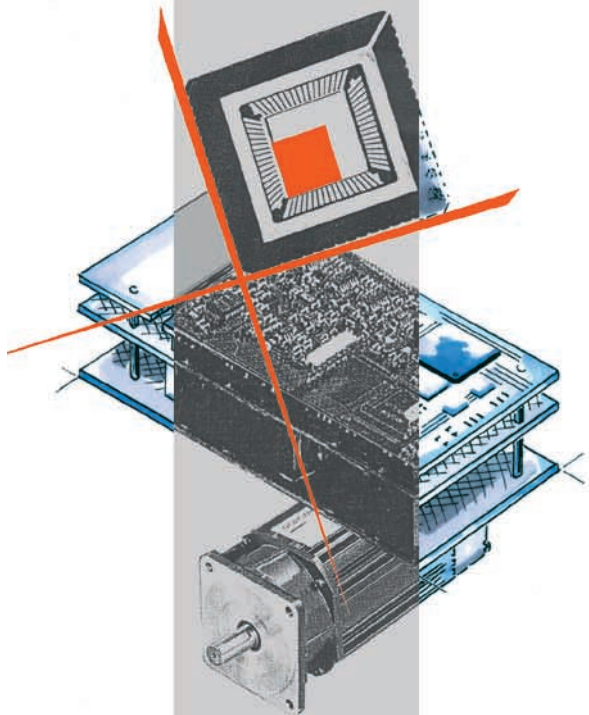


Manual Basic Device ND31 and ND32

Version 4/2004



NOVOTRON
für Dynamik und Bewegung

Please read the following information about the symbols used in the manual:



Danger! Voltages may cause serious or fatal injury!

Noncompliance with instructions can endanger the life and sanity of persons!

Caution !

Caution! Make sure to handle the device correctly!

Noncompliance with instructions can lead to the destruction or can cause malfunction of the device or the entire equipment!



Link or recommendation

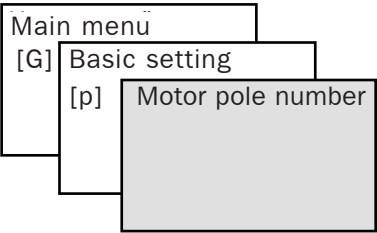
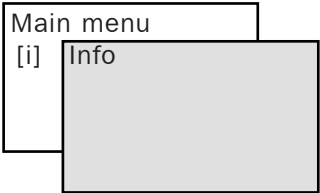
Link to other sections of the text or recommendation for practical usage

1 2

Menu *Limit values*

Command *Channel1*

[], [enter]



Sequencing of an instruction

Designation of a menu or submenu

Designation of a command or function

Designation of a key or key combination

Graphical representation

Accessing a menu or submenu

Adjustment bar

[]< >[]

Adjustment bar, maximum value

[]< >[]

Adjustment bar, minimum value

[]< >[]

Adjustment bar, intermediate value

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1 General Information

1.1 About this manual

The entire documentation of NOVODRIVE comprises 7 parts:

- 1 Manual Basic Device ND31 and ND32**
Standard *)
- 2 Manual Bus Functions ND31 and ND32**
Optional
- 3 Manual Basic Functions ND31 and ND32**
Optional
- 4 Manual Additional Functions ND31 and ND32**
Optional
- 5 Reserved**
- 6 Manual Start-up ND31 and ND32**
Standard
- 7 Instructions for installation/exchange of ND31 and ND32**
Standard (leaflet)

The symbols used in the manuals are listed and explained on the inside front cover.

*) This manual

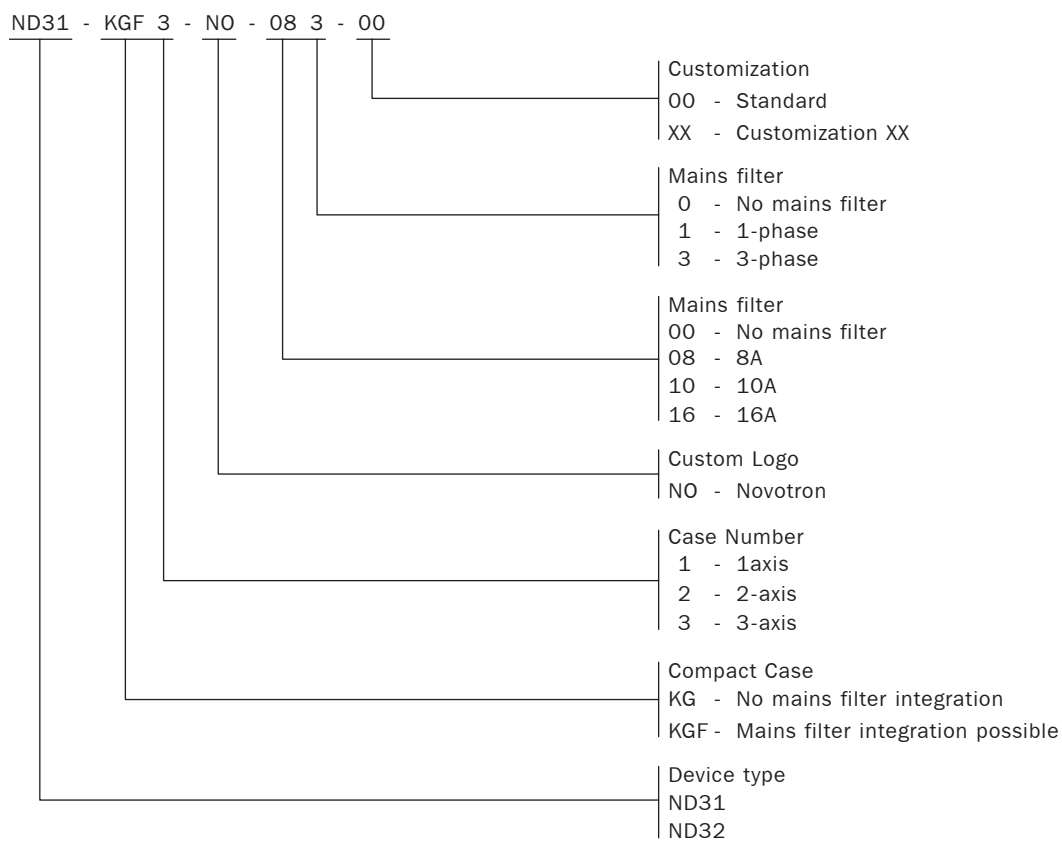
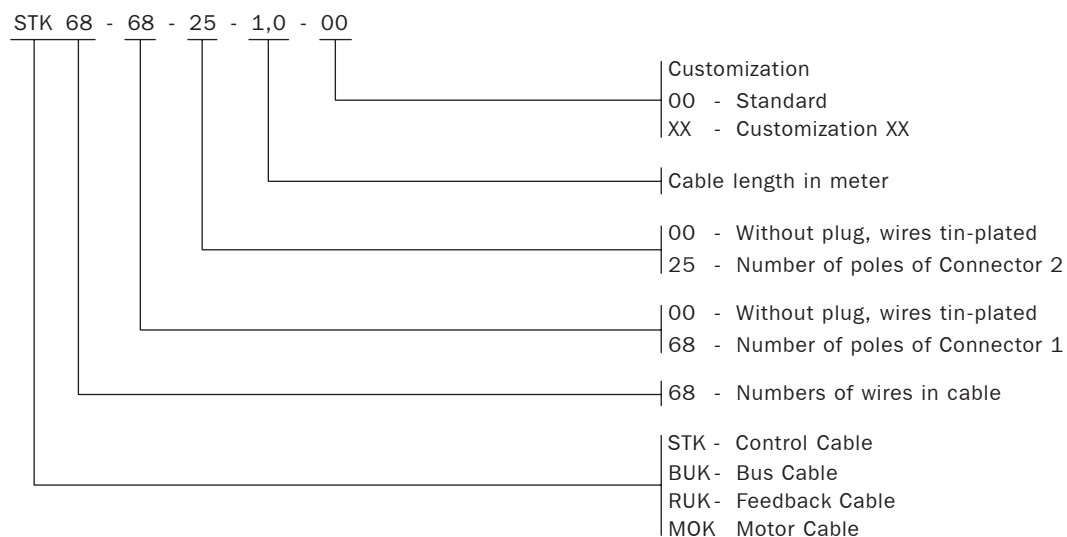
1.2 After-sales service

NOVOTRON GmbH
Mauserstrasse 31
71640 Ludwigsburg
Germany

Phone: +49 - (0)71 41 - 29 69 - 0
Fax: +49 - (0)71 41 - 29 69 - 22

1.3 Designations

ND	31 - 32	07	X	S	- 0 0 0	0 0 0 - 00	
							00 - Customization
							0 - Standard
							1 - Table interpolation
							0 - 8 k memory
							1 - 128 k memory
							0 - Resolver
							1 - ERN 1387 SinCos/EXE
							2 - ECN/EQN on demand
							3 - Hall sensor (open collector) + encoder
							6 - Resolver + SinCos
							7 - Hall sensor (TTL) + encoder
							0 - NOVOBUS RS232
							1 - CAN Bus NOVO
							2 - InterbusS on demand
							3 - Profibus on demand
							4 - Sercos on demand
							5 - NOVOBUS LWL
							6 - CAN Bus Pro
							7 - CAN Open on demand
							8 - NOVOBUS RS 422
							0 - Standard
							1 - CAN coding
							2 - PLC + CAN coding
							3 - PLC 8051
							4 - galv. isolation CAN Bus
							5 - Reserved
							6 - galv. isolation CAN Bus with GND
							0 - no positioning control
							1 - NOVOMERIK positioning control
							T - trapezoidal EMF
							S - sinusoidal EMF
							V - 19" module
							X - prepared for compact case
							02 - 2 A Rated current
							04 - 4 A Rated current
							05 - 5 A Rated current
							07 - 7 A Rated current
							10 - 10 A Rated current
							12 - 12 A Rated current
							20 - 20 A Rated current
							32 - 320 V DC link voltage
							56 - 560 V DC link voltage
							31 - Version
							32 - Version
							ND - NOVODRIVE

Compact case**Cable****1.4 Industrial property rights**

IBM is a registered trademark of the IBM Corporation.

2 Safety Instructions



NOVODRIVE contains voltages that can be fatal !

Wiring

Before switching on NOVODRIVE, carefully check the wiring. Make sure all plugs are properly connected and the device is properly grounded.

Protection

Make sure no voltage-carrying parts may be accidentally touched and NOVODRIVE safety components are in place and properly connected.

Emergency power-off

Provide an emergency power-off by which the motor can be stopped at any time.

Discharge time and contact voltage

After being switched off the electrolytic capacitors require at least five minutes to discharge. That means: After being switched off the device still contains dangerous voltage for up to five minutes. During this time, do not touch the device or disconnect any plug.

In case the motor is still turning after the supply voltage has been switched off, hazardous contact voltage may be present in the device until its standstill. Discharge of the capacitors then begins after the standstill.

Inrush current limitation

Frequent switching of the supply voltage should be avoided, since thereby the inrush current limiter of NOVODRIVE may be overcharged, which may lead to the destruction of the inrush current limiting resistor. Wait one minute between switching on and switching off again.

Switching on/off sequence

When switching on, first apply the 24 VDC supply voltage for the NOVODRIVE control section before connecting with the power supply. When switching off, proceed vice versa.

2.1 Intended Usage

General aspects NOVODRIVE is a servo converter for controlling brushless servo motors. It has been designed according to the state of the art. Usage other than here described may cause serious injury of the user or of bystanders. Moreover, the converter, the drive or other objects may be damaged.

Use the converter only if it is in a technically faultless condition. Use it in compliance with the intended usage and in knowledge of the dangers and safety instructions described in this manual and in other relevant documentation materials.

Suitable drives Use only brushless servo motors, the specifications of which suit the converter and which comply with regulations.

Regulations Install the converter only in compliance with regulations, rules and guidelines applicable in the respective country.

Ambient conditions Do not use the converter in explosion-prone areas or in connection with medical equipment or in other fields classified as dangerous.

Exception:

The converter is mounted in an enclosure that is permitted for such purposes and that has been inspected under consideration of the respective regulations.

2.2 Organizational Measures

Compliance with safety instructions As the producer and/or operator of a facility in which this converter is used, you are responsible for adhering to applicable regulations concerning safety and accident prevention.

Qualified personnel Make sure installation, operation and maintenance of the device is conducted by qualified personnel only. When operating the device, the safety instructions in the Start-up manual must be followed.

Manuals The producer/developer of a facility in which the converter is installed must have read the manuals and follow safety instructions.

Transportation and storage For transportation and storage of the converters, use the original packing.

Written confirmation of personnel Request a written confirmation from every person working with the device indicating they have read and understood the manuals and the safety instructions.

2.3 Safety Components

Emergency power-off If due to moving parts danger may occur to persons or damage to the equipment, provide the equipment with an emergency power-off. Follow instructions given in Chapter 6.3 "Emergency Stop".

2.4 Hazardous Voltage



The converter works with hazardous voltage! Therefore be absolutely sure to take notice of the following warning notices:

- **Make sure no live parts can be touched!**
- **Protective earthing according chapter 6.2 „Earthing and Shielding“**
- **Overcurrent protection according chapter 5.1 „Power Connection, Motor Connection and Braking Resistor“**
- **Connect all plugs according to chapter 5 „Pin Assignment“.**
- **Do not dismantle the device! Do not modify the device! Repair may be done by the manufacturer only!**
- **When starting up keep strictly to the safety instructions and make sure the safety components are in place!**

2.5 Protection Against Electric Shock

General

- Connecting-up the device may be done by a specialist only.
- Do not work on the connectors of NOVODRIVE and do not plug or unplug the connectors of NOVODRIVE as long as NOVODRIVE is energized. NOVODRIVE may be energized only if all connectors are protected from sliding by screw connection with NOVODRIVE.
- Used connection cables and lines must have double or reinforced insulation between wire and surface.
- For the wire ends use wire end sleeves with insulation of the appropriate size.
- Cables leading to moving parts of the machine must be protected by means of suitable strain reliefs.
- Before switching on the supply voltage for the first time, make sure all cables are properly connected and wire ends are properly insulated.
- Repeat these steps during regular maintenance of the equipment. Clamps that may be loose must be retightened.

Compact Device

- The housing must be grounded. Grounding is done over the grounding bolt attached to the housing. Grounding requires a line cross section of $\geq 10 \text{ mm}^2$ (Copper).
- The grounding of the NOVODRIVE is done by a short connection between the PE pin of connector X1 and the grounding bolt of the housing (see chapter 6.2 „Grounding and Shielding“). There is no internal connection between the NOVODRIVE and the housing.
- The integrated mains filter needs a separate grounding (see chapter 6.2 „Grounding and Shielding“).
- The connections area must be covered to prevent accidental touching.
- Do not open the housing!

19" Insert Device

- All components of the 19" rack must be grounded. Grounding requires a line cross section of $\geq 10 \text{ mm}^2$ (Copper).
- The upper and lower side of the 19" rack must be covered to prevent accidental touching of the NOVODRIVE.
- The connection area at the back side of the 19" rack must be covered to prevent accidental touching.
- Pulling out NOVODRIVE from the 19" rack may be done only in an unenergized state and only by a specialist.



The signals at the connectors X2, X3, X4 and X5 are safely separated from the NOVODRIVE power section (connectors X1 and X6) by double insulation.

