M A N U A L

Digital three-phase servo amplifier
DPC-4xx - AC
for EC servo motors
for AC asynchronous motors
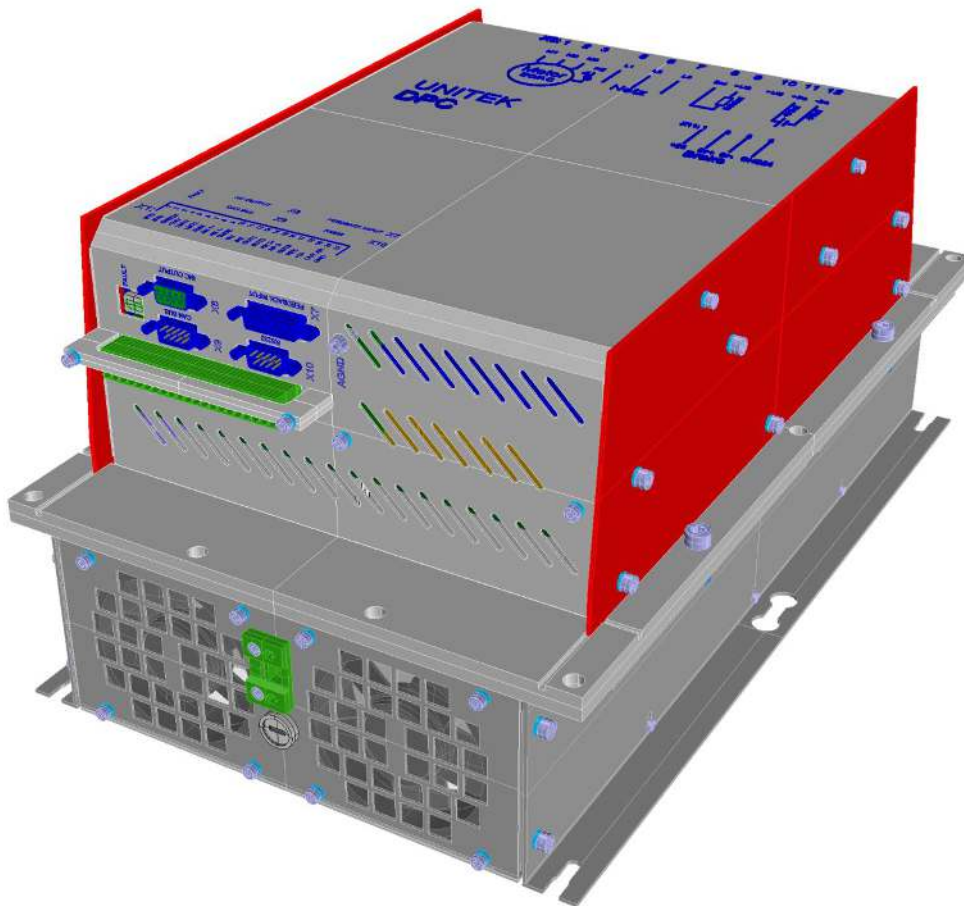
Basic information

Contents

1 Basic information

1.1 History

Version	Change	Date
07/2017 – V01	Chapter 5.5 / CAN-BUS	25.07.2017
2021 – V1	Layout adapted, complete revision, graphics	29.04.2021

1.2 More products from UNITEK

Digital servo amplifiers for lower power	>>>	UNITEK	DS205, DS403
Analogue three-phase servo amplifiers TVD3, TVD6, AS	>>>	UNITEK	Series
Analogue DC servo amplifiers TV3, TV6, TVQ6	>>>	UNITEK	Series
Thyristor converter 1Q, 4Q, Servo	>>>	UNITEK	Classic series 200W up to 800kW
DC and AC servo amplifier for battery operation A2, A3, D3			BAMO series
Analogue and digital			BAMOBIL series BAMOCAR series

1.3 Project planning instructions (MANUAL)

1. MANUAL   DPC 4xx-AC   Hardware
2. MANUAL   NDrive2   Software

Use all 2 MANUALs for project planning, installation and commissioning!

Online at Download: www.unitek.eu

The hardware MANUAL contains warnings and safety instructions, explanations of standards, mechanical and electrical installation instructions.

The MANUAL must be made accessible to all persons working with the unit.

1.4 Validity

Hardware status:	
Firmware version:	

1.5 Designations and symbols used

Device	DPC 440-x, DPC460-x
User:	Machine or plant manufacturer or operator in the industrial sector (B2B, second environment)
Manufacturer:	UNITEK Industry Electronics GmbH
Traders:	
⚠	**Danger to life!** **High voltage!**
⚠	**Warning.** **Important!**
⚠	**Dangerous electric fields**

1.6 Scope of delivery

Device DPC 4xx
Phoenix 10pin plug, Phoenix 11pin plug
Plug Phoenix 4pin, D-plug 9pin, D-plug 15pin
(for fan box plug Phoenix 2pin)

Not included in the scope of delivery:
Programming cable.

1.7   General product information

The DS/DPC xxx digital three-phase servo amplifier, together with the synchronous servo motor (EC motor) or the asynchronous servo motor (AC motor), forms a drive unit that is characterised by freedom from maintenance and high control dynamics.

The drive has the well-known good control characteristics of DC drives without the disadvantages of carbon brush life and commutation limit.

With the synchronous motor, motor heating only occurs in the stator, the rotor remains cold. The motors can be easily cooled via the surface (efficiency up to 96 %).

The physical properties correspond to those of the DC motor, i.e. the current is proportional to the torque and the voltage is proportional to the speed. The speed is controlled stably up to the current limit (max. torque). In case of overload, the speed decreases at constant current.
Rectangular speed-torque characteristic.
Current, speed and position are measured exactly. The rotating field frequency is not a controlled variable, it adjusts itself automatically. The
rotor moment of inertia is considerably smaller and the power limit is higher, resulting in acceleration values up to a factor of 5 higher.

The asynchronous servo motor is cheaper and does not require magnets in the rotor. The control characteristics are very good due to space vector control, the construction power and the efficiency are lower. Due to rotor heating, a motor fan is necessary for a large control range.

The EC and AC motors are designed with IP65 protection.

The motor voltages and motor currents are sinusoidal. Maximum motor efficiency due to compensating current control.

DPC 4xx can be used as a torque amplifier, speed amplifier or single-axis position amplifier.

The actual position and speed values are
generated from the encoder unit (resolver, incremental encoder or
SIN/COS encoder). The encoder pulses are output from the amplifier for a higher-level PLC/CNC control.

Current, speed and position control loops are easy-to-program digital P-I-D controllers. Programming via PC software NDrive.
Communication with higher-level controllers via BUS systems (standard CAN-BUS, RS232) or via analogue interface.

<u>Attention:</u>

In the case of DC, AC or EC servo amplifiers with DC link supply, the energy feedback into the DC link during braking operation must be taken into account (hoist drives, unwinders, large flywheel masses). External ballast resistor.

1.8   Application/use/design/property

Machines and systems of all kinds up to a drive power of 35 KWin
rough use especially as 4Q servo drives
- for highly dynamic acceleration and braking processes - for
large control ranges - for high
efficiency- for
small motor dimensions- for smooth,
quiet runningfor
speed control, torque control or
combined speed-torque control with or without superimposed position control.

Use in:
Pitch and azimuth drives

as well as in placement machines, testing machines, sheet metal working machines,
machine tools, plastics machines, automatic assembly machines,
knitting and sewing machines, textile machines, grinding machines, wood
and stone working machines, metal working machines, X-Y tables,
food processing machines, robots and handling systems, shelf conveyors, extruders, calenders,
and in many other machines and systems.

Structure:
Robust cabinet-mounted unit in all-steel housing in
accordance with VDE, DIN and EC directives (IP20, VGB4).
Heat sink for through-hole installation or control cabinet mountingUniform,
fully digital control electronics.
Power electronics from 40 and 60 A (S1 operation)
Power input voltage 230 V~ to 480 V~.
Diode-decoupled emergency battery input. Independent 24 V chopper power supply for the auxiliary
voltages.

Galvanic separation between
Enclosure to all electrical partsAuxiliary voltage connection
to power section and control electronicsPower section
and control electronicsControl electronics
and logic inputsBrake outputThe
clearances and creepage distances comply with EU standards.

Used:
Fully insulated IGBT power semiconductors, generously dimensioned.
Only commercially available components in industry standard
SMD assemblyLuminescent diode display
, 7-segment display

Properties:

- ✓ EMC-safe all-steel housing
- ✓ Shock and vibration resistant construction
- ✓ Heat sink for through-hole mounting or control cabinet mounting
- ✓ Direct mains connection 230 V~ to 480 V~
- ✓ Charging current limit
- ✓ Phase monitoring
- ✓ Emergency battery connection up to 400 V=
- ✓ Independent auxiliary voltage connection 24 V=
- ✓ Digital interfaces RS232, CAN-BUS (further option)
- ✓ Analogue inputs, programmable differential inputs
- ✓ Digital inputs/outputs, programmable, opto-decoupled
- ✓ Output for brake 24 V/3 A with load monitoring
- ✓ Enable and limit switch logic, emergency stop function, safety
- ✓ BTB-ready, solid state relay
- ✓ Position, speed and torque control
- ✓ Encoder systems: resolver, TTL incremental encoder, SINCOS 1Vss, rotor position
- ✓ Encoder output
- ✓ Static and dynamic current limit
- ✓ Uniform fully digital control unit
- ✓ Intrinsically safe short-circuit-proof power section (EN50178)
- ✓ DC link choke (EMC interference suppression)
- ✓ Integrated ballast circuit
- ✓ DC power bus
- ✓ Processor-independent protective shutdown in case of overvoltage, undervoltage
- ✓ Short circuit, earth fault and overtemperature of amplifier or motor

- ✓ **Option**: DC link power supply for potential-free internal 24 V auxiliary voltage

1.9 Safety regulations

Electronic devices are fundamentally not fail-safe!

Attention high voltage
> 900V AC/DC ~/=
Danger of shock! / Danger to life!
DC link discharge time >4 min.

This MANUAL must be carefully read and understood by qualified personnel before installation or commissioning. The knowledge and understanding of the appliance and in particular of the safety instructions must be available to all persons involved in the application.
In the event of any ambiguities, or if other functions are not described in the documentation or are not described in sufficient detail, the manufacturer or dealer must be contacted.
Incorrect installation can lead to the destruction of the units! Incorrect
programming can trigger dangerous movements!

Intended use:
The
devices of the DPC-4xx-AC series are electrical equipment (EB) of the power electronics for the control of the energy flow.
They are intended for controlling EC synchronous motors and AC asynchronous motors in stationary machines or systems, in industrial use.
When used in residential areas, additional EMC measures are necessary.
Deviating applications require the approval of the manufacturer.
The user must prepare a hazard analysis of his end product

Protection class IP20 for stationary control cabinet installation.

Mains connection only on earthed three-phase mains!
Protective conductor PE firmly connected!
Connect signal GND (AGND) with PE!
If the signal GND (AGND) is isolated, use an external insulation monitor!

Operation only permitted with closed or secured control cabinet!
Control and power connections can lead to voltages without the drive operating!
DC link discharge time is greater than 4 minutes!
Measure voltage before disassembly!

The user must prepare a hazard analysis for his machine, vehicle or plant.

The user must ensure:

- that after a failure of the unit-
in case of incorrect operation,
- in case of failure of the regulation and control unit, etc.

the drive is guided into a safe operating state.

Machines and systems must also be equipped with monitoring
and safety devices that are independent of the equipment.
Suitable measures must be taken to ensure that no danger to
people or property is caused by inadmissible movements!

During operation, the control cabinet must be closed and the
protection systems must be active.
When the control cabinet is open and/or the protection systems
are deactivated, the user must ensure that only qualified
personnel have access to the units.

Assembly work
- Only in a secured, de-energised state -
Only by trained specialist personnel

Installation work
- Only in a secured, de-energised state -
Only by trained electricians -
Observe the safety regulations.

Setting and programming work
- Only by qualified personnel with knowledge of
- electronic drives and-
software-
observe programming instructions-
observe safety
instructions

1.10 Commissioning

In the case of installation in machines and systems, the start of the intended operation of the device is prohibited until it has been determined that the machine, system or vehicle complies with the provisions of the EC Machinery Directive 2006/42/EC, the EMC Directive 2004/108/EC.

The EC Directive 2004/108/EC with the EMC standards EN61000-2 and EN61000-4 is
complied with
under the installation and
test conditions
specified in the chapter EMC notes.

When used in residential areas, additional EMC measures are necessary.

A manufacturer's declaration can be requested.

Compliance with the limit values required by EMC legislation is the responsibility of the manufacturer of the system or machine.

1.11 Details of the safety instructions

Machinery Directive

The machine or system manufacturer must prepare a hazard analysis for his product. He must ensure that no unforeseeable movements can lead to personal injury or damage to property.

Qualified personnelHardware

Qualified specialist personnel are characterised by education and training for the use of electronic drive technology. They know the standards and accident prevention regulations for drive technology and can assess the application. Possible dangers are recognised.

The local regulations (IEC, VDE, VGB) are known to the qualified personnel and are taken into account during the work.

Software

Qualified personnel for the software must be trained for the safe programming of the devices in the machines and systems. Incorrect parameterisation can lead to unauthorised movements. The parameter settings must be checked against incorrect operation. Careful acceptance tests must be carried out according to the 4 eyes principle.

Working environment

Incorrect handling of the units can lead to damage to property or personal injury.

Only operate the units when the control cabinet is closed or secured!

Exceptions are only permitted during initial commissioning or control cabinet repairs by qualified personnel.

Unit covers must not be removed.

Work on electrical connections only in a voltage-free control cabinet that is secured against being switched on.

The voltages and residual voltages (intermediate circuit) must be measured before working on the unit. Maximum permissible voltage < 42 V.

High temperatures > 70 °C

 may occur.

The working environments can be dangerous for wearers of electronic medical aids (e.g. pacemakers). A sufficient distance to these electrical parts must be maintained.

Stress

During transport and storage, the prescribed climatic conditions must be observed.

The units must not show any mechanical damage. Bent housing parts can damage the insulating sections. Never install damaged units!

The units contain components that can be damaged by electrostatic discharges. The general recommendations for handling ESDS components must be observed. Special attention must be paid to highly insulating plastic foils and synthetic fibres.

For operation, it must be ensured that the environmental conditions in the control cabinet are complied with. This applies in particular to the non-permitted condensation of the units.

1.12 Intended use

The devices are intended for controlling EC synchronous motors and AC asynchronous motors in stationary machines or systems.
Other applications require the approval of the manufacturer. The
device protection class is IP20.
Installation is only permitted in fixed switch cabinets or machine frames similar to switch cabinets. The place of use is the industrial environment.
Additional EMC measures are necessary for use in residential areas.

The user must prepare a hazard analysis of his end product
Mains connection only to the earthed TN three-phase mains with a maximum three-phase voltage of 480 V~ (max. 280 V~, phase - N (PE)). Adaptor transformers must be used for other types of mains (IT, TT mains).
Voltage peaks between the outer conductors must not exceed
1000 V, between outer conductors and housing 2000 V.

The capacitances between clocked power assemblies (inverter, motor, filter)
result in high leakage currents. A secure screwed earthing on the control cabinet and motor is necessary. The protective earth conductor must comply with EN 50178 and IEC 364.
Poor protective conductors pose a high risk to health and life.
The residual current devices (RCDs) must be all-current sensitive according to EN 50178.

In the case of emergency battery connection, it must be ensured that the battery voltages are at mains potential. All safety regulations for direct mains connection must be observed.

The control connections (terminals X1, plugs X7, X8, X9, X10) of the unit comply with "safe electrical isolation" according to EN 61800-5-1. The user must ensure that the standards are observed in the entire control wiring.
In the case of components connected to the unit without potential-separated input outputs, attention must be paid to the potential equalisation. (Equalisation connection GND). The equalising currents can destroy components.

For insulation measurements, the units must be disconnected or the power connections among each other and the control connections among each other must be bridged. Failure to observe this can destroy semiconductors in the unit.

Repetitive earth and short circuits below the short-circuit threshold can damage the output stages. (Conditionally short-circuit proof according to EN 50178)

Impermissible applications
 - in life-supporting medical devices or machines

- on unearthed or asymmetrical networks-
on ships-
in potentially explosive environments
-in environments with corrosive vapours

1.13 Regulations and guidelines

The units and the associated components must be installed and connected in accordance with the local legal and technical regulations:

EC Directive	2004/108/EC, 2006/95/EC, 2006/42/EC, 2002/96/EC
EC standards	EN60204-1, EN292, EN 50178, EN60439-1, EN61800-3, ECE-R100
Internal. Standards	ISO 6469, ISO 26262, ISO 16750, ISO 20653, ISO 12100
IEC/UL	IEC 61508, IEC364, IEC 664, UL508C, UL840
VDE regulations and TÜV regulations	VDE 100, VDE 110, VDE 160
Regulations of the employers' liability insurance association	VGB4

EU standards and regulations taken into account in the appliance

Standard	Explanation	Output
EN 60146-1,-2	Semiconductor power converter	2010
EN 61800-1,-2,-3	Variable speed electric drives	2010
EN 60664-1	Insulation coordinates low voltage	2012
EN 61010	Safety regulations for control units	2011
EN 61800-5-1	Electric power drive systems	2010
EN 61508-5	Functional safety of electrical, electronic systems	2011
EN 60068-1,-2	Environmental influences	2011
ISO 20653	Protection class of electrical equipment of vehicles	
ECE-R100	Conditions battery-powered electric vehicles	
UL 508 C	UL regulation power converter	2002
UL 840	UL Regulation Air and Creepage Distances	2005

EU standards and regulations to be observed by the user

Standard	Explanation	Output
EN 60204	Safety and electrical equipment of machines	2011
EN 50178	Equipment of power installations	1998
EN 61800-3	Variable speed electric drives -EMV	2010
EN 60439	Low-voltage switchgear and controlgear assemblies	2011
EN 1175-1	Safety of electric industrial trucks	2011
ISO 6469	Electric road vehicles	2009
ISO 26262	Functional safety of electric road vehicles	2011
ISO 16750	Electrical components Vehicles	2010
ISO 12100	Safety of machinery	2011
ISO 13849	Safety of machines and controls	2011
IEC 364	Protection against electric shock	2010
IEC 664	Insulation coordinates low voltage	2011

1.14 Risks

The manufacturer endeavours to reduce the residual risks emanating from the device as far as possible through design, electrical and software measures.

following known residual risks from drive technology must be taken into account in the risk assessment of machines, vehicles and systems.

Impermissible movements
caused by:
- the failure of safety monitoring systems or switched off Safety monitoring during commissioning or repair
- Software errors in upstream controls, errors in bus systems
- Unmonitored hardware and software errors in the actuators and connecting cables
- Inverted sense of the rules
- Error in parameterisation and wiring
- Limited reaction time of the control properties. Ramps, limits
- Operation outside the specifications
- Electromagnetic disturbances
- Electrostatic disturbances, lightning strike
- Component failure
- Fault in the brakes

Dangerous temperatures
caused by:
- Error during installation
- Defects at connections, bad contacts, ageing
- Error in electrical fuse protection, wrong fuse types
- Operation outside the specifications
- Weather influences, lightning strike
- Component failure

Dangerous tensions
caused by:
- Faulty earthing of unit or motor
- Defects at connections, bad contacts, ageing
- Error in potential separation, component failure
- Conductive pollution, condensation

Dangerous fields
The units, the inductive and capacitive accessories, and the power cabling can generate strong electric and electromagnetic fields. These can be dangerous for wearers of electronic medical aids (e.g. pacemakers). A sufficient distance to these electrical parts must be maintained.

1.15 Technical data

Power voltage connection	3x 230 V~ to 480 V~ +10% 50/60 Hz
Auxiliary voltage connection	24 V= ±10 % / 2 A Ripple <10 % self-healing fuse

Data	Dim.	DPC-440	DPC-460	
Supply voltage Nominal value	V~	3x400 (480)		
Output voltage max. nominal value	V~eff	3x390((470)		
DC link voltage	V=	560 (675)		
Battery voltage	V=	max. 400		
Connected load S1 max.	kVA	28	40	
Output power S1 max.	kW	25	35	
Continuous current	Aeff	40	60	
Peak current max.	Alo	80	120	
Power loss max.	W	80	150	
Clock frequency	kHz	8		
Ballast switch-on voltage	V=	790 ± 10		
Overvoltage switching threshold	V=	860 ± 10		
External ballast resistor minimum	Ω	8	8	
Input fuse Switch-off integral	A A²s	10 150	20 200	
Weight	kg	12		
Dimensions HxWxD	mm	320 x 85 x1 90		

Control signals		V	A	Function	Connection
Analogue inputs		± 10	0.005	Differential input	X1
Digital inputs	ONE OFF	10-30 < 6	0.010 ---	Opto-decoupled	X1
Digital outputs		+24	0.03	Opto-decoupled	X1
Resolver				Differential input	X7
Encoder input		> 3.6		Opto-decoupled	X7
Encoder output		> 4.7		Opto-decoupled	X8
CAN interface				Opto-decoupled	X9
RS232 interface				9600 baud	X10

Environmental conditions	
Protection class	IP20, VGB4
Standards	EN60204, EN61800-2
Operating temperature range	0 to +45 °C
Extended operating temp. range	+45 °C to +60 °C Power reduction 2 %/°C
Storage temperature	-30 °C to +80 °C
Humidity	Class F Humidity <85% **no condensation!** **Option humidity sensor**
Installation height	≤ 1000 m a.s.l. 100 %, >1000 m Power reduction 1.4 %/100 m
Ventilation	Push-through cooler With S1 operation or effective current, > 35 A Fan blower
Mounting position	Cooler vertical, horizontal = power reduction 20 %.

