

# MANUAL

## Digital Servo Controller

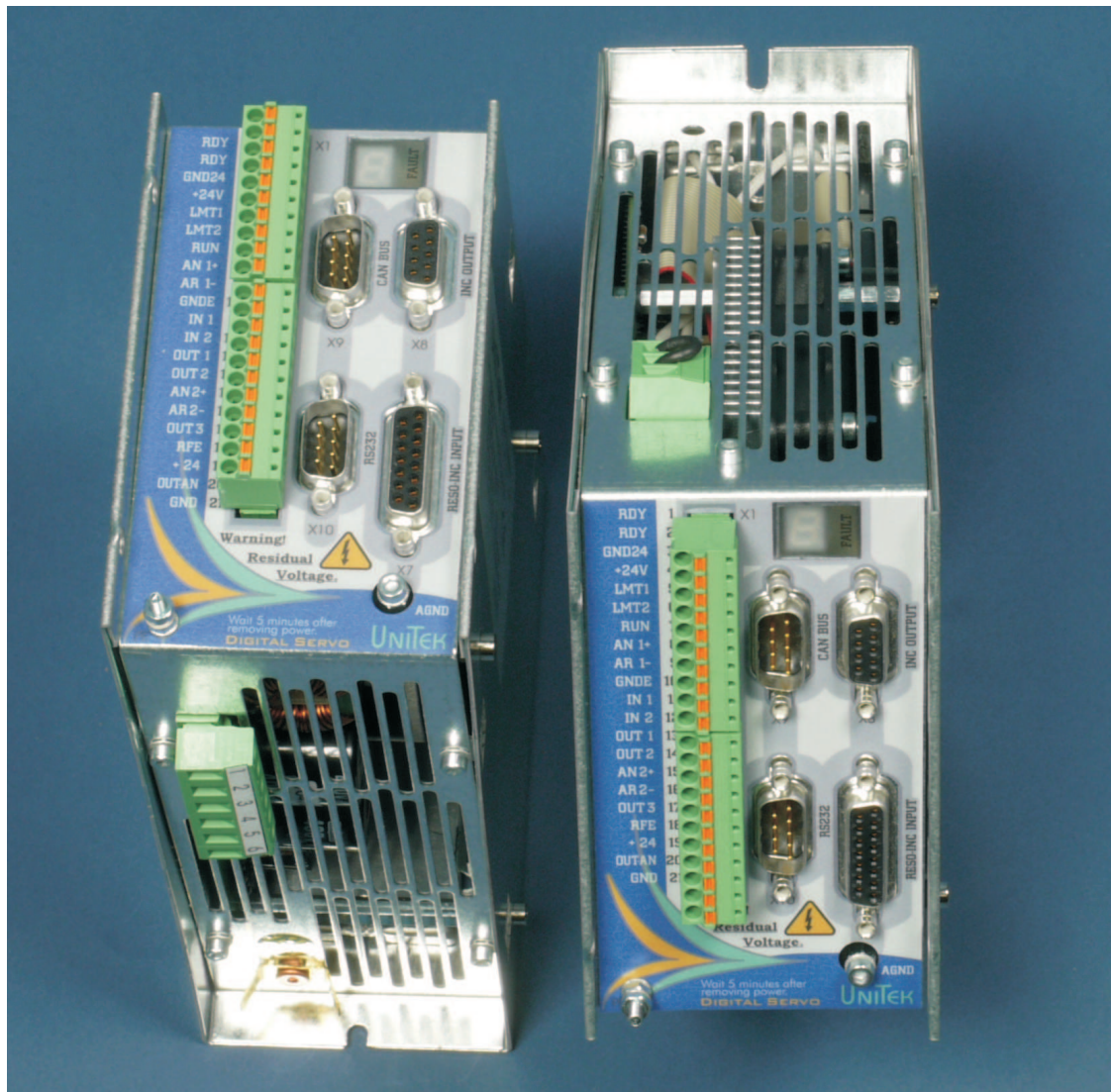
### DS-205.4, DS403.4

for

### EC Servo Motors

### AC Induction Motors

### DC-Servo Motors



### Contents

#### Part 1 Hardware-Manual

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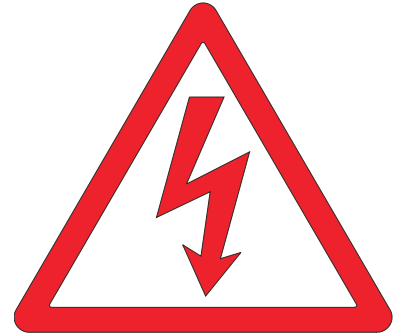
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Electronic devices are never fail-safe.

## Caution: High voltage DC 900V=.

**Electric shock hazard!**  
**Danger to personnel!**  
**DC-BUS discharge - time >4min**



This manual must be carefully read and understood by the professional prior to installation or start-up.

Consult the manufacturer or the dealer if anything is unclear.

Faulty installation can lead to destruction of the devices.

The DS xx series devices are electrical resources (EB) for power electronics regulating electric currents.

They are designed to control EC synchronous motors (brushless dc motors, BLDC) in industrial applications.

IP20 protection standard for cabinet-mounting.

Only connect to earthed mains or an earthed three-phase network.

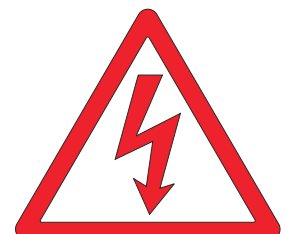
### Regulations and guidelines:

Mount and connect the devices and their appropriate components in compliance with technical regulations locally applicable and required by law:

- EG-guidelines 2004/108/EG, 2006/95/EG, 2006/42/EG
- EN60204-1, EN292, EN 50178, EN60439-1, EN61800-3, ECE-R100
- ISO 6469, ISO 26262, ISO 16750, ISO 20653, ISO 12100
- IEC/UL IEC 61508, IEC364, IEC 664, UL508C, UL840
- VDE-regulations VDE 100, VDE 110, VDE 160 und
- TÜV-regulations
- Trade association regulations, VGB4

**Do not operate unless the control cabinet is closed or secured.**  
**Control and power connections can be live even though the drive is inoperative.**

**The DC-BUS discharge time is more than 4 minutes.**  
**Measure the voltage prior to dismounting!**



### The user must ensure:

- that when the unit fails
  - when an operator error occurs,
  - when the controlling and control units fail, etc..
- the drive homes to a safe operating state.

Apart from that machines and installations must be provided with monitoring and safety systems independent from the unit. Danger to man and property must be impossible to incur!

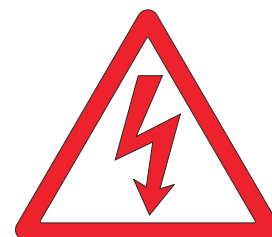


### Assembly work

- only if all power is cut
- only by qualified professionals

### Installation work

- only if all power is cut
- only by qualified electrical professionals
- Comply with safety regulations



### Setting and programming work

- only by qualified professionally specialised in electronic drives and software
- observe programming notes
- Comply with safety regulations

### CE:

When it is mounted in machines and installations the proper operation of the unit is not permitted until the machine or installation has been approved according to the regulations of the EC machine directive 2006/42/EG, and the EMC directive 2004/108/EG .

Die EC directive 2004/108/EG plus the EMC standards EN61000-2 and EN61000-4 are complied with in the EMC Notes chapter specified installation and test conditions. A manufacturer's certificate is available.

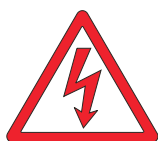
The manufacturer of the machine or the installation is responsible for the observance of the threshold values prescribed in the EMC regulations..

### QS:

Based on their serial number and test data the units are archived by the manufacturer for 5 years.

The test certificates are available on request.

### Safety symbols



**Attention danger**  
**High voltage**



**Attention**  
**Warning**  
**Important**

A feature of the digital three-phase servo amplifier DS xxx and the brushless d.c. motor (synchro servomotor, EC motor) drive unit is that it is maintenance-free and has high control dynamics.

The drive exhibits the known good control characteristics of d.c. drives without the disadvantages of carbon brush service times and the commutation limit.

The moment of inertia of the rotor is considerably smaller and the maximum power is higher than for d.c. motors of an identical construction. This results in acceleration values that are higher up to a factor of 5.

Compared to asynchronous motors with frequency converters the stability, the control range and the efficiency of the drive are considerably improved.

Since the temperature increase of the motor is only in the stator, the EC motors are always designed to protection degree IP 65.

The brushless d.c. motor is electrically designed as a synchronous motor with a permanent magnet rotor and a three-phase stator.

The physical properties correspond to those of the d.c. 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 maximum current (max. torque). When an overload occurs the speed drops and the current remains constant.

Rectangular speed/torque characteristic.

The current, the speed and the position are measured exactly. The rotary field frequency is not a controlled variable, it sets itself automatically.

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

DS 400 can be used as a torque amplifier, a speed amplifier or a single axis position amplifier.

The position and speed actual values are generated from the sensor unit (resolver or incremental encoder). The encoder pulses are emitted from the amplifier for a superposed SPC/CNC control.

The current, speed and position control loops are easily programmable digital PID controllers. Programming is at a PC or a programming box.

Communication with superposed controls through BUS systems (standard CAN-BUS, RS232) or through an analog interface.

### Caution:

For DC-BUS fed DC, AC or bl servo amplifiers in the braking mode it is necessary to take into account the power reverse feed in the DC-BUS. (lifting drives, unwinders, great flywheel masses)

External regenerative circuit discharge resistor.

### Information:

Other products

Classic

BAMO, BAMOBIL, BAMOCAR

Thyristor-Drive

Battery-Motor-Controller

200W up to 800kW

up to 100kW

### **Application in:**

All types of machines and installations up to a drive power of 1kW.

Especially as

4Q- servo drives in feed axes, for highly dynamic acceleration and braking applications, for large control ranges,

for high efficiency,

for small motor dimensions,

for an even and smooth travel.

For speed and torque regulation or combined speed and torque regulation with or without a superimposed position controller.

Constant drives for hoisting equipment, spindle drives, pumps, transverse and longitudinal slitting drives, multi-motor parallel drives. Synchro –servo drives are compacter than other electrical drives.

### **For use in:**

Insertion machines, testing machines, sheet-metal working machines, machine tools,

machines for the plastics industry, automatic assembly machines, knitting and sewing

machines, textile machines, grinding machines,

wood and stone working machines, metal working machines, XY tables, machines for the

food industry, robot and handling systems, rack feeders, extruders, calenders and

also in many other machines and installations

### **The motors are:**

designed for protection standard IP 65,

compact, for harsh environments,

for a high dynamic overload, maintenance-free

### **Note:**

Braking operation for EC - drives

For example.: Un-reeling machines, hoists, flyweights. The braking energy is dissipated in the regenerative circuit or fed back to the mains via an external inverter.

**Caution: The internal regenerative resistors have only a small continuous rating. Calculate the retarding power and use external regenerative circuit discharge resistors if necessary or for design safety. Calculation of regenerative power. See page 24.**

### Construction, characteristics:

Cabinet-mounted device in an all-steel housing.  
In compliance with VDE/DIN and EU guidelines. (IP20, VGB4).  
Standard fully-digital regulation electronics.  
Power electronics from 5A ;3A (S1 - operation).  
Power input voltage 30V~ to 480V~.  
Independent 24V - chopper power supply unit for auxiliary voltages.

### DC decoupling between:

the housing to all electrical parts  
auxiliary voltage connection to power unit and control electronics,  
power unit and control electronics  
Control electronics and logic inputs.  
The clearance in air and leakage distances comply with VDE.

### Used are:

Generously dimensioned, fully insulated FET or IGBT - power semiconductors.  
Only commercially available, industrial standard components,  
SMD - placed,  
LED displays

### Characteristics:

- \* Direct to 230 V~ (DS 205xx), up to 480 V~ (DS403xx) mains connection
- \* Independent 24V= auxiliary voltage connection.
- \* Digital RS232, CAN-BUS (additional option) interfaces.
- \* Analog inputs, programmable differential inputs,
- \* Digital programmable inputs/outputs. Opto-decoupled,
- \* Enable and limit switch logic,
- \* Ready for operation signal BTB, relay contact.
- \* Position, speed and torque regulation,
- \* Incremental resolver or encoder (optionally a sinus transmitter),
- \* Encoder output,
- \* Static and dynamic current limit.
- \* Standard, fully digital control unit,
- \* Intrinsically safe, short-circuit proof power unit,
- \* DC-BUS choke (EMC choke),
- \* Integrated regenerative discharge circuit,
- \* DC power bus.
- \* Processor-independent safety switch-off when either the amplifier or the motor have over voltage, under voltage, a short circuit, a line-to-earth fault or excess temperature.
- \*

## Basic - Information

Power supply voltage DS205.4	1x oder 3x 30V~ bis 1x230V~ +10% 50/60 Hz
Power supply voltage DS403.4	1x oder 3x 30V~ bis 1x480V~ +10% 50/60 Hz
Auxiliary supply	24V= $\pm 10\%$ / 2A Ripple voltage <10%, self-resttable fuse

Data	Dim.	DS-405.4		DS-403.4
Rated supply voltage	V~	1xoder 3x 230		1xoder 3x 400(480)
Rated output voltage	V~eff	3x200		3x380 (420)
DC-link voltage	V=	320		560 ( 670)
Rated installed load S1	kVA	1,2		1.2
Rated output load S1.	kW	1		1
Continue current rms	A <sub>eff</sub>	5		3
Peak current	A <sub>lo</sub>	10		6
Dissipation max.	W	51		80
Clock frequency	kHz	8		8
Level regen circuit	V=	400 $\pm$ 10		780 $\pm$ 10
Level Over voltage	V=	440 $\pm$ 10		820 $\pm$ 10
Regen resistor extern minimum	$\Omega$	80		100
External fusing integral	A <sub>2</sub> s	10 150		10 150
Weight	kg	1.2		1.2
Dimension HxWxD	mm	140x70x190		140x70x190
Size		1		1

Input / Output	V	A	Function	Connector
Analog Input	$\pm 10$	0.005	Differential input	X1
Digital input ON OFF	10-30 <6	0.010 0	Opto	X1
Digital output	+24	0.03	Opto	X1
Resolver input			Differential input	X7
Encoder input	>3.6V		Opto	X7
Encoder output	>4.7		Opto	X8
CAN-interface			Opto	X9
RS232-interface			9600 Baud	X10

Ambient conditions	
Enclosure protection	IP20, VGB4
Norms	EN60204,
Ambient temperature	0 bis +45°C
Maximum ambient temperature	+45°C to +60°C with power derating 2%/°C
Storage temperature	-30°C to +80°C
Humidity in operation	Klasse F rel. humidity <85% , <b>no condensation !</b>
Site altitude	≤ 1000m a.m.s.l. 100%, >1000m with power derating 2%/100m
Ventilation	Built-in fan
Mounting position	Vertical, Horizontal with power derating 20%

Program	Type	Software-Version	Extension
Firmware		> FW-V350	x
			x
			x
			x



### Important notes:

Mounting surface blank metal, not varnished (surface EMC contact)

Check device for mechanical damage. Mount only perfect devices.