3 Functional Description

3.1 General Information

Basic function	NOVODRIVE is a digital servo converter for brushless synchronous motors.
Inputs and outputs	NOVODRIVE has a number of digital and analog inputs and outputs. These may be used for standard functions such as enable, start, limit switch, ready-to-operate on etc.
Start-up	<p>The start-up of NOVODRIVE is done with a laptop or desktop PC. A built-in storage oscilloscope function of NOVODRIVE allows to graphically display on the screen all desired and actual values for current, torque and rotor position.</p> <p>The oscilloscope function make the adjustment of NOVODRIVE very easy, as the impact of a change in the parameters can be observed immediately. Parameters are stored in NOVODRIVE and backed-up on a floppy disk. Parameter sets can be transfered to other NOVODRIVES easily.</p>
NOVOBUS	NOVOBUS is used to connect drives with a central computer, based on a ring-shaped wiring. No other hardware components are required. As the physical communication medium the standard serial interface RS232 or RS422 is used.
CAN bus	Optionally, NOVODRIVE can comprise a CAN bus. The CAN bus represents a cost-efficient solution for connecting a central computer with NOVODRIVE and for connecting NOVODRIVES with each other.
Positioning control	Optionally, NOVODRIVE can comprise a single-axis positioning control.
Tabular interpolation	The NOVODRIVE can be equipped with a battery-backed RAM of up to 64 kWord. Therein a motion sequence of up to 50 seconds can be stored.

3.2 NOVODRIVE Power Section

Power connection NOVODRIVE contains all necessary components for operating a servo motor at line voltage. Part of the package is a power pack for direct connection of NOVODRIVE with the 230 VAC power supply system. Protective circuits limit the inrush current and protect NOVODRIVE against overvoltage.

DC link The motor's braking energy is feedback in the DC link. If the capacity of the DC link capacitors is not sufficient, the integrated braking chopper is activated to prevent the DC link voltage from getting to high.

When using several ND31 or ND32, the DC links can be coupled. By this, the braking energy can be distributed to several DC link capacitors.

Do not connect the DC links of NOVODRIVE converters with the DC links of devices of other manufacturers.

If the DC links of several ND31 are coupled, make sure the power connections E1, E2 and E3 are equally connected at all ND31.

The connection of several ND31 with coupled DC links to different mains phases leads to the destruction of the converter, as in this case the 400 V phase-to-phase voltage becomes effective.

Braking circuit The integrated braking circuit is monitored electronically. In case of overload, the braking circuit is switched off and NOVODRIVE signals overvoltage.

IGBT Inverter An IGBT inverter supplies the motor with current. The inverter outputs are short-circuit proof.

3.3 NOVODRIVE Control Section

Internal power supply For internal power supply of the NOVODRIVE control section, an external 24 VDC power pack is necessary.

Control Position, speed and current control as well as pulse width modulation is done digitally in ND31 and ND32. Current control and pulse width modulation are accommodated in the ASIC („Potentialchip“ ND32XX), which has been developed specifically for NOVODRIVE. Another ASIC („Peripheriechip“ ND31XX) comprises, among other things, a resolver converter, a pulse counter, a coordinate transformer and an encoder emulator.

Feedback system The rest of the control and regulation tasks is taken over by a micro controller. NOVODRIVE requires a resolver or an encoder as feedback system in the motor.

Resolver/digital conversion is done by the „Peripheriechip“ ND31XX. The resolution of the rotor position measurement is 16 bit for the entire speed range.

Setpoints For setpoint setting the following options are available:

- Analog ± 10 V
- Encoder pulses
- Step/Direction setting
- Digital setpoint setting over the no-cost sensor-actor bus NOVOBUS (RS232 / RS422)
- CAN interface
- Internal positioning control
- Internal position table
- Sequence control
- Cam drive

4 Specifications

4.1 Characteristics

Standards	Overvoltage protection	IEC 801-4 class 2
	Noise suppression	EN 50081-2 (is kept in connection with mains filter)
	Interference immunity	EN 50082-2
	Inspections	EN50178
	Protection class	ND31 32XX VS: IP00 ND32 56XX VS: IP00 (protection class determined by 19" rack) ND31 32XX KS: IP20 ND32-56XX KS: IP20 according EN60529:1991
	Serial interface	RS232: ANSI/EIA232D RS422: EIA422
Signal processing	Modulation of inverter	Digital pulse width modulator
	Modulation mode	Modified sine-triangle mode
	Current control	Digital PI-controller with EMF compensation, symmetrical limiter and anti-wind-up circuit. Cycle time: 102,4 μ s.
	Resolution of motor current measuring	11 bit
	Speed controller	Digital PID-controller with torque pre-control and anti-wind-Up circuit. Cycle time: P-proportion: 102,4 μ s DI-proportion and pre-control: 512 μ s
	Position controller	Digital PD-controller with speed pre-control. Cycle time: 512 μ s.
	Position feedback system	Resolver and/or encoder
	Motor temperature sensor	Break contact or PTC

Communication	Serial data communication	RS232/RS422, communication protocol: NOVOBUS
	CAN interface	Specification CAN 2.0 Part A and B ISO/DIS 11898
	Step/Direction interface	Differential inputs, RS422 Maximum frequency: 500 kHz
	Analog interfaces	
	Inputs	$\pm 10\text{ V}$ 14 Bit $\pm 10\text{ V}$ 8 Bit
	Outputs	$\pm 10\text{ V}$ 8 Bit $\pm 10\text{ V}$ 8 Bit
	Encoder input	differential inputs, RS422 or sine signals 1 Vss

4.2 Electrical Data

4.2.1 Power Connection and Supply Voltage

	ND31				ND32		
Version	3202	3204	3207	3212	5605	5610	5620
Rated supply voltage	230 VAC				400 VAC		
Input frequency	50/60Hz						
Supply voltage range	20 ... 240 VAC± 10%				400 VAC ± 10%		
Number of input phases	2 / 3				3		
Connected load at rated current in kVA	0,75	1,5	2,7	4,5	3,5	7	14

Periodic and nonperiodic transient overvoltage

Permissible transient energy at the connections	10 WS	3 WS	
Rise time / Half-life period	1,2/50μs		
One-time-only peak value	380 V	650 V	
Max. inrush current (internally limited)	160 A	5 A	10 A

Max. supply inductance	-				2 mH		
Protection (three-phase)	3 x 4A	3 x 8A	3 x 14A	3 x 24A	3 x 10A	3 x 20A	3 x 35A
Protection (one-phase)	5 A inertial	9 A inertial	15 A inertial	25 A inertial	-	-	-
Voltage supply on signal side	24 VDC \pm 10%, externally fed, grounded and stabilized. Rated current 1 A, inrush current 2 A. Additional 0,5 A in compact cases for internal fan. Protected per device with 1,5A inertial.						
Power consumption on signal side	24 W if no outputs are involved (additional 2,5 W per output).						

4.2.2 DC Link and Inverter

	ND31				ND32		
Version	3202	3204	3207	3212	5605	5610	5620
DC link voltage at rated supply voltage	320V				560V		
Turn-off threshold in case of overvoltage	430V				720V		
Turn-off threshold in case of undervoltage	30V				200V		
Rated output voltage	300V _{eff}				500V _{eff}		
Number of output phases	3						
Load class	III						
Load type	Motor load						
DC link capacity	360μF	480μF	480μF	1320μF	300μF	300μF	675μF
Power dissipation of inverter at rated current	40W	50W	60W	100W	100W	130W	260W
Residual voltage drop at rated current	4V				6V		
Clock frequency of inverter in kHz	19,5	9,76	9,76	9,76	9,76	4,9	4,9
Clock frequency at motor in kHz	39	19,5	19,5	19,5	19,5	9,8	9,8
Rated motor current T _u =25°C in A _{eff}	2	4	7	12	5	10	20
Peak motor current T _k =25°C in A _{eff}	4	8	14	24	10	20	35

Maximum output current with respect to heat sink temperature:

Temp	25	35	45	55	65	75	85	°C
ND31-3202	4,0	3,8	3,5	3,1	2,7	2,4	2,0	A_{eff}
ND31-3204	8,0	7,6	6,9	6,1	5,4	4,7	4,0	A_{eff}
ND31-3207	14,0	13,3	12	10,6	9,5	8,2	7,0	A_{eff}
ND31-3212	24,0	22,8	20,6	18,2	16,3	14,1	12,0	A_{eff}
ND32-5605	10,0	8,9	8,0	7,0	6,01	5,2	4,2	A_{eff}
ND32-5610	20,0	17,8	16,0	14,0	12,2	10,3	8,4	A_{eff}
ND32-5620	35,0	33,5	30,4	27,4	24,3	21,3	18,2	A_{eff}

These currents can be supplied without time limitation, if the heat sink temperature is kept on the respective value.

There is an exception for ND31-3212 and ND32-5620. Continuous current of the NOVODRIVE may not exceed its nominal current.

Example In case of good separate ventilation, an ambient temperature of 40 °C and a motor current of $7 A_{eff}$, the heat sink of ND31-3207 reaches approx. 75 °C.

**New feature since H8 Version 2.01, dated July 1, 1998:**

At a speed of < 600 Upm, for the duration of 200 ms NOVODRIVE can supply 50 % more current than indicated in the above table.

At a speed of > 600 Upm, there is no time limitation in effect, i.e. 50 % more current can be supplied permanently.

However, the maximum current of the device cannot be exceeded.

Practical benefit:

In case of dynamic applications where the motor accelerates quickly, there is always 50 % more current available. Up to 60 °C, always 200 % current is available.

4.2.3 Braking Circuit

		ND31				ND32		
1	Version	3202	3204	3207	3212	5605	5610	5620
2	Permanent power dissipation of integrated braking resistor	34W	68W	68W	100W	40W	40W	80W
3	dto separately ventilated	68W	130W	130W	200W	80W	80W	150W
4	External braking resistor	500W	2kW	2kW	3,5kW	5kW	5kW	5kW
5	Pulse power of braking circuit	2,5kW	5kW	5kW	8kW	15kW	15kW	15-30kW
6	Max. braking energy of integrated braking resistor	200Ws	400Ws	400Ws	600Ws	300Ws	300Ws	600WS
7	Repetition rate of max. braking energy in case of integrated braking resistor	4s						
8	Turn-on threshold (automatic threshold)	375 - 415V				660 - 700V		
9	Resistance value for external braking resistor	50 Ohm	25 Ohm	25 Ohm	16,7 Ohm	33 Ohm	33 Ohm	>17-33 Ohm

The maximum time-averaged braking power is indicated in row 3. A braking process must never produce more energy than the respective value indicated in row 6. At a given braking energy, the repetition rate of the braking process can be calculated according to the following equation:

$$t = W/P$$

whereby: W = braking energy in Ws

P = see row 3



When using an external braking resistor, it must be taken into consideration that in case of extreme failure the clamps of the braking resistor may carry a DC voltage of 400 V in case of ND31 or 700 V in case of ND32.

In this case it must be made sure that the resistor cannot cause fire or endanger the electrical safety through overheating or flying sparks!

4.2.4 Fan for Compact Case

In case of newer compact devices, the fan is connected directly in ND31/32.

Older compact devices of the ND31 series are equipped with a bipolar Combicon connector for supplying the integrated fan with current.

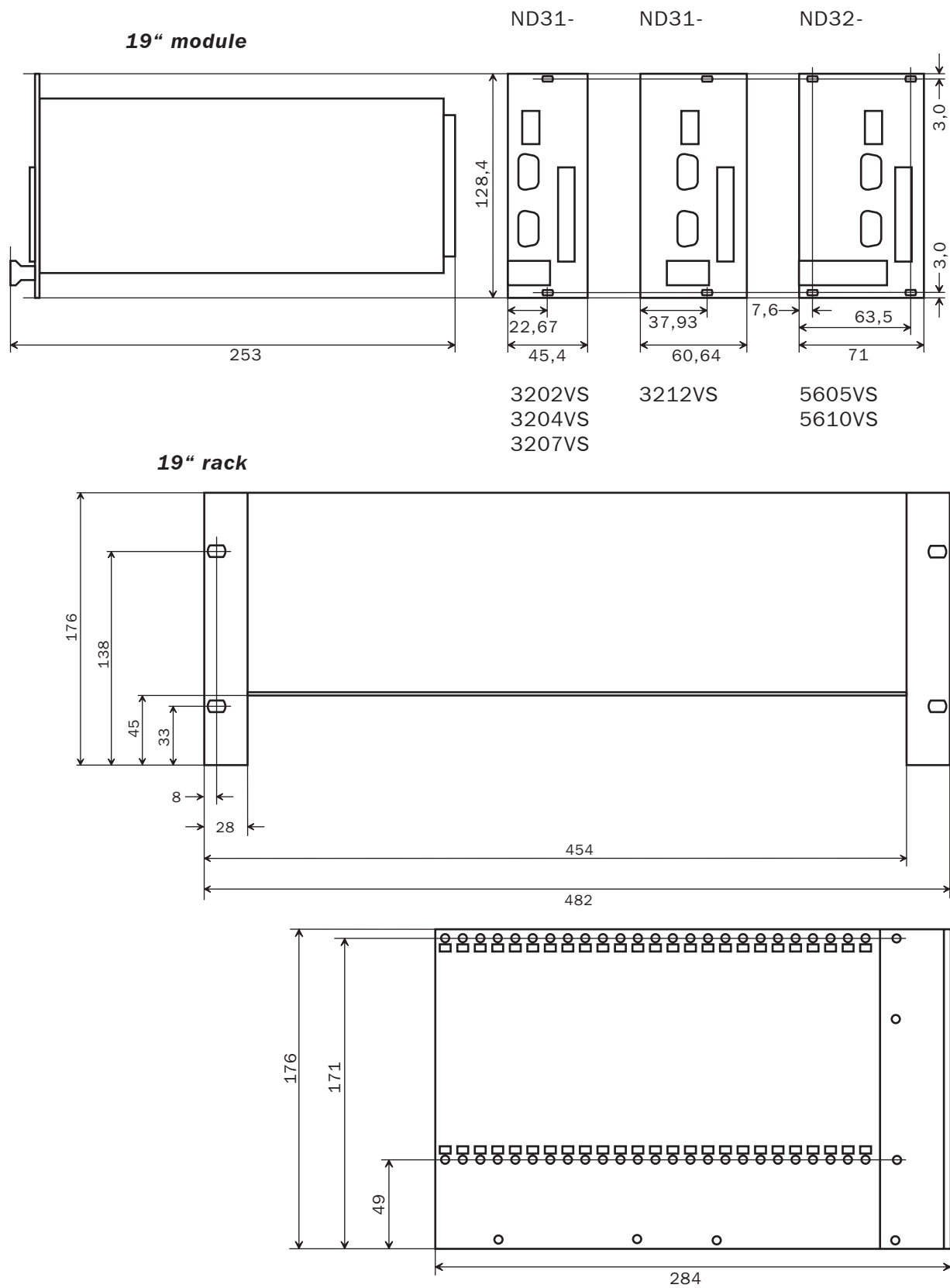
	two-axis case	single-axis case
Supply voltage	230 VAC	24 VDC
Current consumption	< 200 mA	< 300 mA
Protection	315 mA inertial	315 mA inertial
Connector	Phoenix Combicon MSTB 2,5/2-ST-5,08	

