

**User,
Installation and
Maintenance Manual**

**TG Power E
TG Power A**

Edition: 12.07

Type of documentation	Project planning
Intention of the document	<p>This document gives information about</p> <ul style="list-style-type: none">• the planning of the mechanical construction of the switchgear cabinet• the planning of the electrical equipment• the logistic handling of the servo drive• the preparation of servo drives for the commissioning
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0	CONTENTS	
1	GENERAL	5
1.1	About this manual	5
1.2	Safety Instructions	7
1.3	Components of a servo system	9
1.4	Conformity with European directives	10
1.5	Prescribed use	11
1.6	Non-prescribed use	11
1.7	Nameplate	12
1.8	Block diagram and concept	13
1.9	Technical data	15
1.10	Ambient conditions, ventilation and mounting	16
1.11	Auxiliary Power Supply	16
2	INSTALLATION	17
2.1	Important instructions	17
2.2	Planning of the switchgear cabinet	18
2.2.1	Connection diagram and pin assignment	18
2.2.2	Mechanical construction and mounting	20
2.2.3	Connector properties	22
2.2.4	Wire sizing	22
2.2.5	External fusing	22
2.2.6	Serial cable connection	23
2.2.7	Possibilities of mains supply	23
2.2.8	Usage of cooling units	24
2.2.9	Switch-on / off handling	25
2.2.10	Holding brake control	26
2.3	Host interface and setup of the servo drive	27
2.3.1	UNI Interface Board Manual	27
2.3.2	Application	27
3	INTERFACES	29
3.1	Mains input (X1B)	29
3.2	Auxiliary 24V – and Holding Brake – supply (X1A)	30
3.3	External regen Interface (X1B)	31
3.4	Motor connector (X3, X4, X5)	32
3.4.1	Standard configuration	32
3.4.2	Classic emergency stop function (stop category 0)	32
3.4.3	Personnel safe holding brake control	33
3.5	Feedback (X6, X7, X8)	34
3.5.1	Resolver feedback	34
3.5.2	EnDAT® feedback	35
3.5.3	Hiperface® feedback	36
4	MAINTENANCE	38
4.1	Replace and repair	38
5	APPENDIX	39
5.1	Transport, storage and disposal	39
5.2	Troubleshooting and Fault Elimination	40
5.2.1	LED Indication	40

5.2.2	Malfunction of the drive.....	40
5.2.3	Status Register	41
5.3	Commissioning (Quick Guide)	44
5.3.1	Resolver- adjustment	45
5.3.2	Hiperface- and EnDAT- adjustment.....	46
5.4	Index	47

1 General

1.1 About this manual

The manual describes the servo drive of the TG Power E and A series.

The information provides:

- **Technical Data of the servo drive**
- **Assembly and Installation**
- **Connection an pin assignment**
- **Setup of the servo drive**
- **Troubleshooting**
- **Transport, storage, maintenance, disposal**

Abbreviations used in this manual:

Short cuts	Meaning
AWG	American wire gauge
BGND	Ground of 24V-supply and holding brake voltage
CAN	Field bus (CANopen)
CE	Communauté Européenne
CLOCK	Clock signal
DIN	DIN standard
EEC	European Economic Community
EMC	Electromagnetic compatibility
EMI	EMI-Filter, (electromagnetic interference)
EN	European standard
IGBT	Insulated Gate Bipolar Transistor
LED	Light-emitting diode
PELV	protected extra low voltage
RCD	Residual-current-operated protective device
RES	Resolver
RMS	Root mean square
R _{int.}	connection internal regen resistor
R _{tr}	connection regen chopper
SELV	Safety extra low voltage
V AC	AC voltage
V DC	DC voltage

Symbols used in this manual



Danger!

Shock current

Danger to personnel from electricity



Caution!

General

General warning, see document



Caution!

Hot surface

Hot surface above 80°C (176°F)



Important note

See document

1.2 Safety Instructions



The safety instructions must be read before installation and set-up of the servo drive, to prevent injury or material damage. It is fundamental to keep the technical data and information on connection requirements (on the nameplate and in the documentation).

Only 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 this product.

The manufacturer of the machine must generate a safety analysis for the whole machine. He has to take appropriate measurements to ensure that unforeseen movements cannot cause injury or equipment damage.

Inappropriate handling of the servo drive or ignoring of the warning notices below and inappropriate engagement in the safety arrangement can result in equipment damage, personal injury, electric shock or death in an extreme situation.

Annotations



Danger! Shock current

Wait at least five minutes after disconnecting the servo drive from the mains supply voltage before touching live sections of the equipment (e.g. contacts) or undoing connections. Up to five minutes after switching off the supply voltages capacitors can still have dangerous voltages present. To be sure, check the voltage in the DC-link circuit and wait until it dropped below 40V.

Never remove the electrical connections to the servo amplifier while it is live. There is a danger of electric arcing with damage to contacts and danger to persons.

If a leakage current sensor is used in the mains supply of the servo drive, a leakage current sensor RCD type B has to be used in any case.

If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive inhibits the leakage current sensor.

Failure to observe any one of these instructions will lead to death, serious injury or equipment damage.

Continued on next page ►

[Back to Contents](#)

**Caution** **General**

The utilization of the servo drive is limited according to EN61800-3. This product can cause radio interference problems in living quarters. In this case it can be necessary for the operator to accomplish adequate measurements.

The servo drive contains electro statically sensitive components which may be damaged by incorrect handling. Ground yourself before touching the servo drive by touching any grounded unpainted metal surface. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the servo drive on a conductive surface.

Do not open the units. Keep all covers and switchgear cabinet doors closed during operation. Otherwise there are deadly hazards, with the possibility of severe danger to health or material damage.

During operation, servo amplifiers, according to their degree of enclosure protection, may have uncovered live components. Control and power connections may be live, even if the motor is not rotating.

The mains supply of the **TG Power** demands a fixed connection. If the servo drive is mounted in a moveable part of a machine with mains connector plug, the ground connection has to have a minimum wire size of 10 mm² (8 AWG) because of the high leakage current of the servo drives (> 3.5mA).

The +24V auxiliary power supply and also the power supply for the +24V-BR holding brake supply must be galvanic isolated with SELV output voltage according to EN 60950.

Failure to observe these precautions can result in severe injury and equipment damage.

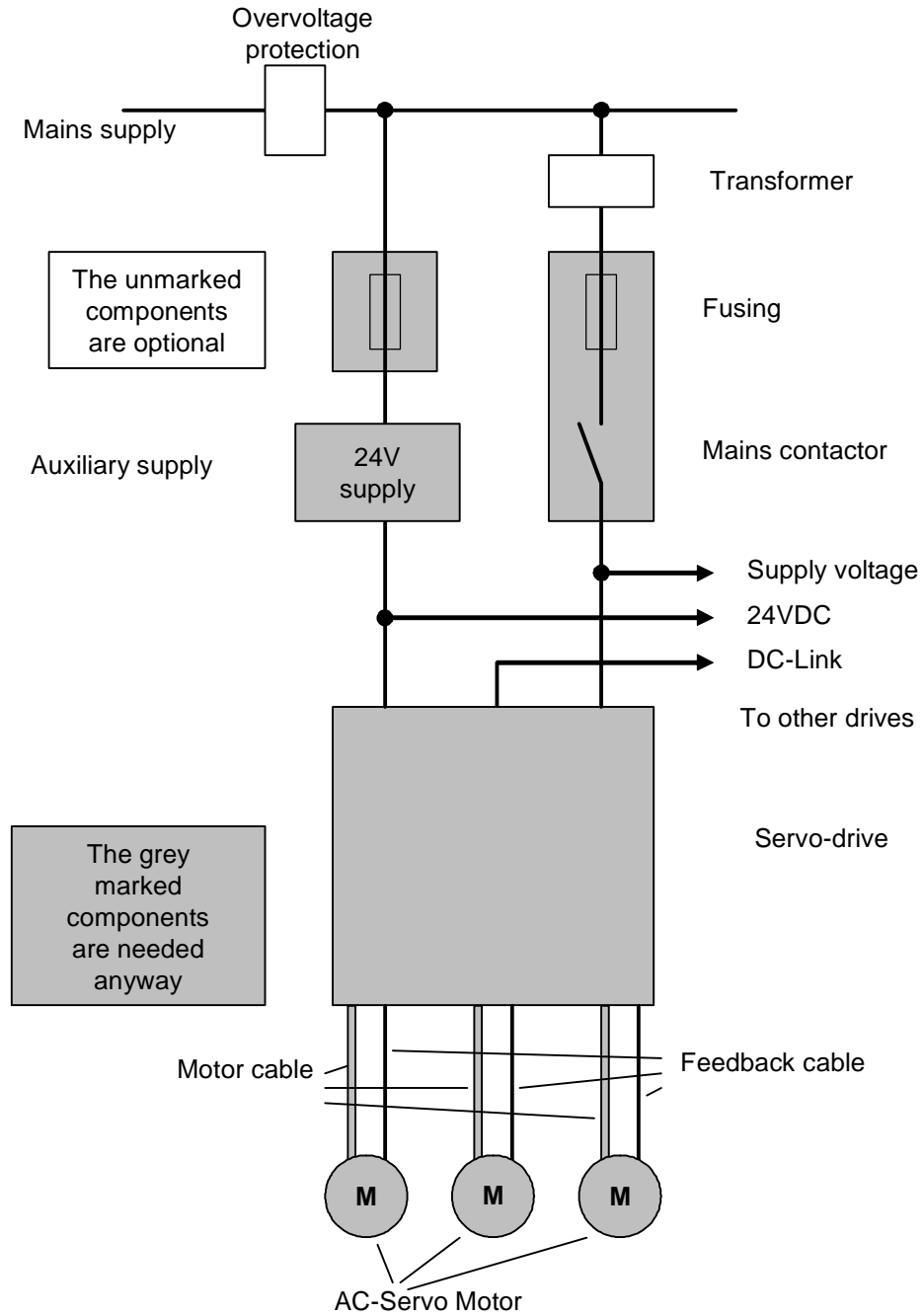
**Caution!** **Hot surface**

During operation, the heat sink of the servo drive can become hot and may reach temperatures above 80°C (176°F). Check (measure) the temperature and wait until it has cooled down below 40°C (104°F) before touching it.

Failure to observe this precaution can result in severe injury

[Back to Contents](#)

1.3 Components of a servo system



Servo Systems of a closed loop are applied in many different fields for automation. They comprise a servo motor and a servo drive, operating with a connected PLC. Every servo drive needs a device to return feedback information about position and speed of the motor. The servo drive ascertained, with the integrated closed loops, the appropriate currents for the motors and controls the speed that way.

[Back to Contents](#)

1.4 Conformity with European directives

Servo drives are components, which are built in electrical equipment and machines for industrial use.

The operation is forbidden, until the machine or plant fulfils the requirements defined by the EC Directive on Machines 98/37/EC, represented by EN 60204, and the EC Directive on EMC 89/336/EEC



Note: To ensure unforeseen movement which can cause injury or damage to any person or property, the manufacturer of the machine must generate a safety analysis for the machine.

CE – Conformity

The conformance with the EC Directive on EMC 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of servo drives within the European Community.

The harmonised standard EN 61800-5-1 (Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy) is applied to the servo drive in connection with the Low Voltage Directive 73/23/EEC.

The harmonised standard EN 61800-3 (Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods) is applied to the servo drive in connection with the EMC Directive 89/336/EEC.

A correct installation to meet the EMC regulations can be found in this documentation, particularly information's about:

- shielding
- grounding
- layout of the cabinet cabling
- filters (if necessary)

The servo drives of the **TG Power** series have been tested in a defined configuration with system components described in this documentation.

Any divergence from the configuration and installation described in this documentation means that new measurements have to be done, to ensure that the regulatory requirements are met.

[Back to Contents](#)

1.5 Prescribed use

The servo drives (Complete Drive Module CDM) of SD Antriebstechnik GmbH are developed and produced according to the actual prior art. The products are fully tested before delivery, especially in terms of fail-safe conditions.

They are components which are built into electrical equipment and can only be used as integrated component of such equipment.

Before the products are installed, following requirements have to be fulfilled to meet the prescribed use.

- Everyone who is working in any way with the products has to read and understand the safety instructions, the prescribed use and the not prescribed use.
- The machine builder has to generate a safety analysis for the machine to ensure that unforeseen movements cannot cause injury or damage to any person or property.
- The servo drive has to run under the mounting and installation conditions described in this documentation. Especially the environmental conditions (temperature, protection class, humidity, mains input, EMC and the mounting position)
- It must be mounted in a closed switchgear cabinet.
- The servo drive has to be used in the original delivery condition (without any mechanical or electrical modification).
- Do not mount or use mechanical or electrical damaged or faulty servo drives.
- The servo drive is intended to control synchronous servo motors in closed loop control of torque, speed or position.
- The rated voltage of the motor must be at least as high as the setting of the mains input voltage (85V or 230V) of the servo drive.
- The servo drive is developed for usage in industrial environment. If it is used in residential areas, then an additional filter must be installed in the mains input line

1.6 Non-prescribed use

If the servo drive is used according to the environmental conditions described in this documentation, means "prescribed used".

- It must not be used in electrical equipment on ships (service afloat) or in off-shore applications because of the conductive pollution.
- It must not be used in environmental conditions that are not according to the conditions described in the documentation (too hot, without closed switchgear cabinet, wrong mounting position, etc.)

Be very careful in plants, where conductive material (carbon fibre, graphite with machining of graphite cast iron or similar) is easy purge able on the factory floor. In this case, the switchgear cabinet has to be sealed very carefully (no forced ventilation with blower filter) or has to be placed outside the factory floor. Especially at start-up of the machine, the risk is high because of open switchgear cabinet doors. Servo drives, which are contaminated in that way, must not be used any more.