Motor current reduction depending on the installation height
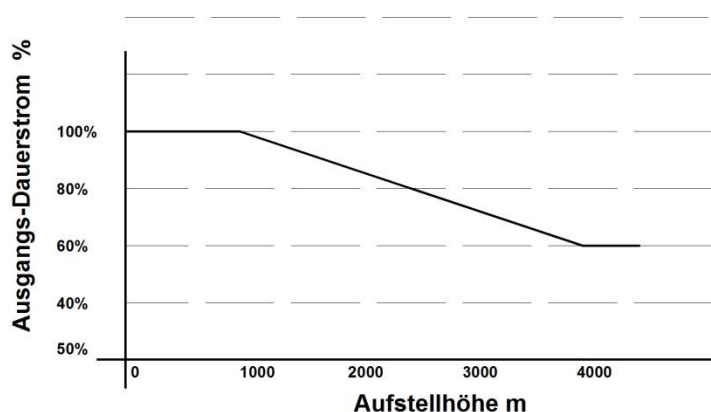
Motor current reduction depending on the ambient temperature
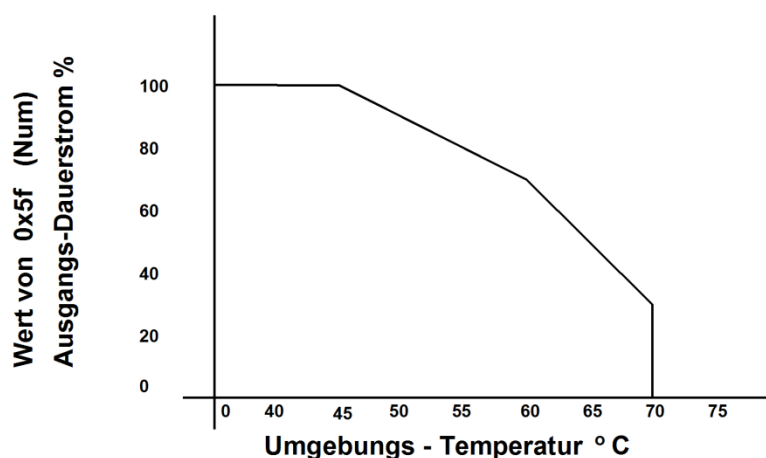
Motor current reduction depending on the power stage temperature
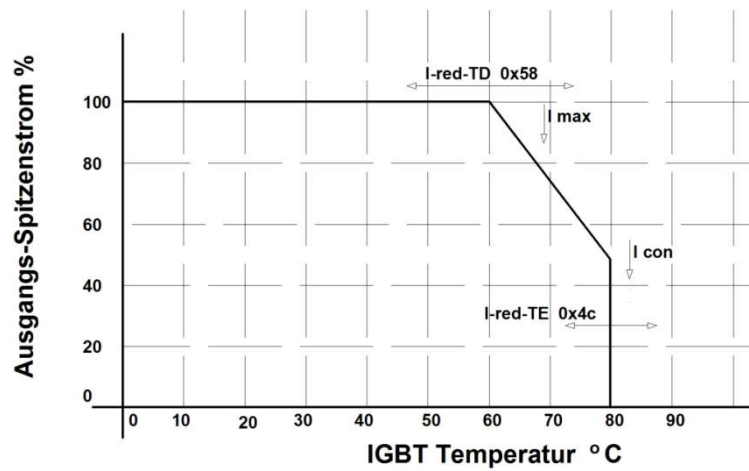
Motor current reduction depending on the power stage overload
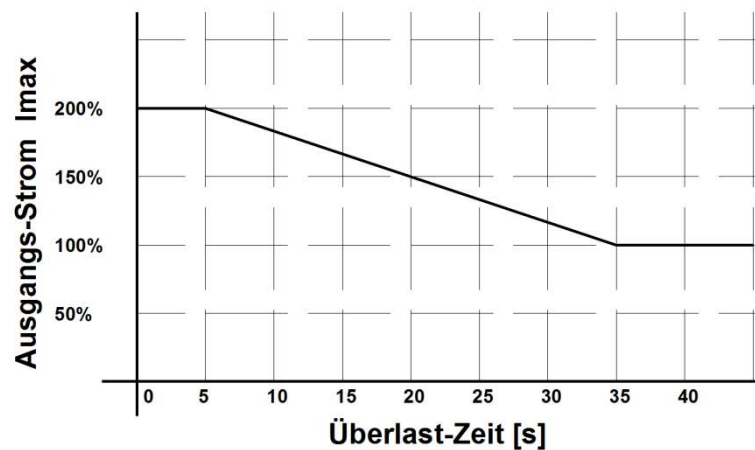
Motor current reduction as a function of the output stage clock frequency
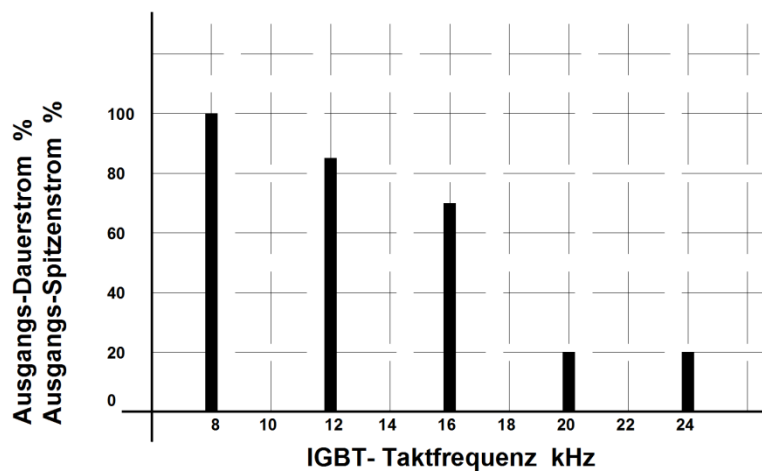
Power dissipation of the output stage
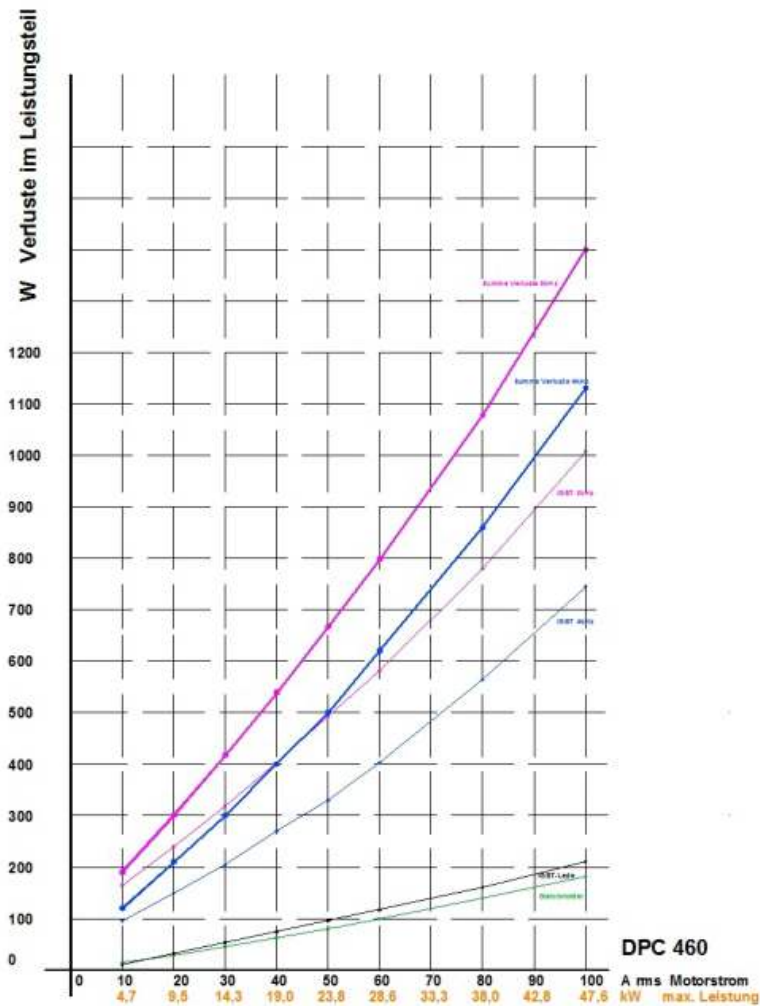
Current-power limits for operation with and without fan set
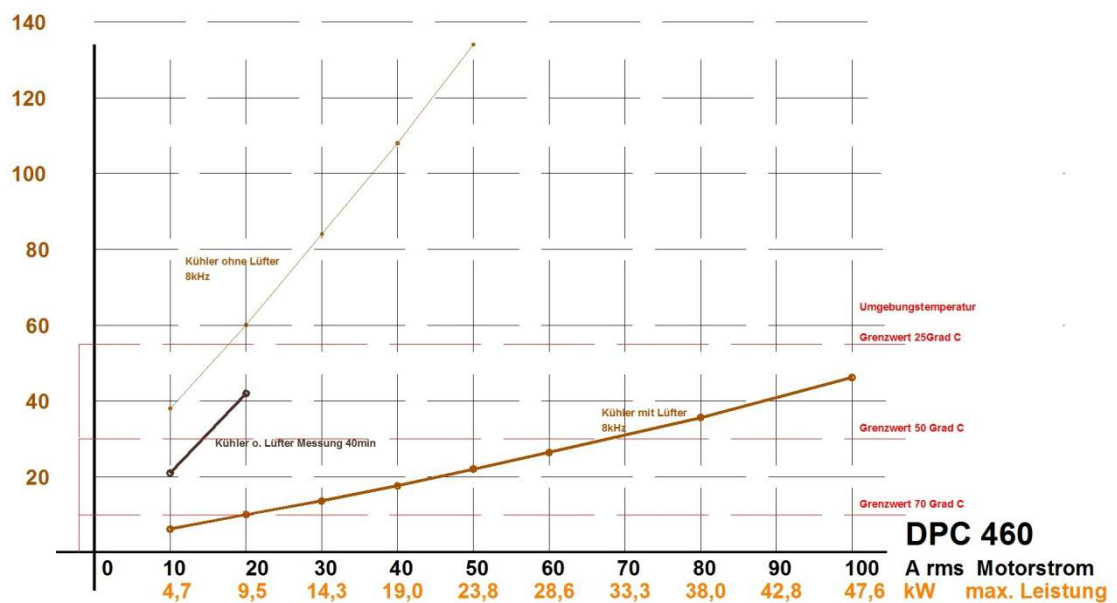
2   Mechanical installation

2.1   Important notes

Observe ESD instructions.
Mounting surface blank, not painted (flat EMC contact)
The unit must be safely protected in the control cabinet against mist and water and the ingress of metallic dust.

Check the unit for mechanical damage.
Only install faultless units.

Installation only in a safe, de-energised state.
In case of electrically connected systems, insert
short-circuit clamp and attach warning signs.
Installation only by trained and qualified personnel.

Vertical installation position.
Observe power reduction for horizontal installation.
In the case of through-hull installation, the user
 must ensure that the heat loss is dissipated.
When mounting the unit inside a control cabinet, make sure there is enough space for the exhaust air (min. 100mm).

Take the unit mounting holes from the dimensional drawing or from the drilling plan.
Do not mark off the unit. Make
mounting holes in the mounting plate.
For through-hole mounting, insert gasket. Use screw seal.
Insert the unit and tighten the screws.

Caution: Protect the unit   against the ingress of foreign bodies
(drilling chips, screws, etc.)!

Mount the filter and choke spatially close to the unit.

Contact the cable shields with the mounting surface over a wide area.
Keep shieldless cable ends as short as possible.

Brake resistors can become very hot (200 °C).
Mount the resistors in such a way that neither injuries (burns)
nor heat damage can occur.

Use vibration-proof screw connections.

Control cabinet internal temperature **max. 45 °C**

When installing indoors, ensure sufficient ventilation of the control cabinet.
If room temperatures are too high (> 30 °C), use air-conditioning units.

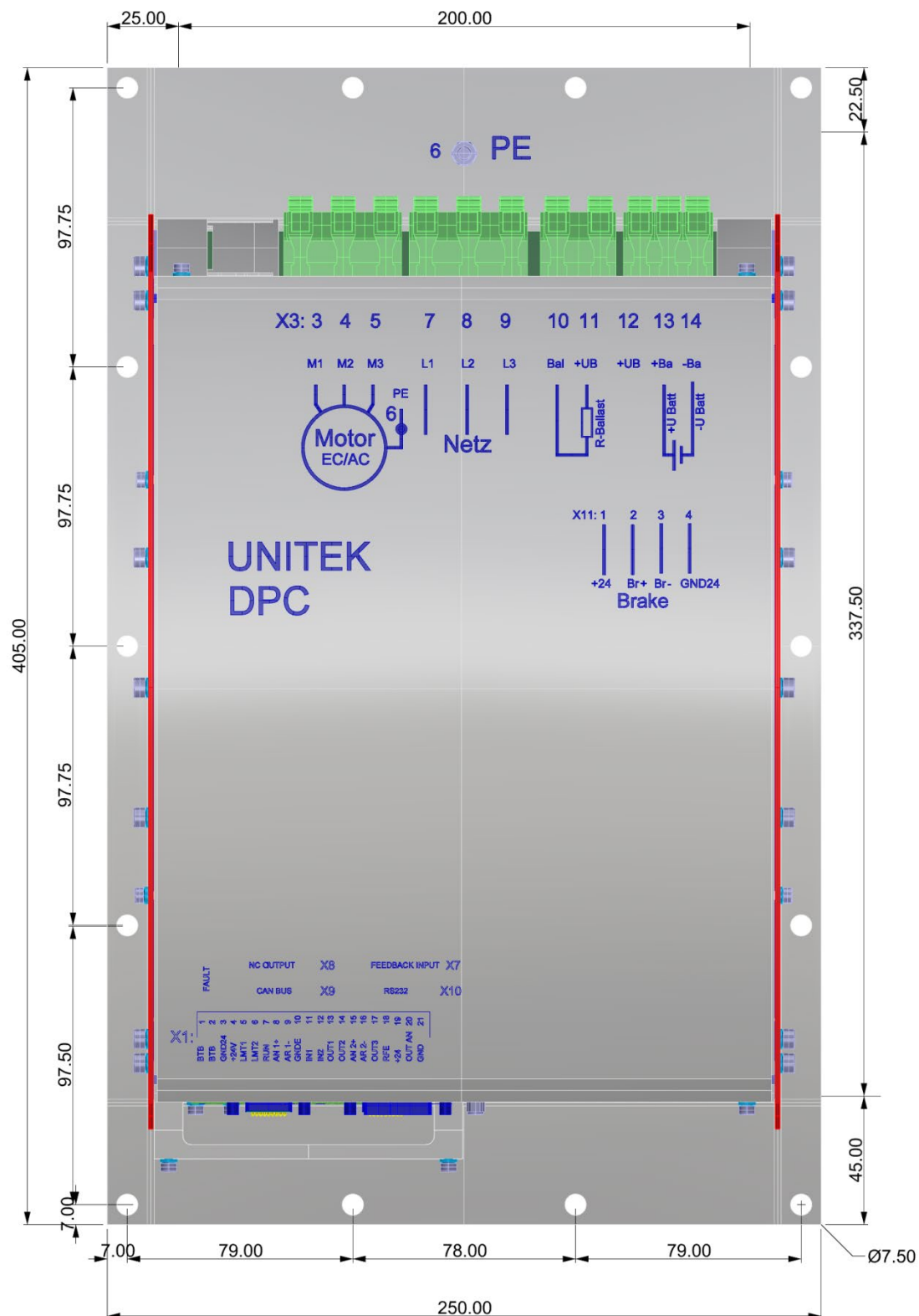**Attention: Operation with dew-covered units is not permitted!**