4.2.5 Required Plugs

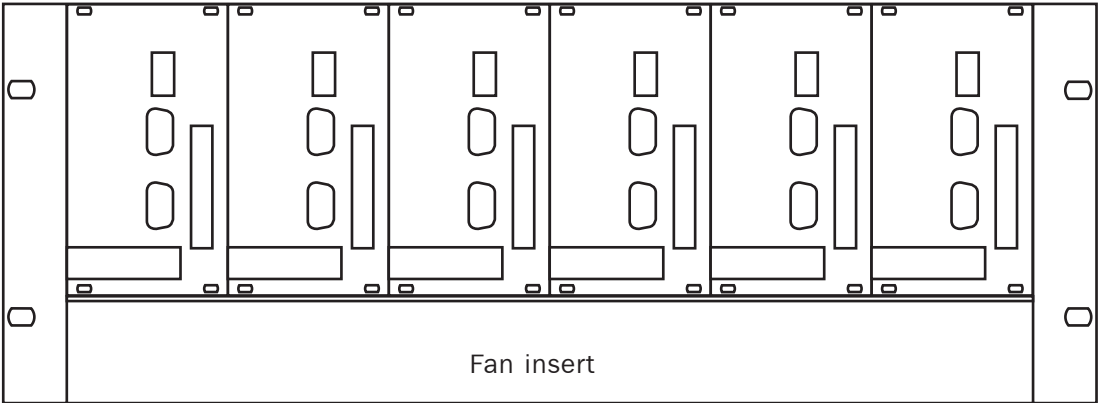
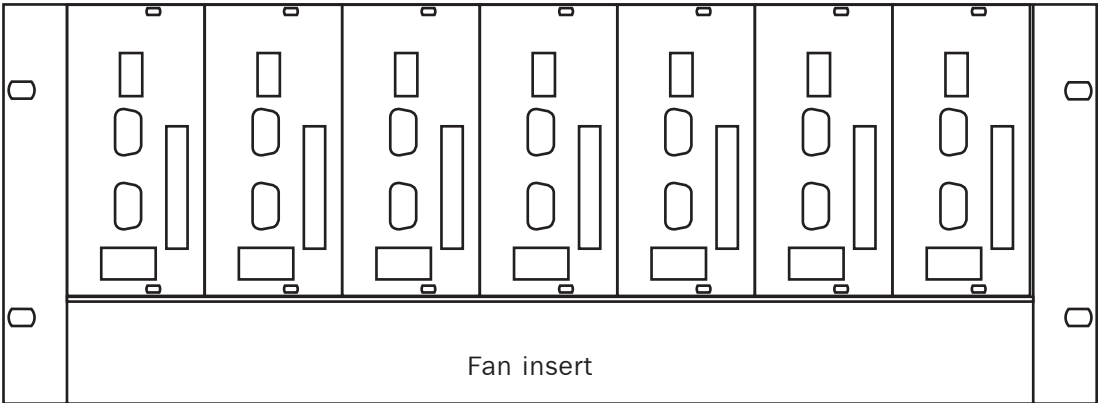
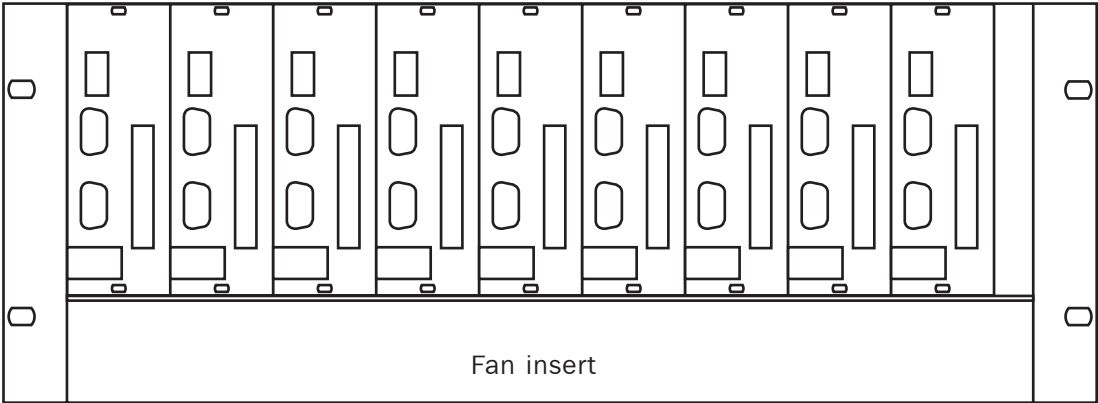
Power connector X1 ND31 ND32-5605, ND32-5610 ND32-5620	Phoenix Combicon Front-MSTB 2,5/16-STF-5,08 Front-GMSTB 2,5/12-STF-7,62 PC 4/12-STF-7,62
Feedback and motor temperature sensor connector X2	HD D-Sub 15-pin (female contacts at NOVODRIVE)
Peripherals connector X3	SCSI2 68-pin (female contacts at NOVODRIVE)
Bus-out connector X4	D-Sub 9-pin (male contacts at NOVODRIVE)
Bus-in connector X5	D-Sub 9-pin (female contacts at NOVODRIVE)
Motor temperature sensor connector X6	(only ND32, for ND31 see X1) Front-GMSTB-2,5/2-STF-7,62

4.3 Mechanical Data

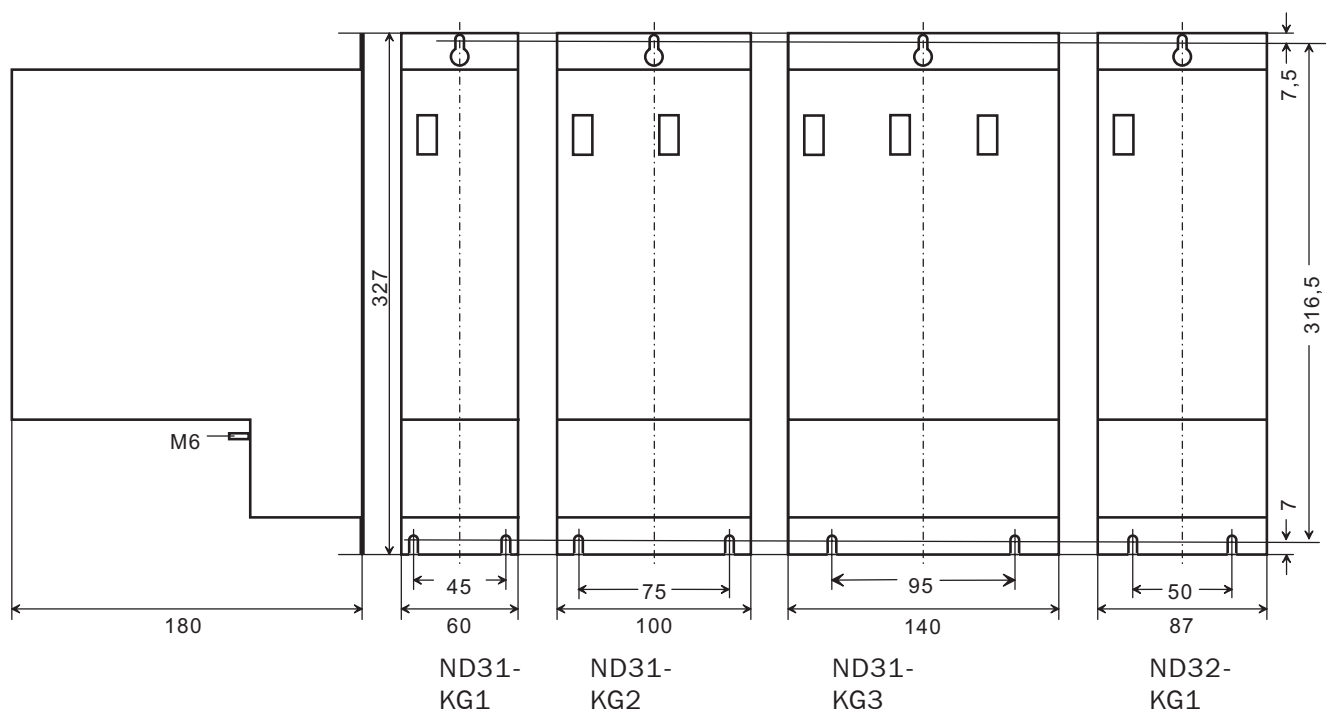
4.3.1 Dimensions



Examples



Compact case



Note: Installation with screw size M4.

In the compact case, ND31-3212 needs twice the space of ND31-3207.

4.3.2 Weight

Electronics	ND31-3202, 3204 and 3207	0,55 kg
	ND31-3212	0,75 kg
	ND32-5605 and 5610	1,0 kg
	ND32 - 5620	2,2 kg
Case	ND31-KG1	2,15 kg
	ND31-KG2	2,9 kg
	ND31-KG3	2,9 kg
	ND32-KG1	2,7 kg
	ND32-KG2	2,5 kg

4.4 Ambient Conditions

Storage **Storage temperature** -25°C to +50°C

Max. air humidity 85 %

Do not pack NOVODRIVE converters in ESD films, for this might discharge the battery which would lead to an early failure of the NOVODRIVE.

Operation **Operating temperature** 0°C to 70°C

Ambient temperature 0°C to 50°C

Relative air humidity 5 % to 85 %

Height above sea level At altitudes higher than 1000 m above sea level, a decrease in performance must be expected.

Condensation or icing Not permitted

Climatic class Type B EN 50178

Pollution degree II EN 50178

Operation requires forced ventilation:

- In case of compact devices, ventilation is ensured by the integrated fan.
- In case of 19" insert devices, sufficient ventilation of the entire NOVODRIVE must be provided.
For each NOVODRIVE, 30-40 m³/h are recommended.

5 Pin Assignment



High voltage! Dangerous although driver is switched off!

As long as the motor turns, the motor is a generator!

Therefore: In case of error, prevent uncontrolled driving of the motor by installing a brake!

5.1 Power Connection, Motor Connection and Braking Resistor

Connector X1

Note:

In the following sections, the pin assignment is given for NOVOTRON motors. For a different pin assignments for other motors, see Motor Connection table.

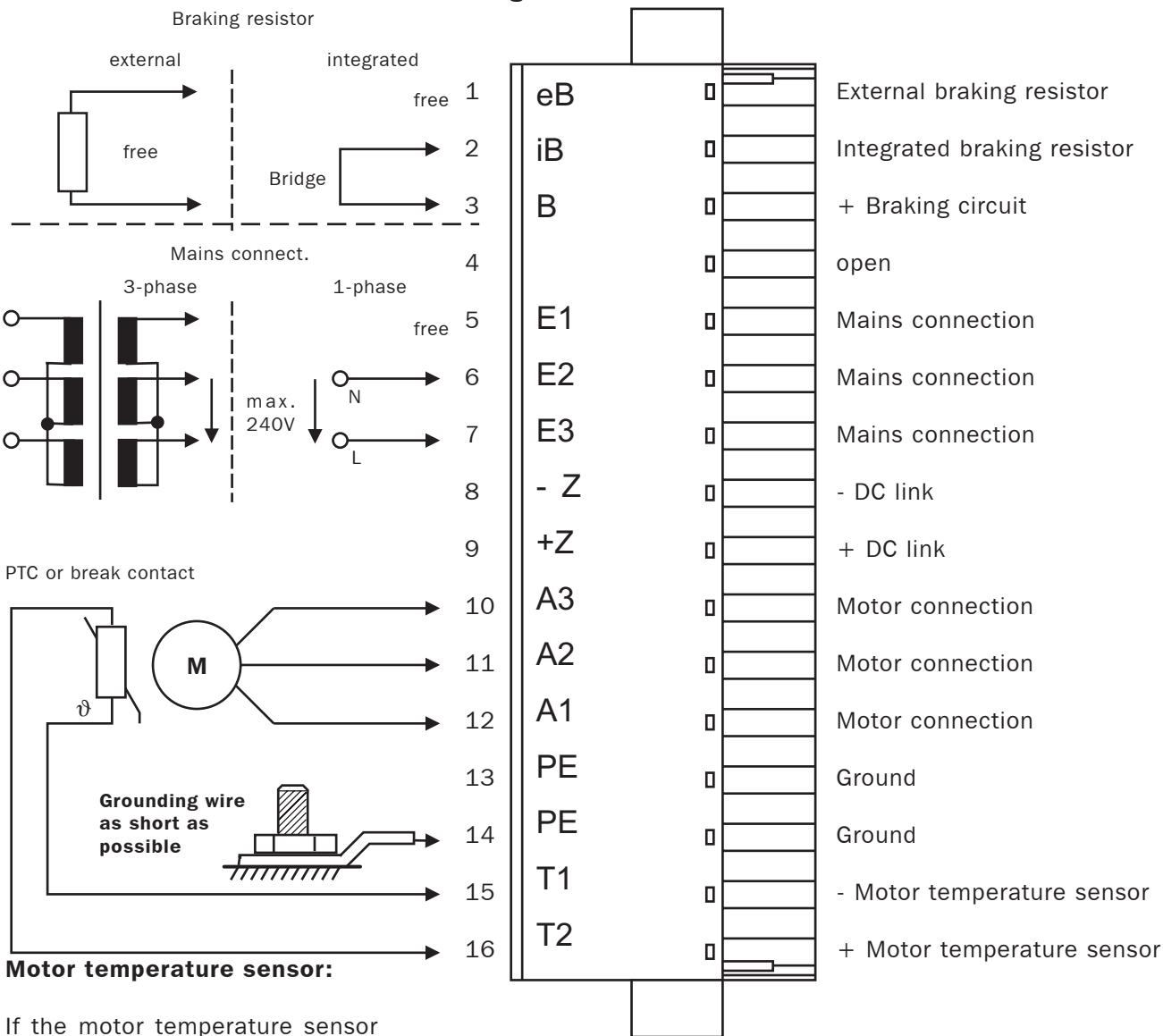


The maximum supply voltage of ND31 is 240 VAC. A higher supply voltage leads to the destruction of the converter!

If ND31 is to be run with a 400 VAC power source, a suitable transformer must be installed!

If the DC links of several ND31 are coupled, make sure the power connections E1, E2 and E3 are equally connected at all ND31. The connection of several ND31 with coupled DC links to different mains phases leads to the destruction of the converter!

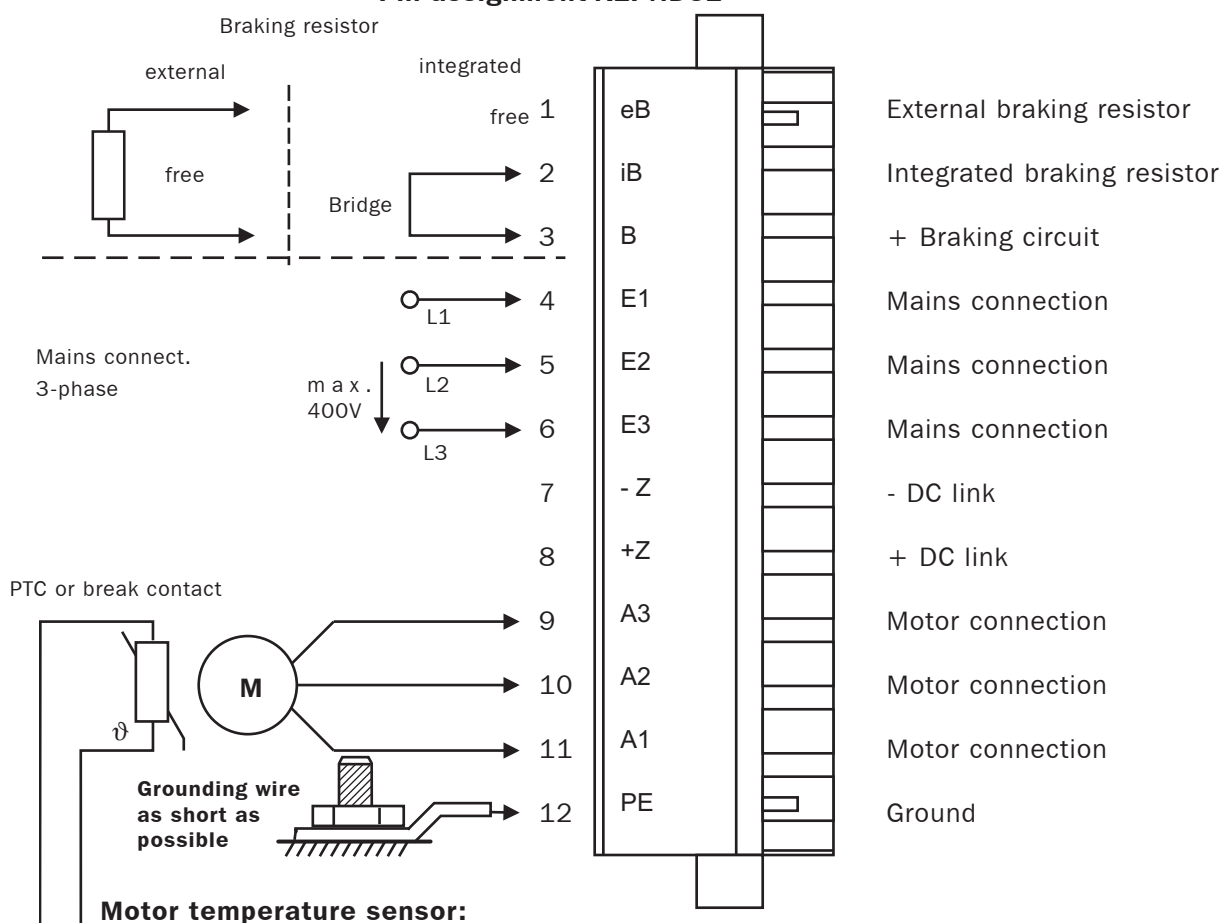
Pin assignment X1: ND31



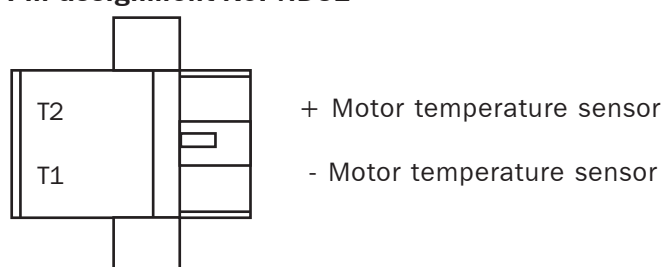
If the motor temperature sensor is wired in the motor cable, connect here (follow instructions for connectors to X1 and X6, respectively).