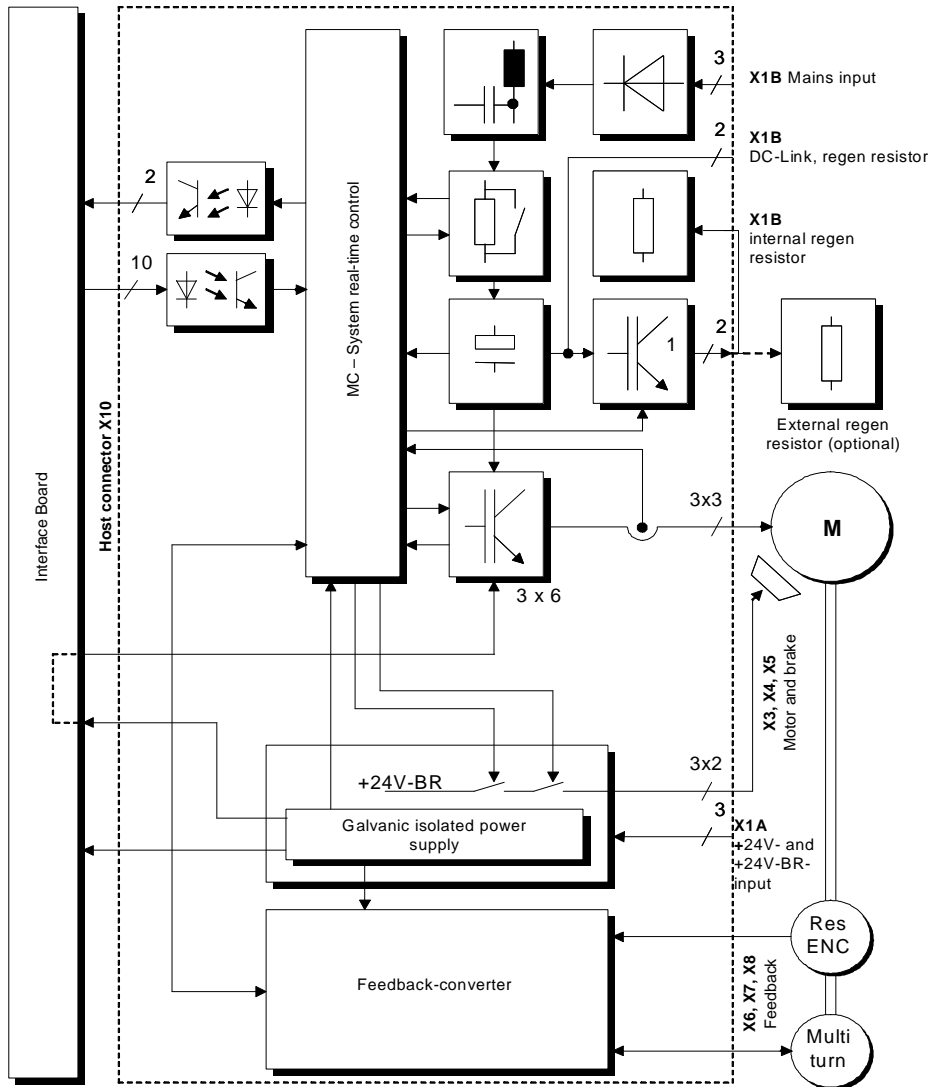
[Back to Contents](#)

1.7 Nameplate

The name plate is attached to the side of the heat sink of the drive.
The information in the individual fields depends on the individual drive data.

[Back to Contents](#)

1.8 Block diagram and concept



Hardware

- The mains input is connected to a power rectifier, an input filter and the inrush circuit to reduce the charge current of the DC-link capacitor when the mains contactor is switched on.
- IGBT – power stage with isolated current measurement (short circuit protected).
- Regen unit (short circuit protected) with internal regen resistor. If wattage is not high enough, disconnect internal and connect external regen resistor.
- DC-link connection for power distribution to other drives.
- Auxiliary power supply input for internal supply distribution.
- Separate power supply input for the holding brake for safety reasons.
- Feedback converter for resolver, resolver with Multiturn, EnDAT and Hiperface devices.
- Microcontroller system with communication unit to the interface board.

[Back to Contents](#)

Concept of the TG Power

- Single-axis and triple-axes drives, to optimise the cost situation of the machine. Triple-axes drive has advantages through reduced component cost.
- Range function to optimise the resolution of the actual current of all axes in the different configurations.
- Housing width 114mm
- Wide mains input voltage range,

Single-axis-drive	A310	3x10A/20A – 85VAC
Three-axes-drive	E305	3x 5A/10A – 230VAC
- Inrush circuitry to limit the maximum charge current at switch on of the mains contactor
- Fusing provided by the user (drive detects phase failure by itself)
- Single phase mains supply
- 24V auxiliary supply input, electrically isolated for internal supply
- Separate 24V input for holding brake control
- Input EMI – filter for AC-input, 24V auxiliary supply and holding brake supply for class A (industrial environment)
- All shield connections at the housing
- Protection functionality:
 - DC-link under/over voltage
 - several short circuit conditions
 - phase failure of the mains input
 - overheating of the regen resistor
 - over temperature protection (heat sink, ambient and motor)

Software functionality

- Modified space vector modulation (SVM) technique to reduce the power stage losses
- Field oriented current controller (update time 62.5µs)
- Feedback converter and speed controller (update time 62.5µs)
- Spline interpolator and position controller (update time 62.5µs)
- Full synchronisation down to the power stage, to the beat of the host controller with cycle times of 250µs, 500µs, 1ms and every ms up to 8ms
- The servo drive has no non-volatile data memory. After switch-on, the parameters are sent via host communication to the servo drive (see interface manual)

[Back to Contents](#)

1.9 Technical data

	DIM	TG Power	
		A310	E305
Rated Data			
Rated mains voltage (symmetrically to ground) maximum 5000 rms symmetrical amps (L1, L2, L3)	V _{AC}	3 x 48V _{-10%} - 85V ^{+20%} 45 - 65 Hz	3 x 115V _{-10%} - 230V ^{+10%} 45 - 65 Hz
Maximum peak current at switch on of the mains contactor (limited by the inrush circuit)	A	1.2	
Rated installed power for S1 operation	kVA	3	6
Rated DC-link voltage	V _{DC}	60 - 130	150 - 360
Auxiliary supply voltage +24V	V _{DC}	22 - 30	
Power of auxiliary supply voltage +24V	W	24	
Holding brake supply voltage +24V-BR	V _{DC}	25 - 27	
Max. holding brake current per axis	A _{DC}	1	
Holding brake voltage drop from +24V-BR to output	V _{DC}	Max. 1 (at 3 x 1A holding brake current)	
Rated output current axis 1 (rms +/- 3%)	A _{rms}	10	5
Rated output current axis 2 (rms +/- 3%)	A _{rms}	10	5
Rated output current axis 3 (rms +/- 3%)	A _{rms}	10	5
Max. continuous sum current of all axes (heat sink)	A _{rms}	20	15
Peak output current axis 1 for max 5sec. (rms +/- 3%)	A _{rms}	20	10
Peak output current axis 2 for max 5sec. (rms +/- 3%)	A _{rms}	20	10
Peak output current axis 3 for max 5sec. (rms +/- 3%)	A _{rms}	20	10
Power stage losses (sum average currents of the 3 axis and multiply with factor), without regen losses	W / A _{rms}	2.5	5
Power stage output frequency	kHz	8	
Regen Circuit			
DC-Link capacitance	μF	940	
External regen resistor value	Ω	33	
Internal regen resistor value	Ω	33	
Rated power of the internal regen resistor	W	66	
G-VMAINS = 85 (rated mains voltage = 85V)			
Switch-on threshold	V _{DC}	170	-
Switch-off threshold	V _{DC}	160	-
Over voltage threshold	V _{DC}	180	-
Max. rated power of the external regen resistor	W	200	-
Peak power of the internal regen resistor (max. 1sec)	W	800	-
G-VMAINS = 230 (rated mains voltage = 230V)			
Switch-on threshold	V _{DC}	-	420
Switch-off threshold	V _{DC}	-	400
Over voltage threshold	V _{DC}	-	450
Max. rated power of the external regen resistor	W	-	400
Peak power of the internal regen resistor (max. 1sec)	W	-	5100
Internal fusing			
Auxiliary supply 24V (+24V to BGND)	-	Electronic fuse	
Holding brake supply 24V-BR (+24V-BR to BGND)	-	No fuse	
Regen resistor	-	Electronic protection	
Plug types			
Auxiliary Supply (X1A, X2A)	-	Combicon 5, 3-pole, 2.5mm ²	
Power Supply (X1B)	-	Power Combicon 7.62, 8-pole, 4mm ²	
Feedback (X6, X7, X8)	-	Sub-D 25-pole (female)	
Motor (X3, X4, X5)	-	Combicon 7.62, 6-pole, 2.5mm ²	
Mechanics			
Height	mm	249	
Width	mm	114	
Depth with / without plugs	mm	300 / 225	
Weight	kg	3	

1.10 Ambient conditions, ventilation and mounting

Storage conditions	à page 39
Transport conditions	à page 39
Ambient temperature in operation	0 to +45°C (32 to 113°F) at rated data +45 to 55°C (113 to 131°F) with power derating of 2.5% / K
Humidity in operation	Relative humidity 85%, no condensation
Site altitude	Up to 1000m above sea level at rated data 1000 to 2500m above sea level with derating of 1.5% / 100m
Pollution level	Pollution level 2 (EN 61800-5-1)
Servo drive enclosures protection class	IP 20
Mounting position	à page 20
Ventilation	Forced ventilation by controlled internal fan

1.11 Auxiliary Power Supply

The power supply that is used for the +24V auxiliary power supply voltage and also for the holding brake supply (+24V-BR) must be a power supply with a galvanic isolated SELV output voltage according to EN60950.

The current rating must be at least 5A because of the inrush current of the drive while switch-on.

[Back to Contents](#)

2 Installation

2.1 Important instructions



- If a leakage current sensor is used in the mains supply of the servo drives, a leakage current sensor RCD type B has to be used in any case. If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive inhibits the leakage current sensor.
- The servo drive and the motor have to be grounded properly. Use uncoated, zinc plated mounting plates (sub plates).

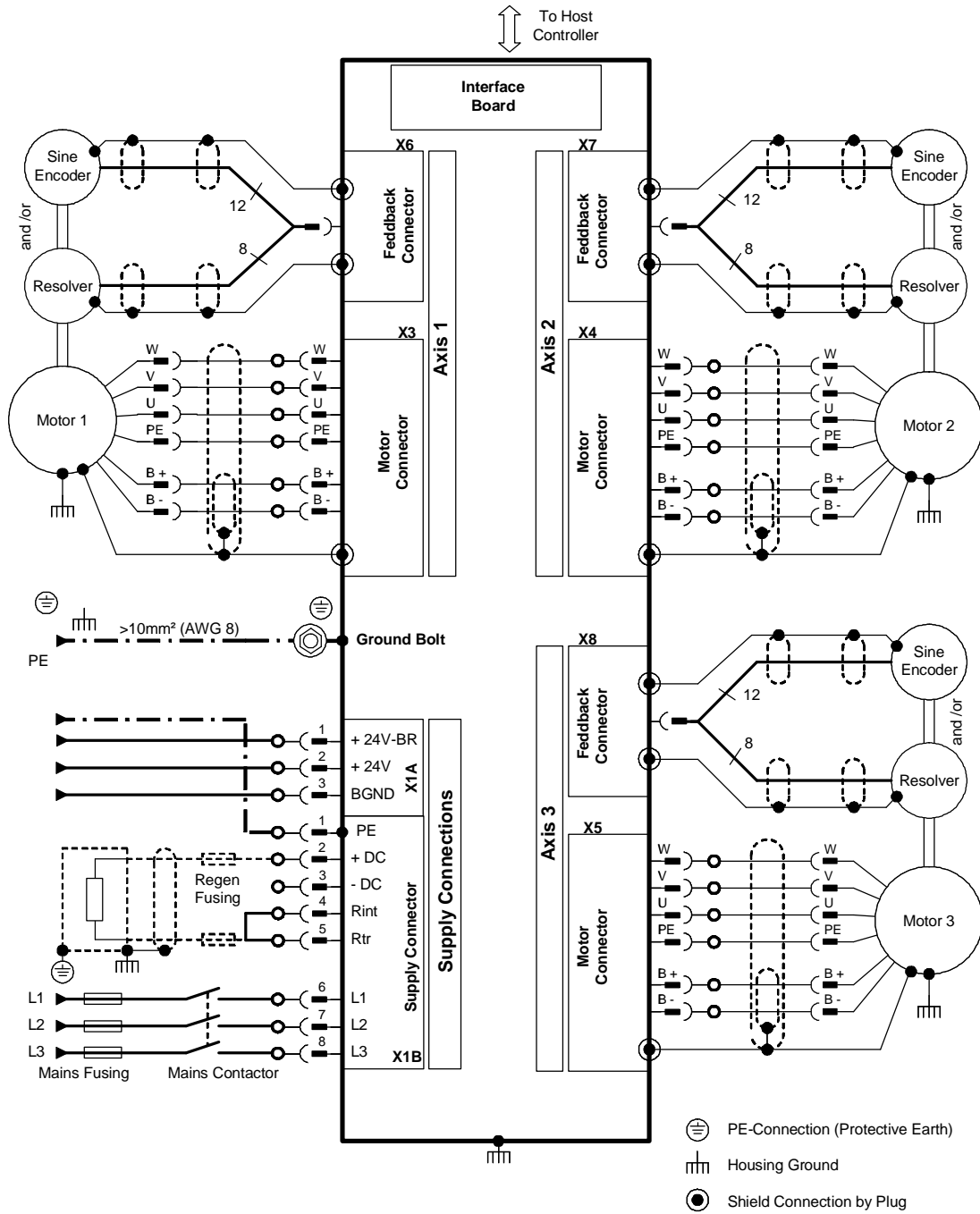


- Ground the **TG Power** with a minimum wire size of 10mm² (AWG 8) at the ground bolt.
- The mains supply of the **TG Power** demands a fixed connection. If the servo drive is mounted in a moveable part of a machine with mains connector plug, the ground connection has to have a minimum wire size of 10 mm² (8 AWG) because of the high leakage current of the servo drives (> 3.5mA).
- Check the mechanics of the servo drive. If the housing is damaged e.g. by transport, don't use it. Don't touch electronic components of the drive.
- Compare the rated voltage and current of the servo motor to the data of the servo drive. Do the wiring according to the **Connection diagram**, [page 18](#).
- Make sure, that the mains input voltage does not exceed the maximum rating of the servo drive under any condition. Note also **Possibilities of mains supply**, [page 23](#).
- Define the external fusing of the mains input, 24V auxiliary supply and holding brake supply according to **External fusing**, [page 22](#).
- Install the motor and control cables separately (distance about 100mm). This decreases the noise level of the control signals caused by the high radiation of the motor cables. Use only screened motor and feedback cable with shield connections on both ends.
- The prescribed mounting position is vertical. See [page 20](#).
- The air flow in the switchgear cabinet has to be in a way, that the servo drives has enough cool and filtered air. See **ambient conditions** [page 16](#).
- **All alterations of the servo drive will invalidate the warranty**, except setting the software functions by parameter.
- At start-up of the servo drive, check the setting of the peak current of the servo drive. Especially small motors are damaged very quickly, if the setting of the servo drive is too high (e.g. a 1A – motor and the 10A-unit, not reduced to 1A!)

