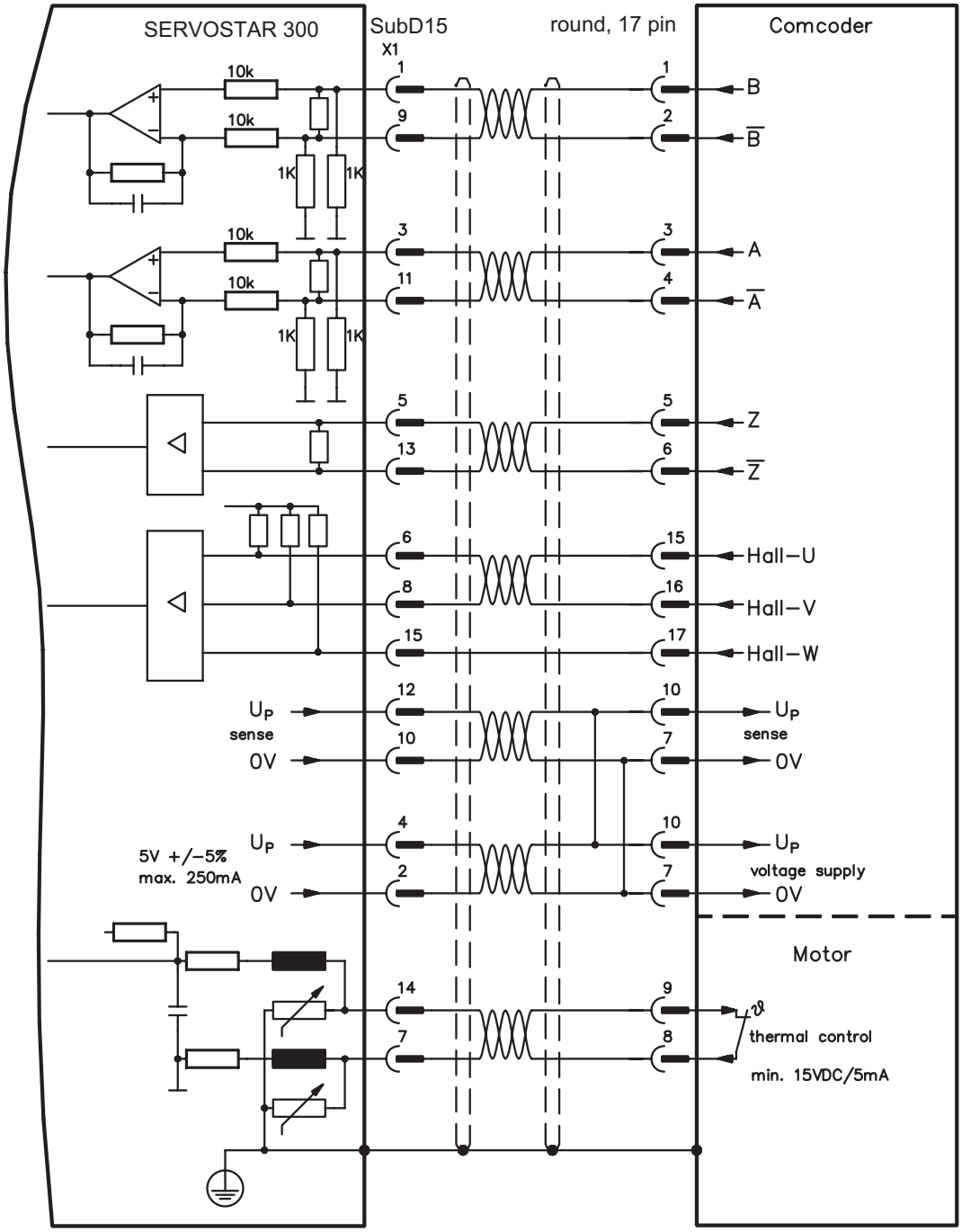
4.5.2 Comcoder (X1)

As an option our motors can be equipped with a ComCoder as feedback unit. For the commutation hall sensors are used and for the resolution an incremental encoder.

The thermostat contact in the motor is connected via the ComCoder cable to X1 and evaluated there.

If cable lengths of more than 25m are planned, please consult our customer service.

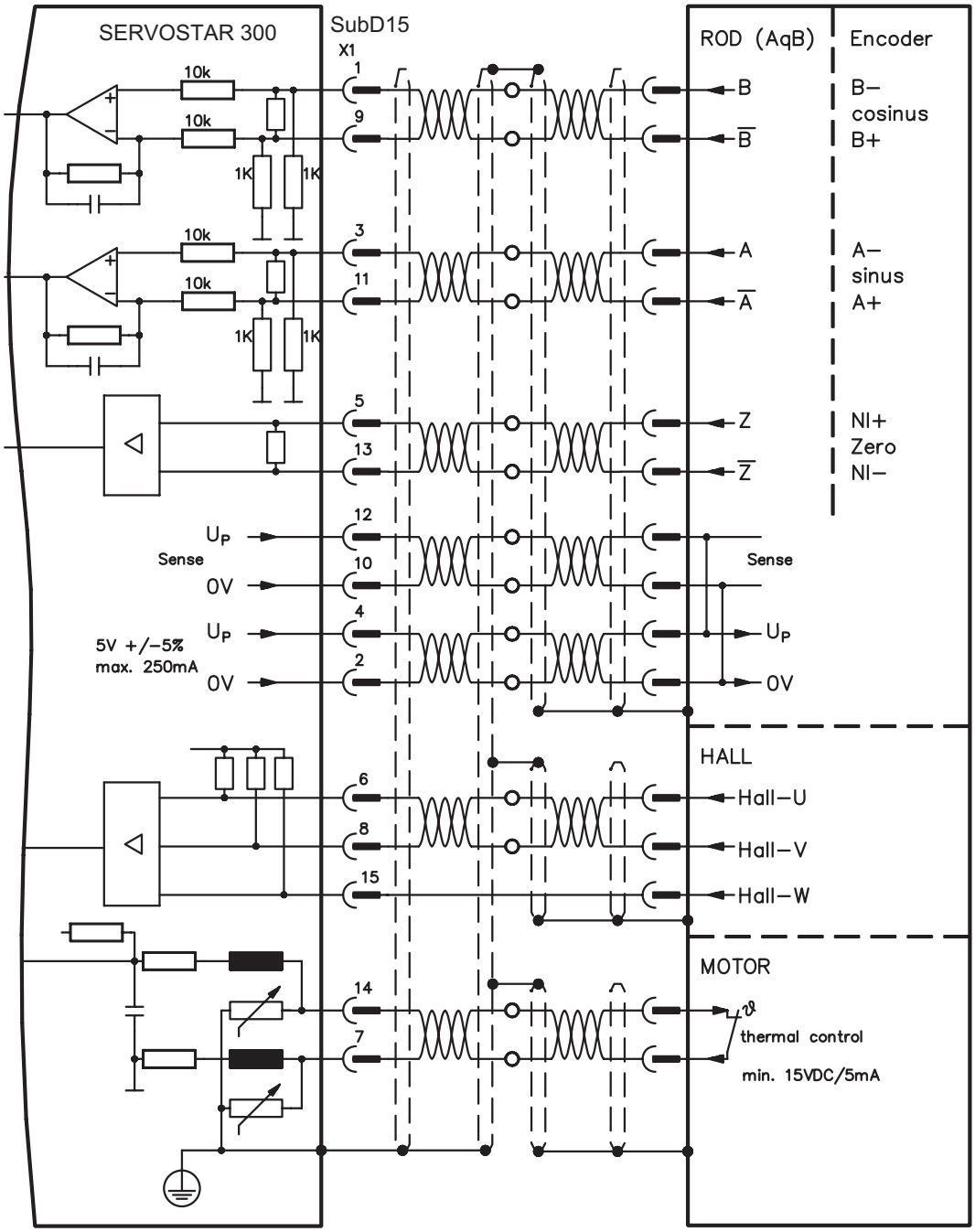
Frequency limit (A,B): 350 kHz



4.5.3 Incremental or sine encoder with hall sensors (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. All signals are connected to X1.
If cable lengths of more than 25m are planned, please consult our customer service.

Frequency limit (A,B): 350 kHz



4.5.4 Encoder with EnDat or HIPERFACE (X1)

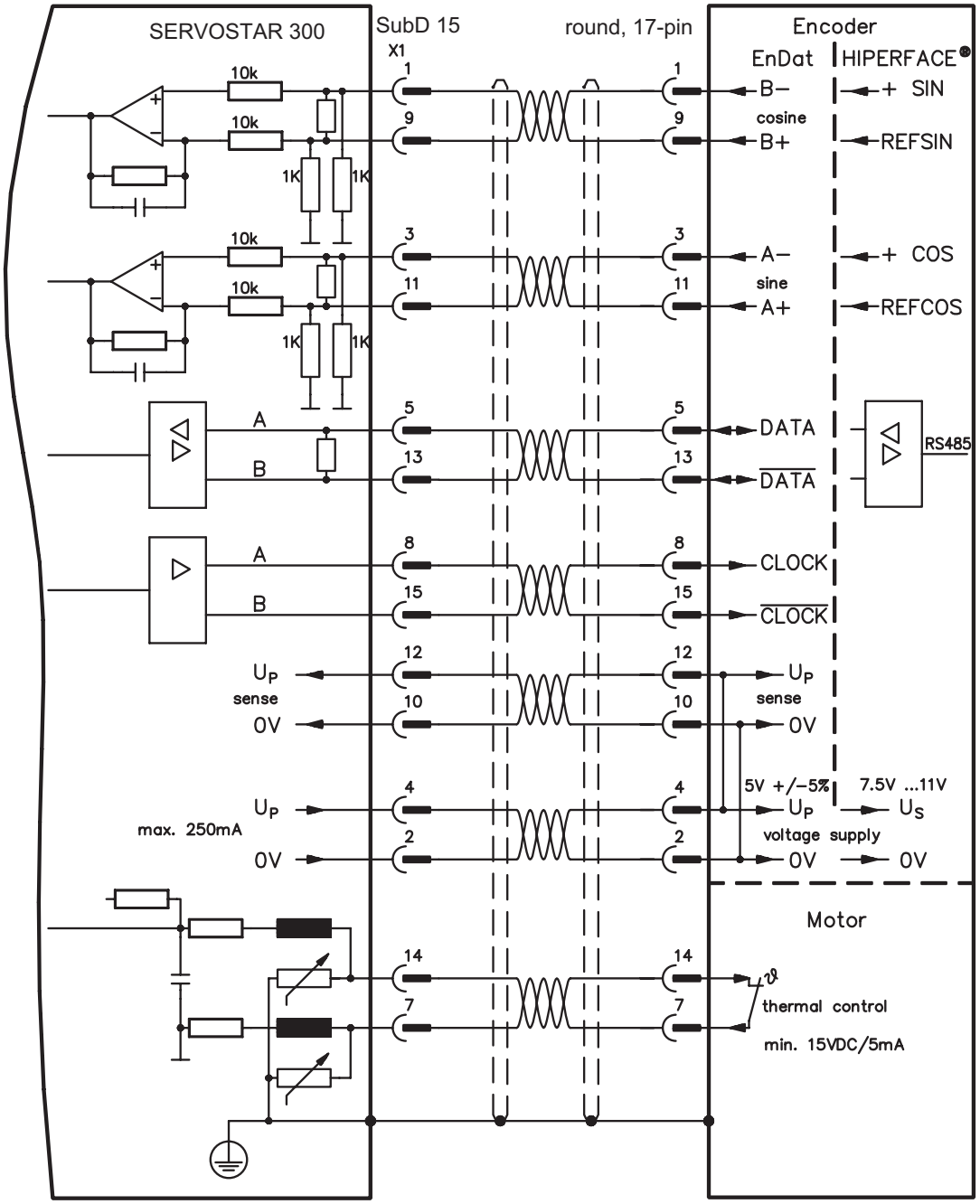
As an option, our servomotors can be fitted with a single-turn or multi-turn sine-cosine encoder. Preferred types are the ECN1313 and EQN1325 encoders.

The encoder is used by the SERVOSTAR 300 as a feedback device for drive tasks that require highly precise positioning or extremely smooth running.

The thermostat contact in the motor is connected via the encoder cable to X1 and evaluated there.

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

Frequency limit (A,B): 350 kHz



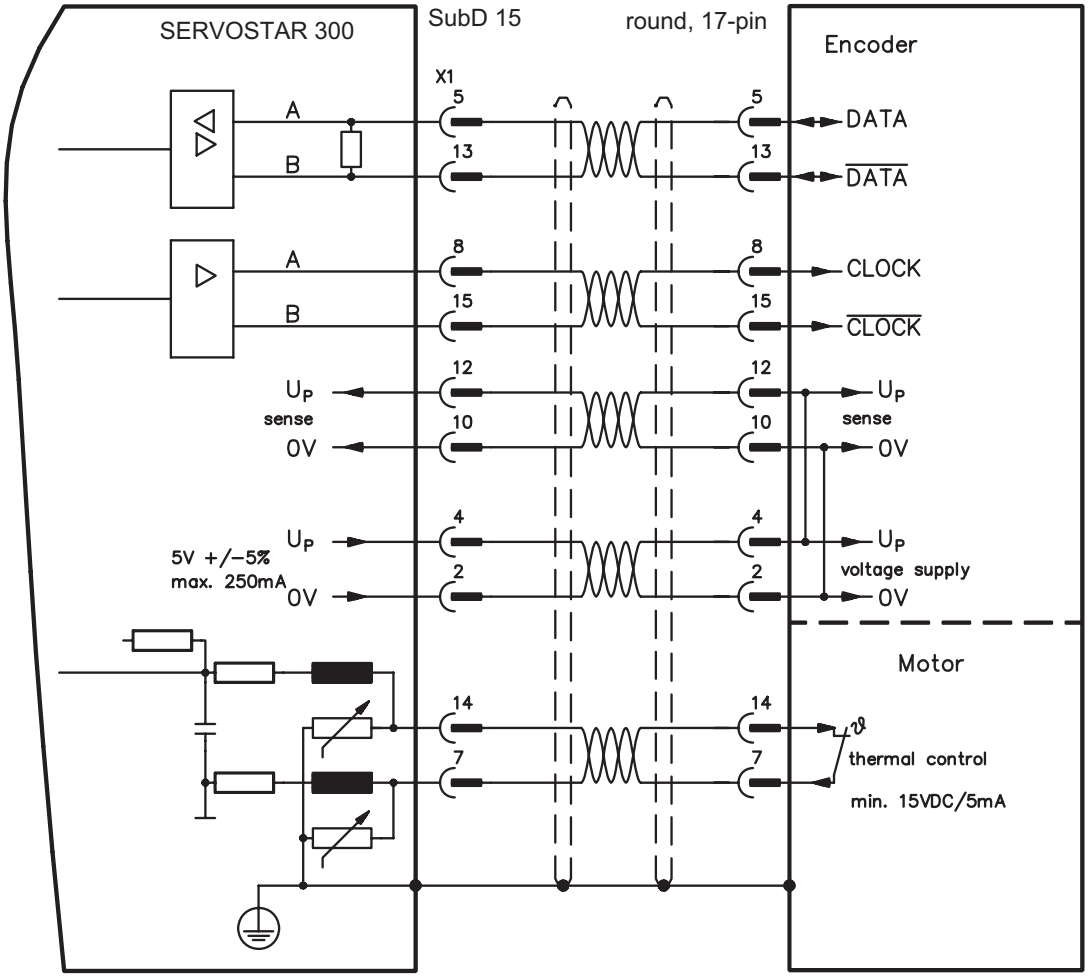
4.5.5 ACURO encoder, BISS interface (X1)

As an option, our servomotors can be fitted with a single-turn or multi-turn ACURO encoder with BISS interface.

The encoder is used by the SERVOSTAR 300 as a feedback device for drive tasks that require highly precise positioning or extremely smooth running.

The thermostat contact in the motor is connected via the encoder cable to X1 and evaluated there.

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



4.5.6 Incremental Encoder (X5)

An incremental encoder can be used as standard motor feedback.

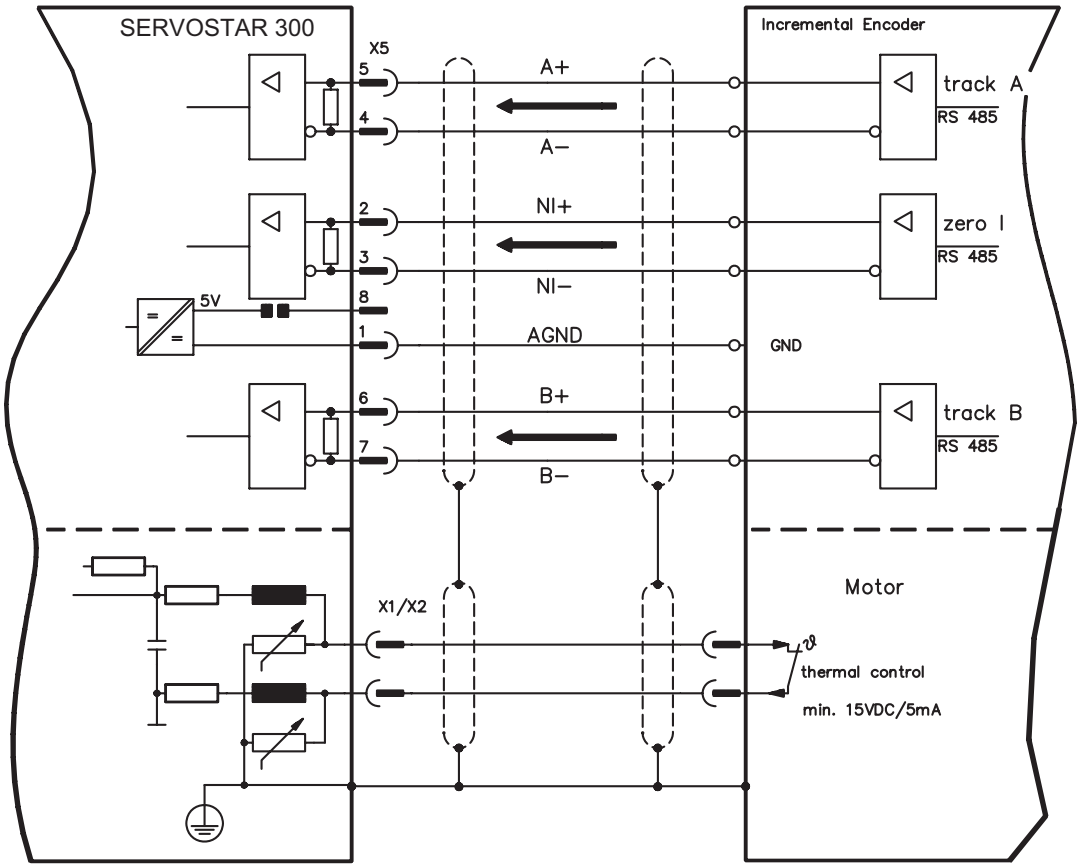
Select feedback type 19 "ROD 5V with W&S". Drive executes wake&shake to calculate the necessary start-up information for the position controller every time the 24V auxiliary voltage is switched on.