The maximum supply voltage of ND31 is 240 VAC. If ND31 is to be operated with a 400 VAC power source, a suitable transformer must be installed.

Pin assignment X1: ND32**Motor temperature sensor:**

If the motor temperature sensor is wired in the motor cable, the bipolar connector X6 must be used near connector X1.

Pin assignment X6: ND32

During operation, connector X6 must always be plugged and tightly screwed to ensure contact protection against mains voltage.

Notes regarding the use of the temperature sensor at X1 and X6:



The connection of the motor temperature sensor to X1 or X6 lies on negative DC link potential.

If the motor temperature sensor is connected to X1 or X6 over the motor cable, disturbances may occur, particularly in case of longer motor cables. Therefore, the following aspects must be considered:

- Both lines of the sensor must be shielded separately from the motor lines to prevent disturbances.
- If disturbances continue to occur, a capacitor (1 μ - 10 μ F, min. 16 V) must be mounted to connector X1 and X6, respectively. If an electrolytic capacitor is used, make sure the polarity is correct.
- When using a contact breaker type of temperature sensors, no additional capacitor is required normally.

Cross section of connecting cables

Version ND31-	3202	3204	3207	3212
Mains connection 4 x	1,5	1,5	2,5	2,5 mm ²
Motor connection 4 x (without brake)	1,5	1,5	2,5	2,5 mm ²
DC link bus 2 x	1,5	1,5	2,5	2,5 mm ²
Braking resistor 2 x	1,5	1,5	2,5	2,5 mm ²
Version ND32-	5605	5610	5620	
Mains connection 4 x	1,5	2,5 mm ²	4,0 mm ²	
Motor connection 4 x (without brake)	1,5	2,5 mm ²	4,0 mm ²	
DC link bus 2 x	1,5	2,5 mm ²	4,0 mm ²	
Braking resistor 2 x	1,5	2,5 mm ²	4,0 mm ²	



All cables must be shielded !



Used cables and lines must have double or reinforced insulation between wire and surface.

Protection	Version ND31-	3202	3204	3207	3212
	3-phase (230 VAC)	3 x 4 A inertial	3 x 8 A inertial	3 x 14 A inertial	3 x 24 A inertial
	1-phase (230 VAC)	5 A inertial	9 A inertial	15 A inertial	25 A inertial
	Version ND32-	5605	5610	5620	
	3-phase (400 VAC)	3 x 10 A inertial	3 x 20 A inertial	3 x 35 A inertial	

If several devices are protected together, total protection is calculated from the sum of the individual devices' protection.

Motor connection

The motor is connected to connector X1 of NOVODRIVE by means of a shielded cable. The shielding is to be attached both on the motor side and on the NOVODRIVE side (double-sided shielding). In order to attach the shielding on the NOVODRIVE side, use the cable clips provided.

The cross section of the wires can be chosen according to the motor currents expected.

Current-carrying capacity	Rated cross sect.	0,75mm ²	1,00mm ²	1,50mm ²	2,50mm ²	4mm ²
	Rated current	7,5 A _{eff}	10 A _{eff}	13 A _{eff}	18 A _{eff}	24A _{eff}

Used cables and lines must have double or reinforced insulation between wire and surface.

For the wire ends, use wire end sleeves with insulation of the appropriate size.



The connections area must be covered to prevent accidental touching! Before switching on the supply voltage, make sure all cables are properly connected and wire ends are properly insulated!

Grounding is done over the provided grounding screw on the case of the compact device or on the back side of the 19" rack.

Motor connection **Recommended motor cables:** Luetze Silflex NSY, Lapp Oelflex-400CP

Make	Design.	Poles	u	v	w	phipo
Novotron	NHD55	4	A1	A2	A3	1020h
	NHD70	4	A1	A2	A3	0h
	NHD92	4	A1	A2	A3	0h
	NHD115	6	A1	A2	A3	2B0h
	NHD142	6	A1	A2	A3	2B0h
	NHD190	6	A1	A2	A3	2B0h
	NBL2	6	A3	A1	A2	
	NBL3	6	A3	A1	A2	
	NBL4	6	A3	A1	A2	
AEG	MS34-62	6	A1	A3	A2	380h
S.B.C.	MB70400	4	A1	A3	A2	158h
Stoeber	ES42/54	6	A1	A2	A3	2B0h



Phipo is a NOVODRIVE parameter by which it is possible to electronically adjust any resolver settings to NOVODRIVE.

Braking Resistor For use of the integrated braking resistor there is only a jumper between clamp iB and B at connector X1 necessary.

The external braking resistor is connected to connector X1, clamps eB and B. The values of the external braking resistor are indicated in the table in Chapter 4.2.3. The cables to the external braking resistor must be shielded.



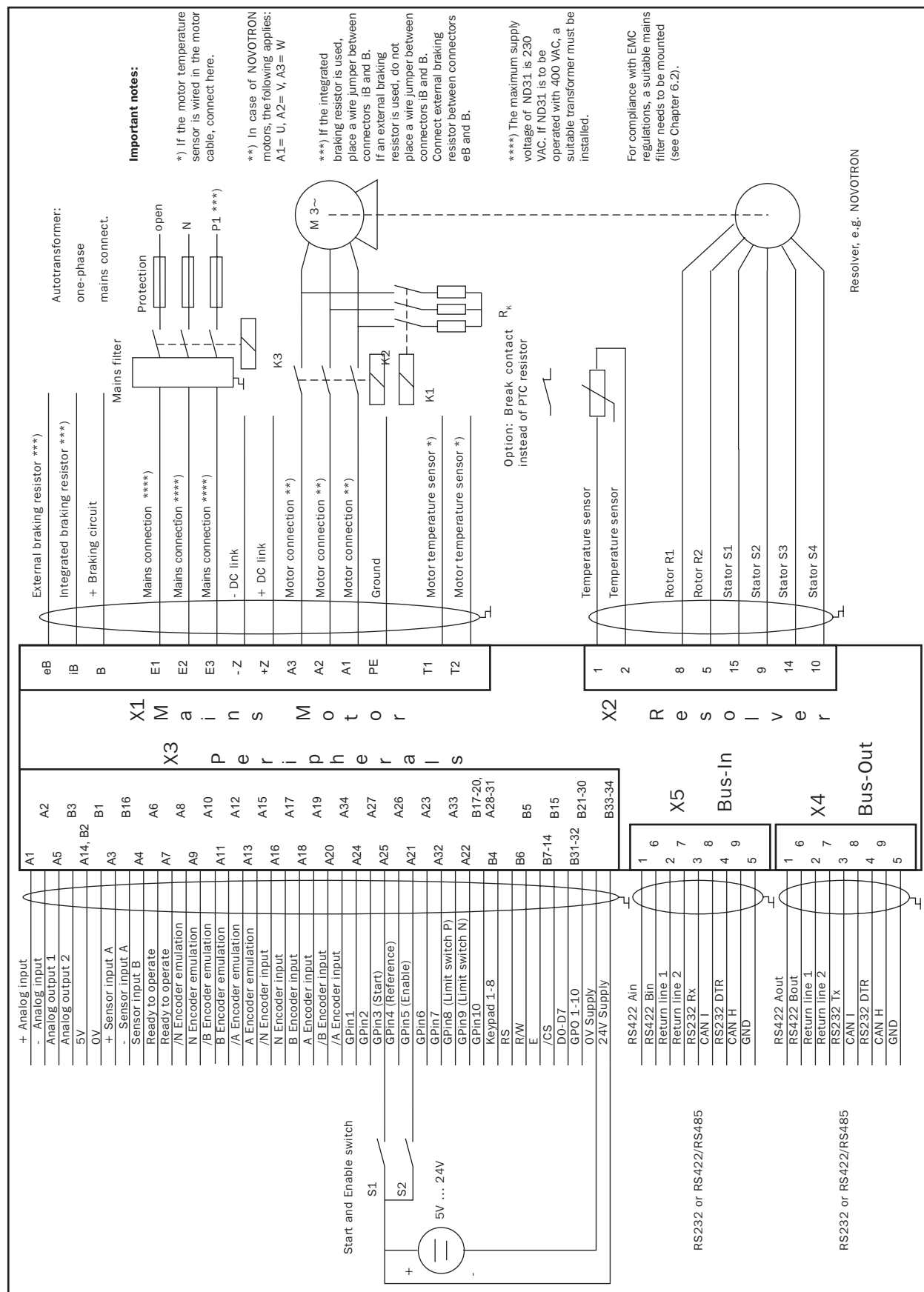
Do not use the integrated braking resistor and an external braking resistor at the same time!

The braking circuit is monitored electronically. In case of overload, the braking circuit is switched off and NOVODRIVE signals overvoltage. After switching off the supply voltage and waiting for five minutes, NOVODRIVE can be put into operation again. The braking circuit is then fully functionable again.

The turn-on threshold of the braking circuit is 395 V DC link voltage in case of ND31 and 680 V DC link voltage in case of ND32. The built-in automatic threshold allows to shunt-connect the DC links of several NOVODRIVES that have the same DC link voltage. As the braking circuit working at a certain moment is able to rise its response threshold by up to 20 V, it is ensured that the braking energy is equally distributed to all braking circuits connected.



Due to the difference in voltage, the DC links of ND31 may not be connected to the DC links of ND32!



5.2 Position Sensor Connection (X2)



Danger through irregularly running drive!

If the sensor is connected incorrectly, the drive may accelerate in an uncontrolled way.

Therefore, when connecting a motor to NOVODRIVE, make sure the sensor is connected correctly!

Connection of various feedback systems to NOVODRIVE:

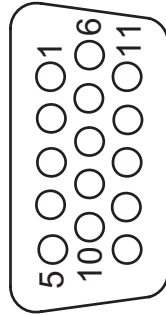
Feedback system	Description	Examples
Resolver	Single-turn resolver, Input voltage 5,0 V _{eff} /10 kHz, Type: transmitter, Transformation ratio 1:0,5	Sagem 21RX360407 Sagem 15RX310107 Litton JSSBH-15 E-5 Litton JSSBH-21-P4 Siemens V23401-H2001-B2002 Tamagawa TS2112N21 E11
Digital encoder	Two 90° phase-shifted square-wave signals according to RS422. Zero-track according to RS422.	- -
Sinusoidal encoder or Linear measuring system	Two 90° phase-shifted sinusoidal differential signals with a signal swing of 1 V _{ss} . Zero-track must have a signal swing of > 200mV.	Heidenhain ERN 1387 Renishaw RGH22B SIKO LE100
Commutation track	Two 90° phase-shifted sinusoidal differential signals with a period length of one revolution and a signal swing of 1 V _{ss} .	Heidenhain ERN 1387
Hall sensor OC	Digital Hall sensor with 3 open-collector outputs RLG1, RLG2 and RLG3 for trapezoidal commutation. Requires modified NOVODRIVE with type specification ND3x-xxxxT-3xx-xx.	- -
Hall sensor TTL	Digital Hall sensor with 6 TTL outputs U, /U, W, /W, V, /V for trapezoidal commutation. Requires modified NOVODRIVE with type specification ND3x-xxxxT-xxx-7xx-xx	- -
Analog Hall sensor	Two 90° phase-shifted sinusoidal differential signals with a period length equal to the north-north pole distance of the magnets in the motor. Signal swing 1 V _{ss} . This kind of signals is used for synchronous linear motors.	- -



Number of poles: If Hall signals are connected, the setting for the number of motor poles must always be „2“.

Connector X2

HD D-Sub 15-pin,
female contacts at NOVODRIVE, male contacts at cable.



Shielding: Attach to cable housing HD D-Sub.
Cable: Shielded and twisted pairs.

Recommendations for the resolver cable:

Luetze Superflex (C)Y-PUR-Kombi,
Order number: 111094 (capable of being used as trailing cable, oil-resistant)

Luetze Electronic-LIY(C)Y-(C)Y-Kombi
Order number: 110652 (oil-resistant)

Connector assignment for various feedback systems:

Type Pin	Resolver	Digital Hall sensor OC	Digital Hall sensor TTL	Analog Hall sensor	Digital encoder	Sinusoidal encoder or Linear measuring system	Sinusoidal encoder with commutation track
1	Temperature sensor -						
2	Temperature sensor +						
3	-	-	-	-	A+	VA	A+
4	-	-	-	-	A-	/VA	A-
5	Rotor R2	GND	GND	GND	GND	GND	GND
6	-	-	-	-	N+	VM	R+
7	-	+5V	+5V	+5V	+5V	+5V	+5V
8	Rotor R1	-	-	-	-	-	-
9	Stator S2	RLG3	Hall V	/Sine	-	-	C-
10	Stator S4	RLG2	Hall W	Sine	-	-	C+
11	-	-	-	-	B+	VB	B+
12	-	-	-	-	B-	/VB	B-
13	-	-	-	-	N-	/VM	R-
14	Stator S3	RLG1	Hall /U	Cosine	-	-	D-
15	Stator S1	-	Hall U	/Cosine	-	-	D+



Pin 1 can also be used as an alternative GND connection.



The above assignments refer to the selected examples. Depending on the type of measuring system and the motor, it may be necessary to change the assignments of tracks A and B in order to achieve correct counting direction. The same applies to the polarity of the zero pulse in the case of encoders.

5.3 Peripherals Connection (X3)

Cable For analog command setting, step-direction setting and encoder emulation, shielded cables are absolutely necessary. It is recommended that also the other signals be connected with shielded cables.

Connector X3 SCSI2 68-pin: female contacts at NOVODRIVE, male contacts at cable.