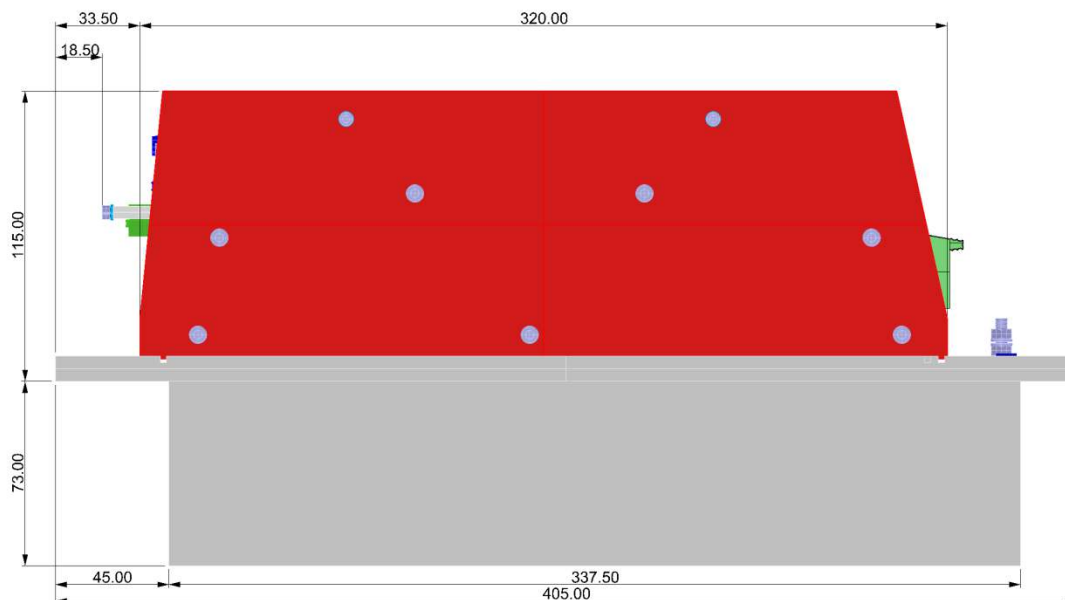## 2.2   Unit version / Dimension drawings
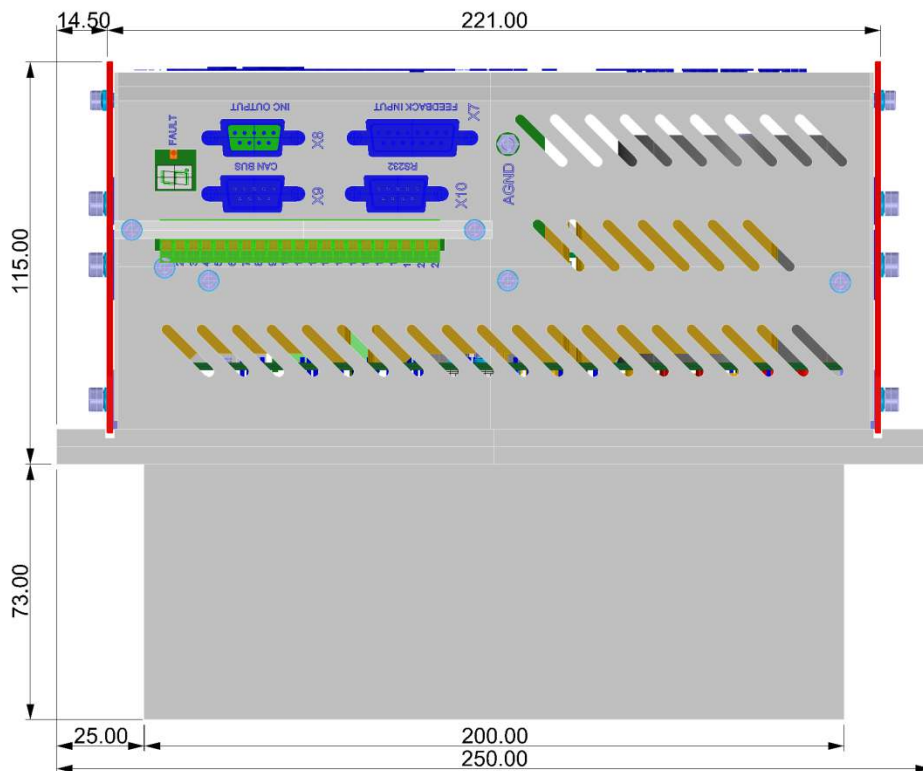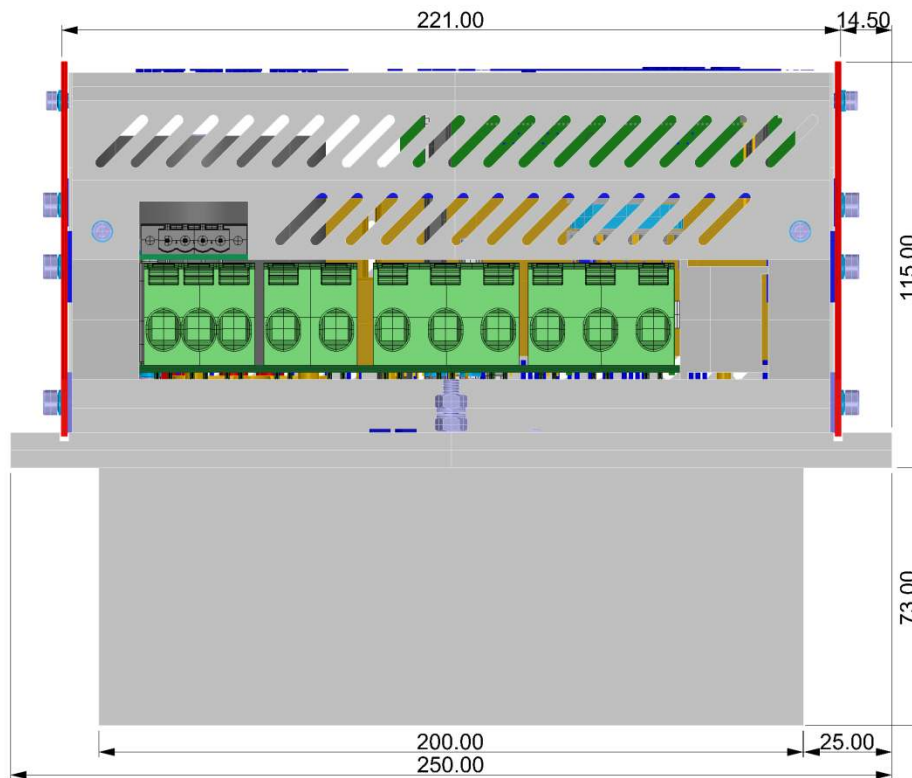
Push-through version
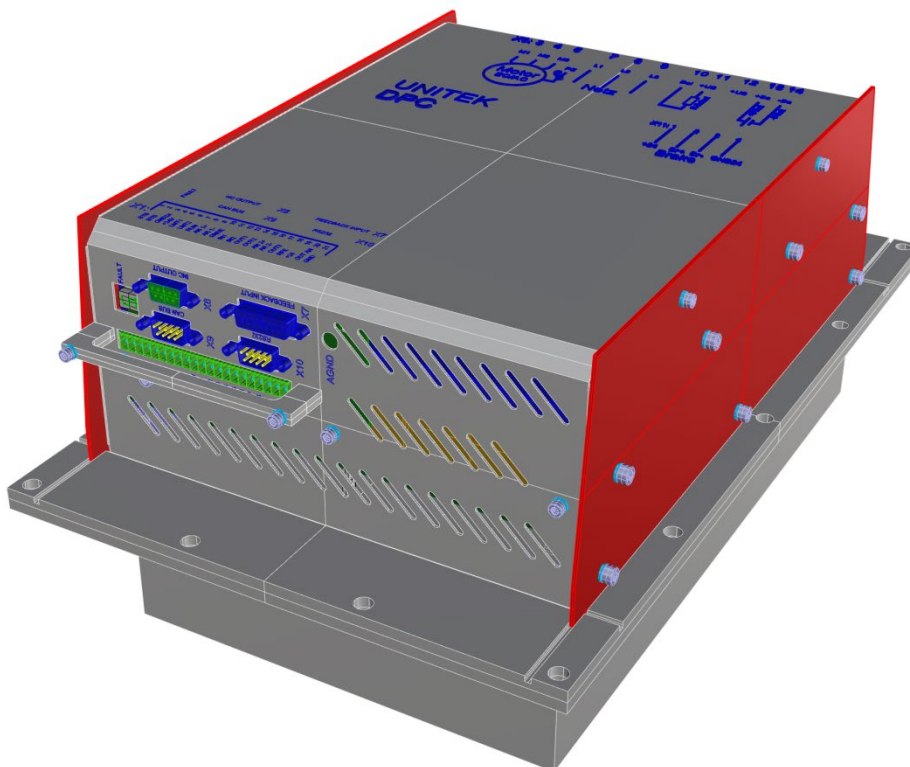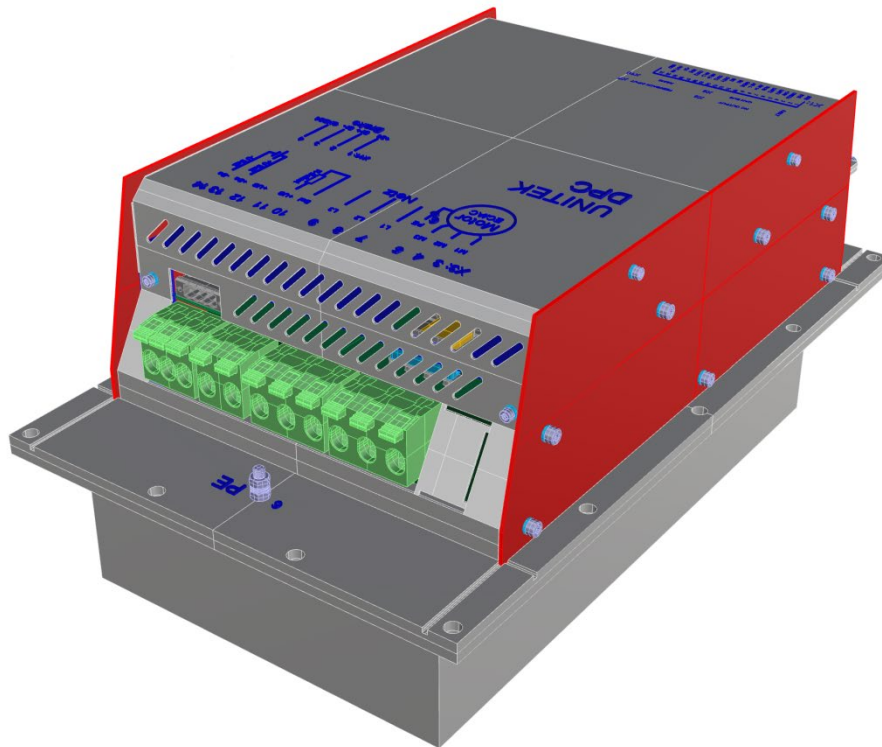
Push-through version

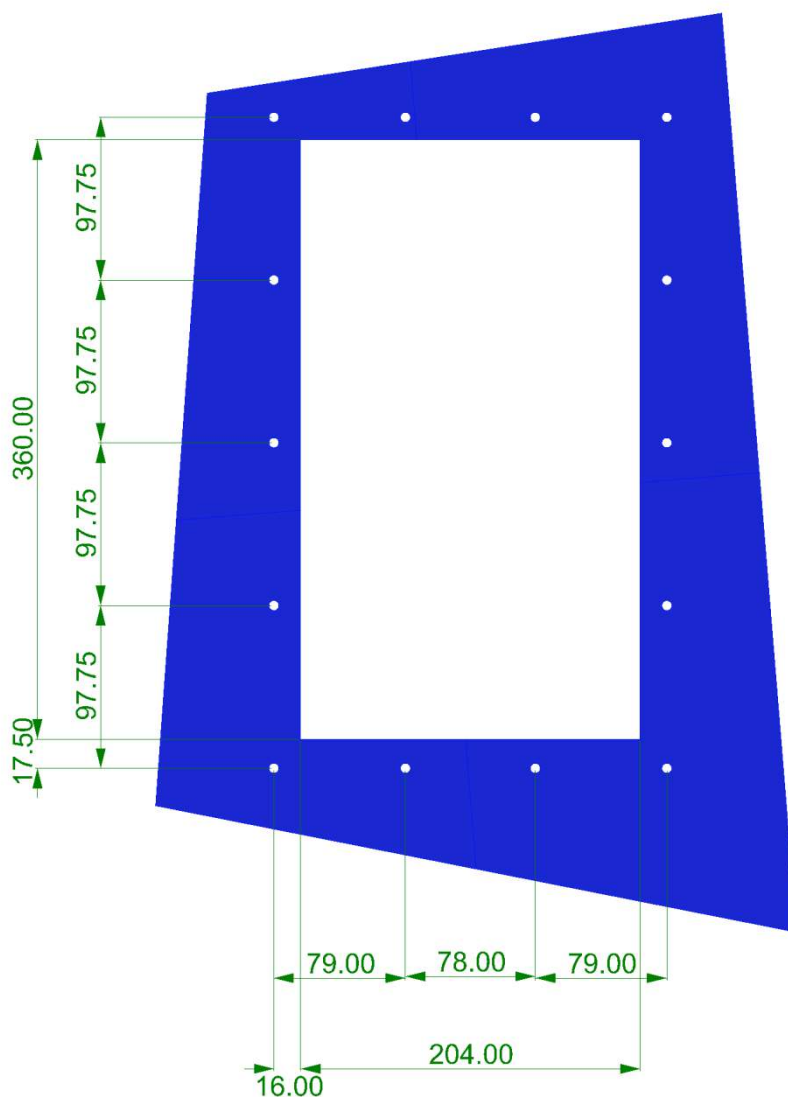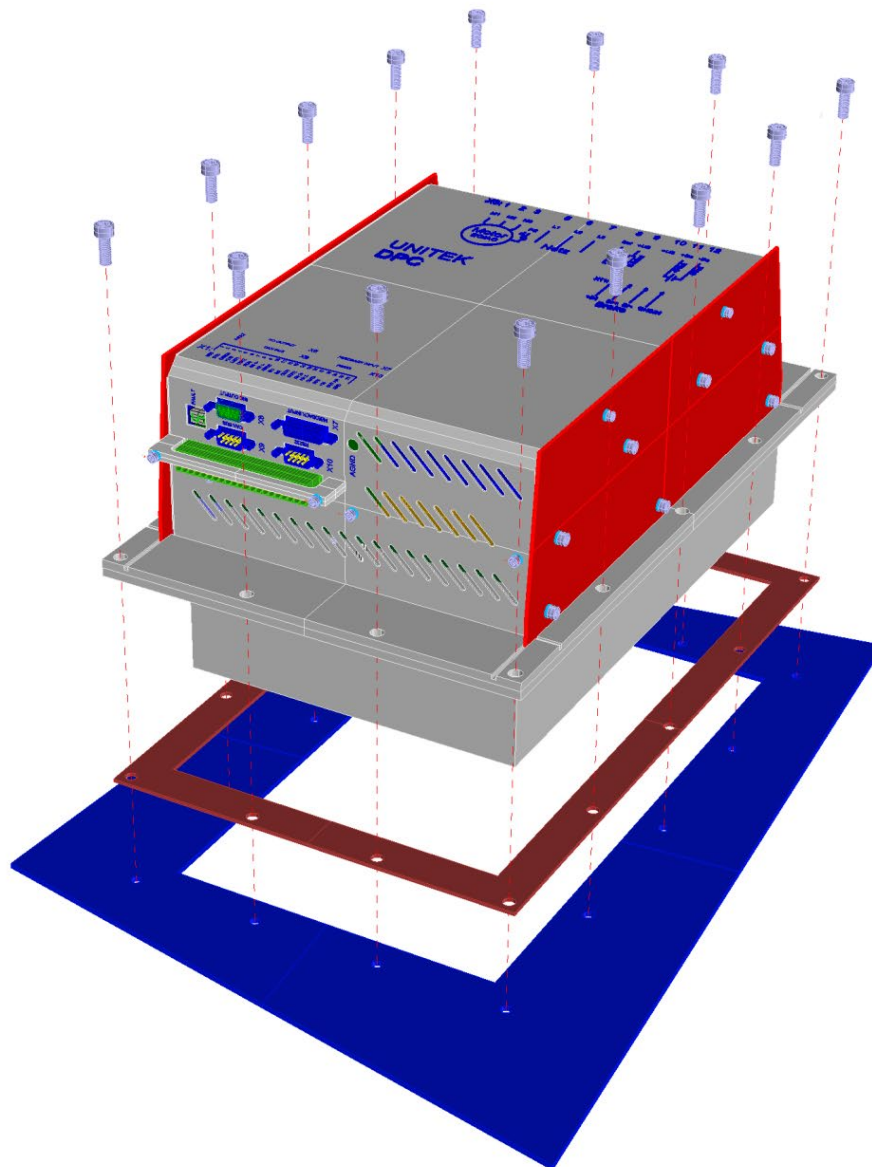*Mounting screws M6x20 (recommended DIN 912)*

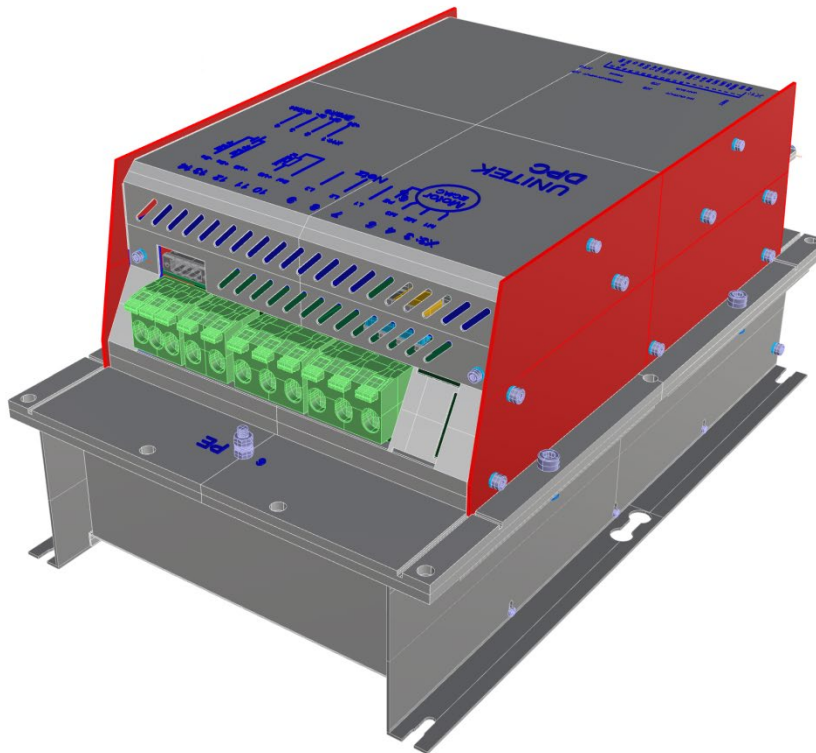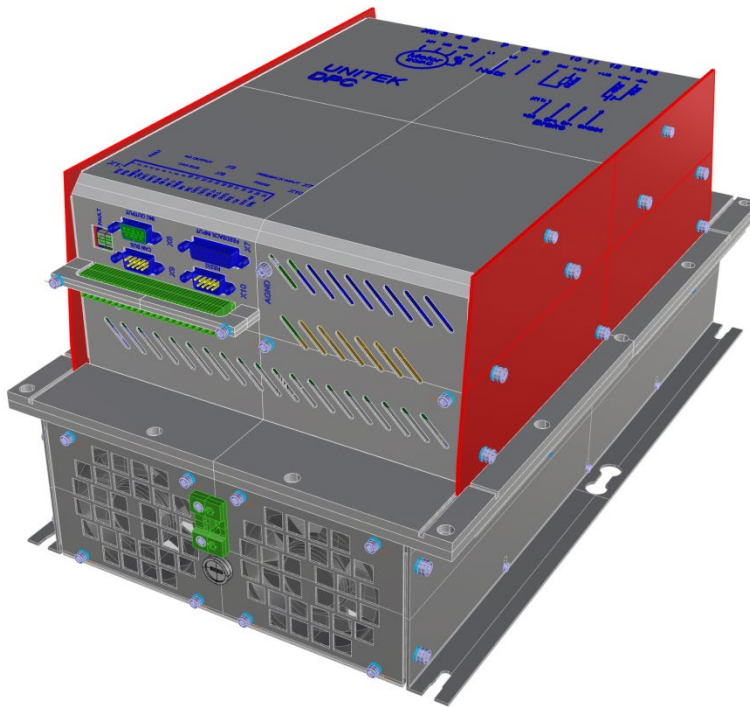**Push-through variant**