[Back to Contents](#)

2.2 Planning of the switchgear cabinet

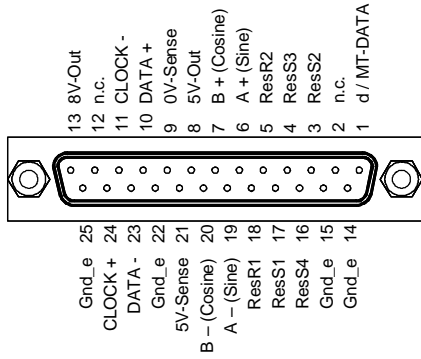
2.2.1 Connection diagram and pin assignment



[Back to Contents](#)

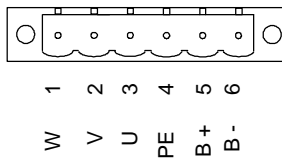
Feedback Connector

Axis 1: X6
 Axis 2: X7
 Axis 3: X8



Motor Connector

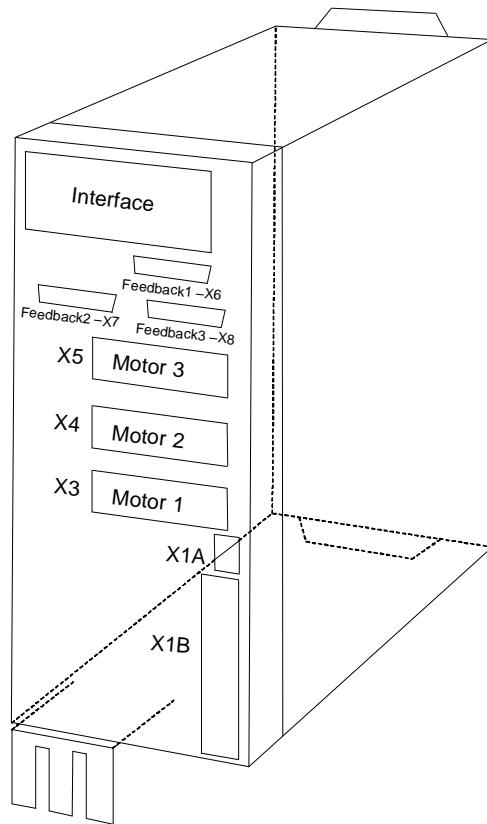
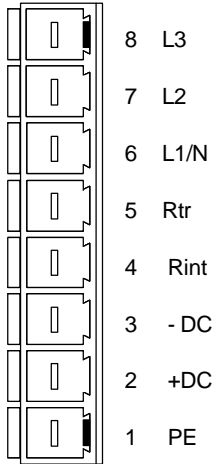
Axis 3: X5
 Axis 2: X4
 Axis 1: X3



24V Supply X1A

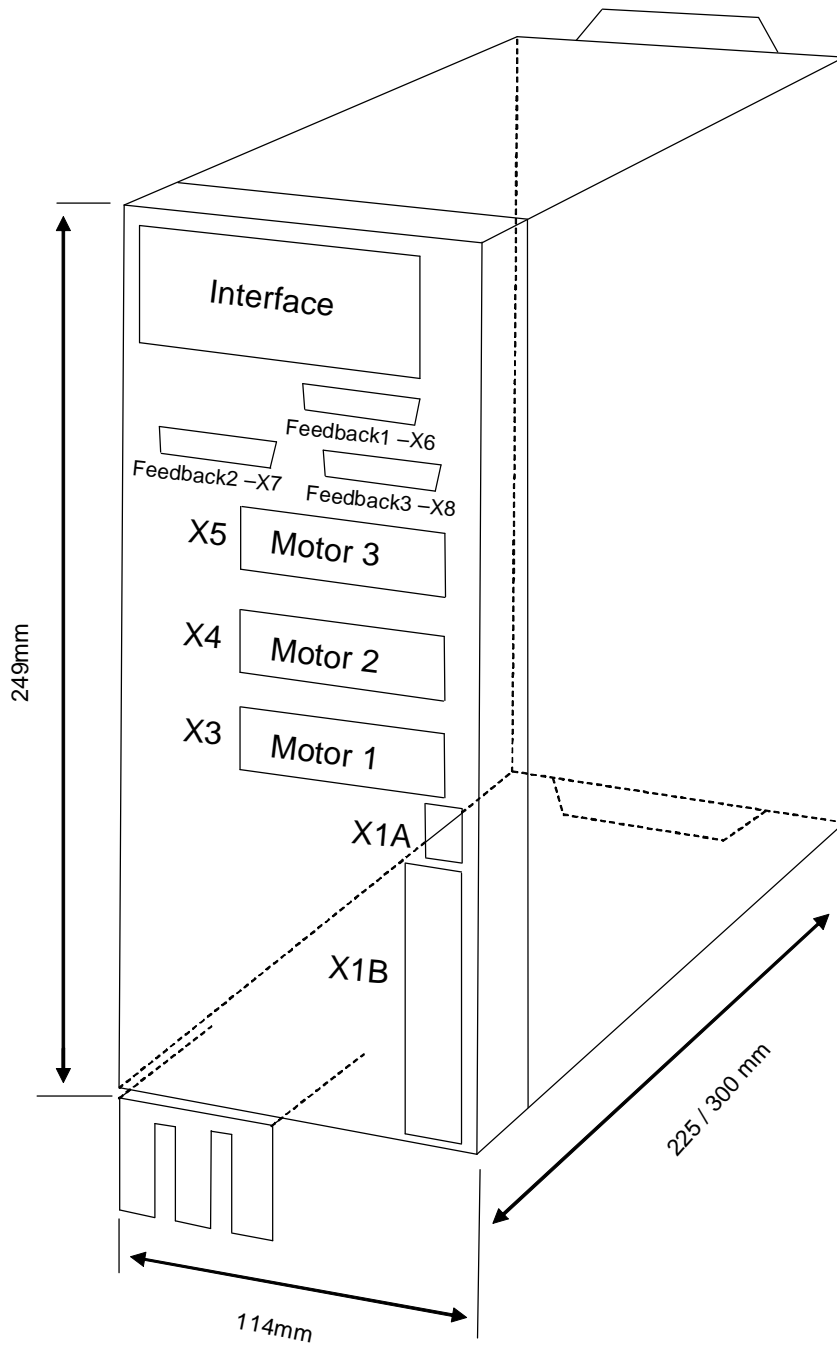


Supply Connector X1B



[Back to Contents](#)

2.2.2 Mechanical construction and mounting

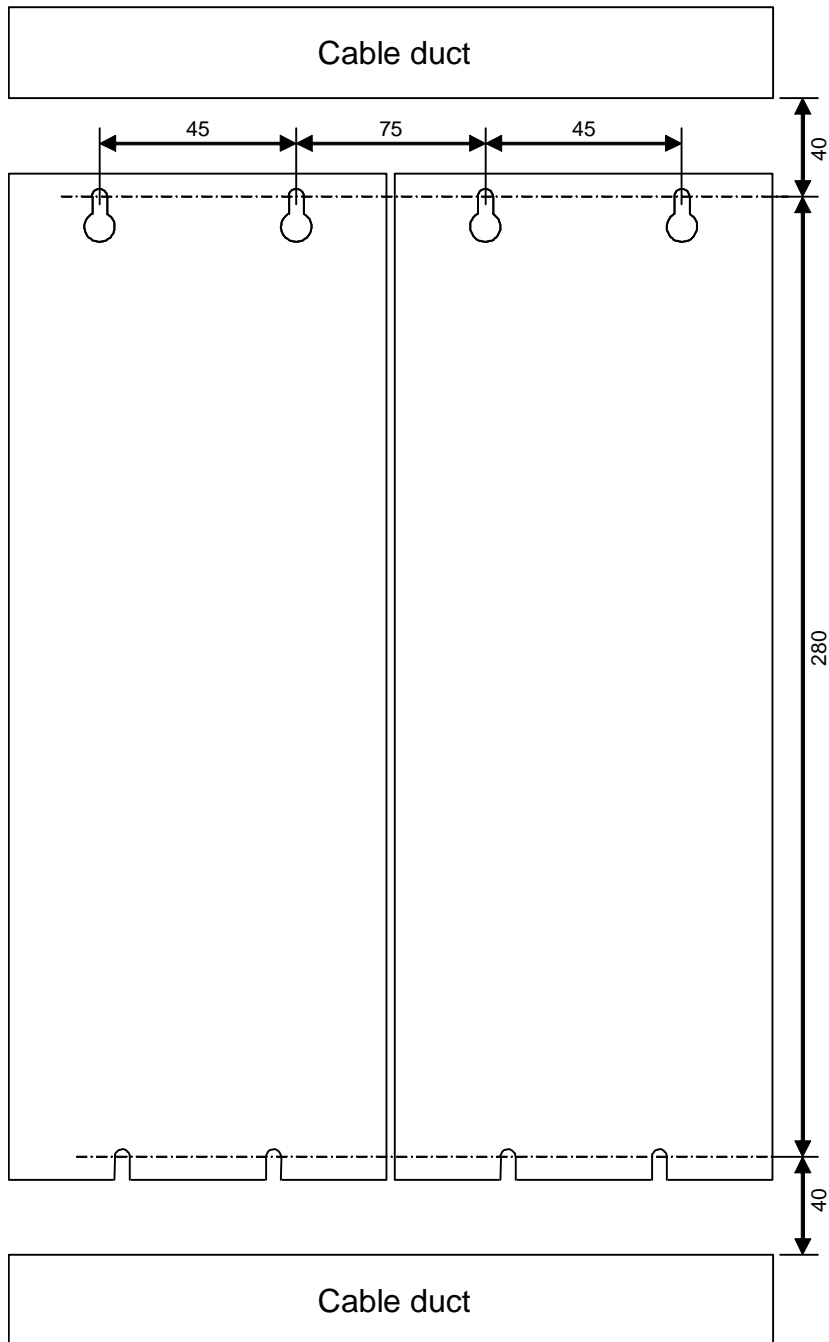


The mechanical dimensions of the servo drives are shown in the figure above.

Cable mounting:

The waisted metal tongue can be used to fix the cable secure. The grounding will be done too, if the shielding has connection.

[Back to Contents](#)



The cable ducts below and above the servo drive must have the distance as shown. This is necessary to get enough air through the heat sink.

- Material: 4 hexagon socket screws to DIN 912, M5
- Tool required: 4 mm Allen key

[Back to Contents](#)

2.2.3 Connector properties

All connections of the servo drive (except the ground bolt) are wrap connectors. This makes it easier to install the cables and to replace a drive. Never the less it also opens the possibility to create cable sets for high volume machines.

The mechanical properties of the interface connectors are:

Connector	Type	Wire size	Max. screw torque
X1A	Phoenix MSTB 2,5 HC/3-ST	1 – 2.5 mm ² (14 – 16 AWG)	0.3 Nm (2.25 inch lb)
X1B	Phoenix PC4/8	1 – 4 mm ² (12 – 16 AWG)	1.3 Nm (12 inch lb)
X3, X4, X5	Phoenix GMVSTBR 2.5-6-STF-7.62	1 – 2.5 mm ² (12 – 16 AWG)	0.3 Nm (2.25 inch lb)
X6, X7, X8	D-Sub 25 with metal housing	0.25 – 0.5 mm ² (20-22 AWG)	Soldered or crimped
Ground bolt	M5	10 mm ² (8 AWG)	3.5 Nm (31 inch lb)

2.2.4 Wire sizing

According to EN 60204 (for AWG: table 310-16 of the NEC 60°C or 75°C column), we recommend:

Signal		Cable rating
AC mains input	Maximum 4 mm ² (12 AWG)	600V, 105°C (221°F)
DC-link	Maximum 4 mm ² (12 AWG)	1000V, 105°C (221°F)
Regen resistor	2.5 mm ² (12 AWG)	1000V, 105°C (221°F)
Motor cable	Maximum 2.5 mm ² (12 AWG), shielded, max.25m, capacitance <150pF/m	600V, 105°C (221°F)
Holding brake	Min. 0.75 mm ² (18 AWG), part of the motor cable, shielded separately, check voltage drop	600V, 105°C (221°F)
Resolver with thermal contact	4x2x0.25 mm ² (22 AWG), twisted pairs, shielded, max.25m, capacitance <120pF/m	
EnDAT [®] encoder	7x2x0.25 mm ² (22 AWG) twisted pairs, shielded, max.25m, capacitance <120pF/m	
+24V and +24V-BR input	Maximum 2.5 mm ² (14 AWG), check voltage drop	

2.2.5 External fusing

The AC-mains and 24V – fuses are calculated for all consumers belonging to their electric circuit.