### Cut all power prior to assembly.

Insert shortening plug and attach warning signs at installations already electrically connected.

Assembly permitted only by competent professionals.

Vertical mounting position.

Note power reduction if mounted horizontally.

Ensure adäquate ventilation clearance. (at least 100mm).

Use dimension diagram or drill template to trace fastening holes of device.

Do not mark off from device.

Drill mounting holes (M4) in mounting base.

Screw in screws up to 4mm.

Insert device and tighten screws.

Mount filter and choke near to device.

Surface-contact line shields to mounting surface.

Keep unshielded cable ends as short as possible.

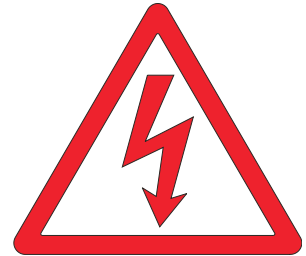
Brake resistors can become very hot. (200°C).

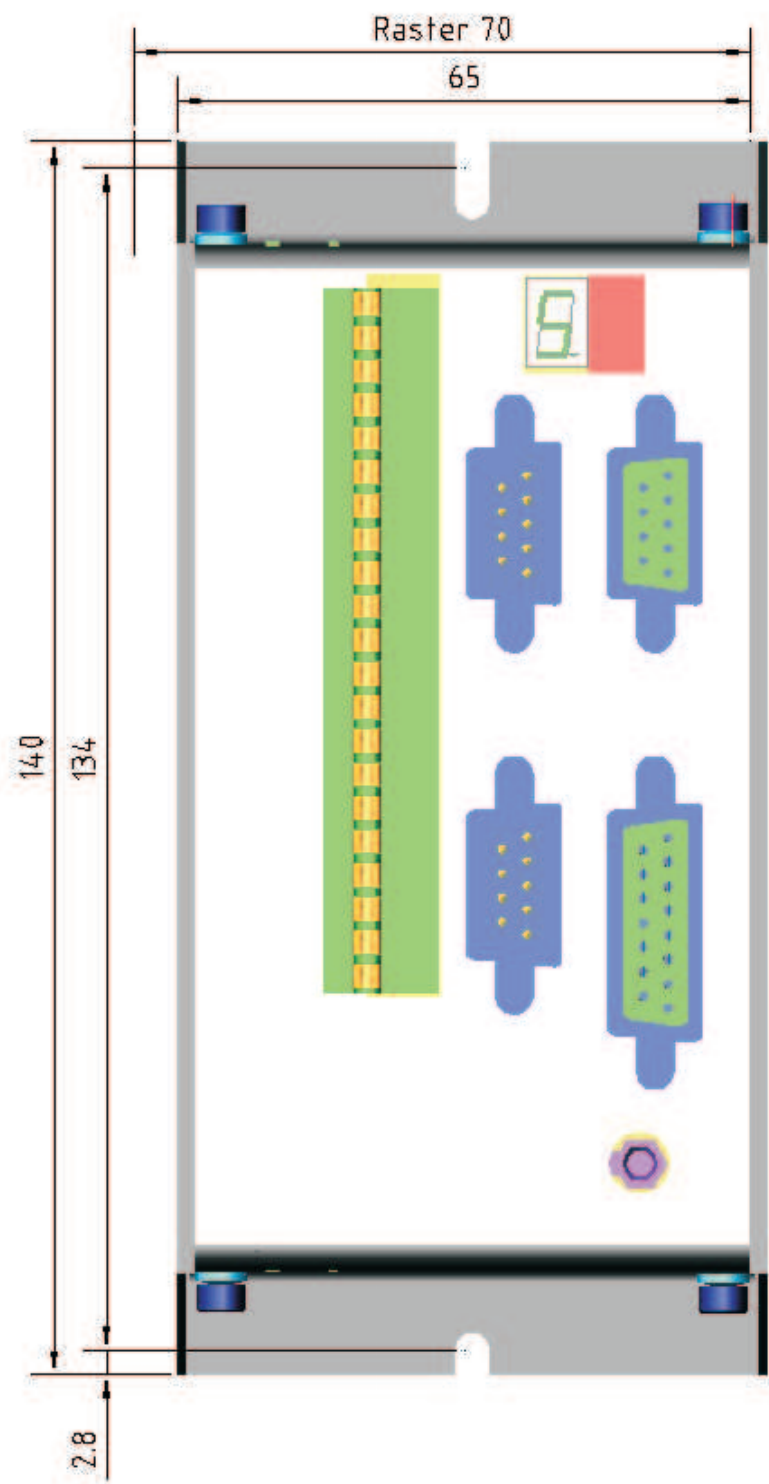
Mount resistors so that neither injuries (burns) nor damage caused by their heat can occur.

Use vibration-proof bolted joints.

Ensure adequate control cabinet ventilation. Use air conditioners for excessive room temperatures (>30°C).

**Caution: Operation with devices covered in dew is not permissible!**



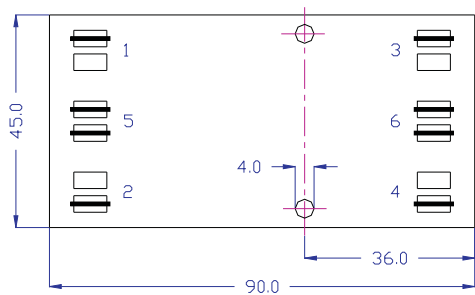


Size 1  
DS-205.4 to DS-403.4

Depth	without connectors	190mm
	with connectors max.	250mm
Screw for hex key	M4x10 DIN 912	

Dimensions accessories

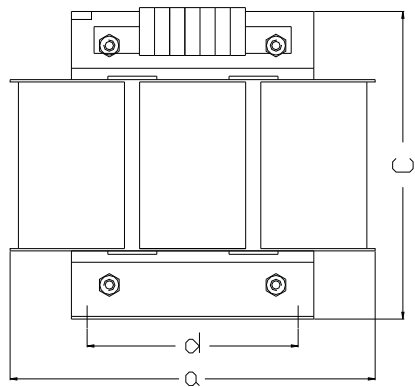
EMC-Filter



Type	Spannung	Strom	Masse	Gew.
	V~	A~	HxBxTmm	kg
F250V-B90-16	1x250	1x16	45x90x40	0,4
F400V-B51	1x400	1x5	35x51x40	0,3

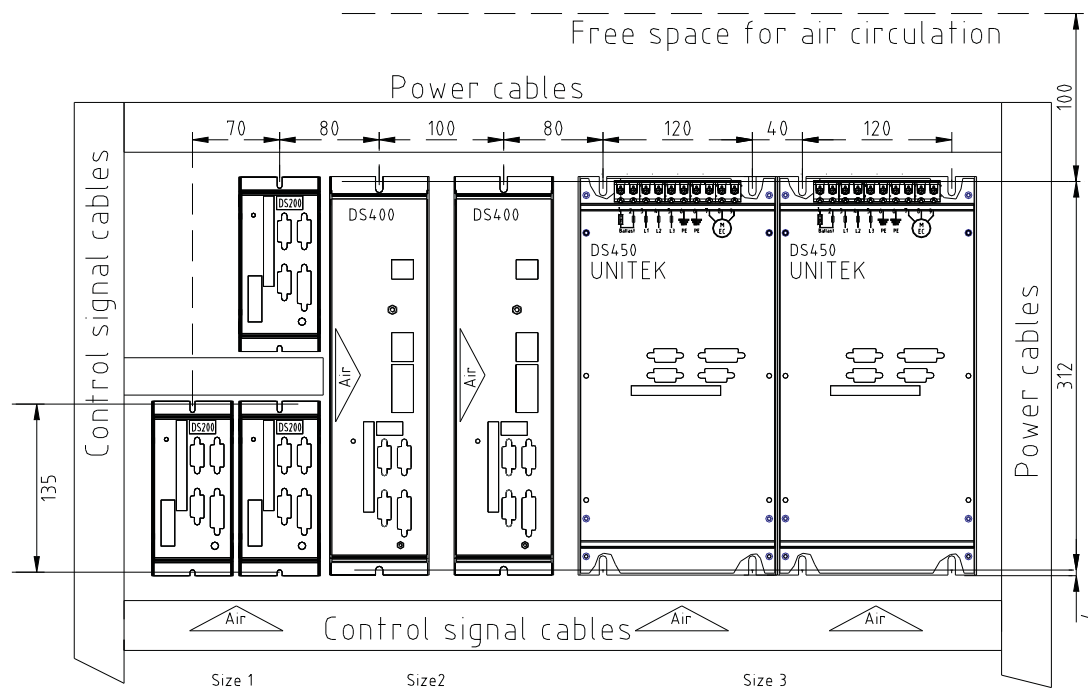
Filter for stricter EMC - requirements.  
DC-BUS filters and input capacitors are incorporated in the device.  
Mount filter close to device.

Motor choke



Type	Strom	Indukt.	Masse	Ge w.
	A	mH	HxBxTmm	kg
MDD 1.6a-5	5	1.9	95x54x108	1.3
MDD 1.6b-10	10	1	95x58x108	1.4

Motor choke cable core to screen capacitance >5nF.  
Cable length 25m approx.



For good EMC values we recommend blank metal, unvarnished mounting bases. Good surface contact is achieved by the blank metal rear wall of the device. Lay signal lines and power cables in separate cable channels, cross them at right angles. (Spatial separation of interference coupling).

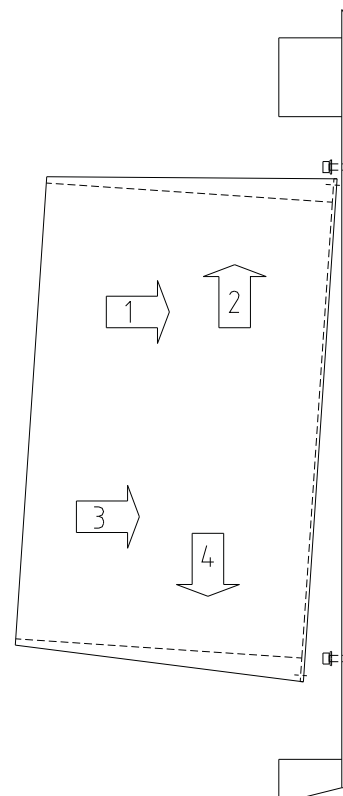
### Assembly notice:

Recommended DIN 912 M4x12 fixing bolt with lock washer.  
Place M4 tap holes at a vertical distance of 312mm.

Drilling template in appendix.  
Fix M4x12 screws.  
Distance to rear wall of control cabinet approx. 4mm.

Position device with the top edge (1).  
Slide it upwards to stop (2).  
Press its bottom up to rear wall of control cabinet (3) and lower it (4).

Tighten screws.





## Important notes

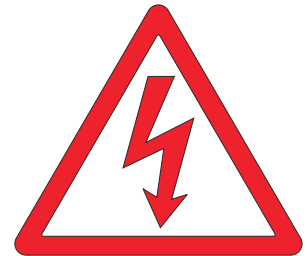
With reference to allocation of connections to the plug and terminal numbers the connection notes are binding.!

All other notes on this subject are not binding.  
The input and output lines can be changed and supplemented to comply with electrical regulations and guidelines.

The regulations to be observed are:  
Connection and operation notes, local regulations,  
EU regulations such as the 2006/42/EG machine directive,  
VDE, TÜV and trade association regulations

### Cut all power prior to the electrical installation.

Make sure enabling is safe.  
Insert shortening plugs,  
attach warning signs  
Installation is permissible only by electro technically competent professionals.



Compare connected loads with information on rating plate.

Ensure adequate fuse protection for the feed, the auxiliary voltage and the external regenerative resistors.

Lay power cables and control lines spacially separated. Perform shield connections and earthing work in compliance with EMC guidelines. Use the right lead cross sections.