Push-through variant

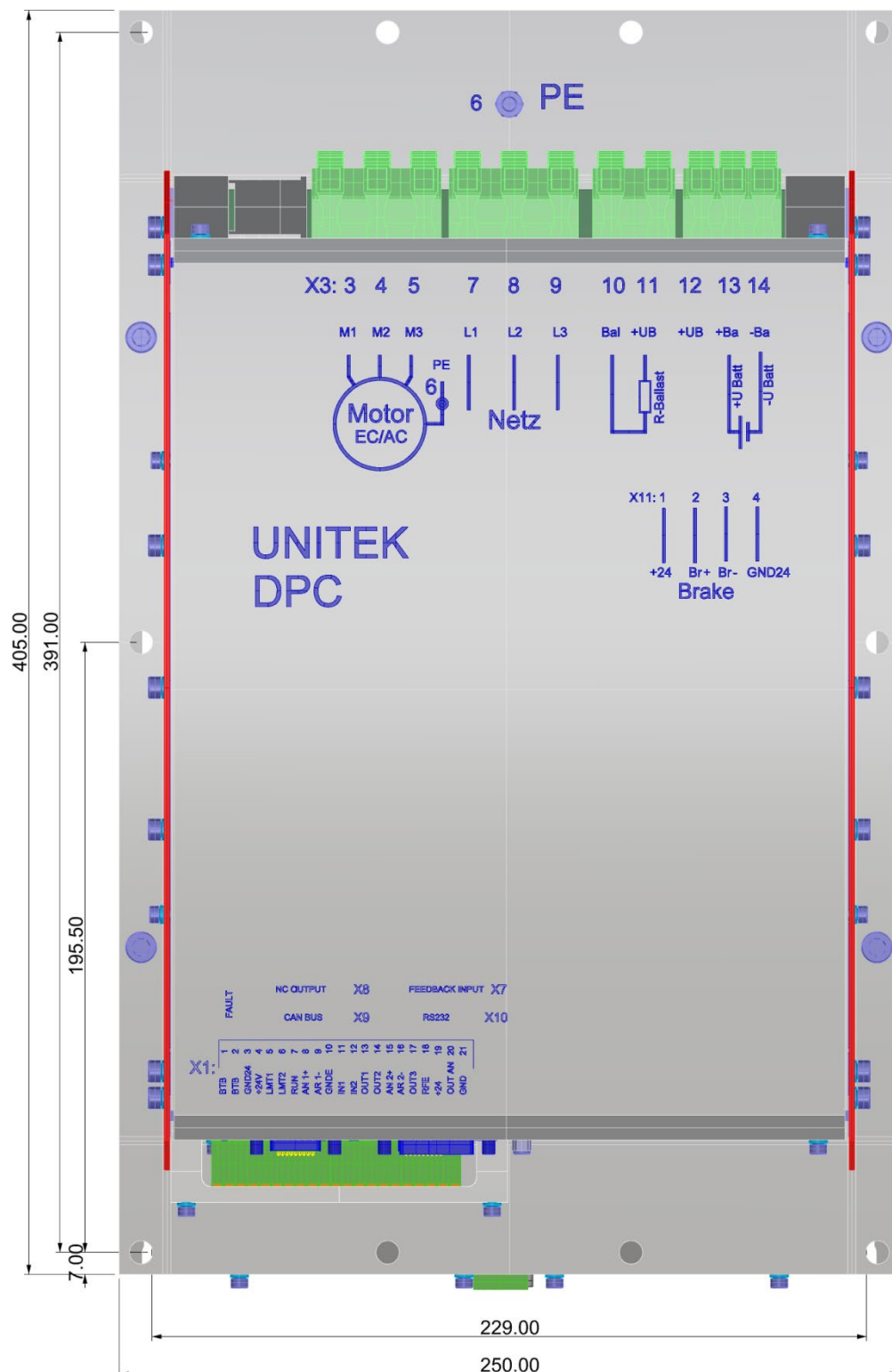**Drilling plan push-through variant**

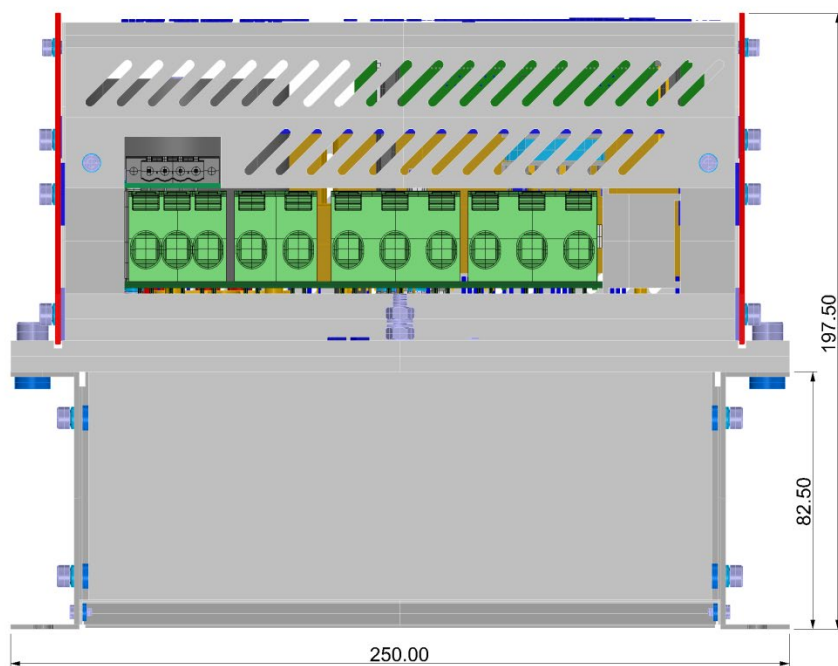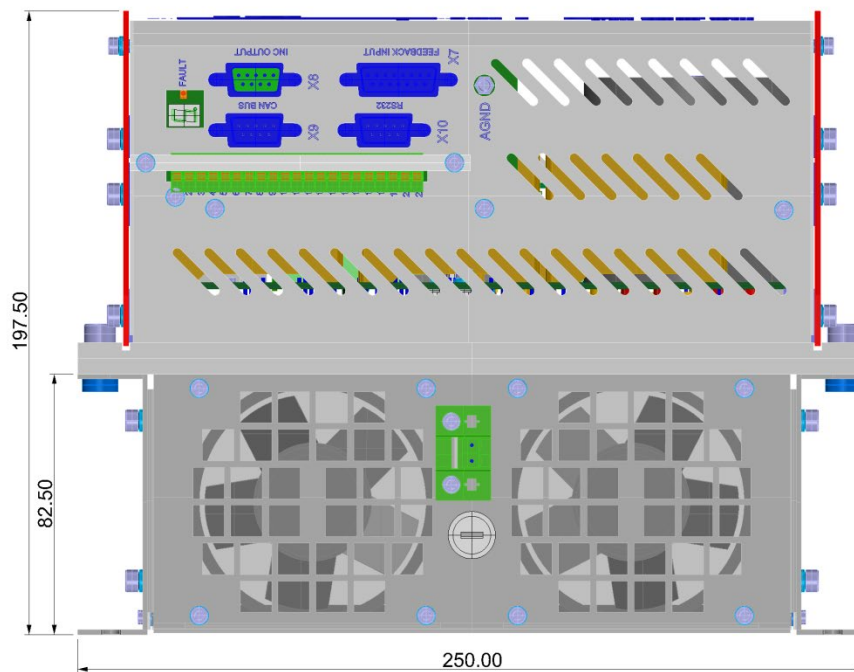**Mounting push-through version**

Varianter control cabinet interior mounting

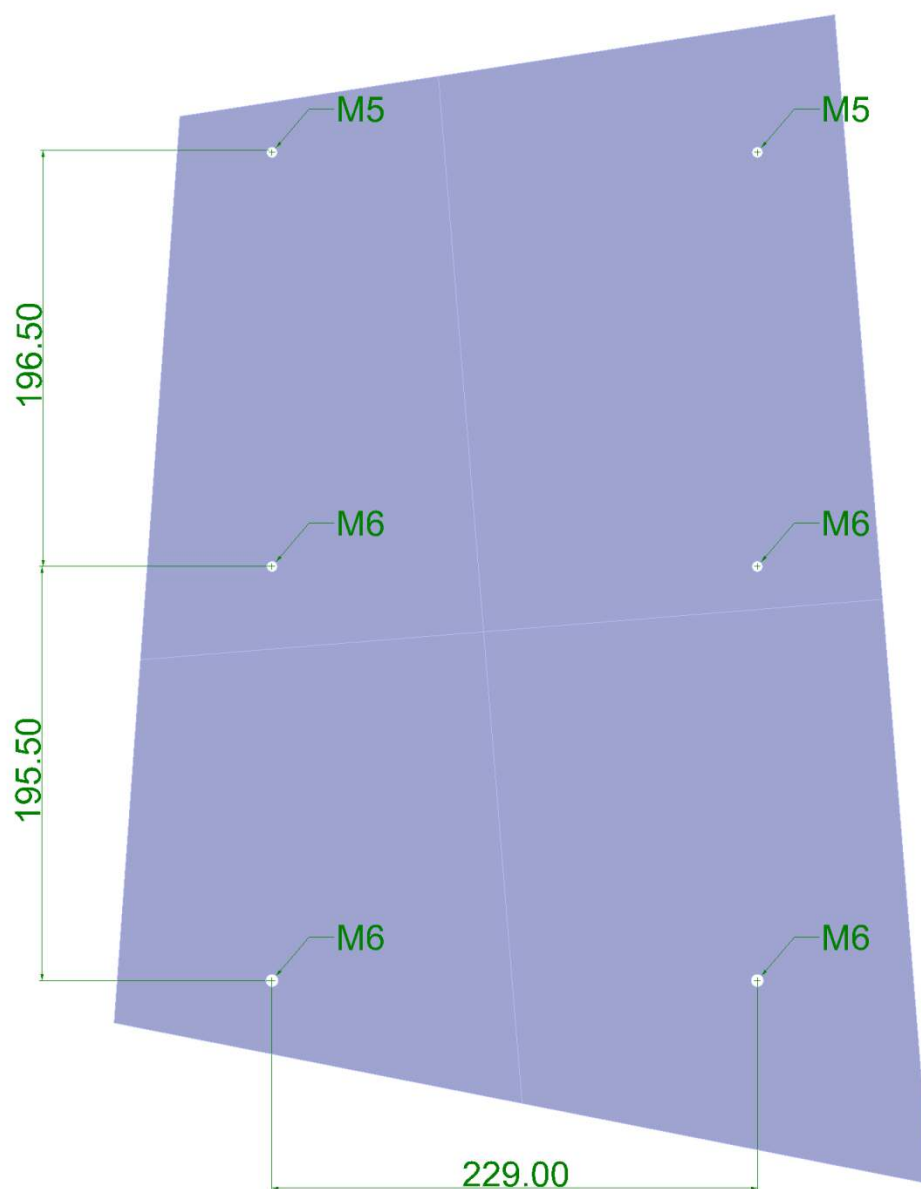**Varianter control cabinet interior mounting**
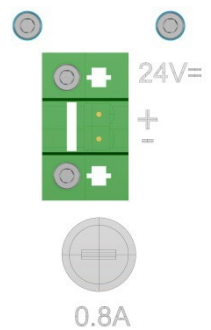
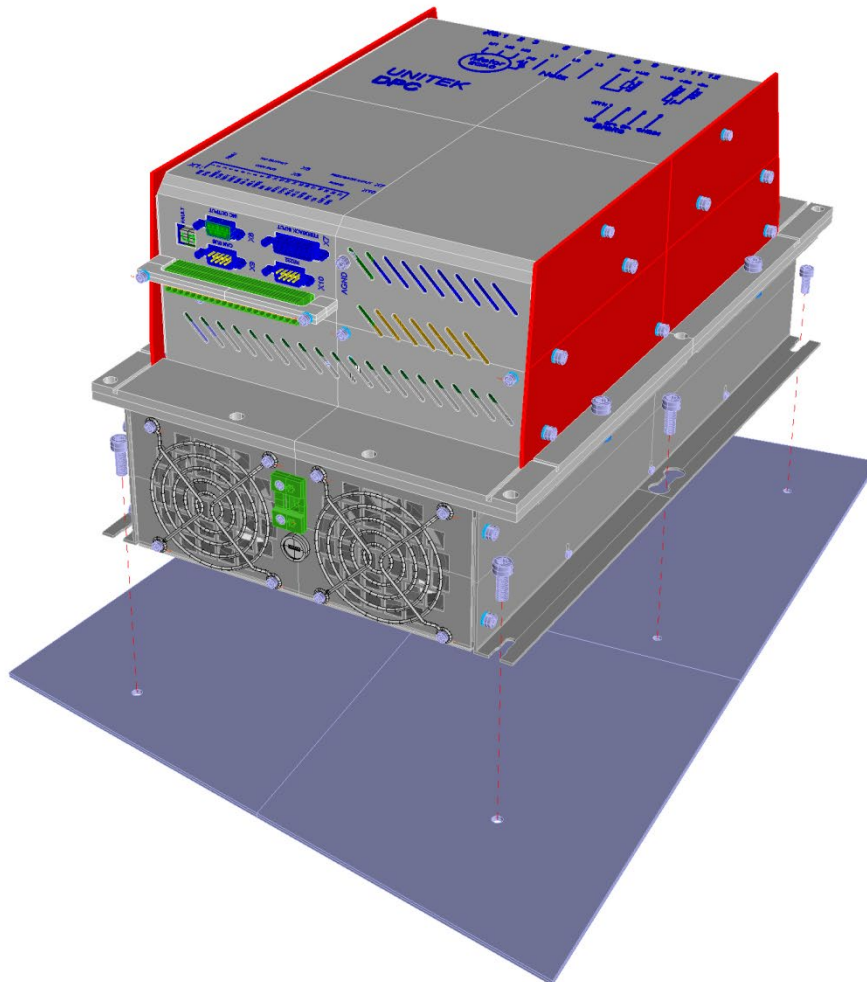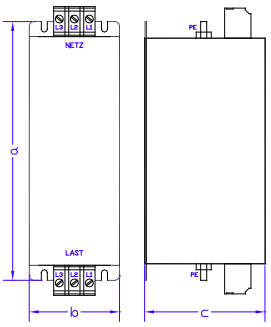**Varianter control cabinet interior mounting**

Drilling plan
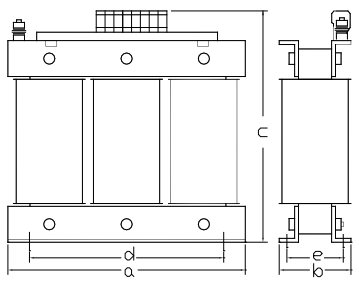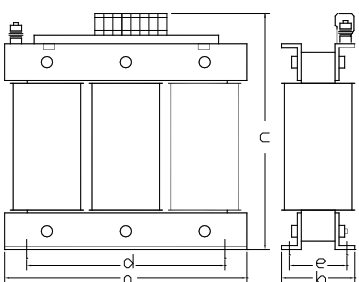Varianter control cabinet interior mounting

## Control cabinet interior mounting

2.3   Accessories Dimension drawings

EMC -filter

Accessory Filter FN258-1

Type	Voltage V~	Current A~	Mass a x b x c	Wt. kg
FN 255-42	3x480	3x42	329x70x185	2,5
FN 258-55	3x480	3x55	329x80x185	2,9
FN 258x75	3x480	3x75	329x80x220	3,9

Filter for increased EMC requirements. For residential and commercial areas or unknown locations.
Mount the filter directly on the unit.
DC link filters and input capacitors
are built into the unit.

Mains choke

Accessory mains choke-FN

Type	Power A	Induct. mH	Mass a x b x c	Wt. kg
KD 2.5b - 50	50	0,3	155x90x150	5,8
KD 3a-75	75	0,2	190x90x220	9,5

Use mains choke in unknown and rough industrial networks, as well as to reduce the load on the DC link.

Motor choke

Accessory three-phase transformer-257

Type	Power A	Induct. mH	Mass a x b x c	Wt. kg
MDD 3.5a-75	75	0,45	210x105x220	13,5
MDD 3c-50	50	0.5	190x115x180	11

Motor choke only with cable shield capacitance > 5nF
Cable length approx. 25 m

Ballast resistor 300 W
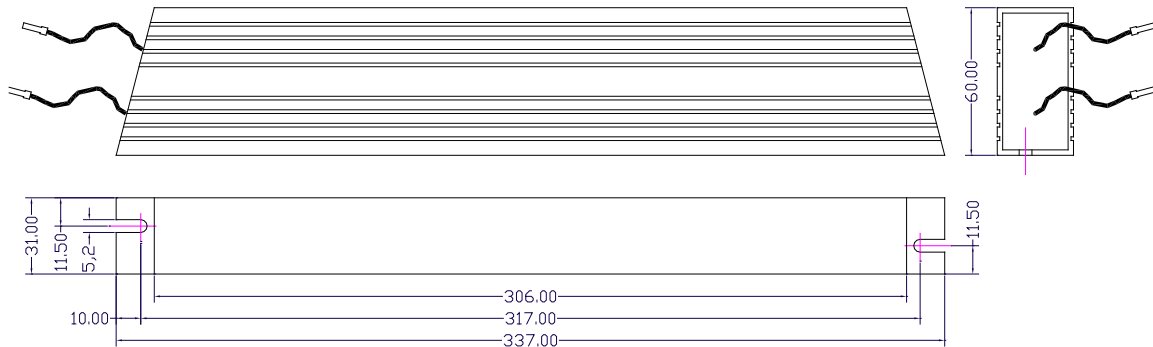
Weight 1.1 kg / fixing screws M5x12

Ballast resistor in aluminium housing Protection class IP65

Attention:
The ballast resistor can become hot up to 200°C.
Mount the resistor so that it is safe to touch.
Do not place any heat-sensitive parts directly on the resistor or in the heat air flow.
Note the temperature increase in the control cabinet,
Mount the resistor outside if possible.

3 Electrical installation

3.1 Important notes

The connection instructions are binding in their assignment of the connections to the plug numbers or terminal numbers!

All further information is non-binding.
The input and output lines can be connected in compliance with the
electrical regulations and guidelines are changed and supplemented.

The regulations to be observed are
-Connection and operating instructions
-Local regulations
-EC regulations such as EC Machinery Directive 2006/42/EEC
-VDE, TÜV and trade association regulations

Electrical installation only in de-energised state.

Ensure that it is safely disconnected.
Insert shorting bar.
Attach warning signsInstallation
only by electrotechnically trained personnel.

Compare the connection values with the nameplate data.

Ensure correct fusing of the supply, the auxiliary voltage and the external
ballast resistors.

Lay power cables and control cables spatially separated.
Carry out shield connections and earthing measures according to EMC guidelines.
Use the correct cable cross-sections.

Attention:

Always insert BTB contact into the safety circuit!
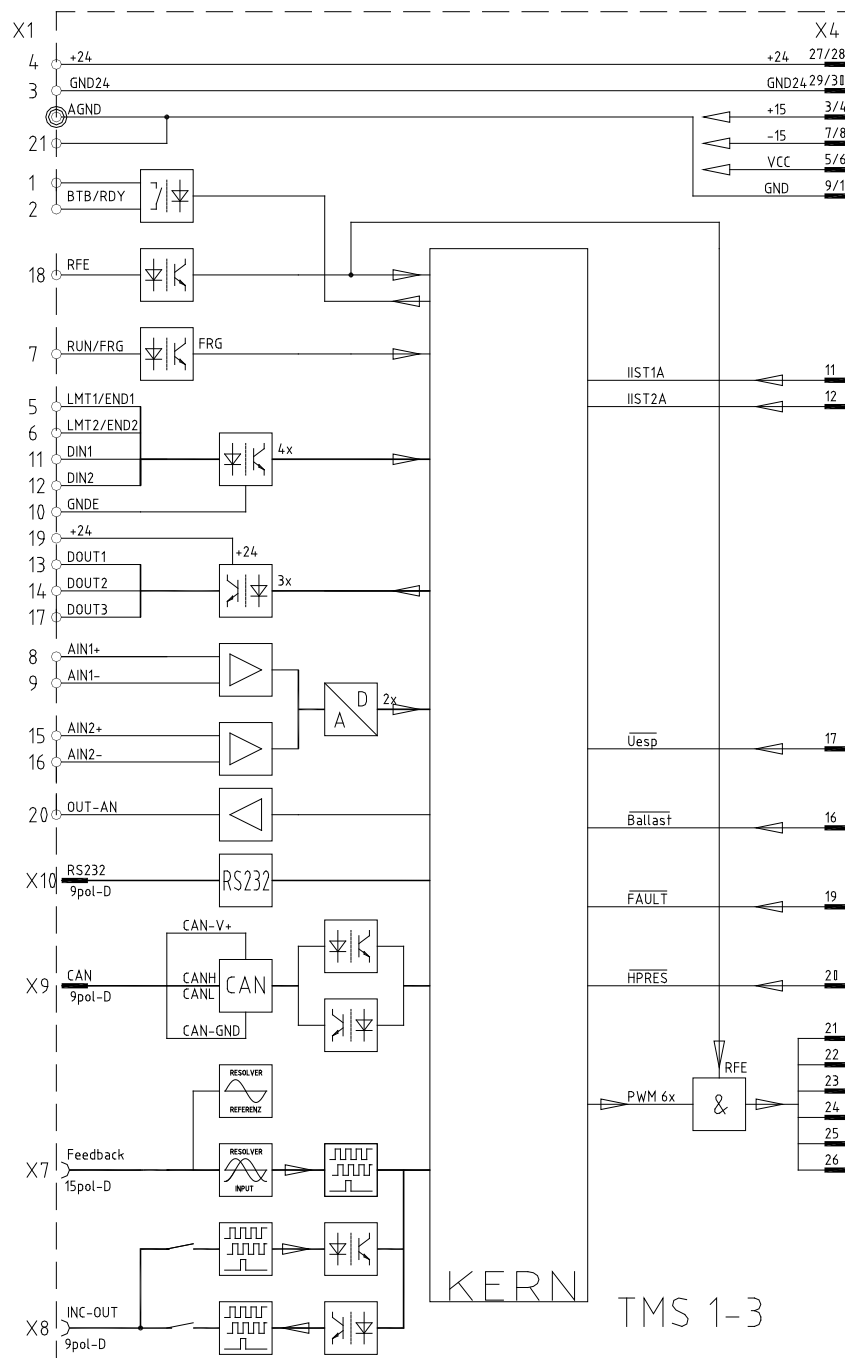**PE connection according to EN 61800-51-1.**
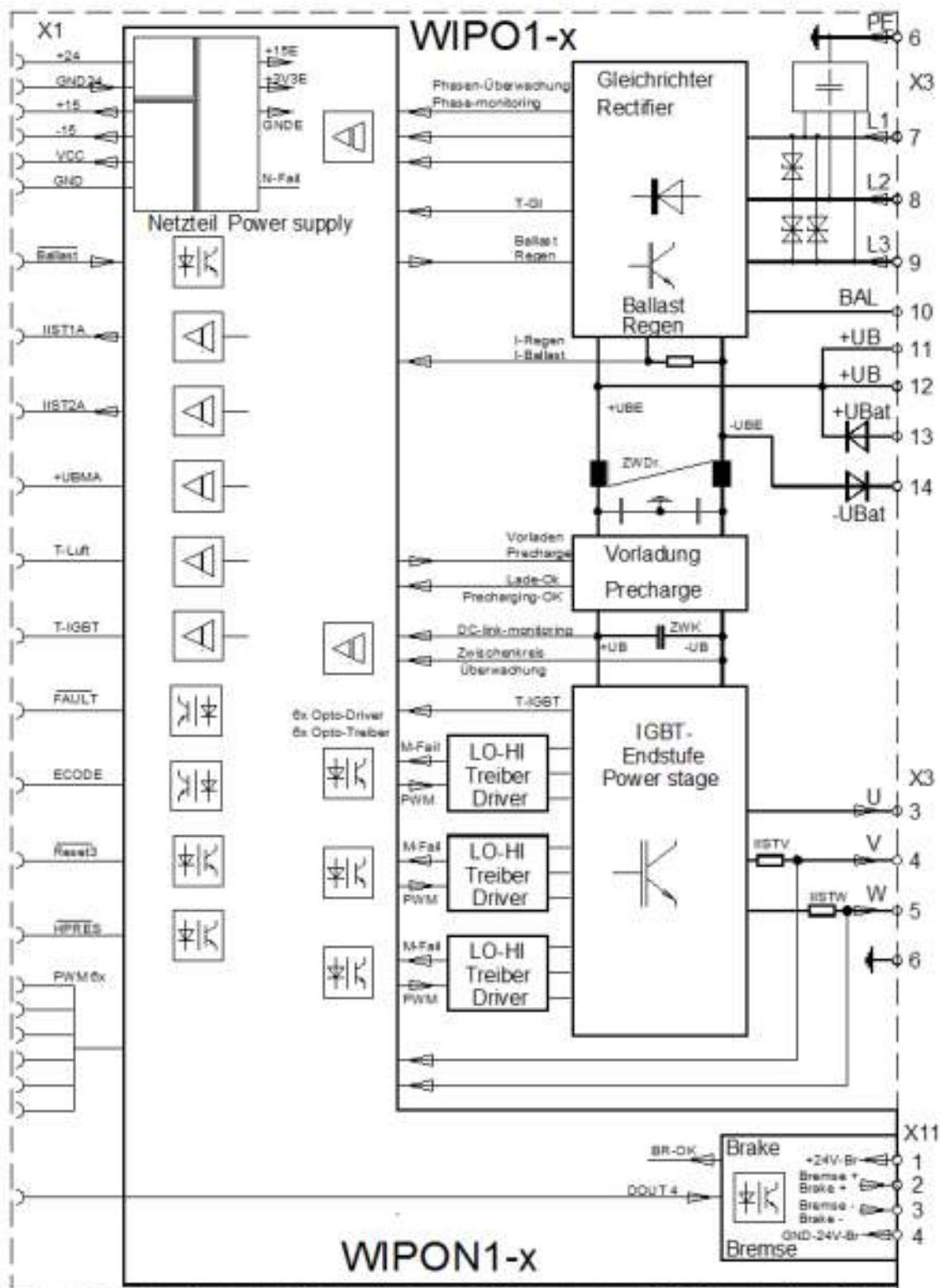**Operation without PE connection is prohibited!**
Connect signal GND (AGND) to PE.
With isolated signal GND (AGND) external isolation monitor
deploy.