Signal	Fuses, time delay
AC mains input (L1-L3)	Size the fuses to the average power of the servo drives, connected to the circuit. Maximum rating is 20A corresponding to cable diameter of 4 mm ² (12 AWG) (FRS-25)
24VDC input (24V, 24V-BR to BGND)	Limited to 16A time delay at 2.5 mm ² / 14 AWG for the electric circuit
External regen resistor	10A time delay

[Back to Contents](#)

2.2.6 Serial cable connection

Further information (à UNI interface manual)

2.2.7 Possibilities of mains supply



Note: The mains supply of the **TG Power** demands a fixed connection. If the servo drive is mounted in a moveable part of a machine with connector plug, the ground connection has to have a minimum wire size of greater than 10 mm² (8 AWG) because of the high leakage current of the servo drives (> 3.5mA).



If a leakage current sensor is used in the mains supply of the servo drives, a leakage current sensor RCD type B has to be used in any case.

If a RCD type A or AC is used, there is a risk, that the DC ground current of the servo drive inhibits the leakage current sensor.

Grounded mains

The servo drive can be connected directly to mains with grounded star point or grounded phase conductor in the defined voltage range without galvanic isolation.

High voltage mains

If the mains voltage exceeds the maximum allowed input voltage of the servo drive; a transformer has to be used to bring it into the specified range.

[Back to Contents](#)

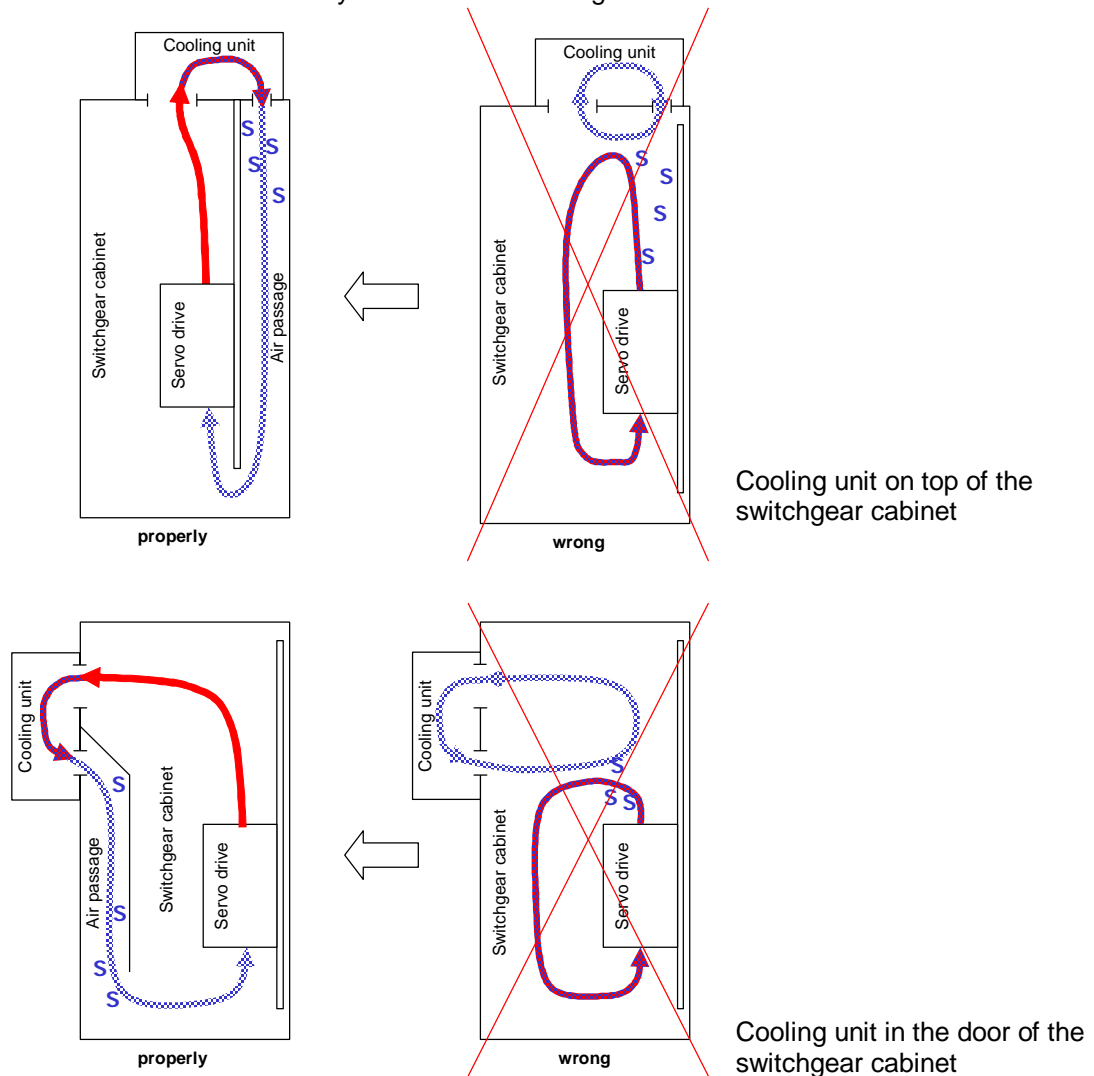
2.2.8 Usage of cooling units

The servo drive works up to 45°C(113°F) (55°C (131°F) with power reduction) ambient temperature. This means, that there could be a need to use a cooling unit.



Note: By principle, the usage of a cooling unit can and will produce condensation water. So it is important to notice following:

- Mount cooling units in a way that condensation water does not drop in electronic devices in the switchgear cabinet.
- Mount cooling units that amassed condensation water can not be sprayed into electronic devices by the fan of the cooling unit.



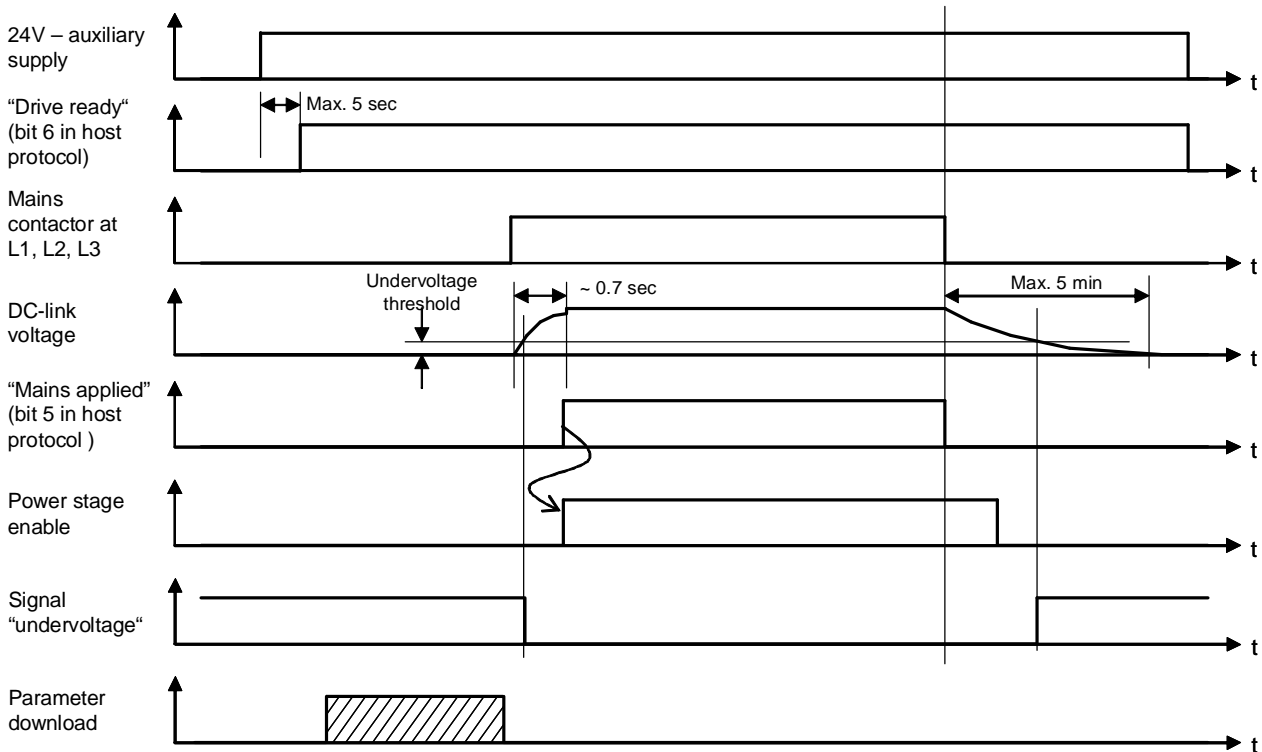
Avoid dewing also by following rules:

- Set the set point of the temperature control of the cooling unit minimal below the factory building temperature.
- Use only properly sealed switchgear cabinets to avoid dewing by external moistly air.
- Especially at installation or service, when the machine is running with open switchgear cabinet doors, make sure, that the temperature of the electronic devices is not colder than the air in the switchgear cabinet. This will generate dewing in the electronic devices.

[Back to Contents](#)

2.2.9 Switch-on / off handling

The switch-on / off behaviour of the servo drive is shown below.



About 5 seconds after switch-on of the 24V auxiliary supply (boot time of the microcontroller), the drive ready signal, is set to high (bit 6 in Receive Control Byte of the host communication protocol, see Functionality Manual).

The host controller logic has to be programmed, that the mains contactor only can be switched on, if this bit is high and has to be switched off, if the bit is low.

Downloaded parameters have to be stored in the host controller. The servo drive does not have a non-volatile data memory. Advantage is that a replacement drive gets automatically the right application data. Exception is the use of the interface boards UNI, CAN and EtherCAT. In this case the parameters are automatically loaded at start-up

When the mains contactor is switched on, the inrush circuit charges the DC-link capacitors, for about 0.7 seconds.

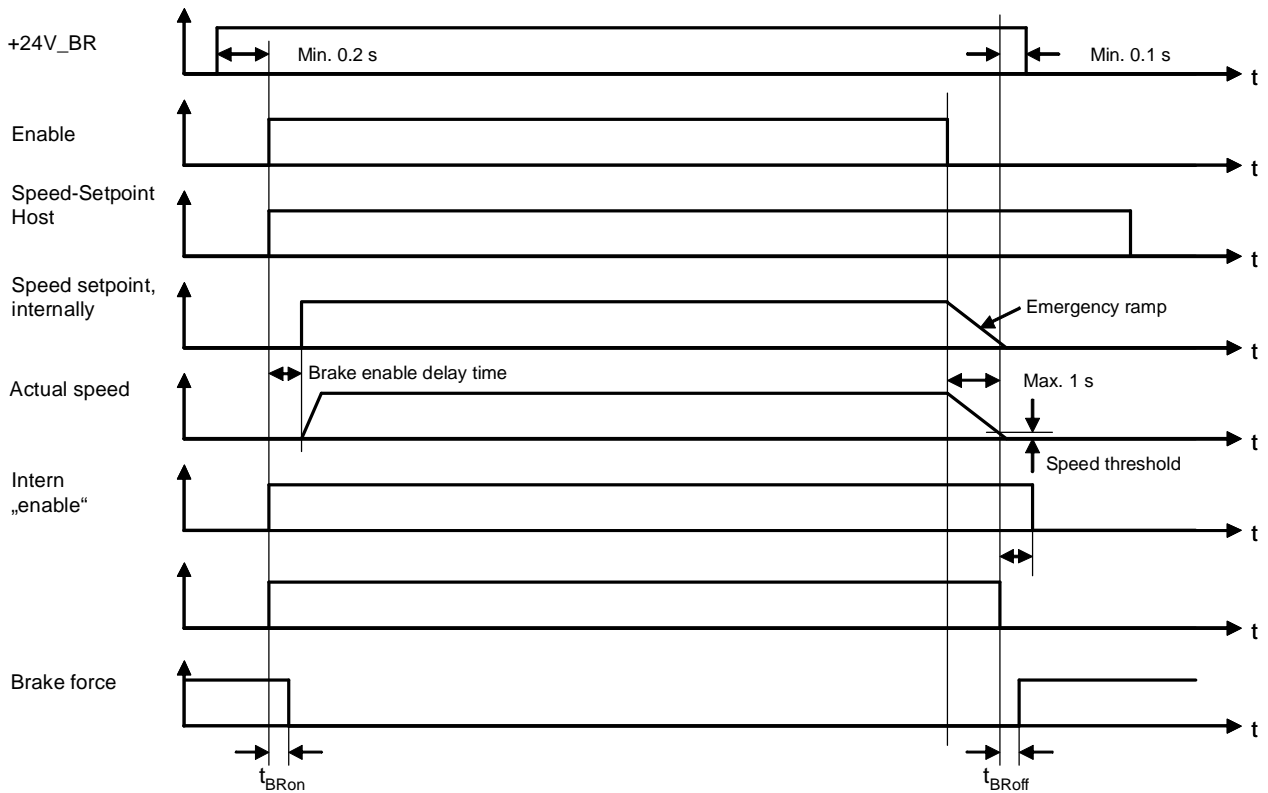
After that, the “mains applied” bit 5 in receive control byte of the host communication is set to high. Now the servo drive can be enabled.

If the mains contactor is switched off, the DC-link voltage is still available and can be controlled used to stop the motor. When the motor is decelerating, energy is fed back to the DC-link.

When the motor has stopped, the enable signal can be switched off. After maximum 5 minutes, the DC-link capacitor is discharged.

[Back to Contents](#)

2.2.10 Holding brake control



A standard holding brake with 24VDC input voltage and maximum 2A can directly be executed by the servo drive.



The circuit has a high level of functional safety, but is **not personnel safe**.

The figure above shows the processing of the holding brake. The processing in detail is described in the Functionality Manual.

A personnel safe operation of the holding brake is described in the corresponding interface manual.