Pin assignment	Pins	Pins	Pin assignment
+ Analog input	A1	B1	0V
- Analog input	A2	B2	5V
+ Sensor input A	A3	B3	Analog output 2
Sensor input B	A4	B4	RS
Analog output 1	A5	B5	R/W
Ready to operate	A6	B6	E
Ready to operate	A7	B7	D0
/N Encoder emulation	A8	B8	D1
N Encoder emulation	A9	B9	D2
/B Encoder emulation	A10	B10	D3
B Encoder emulation	A11	B11	D4
/A Encoder emulation	A12	B12	D5
A Encoder emulation	A13	B13	D6
5V	A14	B14	D7
/N Encoder input	A15	B15	/CS
N Encoder input	A16	B16	- Sensor input A
B Encoder input	A17	B17	Tast 2
A Encoder input	A18	B18	Tast 3
/B Encoder input	A19	B19	Tast 1
/A Encoder input	A20	B20	Tast 4
GPIn 6	A21	B21	GPO 2
GPIn 10	A22	B22	GPO 1
GPIn 7	A23	B23	GPO 8
GPIn 2	A24	B24	GPO 3 (Motor brake)
GPIn 4 (Reference)	A25	B25	GPO 7
GPIn 5 (Enable)	A26	B26	GPO 6
GPIn 3 (Start)	A27	B27	GPO 5
Tast 5	A28	B28	GPO 4
Tast 6	A29	B29	GPO 10
Tast 7	A30	B30	GPO 9
Tast 8	A31	B31	0V Supply
GPIn 8 (Limit switch P)	A32	B32	0V Supply
GPIn 9 (Limit switch N)	A33	B33	24V Supply
GPIn 1	A34	B34	24V Supply

 B31/B32 and B33/B34 must be shunt-connected.

5.3.1 Analog Inputs

Differential input Analog input for command value or as process signal input, input resistance $R_i = 78 \text{ k}\Omega$, voltage range: $-10 \text{ V} \dots +10 \text{ V}$.

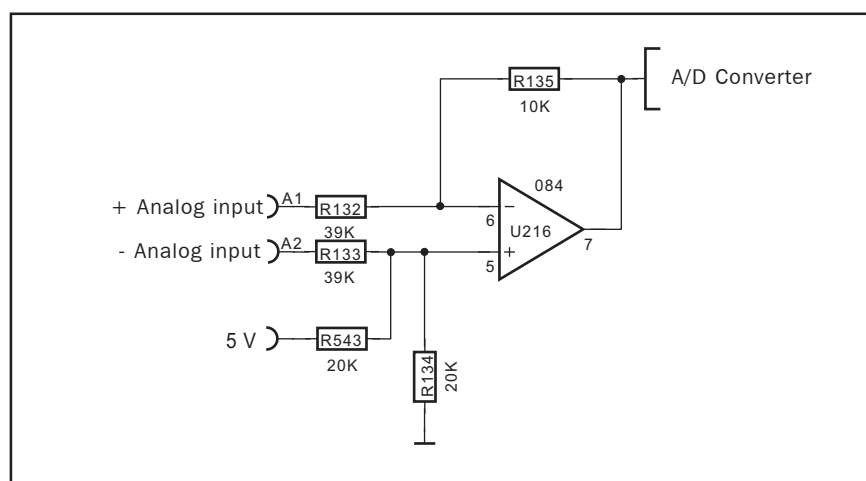
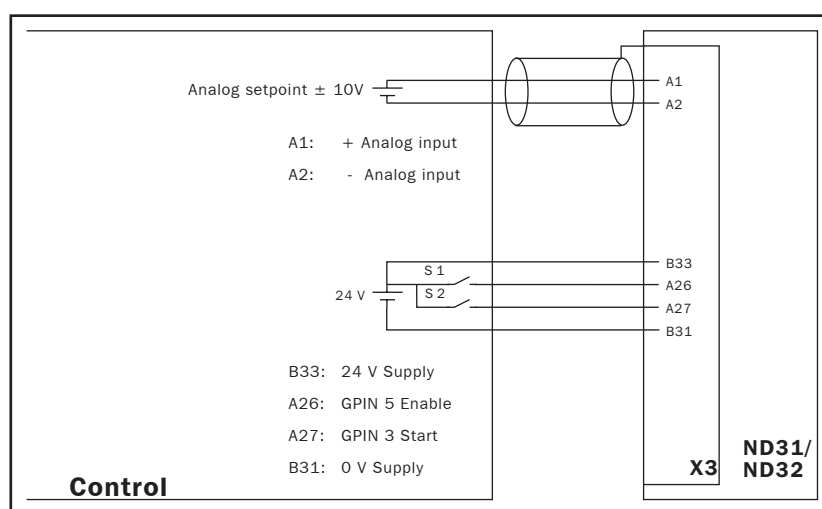
Differential input: Resolution: 14 Bit /12 Bit

+ Analog input: Connector X3 Pin A1

- Analog input: Connector X3 Pin A2



For speed command over analog input see Manual 'Start-up', Chapter 3).



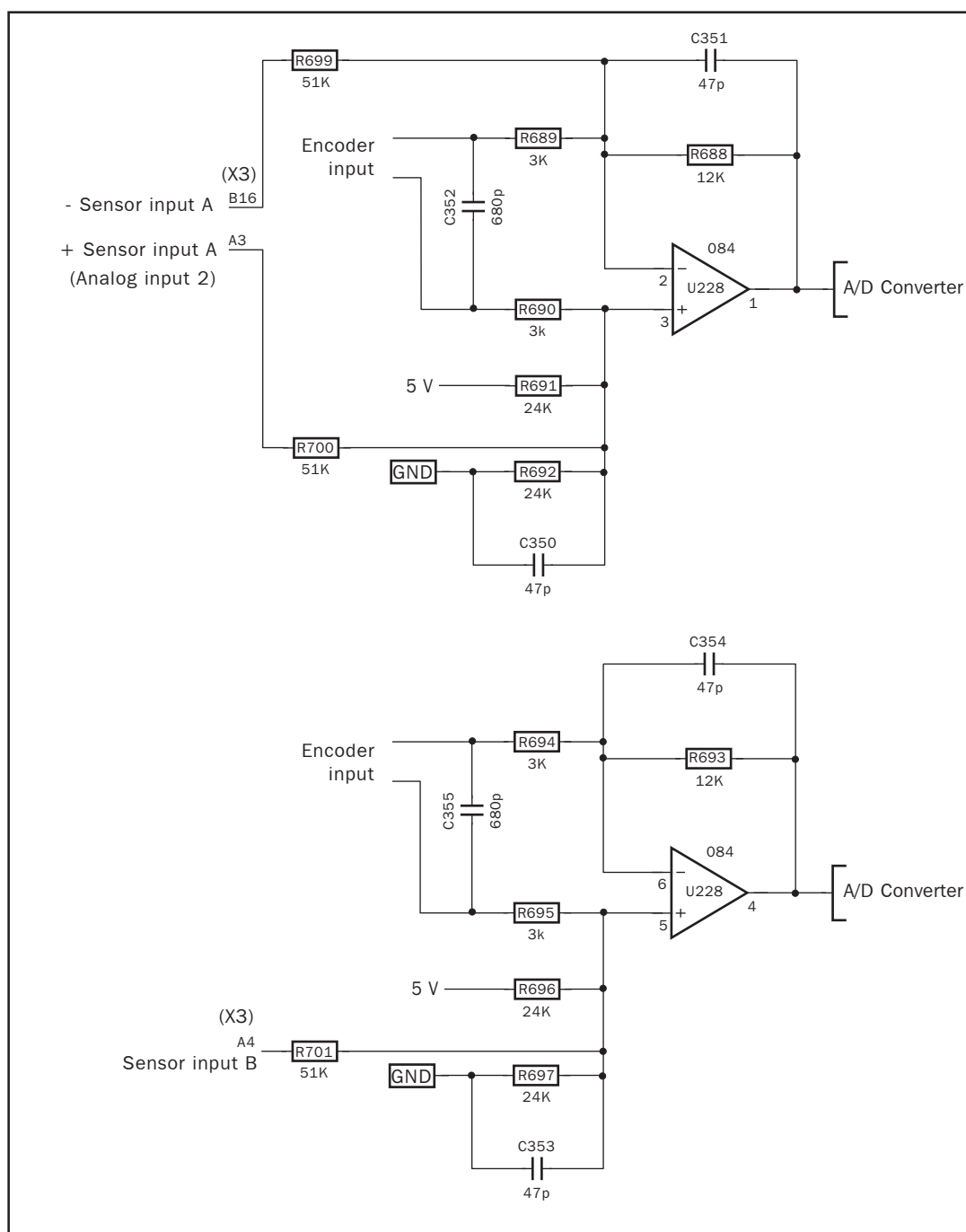
Sensor input A In addition, another analog input is available:

Sensor input A: Analog input as process signal input,
voltage range: -10 V ... +10 V.

Differential input: Resolution: 8 Bit

+ Sensor input A: Connector X3 Pin A3

- Sensor input A: Connector X3 Pin B16



5.3.2 Analog Outputs

Analog outputs are not short-circuit proof!

Analog output 1 Connector X3 Pin A5

+/- 10 V analog output for analog process peripherals control, 5 mA power-handling capacity, 8 bit resolution. When using analog output 1, GP08 cannot be used as digital output.

Mode of operation: A 20 kHz PWM signal on GP08 is filtered and outputted as an analog value.

Analog output 2 Connector X3 Pin B3

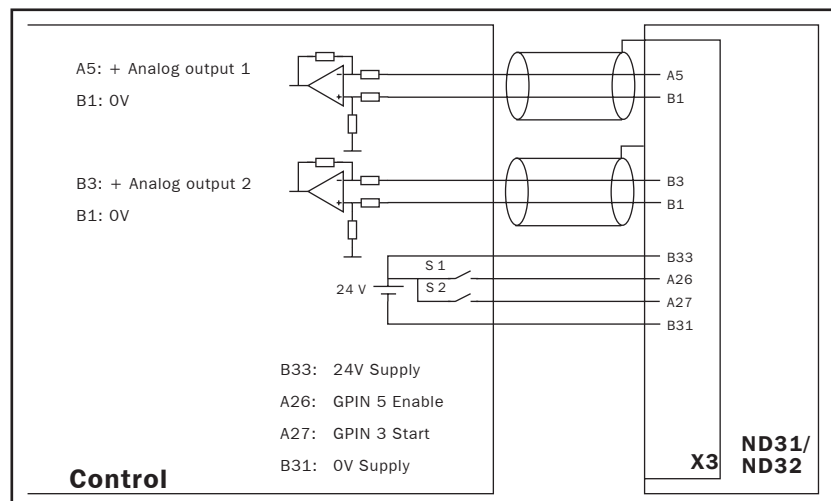
+/- 10 V analog output for analog process peripherals control, 5 mA power-handling capacity, 8 bit resolution. When using analog output 2, GP01 cannot be used as digital output.

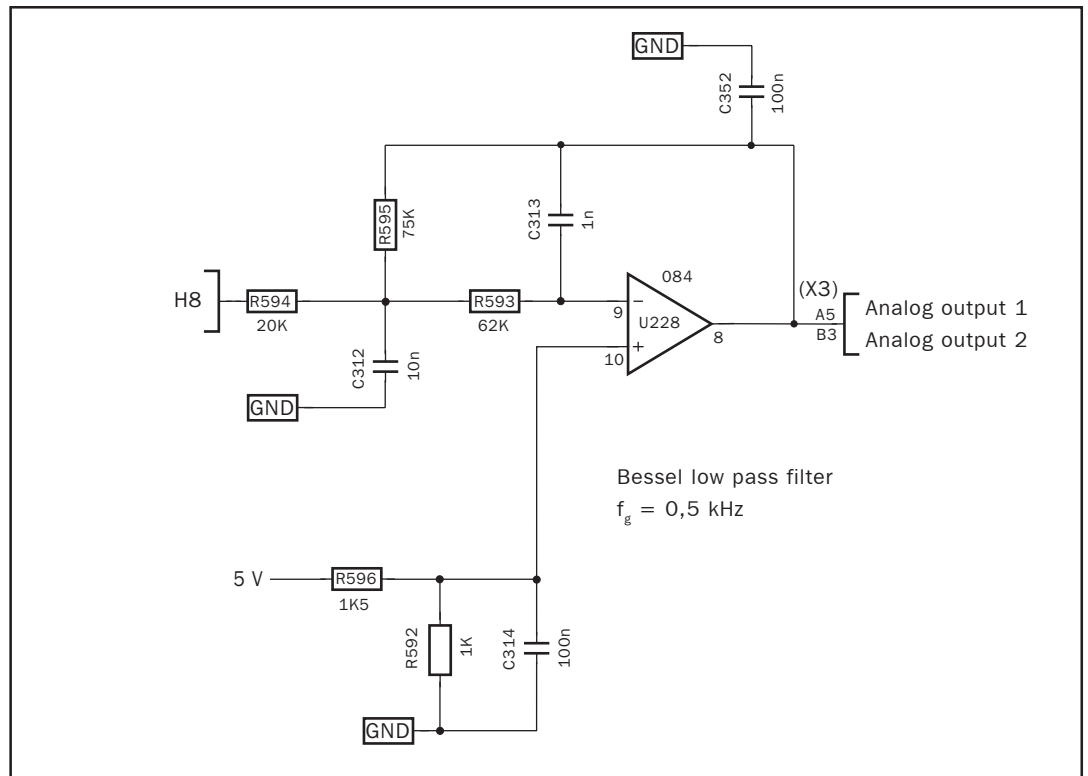
Mode of operation: A 20 kHz PWM signal on GP01 is filtered and outputted as an analog value.

The analog outputs should not be used for control purposes, as in most cases the 8 bit resolution will not be sufficient.



For use of analog outputs, see Manual 'Start-up' or Manual 'Basic Functions'.





5.3.3 Digital Inputs

Signal level of digital inputs: GPIN 1 - 10, Tast 5 - 8

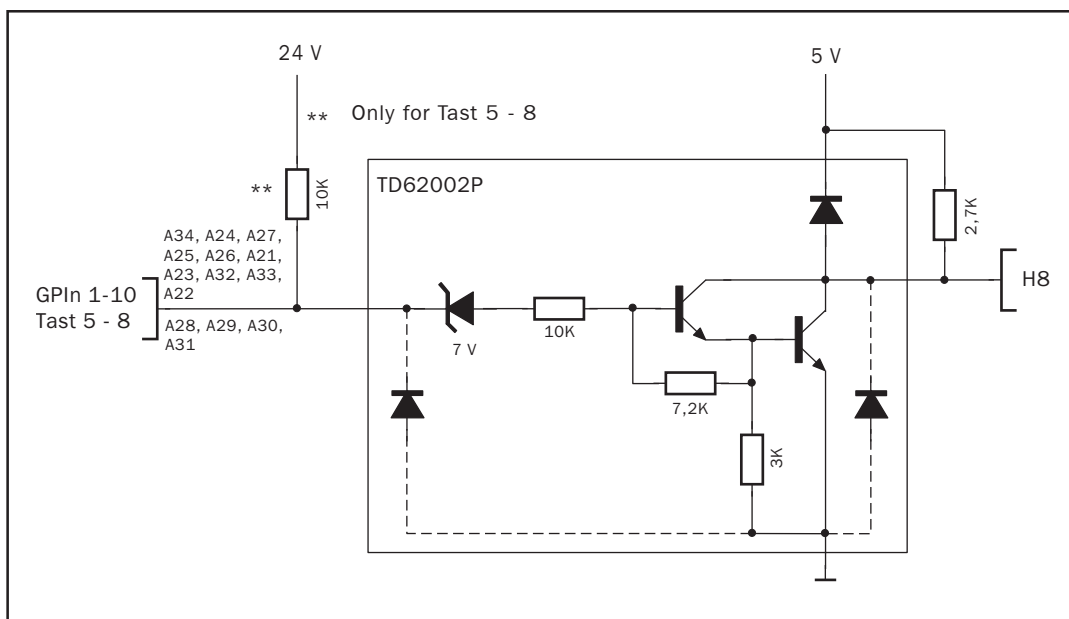
„0“: < 5 V

„1“: > 13 V (max. 24 V +10 %)

Input resistance: 10,5 kOhm

Input	Function	Connector X3 Pin
GPIn 1		A34
GPIn 2		A24
GPIn 3	Start	A27
GPIn 4	Reference	A25
GPIn 5	Enable	A26
GPIn 6		A21
GPIn 7		A23
GPIn 8	Limit switch P	A32
GPIn 9	Limit switch N	A33
GPIn 10		A22
Tast 5	keypad connection	A28
Tast 6	keypad connection	A29
Tast 7	keypad connection	A30
Tast 8	keypad connection	A31

In case of long lines, the inputs should be equipped with pulldown resistors (ca. 3,9 kOhm).



