Intelligent Drivesystems, Worldwide Services

MANUAL BU 0500 GB

NORDAC SK 500E
Frequency Inverters

NORDAC SK 500E Frequency Inverter

Safety and operating instructions for drive power converters

(as per: Low voltage guideline 73/23/EEC)

1. General

During operation, drive power converters may have, depending on their protection class, live, bare, moving or rotating parts or hot surfaces.

Unauthorised removal of covers, improper use, incorrect installation or operation leads to the risk of serious personal injury or material damage.

Further information can be found in this documentation.

All transportation, installation and initialisation and maintenance work must be carried out by qualified personnel (compliant with IEC 364, CENELEC HD 384, DIN VDE 0100, IEC 664 or DIN VDE 0110, and national accident prevention regulations).

For the purposes of these basic safety instructions, qualified personnel are persons who are familiar with the erection, installation, commissioning and operation of this product and who have the relevant qualifications for their work.

2. Proper use

Drive power converters are components intended for installation in electrical systems or machines.

When being installed in machines, the drive power converter cannot be commissioned (i.e. implementation of the proper use) until it has been ensured that the machine meets the provisions of the EC directive 89/392/EEC (machine directive); EN 60204 must also be complied with.

Commissioning (i.e. implementation of the proper use) is only permitted when the EMC directive (89/336/EEC) is complied with.

The drive power converters meet the requirements of the low voltage directive 73/23/EEC. The harmonised standards in prEN 50178/DIN VDE 0160, together with EN 60439-1/VDE 0660 Part 500 and EN 60146/VDE 0558 were applied for the drive power converter.

Technical data and information for connection conditions can be found on the rating plate and in the documentation, and must be complied with.

3. Transport, storage

Information regarding transport, storage and correct handling must be complied with.

4. Installation

The installation and cooling of the equipment must be implemented as per the regulations in the corresponding documentation.

The drive power converter must be protected against impermissible loads. In particular, no components must be bent and/or the insulation distances changed during transport and handling. Touching of electronic components and contacts must be avoided.

Drive power converters have electrostatically sensitive components that can be easily damaged by incorrect handling. Electrical components must not be mechanically damaged or destroyed (this may cause a health hazard!).

5. Electrical connection

When working on drive power inverters which are connected to high voltages, the applicable national accident prevention regulations must be complied with (e.g. VBG 4).

The electrical installation must be implemented as per the applicable regulations (e.g. cable cross-section, fuses, earth lead connections). Further information is contained in the documentation.

Information about EMC-compliant installation – such as shielding, earthing, location of filters and installation of cables – can be found in the drive power converter documentation. These instructions must also always be observed for drive inverters with CE approval. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Systems where drive power converters are installed must be equipped, where necessary, with additional monitoring and protective equipment as per the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc. Modifications to the drive power converter using the operating software are permitted.

After the drive power converter is disconnected from the power supply, live equipment components and power connections should not be touched immediately because of possibly charged capacitors. Comply with the applicable information signs located on the drive power converter.

All covers must be kept closed during operation.

7. Maintenance and repairs

The manufacturer documentation must be complied with.

These safety instructions must be kept in a safe place!

Documentation

Bezeichnung: BU 0500 DE

Mat. Nr.: 607 50 01

Series: SK 500E

Device series: SK 500E, SK 505E, SK 510E, SK 511E, SK 515E
SK 520E, SK 530E, SK 535E

Device types: **SK 5xxE-250-112-O ... SK 5xxE-750-112-O**
(0.25kW … 0.75kW, 1~ 115V, output 3~ 230V)

SK 5xxE-250-323-A ... SK 5xxE-112-323-A
(0.25kW … 2.2kW, 1/3~ 230V, output 3~ 230V)
(3.0kW … 11.0kW, 3~ 230V, output 3~ 230V)

SK 5xxE-550-340-A ... SK 5xxE-222-340-A
(0.55kW … 22.0kW, 3~ 400V, output 3~ 400V)

Version list

Designation of previous issues	Software Version	Comments
BU 0500 DE, March 2005	V 1.1 R1	First issue based on BU 0750 DE
BU 0500 DE, May 2005	V 1.1 R2	Revision, supplementation and correction
BU 0500 DE, June 2005	V 1.2 R0	Supplementation and correction P220, additionally P466/P554 EMC standards
BU 0500 DE, August 2005	V 1.2 R0	Jumper illustration mains/motor, information on array levels with SK TU3-PAR, P107 lifting gear, P215, P420...425 + P470 terminal numbers
BU 0500 DE, December 2005	V 1.3 R1	Brake resistance, NED address, Caution hot, output current 2.2kW/230V, P415 process controller, radio interference suppression level 400V, E13.2 supplemented
BU 0500 DE, May 2006 Mat. No. 607 5001 / 1806	V 1.4 R0	Switchover of nominal voltage/current value is reversed, Section 2.9 illustration corrected, new parameter P534 → Error 12.1 and 12.2, P513 adjustment range extended.
BU 0500 DE, October 2006 Mat. No. 607 5001 / 4006	V 1.5 R0	115V devices, information on repairs, P218, P400/546=46, P420-425=3-Wire-Control, P520 fmin, P543=22, P748 -01, UL-Data Sect 7.5, 3-Wire-Control (Fct. P420-425)
BU 0500 DE, May 2007 Mat. No. 607 5001 / 2207	V 1.6 R0	Note on SK530E integrated, DIP switch 485/CAN, EMV kit, further details in P744-746, E004 extended to error 4.1, P217
BU 0500 DE, August 2007 Mat. No. 607 5001 / 3307	V 1.6 R0	UL text, note on functional safety “pulse lock”, P217 vibration damping, P219, value range P414, P418=33, P420…425=71/72, P509=10, P515, P533, P535 extended, P551, P552. P557 extended, P559 to 30 sec., P737 extended, parameter overview expanded by P6xx
BU 0500 DE, February 2008 Mat. No. 607 5001 / 0808	V 1.7 R0	External 24V supply (SK 5x5E) CP=Cold Plate version, push-through technique, SK TU3-POT, KTY-84 function Section 4.3/P400/405, P551 corrected, evaluate HTL sensor via DIN (P421/423, P461, P462, P463), P560 correction, E013.2 / E018 corrected
BU 0500 DE, Mai 2008 Mat. Nr. 607 5001 / 2008	V 1.7 R0	RoHS-conform, WAGO-RJ45 terminals, Ri analog input, P434/441/450/455=18 FI ready, dimensions external heat sink technology, addresses
BU 0500 DE, April 2009 Mat. Nr. 607 5001 / 1409	V 1.7 R0	Addition of the series of devices (up to 22kW) BG5 and BG6, correction of errors, extension of functions / changes to parameters P108, P113; P434, P441, P450, P455, P481, P464, P707 Caution: Incompatibility of the function of parameter P113 with older software versions

Intended use of the frequency inverter

Compliance with the operating instructions is the requirement for error-free operation and the fulfilment of any warranty claims. **You must first read these operating instructions** before working with the device!

These operating instructions contain important information about service. They must therefore **be kept close** to the device.

The SK 500E frequency inverters are devices for industrial and commercial plants for operating three-phase asynchronous motors with squirrel-cage rotors. These motors must be suitable for operation with frequency inverters, other loads must not be connected to the devices.

The SK 500E frequency inverters are devices for stationary installation in control cabinets. All details regarding technical data and permissible conditions at the installation site must be complied with.

Commissioning (implementation of the intended use) is not permitted until it has been ensured that the machine complies with the EMC directive 89/336/EEC and that the conformity of the end product meets the machine directive 89/392/EEC (note EN 60204).

1 General information

The NORDAC SK 500E is based on the tried and tested Nord platform. These devices feature a compact design with optimum control characteristics.

These devices are provided with sensorless vector current control system which in combination with asynchronous three-phase motor types constantly ensures an optimised voltage-to-frequency ratio. This has the following significance for the drive: Peak start-up and overload torques at constant speed.

This series of devices can be adapted to individual requirements by means of the modular technology boxes.

Due to the numerous setting options, these inverters are capable of controlling all three-phase motors. The power range is from **0.25kW to 22.0kW** with integrated mains filter.

This manual is based on the device software V1.7 R0 (see. P707) of SK 500E. If the frequency inverter used has a different version, this may lead to some differences. If necessary, you can download the current manual from the Internet (http://www.nord.com/).

For the SK 51xE/53xE there are additional descriptions for the functional safety (BU 0530) and the positioning system (BU 0510). These contain all the necessary additional information for start-up.

If a bus system is used for communication, a corresponding description (BU 0020…BU 0090) is provided, or this can be downloaded from the Internet (http://www.nord.com/).

In the standard version the device has a fixed cooling element, which causes corresponding heat dissipation if it is installed in a control cabinet. In order to achieve less heat dissipation in the control cabinet or to enable a smaller size, there are the following possibilities:

ColdPlate-Technology

Instead of a cooling element/fan, ColdPlate versions of the frequency inverter have a flat metal plate on the rear side which is mounted on an existing mounting plate (e.g. the rear wall of the control cabinet) so as to provide thermal conduction. The mounting surface can also be provided with a flow of cooling medium (water. oil), which enables a better heat dissipation than air due to its greater thermal conductivity. Because the heat dissipation does not take place in the control cabinet, the temperature of the interior remains considerably lower, which results in a longer life span of the power electronics. The installation depth is also reduced and the possible failure of the frequency inverter due to clogged air filters is avoided.

External heat sink technology

External heat sink technology is an optional supplement for ColdPlate devices. This is used if an external cooling system is provided, but no liquid-cooled mounting plate is available. A cooling element is mounted on the ColdPlate device, which passes through an opening in the rear panel of the control cabinet into the exterior air-cooled environment. Convection takes place outside of the control cabinet, which results in the same advantages as with ColdPlate technology.

1.1 Overview

Properties of the basic device **SK 500E:**

- High starting torque and precise motor speed control setting with sensorless current vector control.
- Can be mounted next to each other without additional spacing
- Permissible ambient temperature range 0 to 50°C (please refer to the technical data)
- Integrated EMV mains filter for limit curve A1 (and B1 for size 1 - 4 devices) as per EN55011 (not for 115V devices)
- Automatic measurement of the stator resistance or determination of the precise motor data
- Programmable direct current braking
- Integrated brake chopper for 4 quadrant operation (optional brake resistors)
- 5 digital inputs, 2 Analogue inputs, 2 relay messages, 1 analogue output
- Four separate online switchable parameter sets
- RS232/485 interface via RJ12 plug

Additional features of the **SK 510E** compared with the SK 500E:

- Functional safety – secure pulse block (Manual BU 0530)

Additional features of the **SK 511E** compared with the SK 510E:

- 2 x CANbus/CANopen interfaces via RJ45 plug (Manual BU 0060)

Additional features of the **SK 520E** compared with the SK 500E:

- 2 x CANbus/CANopen interfaces via RJ45 plug (Manual BU 0060)
- RS485 interface additionally via terminals
- 2 x digital inputs and 2 x digital outputs
- Speed feedback by means of incremental rotation encoder input

Additional features of the **SK 530E** compared with the SK 500E:

- Integrated Posicon positioning control (Manual 0510)
- CANopen absolute value encoder evaluation
- Functional safety – secure pulse block (Manual BU 0530)

Differing features of the **SK 5xxE-…-CP** compared with SK 5xxE:

- ColdPlate or external heat sink technology (included in Manual BU 0500)

Differing features of the **SK 5x5E** compared with SK 5x0E:

- External 24V supply voltage (included in manual BU 0500), communication with the device can be performed even without power supply.

Differing features of **sizes 5 and 6** compared with sizes 1 to 4:

- Additional, separately mounted PTC input (potential isolated)
- External 24V supply voltage with automatic switchover to the internal 24V low voltage generator on failure of the external control voltage.
- Processing of both bipolar and analog signals

NOTE: The features of the particular basic unit are different in the SK 500E series. These differences will be pointed out in the course of this description (Section 2.12).

1.2 Delivery

Check the equipment **immediately** after delivery/unpacking for transport damage such as deformation or loose parts.

If there is any damage, contact the carrier immediately and implement a thorough assessment.

Important! This also applies even if the packaging is undamaged.

1.3 Scope of supply

Standard design: IP20

Integrated brake chopper

Integrated EMV mains filter for limit curve A1 as per EN55011
(not for 115V devices)

Blanking cover for technology unit slot

Screening terminal for control terminals

Covering for the control terminals

Operating manual

Available accessories: Braking resistor, for energy feedback (Section 2.6)

Interface converter RS232 → RS485 (additional description BU 0010)

NORD CON, PC parameterising software > www.nord.com <

ePlan macros for producing electrical circuit diagrams > www.nord.com <

EMC Kit (SK EMC 2-1, SK EMC 2-2, SK EMC 2-3, SK EMC 2-4) Section. 2.5

Mains filter, line choke, output chokes

Technology unit,
Section 3.2:

SK CSX-0, SimpleBox,
removable operating panel, 4 digit 7 segment LED display, single button control

SK TU3-CTR, ControlBox,
detachable operating panel, 4 figure 7 segment LED display, keyboard

SK TU3-PAR, ParameterBox,
removable control panel, multi-line plain language LCD display, keyboard

SK TU3-PBR, Profibus, additional unit for Profibus communication (1.5Mbaud)

SK TU3-PBR-24V, with external 24V supply(12Mbaud)

SK TU3-CAO, CANopen, bus switch-on

SK TU3-DEV, DeviceNet, Bus switch-on

SK TU3-IBS, InterBus, Bus switch-on

SK TU3-AS1, AS interface

SK TU3-POT, PotentiometerBox,
removable control panel for control with a potentiometer and two buttons

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NOTE: Additional BUS descriptions are available (BU 0020… BU 0090)
> www.nord.com

1.4 Safety and installation information

NORDAC SK 500E frequency inverters are equipment for use in industrial high voltage systems and are operated at voltages that could lead to severe injuries or death if they are touched.