[Back to Contents](#)

2.3 Host interface and setup of the servo drive

2.3.1 UNI Interface Board Manual

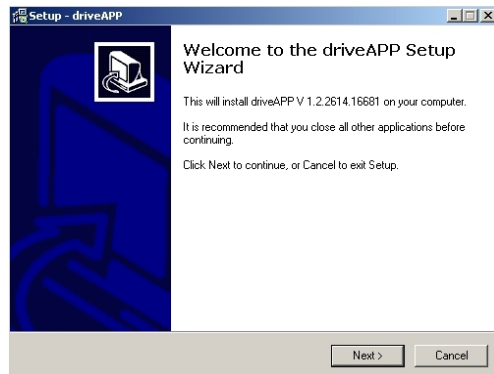
Further information → UNI Interface Board Manual

2.3.2 Application

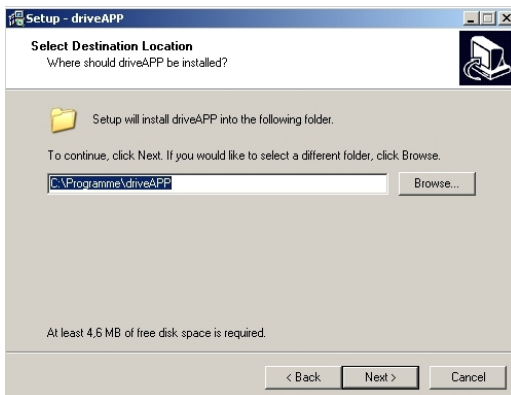
For commissioning and parameterisation the **TG Power** application can be used. Further information → online help of the application.



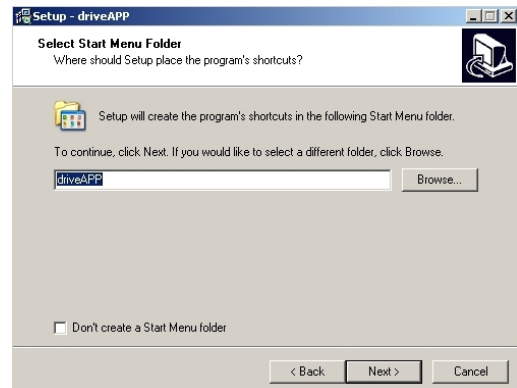
The start menu of the set-up Wizards. Select the language, desired here for the installation.



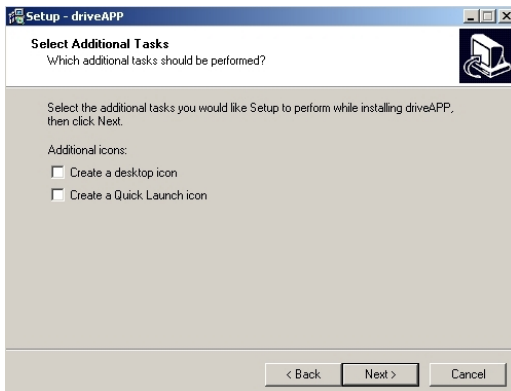
A start screen is shown.



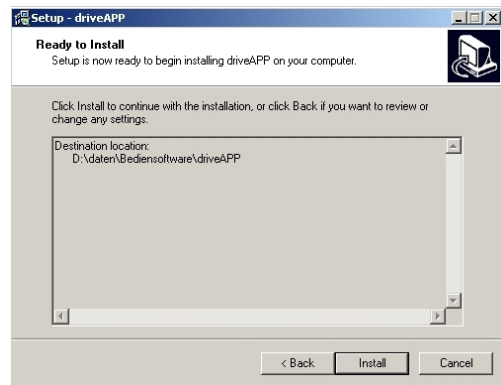
Normally the program is installed in the path c:\programme\driveAPP. With "Browse", another place can be selected. A storage space of approx. 5 MB on your hard disk drive is required.



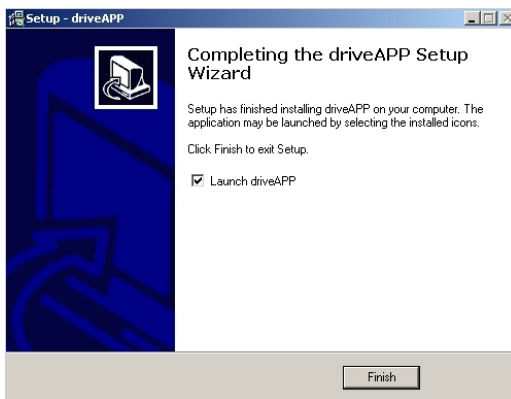
If requested, no folder is put on in the start menu.



If demanded, a program icon on the desktop can be put on. Furthermore, a quick launch icon can be created.



Now the installation will be started.



The installation was finished successfully. With the next step, the application can be started.

[Back to Contents](#)

3 Interfaces

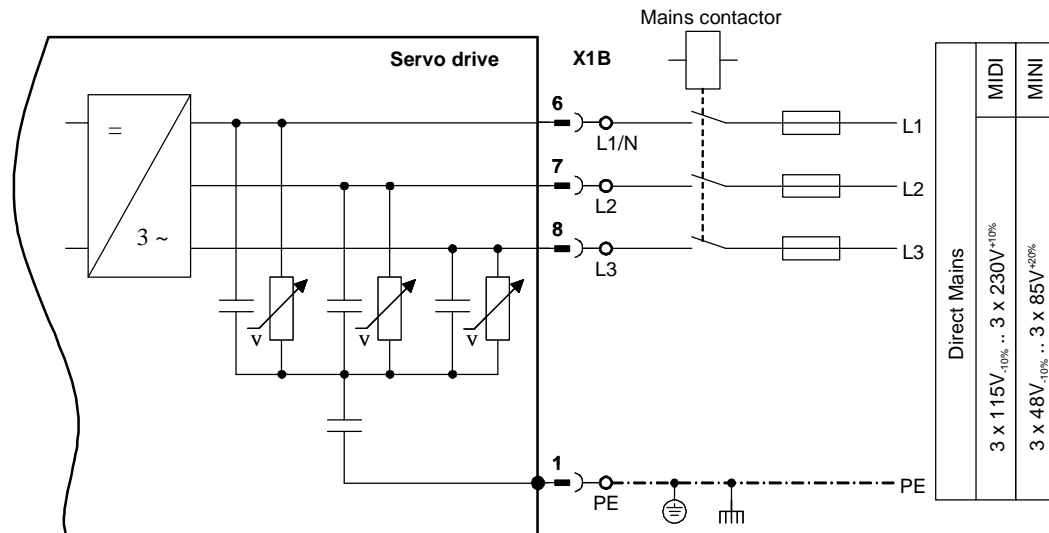
3.1 Mains input (X1B)

The mains input is prepared for direct mains 230VAC to 480VAC input voltage. If the neutral point of the connected mains is not grounded, an over voltage protection unit has to be installed in the input of the switchgear cabinet (à [page 23](#)).

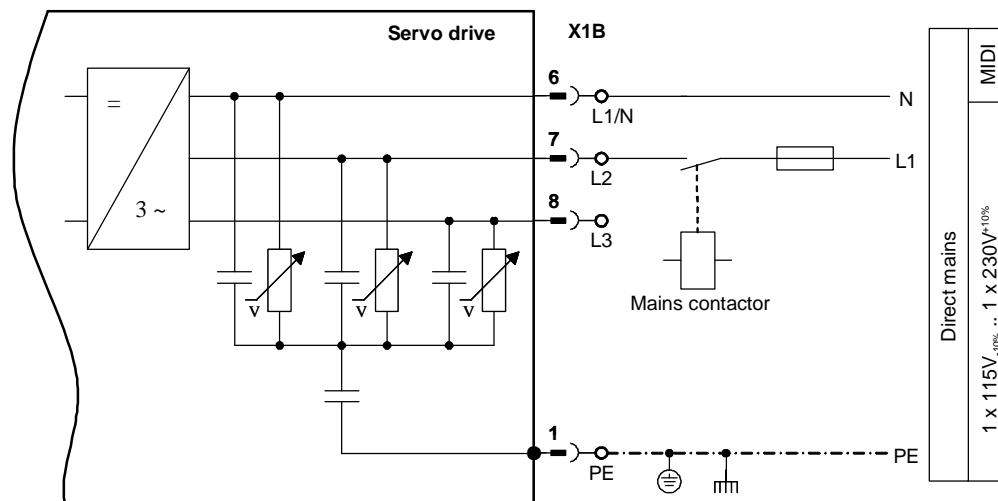


Note: If the main input is linked together, also the DC-link has to be linked together, to enable power sharing between the servo drives of the group.

3-phase connection:



1-phase connection:



[Back to Contents](#)

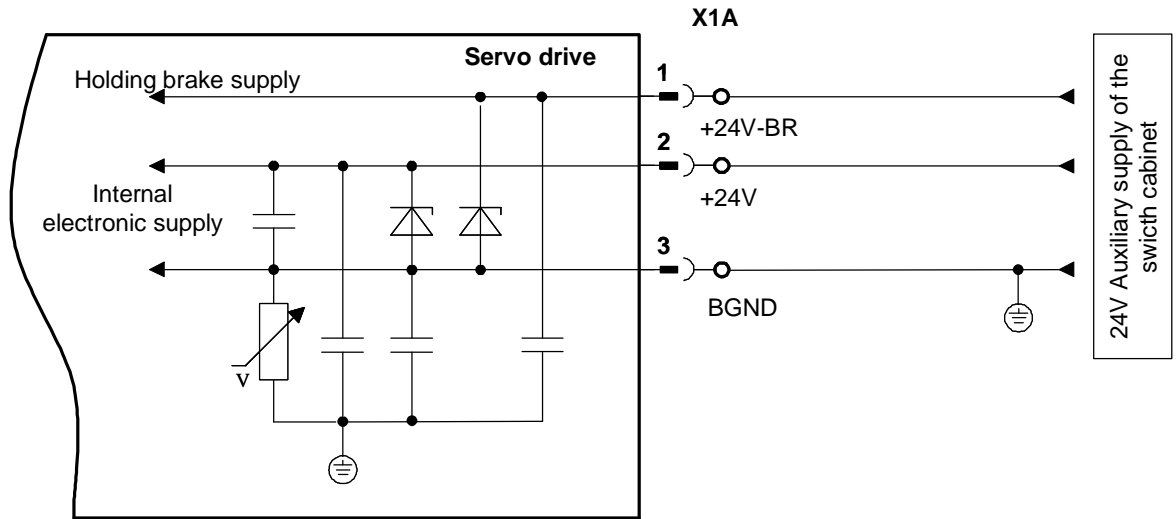
3.2 Auxiliary 24V – and Holding Brake – supply (X1A)

Use only power supply with galvanic isolated SELV output voltage!

If a 24V auxiliary power supply is installed for relays, contactors or other devices in the switchgear cabinet, this 24V can be also used to supply the servo drive (notice the current rating of the power supply).

The drive has an additional input for the holding brake supply to be able to switch off this supply independently from the auxiliary supply of the drive.

Note, that the return of the 24V power supply has to be grounded next to the power supply.



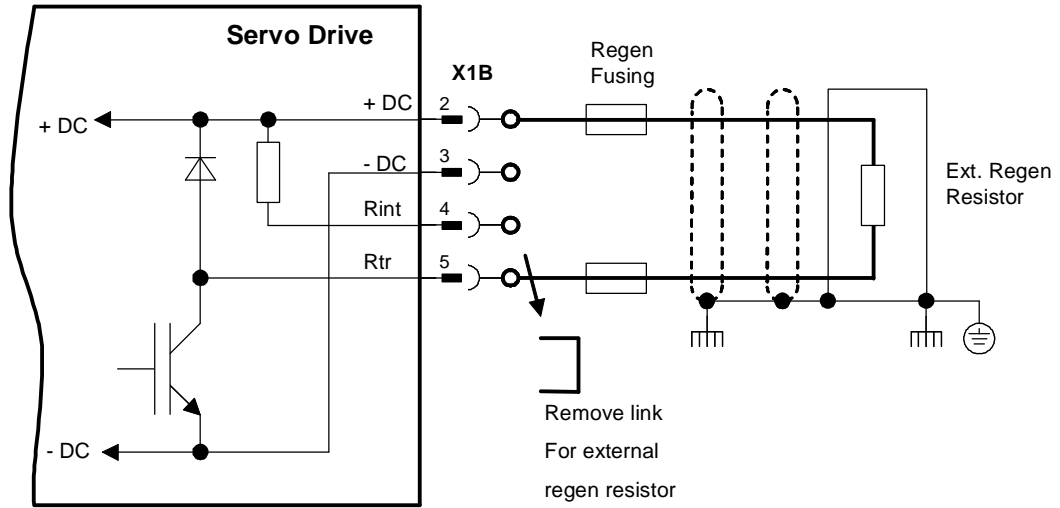
[Back to Contents](#)

3.3 External regen Interface (X1B)

If the wattage of the internal regen resistor is not sufficient, an external can be connected. Therefore remove the link between Rint (terminal 4 of X1B) and Rtr (terminal 5 of X1B) and connect the external resistor to connector 2 and 5 of X1B. Fusing of the two lines of the external regen resistor is **mandatory**. Use high voltage fuses with a time delay characteristic.



Note: The external regen resistor is electronically protected by the drive. The fuses protect the cabling under short circuit conditions.

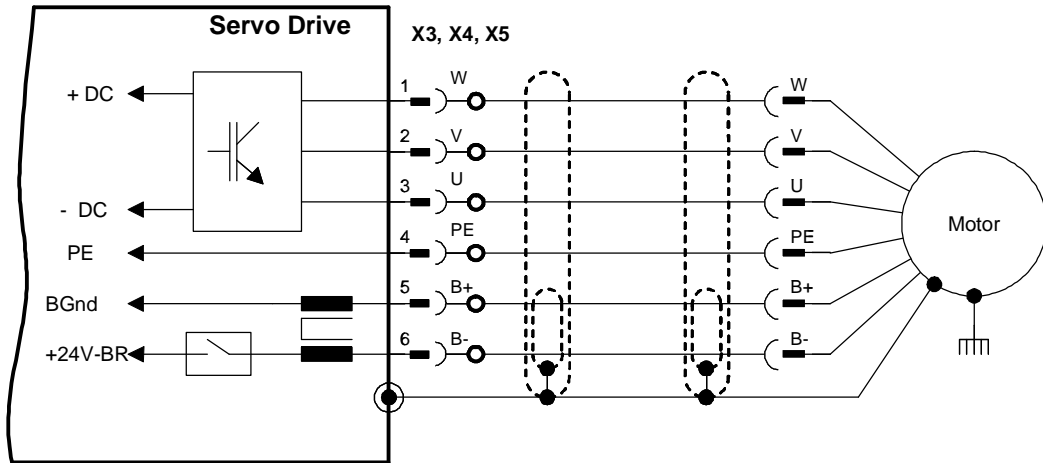


[Back to Contents](#)

3.4 Motor connector (X3, X4, X5)

3.4.1 Standard configuration

The motor cable length is limited to 25m. If a longer motor cable is required an additional motor choke in the servo drive output has to be used.