**Caution: Operation without a “ PE - connection “ is forbidden!**

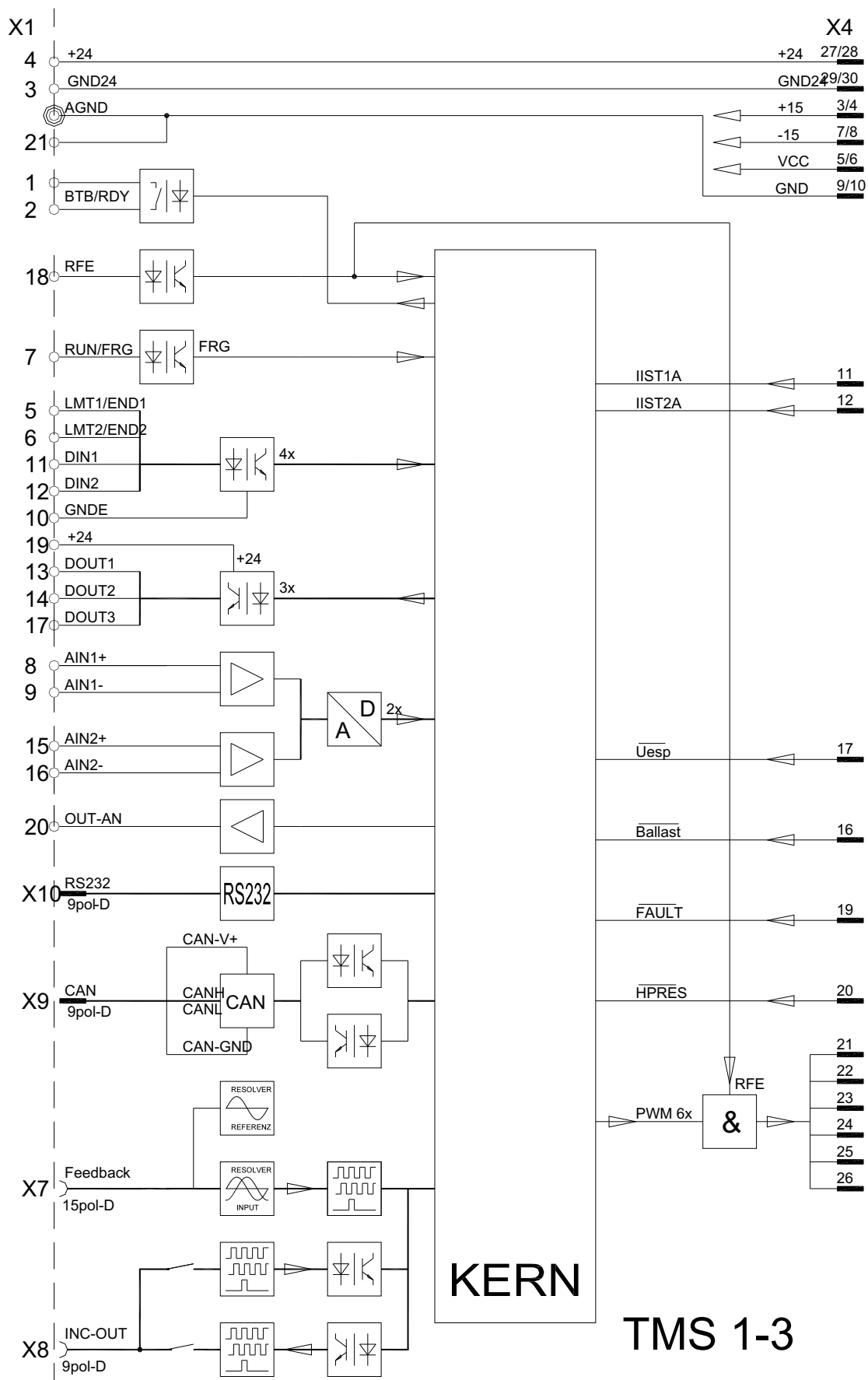


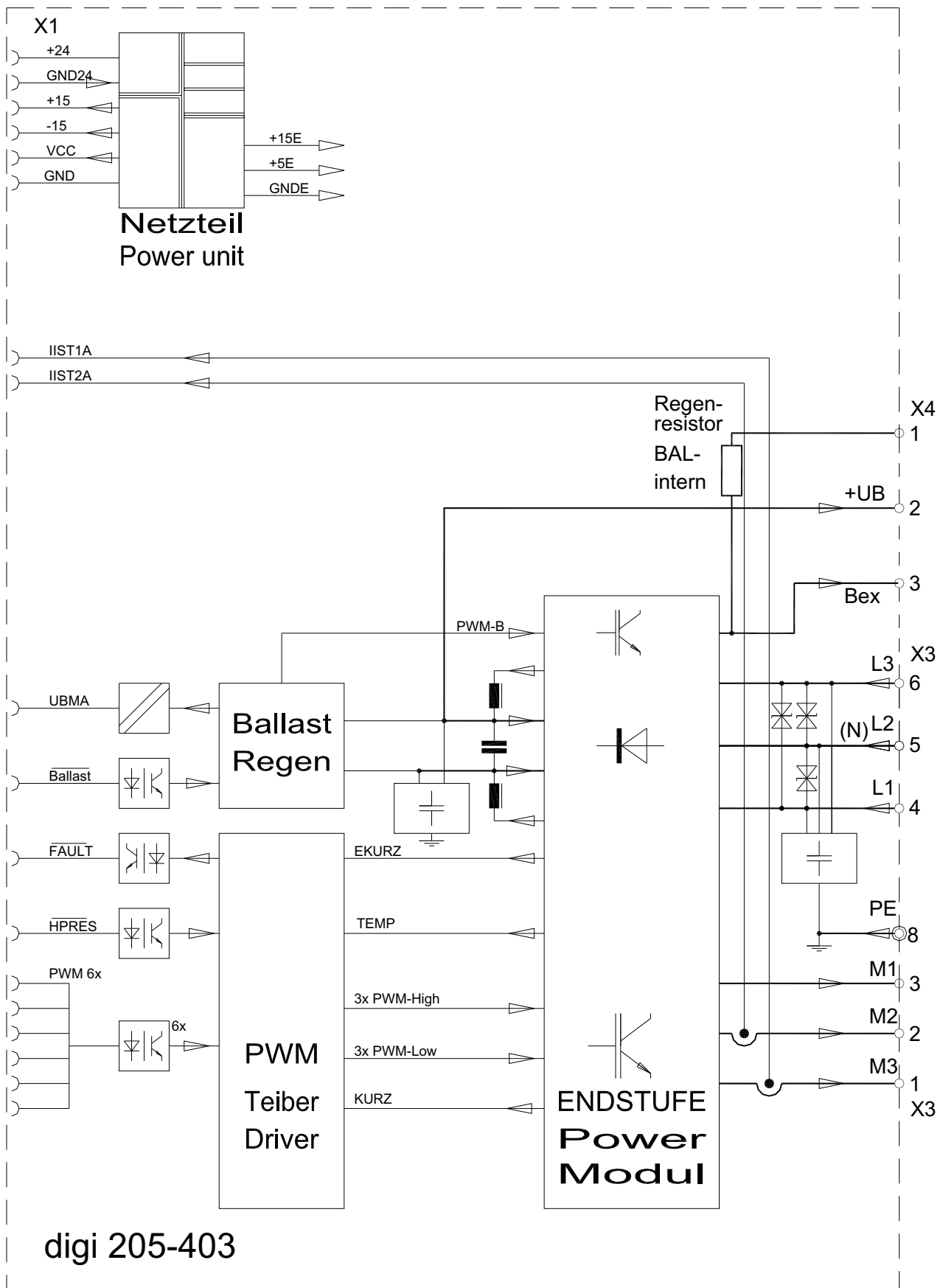
Rating plate (example),

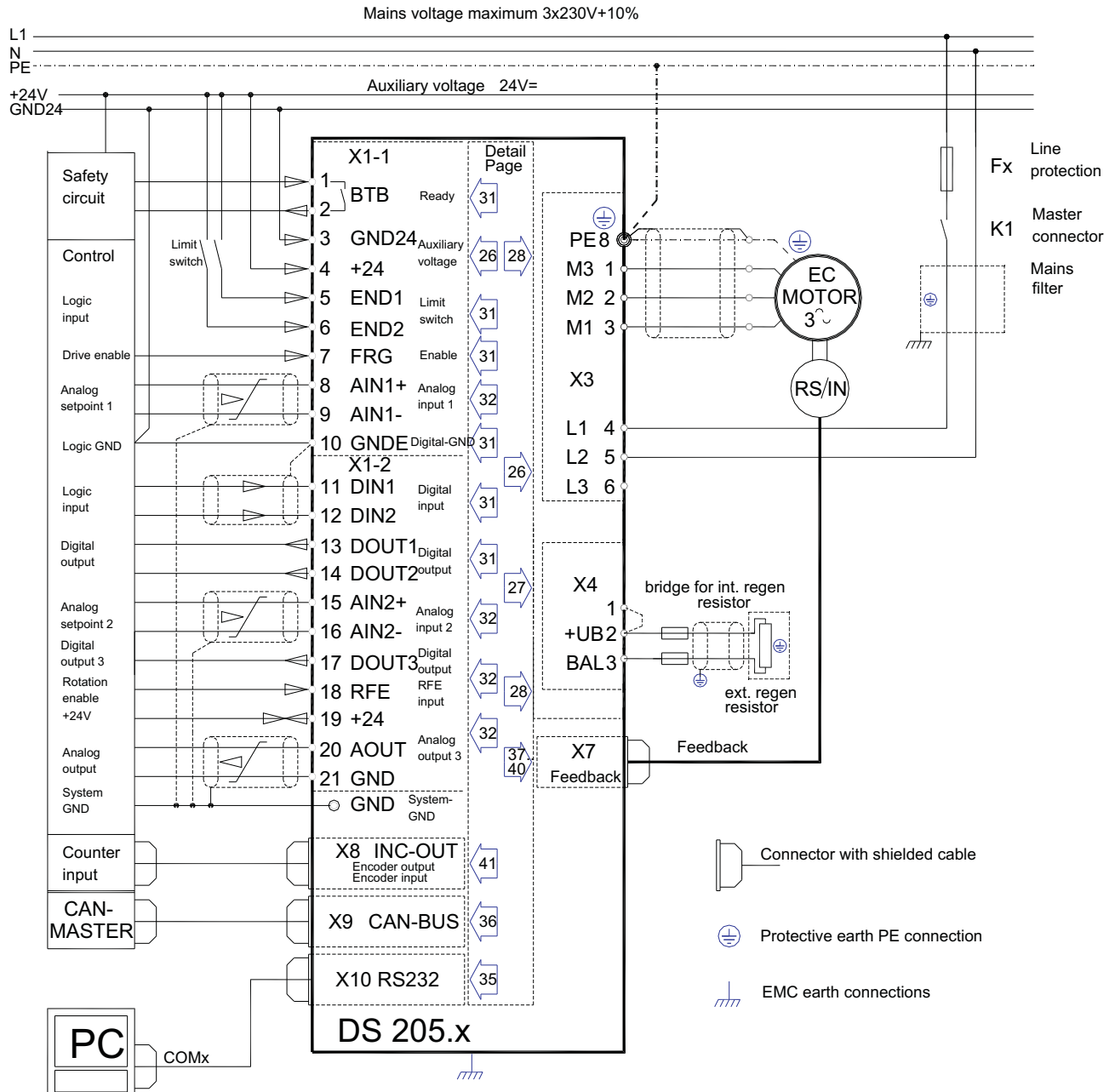


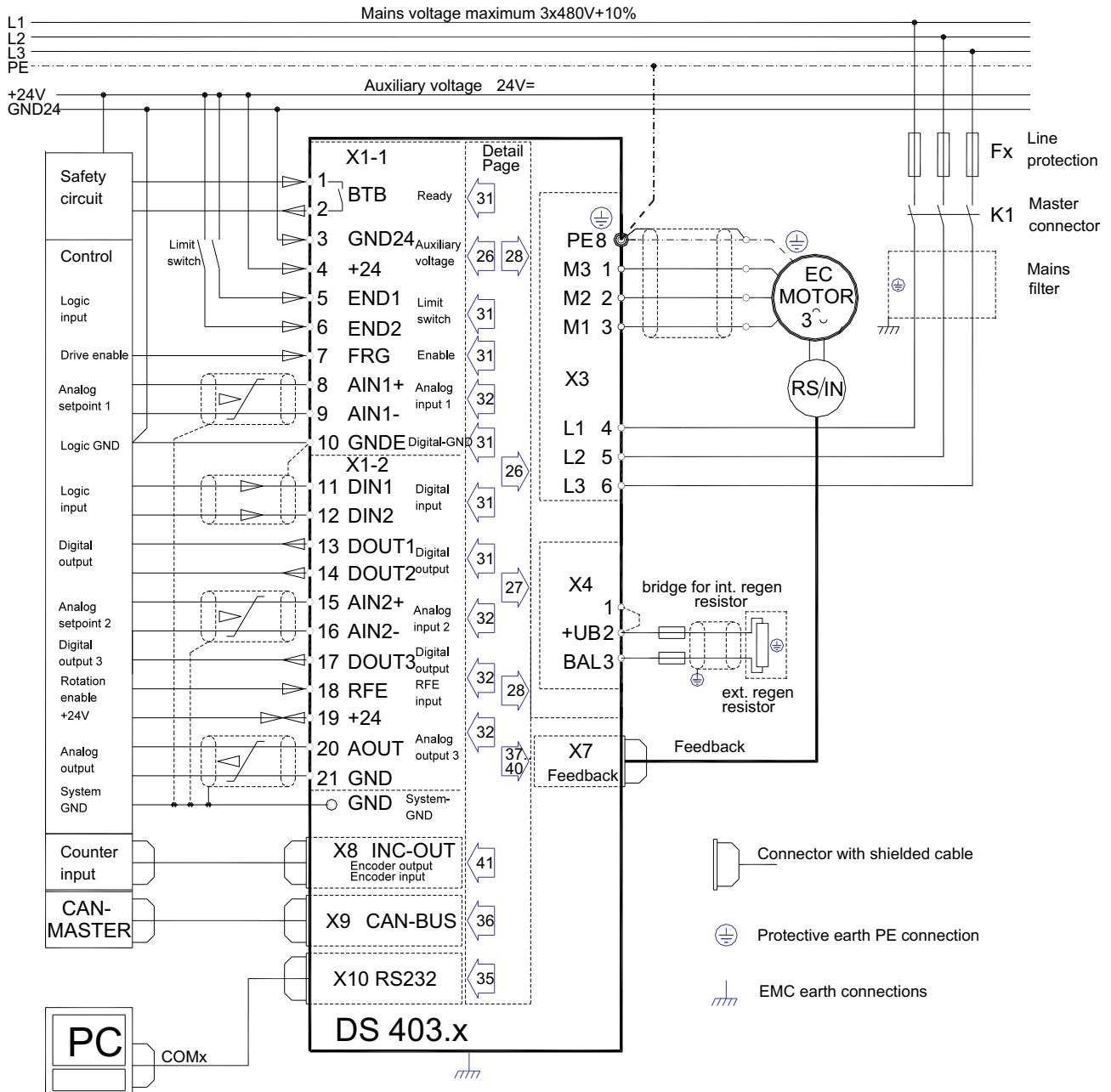
serial number

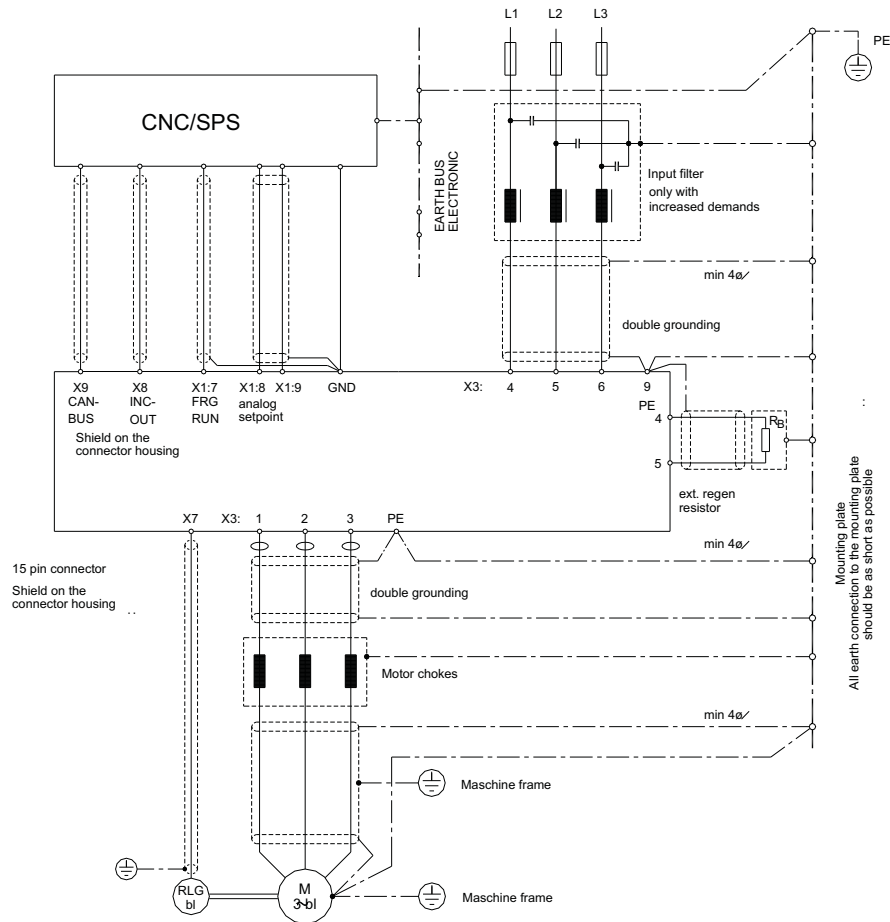
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Under the following installation and test conditions the devices comply with the EU 2004/108/EG guideline in standards EN61800-3

## Assembly:

The controller is conductively mounted on a 500x500x2 mm blank metal assembly base. For 10 mm the assembly base is connected with the PE. For 10 mm the motor housing is connected with the PE. Zero of device For 2,5mm X-AGND is connected with the assembly base. Device's -PE - screw X3:6 connected to assembly base with a 4mm line

## Control connections:

Signal lines shielded, analog signal lines twisted and shielded

## Mains three-phase connection:

3x 400V~ with protective earthed conductor

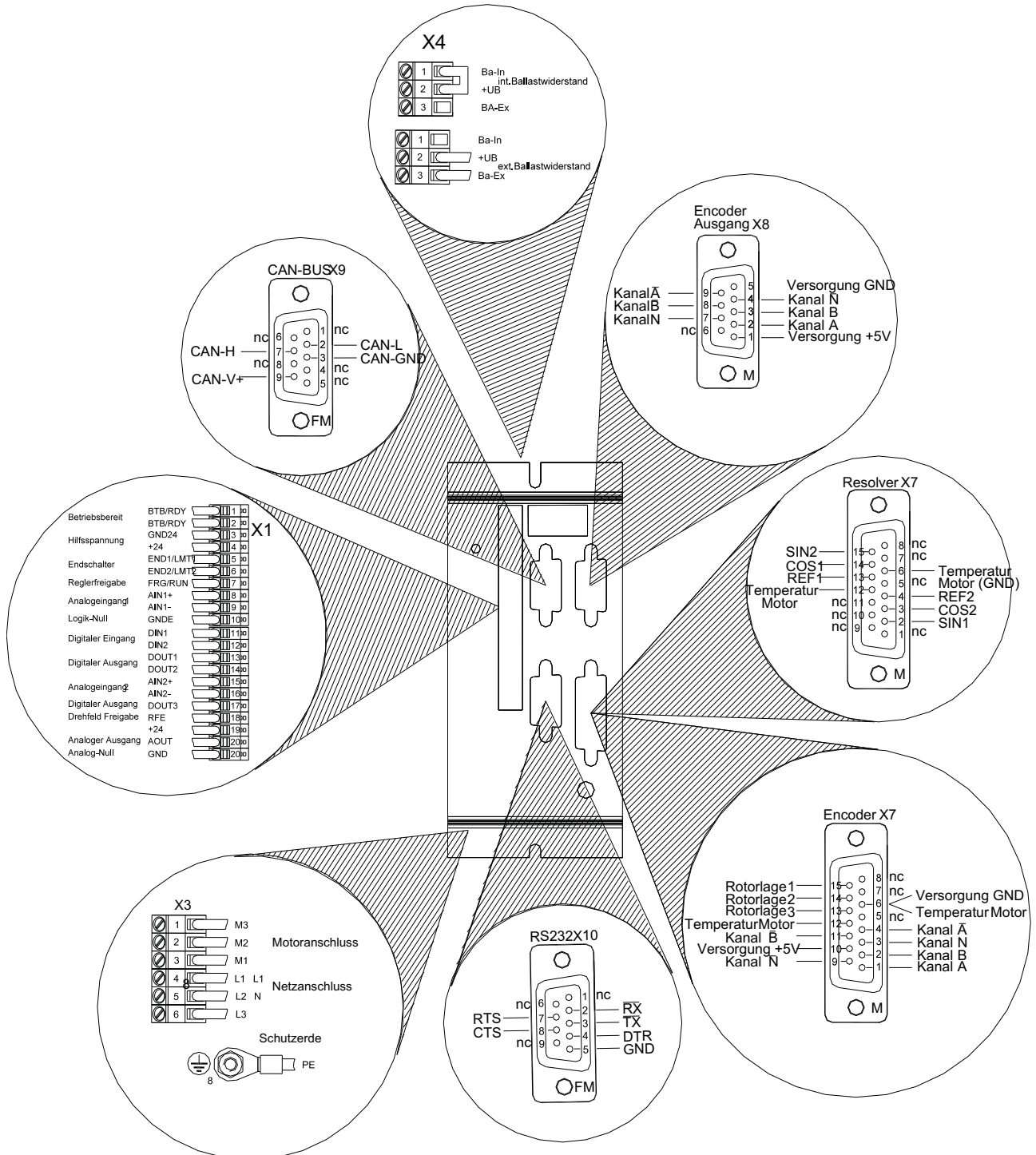
## Motor connection:

Motor connection shielded, surface earth contact

When mounted in machines and installations it is forbidden to start the proper use of the device until the machine or the installation has been approved to comply with the regulations of the 2006/42/EG machine directive and the 2004/108/EG guideline.

For cars ECE-R83, ECE-R100 manufacturer's certificate is available.





DS205.4 1x230V~

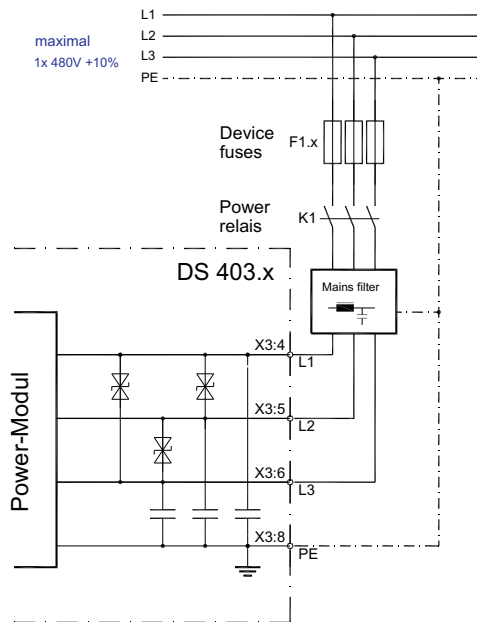


Leakage current> 60mA