- Installation and other work may only be carried out by qualified electricians and when the device is disconnected. The manual must always be available for these persons and must be complied with.
- Local regulations for the installation of electrical equipment as well as for accident prevention must be complied with.
- The equipment continues to carry hazardous voltages for up to 5 minutes after being switched off at the mains.
- For single phase operation (230V) the mains impedance must be at least 100µH for each conductor. If this is not the case, a mains choke must be installed.
- For safe isolation from the mains, all poles of the supply cable to the frequency inverter must be able to be disconnected.
- Even during motor standstill (e.g. caused by a release block, blocked drive or output terminal short circuit), the line connection terminals, motor terminals and braking resistor terminals may still conduct hazardous voltages. A motor standstill is not identical to galvanic isolation from the mains.

- **Attention**, even parts of the control card and, in particular, the connection plug for the removable technology units can conduct hazardous voltages. The control terminals are mains voltage free.
- **Warning**, under certain settings the inverter can start automatically after the mains are switched on.
- The frequency inverter is only intended for permanent connection and may not be operated without effective earthing connections that comply with local regulations for large leak currents (> 3.5mA). EN50178 / VDE 0160 stipulates the installation of a second earthing conductor or an earthing conductor cross-section of at least 10 mm^2.
- Normal **FI-circuit breakers** are not suitable as the sole protection in three-phase frequency inverters when local regulations do not permit a possible DC proportion in the faulty current. The FI circuit breaker must be an all-mains sensitive FI circuit breaker (type B) as per EN 50178 / VDE 0160.
- In normal use, NORDAC 500E frequency inverters are maintenance free. The cooling surfaces must be regularly cleaned with compressed air if the ambient air is dusty.

CAUTION

The heat sink and all other metal components can heat up to temperatures above 70°C.

When mounting, sufficient distance from neighbouring components must be maintained. When working on the components, allow sufficient cooling time beforehand

ATTENTION

DANGER TO LIFE!

The power unit can continue to carry voltages for up to 5 minutes after being switched off at the mains. Inverter terminals, motor cables and motor terminals may carry voltage!

Touching open or free terminals, cables and equipment components can lead to severe injury or death!

Work may only be carried out by qualified specialist electricians and with the electrical supply to the equipment disconnected!

CAUTION

- Children and the general public must be kept away from the equipment!
- The equipment may only be used for the purpose intended by the manufacturer. Unpermitted modifications and the use of spare parts and additional equipment that has not be bought from or recommended by the equipment manufacturer can lead to fire, electric shock and injury.
- Keep these operating instructions in an accessible location and give these to every operator!

WARNING

This product is covered under marketing classification IEC 61800-3. In a domestic environment, this product can cause high frequency interference, which may require the user to take appropriate measures.

An appropriate measure would be the inclusion of a recommended line filter.

1.5 Approvals

1.5.1 European EMC guideline

If the NORDAC SK 500E is installed according to the recommendations in this instruction manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3.

(See also Section. 8.3 Electromagnetic compatibility [EMC].)

1.5.2 UL approval -File No. E171342

"Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical Amperes, 120 Volts maximum (SK 5xxE-xxx-112), 240 Volts maximum (SK 5xxE-xxx-323), or 480 Volts maximum (SK 5xxE-xxx-340), or 500 Volts maximum (SK 5xxE-xxx-350) and when protected by J class fuses as indicated."

Suitable for use with mains with a maximum short circuit current of 5000A (symmetrical), 120V maximum (SK 5xxE-xxx-112), 240V maximum (SK 5xxE-xxx-323), or 480V maximum (SK 5xxE-xxx-340), or 500V maximum (SK 5xxE-xxx-350) and with protection with a J-class fuse as described in BU 0500 DE Section 7.5.

NORDAC SK 500E frequency inverters have a motor overload protection. Further technical details can be found in Section 7.5.

The approval procedure (UL) for sizes 5 and 6 will be completed in the 3rd quarter of 2009.

1.5.3 C-Tick labelling – No. N 23134

Frequency inverters of the NORD product series SK 500E (except 115V devices: SK5xxE-xxx-112-O) comply with all the relevant regulations in Australia and New Zealand.

1.5.4 RoHS-conform

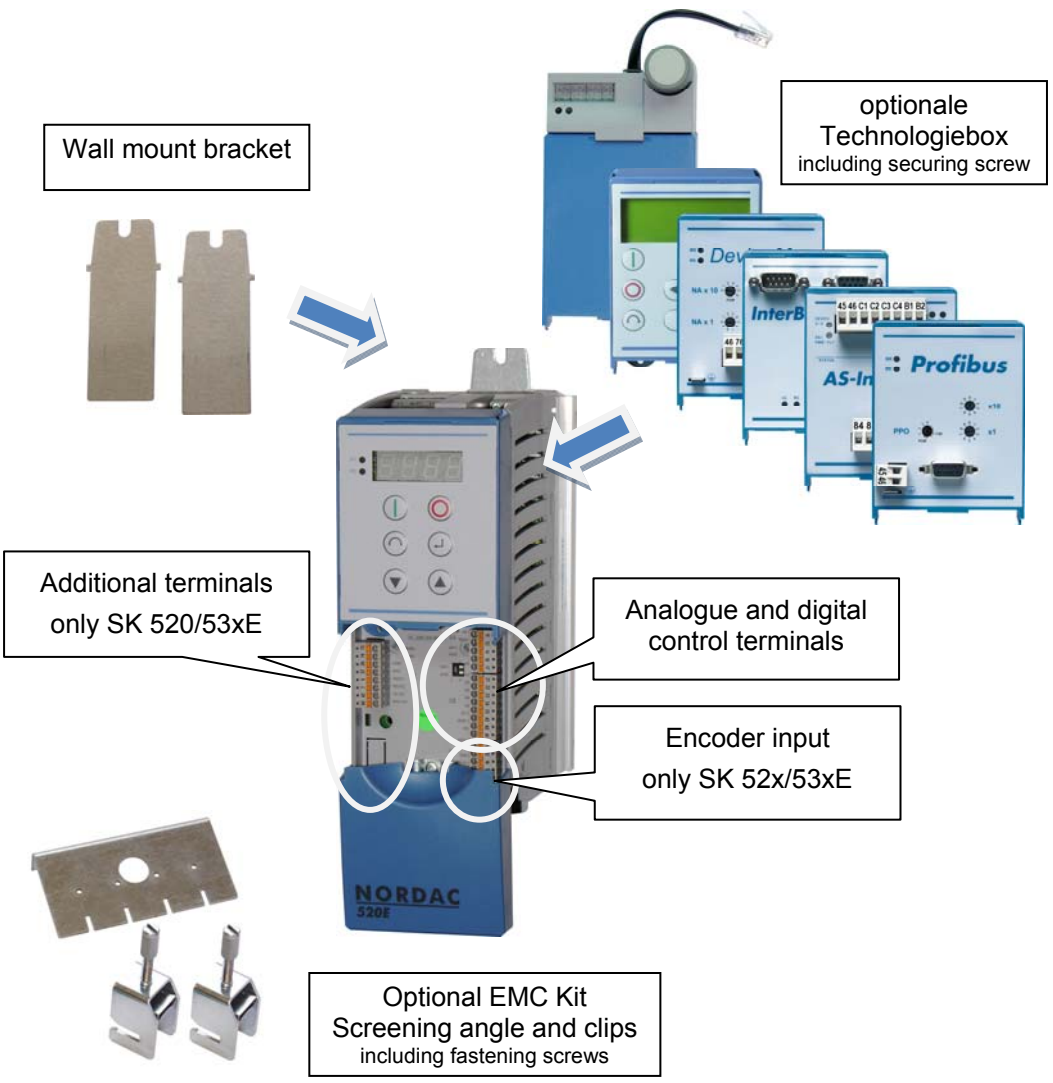
The frequency inverters and optional modules of the SK 500E series frequency inverters are designed to be RoHS compliant according to Directive 2002/95/EU.

1.6 Type code / device design

SK 500E-250-323-A-CP

- Versions: **CP** = **"ColdPlate"** or "External heat sink technology"
- Radio interference filter class: O = without, **A** or B limit value
- Mains voltage: x12 = 115V, x**23** = **230V**, x40 = 400V
- Number of mains phases: 1 = single phase, **3** = **3-phase** *
- Digits before comma for power: 0 = 0.xx, 1 = 0x.x0, 2 = 0xx.0
- Device nominal power (xx): **25** = 0.**25kW**, 37 = 0.37kW, ... 75 = 7.5kW
- Device series: **SK 500E** / SK 505E / SK 510E / SK 511E / SK 515E / SK 520E / SK 530E / SK 535E

*) designation **3** also includes combined devices which are intended for single and three-phase operation (please refer to the technical data)



2 Assembly and installation

2.1 Installation

NORDAC SK 500E frequency inverters are available in various sizes depending on the output. Attention must be paid to a suitable position when installing.

The equipment requires sufficient ventilation to protect against overheating. For this the minimum guideline distances from adjacent components above and below the frequency inverter, which could obstruct the air flow apply. (above > 100 mm, below > 100 mm)

Distance from device: Mounting can be immediately next to each other. However, for the use of brake resistances mounted below the device (not possible with …-CP devices), the greater width (Section 2.5) must be taken into consideration, particularly in combination with temperature switches on the brake resistor!

Installation position The installation position is normally vertical. It must be ensured that the cooling ribs on the rear of the device are covered with a flat surface to provide good convection.

Warm air must be vented above the device!

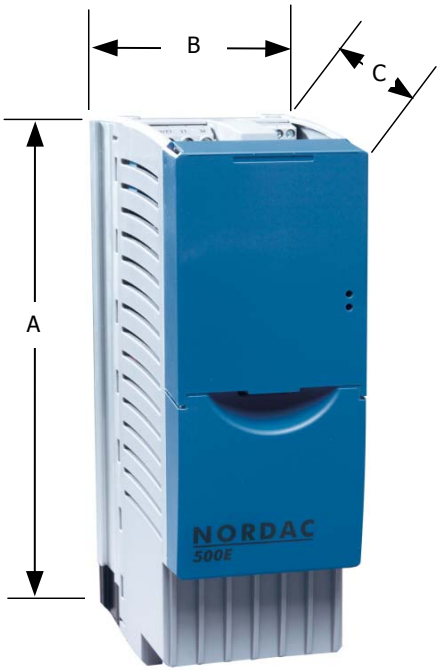
If several inverters are arranged above each other, ensure that the upper air entry temperature limit is not exceeded. (see also Section 7, Technical Details). If this is the case, it is recommended that an "obstacle" (e.g. a cable duct) is mounted between the inverters so that the direct air flow (rising warm air) is impeded.

Heat dissipation: If the device is installed in a control cabinet, adequate ventilation must be ensured. The heat dissipation in operation is approx. 5% (according to the size and equipment of the device) of the rated power of the frequency inverter.