If lead lengths of more than 50m are planned and for questions concerning the power supply of the encoder, please consult our customer service.

The thermostat contact in the motor is connected to X1 (see p.46) or X2 (see p.43).

Frequency limit: 1.5 MHz

Don't use this feedback type with vertical load (hanging load).



4.5.7 Encoder without data channel (X1)

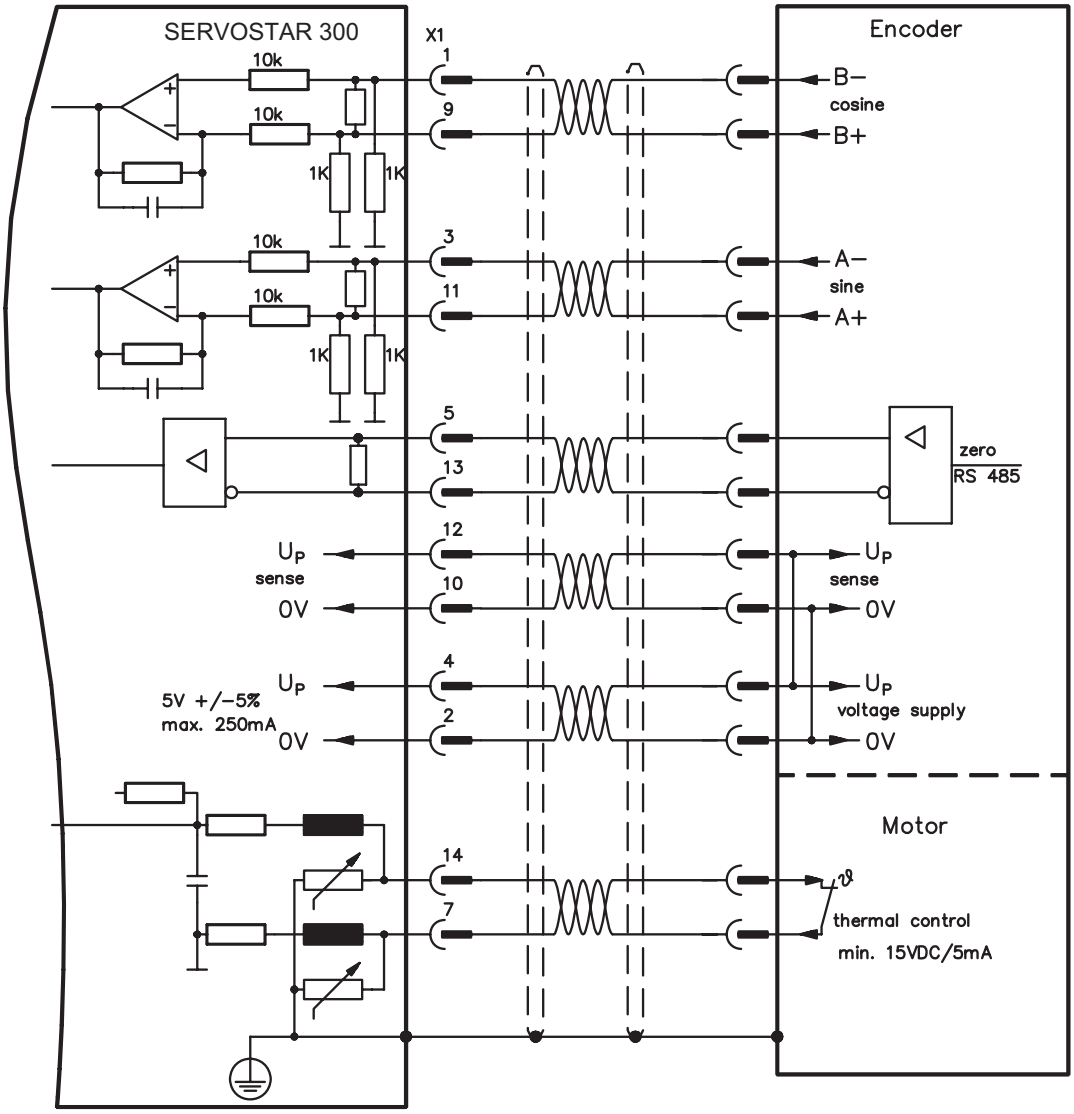
An sine-cosine encoder without data channel can be used as standard motor feedback. Select feedback type 7 "SinCos 5V with W&S". Drive executes wake&shake to calculate the necessary start-up information for the position controller every time the 24V auxiliary voltage is switched on.

The thermostat contact in the motor is connected via the encoder cable to X1 and evaluated there.

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

Frequency limit: 350 kHz

Don't use this feedback type with vertical load (hanging load).



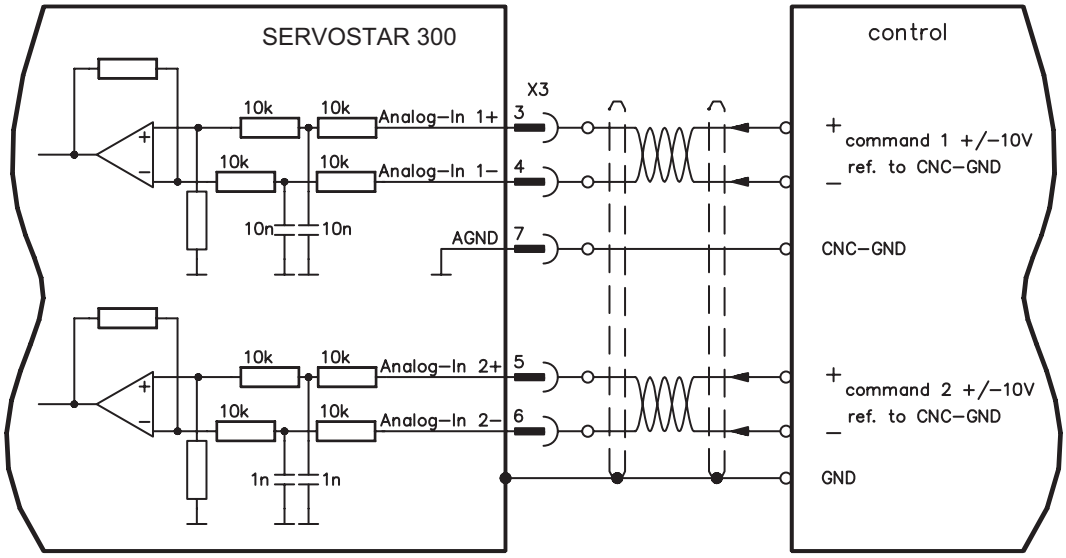
4.6 Control signals

4.6.1 Analog inputs (X3)

The servo amplifier is fitted with two **programmable** differential inputs for analog set-points. AGND (X3/7) must always be joined to the GND of the controls as a ground reference.

Technical characteristics

— Differential-input voltage max. ± 10 V
— Ground reference AGND, terminal X3/7
— Input resistance 20 kΩ
— Common-mode voltage range for both inputs ± 10 V
— Update rate 62,5 µs



Analog-In 1 input (terminals X3/3-4)
Differential input voltage max. ± 10 V, resolution 14-bit, scalable.
Standard setting : speed setpoint

Analog-In 2 input (terminals X3/5-6)
Differential input voltage max. ± 10 V, resolution 12-bit, scalable.
Standard setting : torque setpoint

Application examples for setpoint input Analog-In 2:
— adjustable external current limit
— reduced-sensitivity input for setting-up/jog operation
— pre-control / override

Defining the direction of rotation
Standard setting : clockwise rotation of the motor shaft (looking at the shaft end)
— Positive voltage between terminal X3/3 (+) and terminal X3/4 (-) or
— Positive voltage between terminal X3/5 (+) and terminal X3/6 (-)

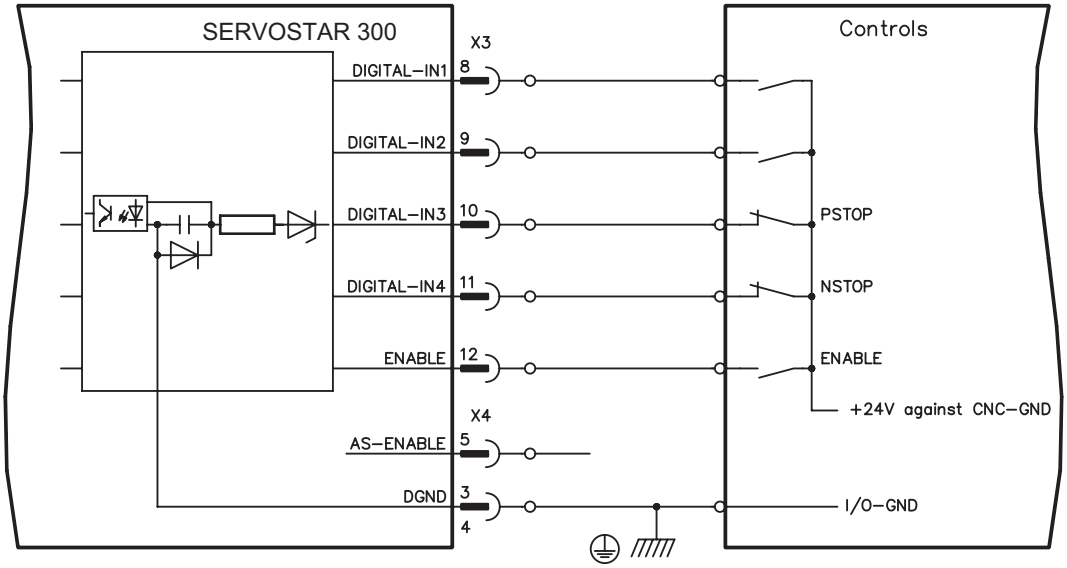
To reverse the direction of rotation, swap the connections to terminals X3/3-4 or X3/5-6 respectively, or change the ROTATION DIRECTION parameter in the “Speed controller” screen page.

4.6.2 Digital inputs (X3/X4)

All digital inputs are **electrically isolated** via optocouplers.

Technical characteristics

— Ground reference is **Digital**-GND (DGND, terminals X4/3 and X4/4)
— The inputs at X3 are **PLC-compatible** (IEC 61131-2 Type 1)
High: 11...30 V / 2...11 mA , Low: -3...5 V / <1mA
— Update rate Software:250 µs / Hardware: 2µs



ENABLE input

The output stage of the servo amplifier is enabled by applying the ENABLE signal (terminal X3/12, 24V input, **active high**).
In the disabled state (low signal) the connected motor has no torque.

AS-ENABLE input

An additional digital input (AS-Enable) releases the power output stage of the amplifier as long as a 24V signal is applied to this input. If the AS-Enable input goes open-circuit, then power will no longer be supplied to the motor, the drive will lose all torque and coast down to a stop. A fail-safe brake function for the drive, if one is required, must be ensured through a mechanical brake since electrical braking with the aid of the drive is no longer possible.
You can thus achieve a restart lock-out for personnel safety by using the AS-enable input in conjunction with an external safety circuit.
You can find further information and connection examples on page 61.

This input is not compatible with IEC 61131-2.

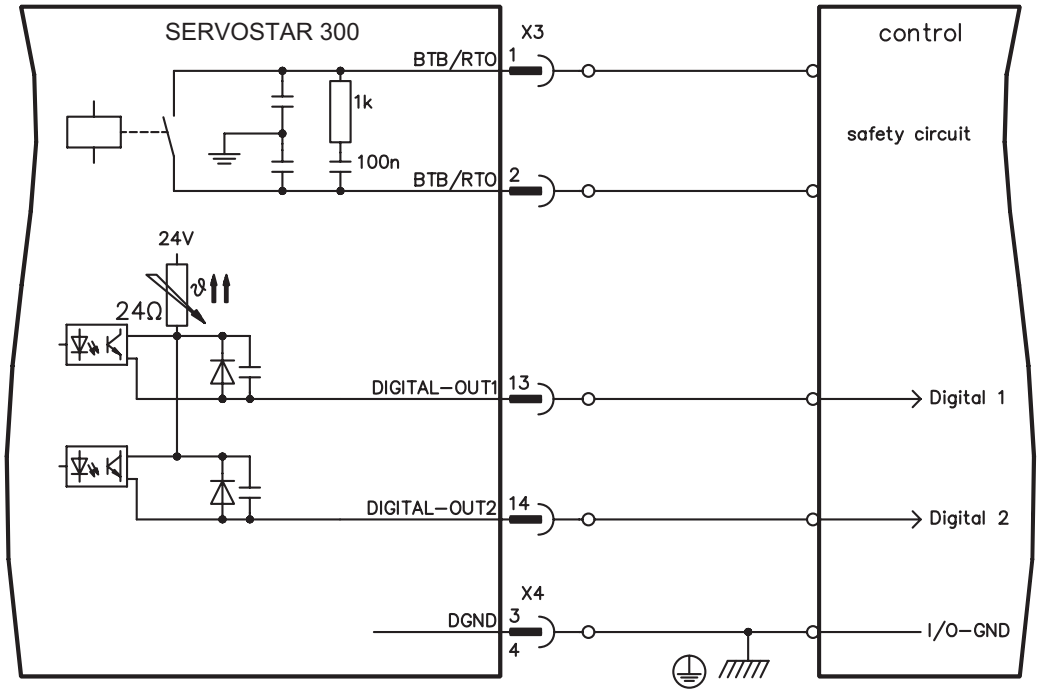
Programmable digital inputs

You can use the DIGITAL-IN1 to DIGITAL-IN4 digital inputs 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 coldstart has to be carried out (to reset the amplifier software).

4.6.3 Digital outputs (X3)

Technical characteristics

— Ground reference is Digital-GND (DGND, terminals X4/3 and X4/4)
— All digital outputs are floating
— DIGITAL-OUT1 and 2 : Open Emitter, max. 30V DC, 10mA
BTB/RTO : Relay output, max. 30V DC or 42V AC, 0.5A
— Update rate 250 µs



Ready-to-operate contact BTB/RTO

Operational readiness (terminals X3/1 and X3/2) 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 regen threshold.

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). A list of the error messages can be found on page 72.

Programmable digital outputs DIGITAL-OUT 1 / 2:

You can use the digital outputs DIGITAL-OUT1 (terminal X3/13) and DIGITAL-OUT2 (terminal X3/14) to output messages from pre-programmed functions that are stored in the servo amplifier.
A list of these pre-programmed functions can be found on the “I/O digital” screen page of our setup software.

If an input 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 coldstart has to be carried out (to reset the amplifier software).

4.7 Encoder emulation

4.7.1 Incremental encoder output (X5)

The incremental-encoder interface is part of the package supplied. 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.

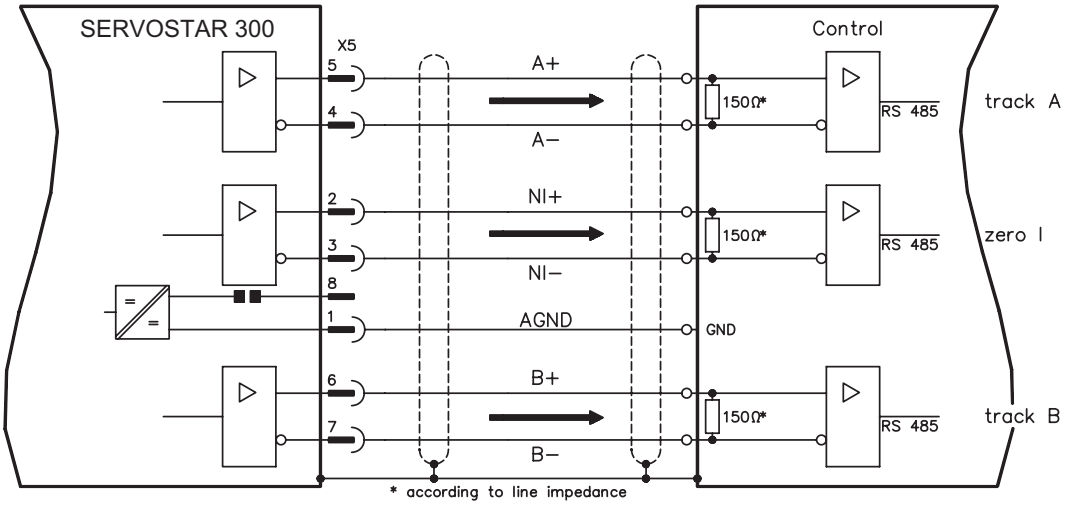
The resolution (before multiplication) can be set by the RESOLUTION function:

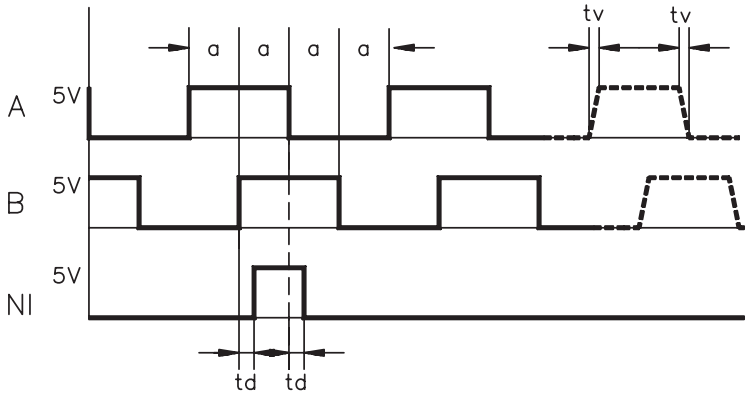
Enc. function (ENCMODE)	Feedback system	Resolution (lines)	Zero pulse (NI)
ROD (1)	Resolver	16 … 1024	once per turn (only at A=B=1)
	EnDat/HIPERFACE	16 … 4096 and 8192…524288 (2^n)	once per turn (only at A=B=1)
ROD interpolation (3)	Incremental encoder without data channel	2^2 … 2^7 (multiplication) TTL line x encoder resolution	encoder signal passed through from X1 to X5

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

The maximum permissible cable length is 100 meters.