3.2 Block diagram

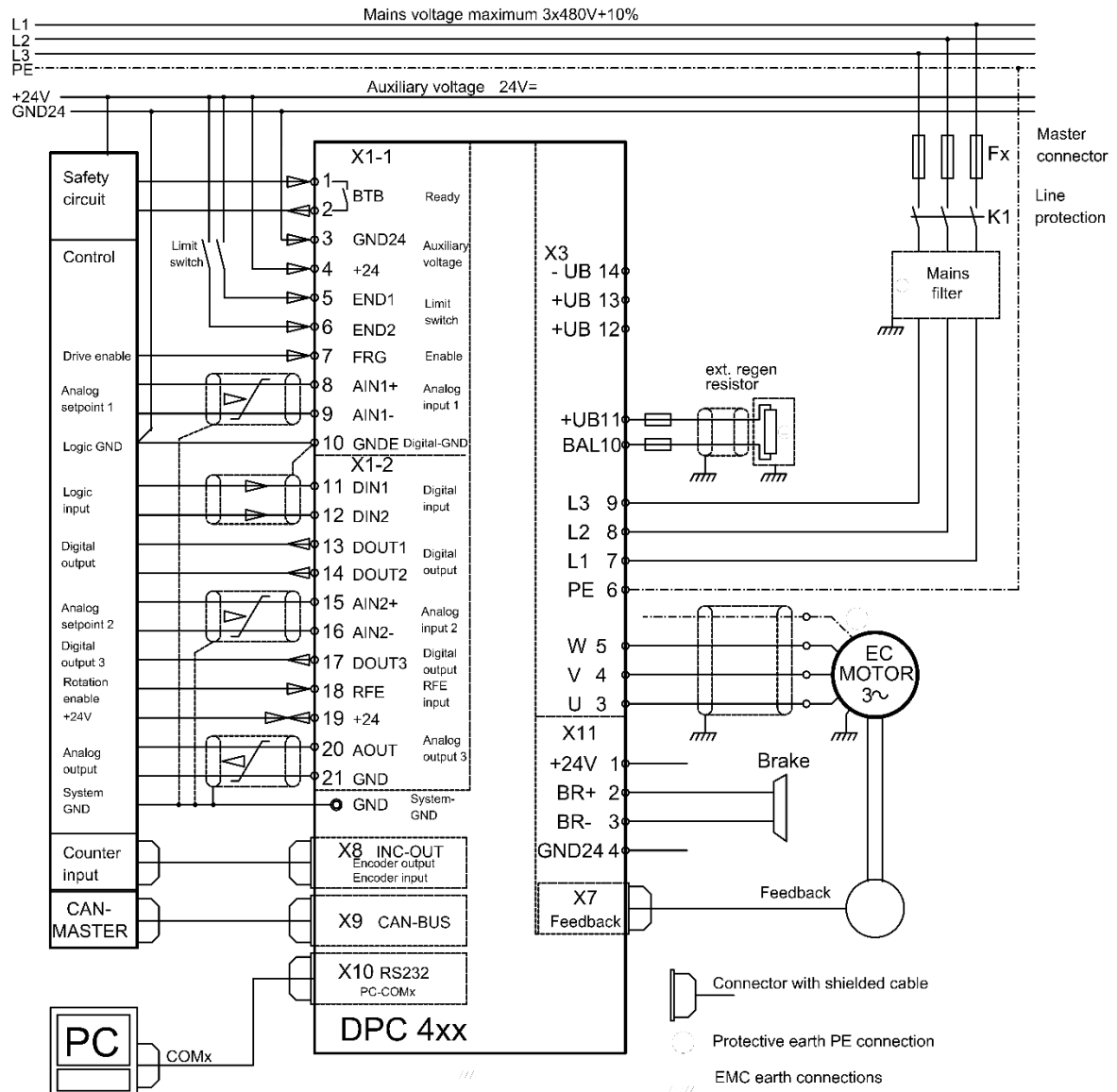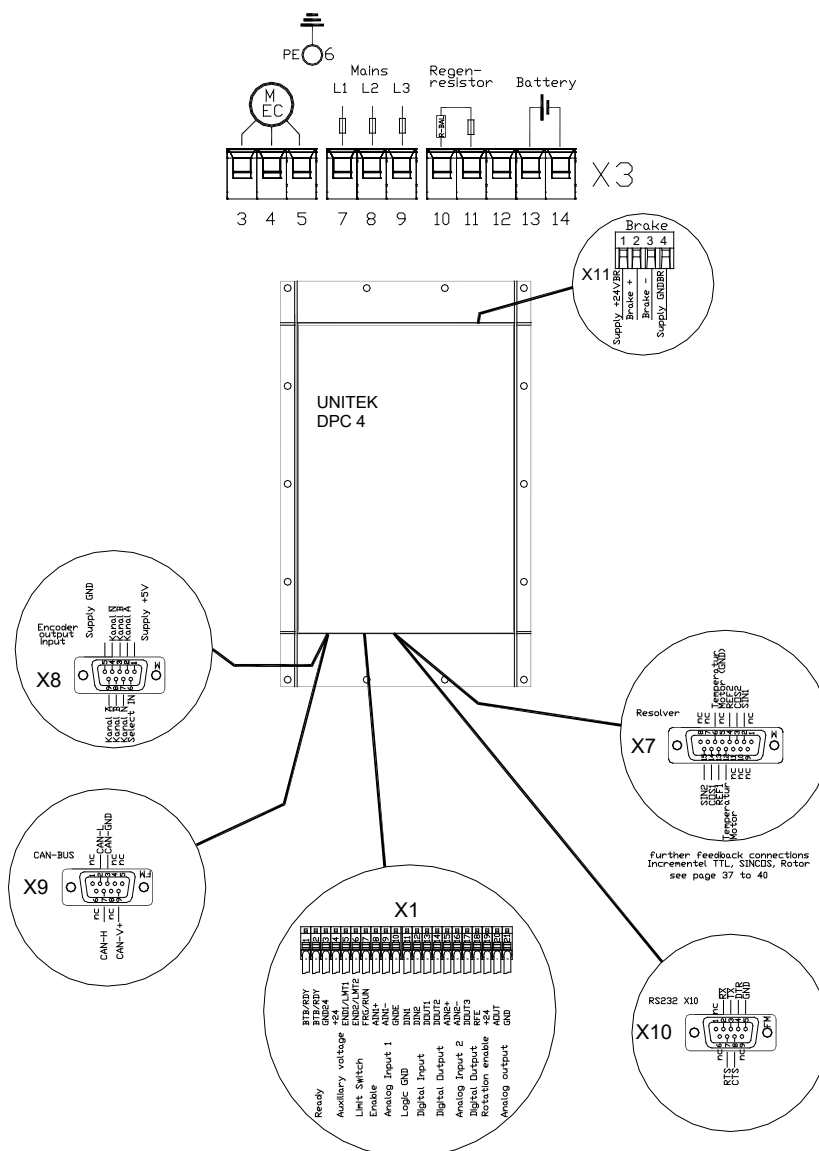## 3.3 Connection overview

Connection overview DPC440, DPC460

3.4 Connector overview

Connector overview DPC40, DPC460

Power connections

Control ports

Connector X1: 10-pin Phoenix, 11-pin Phoenix
Plug X7: D-plug 15 pinPlug
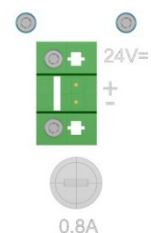Plug X8: D-connector 9 pinConnector X9:
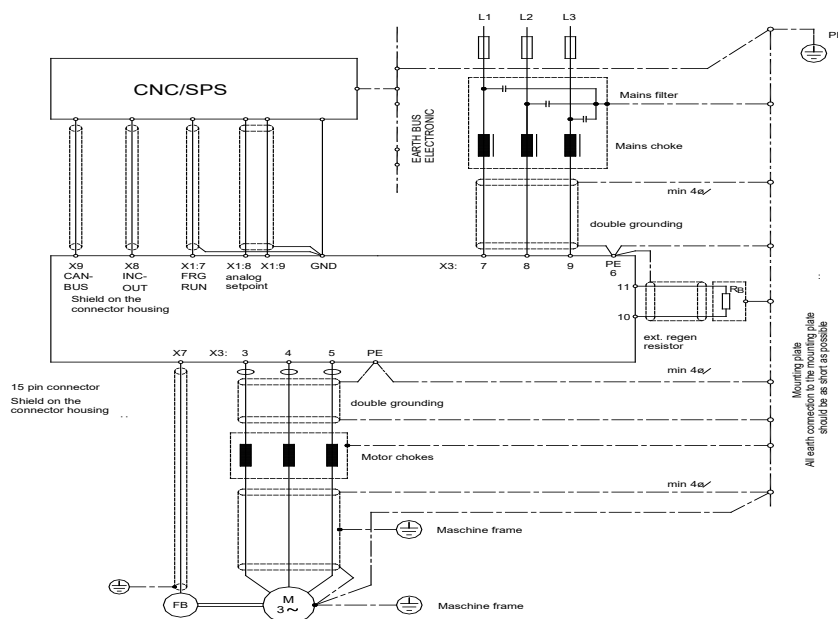D-plug 9 pinplug
plug X10: D-plug 9 polplug
Plug X11: 4 pin Phoenix

Fan box: Plug 2 pin Phoenix

Fan connection 24 V=

3.5 EMC

The units comply with the EC Directive 2004/108/EC in the standards EN61800-3 under the following installation and test conditions

Mounting:
Unit conductively mounted on blank mounting plate 500x500x2 mm.
Mounting plate connected to PE via 10 mm².
Motor housing connected to PE via 10 mm².
Device ground X-AGND connected to mounting plate via
2.5 mm².
Device PE screw X3:6 connected to mounting plate via cable 4mm².

Control connections:
Signal lines shielded, analogue signal lines twisted and shielded

Connection mains three-phase:
3 x 400 V~ with protective earth conductor

Motor **connection:**
Motor cable shielded, flat earth contact

In the case of installation in machines and systems, the start of the intended operation of the device is prohibited until it has been determined that the machine or system complies with the provisions of the EC Machinery Directive 2006/42/EC and the EMC Directive 2004/108/EC.
For vehicles ECE-R83, ECE-R100

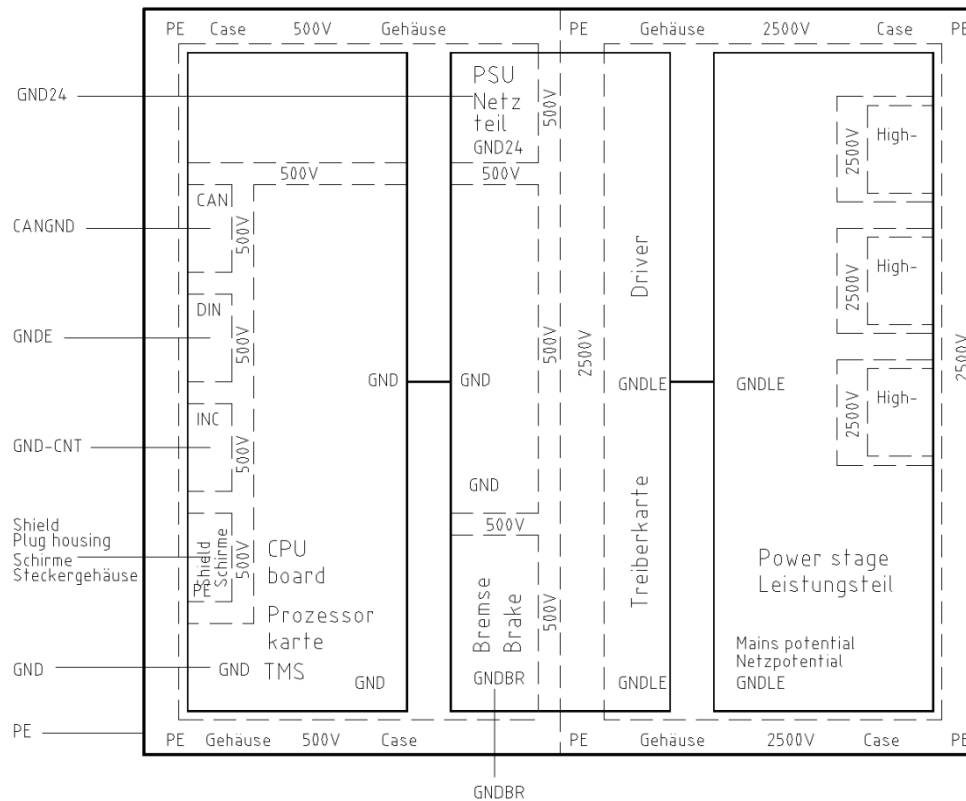A manufacturer's declaration can be requested.

3.6 Potential separation
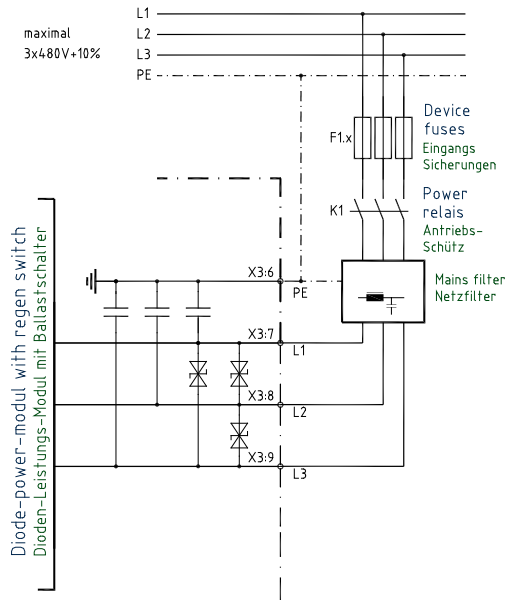
Earthing (PE)
PE connection according to EN 61800-5-1

3.7 Mains connection

Connection to the earthed three-phase mains (TN-C supply mains).
Connect asymmetrically earthed mains only via isolating transformer!

Connection to the T-NC network

Do not exceed the maximum connection
voltage of 528 V~, even for a short time.
Danger of destruction!

F1 = Device protection
Fuses FF, F or semiconductor
 circuit breakers
Additional mains filter for increased
EMC conditions DC link filter
and input capacitors are installed.
Leakage current > 60 mA

Charging current limit max. 48 A~
Charging time 5 ms

Connection T-NC mains with autotransformer
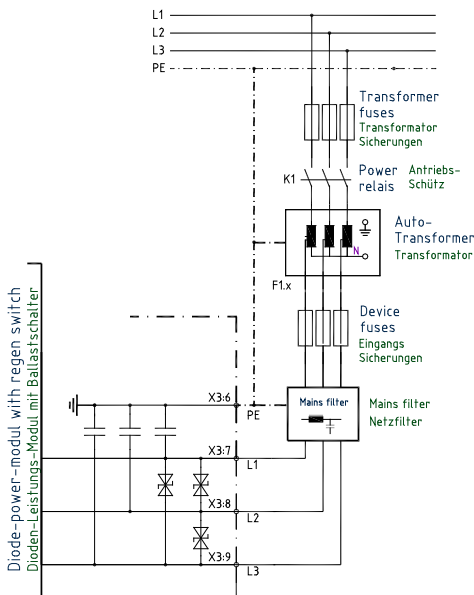
Maximum transformer
Secondary voltage 528 V~
even for a short time.
Danger of destruction!

Transformer fuses Slow characteristic

F1 = Equipment protection
Fuses FF, F or solid-state
 circuit breakers
Install
additional overvoltage protection against
transformer switching overvoltages.
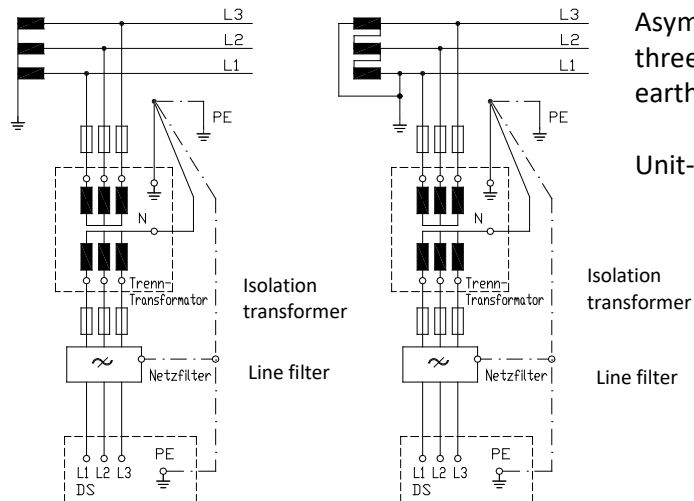
Additional mains filter for increased
EMC conditions DC link filter
and input capacitors are installed.
Leakage current > 60 mA Charge current limit
max. 48 A~
Charging time 5 ms

Attention: For supply networks without PE conductor / connection only via isolating transformer

Connection to the TT network

TT-Net
Asymmetrical three- or four-wire three-phase mains with direct earthing.

Unit-PE via earth connection

Connection to the IT network
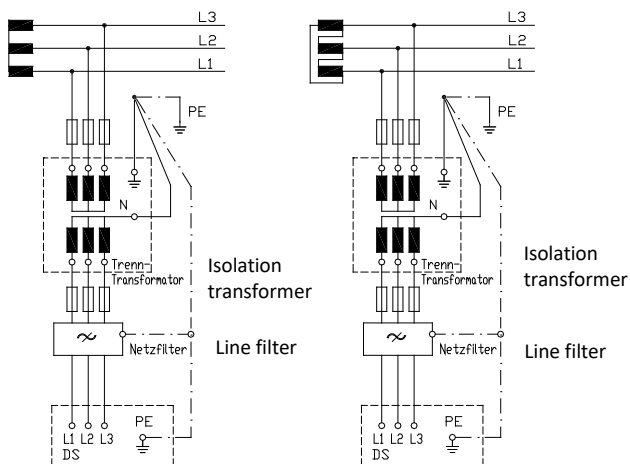
IT network
Asymmetrical three- or four-wire three-phase mains without direct earthing.

Unit-PE via earth connection

Connection data

Type	Three-phase connection 3x230V -10% to 3x480V +10% 50/60 Hz		min.	min. Connection-Cross-section mm2 AWG	recomm. Fuse	Drive-Contactor-Size	Mains filter type
440	L1=X3:3, L2=X3:4, L3=X3:5		2.5	14	40 AFF	DL0	F400V-B150-35
460			4	12	63 AFF	DL1	
PE connection at X3:9		**(operation without PE connection prohibited!)**					

Maximum conductor cross-section for spring-cage terminal PLH = rigid 16 mm2, flexible 25 mm2

3.8 Auxiliary voltage connection

Mains-potential-free auxiliary DC voltage   24 V= +/- 10 % / 2
ADThe auxiliary voltage has
- galvanic isolation from the logic voltage-
galvanic protective isolation from all internal supply voltages -
internal self-healing fuse-
EMC filter

External fuse only for line protection
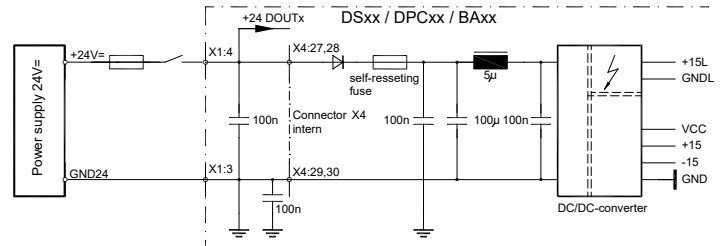
Input voltage	24 V DC	X1:4
	GND24	X1:3

Ripple	10 %
Power up current	2 A
Nominal current	0.8 A

GND must be earthed!