2.2 Dimensions

2.2.1 SK 500E, standard version

Device type	Size	Housing dimensions			Wall-mounting (Sect. 2.3.1)			Weight approx. [kg]
		A	B	C	D	E	Ø	
SK 5xxE-250- … SK 5xxE-750- …	BG1	186	74 *	153	220	/	5.5	1.4
SK 5xxE-111- … SK 5xxE-221- …	BG2	226	74 *	153	260	/	5.5	1.8
SK 5xxE-301- … SK 5xxE-401- …	BG3	241	98	181	275	/	5.5	2.7
SK 5xxE-551- 340… SK 5xxE-751- 340…	BG4	286	98	181	320	/	5.5	3.1
SK 5xxE-551- 323… SK 5xxE-751- 323…	BG5	324	157	224	358	93	5.5	8.0
SK 5xxE-112- 340… SK 5xxE-152- 340…	BG5	324	157	224	358	93	5.5	8.0
SK 5xxE-112- 323…	BG6	364	183	234	398	110	5.5	10.3
SK 5xxE-182- 340… SK 5xxE-222- 340…	BG6	364	183	234	398	110	5.5	10.3
		All dimensions in [mm]						
		*) for the use of brake resistors mounted below the device = 88 mm (Section 2.6)						



2.2.2 SK 500E…-CP in ColdPlate version

Device type	Size	Housing dimensions A	B	C	Wall mounting D	Ø	Weight approx. [kg]
SK 5xxE-250- …-CP SK 5xxE-750- …-CP	BG1	182	95	119	Mounting details in Section 2.3.2		1.3
SK 5xxE-111- …-CP SK 5xxE-221- …-CP	BG2	222	95	119			1.6
SK 5xxE-301- …-CP SK 5xxE-401- …-CP	BG3	237	120	119			1.9
SK 5xxE-551- 340…-CP SK 5xxE-751- 340…-CP	BG4	282	120	119			2.3
		All dimensions in [mm]					
		Brake resistors cannot be directly mounted below –CP devices (Section 2.6)					

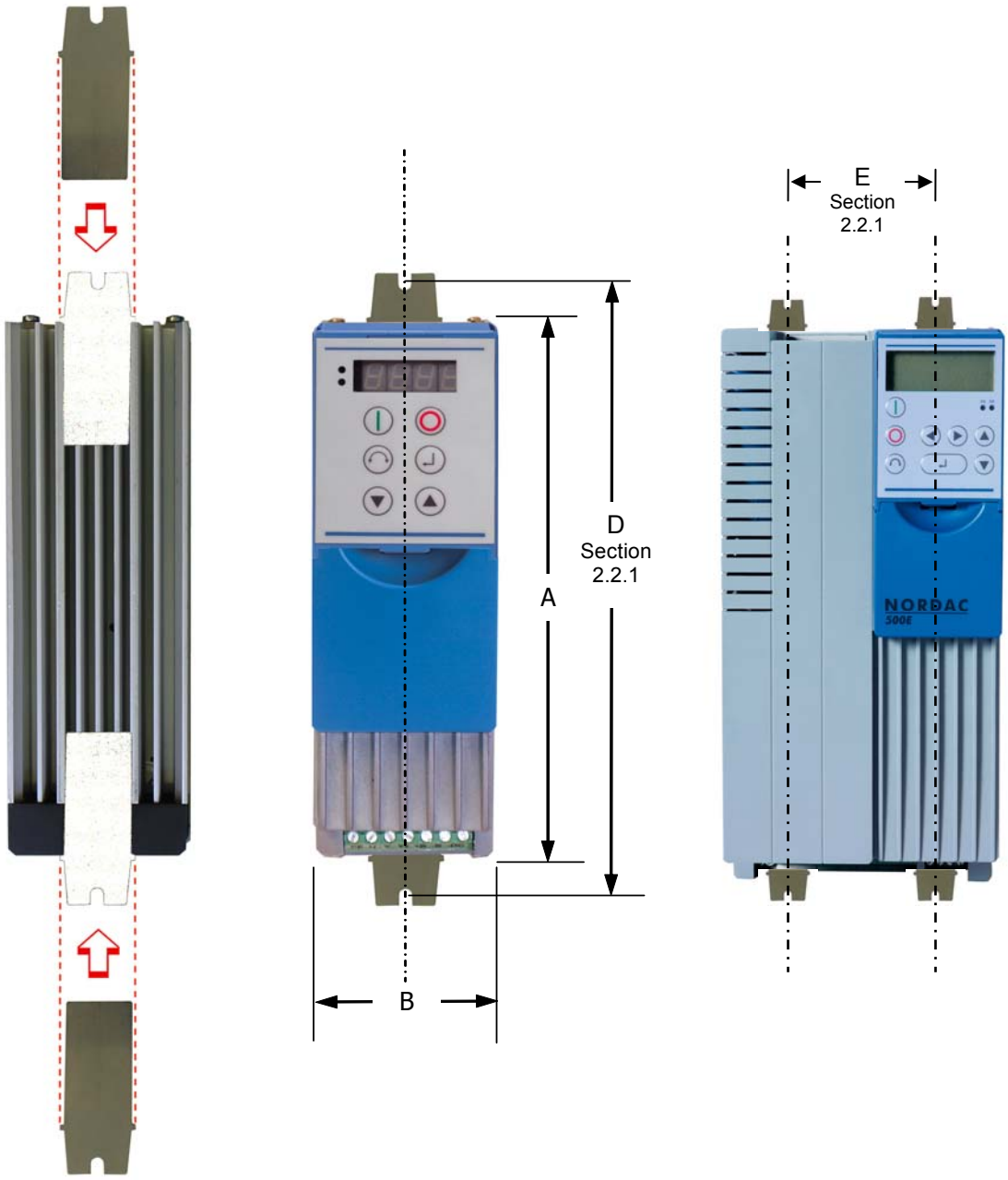
2.3 Mounting dimensions

2.3.1 SK 500E, standard version

For wall mounting of the SK 500E, two (or four, for size 5 and above) appropriate brackets are supplied. These are inserted into the cooling element at the rear of the device as shown in the illustration. For this, no further accessories are needed.

Alternatively, the wall mounting brackets can be inserted at the side of the cooling element in order to minimise the necessary depth of the control cabinet.

In general, care must be taken that the rear of the cooling element is covered with a flat surface and that the device is mounted vertically. This enables optimum convection, which ensures fault-free operation.

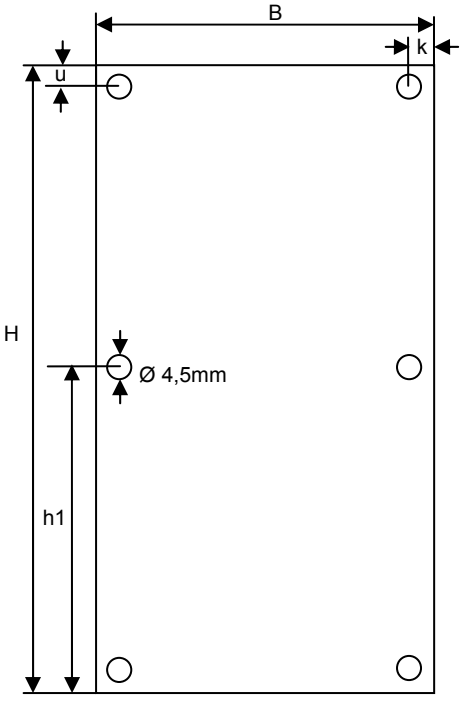


2.3.2 SK 500E…-CP in ColdPlate version

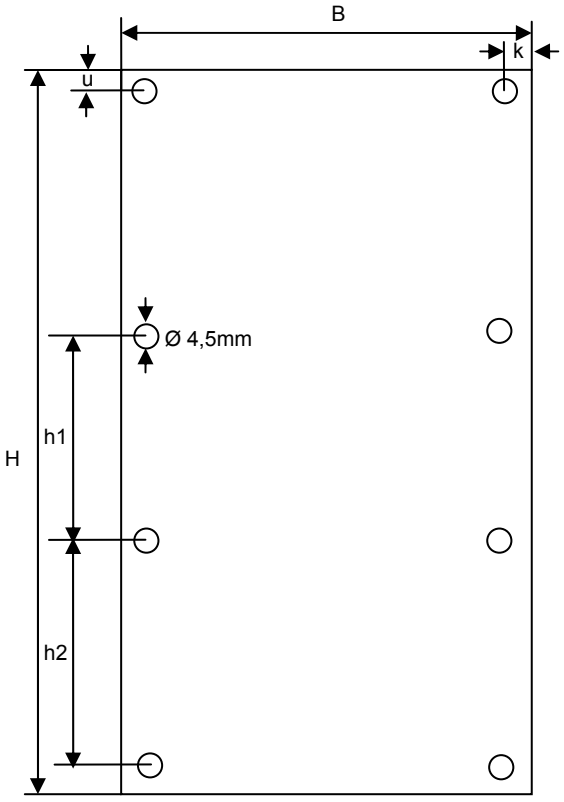
According to the size of the frequency inverter, the dimensions for the drilling pattern listed below must be observed.

Size	Height H	h1	h2	Width W	k	u	Depth of the Cold Plate
S1	182	91	-	95	5.5		10
S2	222	111	-				
S3	237	75.33	75.33	120			
S4	282	90.33	90.33				
All dimensions in [mm]							

Sizes 1 + 2



Sizes 3 + 4



2.4 External heat sink kit

The SK 500E series with ColdPlate technology (SK 5xxE-…-CP) can be extended with the external heat sink kit.

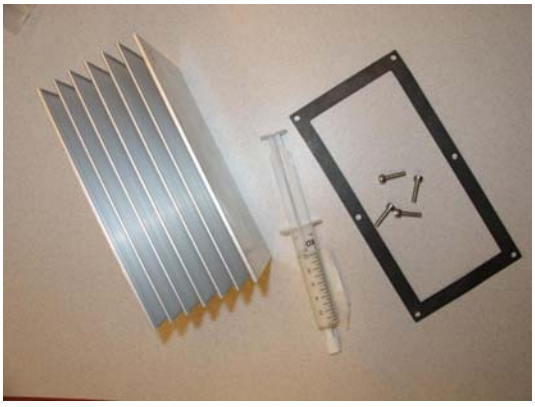
In this construction, the heat sink is outside of the control cabinet and therefore does not need a “suitable cooling surface”. The device is cooled by the external air.

This results in the following operating modes:

Option type	Size	Power [kW]	Operating mode
SK TH1-1 Mat. Nr. 275999050	S1	0.25 – 0.75	S1
SK TH1-2 Mat. Nr. 275999060	S2	1.1 – 1.5	S1

The external heat sink kit contains the following:

- Heat sink
- Gasket
- Heat-conducting paste
- 4 screws



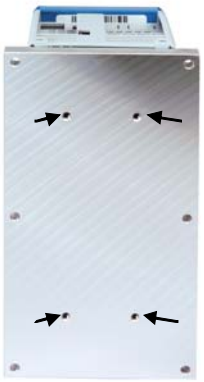
Please only use the parts supplied, in order to ensure safe operation.

2.4.1 Mounting the external heat sink kit:

Before installing the device, please make certain that the walls of the control cabinet can bear the load.

An opening in the wall of the control cabinet, with the dimensions of the supplied heat sink is necessary for the installation.

1. The heat-conducting paste must be applied to the SK 5xxE ColdPlate version.
2. The heat sink must be mounted on the frequency inverter using the screws supplied.



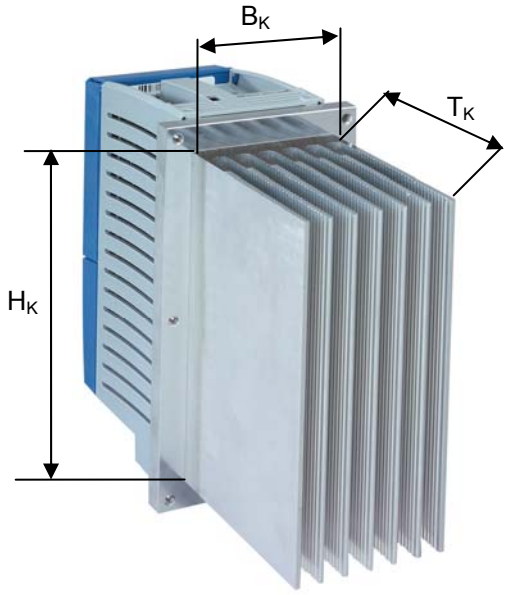
3. The screws must be tightened and any excess heat-conducting paste must be removed.
4. Place the seal between the frequency inverter and the wall of the control cabinet.
5. The assembled device is inserted through the opening in the wall of the control cabinet.
6. Fix the frequency inverter to the wall of the control cabinet with all of the screws.
   (Drilling template, see Section 2.3.2)

If correctly installed, the device is now ready for use.

NOTE: If correctly installed, protection (from outside) of max. IP54 exists.

2.4.2 Dimensions of external heat sink

Device type	Size	Heat sink dimensions			Cold-Plate dimensions			Weight approx. [kg]
		H_K	B_K	T_K	H	B	T	
SK 5xxE-250- … SK 5xxE-750- … **SK TH1-1**	S1	157	70	100	182	95	119	2.3
SK 5xxE-111- … SK 5xxE-221- … **SK TH1-2**	S2	200	70	110	222	95	119	3.4
All dimensions in [mm]								

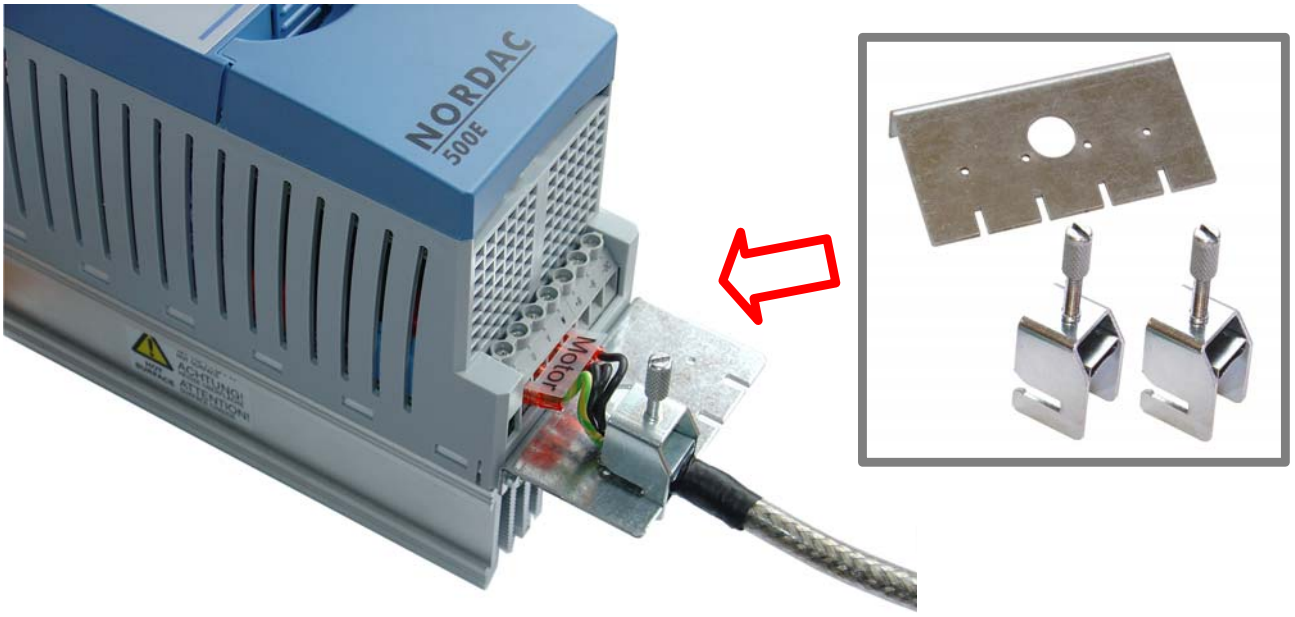


2.5 EMC- Kit

For optimum EMC-compliant wiring, the optional EMC Kit must be used. This includes a screening angle, two hammer clips and two fixing screws.