Connections and signals for the incremental encoder interface :





Edge spacing a ≥ 0.20 µs
Edge steepness tv ≤ 0.1 µs
Delay NI–td ≤ 0.1 µs
IΔUI ≥ 2V/20mA

4.7.2 SSI output (X5)

The SSI interface (synchronous serial absolute-encoder emulation) is part of the package supplied. Select encoder function SSI (“Encoder Emulation” screen page). 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.

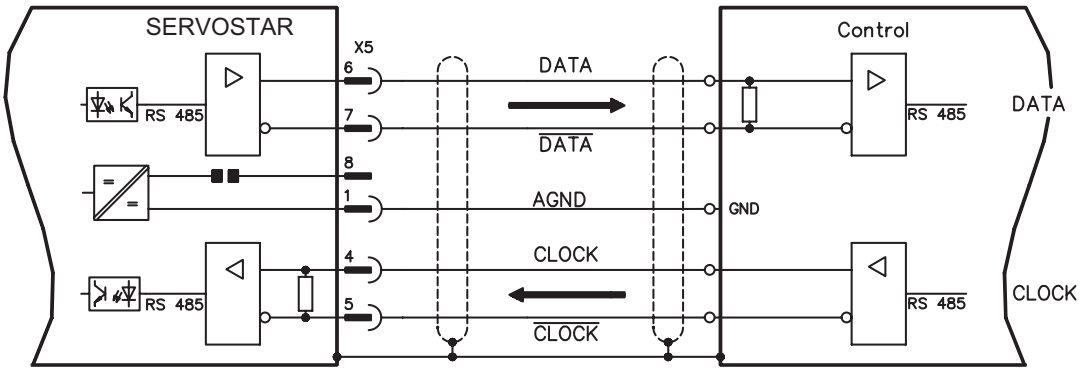
The following table shows the allocation of the SSI date depending upon selected number of revolutions:

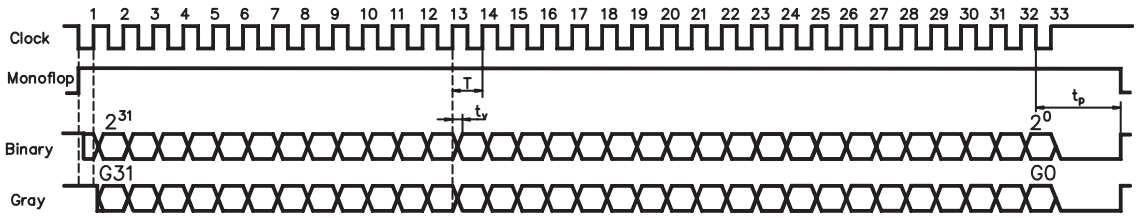
	Revolution																Resolution (variable)															
	SSIREVOL																															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	14		13	12	11	10	9	8	7	6	5	4	3	2	1	0																
	13			12	11	10	9	8	7	6	5	4	3	2	1	0																
	12				11	10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

The drivers operate off an internal supply voltage.

Connection and signals for the SSI interface :
The count direction for the SSI interface is UP when the motor shaft is rotating clockwise (looking at the end of the motor shaft).





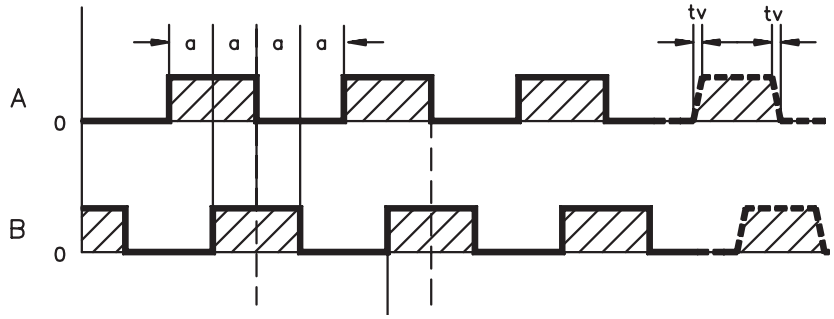
Switch over time Data t_v ≤ 300nsec
Period T = 600 ns
Time Out t_p = 1.3µs/10µs (SSITOUT)

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

4.8 Master-slave operation, encoder master control

This interface can be used to link several SERVOSTAR 300 amplifiers together in master-slave operation.
Parameter setting for the slave amplifier is carried out with the aid of the setup software (electrical gearing). The resolution (no. of pulses/turn) can be adjusted, and the analog setpoint inputs are out of action.

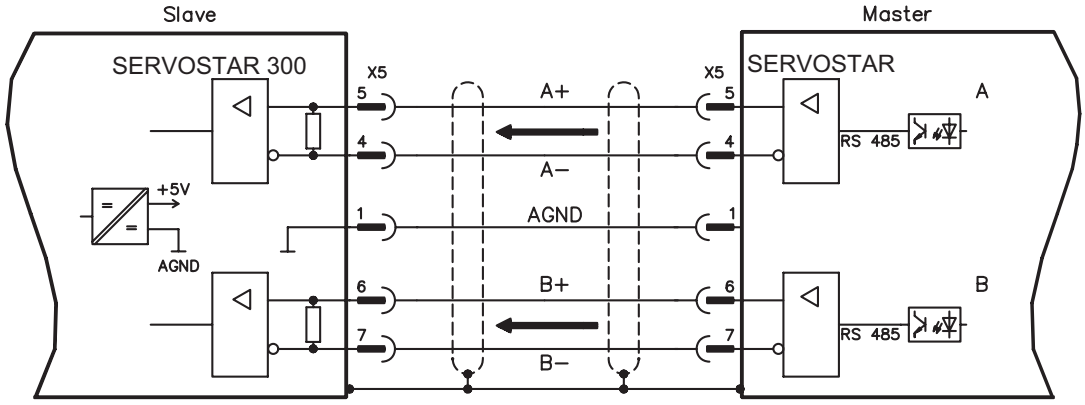
Signal diagram (for encoders with RS422 or 24V output)



4.8.1 Connection to a SERVOSTAR master, 5V signal level (X5)

This interface can be used to link several SERVOSTAR 300 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.

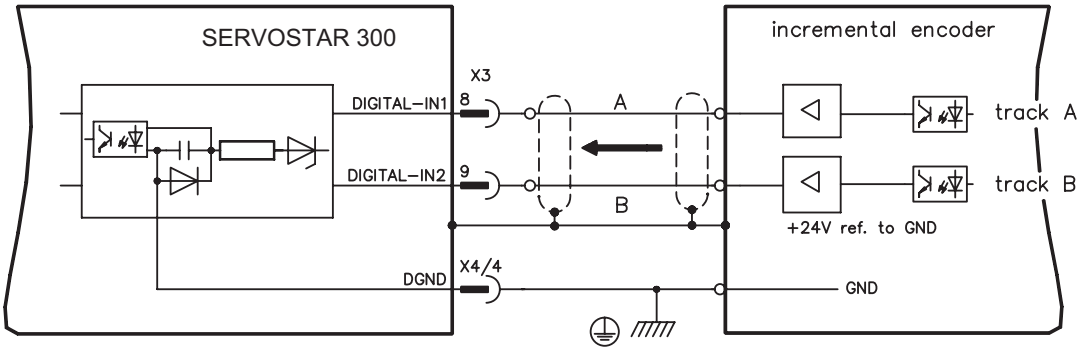
Frequency limit: 1.5 MHz, transition time tv ≤ 0.1µs



4.8.2 Connection to incremental-encoder master with 24V signal level (X3)

This interface can be used to operate the SERVOSTAR as a slave, mastered by an encoder with a 24V signal level (master-slave operation).
This uses the digital inputs DIGITAL-IN 1 and 2 on connector X3.

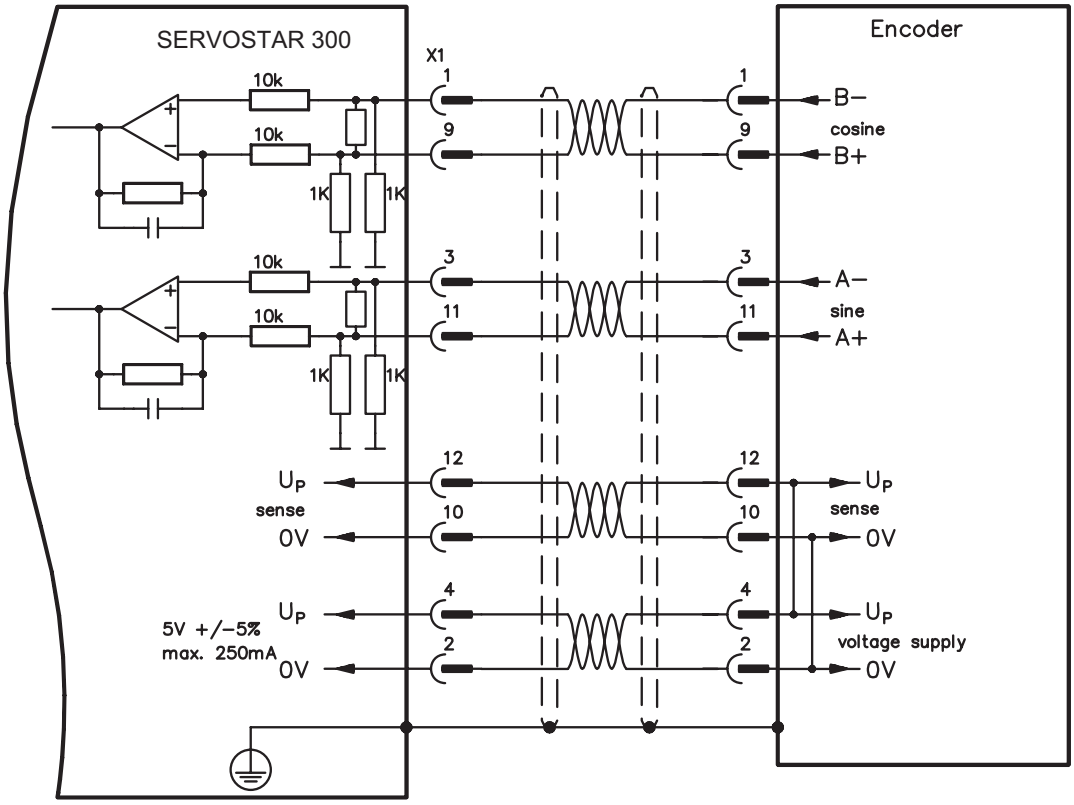
Frequency limit: 100 kHz, transition time tv ≤ 0.1µs



4.8.3 Connection to a sine-cosine encoder master (X1)

This interface can be used to operate the SERVOSTAR as a slave, mastered by a sine-cosine encoder (master-slave operation). This uses the SubD connector X1.

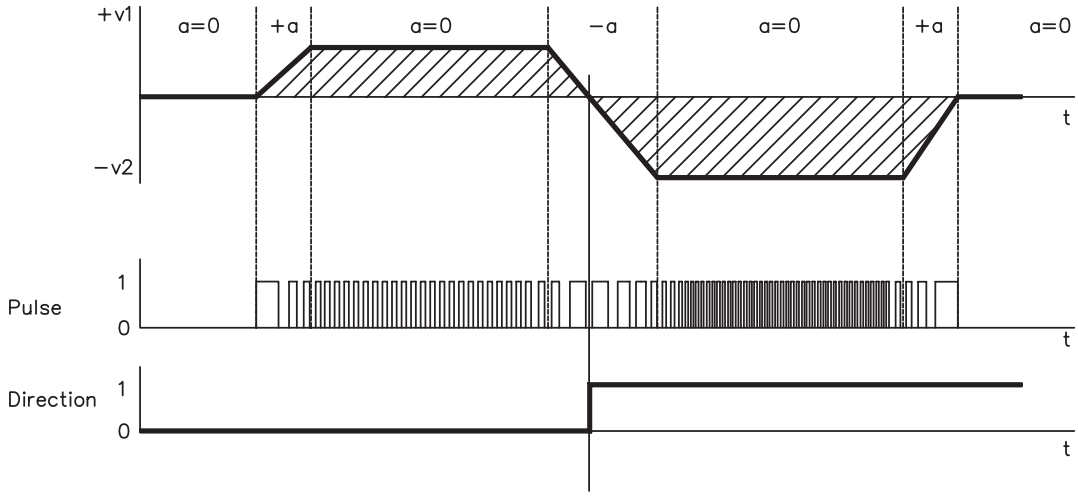
Frequency limit (A, B): 350 kHz



4.9 Interface for stepper motor controllers (step and direction)

This interface can be used to 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 (electrical 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.
The analog inputs are out of action.

Speed profile and signal diagram



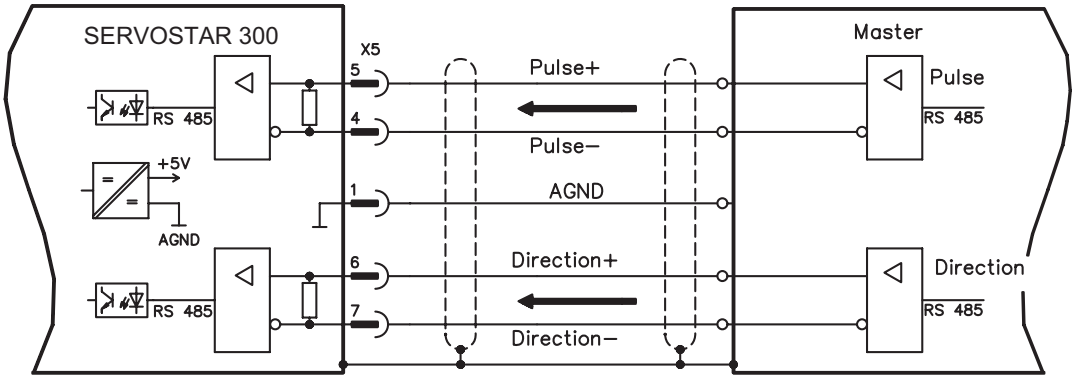
Equivalences

path traversed s	——	number of pulses
velocity v	——	pulse frequency
acceleration a	——	rate of change of pulse frequency

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

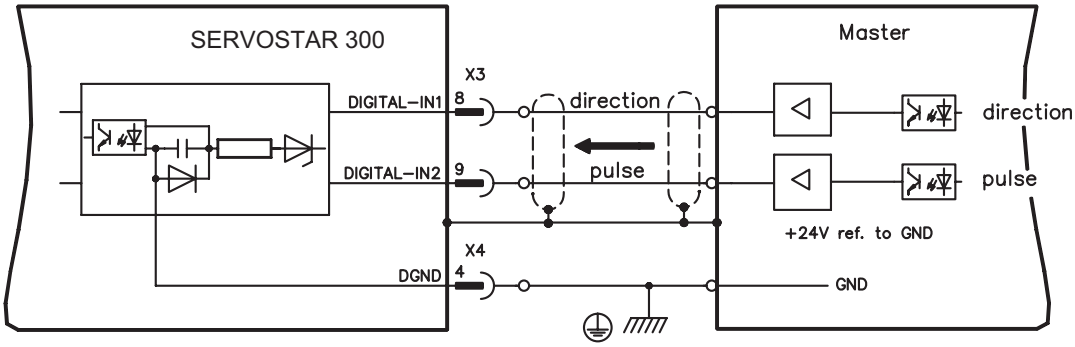
4.9.1 Connection to a stepper controller with 5V signal level (X5)

This interface can be used to connect the servo amplifier to a stepper-motor controller with a 5V signal level. It uses the SubD connector X5.
Frequency limit: 1.5 MHz



4.9.2 Connection to a stepper controller with 24V signal level (X3)

This interface can be used to connect the servo amplifier to a stepper-motor controller with a 24V signal level. It uses the digital inputs DIGITAL-IN 1 and 2 on connector X3.
Frequency limit: 100 kHz



4.10 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.

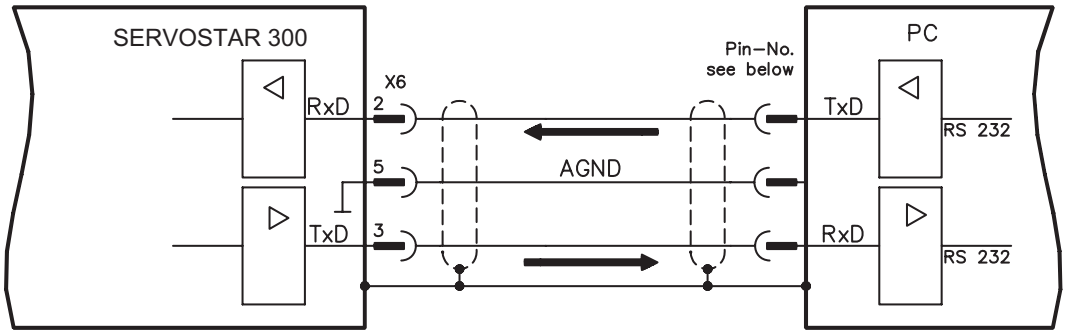
Connect the PC interface (X6) of the servo amplifier to a serial interface on the PC via a null-modem cable, **while the supply to the equipment is switched off.**

Do not use a null-modem power link cable!