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## Connection to the grounded AC-or three-phase system (TN-C-Mains).

Unbalanced grounded and do not connect grounded systems only isolation transformer!  
Connection on the T-NC network



Do not, even briefly, exceed maximum connected voltage of 528V~.

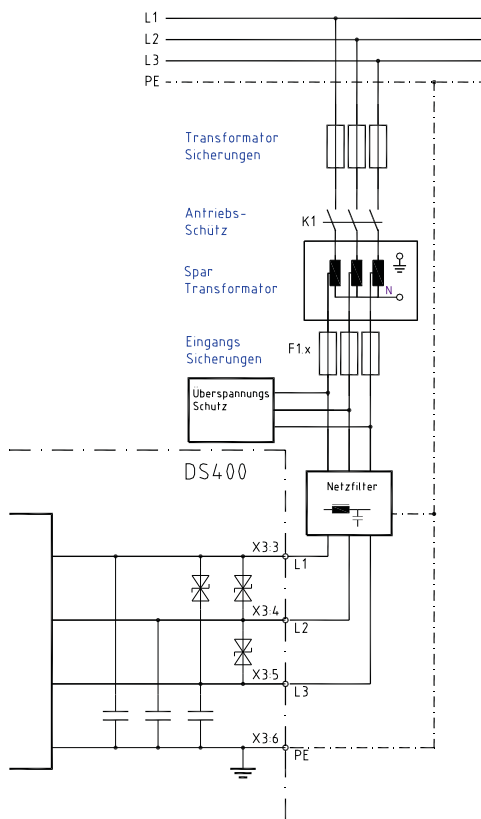
**Destruction hazard!!**

F1 = FF safety fuses or semiconductor cutouts

Additional power filter in increased EMC conditions.  
DC link filter and input capacitors are installed.

Leakage current > 60mA

## Connection on the T-NC network with autotransformer.



Do not, even briefly, exceed maximum connected voltage of 528V~.

**Destruction hazard!!**

Transformer fuse slow

F1 = FF safety fuses or semiconductor cutouts

Additional surge protection  
to transformer switching  
Overvoltages

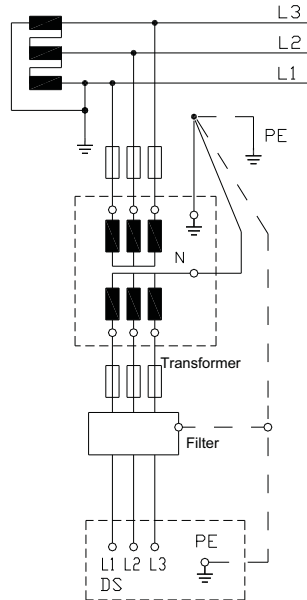
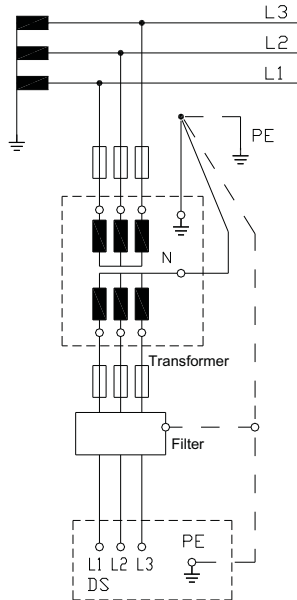
Additional power filter in increased EMC conditions.  
DC link filter and input capacitors are installed.  
Leakage current > 60mA

When supply voltage < 30V the output stage is electronically locked. (no BTB signal)

**Attention: In case of supply networks without PE conductor.**

Connection only via isolation transformer

Connection on the TT network

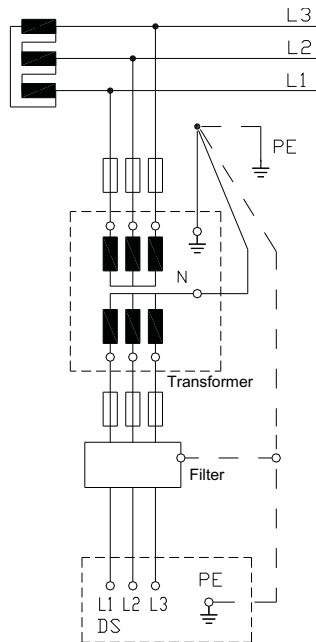
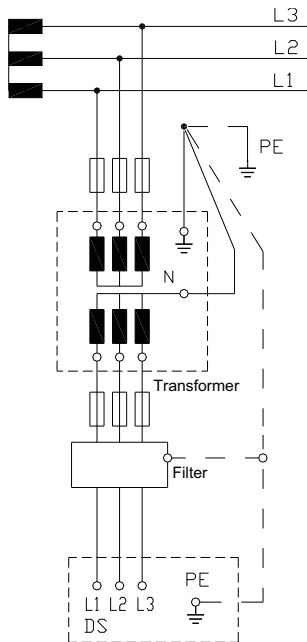


TT network

Asymmetric three-or four-wire three-phase system with a direct ground.

PE device on earth

Connection on the IT network



IT network

Asymmetric three-or four-wire three-phase system with no direct grounding.