The EMC Kit provides the possibility of attaching the screening of the motor cable to a large surface of the frequency inverter (interference source). If necessary a screened brake resistor cable can be attached with the two hammer clips.

The screening angle is attached to the two housing screws on the lower edge (below the U-V-W terminals). The motor cable screening is earthed to a large area of the screening angle by means of the hammer clip.



Device type	Size	EMC- Kit
SK 5xxE-250- … SK 5xxE-750-	S1	**SK EMC 2-1** Mat. Nr. 275999011
SK 5xxE-111- … SK 5xxE-221-	S2	
SK 5xxE-301- … SK 5xxE-401-	S3	**SK EMC 2-2** Mat. Nr. 275999021
SK 5xxE-551-340- … SK 5xxE-751- 340-	S4	
SK 5xxE-551-323- … SK 5xxE-751- 323- SK 5xxE-112-340- … SK 5xxE-152- 340-	S5	**SK EMC 2-3** Mat. Nr. 275999031
SK 5xxE-112-323- SK 5xxE-182-340- … SK 5xxE-222- 340-	S6	**SK EMC 2-4** Mat. Nr. 275999041

Notes: The EMC Kit cannot be combined with ...-CP (ColdPlate) devices. Any cable screening must be earthed to a large area of the mounting surface.

If mounted on the top surface of the frequency inverter (mains connection side), the EMC Kit can also be used as a strain relief, for example to avoid contact problems with CANbus connections.

2.6 Brake resistor (BR)

During dynamic braking (frequency reduction) of a three phase motor, electrical energy is returned to the frequency inverter. In order to avoid an overvoltage switch-off of the frequency inverter, an external brake resistor can be used. With this, the integrated brake chopper (electronic switch) pulses the intermediate circuit voltage (switching wave approx. 420V/775V(/825V) DC, according to the mains voltage(115V, 230V/400V(/500V)) to the brake resistor. Here the excess energy is converted into heat.

CAUTION

The braking resistance and all other metal components can heat up to temperatures above 70°C.

When mounting, sufficient distance from neighbouring components must be maintained. When working on the components, allow sufficient cooling time beforehand

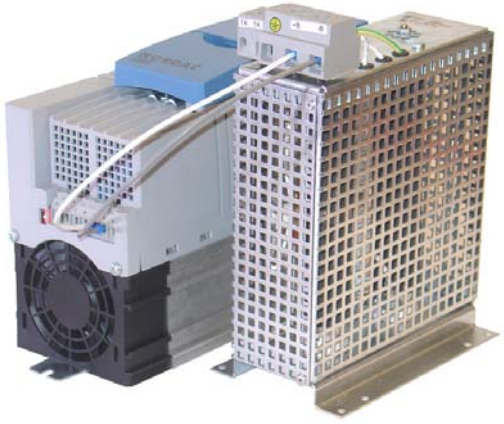
For inverter powers up to 2.2kW a standard bottom-mounted resistor (SK BR4-…IP40) can be used. This can additionally be equipped with an optional temperature switch (bi-metal, switching point 180°C), in order to indicate an overload. The fixing material in the side groove is enclosed. The resistor and the temperature switch are connected by means of flexible stranded conductors. Approval: UL, cUL

Note: Brake resistors cannot be directly mounted below –CP (ColdPlate) devices.

SK BR4-... Size 1

SK BR4-... Size 2

Chassis resistors (SK BR2-…, IP20) are available for frequency inverters from 3kW to 22kW. These must be mounted in the control cabinet, close to the frequency inverter. There is a temperature switch on the braking resistor to provide protection against overload. Connection of the resistor and the temperature switch is by means of screw terminals. Approval: UL, cUL



SK BR2-... Size 3

SK BR2-... Size 4 … 6

2.6.1 Electrical data BR

Inverter type	Resistor type	Resistance	Continuous rating	Energy consumption	Connecting cable / terminals
SK 5xxE-250-112-O … SK 5xxE-370-112-O	SK BR4-240/100 Mat. Nr. 275991110	240 Ω	100 W	1.0 kWs	2 x 1.9mm² AWG 14/19 L = 0.5m
SK 5xxE-550-112-O … SK 5xxE-750-112-O	SK BR4-150/100 Mat. Nr. 275991115	150 Ω	100 W	1.0 kWs	
SK 5xxE-250-323-A … SK 5xxE-370-323-A	SK BR4-240/100 Mat. Nr. 275991110	240 Ω	100 W	1.0 kWs	2 x 1.9mm² AWG 14/19 L = 0.5m
SK 5xxE-550-323-A … SK 5xxE-750-323-A	SK BR4-150/100 Mat. Nr. 275991115	150 Ω	100 W	1.0 kWs	
SK 5xxE-111-323-A … SK 5xxE-221-323-A	SK BR4- 75/200 Mat. Nr. 275991120	75 Ω	200 W	4.0 kWs	
SK 5xxE-301-323-A … SK 5xxE-401-323-A	SK BR2- 35/400-C Mat. Nr. 278282045	35 Ω	400 W	6.0 kWs	2 x 10mm²
SK 5xxE-551-323-A … SK 5xxE-751-323-A	in preparation				2 x 10mm²
SK 5xxE-112-323-A	in preparation				2 x 10mm²
SK 5xxE-550-340-A … SK 5xxE-750-340-A	SK BR4-400/100 Mat. Nr. 275991210	400 Ω	100 W	0.75 kWs	2 x 1.9mm² AWG 14/19 L = 0.5m
SK 5xxE-111-340-A … SK 5xxE-221-340-A	SK BR4-220/200 Mat. Nr. 275991220	220 Ω	200 W	4.0 kWs	
SK 5xxE-301-340-A … SK 5xxE-401-340-A	SK BR2-100/400-C Mat. Nr. 278282040	100 Ω	400 W	6.0 kWs	2 x 10mm²
SK 5xxE-551-340-A … SK 5xxE-751-340-A	SK BR2- 60/600-C Mat. Nr. 278282060	60 Ω	600 W	7.5 kWs	
SK 5xxE-112-340-A … SK 5xxE-152-340-A	SK BR2- 30/1500-C Mat. Nr. 278282150	30 Ω	1500 W	20 kWs	2 x 10mm²
SK 5xxE-182-340-A … SK 5xxE-222-340-A	SK BR2- 22/2200-C Mat. Nr. 278282220	22 Ω	2200 W	28 kWs	2 x 10mm²

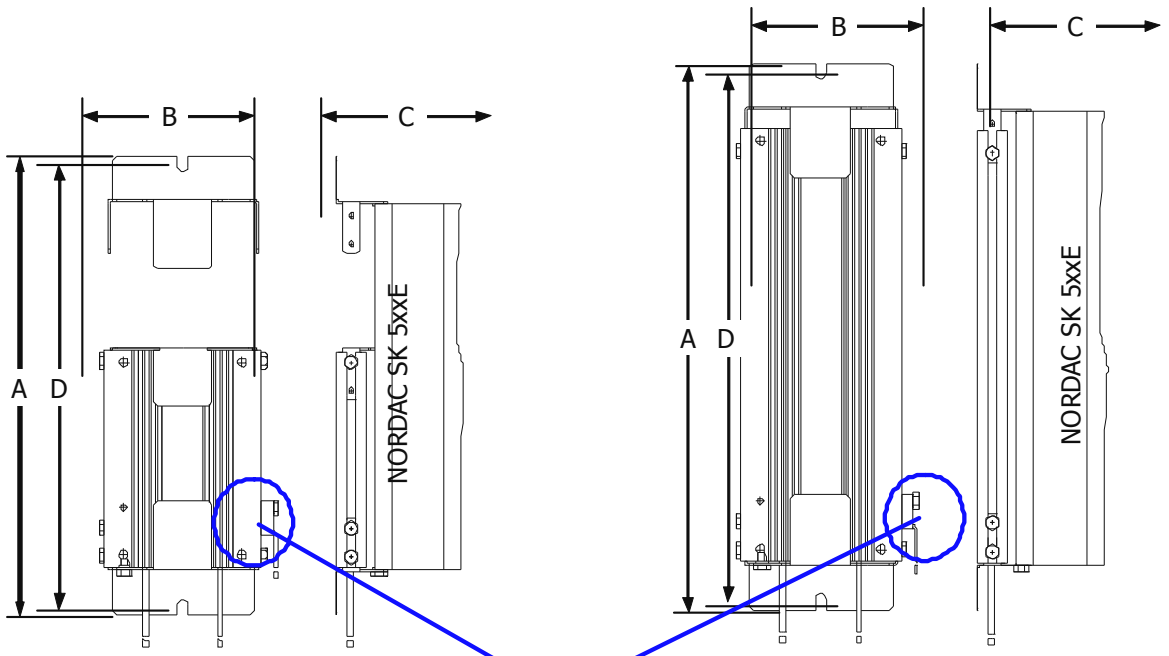
*) Maximum once within 120s

Bi-metal temperature switch

	Protection class	Voltage	Current	Dimensions	Connecting cable/ terminals
SK BR4-...	IP40	250Vac	2,5A at cosφ=1 1,6A at cosφ=0.6	Width +10mm (one side)	Flexible strand, 2 x 0.8mm² AWG 18 L = 0.5m
SK BR2-...	IP00	250Vac 125Vac 30Vdc	10A 15A 5A	internal	Terminals 2 x 4mm²

2.6.2 Dimensions bottom-mounted BR

Resistor type	Size	A	B	C	Fixing dimensions	
					D	∅
SK BR4-240/100 **SK BR4-150/100** **SK BR4-400/100**	S 1	230	88	175	220	5.5
SK BR4- 75/200 **SK BR4-220/200**	S 2	270	88	175	260	5.5
C = instalment depth of the frequency inverter + bottom-mounted BR					all measurements in mm	



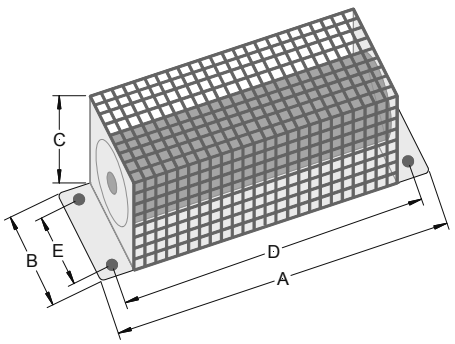
SK BR4-... Size 1

SK BR4-... Size 2

Optional temperature switch

2.6.3 Dimensions Chassis BR

Resistor type	A	B	C	Fixing dimensions		
				D	E	∅
SK BR2-100/400-C	170	100	240	150	90	4.3
SK BR2- 35/400-C						
SK BR2- 60/600-C	350	92	120	325	78	6.5
SK BR2- 30/1500-C	560	185	120	530	150	6.5
SK BR2- 22/2200-C	460	270	120	430	240	6.5
All measurements in mm						



SK BR2-... Size 3 … 6
(schematic diagram, the design varies according to power)

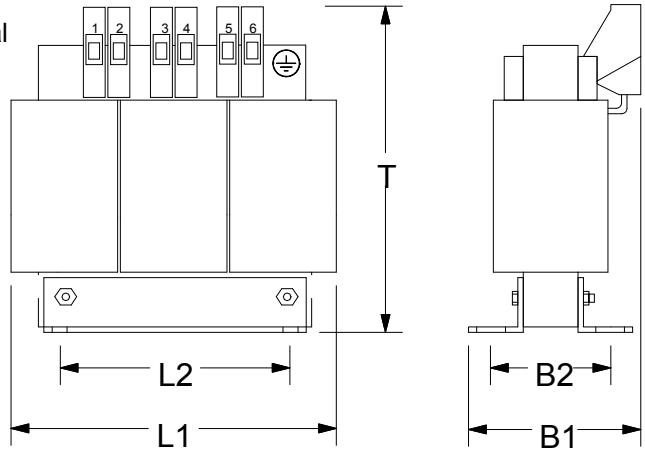
2.7 Line choke (accessory)

To reduce input side current harmonics, additional inductivity can be installed into the line supply to the inverter.

These chokes are specified for a maximum supply voltage of 230V or 480V at 50/60 Hz.