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

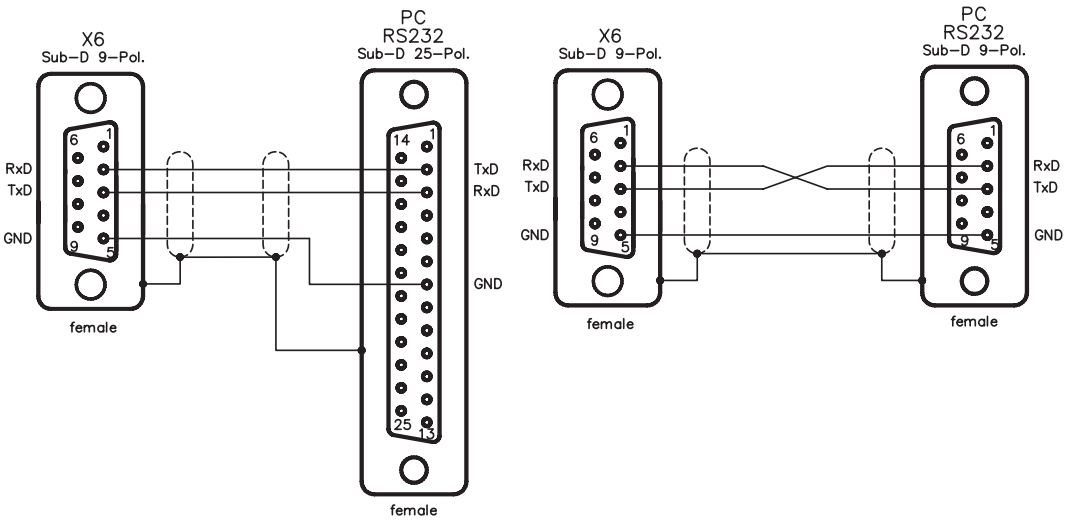
The interface is selected and set up in the setup software. Further notes on page 36.

With the optional -2CAN- expansion card, the two interfaces for RS232 and CAN, which would otherwise use the same connector X6, are separated out onto three connectors (⇨ p.84).



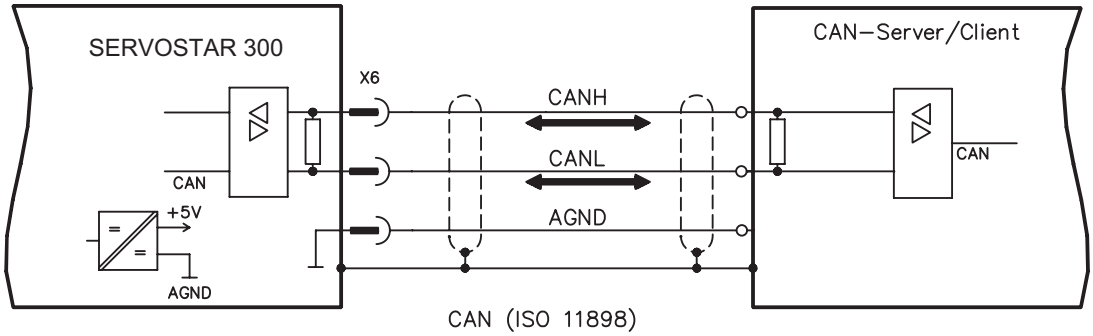
Interface cable between the PC and servo amplifiers of the SERVOSTAR 300 series:

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



4.11 CANopen 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 electrical potential as the RS232 interface. The analog setpoint inputs can still be used. With the optional -2CAN- expansion card, the two interfaces for RS232 and CAN, which otherwise use the same connector X6, are separated out onto three connectors (with termination, ⇨ p.84).



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:

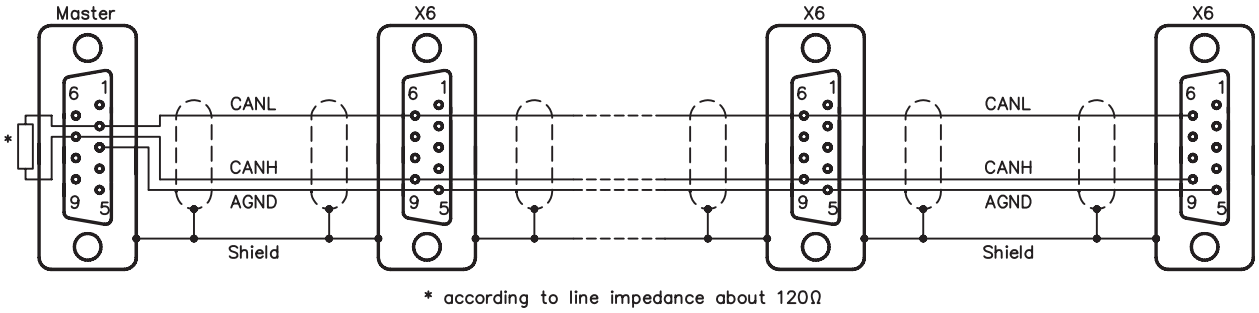
Cable data:	Characteristic impedance	100-120 Ω
	Cable capacitance	max. 60 nF/km
	Lead loop resistance	159.8 Ω/km

Cable length, depending on the transmission rate

Transmission rate (kBaud)	max. cable length (m)
1000	10
500	70
250	115

Lower cable capacitance (max. 30 nF/km) and lower lead resistance
(loop resistance, 115 Ω/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



4.12 Personnel safe restart lock -AS-

A frequently required application task is the protection of personnel against the restarting of drives. This can be achieved by an electronic inhibit or with mechanical elements (positively driven relay contacts).

When positively driven relay contacts where used, either the net contactor in the mains supply circuit switched off or the motor was disconnected from the servo amplifier by an additional contactor.

The disadvantages of this method are :
— the DC bus link has to be charged up again at restart
— wear on the contacts of the contactors, caused by switching under load
— extensive wiring required, with additional switching components

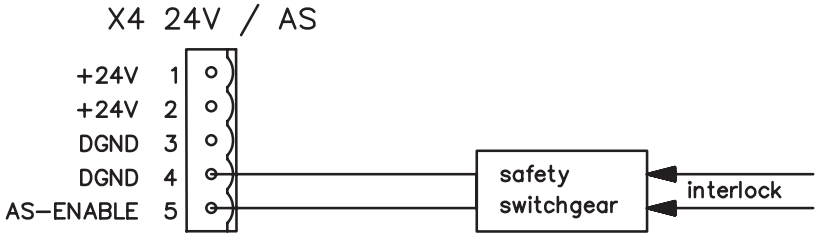
The restart lock -AS- avoids these disadvantages.

The conceptual examination of the function "safe stop" (called restart lock AS in the following) was accomplished by the BG-Institute for Occupational Safety and Health and the classification in category 3 according to EN 954-1 was confirmed.

Advantages of the restart lock -AS- :
— 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
— the functionality and the personnel safety when using the circuit recommendations in this documentation have been approved by the Trade Liability Association.

4.12.1 Technical data and pinning

Input voltage	20V..30V
Input current	40mA – 75mA (Ieff)
Peak current	220mA (Is)



4.12.2 Environment

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

4.12.3 Wiring

If the wiring leads outside the demanded enclosure (IP54), 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.
If wiring remains within the demanded enclosure, then it has to meet the requirements of the standard EN 60204-1, section 14-3.

4.12.4 Functional description

If the restart lock -AS- is not needed, then the input AS-ENABLE must be connected directly with +24VDC. The restart lock is then passed by and cannot not be used.

In case of use of the restart lock the input AS Enable must be connected to the exit of a security control or a safety relay, which meets at least to the requirements of the category 3 after EN 954-1 (see the connection diagram on page 64).

Possible states of the servo amplifier in connection with restart lock -AS-:

AS-ENABLE	ENABLE	Display	Motor has torque	Safety cat. 3
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

If the restart lock is engaged during operation by separating input AS ENABLE from 24VDC, the motor runs down out of control and the servo amplifier displays the error F27. There is no possibility of braking the drive controlled. If a controlled braking before the use of the restart lock is necessary, the drive must be braked and the input AS-ENABLE has to be separated from +24VDC time-delayed.

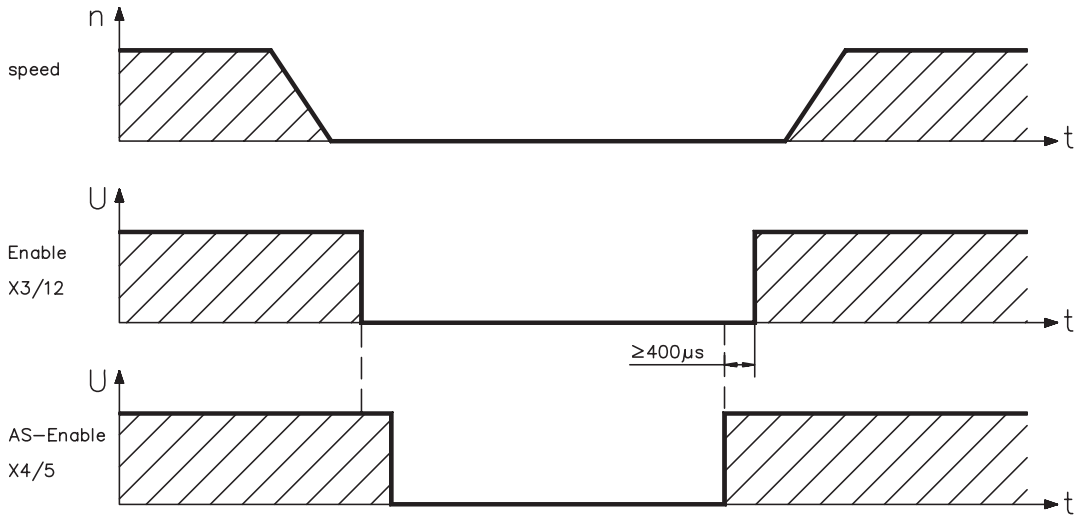
The restart lock -AS- does not provide an electrical separation from the power output. If access to the motor power terminals is necessary, the servo amplifier must be disconnected from mains supply considering the discharging time of the intermediate circuit.

Since the restart lock is a single-channel system, erroneous engaging will not be recognized. When wiring the input AS-ENABLE within one enclosure it must be paid attention to the fact that the used cables and the enclosure meet the requirements of EN 60204-1.

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

4.12.4.1 Signal diagram (sequence)

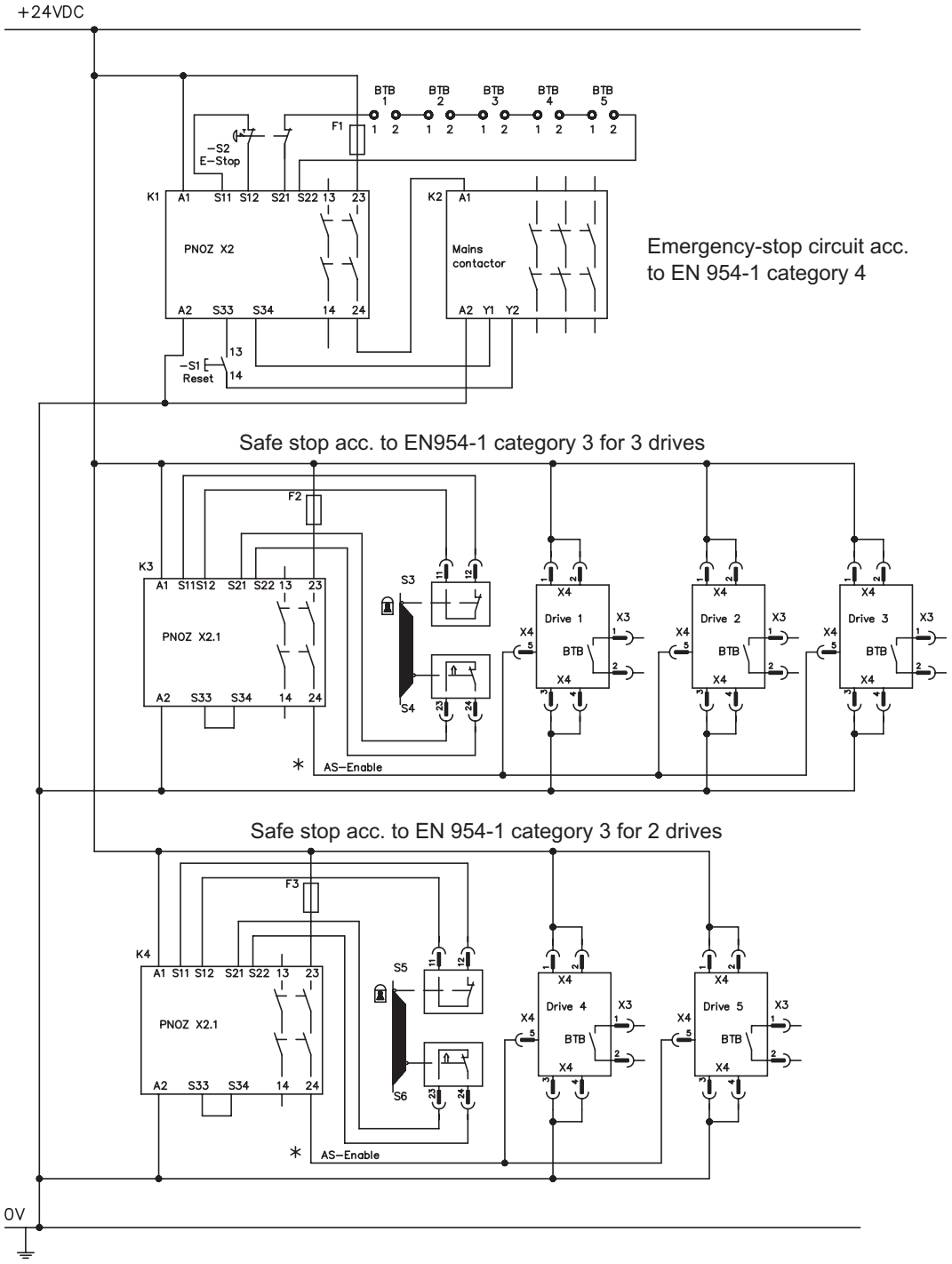
The diagram shows how to use restart lock -AS- to ensure a safe stop of the drive and error free operation of the servo amplifier.



1. Brake the drive in a controlled manner (speed setpoint = 0V)
2. When speed = 0 rpm, disable the servo amplifier (Enable = 0V)
3. Activate the restart lock -AS- (AS-Enable = 0V)

Suspended loads can set themselves to motion on motors without brake, because the motor loses all torque when restart lock -AS- is engaged (AS Enable open and/or 0V).

4.12.4.2 Control circuit



The example shows a circuit diagram with two separated work areas connected to one emergency stop circuit. For each work area individually "safe stop" of the drives is switched by a protective screen.

The safety switchgears used in the example are manufactured by Pilz and fulfill at least the safety category 3 according to DIN 954-1. Further information to the safety switchgears is available from Pilz. The use of safety switchgears of other manufacturers is possible, if these also fulfill the safety category 3 according to DIN 954-1.

Consider the wiring instructions on page 61.

4.12.4.3 Functional test

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 the restart lock must be tested.

1. Method:

1. Stop drive, with setpoint 0V, keep servo amplifier enabled.
   Do not enter hazardous area!
2. Activate the restart lock -AS- e.g. by opening protective screen. (voltage at X4/5 0V)

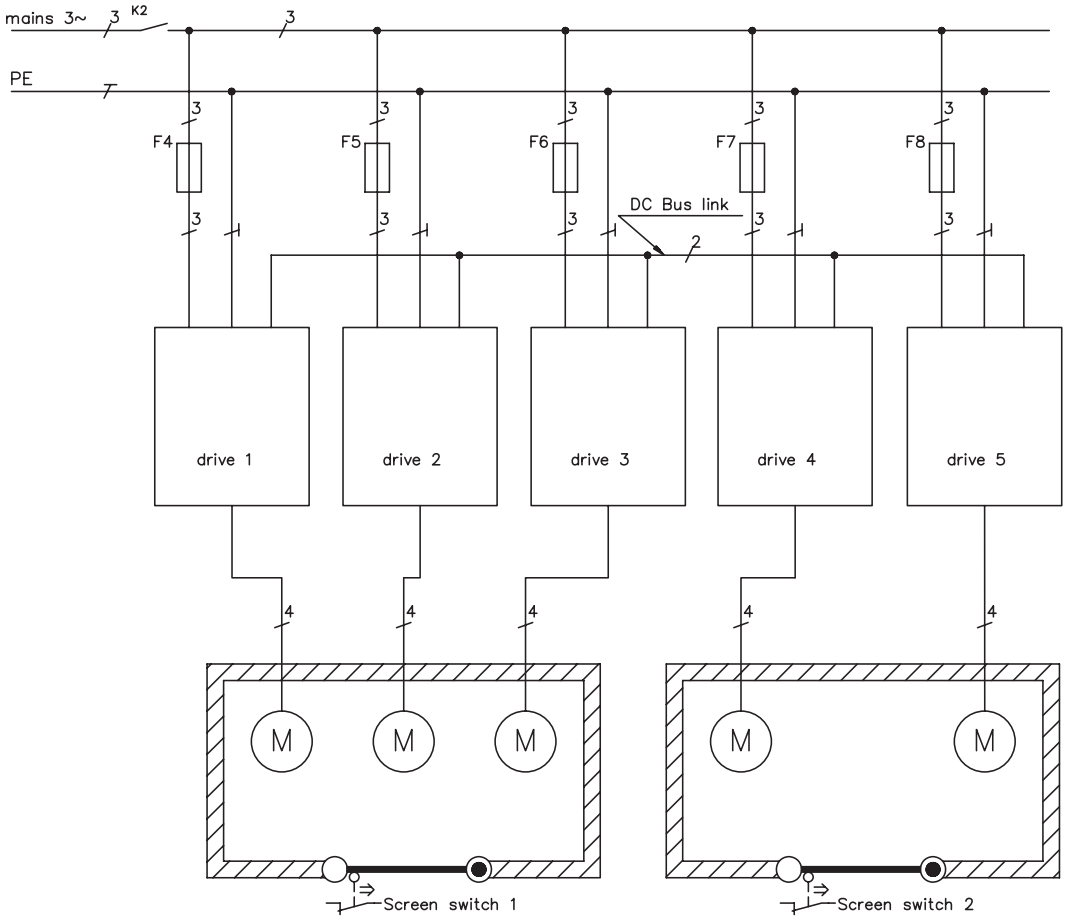
Now the BTB/RTO contact opens, the net contactor releases and the servoamplifier displays error F27.

2. Method:

1. Stop all drives, with setpoint 0V, disable servo amplifier.
2. Activate the restart lock -AS- e.g. by opening protective screen. (voltage at X4/5 0V)

Now the servo amplifier displays -S-.

4.12.4.4 Mains supply circuit



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5 Setup

5.1 Important notes

Only professional personnel with extensive knowledge in the fields of electrical engineering and drive technology are allowed to setup the servo amplifier.