5.3.4 Pulse Inputs

Differential inputs, RS422 Standard

Input resistance: 120 kOhm

Pulse inputs may be used for

1. Encoder connection
2. Step/Direction setting

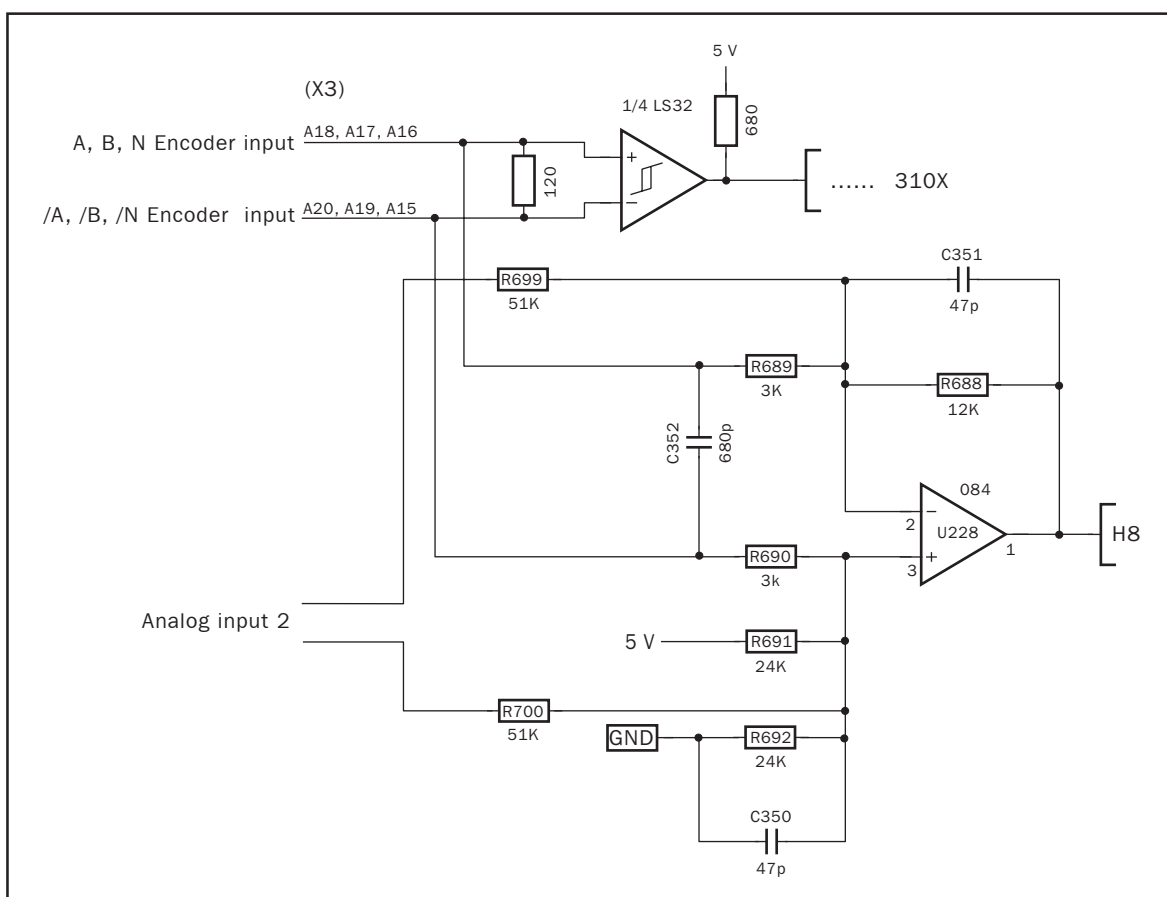
High level: The non-inverting input is 0,2 V higher than the inverting input.

Low level: The inverting input is 0,2 V higher than the non-inverting input.

Pin	Function 1	Function 2
A15	Encoder input / N	Diff. input 1
A16	Encoder input / N	Diff. input 1
A18	Encoder input / A	Direct. input
A20	Encoder input / A	Direct. input
A17	Encoder input / B	Freq. input
A19	Encoder input / B	Freq. input



Step/Direction setting see Manual 'Start-up'.






5.3.5 Digital Outputs

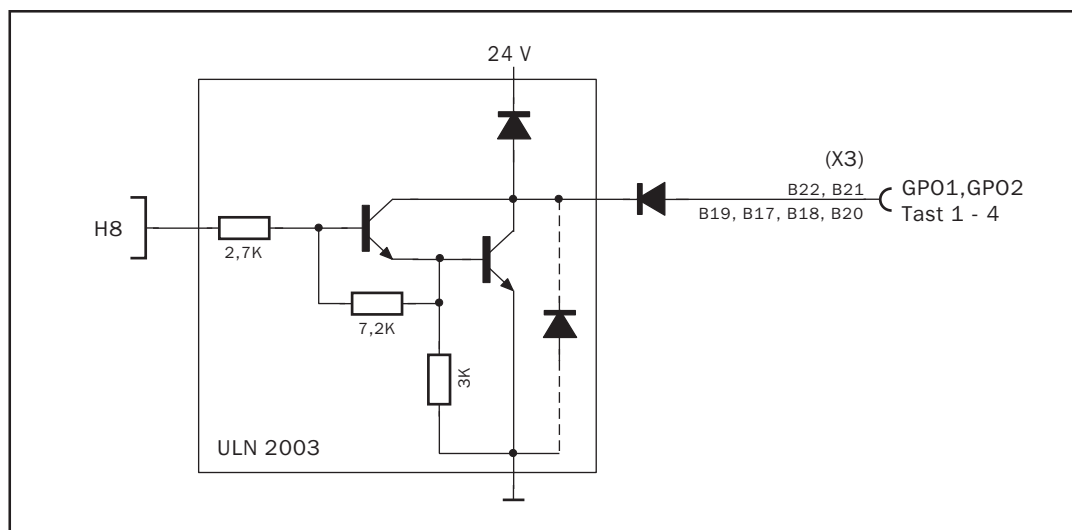
(does not apply to encoder emulation)

Output level: 24 V

Power-handling capacity: 100 mA

Pin	Output	Type of output
B22	GPO 1	Open Collector
B21	GPO 2	Open Collector
B24	GPO 3	Open Emitter
B28	GPO 4	Open Emitter
B27	GPO 5	Open Emitter
B26	GPO 6	Open Emitter
B25	GPO 7	Open Emitter
B23	GPO 8	Open Emitter
B30	GPO 9	Open Emitter
B29	GPO 10	Open Emitter
B19	Tast 1	Open Collector
B17	Tast 2	Open Collector
B18	Tast 3	Open Collector
B2	Tast 4	Open Collector

-  For programming of digital outputs see manual „Basic Functions“.
-  The total load current of the open-collector outputs must not exceed 500mA.
-  The total load current of the open-emitter outputs must not exceed 500 mA.



Example Suitable pull-up resistor for GP01 and GP02 to run a 24 V / 10 mA PLC input with a level of 20 V:

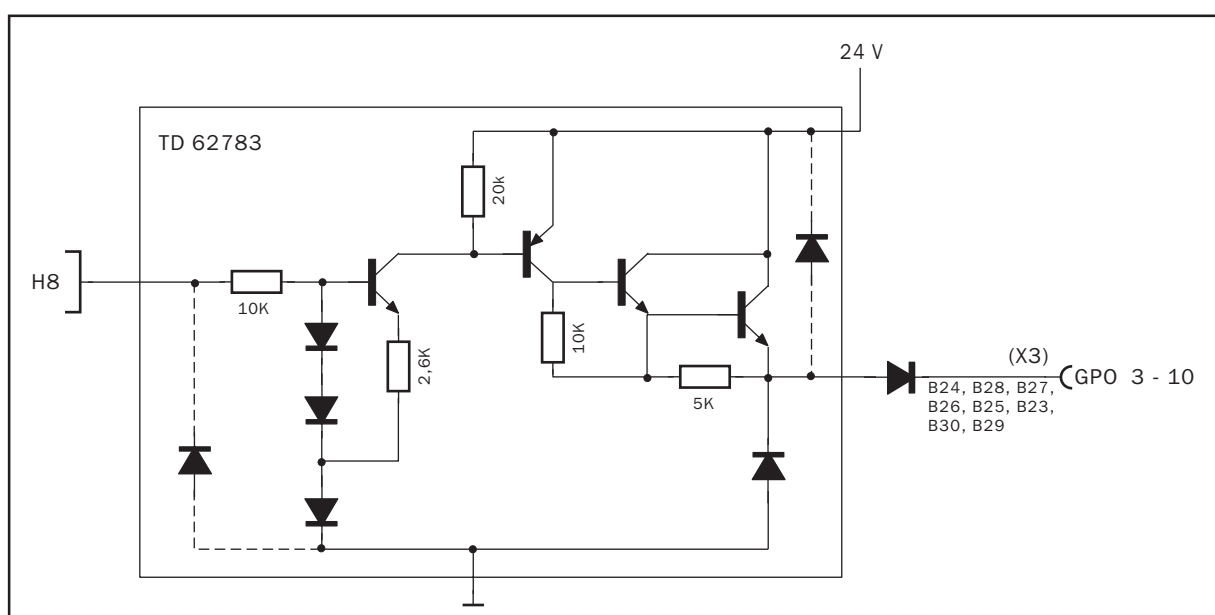
$$R = \frac{24V - 20V}{10mA} = 400 \text{ Ohm}$$

Power of pull-up resistor:

$$P = \frac{24V^2}{400\Omega} = 1,44 \text{ W}$$

Power-handling capacity of 24 V supply through pull-up resistor:

$$I = \frac{24V}{400\Omega} = 60 \text{ mA}$$



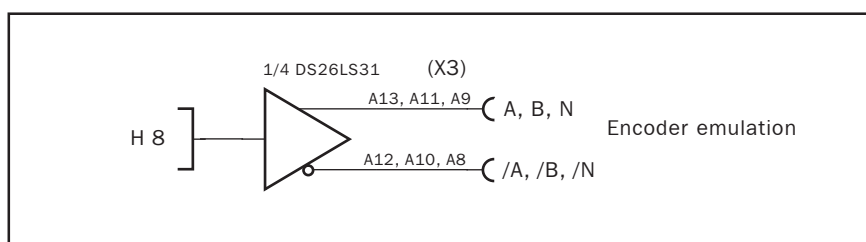
5.3.6 Encoder Emulation

Differential outputs RS422 Standard as encoder outputs.

Pin	Function 1	Function 2
A9	N Encoder emulation	Differential output 1 +
A8	/N Encoder emulation	Differential output 1 -
A13	A Encoder emulation	Differential output 2 +
A12	/A Encoder emulation	Differential output 2 -
A11	B Encoder emulation	Differential output 3 +
A10	/B Encoder emulation	Differential output 3 -



For use of encoder emulation see Manual 'Start-up'.



Encoder emulation can be used only with resolver and encoder as feedback systems.

In connection with a sinusoidal encoder, no proper usage is possible.

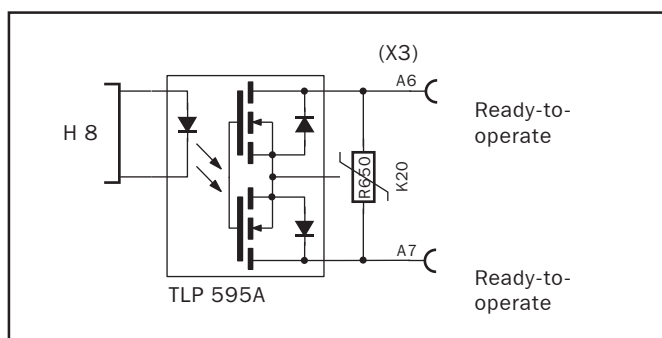
5.3.7 Ready-to-operate contact

Potential-free contact (closer),
Capacity: < 500 mA, < 100 V

Ready-to-operate contact 1: Connector X3 Pin A6

Ready-to-operate contact 2: Connector X3 Pin A7

Function: Ready-to-operate contact closes, if there is no error and if the DC link voltage has been applied.



5.4 Bus Connection

For bus connection, you may choose from several options:

- NOVOBUS RS232 (Standard)
- NOVOBUS RS422
- NOVOBUS RS232 + CAN Bus Protocol NOVOTRON

For the setup and for service purposes, NOVODRIVE must be connected with a personal computer over RS232. This can be done with a common serial cable. Null modem cables are **not** suitable, since they cross-couple pins 2 and 3.

NOVOBUS is characterized by a ring structure, with the return line being accommodated in the same cable. In order to close the ring at the last NOVODRIVE, a terminating plug with a bridge between pins 2 and 3 is necessary.

By means of the setup software, parameter sets can be stored and loaded, and configurations can be changed.



If you decide to use NOVOBUS RS422, an interface inverter RS422/RS232 must be used for connecting NOVODRIVE with a personal computer in order to perform service activities.



The ground potential of the RS232 and RS422 connections is identical with the ground potential of the 24 V supply voltage. Therefore provide a common grounding.

Both NOVOBUS and CAN bus can be used for controlling NOVODRIVE by a personal computer or a PLC. Both busses may also be wired in parallel. If done so, usually NOVOBUS is used for service purposes and the CAN bus is used for controlling purposes. For the differences in functionality see 'Bus Functions' manual.



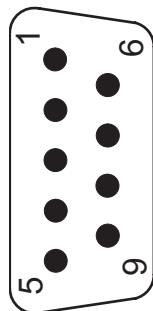
The CAN bus is usually not galvanically isolated, i.e. its ground potential is identical with the ground potential of the 24 V supply voltage. As an option, however, the CAN bus can be delivered with galvanic isolation.

5.4.1 Bus-Out Connector X4

Cable Standard RS232 or RS422, shielded

Connector X4 D-Sub, 9-pin,
male contacts at NOVODRIVE, female contacts at cable.

Pin assignment



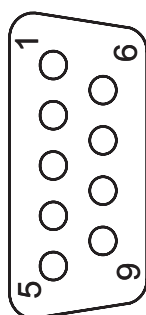
PIN	Pin assignment	
1	RS422 Aout	CAN GND *)
2	Return line 1	
3	RS232 TX	
4	RS232 DTR	
5	GND	
6	RS422 Bout	
7	Return line 2	
8	CAN L	
9	CAN H	

5.4.2 Bus-In Connector X5

Cable Standard RS232 or RS422, shielded.

Connector X5 D-Sub, 9-pin,
female contacts at NOVODRIVE, male contacts at cable.