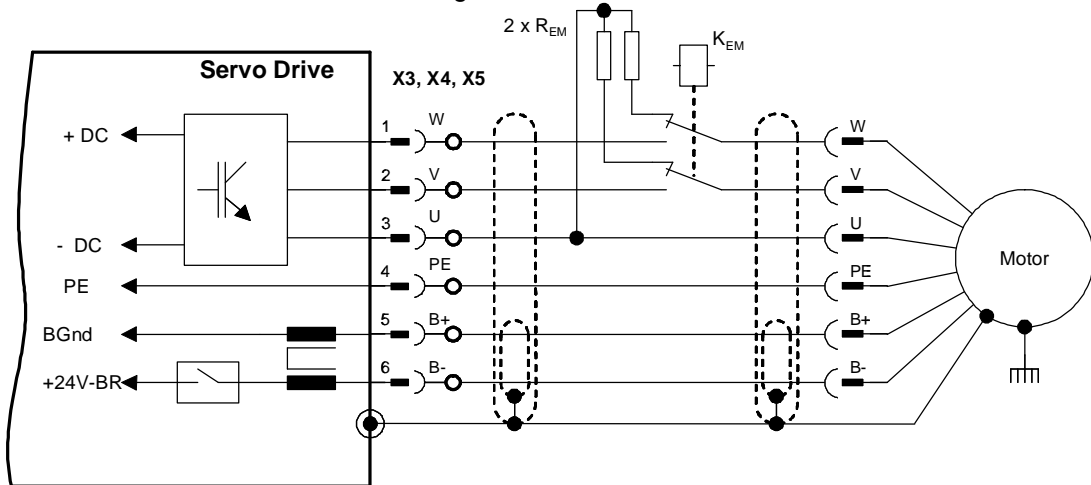
[Back to Contents](#)

3.4.2 Classic emergency stop function (stop category 0)

The motor cable length is limited to 25m. If a longer motor cable is required an additional motor choke in the servo drive output has to be used.



Note: The contactor K_{EM} has to be switched on, before the servo drive is enabled and to be switched off minimal 1ms after disabling.



The resistance and wattage of the resistors R_{EM} are calculated by following formulas:

$$R_{EM} [\Omega] = \frac{\max \text{ SPEED} \cdot K_{Erms}}{I_{\max} \cdot 0.8}$$

$$P_{EM} [W] = \frac{(I_{\max} \cdot 0.8)^2 \cdot R_{EM}}{10}$$

Max. SPEED maximum application speed [rpm]
 I_{\max} maximum allowed rms current of the motor [A]
 K_{Erms} Voltage const. of the motor [V*min]

[Back to Contents](#)

3.4.3 Personnel safe holding brake control

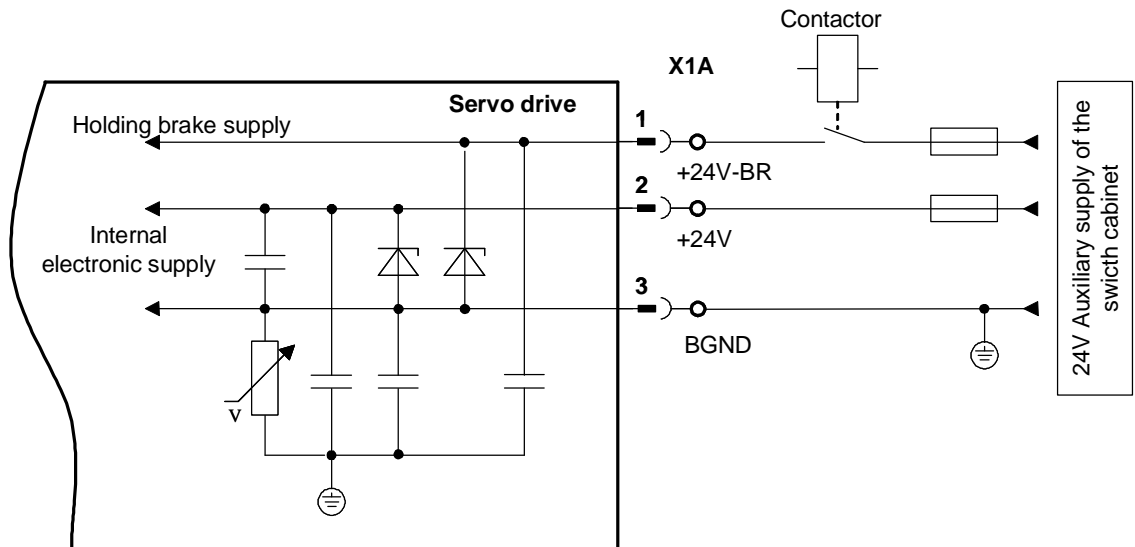
X2B is not available for the standard drive.

The servo drive has a high level of functional safety by control of the holding brake.

If it is necessary to have a **personnel safe** control of the holding brake, this requires an additional safety contact in compliance with the safety standards in the +24V-BR - line. See the corresponding Interface Manual for detailed information.



Even in case of a mechanical defect of the holding brake can cause injury and/or machine damage.



[Back to Contents](#)

3.5 Feedback (X6, X7, X8)

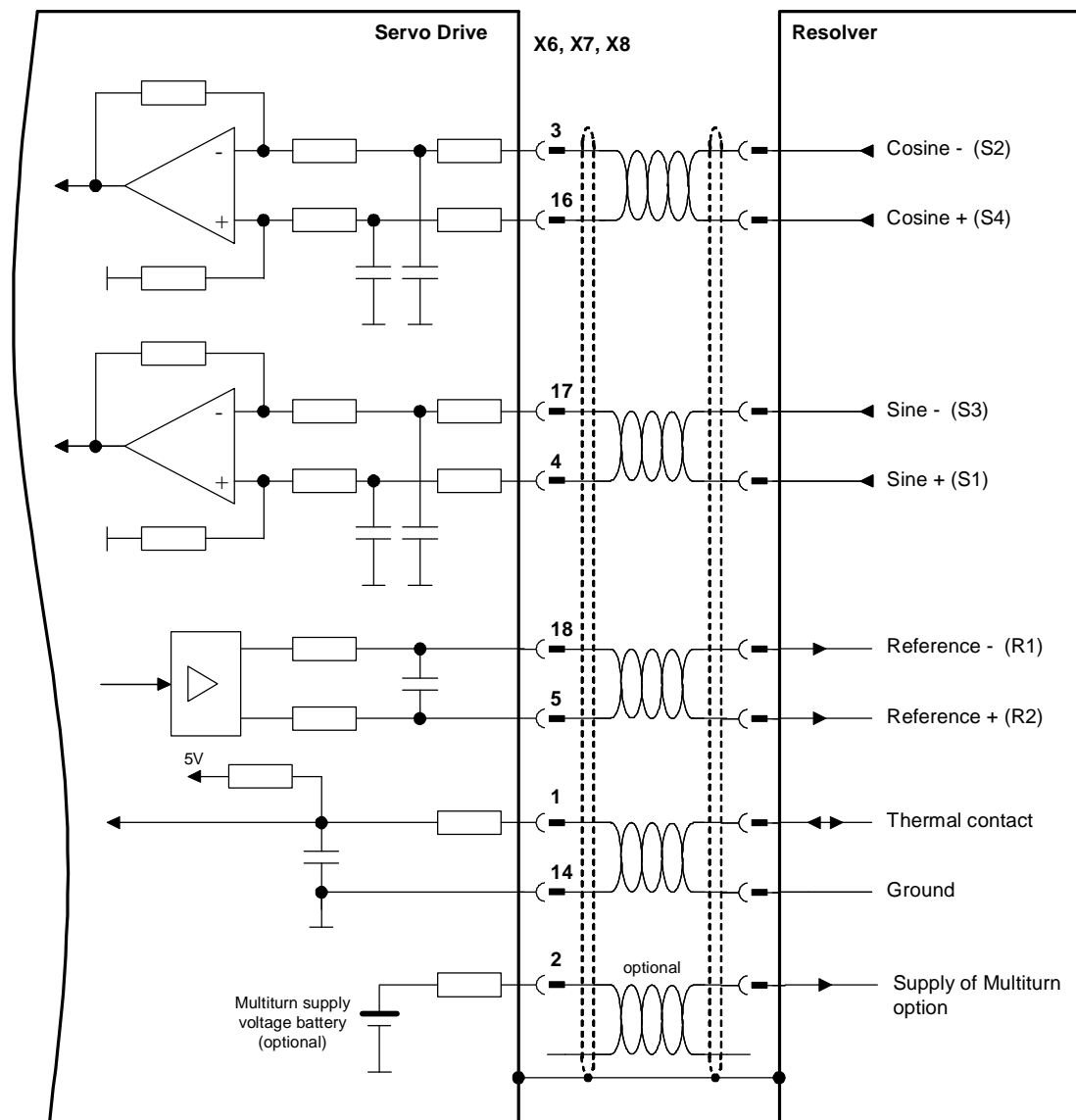
The servo drive has feedback inputs for several different feedback devices.

- Resolver Feedback with thermal contact in the motor winding
- Multiturn resolver feedback
- EnDAT[®] encoder (single and Multiturn)
- Hiperface[®] encoder (single and Multiturn)

3.5.1 Resolver feedback

The standard feedback system for servo motors is resolver feedback. The servo drive allows the evaluation of single speed (2-pole) and also multi speed resolver (up to 32-pole). The maximum cable length is limited up to 50 m.

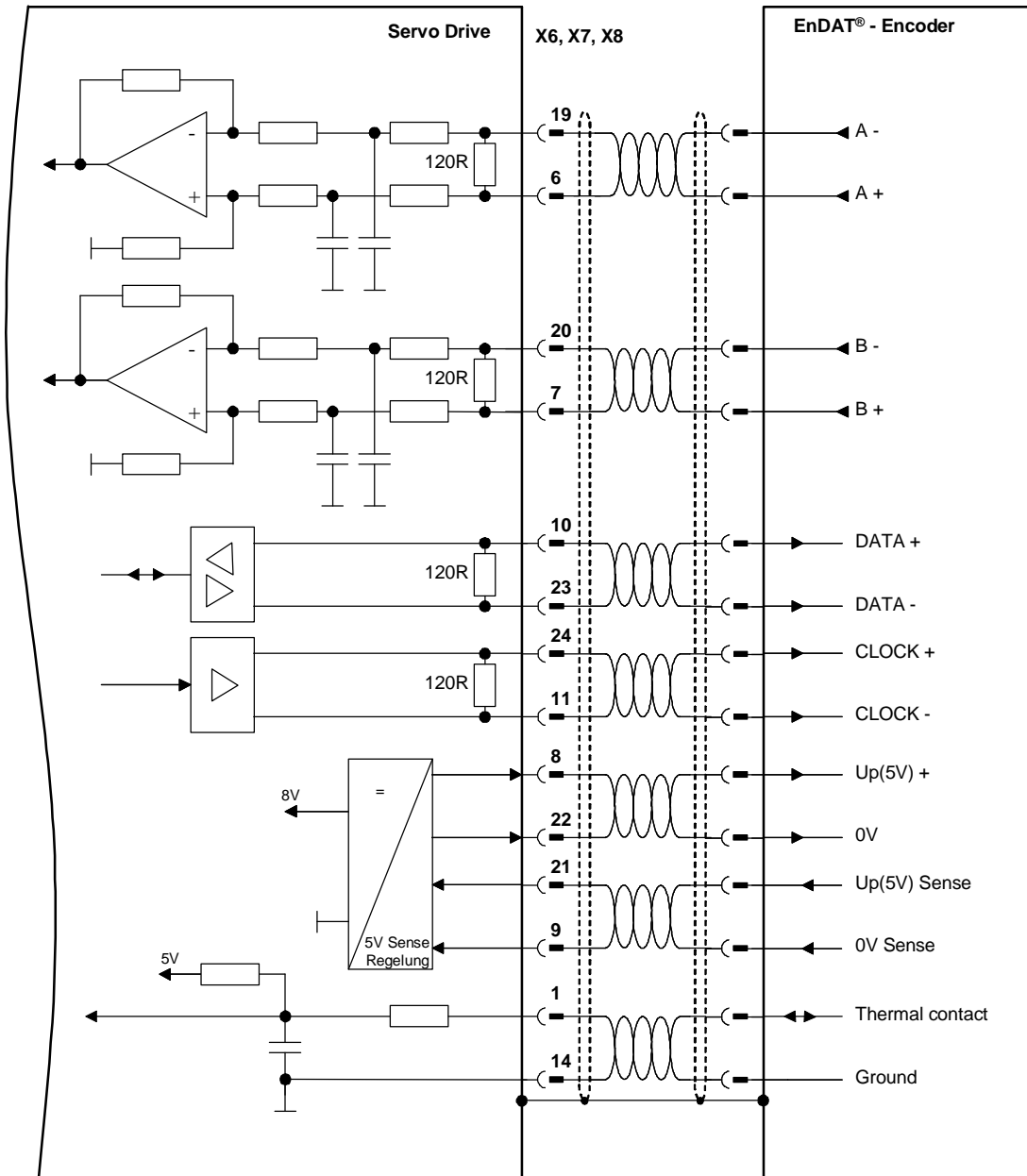
If a thermal contact is used in the motor, the signal is also connected via the resolver cable. Another possibility is connecting a motor with resolver and Multiturn add-on. In this case the same connection for the thermal contact is used to communicate with the unit. The thermal contact of the motor is then connected in the motor directly to the Multiturn add-on.