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 hazard analysis for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Check that all connection components that are live in operation are safely protected against bodily contact. The equipment produces potentially lethal voltages up to 900V.
Never undo the electrical connections to the servo amplifier while it is live. Capacitors can still have dangerous residual charges up to 300 seconds after switching off the supply voltage.
The heat sink and front panel of the amplifier can reach temperatures up to 80°C in operation. Check the heat sink temperature. Wait until the heat sink has cooled down to 40°C before touching it.

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 230V AC to terminals L1 / L2 of the servo amplifier for about 30 minutes. This will re-form the capacitors.

Additional information on setting up the equipment:
The adaptation of parameters and the effects on the control loop behavior are described in the manual and 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).

5.2 Guide to setup

The following instructions should help you to carry out the setup in a sensible order, without endangering people or machinery.

Check installation	See Ch. 3. **Disconnect the servo amplifier from the supply.**
Block the Enable signals	Apply 0V to terminal X3/12 (Enable) **and** to terminal X4/5 (AS-Enable)
Switch on 24V auxiliary supply	Apply 24V DC to terminal X4/1, ground terminal X4/3 After the initialization procedure (about 0.5 sec.) the status will be shown in the LED display (⇨ p.69)
Switch on PC, start setup software	Select the interface to which the servo amplifier is connected. The parameters which are stored in the SRAM of the servo amplifier are then transferred to the PC.
Check the displayed parameters, and correct if necessary	**It is especially important to check the following parameters. If these critical values are not set properly, the system may be damaged or destroyed.**

Supply voltage: Set to the actual electrical supply voltage
Rated motor voltage: at least as high as the DC bus link voltage of the amplifier
Motor pole-no.: must match the motor (see motor manual)
Feedback: must match the feedback device in the motor
I_{RMS}: maximum is the motor standstill current I_0 (on nameplate)
I_{PEAK}: maximum is 4 x motor standstill current I_0
Limit speed: maximum is the rated motor speed (on nameplate)
Regen power: maximum is the permitted regen resistor dissipation
Station address: unique address (see manual for setup software)

Check safety devices	**Make sure that any unintended movement of the drive cannot cause and danger to personnel or machinery.**
Switch on supply power	Use the ON/OFF button of the contactor controls
Apply 0V command	Apply 0V to terminals X3/3-4 or X3/5-6 respectively
Enable	Apply 24V DC (500 ms after switching on the supply power) to terminal X3/12, motor stands with standstill torque M_0
Setpoint	Apply a small analog setpoint (about 0.5V is recommended) to terminals X3/3-4 or X3/5-6 respectively **If the motor oscillates, the parameter Kp on the menu page "Speed controller" must be reduced – motor is in danger!**
Optimization	Optimize speed, current and position controllers (see Online Help)
Set up the expansion card	See setup instructions in the corresponding manual on the CD-ROM

5.3 Parameter setting

A default parameter set has been loaded into your servo amplifier by the manufacturer. This contains valid and safe parameters for the current and speed controllers.
A database for motor parameters is stored in the servo amplifier. During setup you must select the data set for the motor that is connected and store it in the servo amplifier. For most applications these settings will already provide good to very good control loop characteristics.
An exact description of all parameters and the possibilities for optimizing the control loop characteristics can be found in the manual “Setup Software DRIVEGUI.EXE”.

5.3.1 Multi-axis systems

5.3.1.1 Station address for CAN-bus

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 (⇨ p.71).

5.3.1.2 Baud rate for CAN-bus

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
0	10	5	250
1	20	6	333
2	50	7	500
3	100	8	666
4	125	9	800
		10	1000

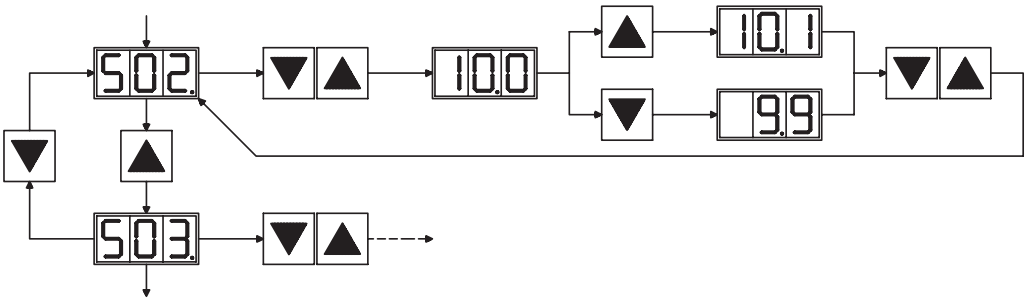
5.3.2 Keypad operation / LED display

This section illustrates the two possible operating menus and the use of the keys on the front panel. Normally, the SERVOSTAR 300 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.

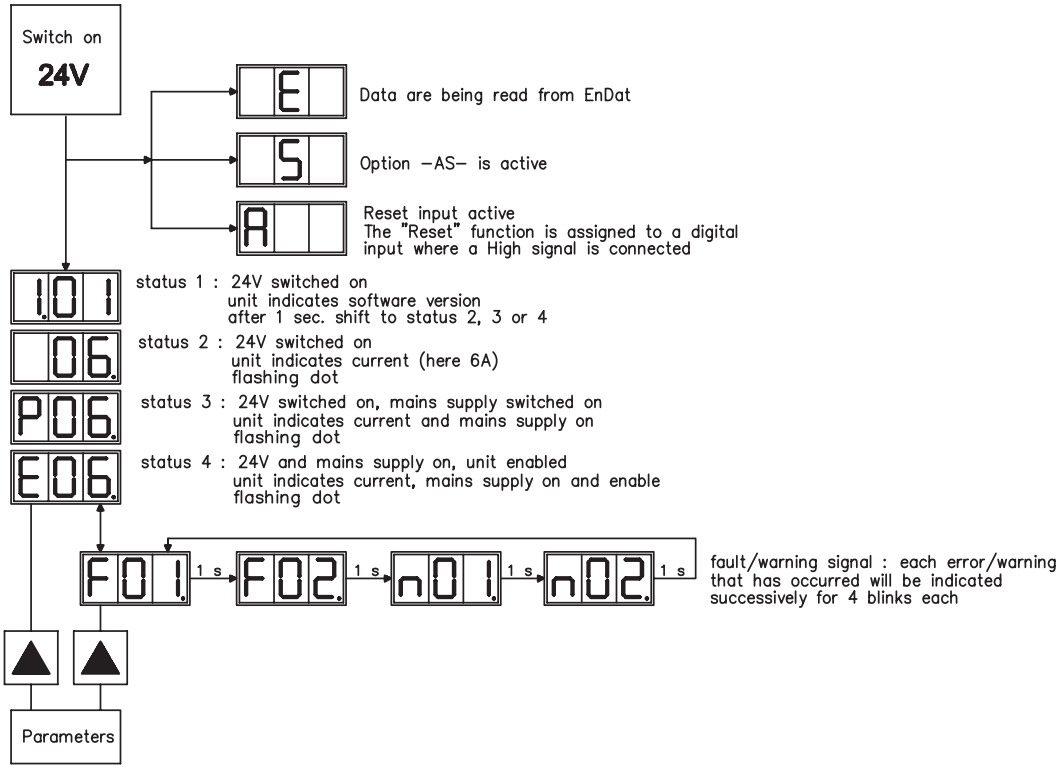
5.3.2.1 Keypad operation

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

Key symbol	Functions
▲	**press once** : move up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : move down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**hold right key pressed, and then press left key as well** : to enter a number, “Return” function

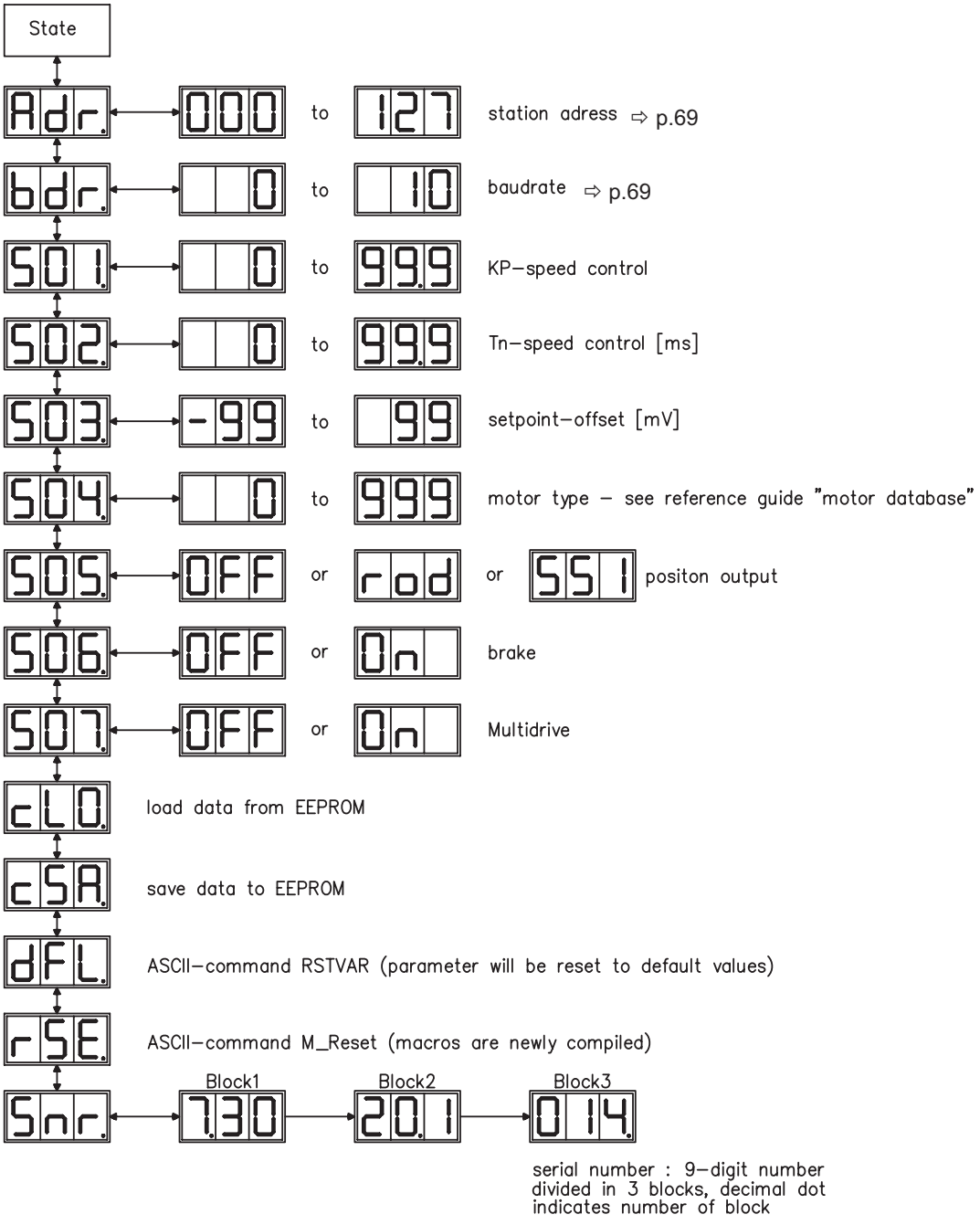


5.3.2.2 Status display



5.3.2.3 Standard menu

5.3.2.4 Advanced menu



5.4 Error messages

Any errors that occur are shown in coded form by an error number in the LED display on the front panel. All error messages result in the BTB/RTO contact being opened, and the output stage of the amplifier being switched off (motor loses all torque), and the motor-holding brake is activated.

Number	Designation	Explanation
E / S / A / P	Status Messages	Status messages, no error, see p. 70
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 limit is set by manufacturer to 145°C
F07	reserved	reserved
F08*	overspeed	motor runs away, speed is too high
F09	EEPROM	checksum error
F10	Flash-EPROM	checksum error
F11	brake	cable break, short-circuit, short to ground
F12	motor phase	motor phase missing (cable break or similar)
F13*	internal temperature	internal temperature too high
F14	output stage	fault in the power output stage
F15	I²t max.	I²t maximum value exceeded
F16*	supply BTB/RTO	2 or 3 phases missing in the mains supply feed
F17	A/D converter	error in the analog-digital conversion, normally caused by extreme electromagnetic interference
F18	regen	regen circuit faulty or incorrect setting
F19*	supply phase	a phase is missing in the mains supply power feed (can be switched off for 2-phase operation)
F20	slot fault	slot error (hardware fault on expansion card)
F21	handling error	software 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	homing error (machine has driven onto hardware limit switch)
F27	AS	operational error with -AS- , input for AS-Enable and ENABLE have been set at the same time
F28	reserved	reserved
F29	Fieldbus-Sync	Sync is not logged in
F30	Emergency timeout	Timeout emergency stop
F31	reserve	reserve
F32	system error	system software not responding correctly

* = these error messages can be cleared without a reset, by using the ASCII command CLRFAULT. If only one of these errors is present and the RESET button or the I/O RESET function is used, only the CLRFAULT command will be executed.

You can find further information on handling errors from page 96.

5.5 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.

Number	Designation	Explanation
E / S / A / P	Status Messages	Status messages, no error, see p. 70
n01	I^2t	I^2t threshold exceeded
n02	regen power	reached preset regen 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	passed software limit switch 1
n07*	Sw limit switch 2	passed 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 or HIPERFACE® : discrepancy between motor number saved in the encoder and the amplifier, motor default values loaded
n13*	expansion card	expansion card not operating correctly
n14	SinCos feedback	SinCos commutation (wake & shake) not completed, will be canceled when amplifier is enabled and wake & shake carried out
n15	table error	fault according to speed/current table INXMODE 35
n16	Summarized warning	Summarized warning for n17 to n31
n17	Fieldbus-Sync	Sync is not logged in
n18	Multiturn overflow	Max. number of motor turns exceeded
n19-n31	reserve	reserve
n32	firmware beta version	firmware is an unreleased beta version
A	reset	RESET is present on input DIGITAL INx

* = these warning messages result in a controlled shut-down of the drive (braking by emergency stop ramp)

You can find further information on handling errors from page 96.

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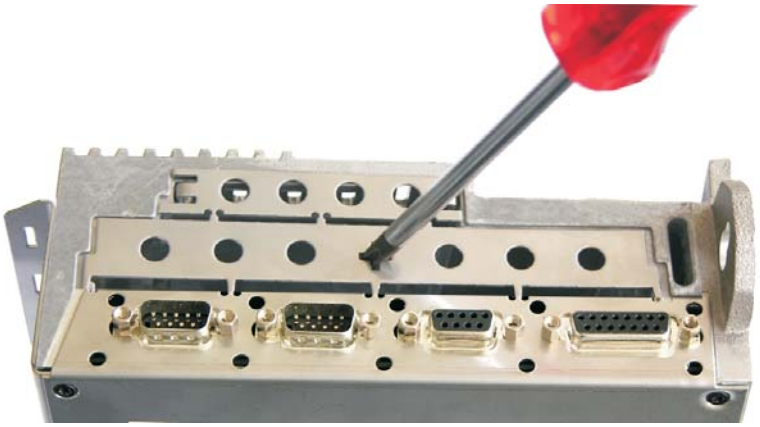
6 Expansions and Accessories

You can find information about availability and order numbers on page 101.

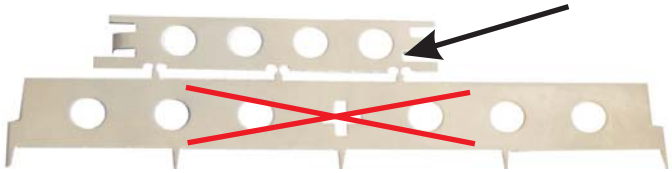
6.1 Expansion Cards

6.1.1 Guide to installation of expansion cards

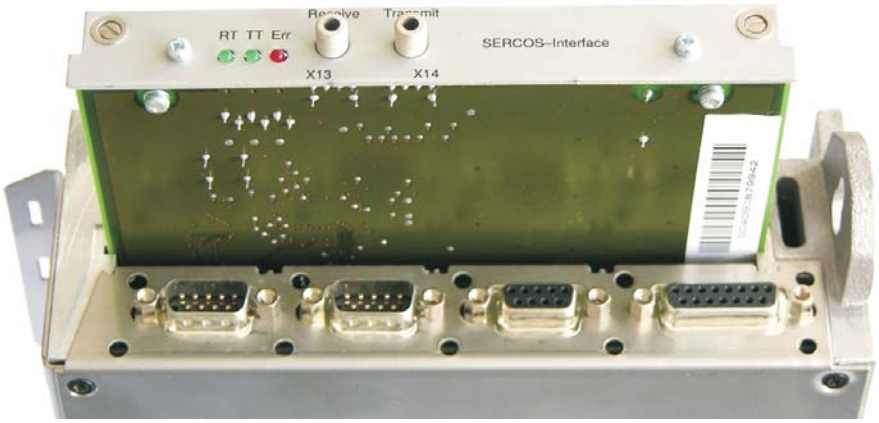
- **Use a suitable screwdriver to lever off the cover of the option slot.**



- **Take care that no small items (such as screws) fall into the open option slot.**
- **Lever off the small metall sheet and push it back to the small slot. Dispose the big metall sheet.**



- **Push the expansion card carefully into the provided guide rails of the main slot, without twisting it.**
- **Press the expansion card firmly into the slot, until the front cover touches the fixing lugs. This ensures that the connectors make good contact.**



- **Screw the screws on the front cover into the threads in the fixing lugs.**

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

This section describes the additional features that the expansion card -I/O-14/08- provides for the SERVOSTAR 300. 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.
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.

6.1.2.1 Front view

6.1.2.2 Technical data

Control inputs	24V / 7mA , PLC-compatible, IEC 1131
Signal output	24V / max. 500mA , PLC-compatible, IEC 1131
Supply inputs, to IEC 1131	24V (18 … 36V) / 100mA plus total current of the outputs (depends on the input wiring of the controls) **The 24V DC voltage must be supplied by an electrically isolated power supply (e.g. with isolating transformer).**
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

6.1.2.3 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).