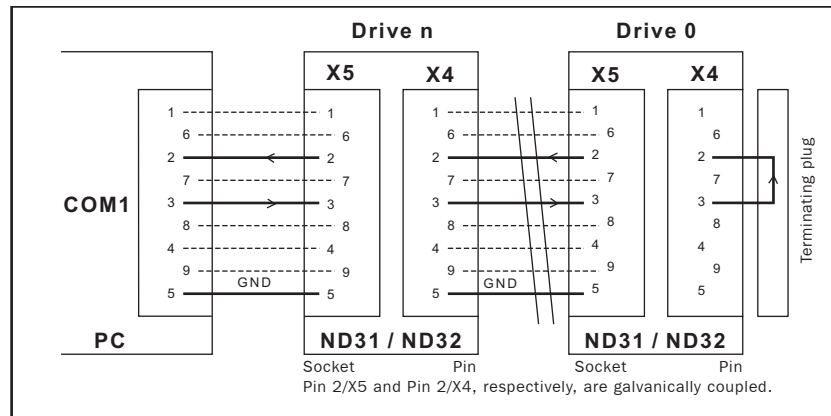
Pin assignment



PIN	Pin assignment	
1	RS422 Ain	CAN GND *)
2	Return line 1	
3	RS232 RX	
4	RS232 DTR	
5	GND	
6	RS422 Bin	
7	Return line 2	
8	CAN L	
9	CAN H	

*) only for ND3x-xxxx xx-x6x-xxx-xx

NOVOBUS with RS232 (Standard)

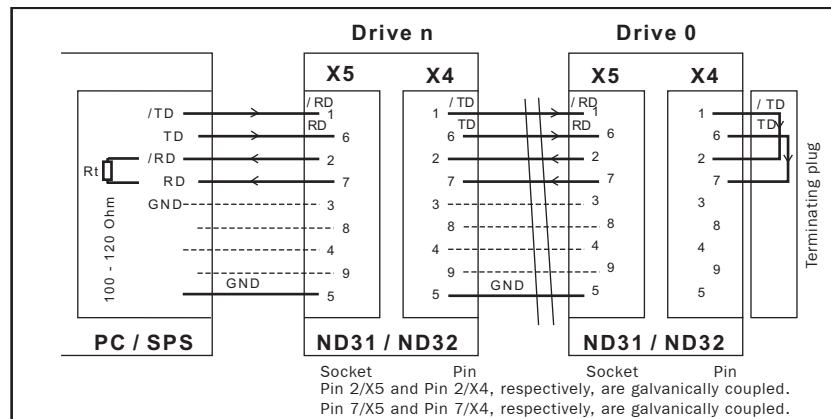


For connection with a personal computer, a common serial cable can be used (no null modem cable).

Without the terminating plug, no connection is possible.

Use shielded cables only!

NOVOBUS with RS422 (ND 3x-xxxxxx-x08-xxx-xx)

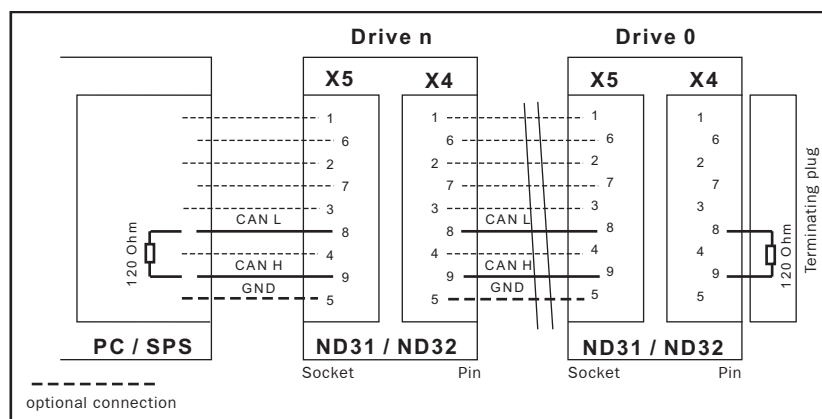


The receive line in the central computer (PC) must be terminated with a resistor $R_t = 100 \dots 120 \text{ Ohm}$ (NOVODRIVE already has the terminating resistor installed).

Without the terminating plug, no connection is possible.

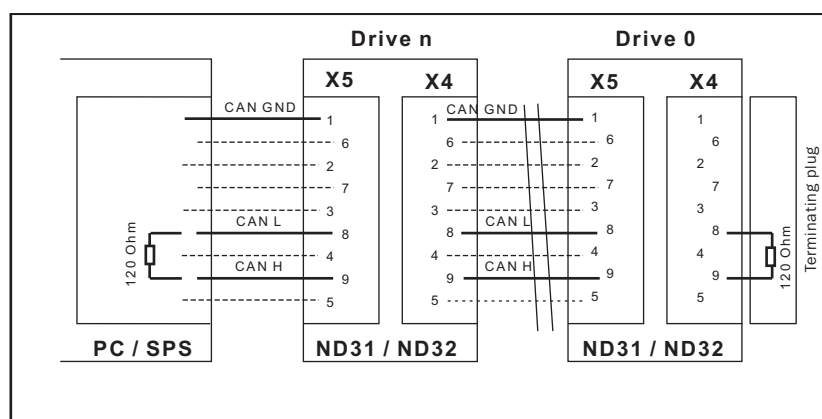
Use shielded cables only!

CAN-Bus with/without galvanic isolation (ND 3x-xxxxxx-x01-xxx-xx, ND 3x-xxxxxx-x41-xxx-xx)



Use shielded cables only!

CAN Bus with galvanic isolation and separate GND (ND 3x-xxxxxx-x61-xxx-xx)




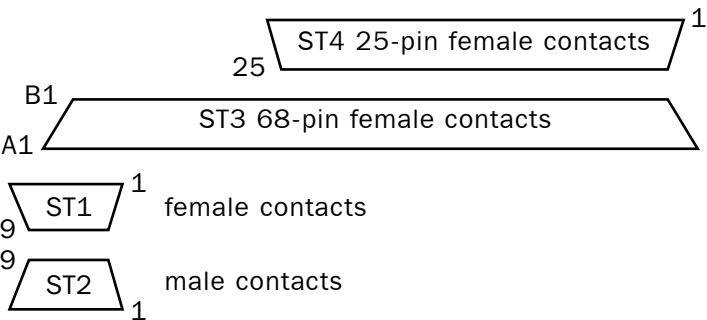
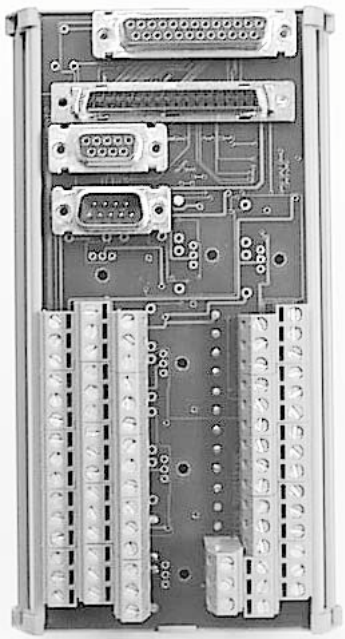
Use shielded cables only!

5.5 NOVODRIVE Connector Module

Product name: ND31-KM00

All designations refer to the connector module.

 For exact description of signal levels and capacities see Chapter 5.3.



-	GP07	Earth
-	24 V	Earth
-	24 V	Earth
-	GP010	Earth
24 V	GP01	Earth
24 V	GP02	Earth
-	GP06	Earth
-	GP08	Earth
-	GP09	Earth
-	GP03	Earth
-	GP04	Earth
-	GP05	Earth
Earth	AnOut1	Earth
Earth	AnOut2	Earth
BTB1	BTB2	Earth

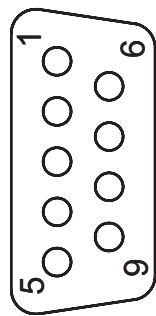
	24 V	Earth
	24 V	Earth
	GPIn10	Earth
	GPIn7	Earth
	GPIn6	Earth
	GPIn2	Earth
	GPIn4	Earth
	GPIn9	Earth
	GPIn8	Earth
	GPIn1	Earth
	GPIn3	Earth
	GPIN5	Earth
Shielding	SensB	Earth
Shielding	+SensA	Earth
Shielding	+AnIn	-AnIn

Connector ST1

Encoder emulation: Differential output, RS422 Standard.

D-Sub, 9-pin,
female contacts at connector module, male contacts at cable.

Connector ST1



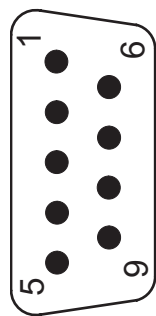
PIN	Assignment
1	Not connected
2	A
3	B
4	N
5	GND
6	/A
7	/B
8	/N
9	GND

Connector ST2

Encoder input: Differential input, RS422 Standard.


D-Sub, 9-pin,
male contacts at connector module, female contacts at cable.

Connector ST2



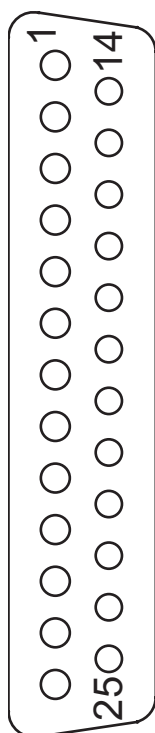
PIN	Assignment
1	VCC
2	A
3	B
4	N
5	GND
6	/A
7	/B
8	/N
9	GND

Connector ST3

 See Chapter 5.3 (X3)

Connector ST4

D-Sub, 25-pin,
female contacts at connector module, male contacts at cable.



PIN	Assignment
1	GND
2	Tast8
3	Tast6
4	Tast4
5	Tast2
6	/CS
7	D7
8	D5
9	D3
10	D1
11	E
12	RS
13	VCC
14	GND
15	Tast7
16	Tast5
17	Tast3
18	Tast1
19	D6
20	D4
21	D2
22	D0
23	R/W
24	-
25	GND

6 Installation

6.1 Warnings for physical installation

If operated in an improper environment, NOVODRIVE can be destroyed!

Direction NOVODRIVE may be installed in its vertical position only. In case of the compact device, the power connectors must be on the downside.

Environment Do not place NOVODRIVE above heat-producing devices!

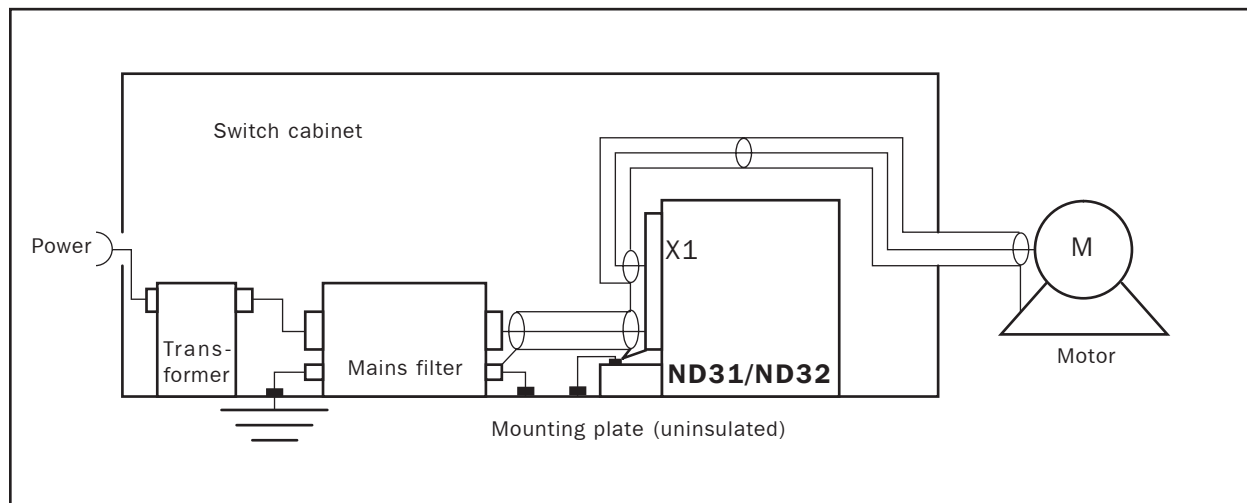
Installation may be done only in places free of dust, soot, metallic particles, corroding or metallic steams, gases or fluids.

Condensation must be prevented. If condensation cannot be prevented when NOVODRIVE is not in operation, it must be made sure that the condensation is removed before start-up. If needed, provide a suitable heater at the place of operation.

Do not operate NOVODRIVE in areas classified as dangerous, unless the converter is mounted in an enclosure that is permitted for such purposes and that has been inspected under consideration of the respective regulations.

Ventilator In case of the 19" rack, the ventilation insert must be mounted below NOVODRIVE. Do not block the area around NOVODRIVE's ventilation openings.

6.2 Grounding and Shielding



For reasons of clarity, the above picture does not contain circuit and safety elements. These elements must be incorporated in a way that they disturb the depicted shielding and grounding scheme as little as possible.

The external mains filter is not needed in case of compact cases with integrated mains filter.

To keep EMC standards, correct grounding and shielding is very important!

External mains filter

On the filter side, the shielding must be connected with the grounding connector of the mains filter. On the NOVODRIVE side, the shielding must be fixed to the compact case or the 19" rack by means of a cable clamp.

To be fully functionable, the mains filter must be mounted on the uninsulated mounting plate. Additionally, the filter must be grounded with a relatively short connection (2,5 mm²) to the mounting plate.

Integrated mains filter

For connection see drawing below.



Before the power voltage is switched on for the first time, check grounding of the mains filter!

Motor connection	Use shielded leads. On the motor side, the shielding must be attached to the motor housing. On the NOVODRIVE side, the shielding must be fixed to the compact case or the 19" rack by means of a cable clamp.
Stopping brake	If motors with brakes are used, the cable leading to a braking relays must be shielded too. If the braking lines are accommodated within the motor cable, the braking lines must be shielded against the motor line. If appropriate, the braking lines, after leaving the motor cable, should be led through ring cores or filters in order to prevent disturbances from spreading to the entire 24 V supply.
Braking resistor	For connecting an external braking resistor, the same rules apply as in the case of the motor line.
24 V supply	The 24 V supply voltage must be grounded.
Grounding conductor	The grounding terminal of NOVODRIVE (ND31 PIN 14 X1, ND32 PIN 12 X1) and of the motor must be connected to the grounding screw of the compact case or with the screws provided with the 19" rack. The line cross section is 2,5 mm ² .
Grounding of compact case and 19" rack	The compact case must be mounted on the uninsulated mounting plate. Additionally, a relatively short grounding connection with 10 mm ² (-> EN 50178) must be provided from the grounding screw of the compact device to the mounting plate or from the grounding screw of the 19" rack to the grounding bar, as the case may be. The mounting plate must be grounded very well.

General rules:

- Provide grounding of shield on both sides.
- Grounding connections must be as short and thick as possible.
- Shielding should be as extensive as possible.
- Keep unshielded parts as short as possible.
- Provide sound grounding of switch cabinet.
- Always keep all lines as short as possible.
- Avoid freely hanging lines. They are very noise sensitive and act as both active and passive antennas.
- Always separate signal and control lines from power lines.