The protection class of the chokes is IP00 and they must therefore be installed in a control cabinet.

For frequency inverters with **an output of 45 kW or more**, a line choke is recommended where several devices are being used, in order to avoid possible adverse effects of one device on another. In addition, the charging currents (mains voltage fluctuations) are significantly reduced.



Inverter type NORDAC SK 500E	Input choke 1 x 220 - 240 V			L1	B1	T	Detail: mounting			Connections
	Type	Continuous current	Inductance				L2	B2	Mounting	
0.25 ... 0.75 kW	SK CI1-230/8-C Mat. No.: 278999030	8 A	2 x 1.0 mH	78	65	89	56	40	M4	4
1.1 ... 2.2 kW	SK CI1-230/20-C Mat. No.: 278999040	20 A	2 x 0.4 mH	96	90	106	84	65	M6	10
All dimensions in [mm]										[mm^2]

Inverter type NORDAC SK 500E	Input choke 3 x 200 - 240 V			L1	B1	T	Detail: mounting			Connections
	Type	Continuous current	Inductance				L2	B2	Mounting	
0.25 ... 0.75 kW	SK CI1-460/6-C Mat. - Nr.: 276995004	6 A	3 x 4.88 mH	125	95	140	100	55	M5	4
1.1 ... 1.5 kW	SK CI1-460/11-C Mat. - Nr.: 276995010	11 A	3 x 2.93 mH	155	95	160	130	56.5	M8	4
2.2 … 3.0 kW	SK CI1-460/20-C Mat. - Nr.: 276995020	20 A	3 x 1.47 mH	185	102	201	170	57.5	M6	10
4.0 … 7.5 kW	SK CI1-460/40-C Mat. - Nr.: 276995040	40 A	3 x 0.73 mH	190	122	201	170	77.5	M6	10
11.0. kW	SK CI1-460/70-C Mat. - Nr.: 276995070	70 A	3 x 0.47 mH	230	125	260	180	98	M6	35
All dimensions in [mm]										[mm^2]

Inverter type NORDAC SK 500E	Input choke 3 x 380 - 480 V			L1	B1	T	Detail: mounting			Connections
	Type	Continuous current	Inductance				L2	B2	Mounting	
0.75 ... 2.2 kW	SK CI1-460/6-C Mat. - Nr.: 276995004	6 A	3 x 4.88 mH	125	95	140	100	55	M5	4
3.0 ... 4.0 kW	SK CI1-460/11-C Mat. - Nr.: 276995010	11 A	3 x 2.93 mH	155	95	160	130	56.5	M8	4
5.5 ... 7.5 kW	SK CI1-460/20-C Mat. - Nr.: 276995020	20 A	3 x 1.47 mH	185	102	201	170	57.5	M6	10
11 ... 15 kW	SK CI1-460/40-C Mat. - Nr.: 276995040	40 A	3 x 0.73 mH	190	122	201	170	77.5	M6	10
18.5 ... 22 kW	SK CI1-460/70-C Mat. - Nr.: 276995070	70 A	3 x 0.47 mH	230	125	260	180	98	M6	35
All dimensions in [mm]										[mm^2]

2.8 Output choke (accessories)

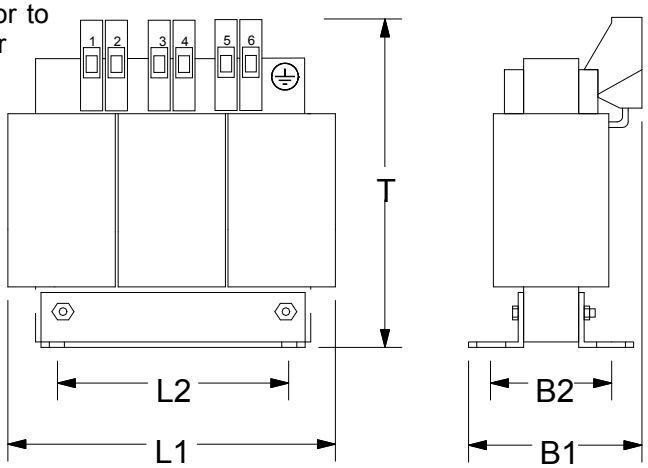
To reduce interference signals from the motor cable or to compensate for cable capacitance in long motor cables, an additional output choke can be installed into the inverter output.

Take care during installation that the pulse frequency of the frequency inverter is set to 3-6 kHz (P504 = 3-6).

These chokes are specified for a maximum supply voltage of 480V at 0-100 Hz.

An output choke should be fitted for cable lengths over **100m/30m** (unshielded/shielded). Further details can be found in Section 2.10.4 "Motor cable".

The protection class of the chokes is IP00 and they must therefore be installed in a control cabinet.



Inverter type NORDAC SK 500E	Output choke 3 x200 – 240V			L1	B1	T	Detail: mounting			Connections
	Type	Continuous current	Inductance				L2	B2	Mounting	
0.25 …0.75 kW	SK CO1-460/4-C Mat. - Nr.: 276996004	4 A	3 x 3.5 mH	120	104	140	84	75	M6	4
1.1 ... 1.5 kW	SK CO1-460/9-C Mat. - Nr.: 276996009	9 A	3 x 2.5 mH	155	110	160	130	71.5	M6	4
2.2 ... 3.0 kW	SK CO1-460/17-C Mat. - Nr.: 276996017	17 A	3 x 1.2 mH	185	102	201	170	57.5	M6	10
4 ... 7.5 kW	SK CO1-460/33-C Mat. - Nr.: 276996033	33 A	3 x 0.6 mH	185	122	201	170	77.5	M6	10
11kW	SK CO1-460/60-C Mat. - Nr.: 276996060	60 A	3 x 0.33 mH	230	125	260	176	71	M6	35
All dimensions in [mm]										[mm^2]

Inverter type NORDAC SK 500E	Output choke 3 x 380 - 460V			L1	B1	T	Detail: mounting			Connections
	Type	Continuous current	Inductance				L2	B2	Mounting	
0.55 ... 4.0 kW	SK CO1-460/9-C Mat. - Nr.: 276996009	9 A	3 x 2.5 mH	155	110	160	130	71.5	M6	4
5.5 ... 7.5 kW	SK CO1-460/17-C Mat. - Nr.: 276996017	17 A	3 x 1.2 mH	185	102	201	170	57.5	M6	10
11 ... 15 kW	SK CO1-460/33-C Mat. - Nr.: 276996033	33 A	3 x 0.6 mH	185	122	201	170	77.5	M6	10
18.5 ... 22 kW	SK CO1-460/60-C Mat. - Nr.: 276996060	60 A	3 x 0.33 mH	230	125	260	176	71	M6	35
All dimensions in [mm]										[mm^2]

2.9 Wiring guidelines

The frequency inverter has been developed for use in an industrial environment. In this environment, high levels of electromagnetic interference can influence the frequency inverter. In general, correct installation ensures safe and problem-free operation. To meet the limit values of the EMC directives, the following instructions should be complied with.

(1) Ensure that all equipment in the control cabinet is securely earthed using short earthing cables that have large cross-sections and which are connected to a common earthing point or earthing bar. It is especially important that every control device connected to the frequency inverters (e.g. an automation device) is connected, using a short cable with large cross-section, to the same earthing point as the inverter itself. Flat conductors (e.g. metal clamps are preferable, as they have a lower impedance at high frequencies.

(2) The bonding cable of the motor controlled by the frequency inverter should be connected directly to the earthing terminal of the associated frequency inverter. The presence of a central earthing bar in the control cabinet and the grouping together of all bonding conductors to this bar normally ensures safe operation. (See also Section. 8.3/8.4 EMC)

(3) Where possible, screened cables should be used for control loops. The shielding at the cable end should be carefully sealed and it must be ensured that the wires are not laid over longer distances without shielding.

The shields of analog setpoint cables should only be earthed on one side on the frequency inverter.

(4) The control cables should be installed as far as possible from power cables, using separate cable ducts etc. Where cables cross, an angle of 90° should be ensured as far as possible.

(5) Ensure that the contactors in the cabinet are interference protected, either by RC circuits in the case of AC contactors or by free-wheeling diodes for DC contactors, **for which the interference traps must be positioned on the contactor coils**. Varistors for over-voltage limitation are also effective. This interference suppression is particularly important when the contactors are controlled by the relay in the frequency inverter.

(6) Use screened or armoured cable for the load connections (motor cable) and earth the screening/armour at both ends. If possible, earthing should be made directly to the electrically conducting mounting plate of the control cabinet or the screening angle of the EMC Kit (Section 2.4).

In addition, an *EMC-compliant cabling* must be ensured. (see also Section 8.3/8.4 EMC). If required, an optional output choke can be supplied.

The safety regulations must be complied with under all circumstances when installing the frequency inverter!

NOTE

The control cables, line cables and motor cables must be laid separately. In no case should they be laid in the same protective pipes/installation ducts.

The test equipment for high voltage insulations must not be used on cables that are connected to the frequency inverter.

2.10 Electrical connection

WARNING

THESE DEVICES MUST BE EARTHED.

Safe operation of the devices presupposes that qualified personnel mount and operate it in compliance with the instructions provided in these operating instructions.

In particular, the general and regional mounting and safety regulations for work on high voltage systems (e.g. VDE) must be complied with as must the regulations concerning professional use of tools and the use of personal protection equipment.

Dangerous voltages can be present at the motor connection terminals even when the inverter is switched off. Always use insulated screwdrivers on these terminal fields.

Ensure that the input voltage source is not live before setting up or changing connections to the unit.

Make sure that the inverter and motor have the correct supply voltage set.

2.11 Electrical connection of power unit

The terminals of the mains connection and the multi-function relay (X3) are located on the top of the frequency inverter.

The motor and brake resistor connections are located on the base of the unit.

The control terminals can be accessed from the front of the frequency inverter. For this the terminal cover (below the TU insert) must be pushed downwards, and can then be removed. The connecting terminals are then easily accessible.

Before connecting the device,
the following must be observed:

1. Ensure that the voltage source provides the correct voltage and is suitable for the current required (see Section. 7 Technical data).
2. Ensure that suitable circuit breakers with the specified nominal current range are installed between the voltage source and the inverter.
3. Connect the line voltage directly to the line terminals **L_1-L_2/N-L_3 and the earth** (according to the device).
4. A four-core cable must be used to connect the motor. The cable is connected to the motor terminals **U - V - W and the earth.**
5. If screened motor cables (recommended) are used, the cable screening must also be connected to a large area of the metallic screening angle of the EMC Kit (Section 2.5), however, at least to the electrically conducting mounting surface of the control cabinet.

NOTE: When using specific **wiring sleeves**, the maximum connection cross-section can be reduced.

To connect the power unit, the following **screwdrivers** must be used:

Size	**Screwdriver**	
Frequency Inverter	**Type**	**Size**
Size 1 - 4	Cross-head	Pozidrive/Supadrive size: 1
S 5	Slot-head	0.6 x 3.5
S 6	Slot-head	1.0 x 6.5

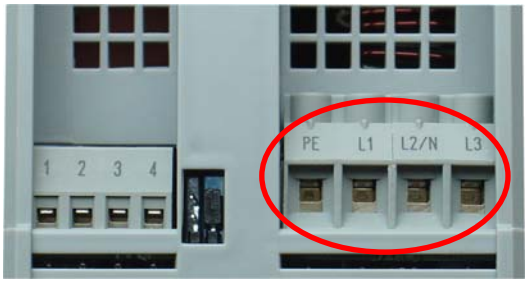
NOTE: If synchronising devices or several motors are connected in parallel, the frequency inverter must be switched over to linear voltage/frequency characteristic curves, → P211 = 0 and P212 = 0.

NOTE: **T**he use of shielded cables is essential in order to maintain the specified radio interference suppression level. (See also Chapter 8.4 EMC limit value classes)

ATTENTION

This device produces high frequency interference, which may make additional suppression measures necessary in **domestic environments.** (Details in Section 8.3/8.4)

2.11.1 Mains supply (X1-PE, L1, L2/N, L3)



No special safety measures are required on the mains input side of the frequency inverter. It is advisable to use the normal mains fuses (see technical data) and a main switch or circuit breaker.

115V devices of 0.25kW to 0.75kW may only be used with a 110…120V (L/N = L1/L2) single phase supply.

230V devices of 0.25kW to 2.2kW may optionally be operated with single phase 230V (L/N = L1/L2) or three phase (L1/L2/L3) supplies, however, not with three-phase 400V!

All 400V devices and devices ≥ 3kW may only be operated with a three-phase supply (L1/L2/L3). For the exact specification, please refer to the technical data in Section 7.

Note: The use of this frequency inverter on an **IT network** is possible after modifications by means of jumpers. Further details in Section 2.11.9 - 2.11.10.

Connection data:

Frequency Inverter	**Size 1 ... 4**	**Size 5**	**Size 6**
Rigid cable cross-section	0.2 … 6mm²	0.5 … 16mm²	0.5 … 35mm²
Flexible cable cross-section	0.2 … 4mm²	0.5 … 10mm²	0.5 … 25mm²
AWG standard	AWG 24-10	AWG 20-6	AWG 20-2
Tightening torque for screw terminals	0.5 … 0.6Nm	1.2 … 1.5Nm	2.5 … 4.5Nm

2.11.2 Multi-function relay (X3 – 1, 2, 3, 4)

The functions of this relay can be set as required using the parameters P434 to P443. The contacts may only be operated with a maximum of 230V AC / 24V DC, 2A.