6.1.2.4 Entering a motion block number

Motion block number (decimal)	Motion block number (binary)							
	A7	A6	A5	A4	A3	A2	A1	A0
174	1	0	1	0	1	1	1	0

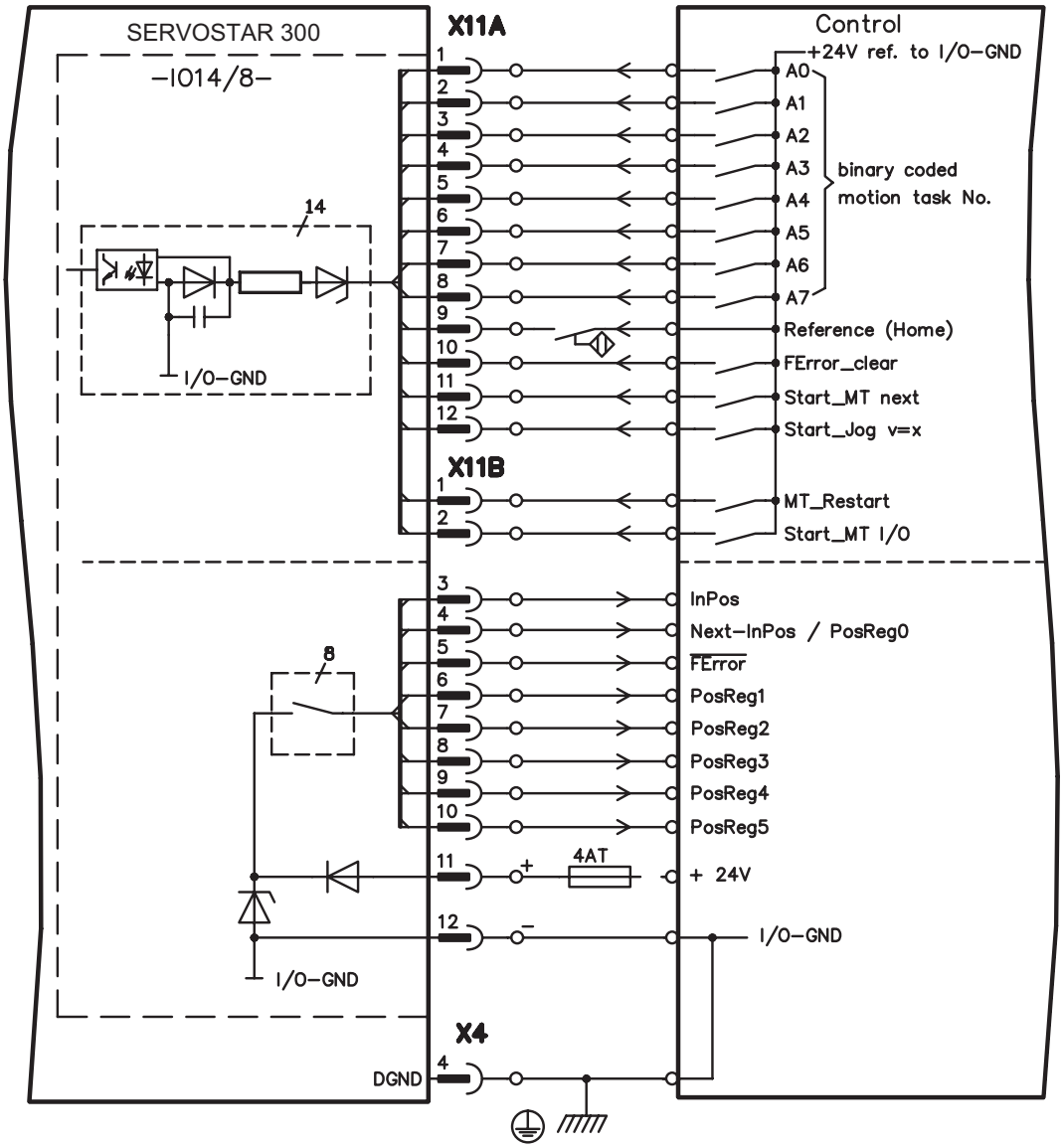
6.1.2.5 Connector assignments

The functions are adjustable with the setup software. In the table below the default values are described.

Connector X11A			
Pin	**Dir**	**Default function**	**Description**
1	In	A0	Motion block number, 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, 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	Start_MT_Next	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	In	Start_MT I/O	Starts the motion task that is addressed by A0-A7 (connector X11A/1...8).
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 only be adjusted by ASCII commands/setup software.
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/setup software.
9	Out	PosReg4	Can only be adjusted by ASCII commands/setup software.
10	Out	PosReg5	Can only be adjusted by ASCII commands/setup software.
11	-	24V DC	Supply voltage for output signals.
12	-	I/O-GND	Digital GND for the control system.

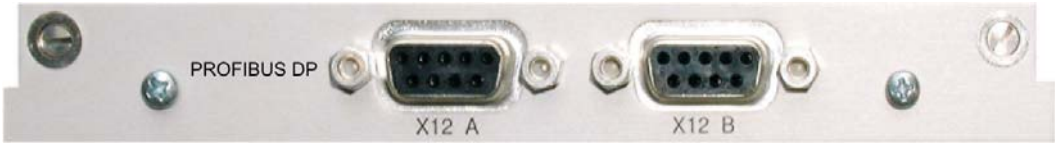
6.1.2.6 Connection diagram



6.1.3 Expansion card -PROFIBUS-

This section describes the PROFIBUS expansion card for the SERVOSTAR 300.
Information on the range of functions and the software protocol can be found in our manual “Communication Profile PROFIBUS DP”.
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.
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.

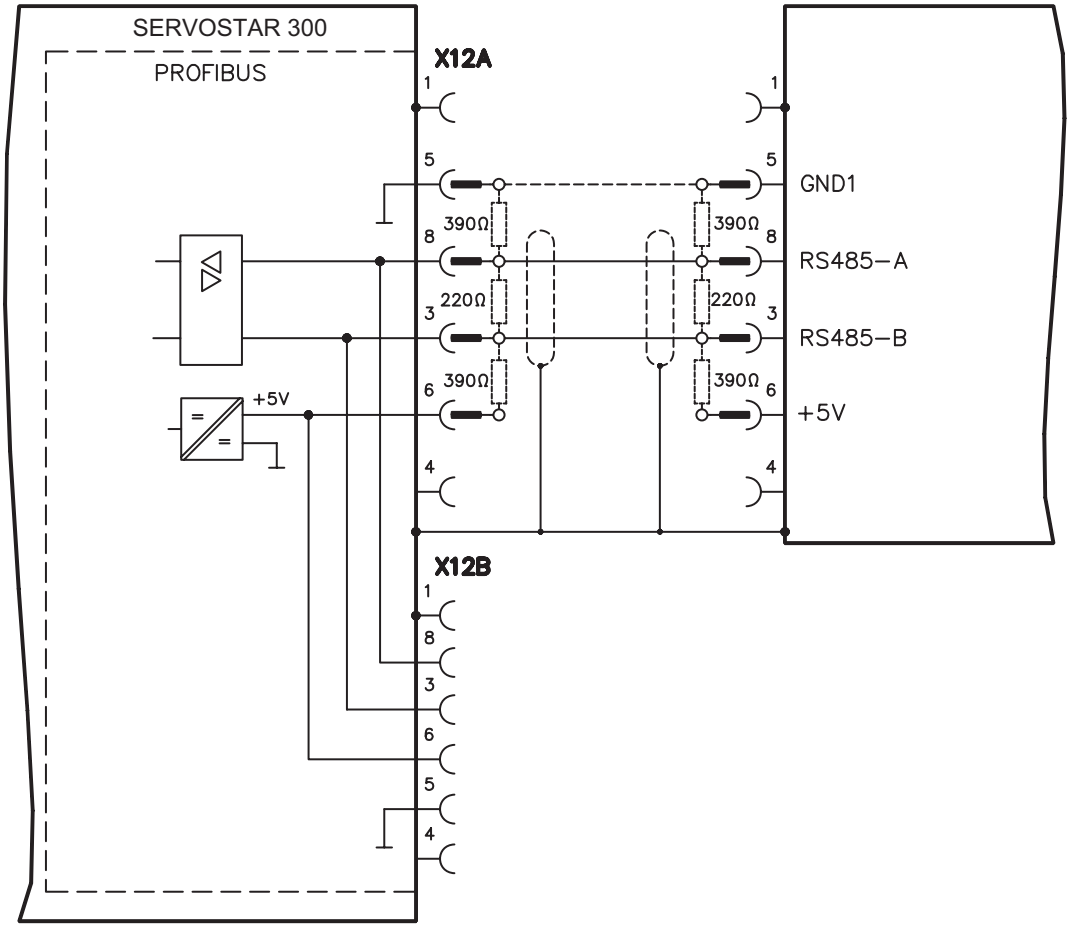
6.1.3.1 Front view



6.1.3.2 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.

6.1.3.3 Connection diagram



6.1.4 Expansion card -SERCOS-

This section describes the SERCOS expansion card for SERVOSTAR 300. Information on the range of functions and the software protocol can be found in our manual “IDN Reference Guide SERCOS”.
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.

6.1.4.1 Front view

6.1.4.2 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 LWL length parameter for the cable length.

6.1.4.3 Connection technology

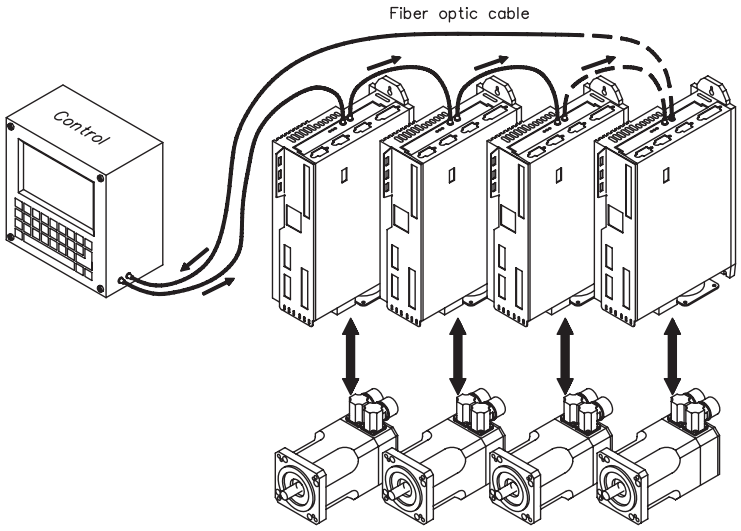
For the optical fiber (LWL) connection, only use SERCOS components to the SERCOS Standard IEC 61491.

Receive data
The optical fiber carrying receive data for the drive in the ring structure is connected to X13 with an FSMA connector.

Transmit data
Connect the optical fiber for the data output to X14 by FSMA connector.

6.1.4.4 Connection diagram

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



6.1.4.5 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 (p. 71).

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

6.1.4.6 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 metres.

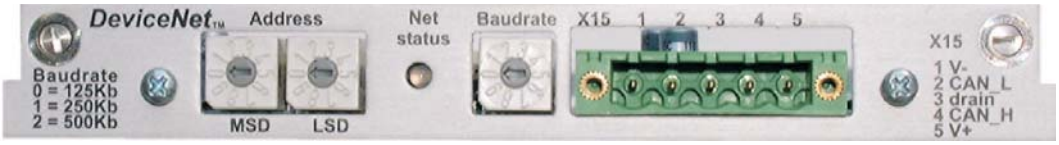
SBAUD		SLEN	
2	2 Mbaud	0	Very short connection
4	4 Mbaud	1…< 15	Length of the connection with a 1 mm² plastic cable
8	8 Mbaud	15…< 30	Length of the connection with a 1 mm² plastic cable
16	16 Mbaud	≥ 30	Length of the connection with a 1 mm² plastic cable

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

6.1.5 Expansion card -DEVICENET-

This section describes the DeviceNet expansion card for SERVOSTAR 300.
Information on the range of functions and the software protocol can be found in our manual “DeviceNet Communication Profile”.
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered..

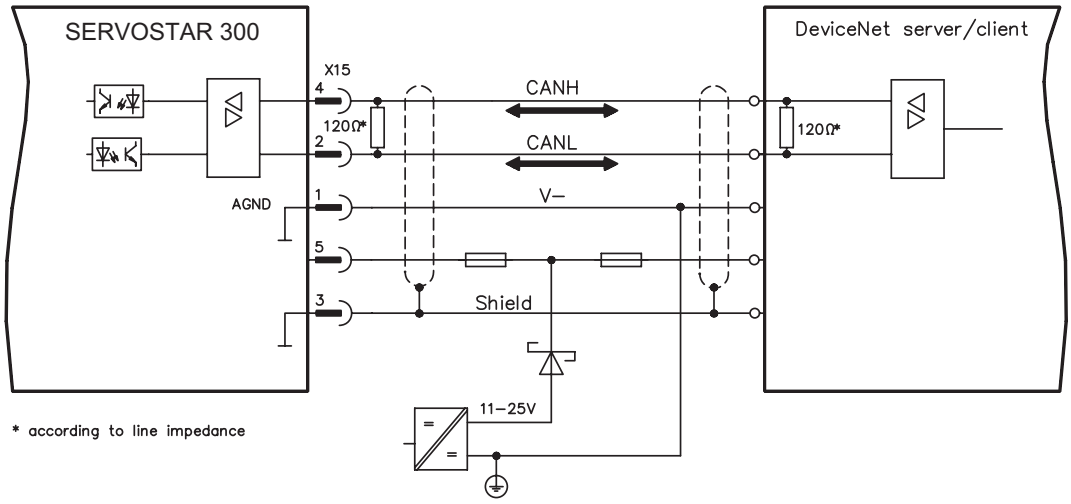
6.1.5.1 Front view



6.1.5.2 Connection technology

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.

6.1.5.3 Connection diagram



6.1.5.4 Combined module/network status-LED

LED	Meaning
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).

6.1.5.5 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/altering the address.

6.1.5.6 Setting the transmission speed

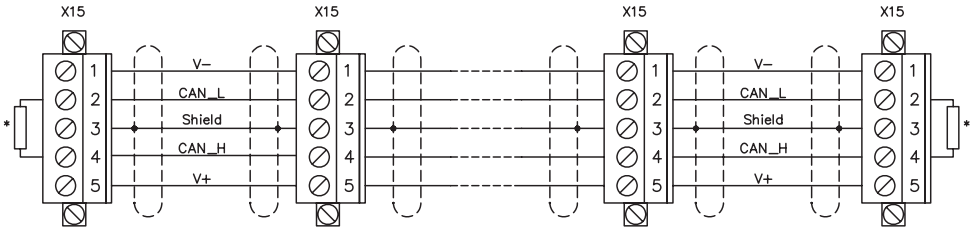
The DeviceNet transmission speed can be set in three different ways:

- 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.

6.1.5.7 Bus cable

To meet ISO 898, 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 meters at 125 kBaud 250 meters at 250 kBaud 100 meters 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 to +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: 120Ω, 1% metal-film, 1/4 W

6.1.6 Expansion card -ETHERCAT-

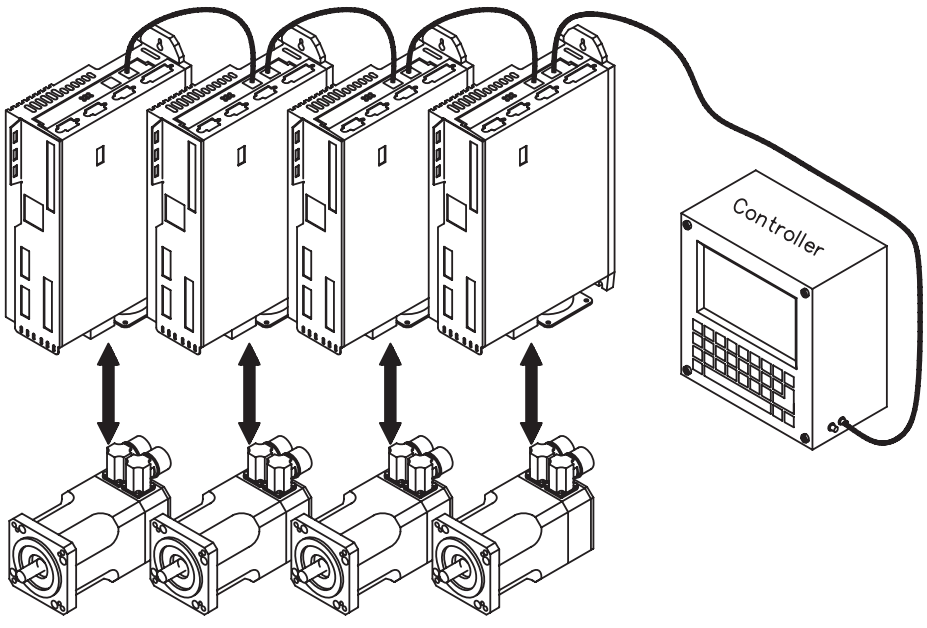
This section describes the EtherCat expansion card for SERVOSTAR 300.
Information on the range of functions and the software protocol can be found in the Ether-Cat documentation. This expansion cards enables the servo amplifier to be connected to the EtherCat network (Beckhoff company).
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.

6.1.6.1 Front view

6.1.6.2 LEDs

LED	Function
ERROR	flickering = Booting Error blinking = Invalid Configuration single flash = Unsolicited State Change double flash = Watchdog Timeout off = No Error
RUN	on = Device is in state OPERATIONAL blinking = Device is in state PRE-OPERATIONAL single flash = Device is in state SAFE-OPERATIONAL off = Device is in state INIT
ACT IN	on = linked, but not active at X20A (in) flickering = linked and active at X20A (in) off = not linked at X20A (in)
ACT OUT	on = linked, but not active at X20B (out) flickering = linked and active at X20B (out) off = not linked at X20B (out)

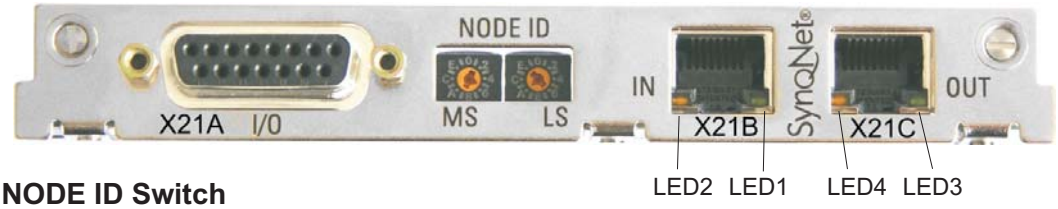
6.1.6.3 Connection diagram



6.1.7 Expansion card -SYNQNET-

This section describes the SynqNet expansion card for SERVOSTAR 300.
Information on the range of functions and the software protocol can be found in the SynqNet documentation.
If you ordered the expansion card together with the servo amplifier, then the expansion card is already fitted and screwed into the slot when the servo amplifier is delivered.