Attention: In addition to the internal supply current (0.8 A), the sum current of the outputs (DOUT) must be supplied by the 24 V power supply unit.

Attention: If the auxiliary voltage is less than 18 V, an error message is displayed.
If the auxiliary voltage is less than 16 V, including brief voltage interruptions, the internal power supply unit switches off. Data in the RAM memory is deleted.
Speed and position setpoints are set to 0, calibration data are lost.
The message OK in the status is dark.

3.9 Brake

The brake driver is electrically isolated from all voltages.

| supply +24 V	X11:1Brake		
plus	X11:2		
Brake minus	X11:2Brake supply	GND24	X11:4

max. braking current   4 A

Error message in case of
-wire break
-short
 circuit
-overvoltage -failure of
power supply
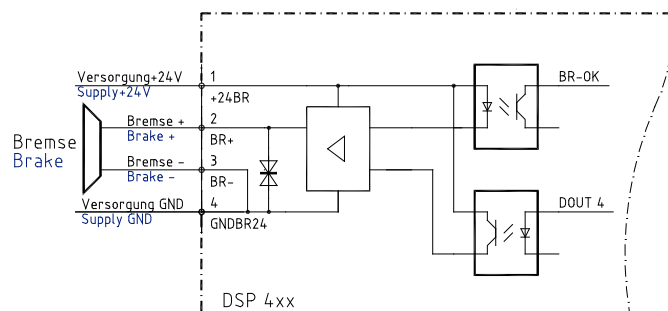
3.10 Motor power connection

Only use electronically commutated synchronous motors (brushless DC motors, EC motors) with resolver or incremental encoder approved by the manufacturer.
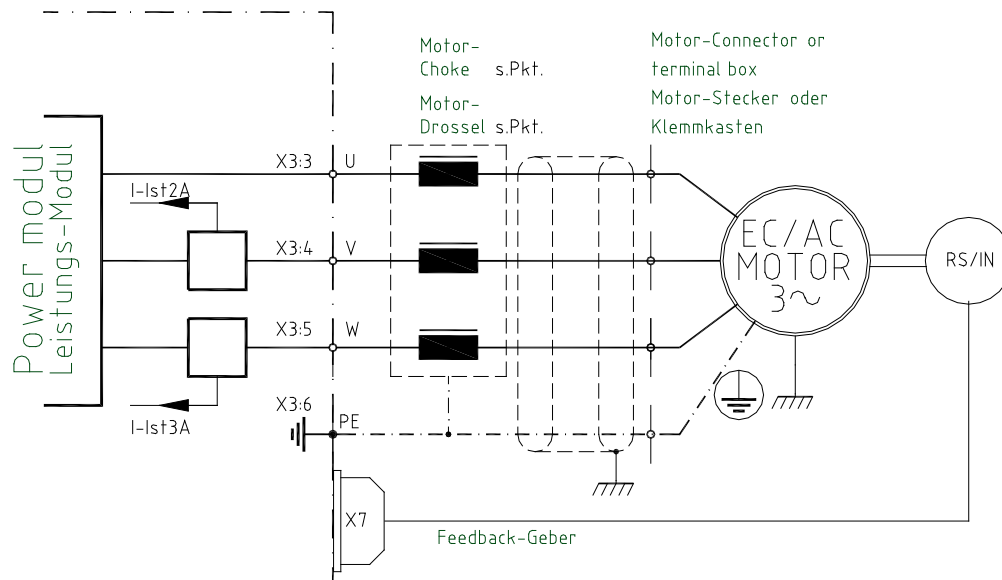
Cable designation	PE	U	V	W	Motor cable
Connection terminal	X3:6	X3:3	X3:4	X3:5	3 cores + protective earth
Only one correct connection sequence possible!					Single shielded for 600 V~, 1000 V= Shield capacitance 150 pF/m Minimum cross-section s. Table

DPC	440	460		Motor choke
Cross section mm²	4	10		Only necessary from a screen capacity of
AWG	10	6		of >5 nF. approx. 25 m motor cable

Maximum conductor cross-section for spring-cage terminal PLH = rigid 16 mm2, flexible 25 mm2
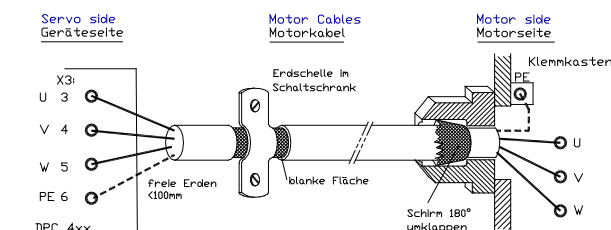
Shield connection
Flat connection at the
Control cabinet input.
Flat or shortest possible
connection on the
Engine side.

If the motor cable is long, earth the screen several times (e.g. earth terminals every 5 metres).

3.11 Ballast circuit / battery connection

The energy that occurs during braking is fed back into the DC link.
The DC link capacitors can only store a small amount of energy.
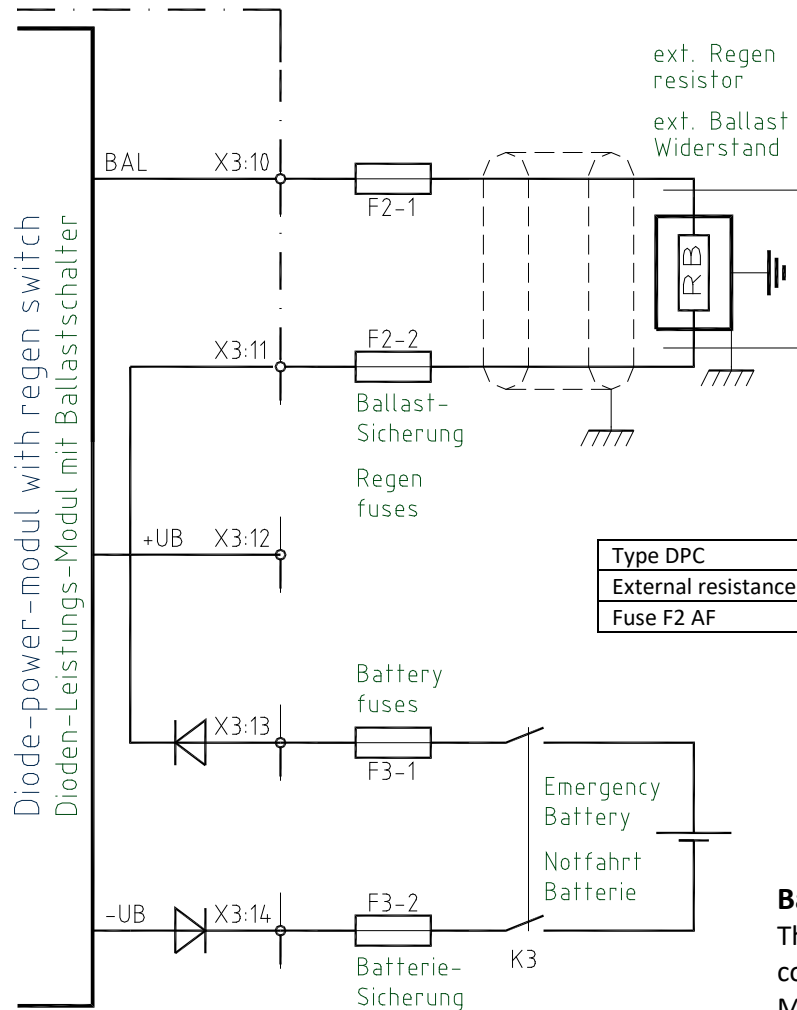The excess energy must be converted into heat in the ballast resistor.

**Always external
Insert ballast
resistors**

F2 hedging against
Earth fault.
Electronic limitation
against overload and
ballast short circuit.

Type DPC	440	460
External resistance min. ohm	8	8
Fuse F2 AF	50	50

Battery connection
The emergency battery is
connected to X3:1 and X3:2.
Maximum battery voltage
400V=
Short-circuit fuses
F3 = 63 A

Diode-power-modul with regen switch
Dioden-Leistungs-Modul mit Ballastschalter

BAL   X3:10   F2-1   ext. Regen resistor   ext. Ballast Widerstand   RB

X3:11   F2-2   Ballast-Sicherung   Regen fuses

+UB   X3:12

Battery fuses

X3:13   F3-1   Emergency Battery   Notfahrt Batterie

-UB   X3:14   F3-2   Batterie-Sicherung   K3

3.12 Ballast - Calculation

External ballast resistor

Dimensioning
Maximum value of the braking power

$$P_{max} [W] = \frac{J_g \times n \times \Delta}{91 \times t_B}$$

Power ballast resistor

$$P_{Ballast} [W] = \frac{P_{max}}{K_1 \times K_2}$$

|			
J_g	=	Motor and reduced load torque	[kgm²]
n	=	maximum rotational speed	[min^{-1}]
n	=	Speed difference	[min^{-1}]
t_B	=	Braking time	[x]
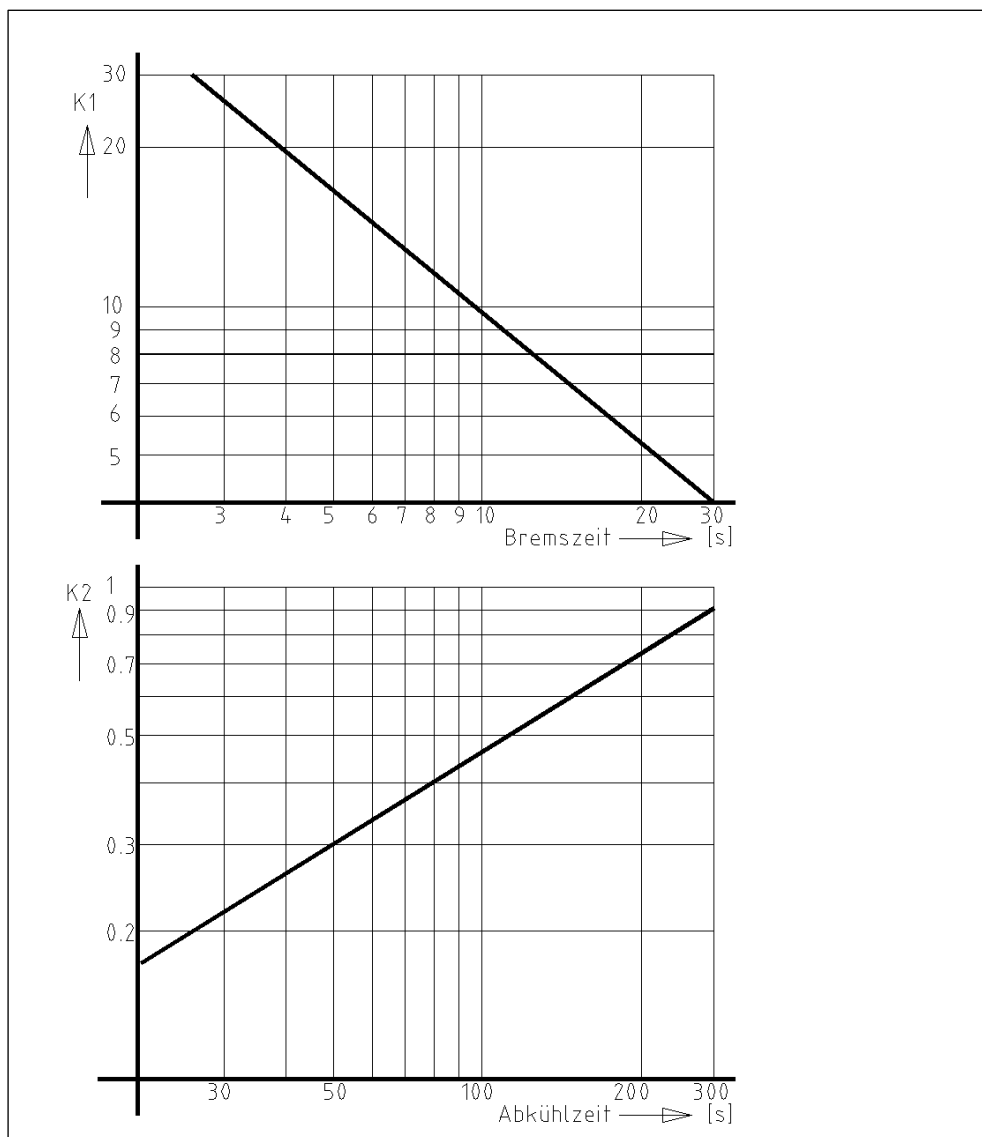
Attention:
The shunt resistor can become hot up to 200 °C. Mount the resistor so that it is safe to touch.
Do not place any heat-sensitive parts directly on the resistor or in the heat air flow.
Observe the temperature rise in the control cabinet, mount the resistor outside if possible.

4 Control ports

4.1 Digital inputs

6 optocoupler inputs
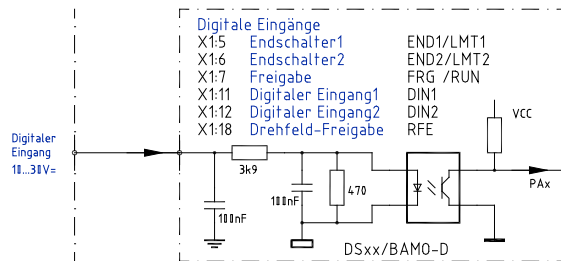
Input voltage		
ON level		+10 to +30 V
OFF level		<+6 V
Input current	Max.	7.5 mA
Nominal voltage/current		24 V/
		6 mA
Reference mass	GNDE	(X1:10)

The enable input (FRG/RUN) and the input for rotating field enable (RFE) are permanently assigned and cannot be programmed.

Without enable (FRG/RUN the servo is electronically locked (no PWM pulses).

Without rotating field release RFE, the rotating field of the output stage is also electronically blocked (second blocking channel).
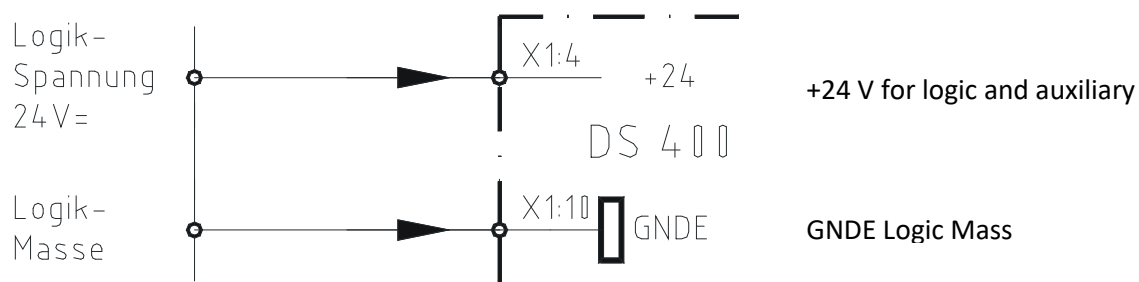
The drive is torque-free (no holding torque).

The other 4 digital inputs are freely programmable.
The inputs LMT1 (X1:5) and LMT2 (X1:6) are preferably to be used as limit switch inputs.

Entrance	Connection	Function	Status	Parameter
FRG/RUN	X1:7	Release/Nable	fixed	
RFE	X1:18	Rotary field/Nable	fixed	
END1/LMT1	X1:5	Limit switch1/Dig. input	programmable	
END2/LMT2	X1:6	Limit switch2/Dig. input		
DIN1	X1:11	Digital input1		
DIN2	X1:12	Digital input2		

External power supply for inputs and outputs

+24 V for logic and auxiliary

GNDE Logic Mass

4.2 Safety input RFE (rotating field - enable)

Stop category 0
Attention:
When the input of the enable or the rotating field enable is switched off, the drive is torque-free. Without a mechanical brake or lock, the drive can fall through or move.
The motor cables are not voltage-free. Only the rotating field is blocked. When working on the motor or servo, the servo amplifier must be disconnected from the mains.

Operation with RFE input
Two-channel enabling lock via a safety switching device.
Enable input FRG/RUN plus
Rotary field enable input RFE

Switch on
Safety device Contacts closed
Release FRG/RUN 0.5 sec. after RFE

Safety shutdown
Safety device contacts opened
No FRG/RUN signal blocks in the first blocking channel the PWM pulses in the processor.
No RFE signal blocks the PWM pulses in A second barrier channel after the Processor.

Switch on again
Unlock the safety device.
Safety device Contacts closed.
The motor can only move after FRG/RUN has been enabled again after the rotating field has been enabled.

Operation without RFE input
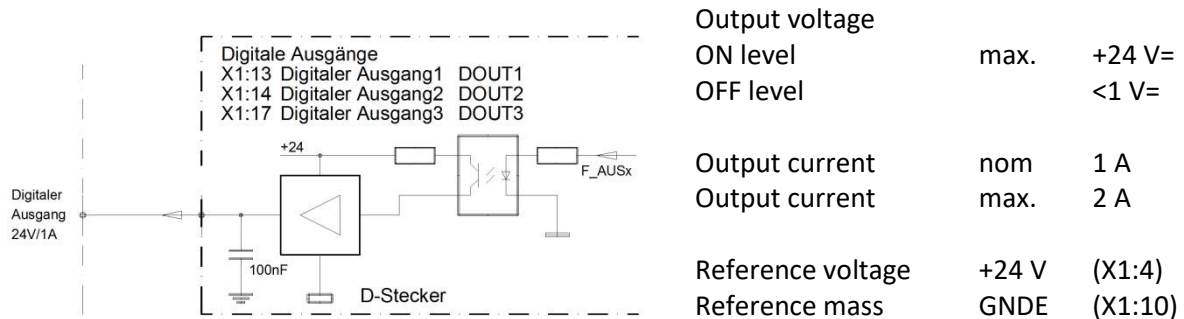The input RFE must be bridged with the logic voltage

If the logic voltage is equal to the supply voltage,
the RFE input is bridged with +24V.
The release FRG/RUN at least 0.5 sec. after the RFE signal.
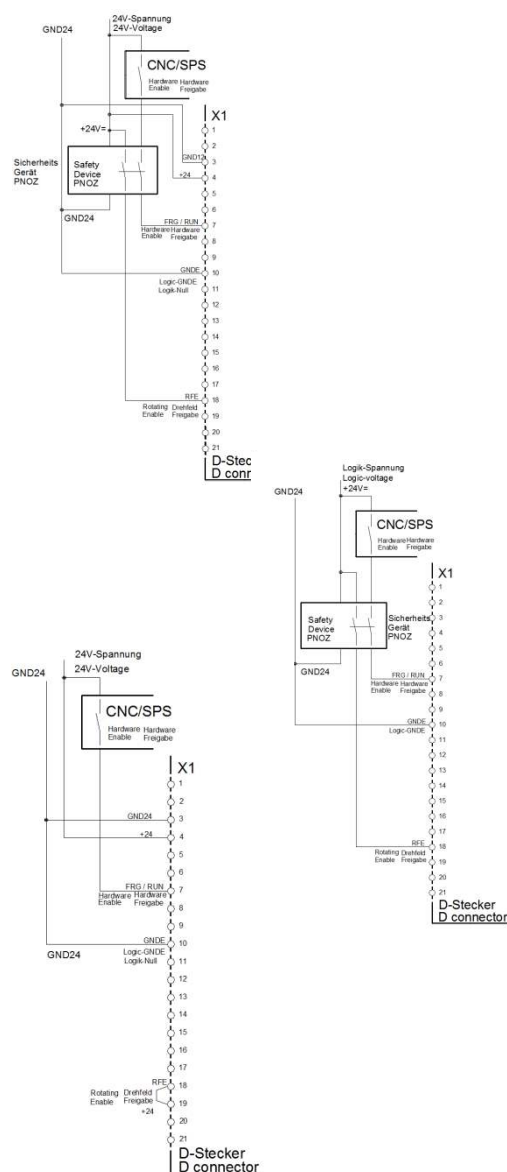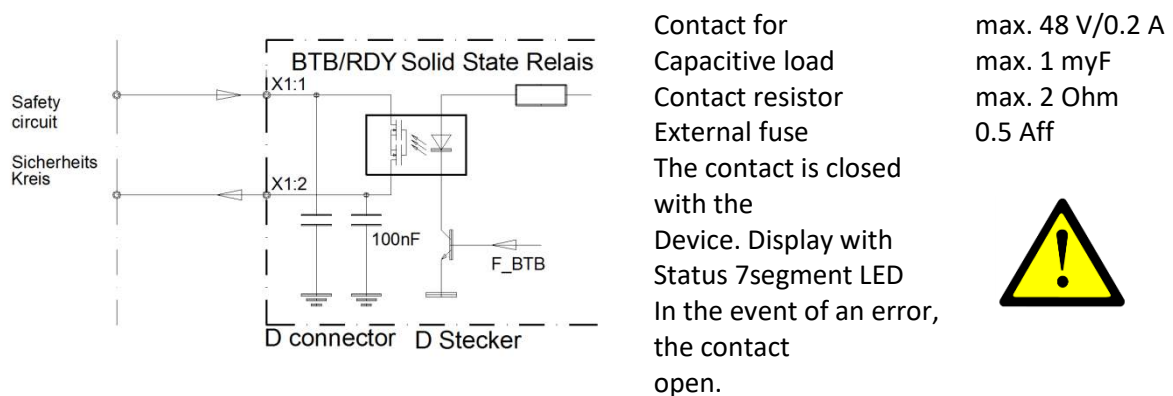
4.3   Digital control signals (0pen emitter)

Logic outputs 1 to 3 are designed for 24 V and 1 A. 2 A for a short time.