In the default setting, the terminals 1-2 (output 1, P434) can control a mechanical motor brake. This is then released or applied at the correct time. To optimise the process, the appropriate delay times (0.2 – 0.3 sec) should be set in the parameters P107/P114.

In the default setting, the closed contact on terminals 3-4 (output 2, P441) reports the readiness of the frequency inverter. If there is an error message or the frequency inverter is without voltage, this contact is open.

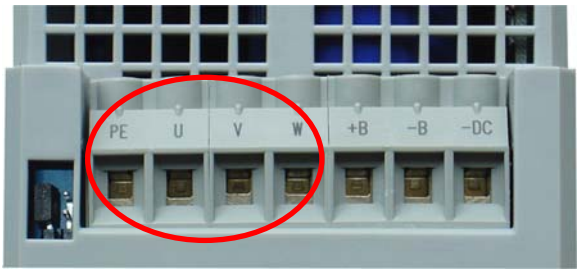
Connection data:

Frequency Inverter	**Size** 1 ... 4	**Size** 5 … 6
Rigid cable cross-section	0.14 … 2.5mm²	0.2…6mm²
Flexible cable cross-section	0.14 … 1.5mm²	0.2…4mm²
AWG standard	AWG 26-14	AWG 24-10
Tightening torque for screw terminals	0.5…0.6Nm	0.5…0.6Nm

2.11.3 Motor cable (X2 - U, V, W, earth)

The motor cable may have a **total length of 100m** if this is a standard cable. If a screened motor cable is used, or if the cable is laid in a metal conduit which is well earthed, **the total length should not exceed 30m.**

For greater lengths of cable, an additional output choke (accessory) must be used.



Note: Please also observe Section 8.4 EMC limit value classes.

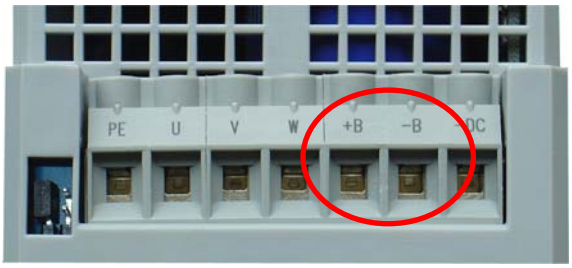
Note: For multiple motor use the total cable length consists of the sum of the individual cable lengths.

Connection data:

Frequency Inverter	Size 1 ... 4	Size 5	Size 6
Rigid cable cross-section	0.2 … 6mm²	0.5 … 16mm²	0.5 … 35mm²
Flexible cable cross-section	0.2 … 4mm²	0.5 … 10mm²	0.5 … 25mm²
AWG standard	AWG 24-10	AWG 20-6	AWG 20-2
Tightening torque for screw terminals	0.5 … 0.6Nm	1.2 … 1.5Nm	2.5 … 4.5Nm

2.11.4 Braking resistor connection (X2 - +B, -B)

The terminals +B/ -B are intended for the connection of a suitable braking resistor. A short screened connection should be selected.



Note: The great production of heat in the braking resistor must be taken into account.

Note: For devices with 115V mains voltage, no DC terminal is provided.

Attention: The terminals **+B, -DC** are suitable for the DC-coupling of several frequency inverters. Never connect a braking resistor to DC! For further details of DC-coupling, please refer to Section 2.11.8.

Connection data:

Frequency Inverter	Size 1 ... 4	Size 5	Size 6
Rigid cable cross-section	0.2 … 6mm²	0.5 … 16mm²	0.5 … 35mm²
Flexible cable cross-section	0.2 … 4mm²	0.5 … 10mm²	0.5 … 25mm²
AWG standard	AWG 24-10	AWG 20-6	AWG 20-2
Tightening torque for screw terminals	0.5 … 0.6Nm	1.2 … 1.5Nm	2.5 … 4.5Nm

2.11.5 Motor – PTC connection (X13 – T1, T2) (size 5 and above)

(As per EN 60947-8)

For size 5 and 6 devices, the connection of the motor thermistor is made via terminals T1 and T2. For smaller sizes of inverter (S 1—4) the thermistor must be connected to digital input 5 (DIN5) on plug block X5 (See section 2.12 “Electrical connection of the control unit”).

Anschlussdaten:

Frequency Inverter	Size 5 … 6
Rigid cable cross-section	0.2…6mm²
Flexible cable cross-section	0.2…4mm²
AWG standard	AWG 24-10
Tightening torque for screw terminals	0.5…0.6Nm
Nominal Ratings	
Triggering value	> 3.6 kΩ
Relapse value	> 1.65 kΩ
Measuring voltage	5V to R < 4 kΩ

2.11.6 External control voltage, 24 V supply (X12 – 44, 40) (Size 5 and above)

Size 5 and 6 frequency inverters are equipped with both an internal switched mains unit for the provision of the control voltage, as well as a separate terminal block for connection to an external low voltage supply. Switchover between the internal and external power supply is carried out automatically. Incorrect connections **must** be avoided.

Size 1 – 4 SK5x5E devices are not equipped with an internal mains unit. This means that in order to provide their function, these units must be connected to an external power supply via terminal block X5:44 / X5:40. For further information, please refer to Section 2.12.

Connection data:

Frequency Inverter	Size 5 … 6
Rigid cable cross-section	0.2…6mm²
Flexible cable cross-section	0.2…4mm²
AWG standard	AWG 24-10
Tightening torque for screw terminals	0.5…0.6Nm
Nominal Ratings	
Terminal X12:44 (input)	+24 … 30V (min 1000mA)
Terminal X12:40	GND

2.11.7 Safe pulse block 24 V (X8 - 86, 87, 89, 88)

Series SK 51xE and SK 53xE frequency inverters are equipped with the option “Functional safety” (See supplementary operating instruction BU 0530). Connection of the corresponding control cables is made via terminal block X8. Up to and including size 4, this terminal block is located under the front cover (See Section 2.12.1 “Terminal blocks”). From size 5 and above, the terminal block X8 is located on the underside of the frequency inverter (motor output side).

Connection data:

Frequency Inverter	**Size 5 … 6**
Rigid cable cross-section	0.2…6mm²
Flexible cable cross-section	0.2…4mm²
AWG standard	AWG 24-10
Tightening torque for screw terminals	0.5…0.6Nm
Nominal Ratings	
Terminal X8:86 (output: +24V supply)	+24 V (max. 300mA)
Terminal X8:87	GND
Terminal X8:89 (Input: “Safe pulse block”	+24 V ± 25% (max. 100mA)
Terminal X8:88	GND

(As supplied, for commissioning without safety switching device, terminals 87-88 and 86-89 are bridged. In order to be able to use the safety function, the bridges must be removed.)

(For further details, see the separate instruction BU 0530 “Functional safety”)

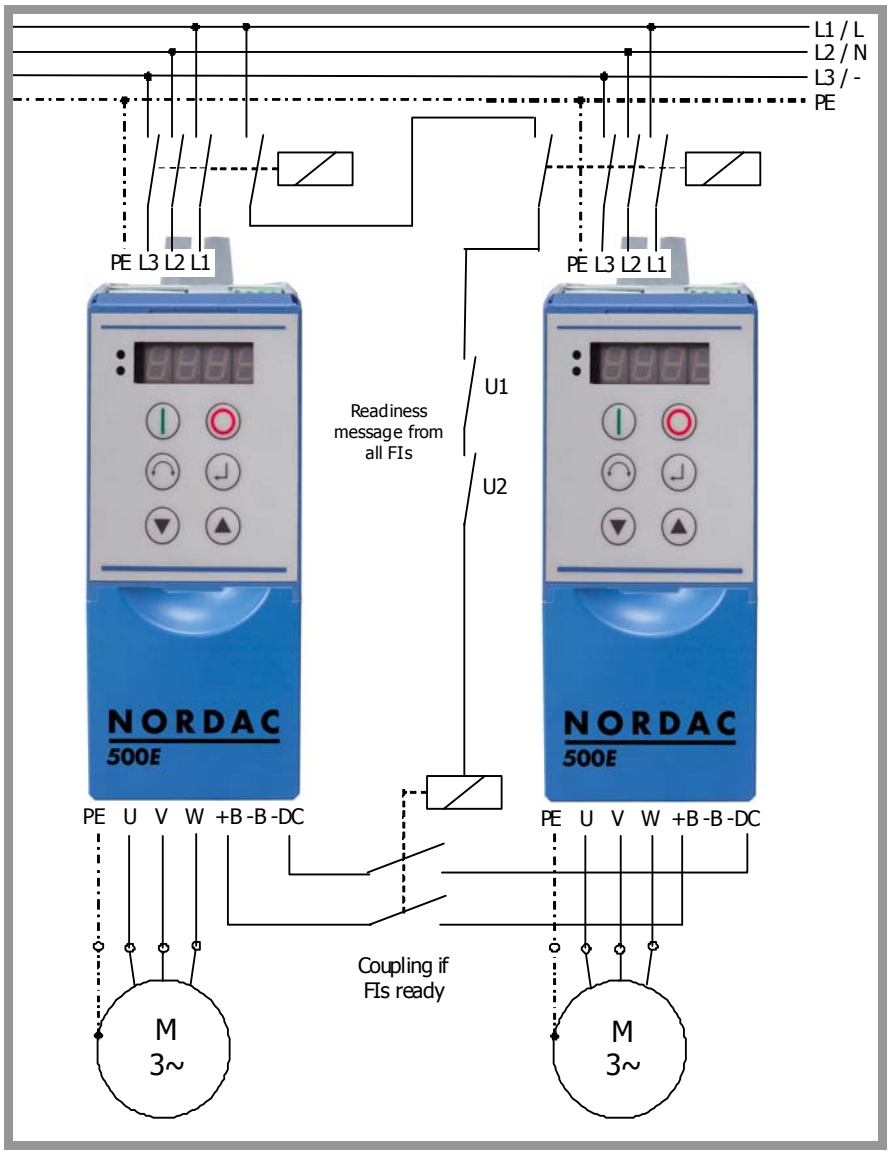
2.11.8 DC-coupling (X2 - +B, -DC)

In drive engineering, DC-coupling is advisable if motors act as drivers and generators at the same time in the system. Here, the energy from the drive which is acting as a generator can be fed back to the drive which is acting as a motor. The advantages are lower energy consumption and the sparing use of braking resistors.

Note: In the 115V devices (SK 5xx-xxx-112-O, no DC terminal is provided. DC-coupling is therefore not possible.

NB: For direct current coupling of single-phase devices, care must be taken that the coupling to the same external conductor is used.

Diagram of a DC-coupling:



The following points must be taken into account:

(1) Use a connecting cable between the equipment (two devices), which is as short as possible. If different sizes of frequency inverter are used, the connection in the DC circuit must be made with the maximum cross-section of the smaller device.

(2) Each device is provided with its own mains supply.

(3) Ensure that the coupling is only made after readiness is reported. Otherwise, there is a danger that all the frequency inverters will be charged via a single device.

(4) Ensure that the coupling is disconnected as soon as one of the devices is no longer ready for operation.

(5) For a high availability a braking resistor (possibly lower power) must be used. If different sizes of frequency inverters are used, the braking resistor must be connected to the larger of the two frequency inverters.

(6) If devices with the same rating (identical type) are coupled, and the same mains impedances are in effect (identical lengths of cable to the mains rail), the frequency inverters may be operated without mains chokes. Otherwise a mains choke must be installed in the mains cable of each frequency inverter.

2.11.9 Jumper “A” mains input

In order to make the frequency inverter SK 500E suitable for IT networks this jumper must be set to position 0.

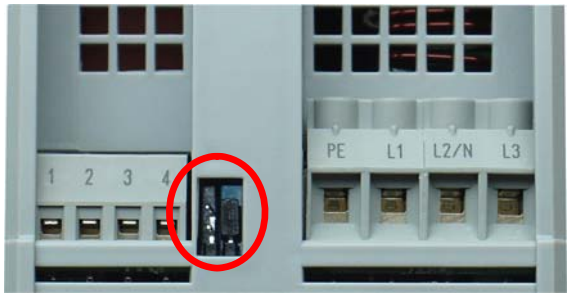
Here it must be noted that the specified degree of radio interference suppression changes. Further details can be found in Section 8.3. EMC.

Size 1 - 4

= **Operation in IT network** = Position 0

= normal position = Position 2

Top side of device



Size 5 - 6

= **Operation in IT network** = Position 0

= normal position = Position 2

Top side of device

2.11.10 Jumper “B” motor output

This jumper makes the device suitable for IT networks or reduces the leakage current of the frequency inverter to earth. This may be necessary of several frequency inverters are operated via a single FI circuit breaker.

Here it must be noted that the specified degree of radio interference suppression changes. Further details can be found in Section 8.3. EMC.

Size 1 - 4

= **Operation in IT network** = Position 0

= normal position = Position 1

= reduced leakage current – Position 2

(The set pulse frequency (P504) only has a slight influence on the leakage current.)