[Back to Contents](#)

3.5.2 EnDAT[®] feedback

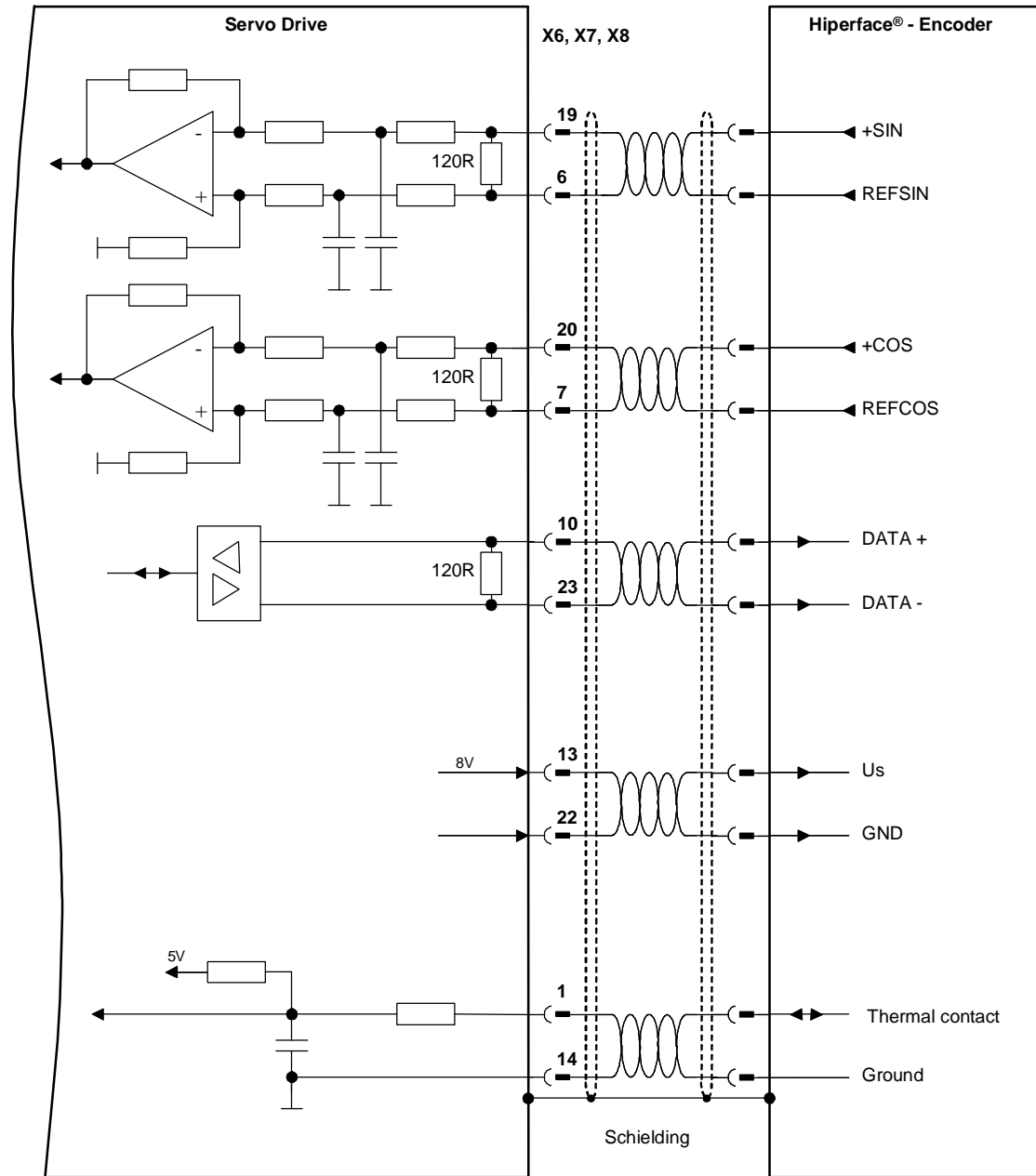
The encoder with EnDAT interface is one of the high resolution feedback systems for servo motors. The maximum cable length is limited up to 25 m.
 If a thermal contact of the motor is used, the signal is also connected via encoder cable.



[Back to Contents](#)

3.5.3 Hiperface® feedback

An encoder with Hiperface® interface is a high resolution interface for servo motors. The maximum cable length is limited to 25m. If a thermal contact is used in the motor, the signal is also connected via the encoder cable.



[Back to Contents](#)

3.6 Host Interface

See corresponding interface manual

4 Maintenance

The servo drive does not require any maintenance.



Note: The opening of the enclosure invalidates the warranty

A dirty housing can be cleaned with Isopropanol or similar cleaning agent.

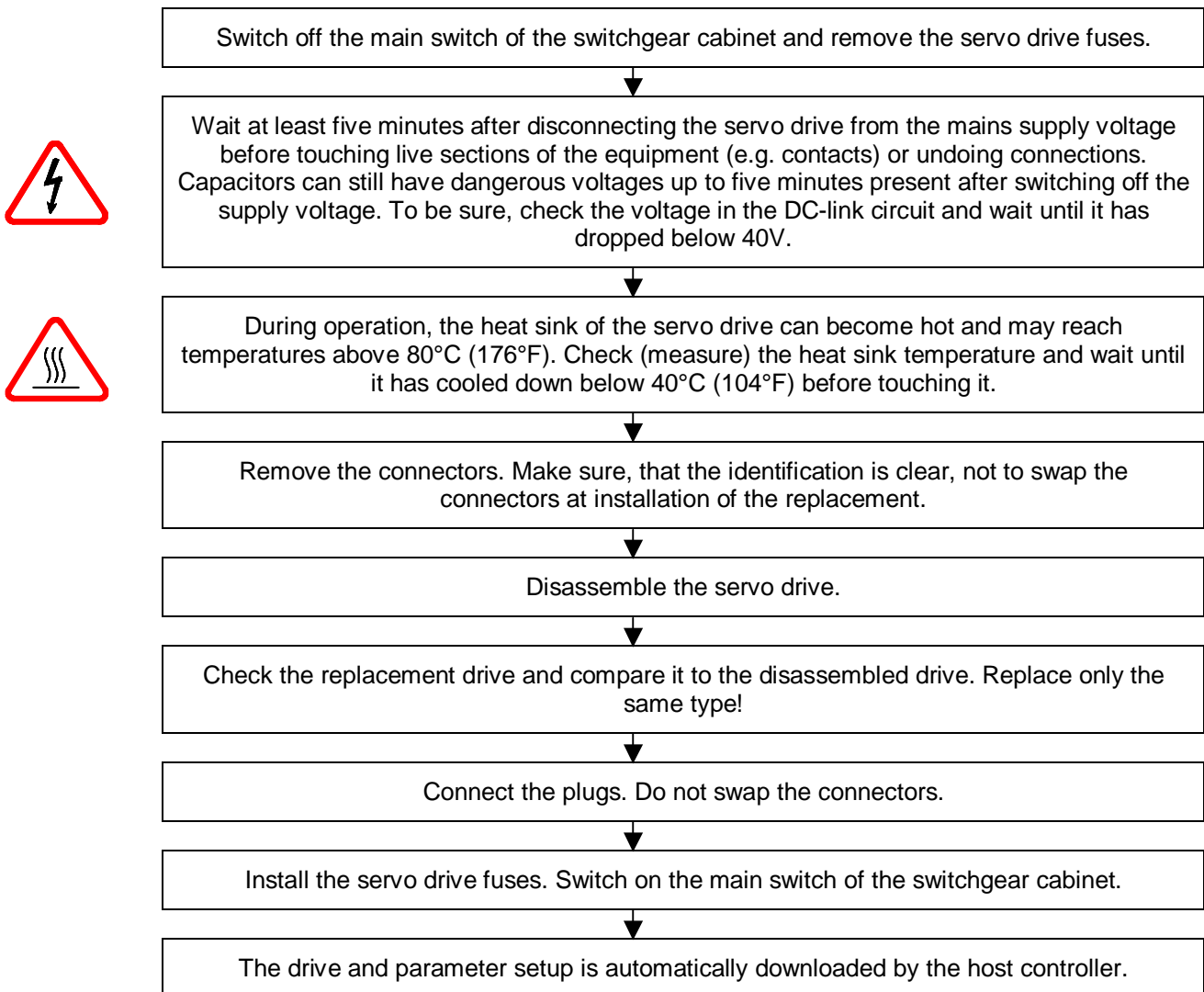
- Dirt inside the unit has to be cleaned by the manufacturer
- Dirty protective grill (fan) may be cleaned with a dry brush
- Do not immerse or spray.

[Back to Contents](#)

4.1 Replace and repair

Repair: The repair of the servo drive has to be done by the manufacturer.

Replace: If a servo drive has to be replaced, notice following checklist (no special mounting tools are required):



5 Appendix

5.1 Transport, storage and disposal

Transport:

- Use only the manufacturer's original recyclable packaging.
- Avoid shocks.
- Maximum temperature range -25 to $+70^{\circ}\text{C}$ ($-13\dots158^{\circ}\text{F}$), maximum rate of change 20K/hr .
- Maximum 95% relative humidity, no condensing.
- The servo drive contains electro statically 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 drive on a conductive surface.
- If the packaging is damaged, check the unit for visible damage. In this case, inform the shipper and the manufacturer. Do not install and operate the unit in this case!

Packaging:

- Card box, can be recycled
- Dimensions: $300\text{mm} \times 400\text{mm} \times 500\text{mm}$ (Height x depth x width)
- Labelling : nameplate outside at the box

Storage:

- Only in the manufacturer's original recyclable packaging.
- The servo amplifiers contain electro statically 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.
- Maximum stacking height 8 card boxes.
- Storage temperature range -25 to $+55^{\circ}\text{C}$ ($-13\dots131^{\circ}\text{F}$), maximum rate of change 20K/hr .
- Maximum relative humidity 95%, not condensing.
- Storage duration:
 - < **1 year**: without restrictions.
 - \geq **1 year**: capacitors must be **re-formed** before servo drive operating. To re-form, remove all electrical connections, and supply the servo amplifier for about 30 min. from 230VAC , single-phase, on terminals L1 / L2.

Disposal:

- The servo drives can be reduced to its principal components by removing the screws (aluminium heat sink, steel housing sections, electronics boards)
- Disposal should be carried out by a certified disposal company.

[Back to Contents](#)

5.2 Troubleshooting and Fault Elimination

Faults and warnings can be detected by LED and bus system (see interface manual for details). The list "Status Register" helps to eliminate errors.

5.2.1 LED Indication

The **TG Power_E_A** has two LED, which display the status of the drive.

LED		Description
green	red	
on	on	Controller in boot mode (no or damaged firmware)
1Hz flashing	off	Ready to switch on, no enable
8Hz flashing	off	Output current limited by I2T limitation (one or more axes)
on	off	Running
on	1Hz flashing	Warning condition
off	on	Fault condition

[Back to Contents](#)

5.2.2 Malfunction of the drive

Malfunction of the drive	Cause	Remedy
– <i>I-FPOS</i> shows decrementing values when the motor rotates clockwise (view of the motor shaft)	– Feedback system is not connected correctly	– Connect feedback system according to drawing (see page 34)
– Motor does not rotate – Motor current is at the limit without torque	– Motor is not connect in correct orientation	– Connect motor in correct relation to terminals U, V, W
– The motor casts without set point – The motor torque is too low or different in the both directions	– <i>M-ROFF</i> is not set to the right value – Motor and/or feedback connection is wrong	– Set <i>M-ROFF</i> to the right value – Connect motor and feedback correctly
– The motor stops in certain positions	– The setting of <i>M-POL</i> and/ or <i>M-RPOL</i> is not correct – The motor cable has a broken wire – Not all wires of the motor cable are connected	– Set <i>M-POL</i> and <i>M-RPOL</i> according to the to the data of the motor – Replace motor cable (especially with drag chains) – Connect all wires of the motor cable
– The motor oscillates	– Control gain too high – Shielding of the feedback cable has a break	– Reduce <i>V-KP</i> and/or <i>P-KV</i> – Replace feedback cable (especially with drag chains)

[Back to Contents](#)

5.2.3 Status Register

The **TG Power** has a status register, read by **I-STATUS**. It is a 32-Bit variable that contains all error and status information. The internal behaviour of the drive to the different bits can be set by **G-MASKE1**, **G-MASKE2** and **G-MASKW**.

According to the setting of the different masks, the drive detects an error, warning or does not react at all. The different bits have default values and also limitations on attribution to the masks.

For detailed information, see additional documentation "OBJECT.CHM".