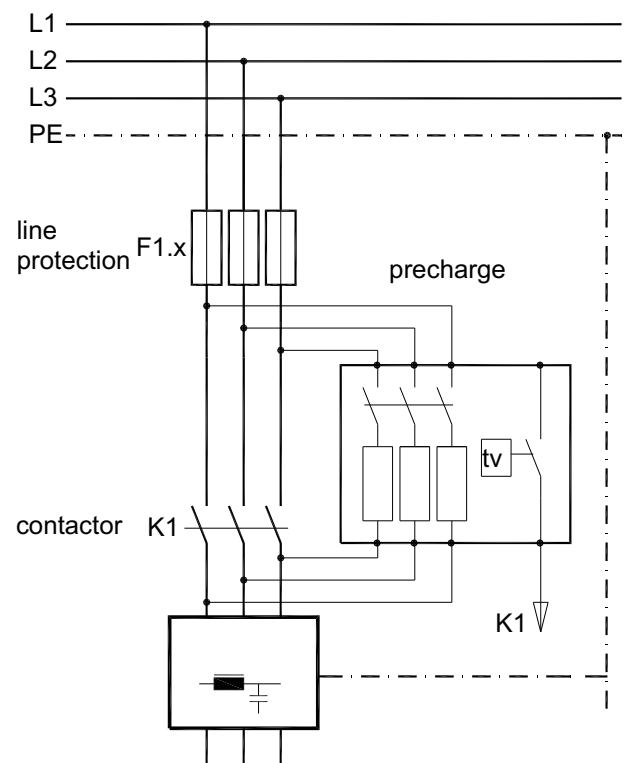
PE device on earth

## Inrush

The initial inrush current is internally limited by an NTC resistor 10 times the rated current (about 2ms). The response is maintained between off and on again when a waiting time of 120sek is maintained. The NTC resistance is in the cooling power of the equipment fan. For faster turn-off, the inrush current to increase to 30 times the value (1ms). The switching contacts of the power contactors must be designed for these values.

## Precharge

By using the assembly precharge the charge current to 2 times rated current is limited. The contactor K1 is switched time-delay.



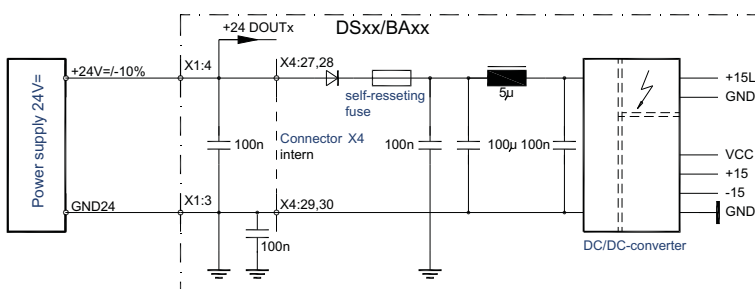
Precharge

Auxiliary voltage

## Auxiliary voltage connection:

Mains potential-free 24V= +/- 10% / 2A auxiliary direct current.

The auxiliary voltage has a: galvanic connection to the logic voltage, galvanic safety dc decoupling to all internal supply voltages of the device, an internal self-healing fuse, an EMC filter, an external fuse only for line protection.



Input voltage	24V DC	X1:4
	GND24	X1:3
Ripple		10%
Power up current		2A
Nominal current		0.8A

GND connection must be earted!

**Note:** In addition to the internal supply current (0.8A) the sum of the output currents (DOUT) must be provided by the mains module 24V.

**Note:** If the auxiliary voltage is inferior to 20V - even in case of short-time voltage drop-outs - the internal mains module is switched off. Any data of the RAM are deleted!

The speed and the position command values are set to zero and any calibrated data are deleted.

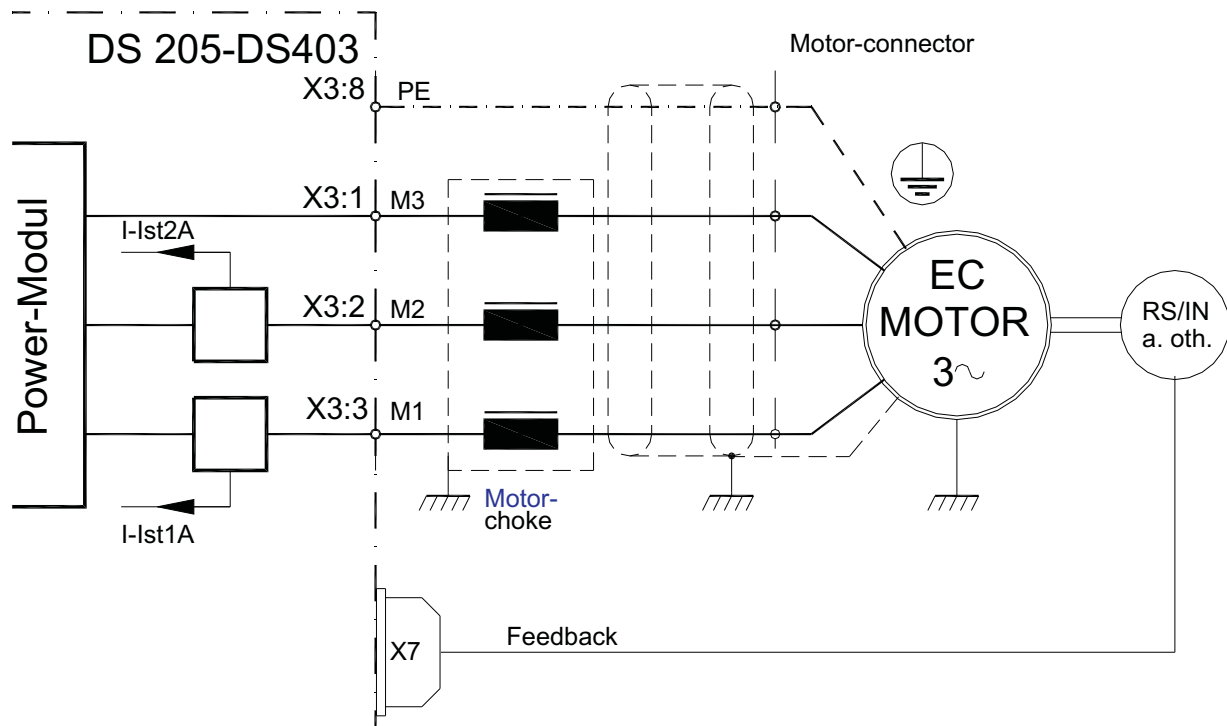
**The LED signal for the state "OK" is dark.**



### Motor power connection

Use only Unitek approved, electronically commutated synchronous motors (brushless DC motors, EC motors) with a resolver or an incremental encoder.

See Appendix A (specific motor connection and parametrizing rules).



Cable indication	PE	M1	M2	M3
Connector	X3:8	X3:3	X3:2	X3:1
Correct wiring is essential !				

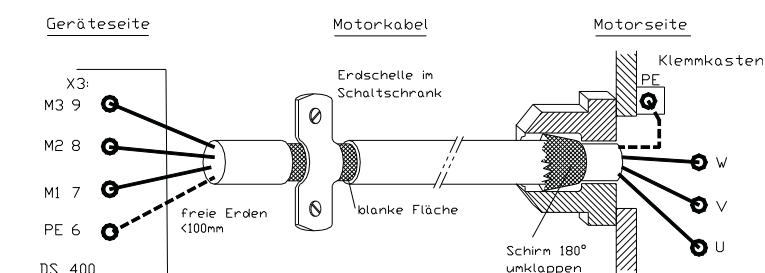
### Motor cables,

3 wires + simply shielded protective earth conductor for 600V~, 1000V=, shield capacity 150pF/m. See table for minimum cross-section

Type DS	205		403
Cable dim. mm <sup>2</sup>	1		1
Cable dim. AWG	18		18

### Motor choke.

Only required upwards of a shield capacity of >5nF. approx. 25m motor cable.

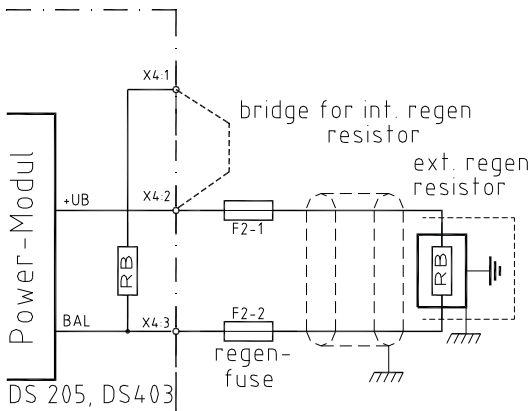


### Shielded connection:

Surface connection at entry to control cabinet. Surface or as short as possible connection at the motor end.

Use multiple earthing for long motor leads. (e.g. an earth clamp on the machine body every 5 m). Connection sequence, cable cross section, shield connection.

## Regenerative circuit



The energy generated during braking is fed to the DC-BUS. The Elkos DC-Buses are able to store only a small amount of energy. The excess energy has to be converted into heat in the regenerative resistor. The internal resistor is designed for drives without flyweights.

Always use external regenerative resistors for flyweights or design uncertainties.

F2- protection from earth fault.

Electronic limit from overload and regenerative discharge short circuit.

Type DS		205		403
Internal regen resistor	Ohm	51		80
Continous power	W	50		50
Pulse power 1s	kW	6		6
External resistor min.	Ohm	51		80
Fuse F2	AF	10		10

## External regen resistor

### Dimensionierung

#### Maximum breaking power calculation

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

$J_g$  = Total inertia at motor

$n$  = maximum speed

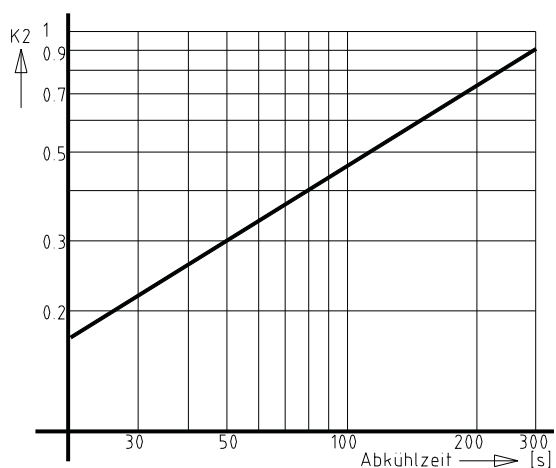
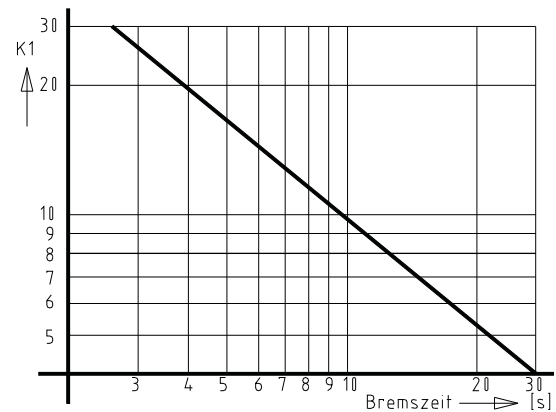
$\Delta n$  = difference in speed

$t_B$  = braking time

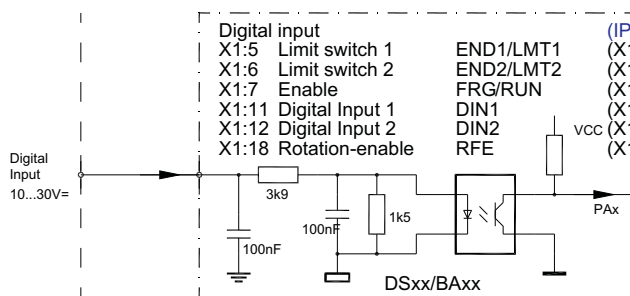
$[\text{kgm}^2]$   
 $[\text{min}^{-1}]$   
 $[\text{min}^{-1}]$   
 $[\text{s}]$

## Power regen resistor

$$P_{\text{regen resistor}} [\text{W}] = \frac{P_{\max}}{K1 \times K2}$$



## Digital input



### Opto-input

Input voltage

H-level (ON)

L-level (Off)

input current

Ratet voltage/curen

Referenc ground

+10 up to +30V

< +6V

max. 7,5 mA

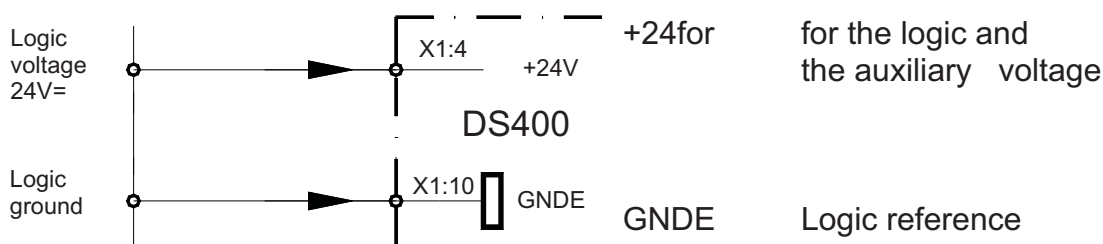
+24V/6mA

GNDE(X1:10)

The enable input (FRG/RUN) and the input for the rotating field enable (RFE) are fixed, they cannot be programmed. Without the enable FRG/RUN the servo-drive is electronically disabled (no PWM pulses). Without the rotating field enable RFE the rotating field of the output stage is additionally electronically disabled (2. disable channel). The drive is free of torque (no holding torque). The remaining four digital inputs can be programmed. The inputs LMT1 (X1:5) and LMT2 (X1:6) are preferably to be used as inputs of the output stage switch.

Input	Plug	Function	Status
FRG/RUN	X1.7	Enable	fix
RFE	X1:18	Rotation Enable	fix
END1/LMT1	X1:5	Limit switch 1/Dig. Input	programmable
END2/LMT2	X1:6	Limit switch 2/Dig. Input	
DIN1	X1:11	Digital Input 1	
DIN2	X1:12	Digital Input 2	

## External Power Supply for Inputs and Outputs

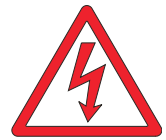


### Safety input RFE (Rotation enable)

#### Warning!

If the input of the enable or of the rotating field enable are switched off, the drive is free of torque. The drive could move if there is no mechanical brake or block provided.