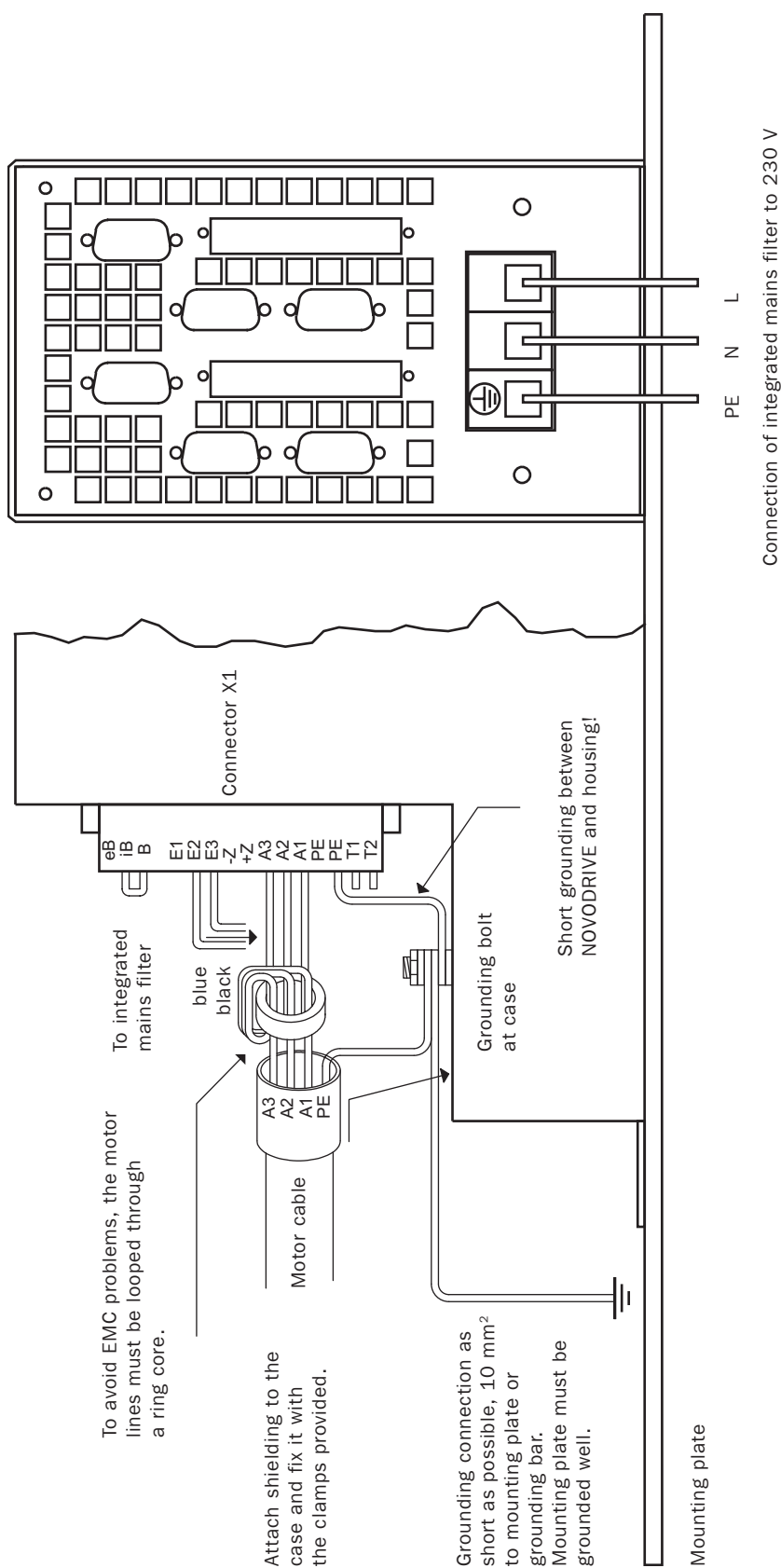
EMC can be achieved only if:

- a NOVODRIVE with an integrated mains filter is used,
- the connecting cables between mains filter and NOVODRIVE and the power lines between NOVODRIVE and motor are shielded,
- the shielding of the cables is connected with the mains filter, the compact case or 19" rack, respectively, and the motor housing.

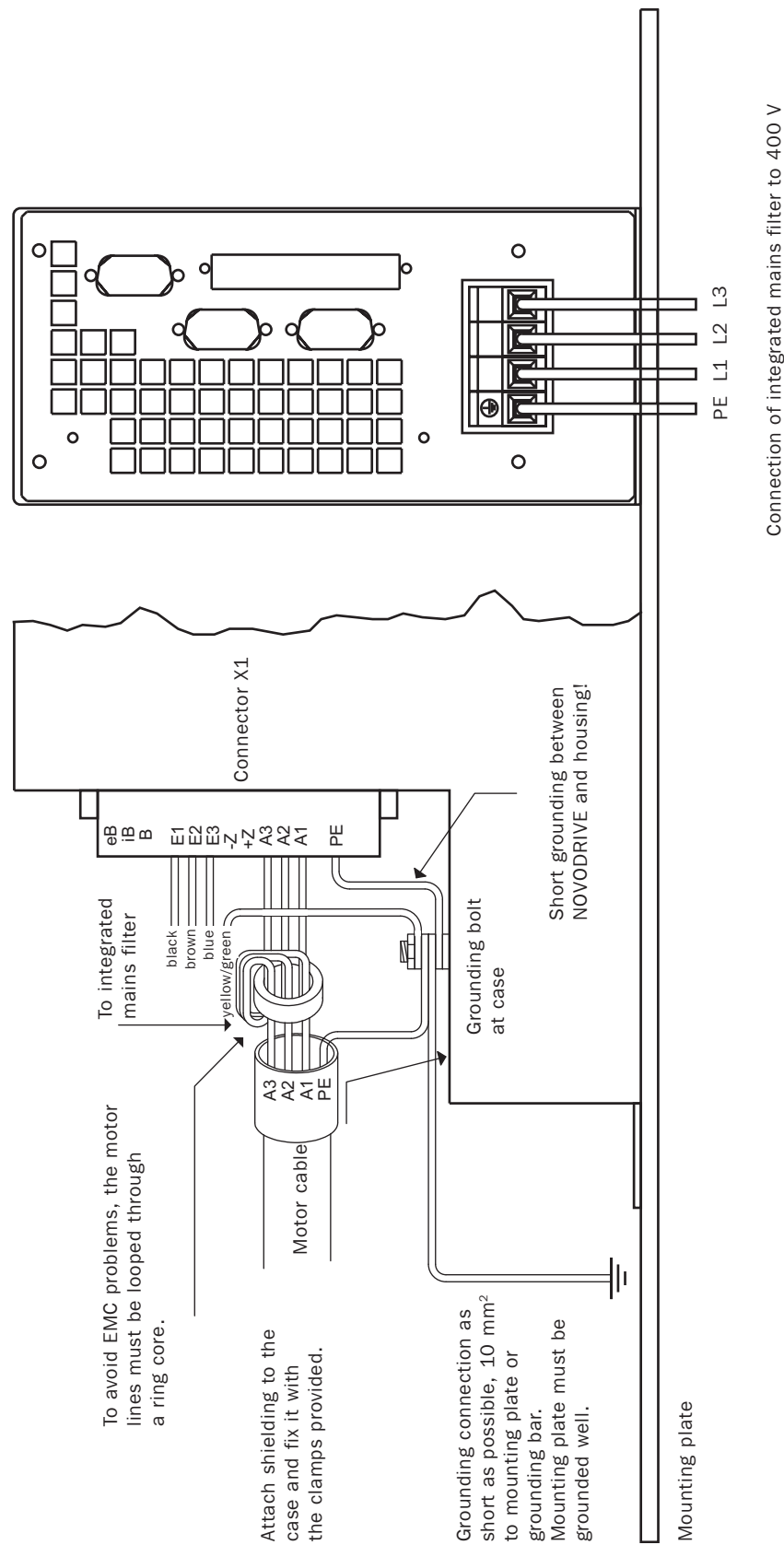
Various compact cases are available with an integrated mains filter:

Compact case	ND31-KGF1 ND31-KGF2	ND31-KGF2	ND32-KGF1
Mains filter type	ND31-NF081	ND31-NF161	ND32-NF103
Rated voltage	230 V	230 V	400 V
Phases	1	1	3
Nominal current	8 A	16 A	10 A
Leakage current	2,5 mA	2,5 mA	1,1 mA
asymmetric	-	-	25 mA

Compact case ND31-KGF1



Compact case ND32-KGF2



6.3 Emergency Stop



Danger through running drive!

Moving parts may cause danger to persons or damage to equipment.

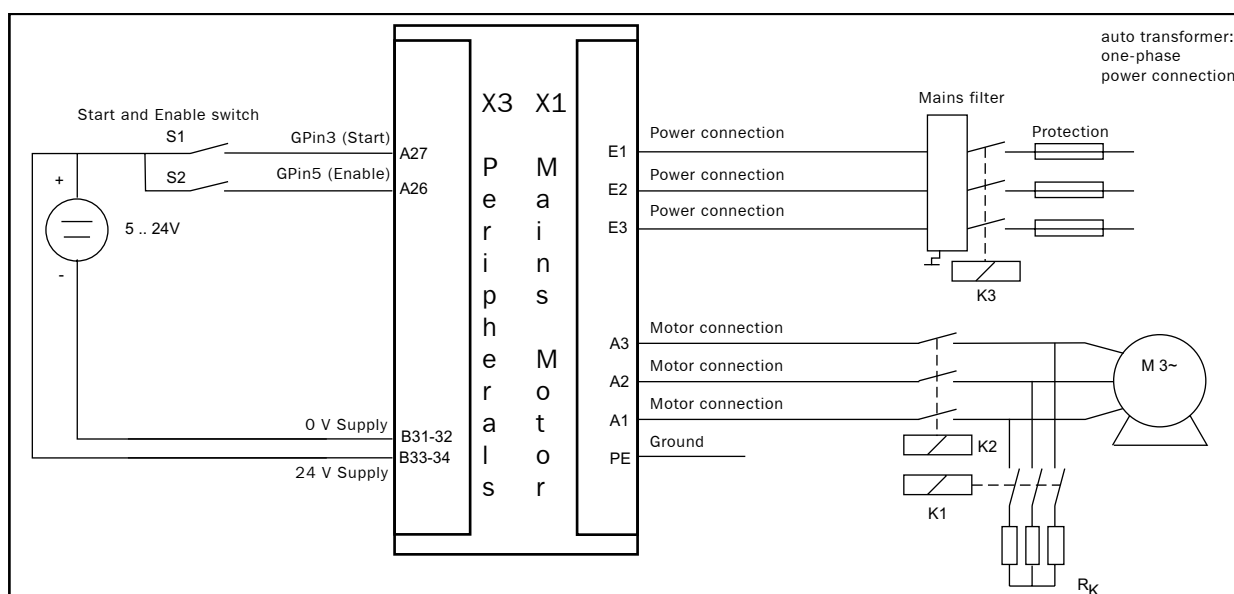
Therefore, machines working with NOVODRIVE must be provided with an emergency stop allowing quickest possible standstill of a machine or of danger-producing parts of a machine.

6.3.1 General information

In this section, two different emergency stop concepts are described:

- Short-circuit braking
- Controlled braking

Which concept is more suitable must be decided for each individual case.



6.3.2 Short-circuit braking

Short-circuit braking allows to stop the motor independent of NOVODRIVE by short-circuiting the motor windings over braking resistors. In order to apply short-circuit braking, you need the contactors K1 and K2 (see drawing above).

Sequencing:

- (1) Disabling of NOVODRIVE, e.g. by putting GPIN5 to 0 V.
- (2) Opening of contactor K2.
- (3) Closing of contactor K1.
- (4) Braking of the motor until it stands still.

Dimensioning of the braking resistors R_k :

Braking resistor $R_k = \frac{\text{Maximum speed (Upm)} * \text{Voltage gradient (V/Upm)}}{\sqrt{3} * \text{Peak current of motor}}$

The dimensioning of the braking resistors must be correctly in order to provide quick braking and to prevent the motor from getting overstrained.

Dimensioning of the contactors:

Contactors

Contactor K2 must be capable of separating a direct current that equals the peak value of the current in your NOVODRIVE.

6.3.3 Controlled braking

Sequencing:

- (1) The motor can be stopped in a controlled way
 - (a) by taking away the starting signal from GPIN 3,
 - (b) by writing a stop signal into the registries NBControl or CANControl by means of NOVOBUS or CAN bus, or
 - (c) in the case of analog speed setting, by putting the analog setpoint to 0 V.

Braking is done by the respective stopping ramp in the cases (a) and (b), and by the respective braking ramp in the case (c).
- (2) Wait until the motor stands completely still. The waiting time is determined by the speed, the ramp and a proper tolerance time.
- (3) Subsequently, NOVODRIVE needs to be disabled, e.g. by putting GPIN5 to 0 V.
- (4) In addition, it is necessary to separate the motor from the mains supply. This can be done in two different ways:
 - (a) by separating NOVODRIVE from the mains supply over contactor K3,
 - (b) by separating the motor from NOVODRIVE over contactor K2.

Only one of the contactors is required for the separation.



Danger through running drive even after emergency stop has been activated!

If controlled braking is to be used, be aware of the following aspects:



Do not disable NOVODRIVE! Controlled braking is possible only if NOVODRIVE is enabled, i.e. if neither software nor hardware disabling is in effect!



Motor parameters and control parameters must be correct!



When applying emergency stop, the motor comes to a standstill only after a possible lag error has been overcome! Be aware that in the course of a mechanical disturbance a lag error may occur.



In case of failure of the position measuring system, no controlled braking is possible!



Contactor K2 must be capable of separating a direct current that equals the peak value of the current in your NOVODRIVE.



A crucial requirement for separating NOVODRIVE and the motor is that NOVODRIVE is placed in a closed operating environment which guarantees that in the case of emergency stop accidental touching of live parts of NOVODRIVE is not possible.

7 Electrical Design of Drive

In this chapter you are given information how to find the suitable drive for a specific task. A computing example will show you how to design your drive correctly.

Example An application requires a torque of 12 Nm for acceleration, and with this torque 2600 rpm are to be achieved. It is to be tested whether such an acceleration is possible with ND31 3207 and a NHD 115C6-88S motor.

The NHD 115C6-88S motor has a continuous stall torque of 6,8 Nm and can be overstrained fivefold for short-time acceleration. The required acceleration is thereby surely possible. To find out whether it is possible to accelerate up to the required maximum speed with the required torque, follow this calculation:

Inductive voltage drop at the motor:

$$U_L = 0,0453 * n * p * L * i$$

with: NHD 115C6-88S

$$n: \text{speed [revolutions per minute]} = 2600$$

$$p: \text{pole number of motor} = 6$$

(from motor specifications)

i: effective acceleration current, calculated from

$$i = \text{acceleration torque} / (3 * \text{torque constant})$$

(torque constant from motor specifications)

$$\frac{12 \text{ Nm}}{3 \cdot 0,34 \frac{\text{Nm}}{\text{A}}} = 11,8 \text{ A}$$

$$L: \text{motor inductance phase - phase [H]} = 0,0126 \text{ H}$$

(from motor specifications)

Therefore:

$$U_L = 0,0453 * 2600 * 0,0126 * 11,8 = 105,1 \text{ V}$$

Resistive voltage drop at the motor:

$$U_R = 0,866 * R * i$$

with

R: winding resistance phase - phase [Ω] = 1,7 Ω
(from motor specifications)

$$\text{Therefore: } U_R = 0,866 * 1,7 * 11,8 = 17,37 \text{ V}$$

Counter-EMF of motor:

$$U_E = 0,5 * \sqrt{2} * V_g * (n / 1000)$$

with

V_g: voltage gradient phase - phase peak [V/1000] = 88
(from motor specifications)

$$\text{Therefore: } U_E = 161,8 \text{ V}$$

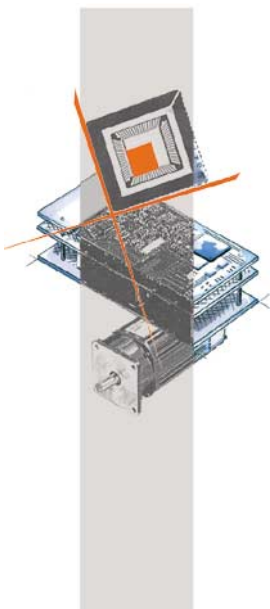
Voltage demand of motor:

$$U = \sqrt{(U_E + U_R)^2 + U_L^2} = 207,7 \text{ V}_{\text{eff}}$$

Required DC link voltage:

$$U_{ZK} = \sqrt{2} U = 293,7 \text{ V}$$

With a three-phase 230 V power connection, ND31 has a DC link voltage of 325 V. As a result, the voltage is high enough to achieve the required speed with the required torque.



NOVOTRON

für Dynamik und Bewegung

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