Output voltage		
ON level	max.	+24 V=
OFF level		<1 V=
Output current	nom	1 A
Output current	max.	2 A
Reference voltage	+24 V	(X1:4)
Reference mass	GNDE	(X1:10)

An energy-saving programme can be programmed (clocked output).
Logic output 4 (24 V, 3 A) is only available with certain units on the power section.

Signalling contact ready for operation (solid rate relay) / Ready BTB / RDY

Contact for	max. 48 V/0.2 A
Capacitive load	max. 1 myF
Contact resistor	max. 2 Ohm
External fuse	0.5 Aff

The contact is closed with the
Device. Display with Status 7segment LED
In the event of an error, the contact open.

**BTB/RDY contact always in the Insert safety circle!**

Ready for operation drops out (LED red, relay contact open)

For error messages
in case of undervoltage of the auxiliary voltage (<20 V)
The message undervoltage in the DC link can be programmed (see NDrive manual).

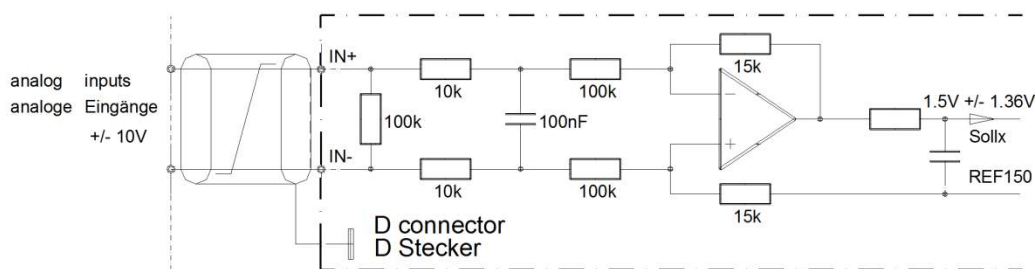| Output	Connection	Function	Status	Parameter
BTB/RDY	X1:1, X1:2	Ready for operation	Fixed / Relay	
DOUT1	X1:13	Digital output 1	Programmable	
DOUT2	X1:14	Digital output 2	Programmable	
DOUT3	X1:17	Digital output 3	Programmable	
DOUT4	Xx:Xx	Digital output 4	Programmable	
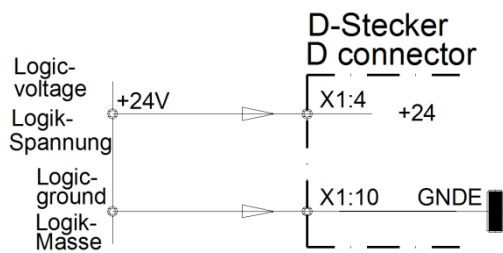
+ 24 V for logic and auxiliary voltage

GNDE Logic Mass

Note the total current of all outputs!

Analogue input +/- 10V

Entrance	Output	Basic function	Voltage	Status	Parameter
AIN1+, AIN1-	X1:8, X1:9	Speed setpoint	+/- 10 V	prog.	
AIN2+, AIN2-	X1:15, X1:16	Current limit	+/- 10 V	prog.	

Properties

Differential input	AIN1+ / AIN1-	AIN2+ / AIN2-	
Input resistance	70 k		
Voltage limit	+/- 12 V		
Resolution	11 bit + sign		

The direction of motor rotation can be changed by swapping the +/- connections on the differential input, by a logic input or by programming.

The analogue inputs can be assigned to different functions.

The analogue input AIN1 can be used with a digital setpoint (RS232, x-BUS).
- as an external analogue speed limit and the analogue input AIN 2 can be
- can be programmed as an external analogue current limit.

Analogue output +/- 10 V

Entrance	Output	Basic function	Voltage	Status	Parameter
AOUT1	X2:20	Speed setpoint	+/-10 V	prog.	
GND	X2:21	Signal zero	0V	fixed	

4.4 Serial interface RS 232

The unit is programmed via the serial PC interface RS232 and operated during commissioning. The software is described in the DS NDrive software manual.
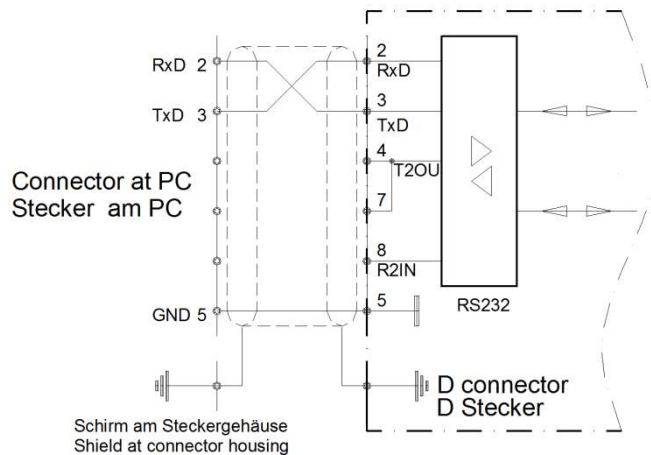
The serial interface is galvanic with the Devices - Zero (GND / AGND) connected

Connection between controller (D-connector X10) and the serial interface (COMx) on the PC only with a null modem cable.
Do not use null modem link cable!
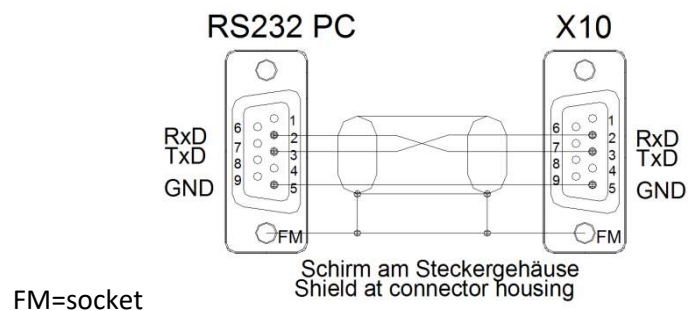Only plug in the cable when it is de-energised.
The interface is fixed at **115200 baud**
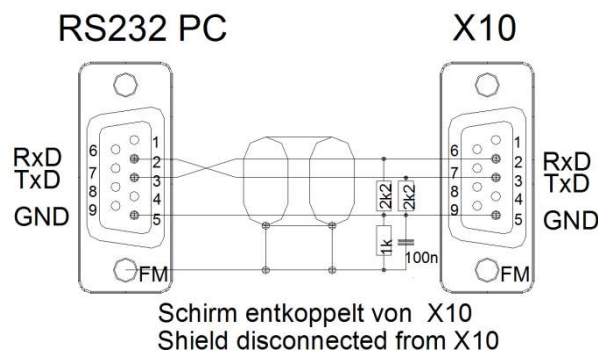
Null modem connection cable
View of solder side
Screen on the housing
Cable length max. 10m

FM=socket

In the event of severe disruptions on the
interface, a line filter should be used.
Laptop with USB-RS232 converter are usually sensitive to interference.

4.5   CAN-BUS

The CAN-BUS is the digital connection to the CNC control.
Optimum conditions with CNC controls and CAN components from
Company LABOD electronic or CAN Open.
Programming and operation via control panel with CAN-BUS.
Interface according to ISO 11898.
For setting and programming, see DS-CAN manual.

The BUS interface is galvanically
separated from the internal device voltage.

The power supply is provided by an internal
isolated DC-DC converter.
(Special version: Without DC/DC converter with
external supply 9-15 V)

CAN-BUS isolated /
Bring CAN-Gnd to common potential
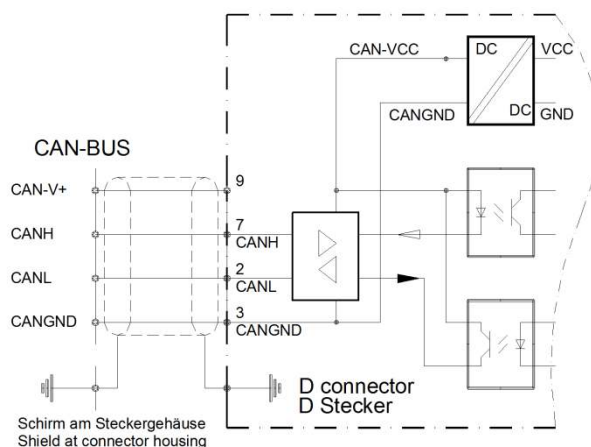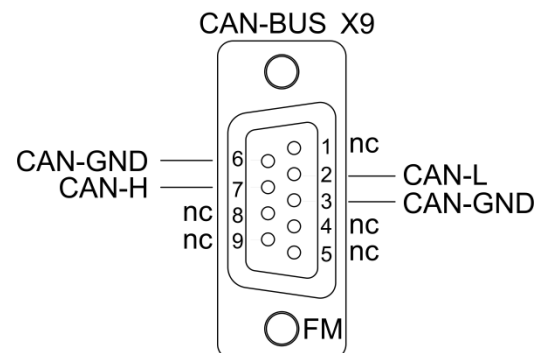
CAN BUS cable
Shielded bus cable with low
Use screen capacity.
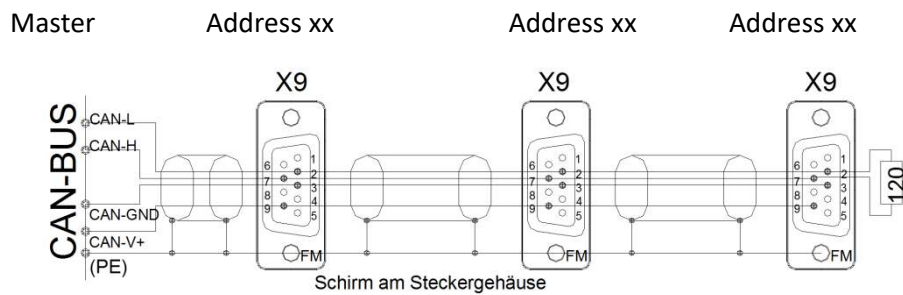D-connector with metallic or metallised
Housing.

LiYCY 4x0.25+Shade

Designation	Plug no.	Cable colour
CAN-V+	9	brown
CAN-GND	3	white
CAN-H	7	green
CAN-L	2	yellow

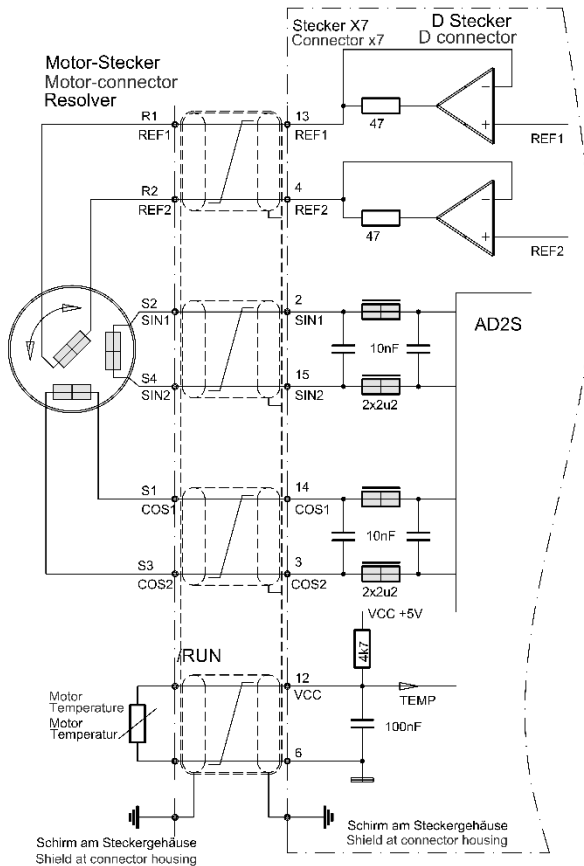**(Attention: Colours can be different)**

FM = jack

CAN-BUS connection with several devices

Termination resistor at the end of the bus line > 120 Ohm between CAN-H and CAN-L

4.6 Resolver connection

Only with variant-RS

The resolver is an absolute measuring system for one motor revolution.
It is robust and insensitive to high engine temperatures.
The design corresponds to a rotating transformer.
The rotor is fed by the reference (10kHz).
The stator supplies the sine and cosine signals modulated by the rotational frequency.
In the servo amplifier, the amplitudes of these signals are evaluated and digitised.
The resolution is automatically set to 10, 12 or 14 bits.
The maximum possible speed is 50 000 (10 bit).
The digitised signals are used for the pole wheel angle, the position control, the speed control and for the increment output.
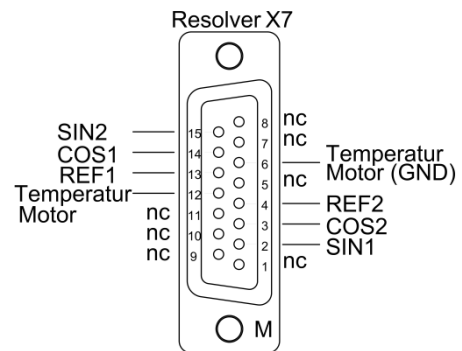
Only use a motor approved by the manufacturer with a 2, 4, 6 or 8-pole resolver. Observe the motor-specific connection sheet (RS)!

Connector plug	X7	15 pole D connector	
Connection cable	4x2 cores twisted in pairs and shielded, plus overall shield. Use only suitable cable for drag chain		
Cable length	for >25m, only use high-quality resolver cables with improved shielding properties.		
Shield connection	at connector X7	combine all umbrellas and Contact with the housing	
	on the motor plug	Contact the overall shield with the connector housing	
Setting parameters	see software manual		

4.7 Encoder TTL connection

Only with variant-IN
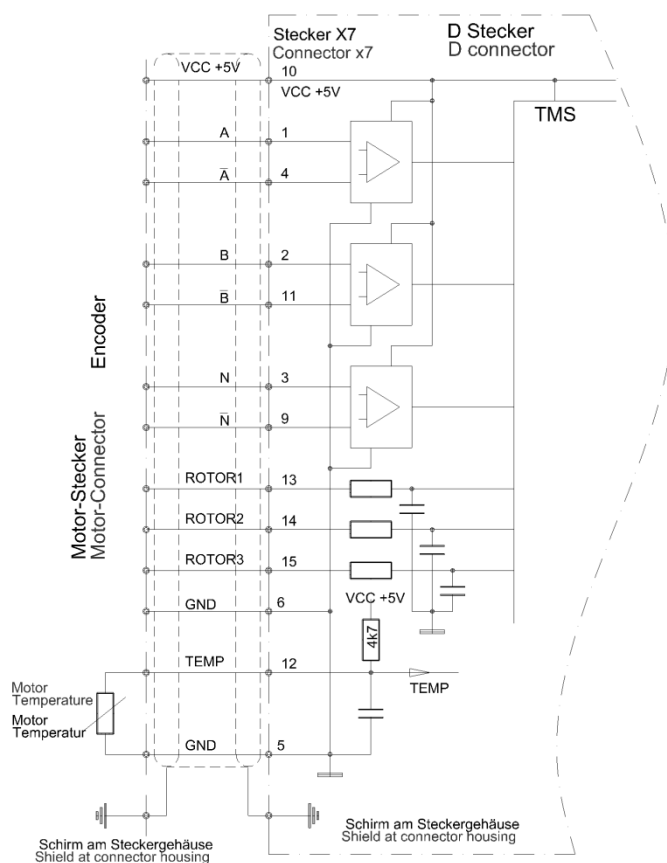
ITTL incremental encoder (encoder) with 2 counting tracks and one zero track
plus 3 rotor position marks. Counting tracks with or without push-pull output.

(With simple connection (only A,B,N channels) do not use the negated inputs).

Count input corresponds to RS485 Maximum counting frequency 500kHz

The incremental encoder is galvanically connected to the device zero (GND).
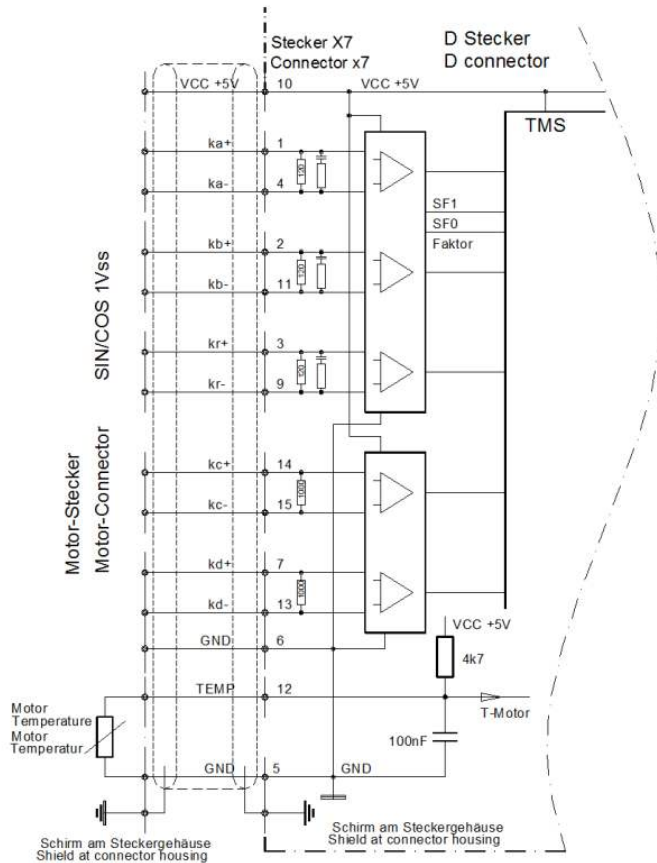
The servo supplies 5 V.
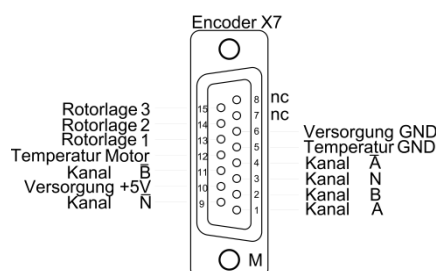
Only use motors approved by the manufacturer with TTL incremental encoder and rotor position tracks. Observe motor-specific connection sheet (IN)!

Connector plug	X7	15 pole D connector	
Connection cable	10 signal wires shielded	Minimum cross section 0.14 mm	
	2 supply cores	Minimum cross section 0.5 mm	
	Use only suitable cable for drag chain.		
Cable length	for >25m cross-section one step larger.		
Shield connection	at connector X7	Contact the shield with the connector housing.	
	on the motor plug	Contact the shield with the connector housing.	
Setting parameters	see software manual		

4.8 SIN COS 1Vss connection

Only with variant-SC

Incremental encoder
with 2 analogue sinusoidal
counting tracks and one zero track
plus 2 commutation tracks.
Differential signals 1 Vpp

Maximum count frequency
500 kHz

The incremental encoder is
galvanically connected to the device
zero (GND).
The servo supplies 5 V.
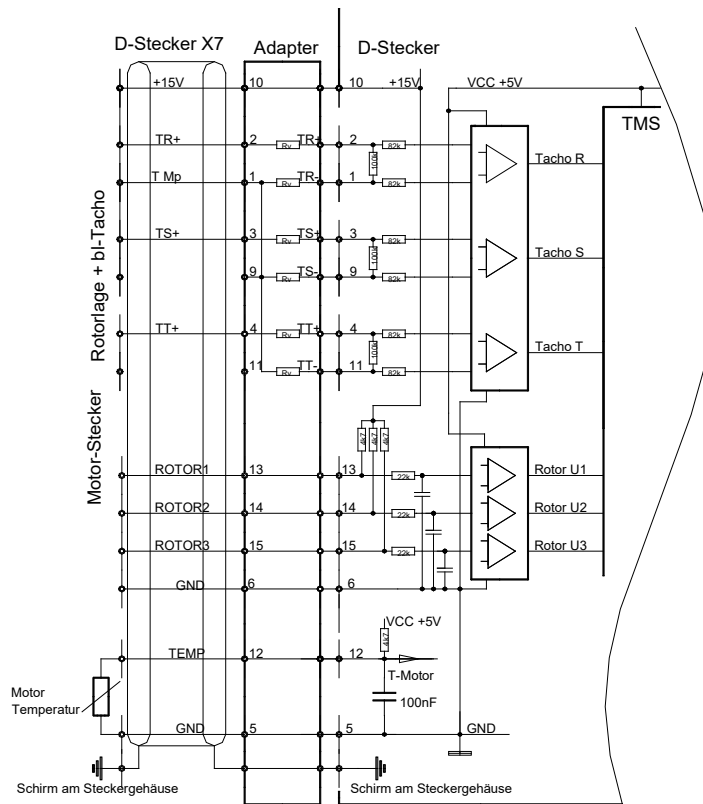
The resolution is automatically set to
optimum.