The motor conductors are not dead. Only the rotating field is disabled. Prior to any work or maintenance on the motor or servo-drive, the servo-drive must be completely disconnected from the mains power supply.



#### Operation with RFE input

Two-channel disable of the enable via a safety switching device.

Enable input FRG/RUN + rotating field enable input RFE.

#### Switching-on

Contacts of the safety device closed: enable FRG/RUN 0.5s after RFE.

#### Safety switch-off

Contacts of the safety device open:

- there is no FRG/RUN signal in the 1. disable channel to disable the PWM pulses in the processor,
- there is no RFE signal in the 2. disable channel to disable the PWM pulses at the output of the processor.

#### Restart

Release the safety switching device.

Contacts of the safety device closed.

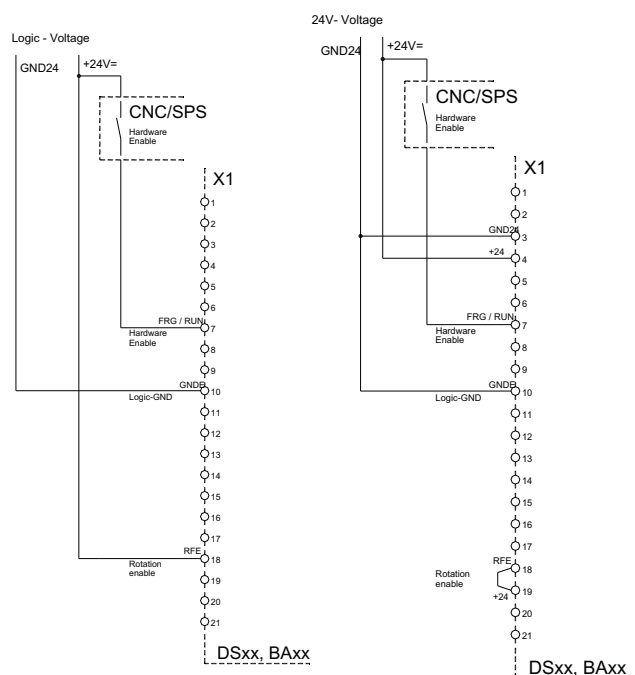
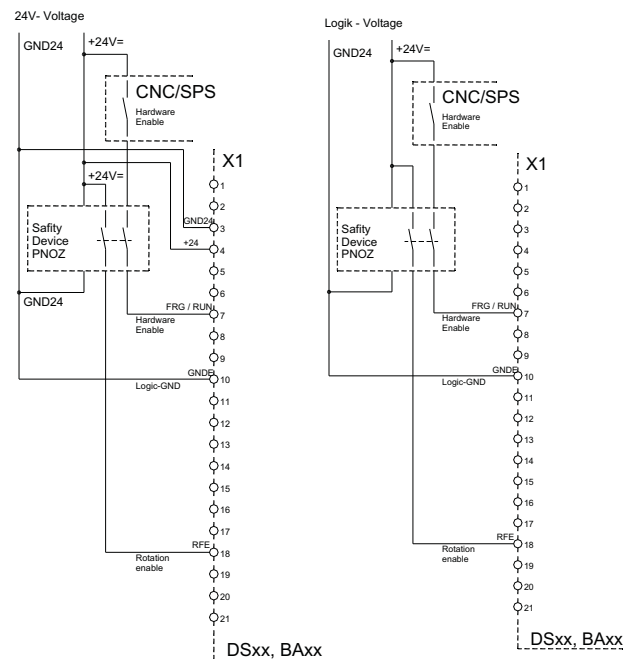
The motor can only move after a second disable FRG/RUN (after the rotating field enable).

#### Operation without RFE input

The input RFE must be bridged with the logic voltage.

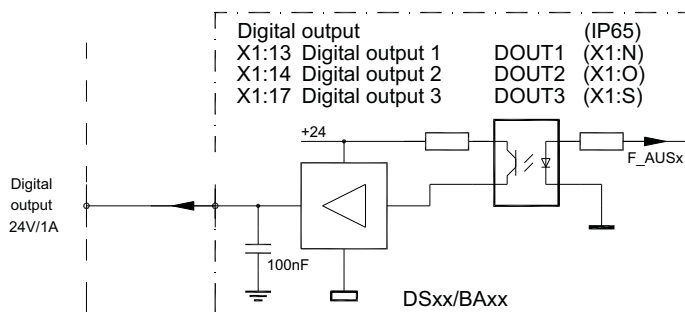
If the logic voltage corresponds to the supply voltage, the RFE input is bridged with +24V.

Enable FRG/RUN at least 0.5s after the RFE signal.



## Digital logic outputs (open emitter)

The logic outputs 1 to 3 are rated for 24V and 1A (short-time: 2A)



Output voltage

On-level max. +24V

Off-level <1V

Output current nom. 1A

Output current max. 2A

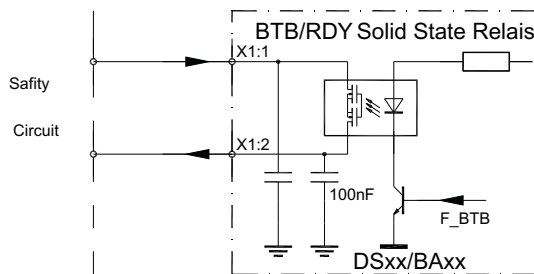
Voltage reference +24V (X1:4)

ground reference GNDE (X1:10)

It is possible to program an energy saving program (clocked output).

The logic output 4 (24V, 3A) at the power section is only available with certain **devices**.

## Signal contact “Ready BTB/RDY” (Solid state relay)



Contact for

max. 48V/0.2A

Capacitive load

max. 1μF

Contact resistance

max. 2 Ohm

external fuse BTB/RDY 0.5A<sub>ff</sub>

The contact is closed when the device is ready for operation.

State signal via seven-segment LED



## BTB opens (red LED, open relay contact)

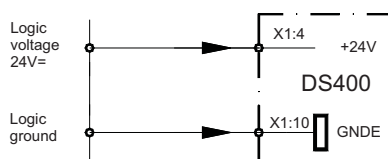
in case of error messages

in case of under-voltage of the auxiliary voltage (<20V)

The message “under-voltage in the bus circuit” can be programmed (see Manual NDrive)

Output	Plug	Function	Status	Parameter
BTB/RDY	X1:1, X1:2	Ready	fix /Relay	
DOUT1	X1:13	Digital output 1	programmable	
DOUT2	X1:14	Digital output 2	programmable	
DOUT3	X1:17	Digital output 3	programmable	
DOUT4	X	Digital output 4	programmable	

## Externe Spannungsversorgung für Ein- und Ausgänge

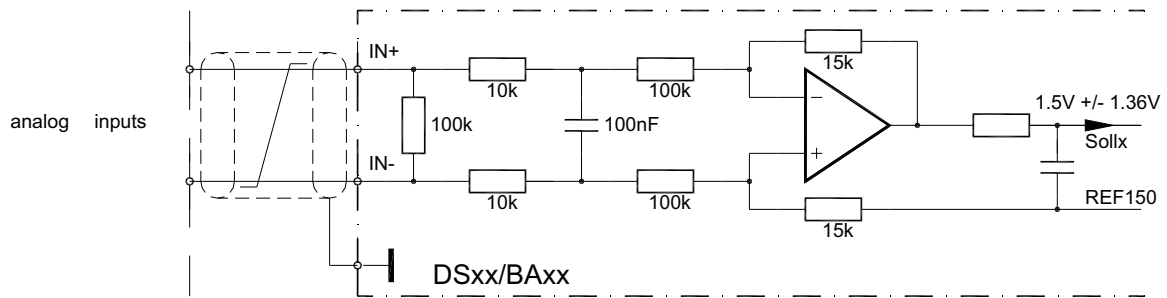


+24V for the logic and the auxiliary voltage

Observe the sum of all output currents!

GNDE logic ground

## Analog inputs $\pm 10V$



Input	Plug	Basic- Function	Voltage	Status	Parameter
AIN1+,AIN1-	X1:8, X1:9	Speed setpoint	$\pm 10V$	prog.	
AIN2+,AIN2-	X1:15,X1:16	Current limit	$\pm 10V$	prog.	

## Characteristics

Differential input	AIN1+/AIN1-	AIN2+/AIN2-	
Input resistance	70k		
Maximum voltage	$\pm 12V$		
Resolution	11Bit + sign		

The direction of rotation of the motor can either be changed by swapping the  $\pm$  connections at the differential input, or by means of a logic input or by programming. The analog inputs can be assigned to different functions.

With a digital command value (RS232, x-bus)

- the analog input AIN1 can be programmed as external analog speed limit
- and the analog input AIN2 can be programmed as external analog current limit.

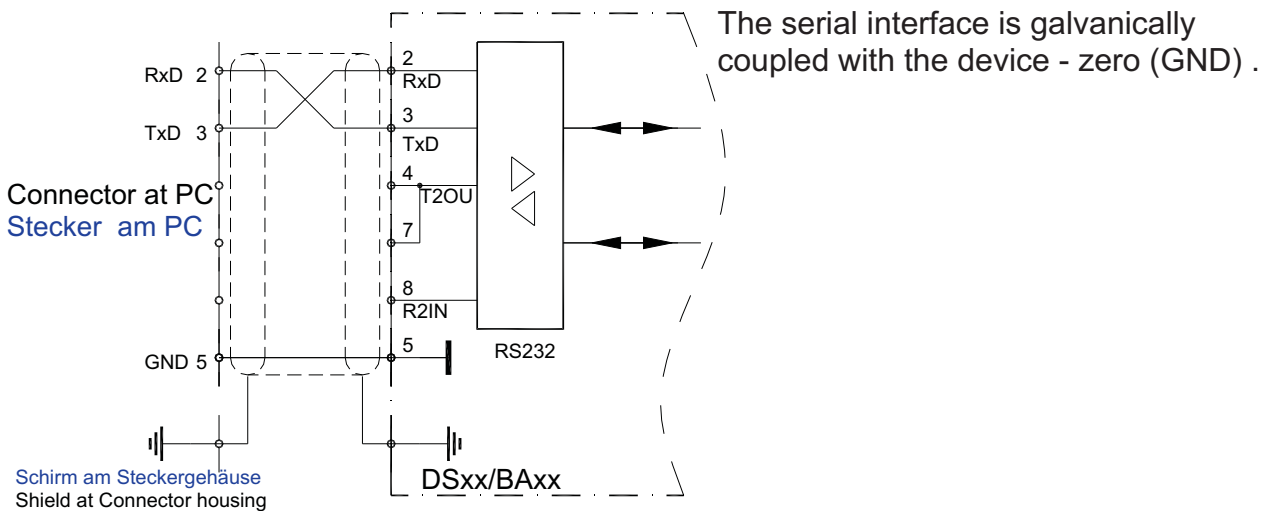
## Analog Output $\pm 10V$

Output	Connection	Basic function	Voltage	State	Param.
AOUT1	X2:20	Speed actual value	$\pm 10V$	programmable	
GND	X2:21	Signal zero	0V	fixed	

### RS 232:

Via the serial PC RS232 interface the DS400 amplifier is programmed and operated for the start-up.

The software is described in the DS software manual.



The DSxx (D connector X10) and the serial interface (COM1/COM2) of the pc must only be connected using a null modem cable.

Do not use a null modem link cable!

Install the cable only after disconnecting the device from the mains.

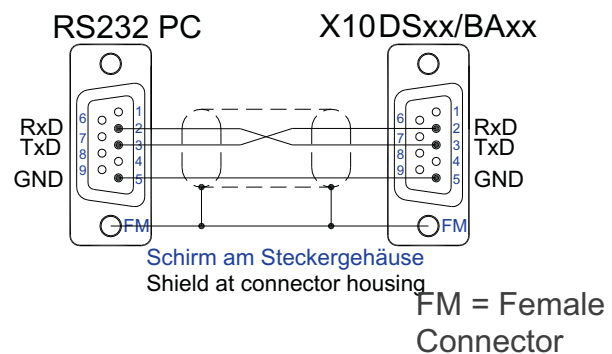
The interface is hard-coded to **115200Baud**.

Null modem cable

Pin assignment. Solder side.

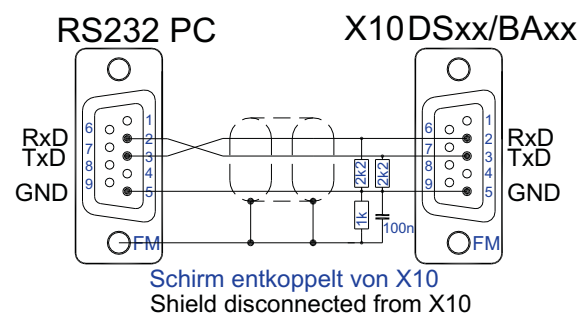
Contact shield with the plug housing.

Cable length max. 10m



In case of strong interferences at the interface a line filter should be installed.

Notebooks with a USB-RS232 converter are usually susceptible to interference.



# Electrical Installation

## CAN-BUS

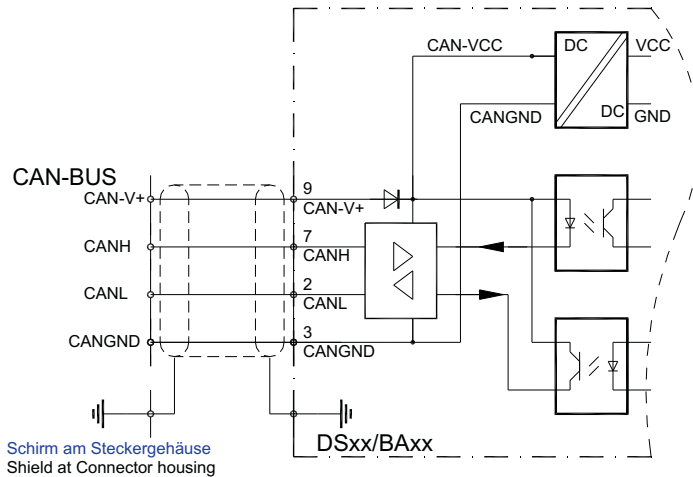
The CAN-BUS is a digital connection to the CNC control.