6.1.7.1 Front view



6.1.7.2 NODE ID Switch

With these hexadecimal switches you can set the main and low significant bytes of the Node ID seperately. 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.

6.1.7.3 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

6.1.7.4 SynqNet Connection, Connector X21B/C (RJ-45)

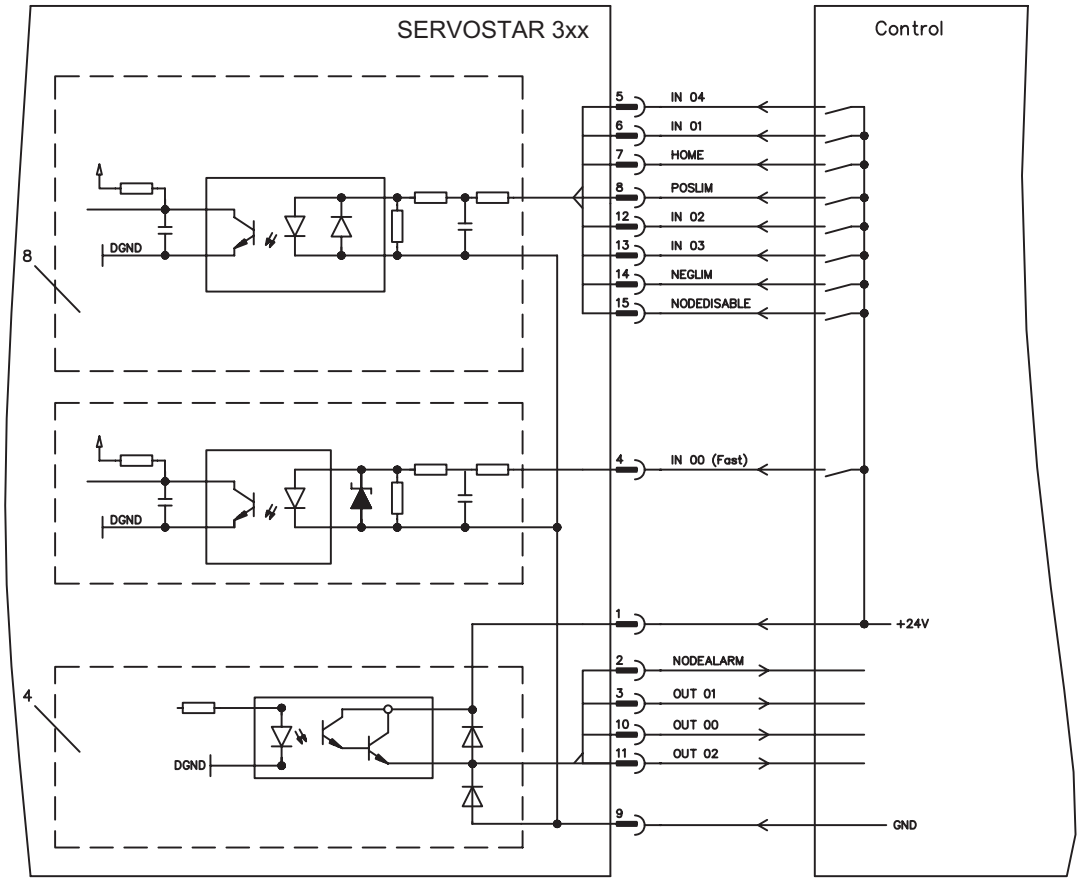
Connection to the SynqNet network via RJ-45 connectors (IN and OUT ports) with integrated LEDs.

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

6.1.7.6 Connection diagram digital inputs/outputs, connector X21A



6.1.8 Expansion module -2CAN-

Connector X6 of the SERVOSTAR 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 Ω) for the CAN bus can be switched into circuit if the SERVOSTAR is at the end of the bus.

6.1.8.1 Installation

The modul must be placed onto the option slot after levering off the cover of the option slot and replacing the small cover (see p. 75):

- **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 SERVOSTAR**

6.1.8.2 Front view

6.1.8.3 Connection technology

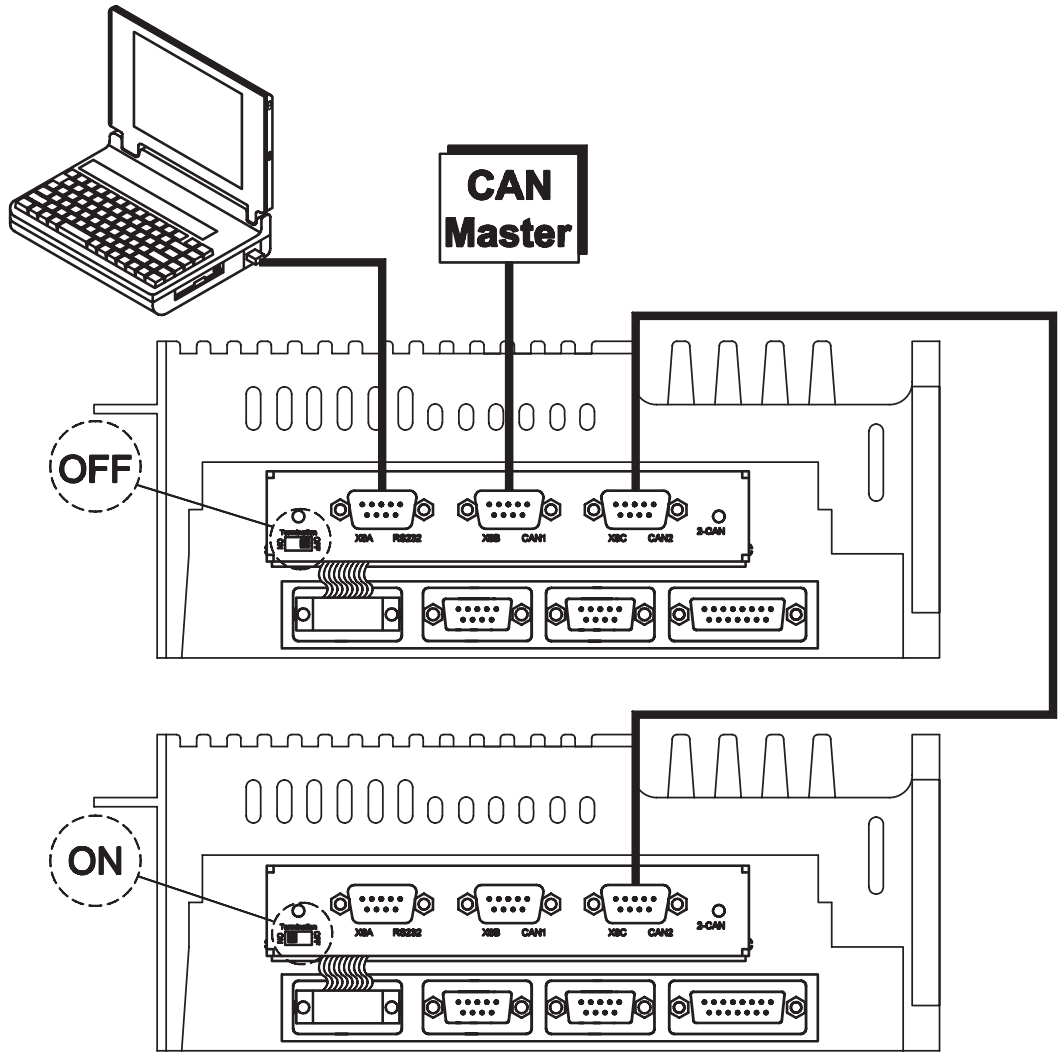
Standard shielded cables can be used for the RS232 and CAN interfaces.

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).

6.1.8.4 Connector assignments

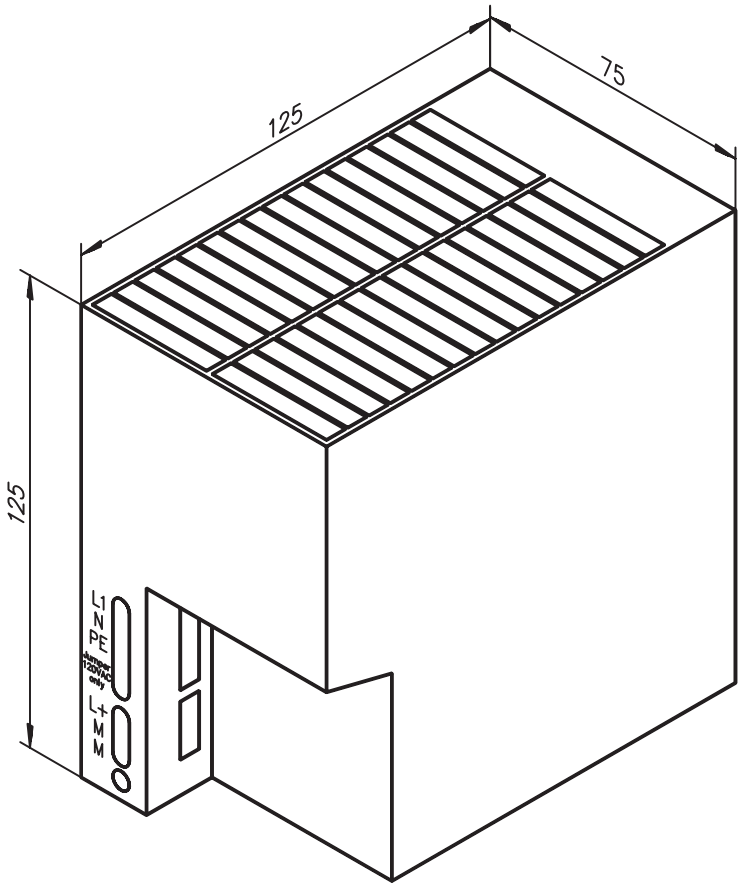
RS232		CAN1=CAN2	
X6A Pin	Signal	X6B=X6C Pin	Signal
1	Vcc	1	
2	RxD	2	CAN-Low
3	TxD	3	CAN-GND
4		4	
5	GND	5	
6		6	
7		7	CAN-High
8		8	
9		9	

6.1.8.5 Connection diagram



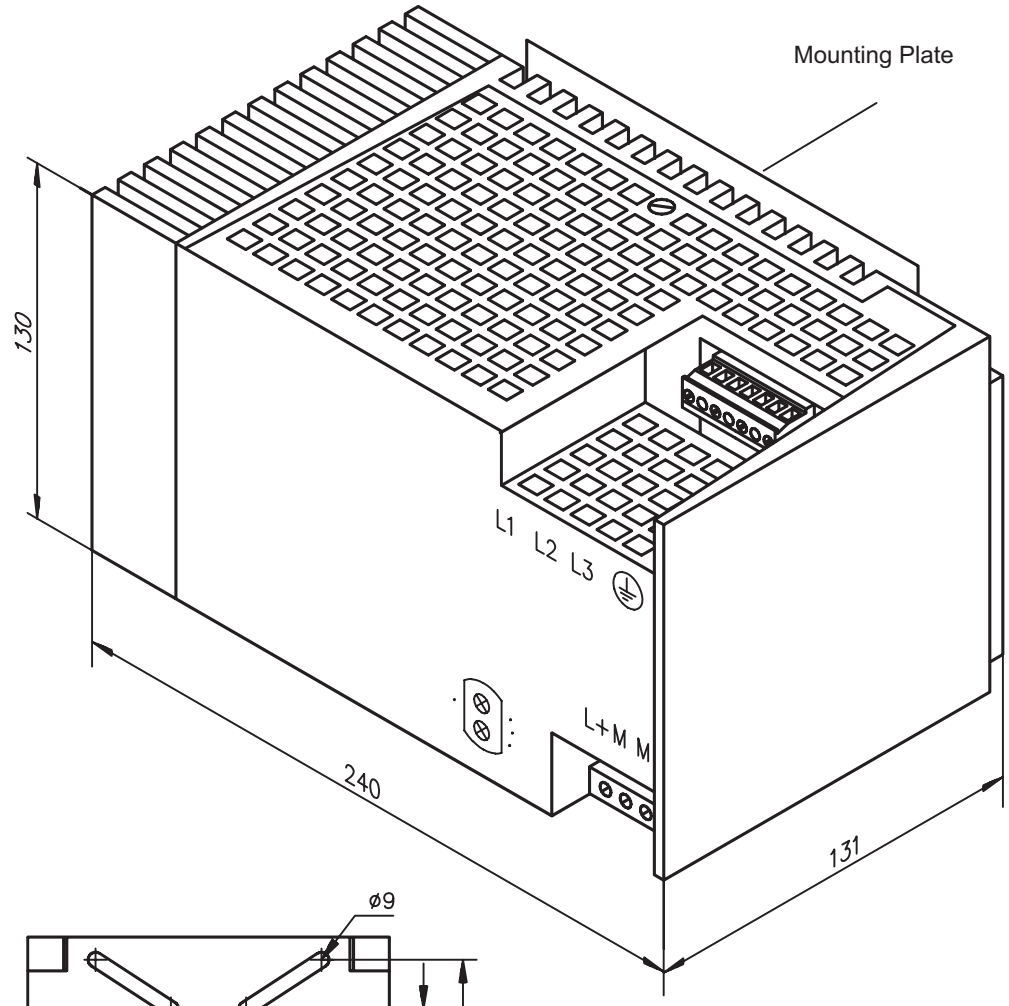
6.2 Accessories

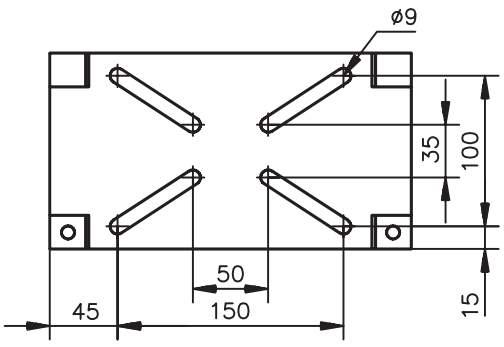
6.2.1 External power supply 24V DC / 5A

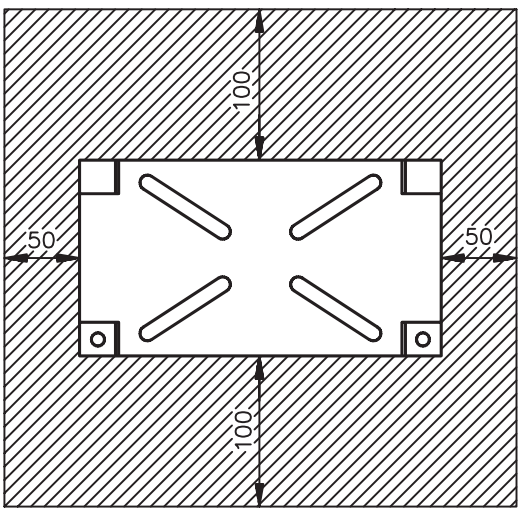


Technical data	(not available in North America)
Input voltage	120 / 230V
Input current	0.9 / 0.6A
Frequency	50/60Hz
Primary fusing	3.15AT
Output voltage	24V ± 1%
Max. output current	5A
Residual ripple	<150mVss
Switching peaks	<240mVss
Output fusing	short-circuit proof
Temperature range	0 to +60°C
Mounting method	DIN-rail, vertical mounting **50mm free space required above and below the device**
Weight	0.75kg

6.2.2 External power supply 24V DC / 20A

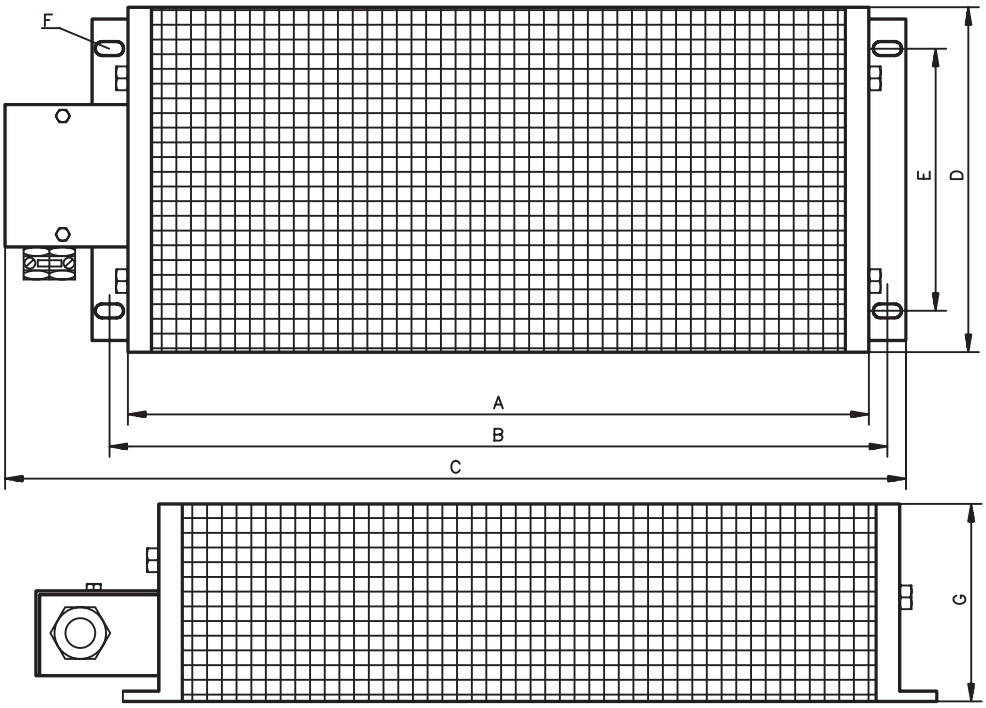


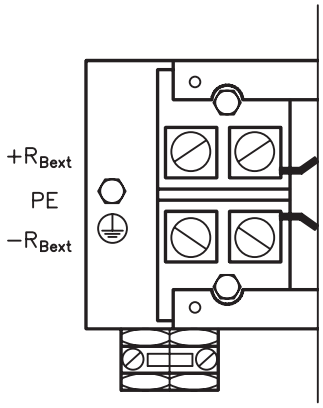




Technical data	(not available in North America)
Input voltage	3 x 400V AC ± 10%
Input current	approx. 1.1A
Frequency	50/60Hz
Primary fusing	none
Output voltage	24V ± 1%
Max. output current	20A
Residual ripple	<0.1%
Output fusing	short-circuit proof
Test voltage	as per VDE 0550
Temperature range	-20 to +60°C
Mounting method	on mounting plate (supplied) **keep necessary space clear**
Weight	3.5kg

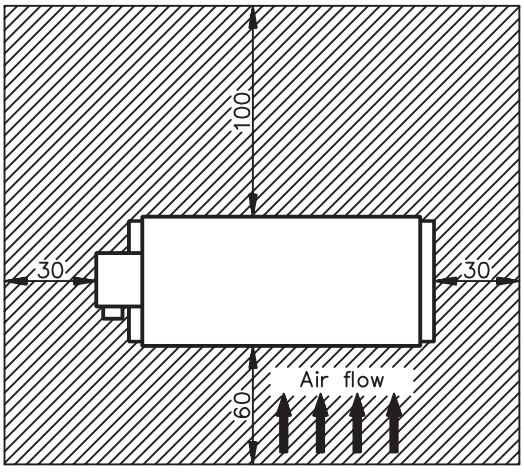
6.2.3 External regen resistor BAR(U)xxx





	R	Rated power	A	B	C	D	E	F	G	weight
	Ω	W	mm	mm	mm	mm	mm	mm	mm	Kg
BAR(U) 300	66	300	200	226	349	92	64	6,5x12	120	1,5
BAR(U) 600	66	600	400	426	549	92	64	6,5x12	120	2,3
BAR(U) 1000	66	1000	600	626	749	92	64	6,5x12	120	3,4
BAR(U) 300	91	300	200	226	349	92	64	6,5x12	120	1,5
BAR(U) 600	91	600	400	426	549	92	64	6,5x12	120	2,3
BAR(U) 1000	91	1000	600	626	749	92	64	6,5x12	120	3,4

Caution:
The surface temperature can exceed 200°C. Make sure that the necessary space is kept clear.
Do not mount the instrument on combustible surfaces!