Bit	Fault	Cause	Remedy
0	One mains phase	– No 3-phase supply from the mains.	– Check fuses in the mains – Check electrical supply
1	Mains fault	– The drive is enabled without applied mains.	– Check fuses in the mains – Check electrical supply – Drive is enabled, before DC – link charged and vice versa
2	Not used		
3	DC over voltage	– Internal/external regen resistor not connected – Internal regen resistor damaged	– Connect regen resistor – Replace drive
4	DC under voltage	– Mains supply voltage too low when drive is enabled	– Disable drive before the DC-link voltage crosses the under voltage threshold set by G-VBUSM
5	Not used		
6	Holding brake fault	– No holding brake connected with M-BRAKE = 1 – Short circuit at the holding brake output	– Connect motor with holding brake – Check wiring of the holding brake – Set M-BRAKE = 0 if no brake is with the motor used. – Check wiring of the holding brake – Check holding brake
7	Brake switch fault	– No holding brake connected with M-BRAKE = 1 – Internal brake supply switch is defect	– Connect motor with holding brake – Set M-BRAKE = 0 if no brake is at the motor – Replace drive
8	Not used		
9	Motor temperature	– Motor thermostat has switched off – Feedback cable or connectors broken	– Check why the motor became so hot (undersized, bad environmental conditions) – Check feedback cable and connectors, replace if necessary
10	Ambient temperature	– Internal temperature too high	– Improve ventilation in the cabinet and check mounting position according to this manual

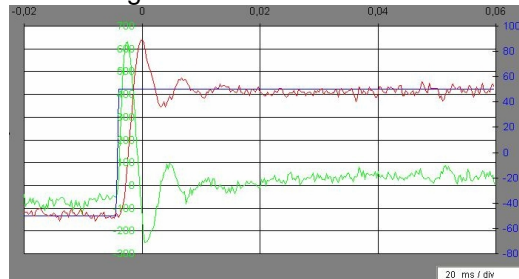
11	Heat sink temperature	<ul style="list-style-type: none"> – Heat sink temperature too high 	<ul style="list-style-type: none"> – Improve ventilation in the cabinet, check mounting position according to this manual or use a cooling unit 	
12	Feedback fault	<ul style="list-style-type: none"> – Feedback cable broken – Feedback device defect – Feedback connector not properly plugged 	<ul style="list-style-type: none"> – Replace feedback cable – Replace feedback device – Stuck feedback connector properly 	
13	Commutation fault	<ul style="list-style-type: none"> – Wrong motor phasing – Wrong wiring of motor or feedback cable 	<ul style="list-style-type: none"> – Check M-ROFF – Check wiring 	
14	Motor over speed	<ul style="list-style-type: none"> – Wrong phasing of the motor – Wrong wiring of motor or feedback cable – High speed overshoot (more than $1.2 * V-NMAX$) 	<ul style="list-style-type: none"> – Check M-ROFF – Check wiring – Optimise control loops 	
15	Following error	<ul style="list-style-type: none"> – Following error window P-PEMAX too small 	<ul style="list-style-type: none"> – Increase P-PEMAX and/or optimise control loops 	
16	Trajectory error	<ul style="list-style-type: none"> – Position change results in speed set point of > 10000 rpm 	<ul style="list-style-type: none"> – Check setting of P-PSCALE and P-SSCALE and position set point generation of the controller 	
17	Host communication	<ul style="list-style-type: none"> – Two set point or actual value telegrams in series were wrong or not sent – Internal communication error in combination with the used option board 	<ul style="list-style-type: none"> – Synchronisation is not locked. Check A-CTIME and accuracy of the cycle time of the controller – A-STIME is not set right – Communication is disturbed – See also I-DERROR 	
18	Drive Error E2 (E2 I-DERROR)	<ul style="list-style-type: none"> – Different internal faults 	<ul style="list-style-type: none"> – See also I-DERROR – Contact manufacturer 	
19	Drive Error E1 (E1 I-DERROR)	Different internal faults	<ul style="list-style-type: none"> – See also I-DERROR – Contact manufacturer 	
		Power stage fault:	<ul style="list-style-type: none"> – Motor cable has (ground) short circuit – Motor has (ground) short circuit – Power stage is damaged 	<ul style="list-style-type: none"> – Replace motor cable – Replace motor – Replace drive
		Regen fault:	<ul style="list-style-type: none"> – Regen resistor cable has (ground) short circuit – Regen resistor has (ground) short circuit – Regen power stage is damaged 	<ul style="list-style-type: none"> – Replace regen resistor cable – Replace resistor – Replace drive
20	Enable locked fault	<ul style="list-style-type: none"> – Drive is software enabled when one of the safety inputs is low 	<ul style="list-style-type: none"> – Enable drive only if ENABLE, LOCK and EN-BRAKE are high 	
21	Driver voltage fault	<ul style="list-style-type: none"> – The supply voltage of the power stage drivers is switched off, when the drive is enabled 	<ul style="list-style-type: none"> – Don't switch the supply voltage of the power stage drivers off, when the power stage is enabled 	

22	DC over voltage and regen limitation	– Regen power is insufficient. Regen power limit was reached and the regen resistor was switched off.	– Use an external regen resistor with higher power rating and change G-MBAL
23	Brake supply fault	– Holding brake supply 24V-BR is not supplied or EN-BRAKE is low when software enable is set (M-BRAKE = 1)	– When the motor has a holding brake, enable the drive only when EN-BRAKE is high and the holding brake input 24V-BR is supplied
24	Brake enable fault	– When software enable is set with M-BRAKE = 1 and G-MODE >0 and EN-BRAKE is low	– Enable drive with holding brake when EN-BRAKE is high
25	I2t fault	– When I-I2T exceeds the warning level A-I2TERR	– Increase the level A-I2TERR
26	Motor temperature warning	– When motor temperature I-TEMPM exceeds the warning level A-TEMPMW	– Increase the warning level A-TEMPMW
27	reserved		
28	reserved		
29	reserved		
30	reserved		
31	reserved		

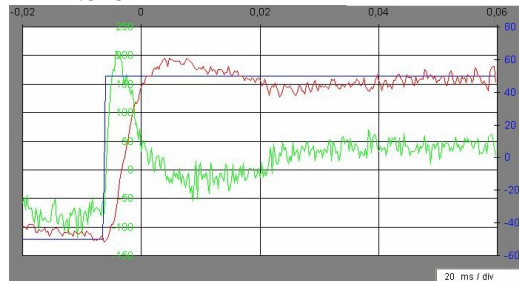
5.3 Commissioning (Quick Guide)

- Connect drive (ref. chapter [1.11](#), [3.1](#) and [3.2](#))
- Connect motor (ref. chapter [3.4](#))
- Connect feedback (ref. chapter [3.5](#))
- Provide shielding
- Observe installation guide (ref. chapter [2.1](#))
- Install software application (ref. chapter [2.3.2](#))
- After switch on of the drive, establish connection between drive and software
 - o Parameterization of the axis
 - § Load motor parameter with software
 - § Where necessary, enter motor parameter manually
 - o Adjust feedback (ref. chapter [5.3.1](#) , [5.3.2](#))
- Enter „50” as value for K-SPEED.
- Enter „1000” as value for K-STEP (This corresponds approx. to one motor revolution).
- Increase the value of V-KP, until a swing noise can be heard.
- Decrease V-KP until a level when the noise disappears.
- Reduce the new value of V-KP for additional 25%.
- Examine the behavior of the machine, by scope after step-forced response:

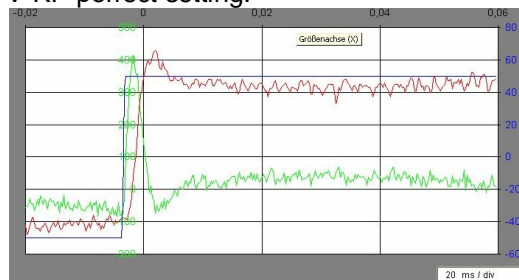
- o V-KP to high.



- o V-KP to low



- o V-KP perfect setting.



- Examine machine behavior.
 - o Low stiffness
 - § Increase V-T, reduce V-T2, increase F-BW , increase V-KP
 - o Oscillation with high frequency
 - § Increase V-T2, reduce F-BW, reduce V-KP
 - o Oscillation with low frequency
 - § Increase V-T2, reduce V-KP

[back to contents](#)

5.3.1 Resolver- adjustment

The following guide will help for commissioning, to adjust a resolver feedback. To adjust, suitable operation software is mandatory. The software installation is described in [chapter 2.3.2](#). As additional help, you can read the file „help.chm“, and contact the application department.

1. Connect motor- and feedback-cable to the drive. Don't flange the motor to the machine (can go through)!
2. Resolver rotational direction control:
 - a. If rotor is turned in positive direction (view from the front of the motor shaft), **I-NFILT** has to be positive. (**I-NFILT** can be easily checked by "actual value" of the application.)
 - b. Alternatively offer: set **K-CINC** „10“, set **K-CI** to 30% of I_0 . Set „**G-MODE** -4“. Enable motor → the motor should turn now for rotational direction control.
 - c. Disable motor (**K-EN** = "0")
3. Enter the correct value for the resolver pole number by parameter **M-RPOL**.
4. Set **M-POL** „0“.
5. In case **M-ROFF** has been change, enter „0“ as default value.
6. Change to "service current mode", (**G-MODE** = -1).
7. Change value of **K-CI** to 30% of I_0 , if not already done.
8. Enable motor (**K-EN** = "1"). Attention, motor may turn spontaneously to a new fixed position!
9. Read **I-FPOS**, by terminal mode.
10. Disable motor (**K-EN** = "0")
11. Calculate **M-ROFF**:
$$Winkel = 90^\circ - \left([I - FPOS] * \frac{360^\circ}{2^{32}} \right) * \frac{[M - POL]}{2} \pm x * 360^\circ$$

Subtract or add 360° from your value as often as necessary, until you have a value between 0° and 360°. This is the correct value for **M-ROFF**.
12. Enter the calculated value for **M-ROFF**.
13. Reenter the correct value for **M-POL**.
14. Change back the **G-MODE** for your needs. Enable the motor (**K-EN** = "1"), Motor has to turn now. If not, the motor phase sequence has to be checked. In this case, change two of the motor phases against each other and start with your adjustment at point 4 again.

[Back to contents](#)

5.3.2 Hiperface- and EnDAT- adjustment

The following guide will help for commissioning, to adjust a Hiperface or EnDAT encoder. To adjust, suitable operation software is mandatory. The software installation is described in chapter [2.3.2](#). As additional help, you can read the file "help.chm", and contact the application department.

1. Connect motor- and feedback cable to the drive. Don't flange the motor to the machine (can go through)!
2. Load motor parameter with software, save M-parameter with „**K-FBRW 2**“ inside your encoder.
3. Set **M-RPOL** „2“.
4. Delete possible error messages by „**K-CLR 1**“.
5. Encoder rotational direction control:
 - a. If rotor is turned in positive direction (view from front of the motor shaft), **I-NFILT** has to be positive. **I-NFILT** can be easily checked by "actual value" of the application).
 - b. Alternatively offer: Set **K-CINC** „10“, set **K-CI** to 30% of I_0 . Set „**G-MODE -4**“. Enable motor → the motor should turn now for rotational direction control. If not, the motor phase sequence has to be checked. In this case two of the motor phases have to be changed, return to point 4 to restart the adjustments. In case the motor turns in the correct direction but **I-NFILT** shows negative values, the cable connection of the encoder has to be checked (ref. chapter [3.5.3](#), [3.5.2](#)) If the connecting has been checked, return to point 4 to restart your adjustments.
 - c. Disable motor (**K-EN** = "0")
6. Set **M-POL** to „0“.
7. In case **M-ROFF** has been changed, enter "0" as default value.
8. Change to "service current mode", (**G-MODE** = -1).
9. Read **I-FPOS**, by terminal mode.
10. Disable motor (**K-EN** = "0")
11. Calculate **M-ROFF**:
$$Winkel = 90^\circ - \left([I - FPOS] * \frac{360^\circ}{2^{32}} \right) * \frac{[M - POL]}{2} \pm x * 360^\circ$$

Subtract or add 360° from your value as often as necessary, until you have a value between 0° and 360°. This is the correct value for **M-ROFF**.
12. Enter the calculated value for **M-ROFF**.
13. Renter the correct value for **M-POL**.
14. Change back the **G-MODE** to your needs. Enable the motor (**K-EN** = "1"), motor has to turn now. Enter **K-FBRW** = „2“ to save your **M-ROFF** inside your encoder.

[Back to contents](#)

5.4 Index

24V-supply	5, 15, 16	Motor cable	22
Accessories.....	5	Motor connector	32
Additional documentation	2	Mounting position	16
Adjustment EnDAT	46	Nameplate.....	12
Adjustment Hiperface	46	Not-prescribed use	11
Adjustment resolver.....	45	Over voltage.....	15
Ambient temperature.....	16, 41	Packaging	39
Assembly	5	Personnel safe	33
Auto-Range-Function	14	Pin assignment.....	18
Auxiliary supply	15	Pollution level	16
AWG	5	Prescribed use	11
BGND	5, 15, 22	Protective grill.....	38
Block diagram (Overview).....	13	Protective note	2
Cable duct.....	21	Publisher	2
CANopen	5	Rating	17, 22, 30, 43
CE-Conformity.....	10	Re-form.....	39
Clean	38	Regen resistor	5, 15, 22
Components.....	9	Register Status.....	40, 41
Condensation.....	16	Repair	38
Condensation water	24	Replace.....	38, 40
Connection diagram	17, 18	Resolver.....	5, 22, 34
Control cable.....	17	Resolver pole number	45
Cooling unit.....	24	Resolver rotational direction	45
Damage	7, 8, 10, 11	Resolver-adjustment.....	45
DC-Link.....	15	RS232.....	23
Dewing.....	24	Safety instruction.....	7, 11
Dimensions	39	screw torque.....	22
Directives	10	serial cable.....	23
Disposal	39	Set-up	5, 7, 14, 27
Emergency stop	32	shielding.....	40
EMV	5	Short cuts.....	5
Encoder rotational direction.....	46	Site altitude	16
EnDAT	22, 34, 35, 46	Software installation	45, 46
European directives.....	10	Space-Vector-Modulation	14
External fusing	17	Stacking height.....	39
Fail-safe condition	11	start-up.....	11, 17
Grounding	10	Status Register.....	40, 41
Hiperface	46	Storage	16, 39
Holding brake control	26	Storage duration.....	39
Host Interface.....	13, 31, 33, 37	Storage temperature.....	39
Hot surface.....	6, 8	Switch-on / off handling	25
Humidity.....	16	Symbols.....	6
IGBT	5, 13	Technical data.....	5, 7
Interface.....	13, 31, 33, 37	Temperatures.....	8, 38
Leakage current sensor.....	7, 17, 23	Tools.....	38
LED.....	5, 40	Transport.....	5, 16, 39
Living quarters.....	8	Troubleshooting	40
Mains supply	7, 8, 14, 17, 23, 38, 41	Ventilation	16
Maintenance	38	Visible damage.....	39
Malfunction.....	40	Warranty	17, 38
Manufacturer.....	7, 10, 38, 39, 42	Wire size	22