Optimum conditions are achieved with CNC controls and CAN components of LABOD electronic or CAN Open.

Programming and operation by means of the control panel via the CAN-BUS.

Interface complies with the standard ISO 11898.

Adjustment and programming see Manual DS-CAN.



The CAN-BUS input is galvanically separated.

The power supply is from the intern DC/DC

Pin assignment. Solder side.

## CAN-BUS cable

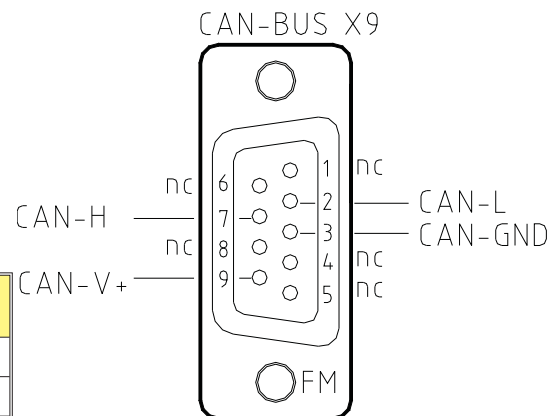
Use a shielded bus conductor with a low shielding capacity.

Signal plus GND (+supply).

D-connector with a metal or metallized housing.

LiYCY 4x0.25+shield.

Designation	Connector no.	Cable colour	Cable no.
CAN-V+	9	brown	1
CAN-GND	3	white	4
CAN-H	7	green	3
CAN-L	2	yellow	2



FM = Female Connector

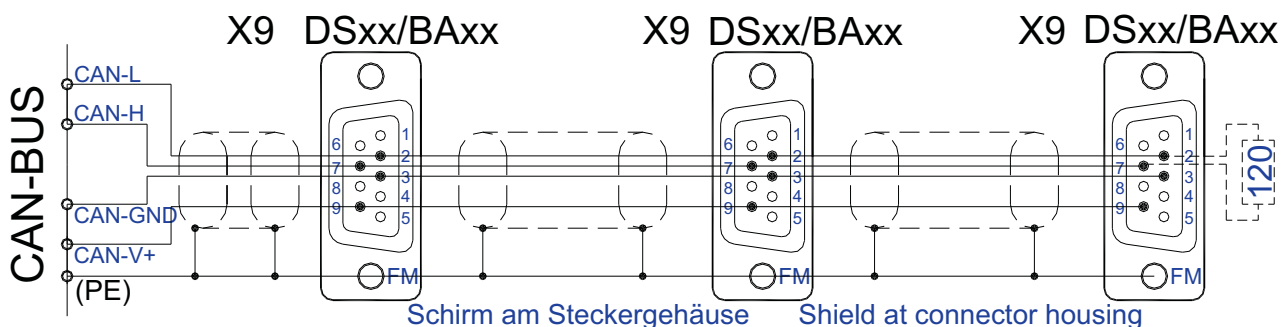
## CAN-BUS connection with several DS-Servo

Master

Adresse xx

Adresse xx

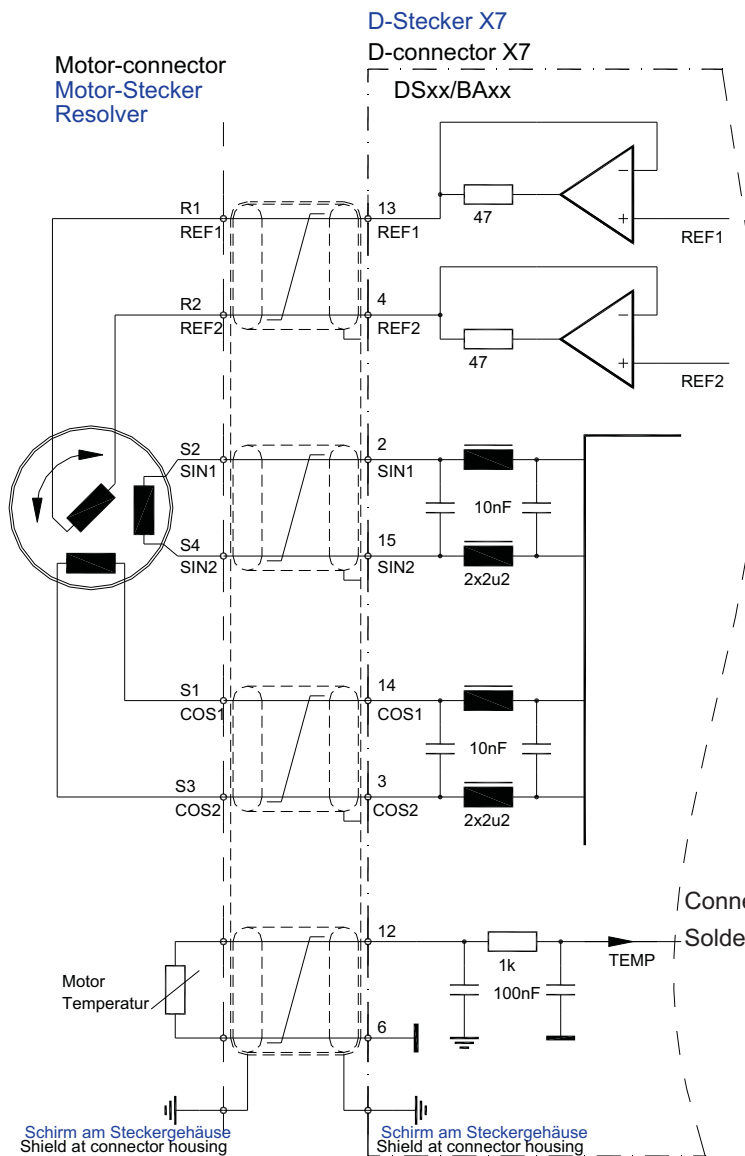
Adresse xx



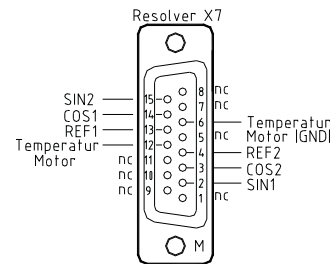
Terminating resistor at the end of the bus line > 120Ohm between the CAN-H and CAN-L

### Resolver - connection.

Applicable only for DS xx-RS



The resolver is an absolute measuring system for one motor revolution. It is rugged and not sensitive to high motor temperatures. Its set-up is like a rotating transformer. The rotor is fed by the reference (10kHz). The stator provides the sinus and cosine signals modulated by the rotation reference. The amplitudes of these signals are evaluated and digitalized in the servo amplifier. The resolution is fixed to 12bit (4096 inc./rpm). The maximum possible rotational speed is 15600. The digitalized signals are used for the rotor angle, the position and speed control and for the incremental output. The absolute accuracy is approx. +/- 10 angular minutes.



M, pin contact

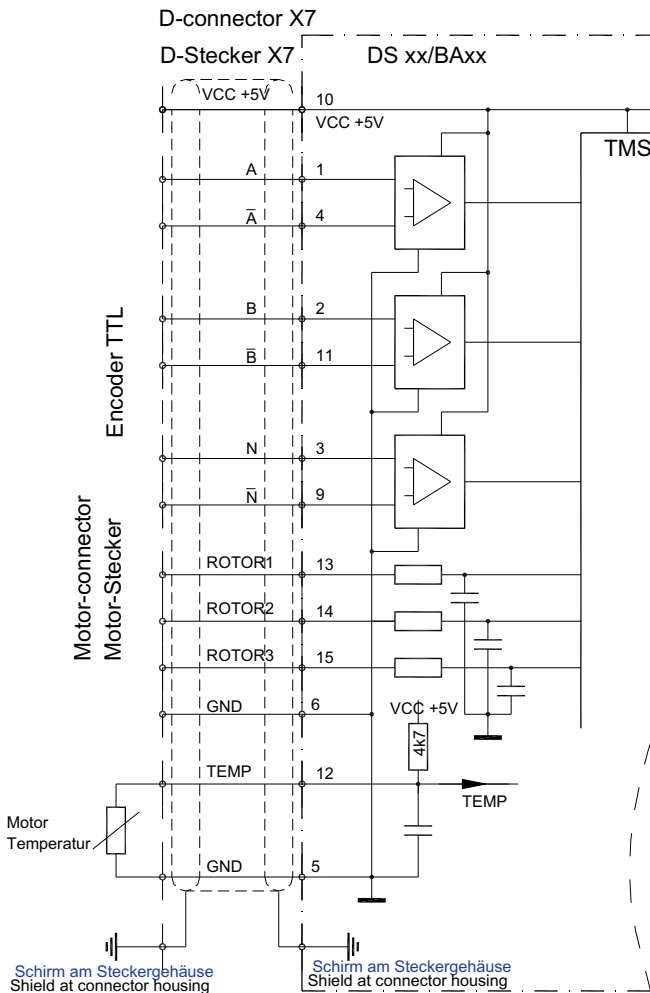
Only UNITEK approved motors (Appendix A) with 2,4 or 6 pole resolvers must be used.  
Note motor-specific connection sheet!

Connecting plug: X7 - 15pin D-plug  
Connecting lead: 4 Twisted pair, individually shielded plus outer shield.  
For Link-chains, only suitable cable should be used.  
Cable length: For > 25m, use only high quality resolver cable with adequate shielding properties.  
Shielded connection: at plug X7 contact shield with the plug housing.  
At the motor plug - contact shield with the plug housing.

For setup - parameters - see DS software manual

## Encoder - connection.

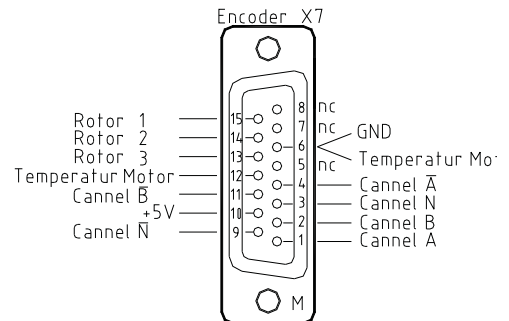
Applicable only for DS 4xx - IN



Incremental encoders with 2 counting tracks and a zero track plus 3 rotor position tracks. Counting tracks with push-pull output. Counting - input corresponds to RS485. Maximum counting frequency 500kHz.

The incremental encoder is galvanically coupled with the device - zero (GND). Supply voltage 5V.

Connect.assignment  
Soldered side



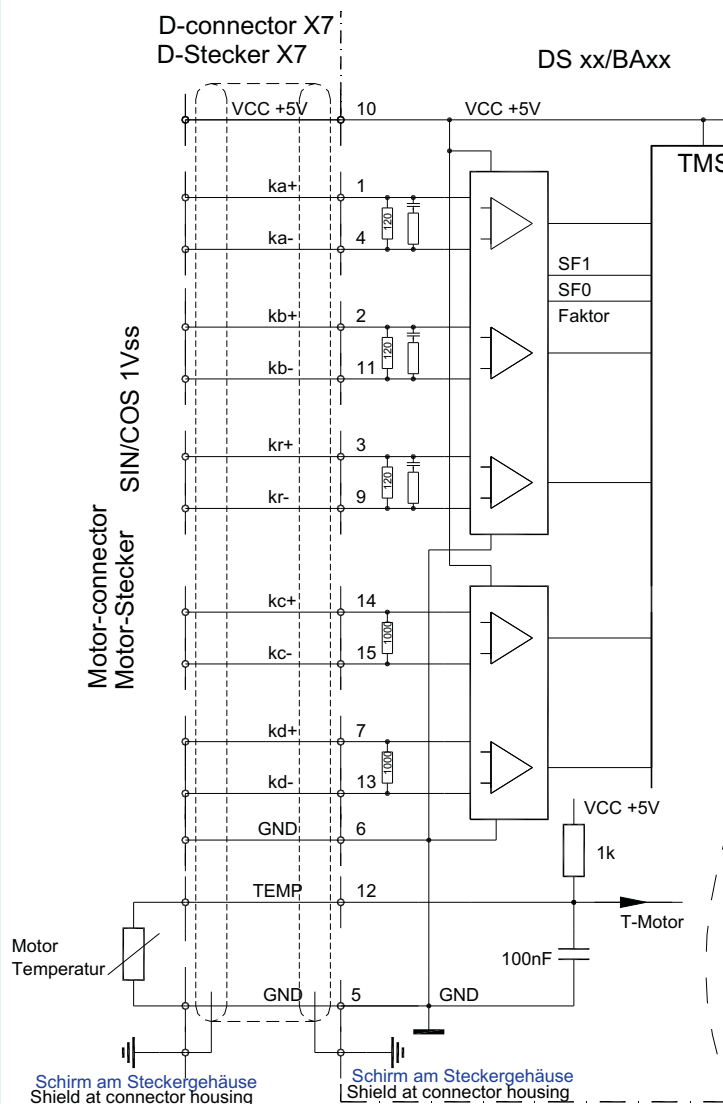
M, pin contact

Only UNITEK approved motors (Appendix A) with incremental encoders.  
Note motor-specific connection sheet!

Connecting plug: X7 - 15pin D-plug  
Connecting lead: 10 signal wires, shielded, minimum cross section 0,14 mm  
2 supply wires, minimum cross section 0, 5 mm.  
Use only suitable cables in a power carrier chain.  
Cable length: The next step up for a section of >25m.  
Shielded connection: at plug X7 contact shield with the plug housing.  
At the motor plug - contact shield with the plug housing.

For setup - parameters - see DS software manual

only for DS xx-SC



The resolution is automatically adjusted to an optimum.

connect.assignment

Considered side

SIN/COS X7

nc

Kanal kc-

Kanal kc+

Kanal kd-

Temperatur Motor

Kanal kb-

Versorgung +5V

Kanal kr+

Kanal kd+

Versorgung GND

Temperatur GND

Kanal ka-

Kanal kr+

Kanal kb+

Kanal ka+

M

M, pin contact

across connector X7-connect the shield to the connector housing  
across the motor connector - connect the shield to the connector

## Rotor position encoder - connection via a bl-tacho only for DS xx-bl

3 rotor position encoder signals (Hall sensors) for the commutation; with or without a brushless tacho.