Underside of the device

Size 5 - 6

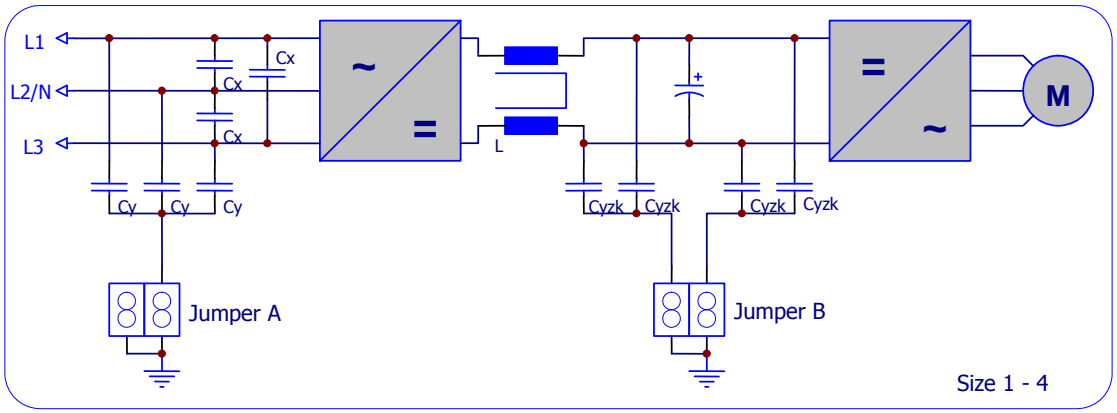
= **Operation in IT network** = Position 0

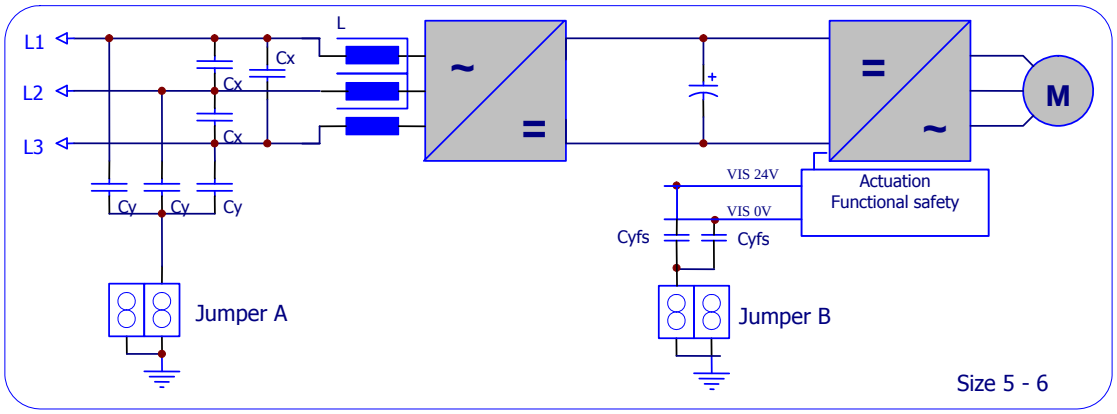
= normal position = Position 1

Underside of the device

2.11.11 Internal jumper switching

As delivered, the jumpers are set in the “normal position”. With this, the mains filter has its normal effect and leakage current.





Summery of operating modes

Frequency Inverter	Jumper A	Jumper B	Comments	Leakage Current
Size 1 - 4	Position 0	Position 0	Operation in IT network	Not applicable
Size 1 - 4	Position 2	Position 1	Large filtering effect (See Section 8.4)	<30 mA
Size 1 - 4	Position 2	Position 2	Limited filtering effect (See Section 8.4)	<< 30mA > 3.5mA
Size 5 - 6	Position 0	Position 0	Operation in IT network	Not applicable
Size 5 - 6	Position 2	Position 1	Large filtering effect (See Section 8.4)	<3.5 mA (Low leakage current, as per EN50178)

2.12 Electrical connection of the control unit

The control terminals are on the front cover of the frequency inverter. The equipment differs according to the version (SK 500E / 505E / 510E / 511E/ 515E/ 520E / 530E / 535E) and size (S 1-4 or S 5-6).

Connection terminals:	Plugs, terminals and connectors can be released with a small screwdriver.
Cable cross-section:	0.14 ... 1.5mm ^{2}, AWG 26-16, stiff or flexible
Control cable:	Lay and shield separately from the mains/motor cables.

Series / Size	Control Voltage	Voltage	max. Load / Comments
SK 5X0E / S 1-4	INTERNAL (OUTPUT)	5V ± 20% 10V 15V ± 20%	250MA 5MA, REFERENCE VOLTAGE FOR AN EXTERNAL POTENTIOMETER 150MA TO SUPPLY THE DIGITAL INPUTS OR A 10-30V INCREMENTAL ENCODER
	ANALOGUE OUTPUT	0…10V	5MA ANALOG OR 20MA DIGITAL
	DIGITAL OUTPUT	15V ± 20%	20MA
SK 5X5E / S 1-4	INTERNAL (OUTPUT)	5V ± 20% 10V 18…30V CORRESPONDING TO EXTERNAL CONTROL VOLTAGE	250MA 5MA, REFERENCE VOLTAGE FOR AN EXTERNAL POTENTIOMETER 150MA TO SUPPLY THE DIGITAL INPUTS OR A 10-30V INCREMENTAL ENCODER
	ANALOGUE OUTPUT	0…10V	5MA ANALOG OR 20MA DIGITAL
	DIGITAL OUTPUT	18…30V CORRESPONDING TO EXTERNAL CONTROL VOLTAGE	20MA
	EXTERNAL (SUPPLY)	18…30V	800MA MIN. FOR THE SUPPLY OF THE FREQUENCY INVERTER CONTROL UNIT
SK 5X5E / S 5-6	INTERNAL (OUTPUT)	5V ± 20% 10V 24V± 25%	250MA 5MA, REFERENCE VOLTAGE FOR AN EXTERNAL POTENTIOMETER 200MA TO SUPPLY THE DIGITAL INPUTS OR A 10-30V INCREMENTAL ENCODER
	ANALOGUE OUTPUT	0…10V	5MA ANALOG OR 20MA DIGITAL
	DIGITAL OUTPUT	24V ± 25%	200MA
	EXTERNAL (SUPPLY)	24V…30V	1,000MA MIN. FOR THE SUPPLY OF THE FREQUENCY INVERTER CONTROL UNIT

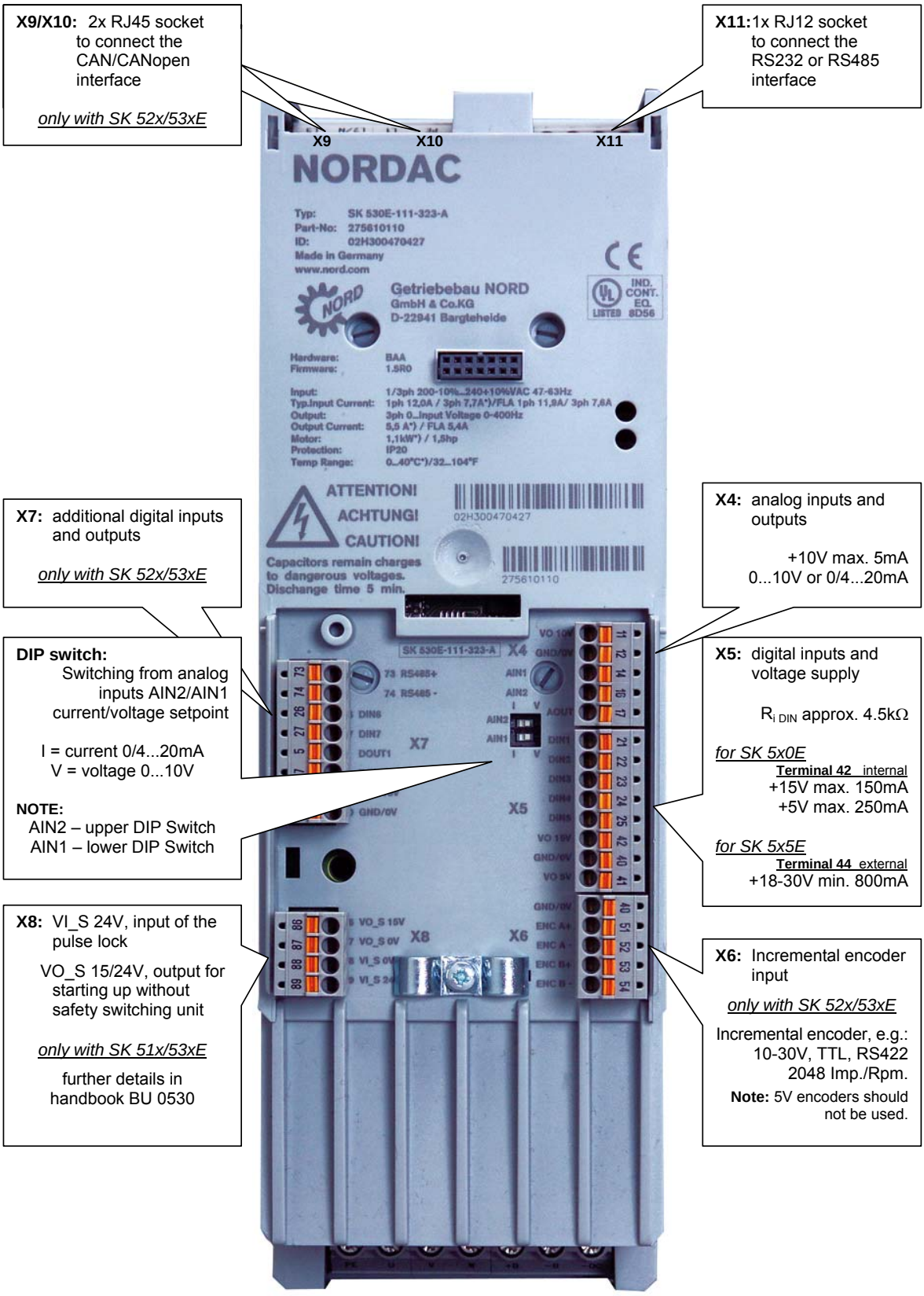
NOTE

GND/0V is a common reference potential for analogue and digital inputs.

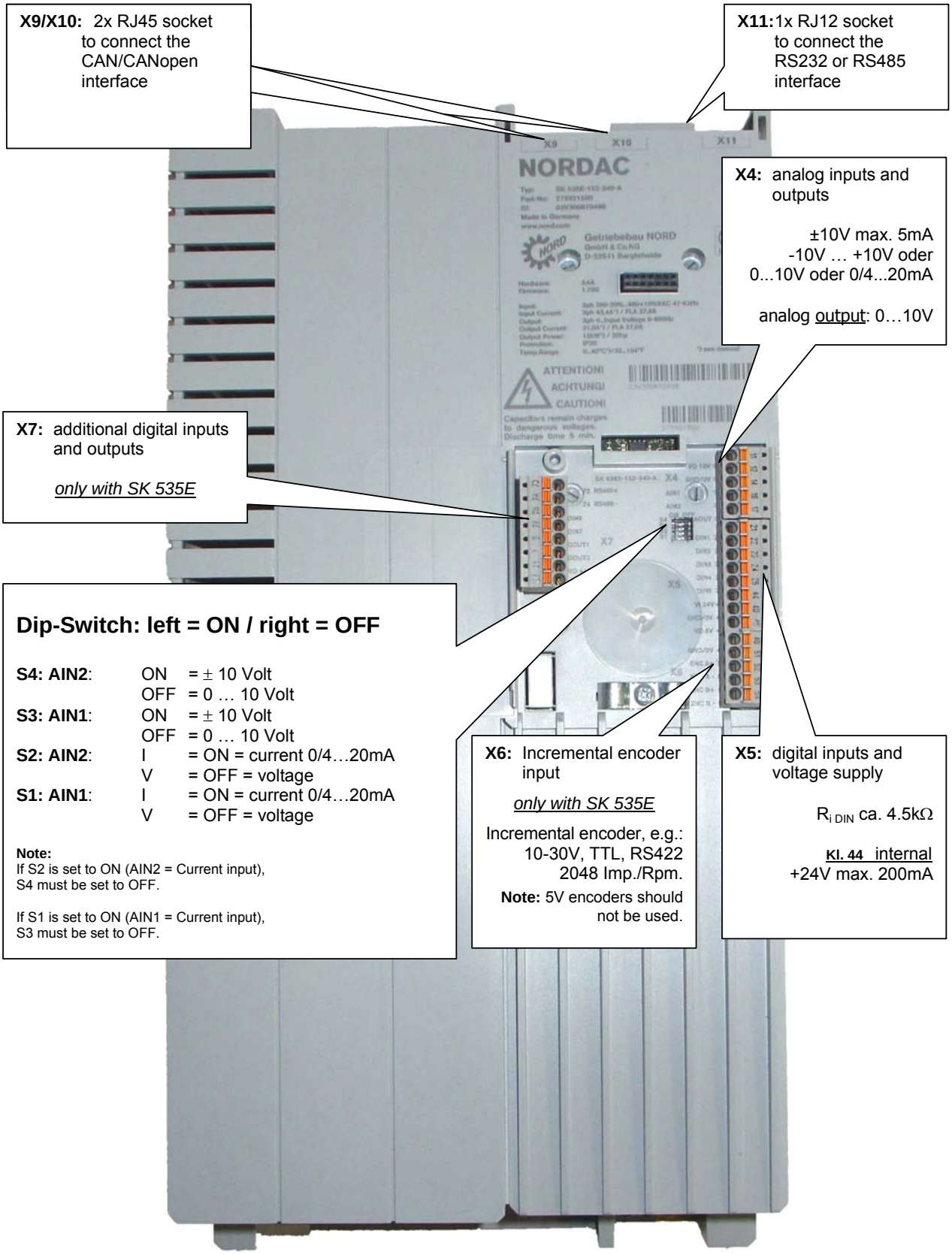
5V / 15V (24V) can be collected by several terminals if required. For Sizes 1-4, the output currents must not exceed 250mA/150mA (5V/15V) For Sizes 5 – 6 the limiting values are 250mA/200mA.