Pin assignment
Solder side
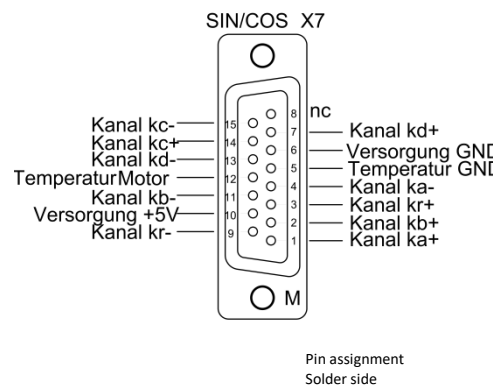
Only use motors approved by the manufacturer with SIN / COS encoder (SC).
Observe the motor-specific connection sheet (SC)!

Connector plugX7	15pin D-plug	
Connection cable mm	4xsignal wires drill-shieldedMinimum cross-section	0.14
	2xsignal cores shieldedMinimum cross-section 0.14 mm	
	4x supply cores, temp. minimum cross-section 0.5 mm	
Cable type	(4x(2x0,14)+(4x0,14)C+4x0,5)C	
	Use only suitable cable for drag chain	
Cable length	for >25m cross-section one step larger	
Shield connection on housing.	connector X7 Contact the shield with the connector	
	on the motor connector Shield contact with the connector	

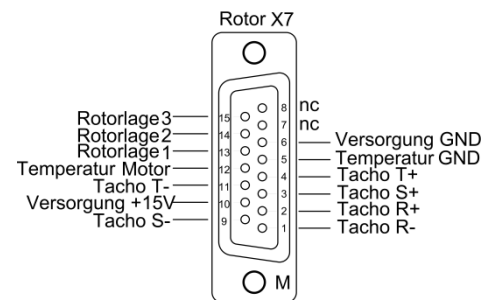## 4.9 Rotor position sensor connection with bl tacho

Only with variant-bl

3 rotor position sensor signals (Hall sensors) for commutation.
With or without brushless tachogenerator.

The rotor position sensor is galvanically connected to the device zero (GND). Supply voltage 15V from the servo.

Adaptor if the tachometer voltage at nominal speed is greater than 10 V~.

For smaller tachometer voltages
X7: Connect pin 1,9 and 11.
Connect tacho centre to X7:1.

M, pin contact / pin assignment solder side

Only use motors with rotor position sensor (bl) approved by the manufacturer.
Observe the motor-specific connection sheet (bl)!

Connector plugX7	15pin D-plug
Connection cable	12 x signal wires, supply wires, temp.
	Minimum cross section 0.25 mm
	Use only suitable cable for drag chain.
Cable length	for > 25 m cross-section one step larger.
Shield connection on housing.	connector X7 Contact the shield with the connector
	on the motor connector shield with the connector housing.
For setting parameters see	Software Manual DS NDrive

4.10 X8 TTL encoder output or input (2)

The D-connector X8 is switched as input or output (default).

Output X8   Pin 6 not connected or bridged with GND.
Input   X8 pin 6 bridged   with +5 V (X8:1)
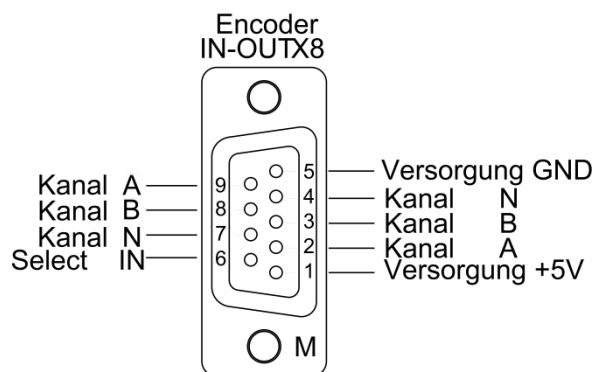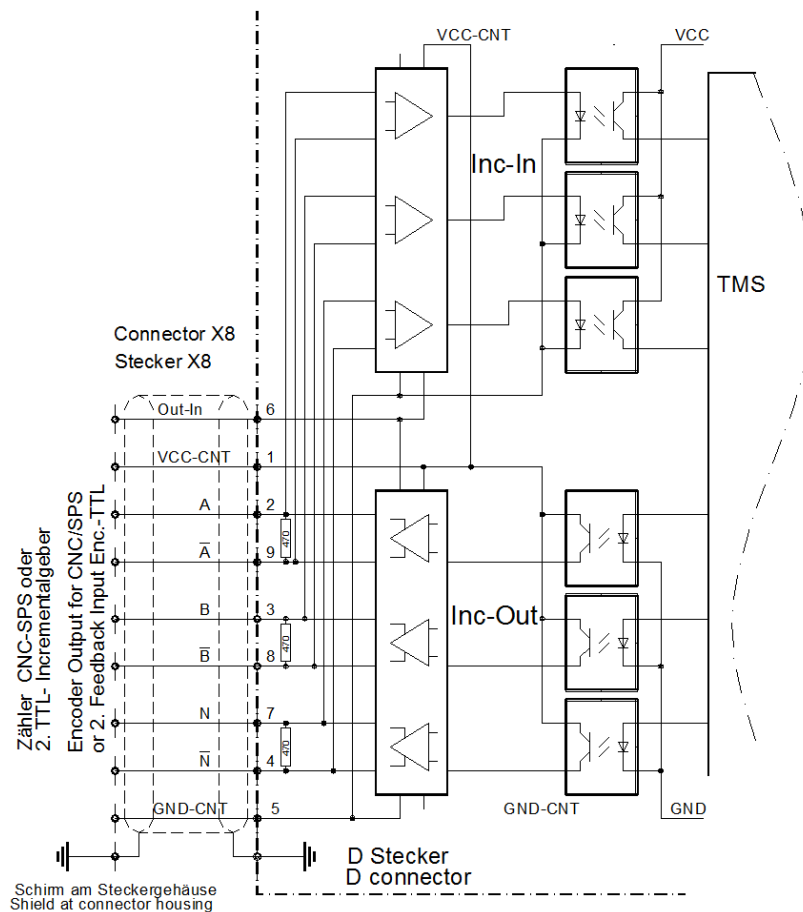
9 pin D connector (M, pins)

Pin assignment solder side

Attention:
X8 as input

X8:6 (Select IN) with X8:1 (+5 V)
connect in the D-connector

4.11 X8 as TTL encoder output

The encoder signals (feedback) supplied by the motor are output as TTL encoder signals for the CNC control at D connector X8.

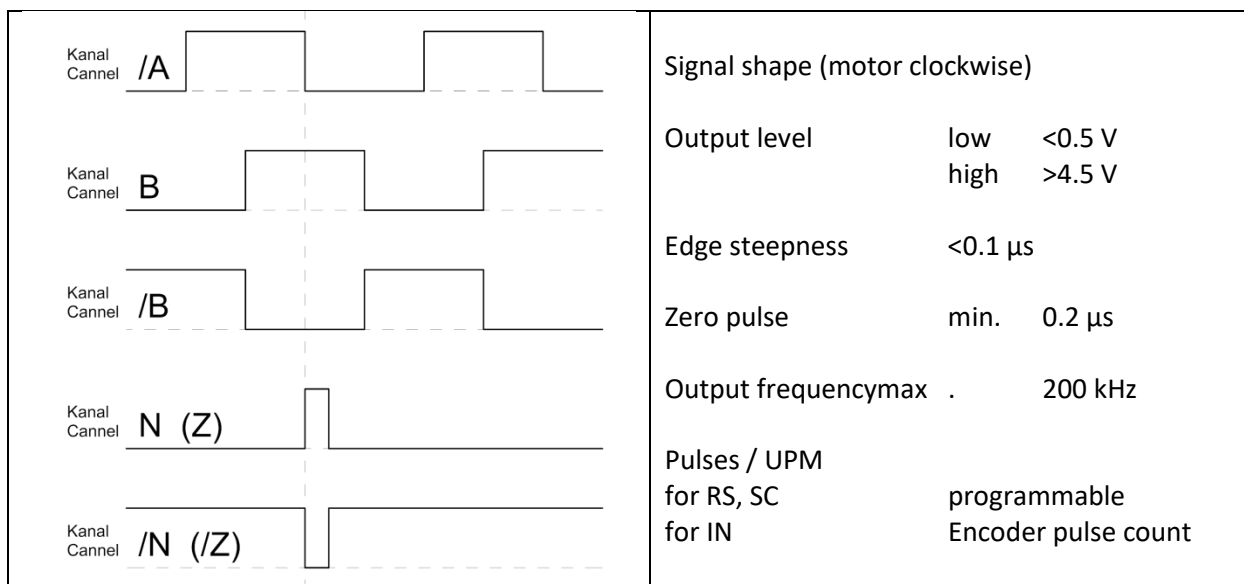The encoder output is electrically isolated.
Power is supplied via the encoder cable from the CNC/PLC control.
Power supply +5 V +/- 0.2 V
The output signal corresponds to RS485

Option: Internal supply from servo (LBR1 + LBR2)

The resolution is programmable for RS and SC. (parameter 0xa4, bit 1), for IN equal to the encoder pulse number.

Kanal Cannel /A	Signal shape (motor clockwise)
Kanal Cannel B	Output level low <0.5 V high >4.5 V
Kanal Cannel /B	Edge steepness <0.1 µs Zero pulse min. 0.2 µs
Kanal Cannel N (Z)	Output frequencymax . 200 kHz
Kanal Cannel /N (/Z)	Pulses / UPM for RS, SC programmable for IN Encoder pulse count

X8 as TTL - encoder input

Attention: X8 pin 6 (Select IN) must be bridged with X8 pin 1 (+5 V)!

The encoder input is electrically isolated.
Power is supplied via the encoder cable
Option: Internal supply with servo
Input signals according to RS485
Input frequency max. 200 kHz

Option: Internal supply from servo (LBR1 + LBR2)

The encoder input can be programmed for different functions.
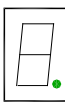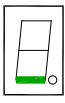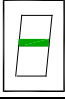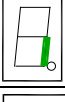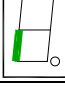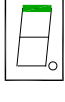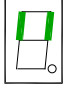See software description NDrive.

4.12 Light display status

In the **"Normal"** state, the green 7-segment display plus decimal point lights up as an operating indicator (status display).

In the **"Error"** state, the red error LED lights up and the 7-segment display shows the error number.

In the **"Warning"** state, the red error LED flashes and the 7-segment display alternately shows the status and the warning number.

Status display on the servo

Display	Dot/ dash	State		Status at NDrive
	flashes	Processor active		
	dark	Auxiliary voltage missing or unit-internal hardware error		
	flashes	Start status after reset (auxiliary voltage 24 V off-on) The first release ends the flashing state		OK = 0
	lights up	Drive enabled		OK = 1, ENA = 1
	dark	Drive locked (not enabled)		OK = 1, ENA = 0
	lights up	Speed equal to zero (standstill message)		N0 = 1
	lights up	Drive turns right, N currently positive		N0 = 0
	lights up	Drive turns left, N currently negative		N0 = 0
	flashes lights up dark	Motor current reduced to continuous current **Icns** Motor current at maximum current limit Imax Normal operation, motor current within the current limit		Icns = 1 Icns = 0 Icns = 0
	Lights up for 0.1 seconds	Left bar:	A new command (value) has been received from the BUS or RS232.	
		Right bar:	Digital input changed	

Example: Motor clockwise
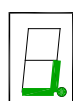
Dot flashes	= Processor active
Bottom line	= Drive enabled
Right line	= Motor turns right

Ballast circuit switches: Direction bar (bottom right or left) is switched off, while the ballast circuit switches on.

4.13 Indicator lights Error

The red "FAULT" LED lights up and the green 7-segment display shows the error number.

Error list

| Display Controller	Error display at NDrive	Meaning
0	BADPARAS	Parameter damaged
1	POWER FAULT	Power stage error
2	RFE ROT	Safety circuit faulty (only active during RUN)
3	BUS TIMEOUT	Transmission error BUS
4	FEEDBACK	Encoder signal faulty
5	POWERVOLTAGE	Power voltage missing
6	MOTORTEMP	Engine temperature too high
7	DEVICETEMP	Unit temperature too high
8	OVERVOLTAGE	Overvoltage >1.8 x UN
9	I_PEAK	Overcurrent 300 %
A	RACEAWAY	Spinning (without setpoint, wrong direction)
B	USER	User - Error selection
C	12R	Overload
D	RESERVE	
E	ADC-INT	Current measurement error
F (device-dependent)	BALLAST	Ballast circuit overloaded
Decimal point flashes	Processor active	
Decimal point dark	Auxiliary voltage missing or unit-internal hardware error	

Indicator lights on the servo:

In case of an error, the red LED FAULT lights up and the error number is displayed.
The BTB contact is opened.
The software BTB message switches from 1 to 0.
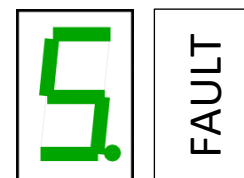The status message Rdy goes dark.
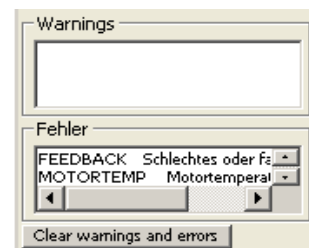
When switching off the release (Enable), the error message remains.

The error message is deleted.
When Cancel errors is switched on by a digital input or via CAN BUS.

Attention:

When applying the 24 V auxiliary voltage with closed enable (FRG/RUN X1:7 active)
the red LED indicates an error. There is no error indication in the 7-segment display.

4.14 Indicator lights Warnings

In the **"Warning"** state, the red error LED flashes and the 7-segment display alternates between the status and the warning number.

Warning messages

Display Controller	Error display at NDrive	Meaning	ID address
			REGID 0x8f
0	WARNING_0	Device recognition inconsistent	Bit 16
1	ILLEGAL STATUS	RUN signal	Bit 17
2	WARNING_2	FE signal inactive	Bit 18
3			Bit 19
4			Bit 20
5	POWERVOLTAGE	Power voltage too low or missing	Bit 21
6	MOTORTEMP	Engine temperature > 87 %	Bit 22
7	DEVICETEMP	Unit temperature > 87 %	Bit 23
8	OVERVOLTAGE	Overvoltage > 1.5 x UN	Bit 24
9	I_PEAK	Overcurrent 200%	Bit 25
A			Bit 26
B			Bit 27
C	I2R	Overload > 87 %	Bit 28
D			Bit 29
E			Bit 30
F (depending on unit)	BALLAST	Ballast circuit > 87 % overloaded	Bit 31

Fault

Example:
Flashes red,
The display alternates between
Status and warning number /
Warning number 5

Warnings

MOTORTEMP
Motortemperatur >87%

Fehler
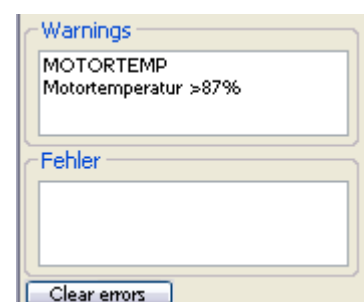
Clear errors

4.15 Measured values

DC link voltage

DPC-xx	DC link-Voltage	Parameter 0xeb	DC BUS - %
Maximum voltage	740 V	22250	135
Battery voltage	400 V	12030	74
Overvoltage cut-off	860 V	25860	158
Ballast voltage	790 V	23755	144
Standardisation			
DC BUS	1 V	30,07	0,184

Actual current value

BPC-xx	I 100 %	Calibration nominal current I-device			Peak current DC blocked	
Maximum value +/- 11Bit	mV	Num	Aeff	A=	Num	A=
440	394	560	40	56	800	80
460	590	840	60	84	1200	120

4.16 Power stage temperature

IGBT module temperature	Analogue voltage X4 Pin6	Parameter 0x4a
Maximum +80	2,70	26474 (FW> 400)
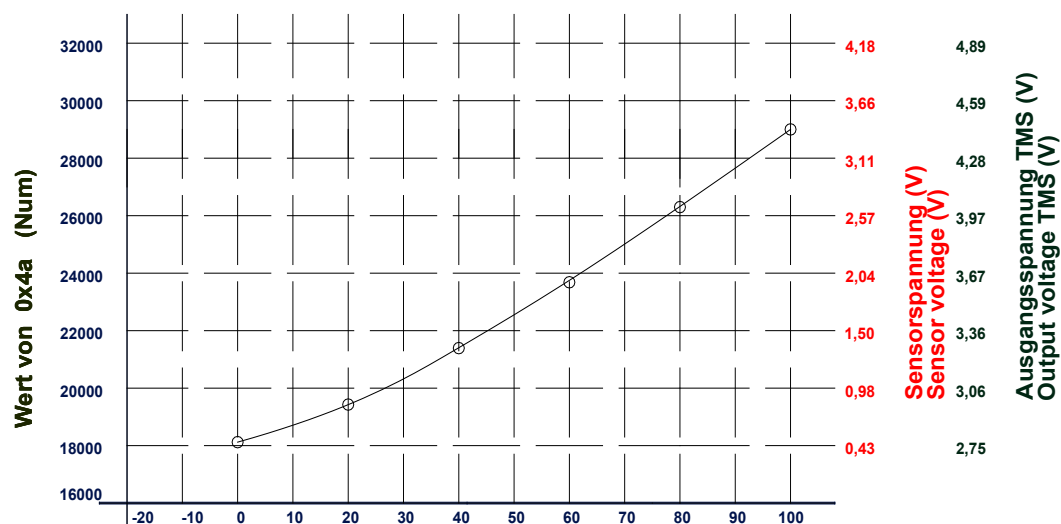
Temperature prewarning 0xa4 = 24000
Temperature shut-off 0xa4 = 25000

DC link voltage
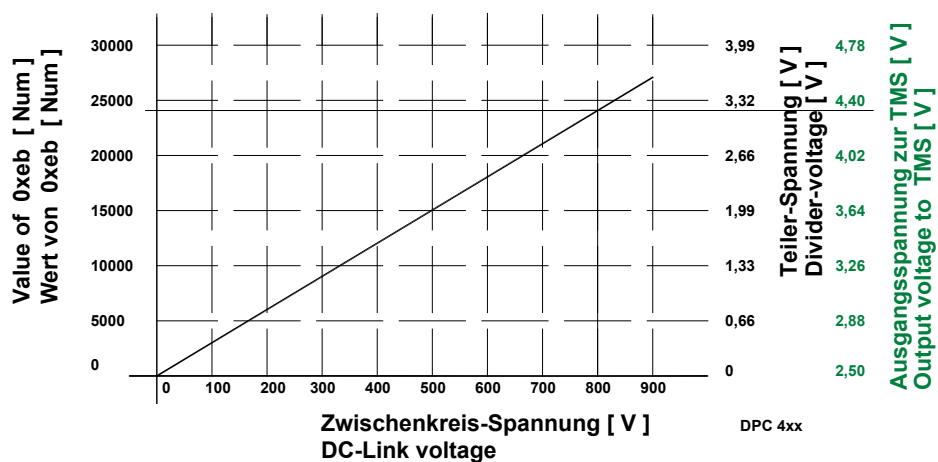
5   Warranty

UniTek guarantees that the device is free from material and manufacturing defects. The values of the pre- and final quality assurance checks are archived with the unit serial number.

The warranty period begins with the delivery of the unit and lasts for two years.

UniTek makes no warranty as to the suitability of the unit for any particular application.

UniTek shall be liable for defects in the delivery, including the absence of warranted characteristics, only in such a way that, if the goods are returned to the manufacturer's works, they will be repaired free of charge or, if necessary, replaced.

This liability for defects is excluded if improper repair work or improper modifications are carried out on the part of the purchaser or third parties, if defects are caused by non-observance of the operating instructions (MANUAL) enclosed with the delivery, by non-observance of the electrical standards and regulations, by improper handling or by unforeseeable effects of nature.

Consequential damage
All further claims for redhibitory action, reduction of the purchase price and compensation for damages of any kind, in particular also damages which have not occurred to the **UniTek** device, are excluded.

Consequential damage resulting from malfunctions or defects of the unit in the machine or system cannot be claimed.

This does not apply insofar as liability is mandatory by law.

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All connection instructions are for general information and are non-binding. The local legal regulations and the provisions of the standards apply.

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