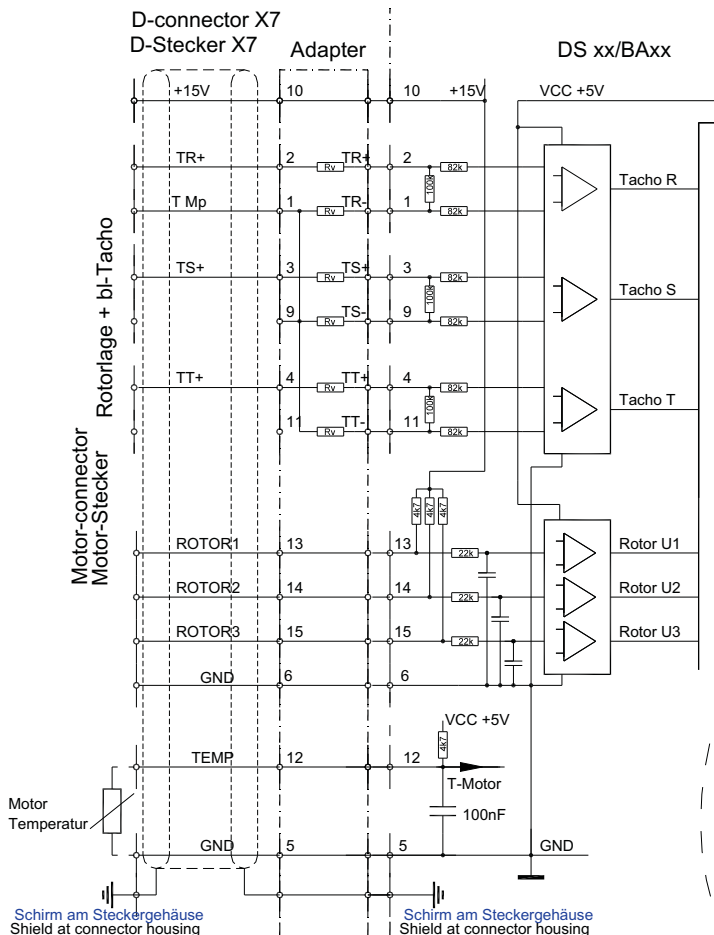
The rotor position encoder is galvanically connected with the device zero (GND).

The voltage of 15V is supplied by the servo-drive.

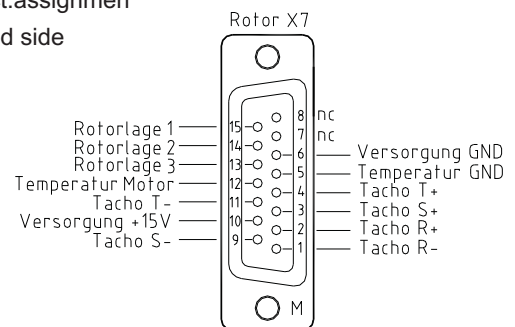
Provide an adapter in case the tacho voltage at rated speed is superior to 10V~.

For lower tacho voltages connect X7: pin 1, 9, and 11.

Connect the tacho center point to X7:1.



Connect.assignmen  
Soldered side



Use only motors with Rotor encoders (bl) which have been approved by UNITEK (Appendix A). Observe the motor specific connection data sheet (bl)!

**Connector** X7 15-pole D-connector

**Connecting cable** 12 signal conductors, min. cross-section 0,25mm

**Cable type** (4x(2x0.14)+(4x0.14)C+4x0.5)C

For link chains use appropriate cables!

**Cable length** for >25m the cross-section of the cable used must be increased by one grade

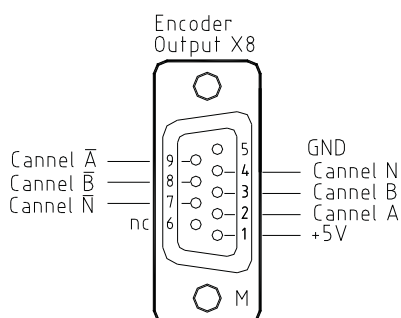
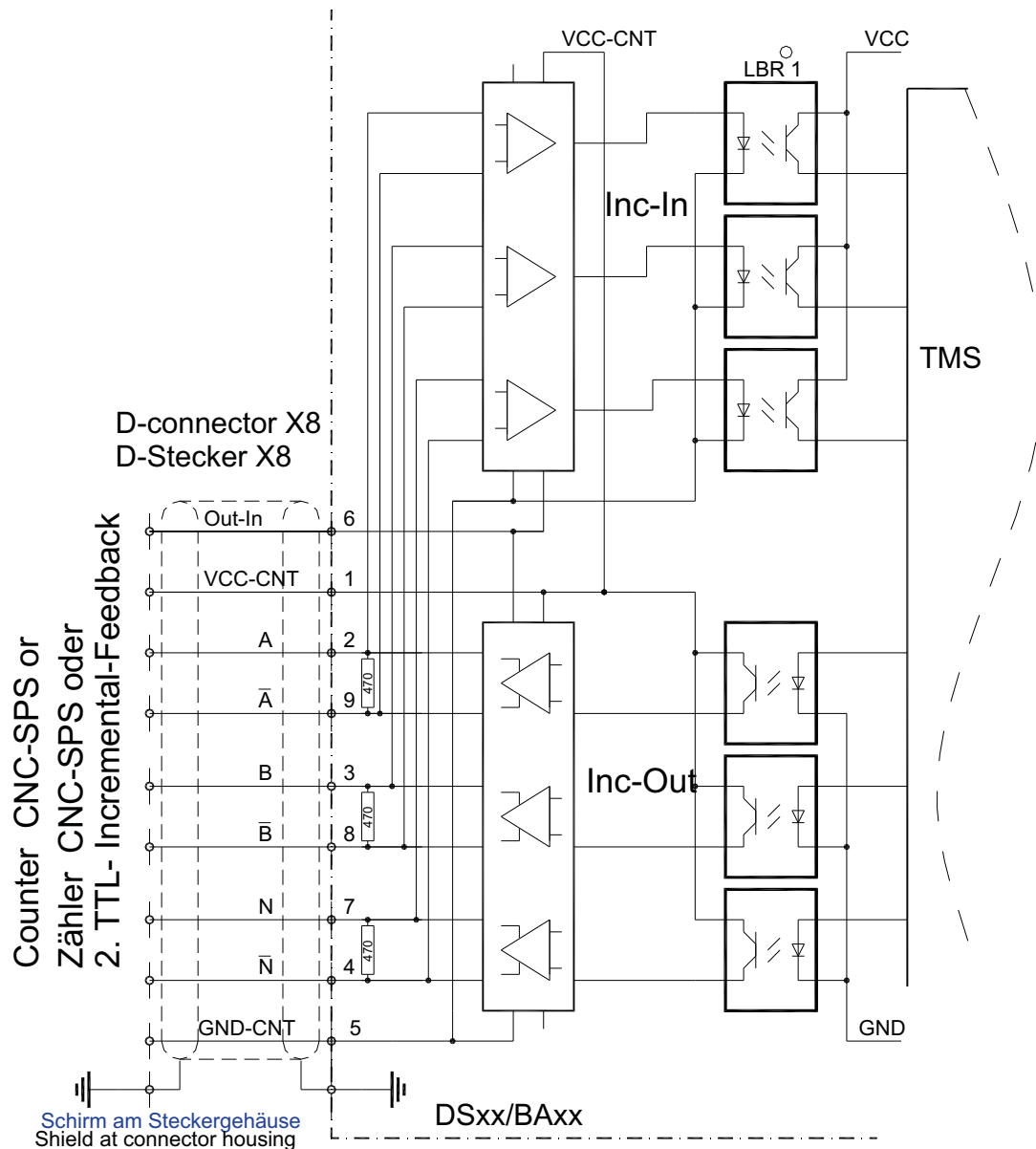
**Shield connection** across connector X7-connect the shield to the connector housing  
across the motor connector - connect the shield to the connector housing

### X8 TTL- Encoder output or input (2)

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

Output X8 pin 6 not connected or bridge to GND

Input X8 pin 6 bridge to +5V (X8:1)



9-pin D connector ( M, pins)

Connector assignment soldering side

#### Attention: X8 as input

X8:6 (Select IN) with X8:1 (+5V) connect with the D connector M = male connector

### X8 as TTL Encoder output

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

The encoder output is internally isolated.

The voltage is supplied via the encoder line from the CNC/PLC control.

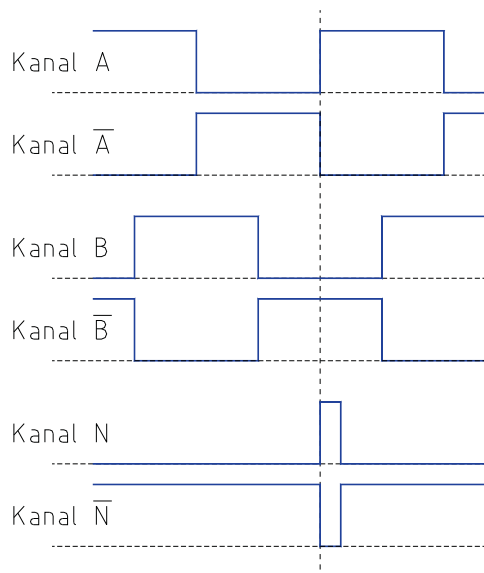
Voltage supply +5V  $\pm$ 0.2V.

The output signal corresponds to RS485.

Option: Internal supply from the servo (LBR1 + LBR2)

For RS and SC the resolution can be programmed (parameter 0xa4), Bit1).

For IN it is equal to the number of encoder pulses.



#### Pulse signals (motor revolving clockwise)

Output level low <0.5V, high >4.5V

Slope <0.1ms

Zero pulse min. 0.2ms

Output frequency max. 200kHz

Pulse/rpm

- for RS, SC programmable

- for IN encoder no.of pulses

Signal Carateristics  
(clockwise rotation)

### X8 as TTL Encoder input

**Attention:** X8 pin6 (select IN) and X8 pin1 (+5V) must be bridged!

The encoder input is internally isolated.

The voltage is supplied via the encoder line.

Option: Internal supply from the servo

The input signals correspond to RS485.

Input frequency: max. 200kHz

Option: Internal supply from the servo (LBR1 + LBR2)

The encoder input can be programmed to fulfill different functions.








## LED displays on the Servo

The state “**normal**” is signalled by a bright green seven-segment display + decimal point (display of the state).

The state “**fault**” is signalled by a bright red fault LED and the seven-segment display indicates the error no.

The state “**warning**” is signalled by the flashing red fault LED and the seven-segment display indicates alternately the state and the warning no.

## Display of the servo-drive state

Display	Point/segment	State	State of NDrive
	flashing dark	Processor active Auxiliary voltage missing or inherent hardware failure	
	flashing bright dark	Starting state after reset (auxil. voltage 24V off-on). The first enable stops the flashing display. Drive enabled Drive disabled (not enabled)	OK = 0 OK = 1, ENA = 1 OK = 1, ENA = 0
	bright	Speed zero (standstill signal)	N0 = 1
	bright	Drive revolves clockwise, N currently positive	N0 = 0
	bright	Drive revolves anti-clockwise, N currently negative	N0 = 0
	flashing bright dark	Motor current reduced to continuous current $I_{cns}$ Motor current at max. current limit $I_{max}$ Normal operation; Motor current within the current limits	$I_{cns} = 1$ $I_{csn} = 0$ $I_{cns} = 0$
	bright for 0.1s	A new command (value) was received from the BUS or RS232	

**Example:** Motor revolving clockwise



Point flashes  
bottom segment  
right segment

= active processor  
= drive enabled  
= motor revolves clockwise

## Error message on the Servo

In case of an error the red LED 'fault' lights up and the green 7-segment display indicates the error number.

## Error list

Display on the Servo	Error message on the NDrive	Description	IP-address
			Ox8f
0	BADPARAS	Parameter error	bit 0
1	POWER FAULT	Output stage error	bit 1
2	RFE FAULT	Error in the safety circuit	bit 2
3	BUS TIMEOUT	Transfer error BUS	bit 3
4	FEEDBACK	Incorrect/faulty encoder signal	bit 4
5	POWERVOLTAGE	No power supply voltage	bit 5
6	MOTORTEMP	Motor temperature too high	bit 6
7	DEVICETEMP	Device temperature too high	bit 7
8	OVERVOLTAGE	Over voltage >1.8 x UN	bit 8
9	I_PEAK	Overcurrent 300%	bit 9
A	RACEAWAY	Racing (without command value, incorrect polarity)	bit 10
B	USER	User's error choice	bit 11
C	RESERVE		bit 12
D	RESERVE		bit 13
E	CPU-ERROR	Software error	bit 14
F	BALLAST	Ballast circuitry overload	bit 15
Flashing decimal point		Active processor	
Dark decimal point		Missing auxiliary voltage or device hardware failure	

Example:



FAULT LED  
Error no. 5

red  
Power voltage (missing power voltage)

### Warnings

The warning messages are displayed in the window 'warnings'.

#### Warning messages

Warning display	Warning message on the NDrive	Description	ID-address
			<b>0x8f</b>
0			Bit 16
1			Bit 17
2			Bit 18
3			Bit 19
4			Bit 20
5	POWERVOLTAGE	Leistungsspannung zu klein oder fehlt	Bit 21
6	MOTORTEMP	Motortemperature > 87%	Bit 22
7	DEVICETEMP	Devicetemperature > 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	Power overload > 87%	Bit 28
D			Bit 29
E			Bit 30
F	Regen	Regen > 87% overload	Bit 31

#### LED displays on the servo

In case of a warning state the red LED changes (low-frequency) and the seven-segment display shows alternately the warning no. (red LED) and the operating state (LED dark).



#### Example:

The red fault LED flashes and the display shows alternately the warning number and the operating state.

Warning no. 5 = POWERVOLTAGE