Keep space free

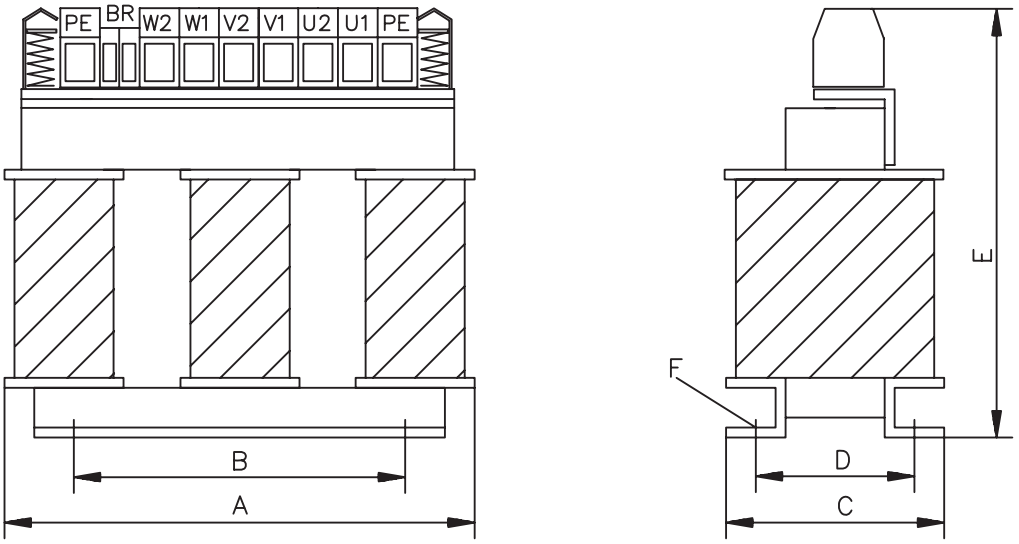
6.2.4 Motor chokes 3YLNxx

To use with motor cables longer than 25m up to 50m max. to reduce velocity ripple and to protect the output power stage of the amplifier. The terminals BR are used to connect the motor holding brake. Beside the terminal are block two shield connection terminals for safe connection of the cables's shielding braid.

Mount the choke nearby the servo amplifier. The cable length between amplifier and choke must never exceed 2m. Connection see page 42 .

The increased absorption reduces the permissible rotative frequency and limits thereby the permitted motor speed:
— with 6 poles motors to n_{max} = 3000 rpm
— with 8 poles motors n_{max} = 2250 rpm
— with 10 poles motors n_{max} = 1800 rpm

The increased leakage current at rising cable length leads to the reduction of usable amplifier output current of about 1A. Use only motors with more than 2A rated current, to get a good regulation quality.



Technical data	Dim	3YLN06	3YLN10	3YLN14	3YLN20
Rated current	A	3x6	3x10	3x14	3x20
Peak current	A	12	30	28	40
Winding inductance	mH	0,9	0,9	0,9	0,45
Winding resistance	Ohm	24,7	14,9	12,7	7,6
Power loss	W	40			
Rotative frequ. (max)	Hz	150			
Clock frequency	kHz	2 - 8			
Test voltage	-	Phase<->PE 2700V DC 1s			
Overload	A	1,5 x Inom, 1 min/h			
Climatic category	-	DIN IEC 68 Part 1 25/085/21			
Weight	kg	4,5	5,5	10	10
Connection diameter	mm²	4	4	4	6
A	mm	155	155	190	190
B	mm	130	130	170	170
C	mm	70	85	115	115
D	mm	55	70	75	75
E	mm	190	190	220	230
F	mm	5,5 x 8	5,5 x 8	6,5 x 10	6,5 x 10

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7 Appendix

7.1 Transport, storage, maintenance, disposal

Transport :
— only by qualified personnel
— only in the manufacturer's original recyclable packaging
— avoid shocks
— temperature -25 to +70°C, max. rate of change 20°C / hour
— humidity max. 95% relative humidity, no condensation
— The servo amplifiers contain electrostatically sensitive components, that can be damaged by incorrect handling. Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials, such as artificial fabrics and plastic films. Place the servo amplifier on a conductive surface.
— if the packaging is damaged, check the unit for visible damage. In such an event, inform the shipper and the manufacturer.

Packaging :
— recyclable cardboard with inserts
— dimensions : (HxWxD) 115x365x275mm
— labeling instrument label on outside of box

Storage :
— only in the manufacturer's original recyclable packaging
— 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.
— max. stacking height 8 cartons
— storage temperature -25 to +55°C, max. rate of change 20°C / hour
— humidity 5 ... 95% relative humidity, no condensation
— storage duration < 1 year without restriction
> 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.

Maintenance :
— the instruments do not require any maintenance
— opening the instruments invalidates the warranty

Cleaning :
— if the casing is dirty: clean with isopropanol or similar
do not immerse or spray
— if there is dirt inside the unit: must be cleaned by the manufacturer
— dirty protective grill on fan: clean with a dry brush

Disposal :
— you can dismantle the servo amplifier into its principal components by unscrewing it (aluminum heat sink, steel housing sections, electronics boards)
— disposal should be carried out by a certified disposal company. We can give you suitable addresses on request

7.2 Finding and removing faults

The table below should be regarded as a “First-aid” box. There may be a wide variety of reasons for the fault, depending on the conditions in your installation.

In multi-axis systems there may be further hidden causes of a fault.

Our customer service can give you further assistance with problems.

Fault	Possible causes	Measures
HMI message: Communication fault	— wrong cable used — cable plugged into wrong position on 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
F01 message: Heat sink temperature	— permissible heat sink temperature exceeded	— improve ventilation
F02 message: Overvoltage	— regen power is insufficient. Regen power limit was reached and the regen resistor was switched off. This causes excessive voltage in the DC bus link circuit. — supply voltage too high	— reduce the RAMP braking time. Use an external regen resistor with a higher power rating and adjust the regen power parameter — use a supply transformer
F04 message: Feedback Unit	— feedback connector not properly inserted — feedback cable is broken, crushed, or otherwise damaged — feedback unit is damaged or wrongly configured	— check connectors — check cables — check feedback unit and settings
F05 message: Undervoltage	— supply voltage is not present, or too low when the servo amplifier is enabled	— only ENABLE the servo amplifier when the electrical supply voltage has been switched on delay > 500 msec
F06 message: Motor temperature	— motor thermostat has been activated — feedback connector is loose, or a break in the feedback cable	— wait till motor has cooled down, then check why it became so hot. — screw connector up tight, or use new feedback cable
F07 message: Aux. voltage	— the aux. voltage produced by the servo amplifier is incorrect	— return the servo amplifier to the manufacturer for repair
F08 message: Overspeed	— motor phases swapped — feedback device set up incorrectly	— correct motor phase sequence — set up the correct offset angle
F09 message: EEPROM	— checksum error	— save data to EEPROM again to force a new calculation

Fault	Possible causes	Measures
F11 message: Brake	— short-circuit in the supply cable for the motor-holding brake — motor-holding brake is faulty — fault in brake cable — no brake connected, although the brake parameter is set to WITH	— remove the short-circuit — replace motor — check shielding of brake cable — set brake parameter to WITHOUT
F13 message: Internal temp.	— permissible internal temperature has been exceeded	— improve ventilation
F14 message: Output stage fault	— motor cable has a short-circuit or earth/ground short — motor has short-circuit or earth/ground short — output module is overheated — output stage is faulty — short-circuit or short to ground in the external regen resistor	— replace cable — replace motor — improve ventilation — return the servo amplifier to the manufacturer for repair — remove short-circuit / ground short
F16 message: Mains BTB/RTO	— enable was applied, although the supply voltage was not present. — at least 2 supply phases missed	— only ENABLE the servo amplifier when the electrical supply voltage has been switched on — check the electrical supply
F17 message: A/D converter	— error in the analog-digital conversion, usually caused by EMC interference	— reduce EMC interference check shielding and grounding
F25 message: Commutation error	— wrong cable used — offset is too large — wake & shake missed	— check cable — check resolver pole number (RESPOLES), motor pole number (MPOLES) and offset (MPHASE) — execute wake & shake
F27 message: error AS	— -AS- enable AND HW enable have been set at the same time	— check programming and wiring of the PLC / control system
Motor does not rotate	— servo amplifier not enabled — software enable not set — break in setpoint cable — motor phases swapped — brake not released — drive is mechanically blocked — motor pole no. set incorrectly — feedback set up incorrectly	— apply ENABLE signal — set software enable — check setpoint cable — correct motor phase sequence — check brake control — check mechanism — set motor pole no. — set up feedback correctly
Motor oscillates	— gain is too high (speed controller) — feedback cable shielding 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} set too low — accel/decel ramp is too long	— increase I_{rms} or I_{peak} (keep within motor ratings!) — shorten ramp +/-
Motor overheating	— I_{rms}/I_{peak} is set too high	— reduce I_{rms}/I_{peak}

Fault	Possible causes	Measures
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 controller-GND of the controls	— adjust offset (analog I/O) — join AGND and controller-GND
n12 message: Motor default values loaded	— Motor numbers stored in the encoder and amplifier do not match the parameters that have been set	— default values for the motor have been loaded, SAVE automatically stores the motor number in the EEPROM
n14 message: SinCos feed-back	— SinCos commutation (wake&shake) not completed	— ENABLE the amplifier

7.3 Glossary

C	Clock	Clock signal
	Common-mode voltage	The maximum amplitude of a disturbance (on both inputs) which a differential input can eliminate
	CONNECT modules	Modules built into the servo amplifier, with integrated position control, that provide special versions of the interface for the connection to the higher-level control.
	Counts	Internal count pulses, 1 pulse = $½^{20}$ $turn^{-1}$
	Continuous power of regen circuit	Mean power that can be dissipated in the regen 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 (0V or open)
E	Earth short	electrical connection between a phase and the protective earth (PE)
	ENABLE	Enable signal for the servo amplifier (+24V)
F	Fieldbus interface	CANopen, PROFIBUS, SERCOS etc.
	Final speed (limit speed)	Maximum value for the speed normalization at ±10V
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	I²t 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 ±10V
	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 electro-magnetic 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 regen circuit	Maximum power which can be dissipated in the regen circuit
R	regen circuit	Converts superfluous energy fed back by the motor during braking (regenerated energy) into heat.
	Reset	New start of the microprocessor
	Resolver/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 PET
	Tachometer voltage	Voltage proportional to the actual speed
	Thermostat (contact)	Temperature-sensitive switch built into the motor winding
	Tn, I-integration time	Integral component of a control loop
Z	Zero pulse	Output once per turn from incremental encoders, used to zero the machine

7.4 Order codes

7.4.1 Servo amplifier, expansion cards

Article	EU order code	US order code
SERVOSTAR 303	S30361-NA*	
SERVOSTAR 306	S30661-NA*	
SERVOSTAR 310	S31061-NA*	
SERVOSTAR 341	S30101-NA*	
SERVOSTAR 343	S30301-NA*	
SERVOSTAR 346	S30601-NA*	
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 EtherCat	DE-108350	OPT-EC
Expansion card SynqNet	DE-200073	OPT-SN
Expansion module 2CAN	DE-101174	not available

*= NA means without built-in expansion card

7.4.2 Mating connectors

Article	EU order code	US order code
Mating connector X3	DE-107554	CON-S3X3
Mating connector X4	DE-107555	CON-S3X4
Mating connector X0 (115/230V)	DE-105856	CON-S3X0L
Mating connector X8 (115/230V)	DE-107556	CON-S3X8L
Mating connector X9 (115/230V)	DE-107631	CON-S3X9L
Mating connector X0 (230/400/480V)	DE-107557	CON-S3X0H
Mating connector X8 (230/400/480V)	DE-107558	CON-S3X8H
Mating connector X9 (230/400/480V)	DE-107467	CON-S3X9H

7.4.3 Motor cables with connectors

Article	EU order code	US order code
Motor cable (230V) 5m (4x1)	DE-107485	Refer to information in the US brochure, to the Danaher Motion Website or ask our sales representative.
Motor cable (230V) 10m (4x1)	DE-107486	
Motor cable (230V) 15m (4x1)	DE-107487	
Motor cable (230V) 20m (4x1)	DE-107488	
Motor cable (230V) 25m (4x1)	DE-107489	
Motor cable (230V) 5m (4x1+(2x0,75))	DE-107491	
Motor cable (230V) 10m (4x1+(2x0,75))	DE-107492	
Motor cable (230V) 15m (4x1+(2x0,75))	DE-107493	
Motor cable (230V) 20m (4x1+(2x0,75))	DE-107494	
Motor cable (230V) 25m (4x1+(2x0,75))	DE-107495	
Motor cable (400V) 5m (4x1)	DE-107473	
Motor cable (400V) 10m (4x1)	DE-107474	
Motor cable (400V) 15m (4x1)	DE-107475	
Motor cable (400V) 20m (4x1)	DE-107476	
Motor cable (400V) 25m (4x1)	DE-107477	
Motor cable (400V) 5m (4x1+(2x0,75))	DE-107479	
Motor cable (400V) 10m (4x1+(2x0,75))	DE-107480	
Motor cable (400V) 15m (4x1+(2x0,75))	DE-107481	
Motor cable (400V) 20m (4x1+(2x0,75))	DE-107482	
Motor cable (400V) 25m (4x1+(2x0,75))	DE-107483	

other lengths on request, up to 50m in Europe and up to 39m in USA

7.4.4 Feedback cables with connectors

Article	EU order code	US order code
Resolver cable 5m (4x(2x0.25))	DE-84972	Refer to information in the US brochure, to the Danaher Motion Website or ask our sales representative.
Resolver cable 10m (4x(2x0.25))	DE-84973	
Resolver cable 15m (4x(2x0.25))	DE-84974	
Resolver cable 20m (4x(2x0.25))	DE-84975	
Resolver cable 25m (4x(2x0.25))	DE-87655	
Encoder cable 5m (7x(2x0.25))	DE-90287	
Encoder cable 10m (7x(2x0.25))	DE-91019	
Encoder cable 15m (7x(2x0.25))	DE-91811	
Encoder cable 20m (7x(2x0.25))	DE-91807	
Encoder cable 25m (7x(2x0.25))	DE-92205	
Comcoder cable 5m (8x(2x0.25))	DE-107915	
Comcoder cable 10m (8x(2x0.25))	DE-107916	
Comcoder cable 15m (8x(2x0.25))	DE-107917	
Comcoder cable 20m (8x(2x0.25))	DE-107918	
Comcoder cable 25m (8x(2x0.25))	DE-107919	

other lengths on request, up to 50m in Europe and up to 39m in USA

7.4.5 Power supplies

Article	EU order code	US order code
Power supply 24V/05A	DE-83034	not available
Power supply 24V/20A	DE-81279	not available

7.4.6 Regen resistors

Article	EU order code	US order code
Regen resistor BAR(U) 300-66	DE-107161	BAR-300-66
Regen resistor BAR(U) 600-66	DE-107162	BAR-600-66
Regen resistor BAR(U)1000-66	DE-107163	BAR-1000-66
Regen resistor BAR(U) 300-91	DE-107164	BAR-300-91
Regen resistor BAR(U) 600-91	DE-107165	BAR-600-91
Regen resistor BAR(U)1000-91	DE-107166	BAR-1000-91

7.4.7 Motor chokes

Article	EU order code	US order code
Motor choke 3YLN06	DE-107929	3YLN-06
Motor choke 3YLN10	DE-107930	3YLN-10
Motor choke 3YLN14	DE-107931	3YLN-14
Motor choke 3YLN20	DE-107932	3YLN-20

7.5 Index

Sales and Service

We are committed to quality customer service. In order to serve in the most effective way, please contact your local sales representative for assistance.
If you are unaware of your local sales representative, please contact us.

Europe

Visit the European Danaher Motion web site at www.DanaherMotion.net for Setup Software upgrades, application notes, technical publications and the most recent version of our product manuals.

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