2.12.1 Terminal blocks

Size 1 to 4 devices (S 1 – 4)

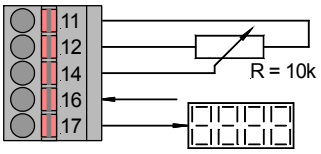


Size 5 to 6 devices (S 5 – 6)

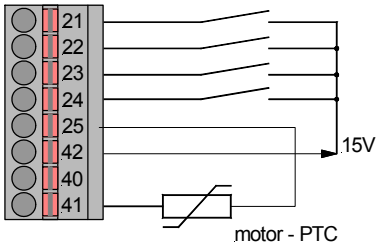


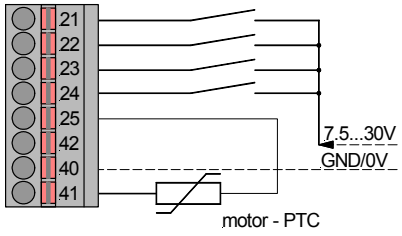
2.12.2 Details of the SK 5x0E control connections

Terminal X5:42 (VO15V), internal 15V control voltage! Terminal 42. Here the frequency inverter provides the control voltage.

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
Terminal block X3 (See also Chap. 2.12)				
1 K1.1 2 K1.2	Output 1 [Braking control]	Relay closing contact 230V AC / 24V DC, 2A	Braking control	P434...
3 K2.1 4 K2.2	Output 2 [Ready/Fault]		Fault / Ready	P441...
Terminal block X4				
11 VO 10V	10V Reference voltage	10V, 5mA	The analogue input controls the output frequency of the frequency inverter.  The possible digital functions are described in the parameters P420...P425.	
12 GND /0V	Reference potential for analogue signals	0V analogue		
14 AIN1	Analog input 1 [set point frequency]	V=0...10V, R_i=30kΩ, I=0/4...20mA, R_i=250Ω, can be switched over with DIP switch, reference voltage GND. For the use of digital functions 7.5...30V.		P400
16 AIN2	Analog input 2 [no function]			P405...
17 AOUT1	Analogue output [no function]	0...10V Reference potential GND max. load current: 5mA analogue, 20mA digital	Can be used for an external display or for further processing in a following machine. Datails of analogue/digital can be found in Parameter P418	P418/419

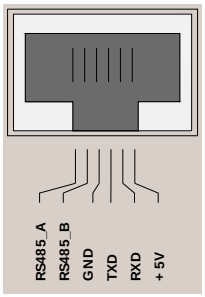
<table>
<tr><th>Terminal</th><th>Function
[factory setting]</th><th>Data</th><th>Description / wiring suggestion</th><th>Parameter</th></tr>
<tr><td colspan="5">Terminal block X5 For SK 5x0E, internal 15V supply</td></tr>
<tr><td>21 DIN1</td><td>digital input 1
[ON right]</td><td rowspan="4">7.5...30V, R_i=6.1kΩ</td><td rowspan="5">Each digital input has a reaction time of 1 – 2ms.

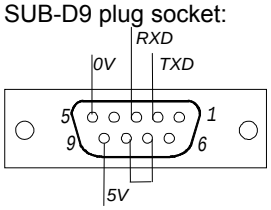
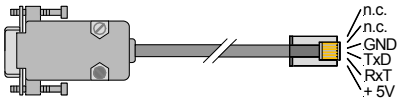
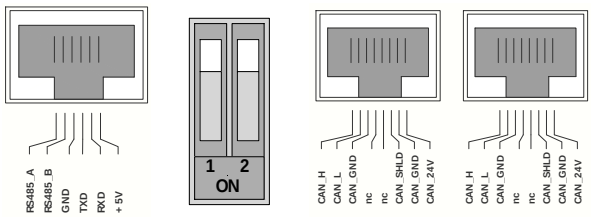
<u>Connection with internal 15V</u>:
 

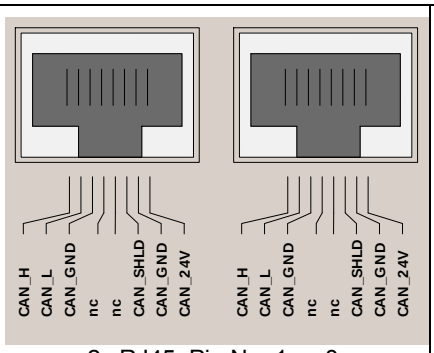
<u>Connection with external 7,5-30V</u>:
 

NOTE: For the motor thermistor (DIN5) P424 = 13 must be set.</td><td>P420</td></tr>
<tr><td>22 DIN2</td><td>digital input 2
[ON left]</td><td>P421</td></tr>
<tr><td>23 DIN3</td><td>digital input 3
[parameter set bit0]</td><td>P422</td></tr>
<tr><td>24 DIN4</td><td>digital input 4
[fixed frequency 1, P429]</td><td>P423</td></tr>
<tr><td>25 DIN5</td><td>digital input 5
[no function]</td><td>2.5...30V, R_i=2.2kΩ, only this input is suitable for evaluation of the thermistor with 5V</td><td>P424</td></tr>
<tr><td>42 VO 15V</td><td>15V supply voltage</td><td>15V ± 20%</td><td>Supply voltage provided by the freequency inverter for connection to the digital inputs or the supply of a 10-30V encoder.</td><td></td></tr>
<tr><td>40 GND /0V</td><td>Reference potential for digital signals</td><td>0V digital</td><td>Reference potential</td><td></td></tr>
<tr><td>41 VO 5V</td><td>5V supply voltage</td><td>5V ± 20%</td><td>Voltage supply for motor-PTC</td><td></td></tr>
</table>

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
Terminal block X6 (only SK 520/530E)				
40 GND /0V	Reference potential for digital signals	0V digital	The incremental encoder input can be used for the exact regualtion of speed of rotation, additional set point functions or positioning. An encoder system with 10-30V supply voltage must be used in order to compensate for voltage drop in long cable connections. **Note:** Encoders with 5V supply are not suitable in order to set up a system which operates reliably.	
51 ENCA+	Track A	TTL, RS422 500…8192Imp./Rpm.		P300 …P327
52 ENCA-	Track A inverse			
53 ENCB+	Track B			
54 ENCB-	Track B inverse			
Terminal block X7 (only SK 520/530E))				
73 RS485 +	Data cable RS485	Baudrate 9600…38400Baud Terminal resistance R=120Ω	BUS connection parallel to RS485 on RJ12 plug **NOTE:** The terminal resistance of DIP switch 1 (see RJ12/RJ45) can also be used for Kl. 73/74.	P502 …P513
74 RS485 -				
26 DIN6	digital input 6 [no function]	7.5...30V, R_i=3.3kΩ	As described for terminal block X5, DIN1 to DIN5. Not suitable for the evaluation of a motor thermistor.	P425
27 DIN7	digital input 7 [no function]			P470
5 DOUT1	Output 3 [no function]	digital output 15V, max. 20mA max. 100kΩ load	For evaluation in a control system. The scope of functions corresponds to the relay (P434/441).	P450 …P452
7 DOUT2	Output 4 [no function]			P455 …P457
42 VO 15V	15V supply voltage	15V ± 20%	Voltage supply for connection to the digital inputs or the supply of a 10-30V encoder	
40 GND /0V	Reference potential for digital signals	0V digital	Reference potential	
Terminal block X8 (only SK 510/511/530E)				
86 VO_S 15V	Supply voltage	15V ± 20%	When setting-up without using a safety function, wire directly to V_IS 24V.	P420 …P426, P470
87 VO_S 0V	Reference potential			
88 VI_S 0V	Reference potential	24V ± 25%, 100mA Refer to technical data!	Fail-safe input	
89 VI_S 24V	Input safe pulse block			

<table>
<tr><th colspan="2">Terminal</th><th>Function
[factory setting]</th><th>Data</th><th>Description / wiring suggestion</th><th>Parameter</th></tr>
<tr><td colspan="6">Plug block X11 (1x RJ12), RS485/RS232
Note: Coupling of two frequency inverters via the RJ12 socket must only be made via the USS BUS (RS485). Care must be taken that no connection to the data cable <u>is possible via RS232</u>, in order to prevent damage to this interface.</td></tr>
<tr><td>1</td><td>RS485 A</td><td rowspan="2">Data cable RS485</td><td rowspan="2">Baudrate
9600…38400Baud
Terminal resistance
R=120Ω DIP 1 (see below)</td><td rowspan="3"> 

RJ12: Pin No. 1 … 6</td><td rowspan="3">P502...P513</td></tr>
<tr><td>2</td><td>RS485 B</td></tr>
<tr><td>3</td><td>GND</td><td>Reference potential for Bus signals</td><td>0V digital</td></tr>
<tr><td>4</td><td>232 TXD</td><td rowspan="2">Data cable RS232</td><td rowspan="2">Baudrate
9600…38400Baud</td><td rowspan="3">Mat. No. 278910240</td><td rowspan="3"></td></tr>
<tr><td>5</td><td>232 RXD</td></tr>
<tr><td>6</td><td>+5V</td><td>internal 5V supply voltage</td><td>5V ± 20%</td></tr>
<tr><td colspan="2">optional</td><td>Adapter cable RJ12 to SUB-D9
... for direct connection to a PC with NORD CON</td><td>Length 3m
Assignments of the SUB-D9 plug socket:
 
</td><td> 
</td><td></td></tr>
<tr><td colspan="6">DIP switches 1/2 (top side of SK 5x0E)</td></tr>
<tr><td colspan="2"></td><td>Plug designation</td><td colspan="3" rowspan="3"> 

RS232/485 DIP CAN /CANopen</td></tr>
<tr><td colspan="2">DIP switch 1</td><td>Terminal resistor for RS485 interface (RJ12); ON = switched in</td></tr>
<tr><td colspan="2">DIP switch 2</td><td>Terminal resistor for CAN/CANopen interface (RJ12); ON = switched in</td></tr>
<tr><td colspan="6">Plug block X9 and X10 (2x RJ45), CAN/CANopen (only 511E/520E/530E)</td></tr>
<tr><td>1</td><td>CAN_H</td><td rowspan="2">CAN/CANopen signal</td><td rowspan="8">Baudrate …500kBaud
RJ45 sockets are connected in parallel internally.
Terminal resistance
R=120Ω DIP 2
(see below)
NOTE: To operate CANbus/CANopen the interface must be externally supplied with 24V (capacity 30mA).
NOTE: Further details about the connection can be found in Chapter 2.11 RJ45 WAGO connection module.</td><td rowspan="8"> 

2x RJ45: Pin No. 1 … 8
NOTE: For SK 53xE frequency inverters this CANopen interface can be used for the evaluation of an absolute value encoder. Further details can be found in Manual BU 0510.
Recommendation: Provide strain relief (e.g. with EMC Kit)</td><td rowspan="8">P502...P515</td></tr>
<tr><td>2</td><td>CAN_L</td></tr>
<tr><td>3</td><td>CAN_GND</td><td>CAN GND</td></tr>
<tr><td>4</td><td>nc</td><td rowspan="2">No function</td></tr>
<tr><td>5</td><td>nc</td></tr>
<tr><td>6</td><td>CAN_SHD</td><td>Cable shield</td></tr>
<tr><td>7</td><td>CAN_GND</td><td>GND/0V</td></tr>
<tr><td>8</td><td>CAN_24V</td><td>External 24V DC supply voltage</td></tr>
</table>

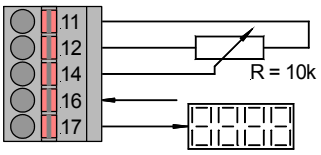
2.12.3 Details of the SK 5x5E control connections

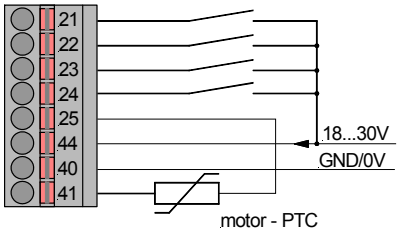
Size 1 - 4:

Terminal X5:44 (VI24V): Control voltage 24V **external**! The frequency inverter must be provided with an external 24V supply.

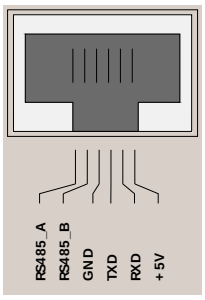
Size 5 – 6:

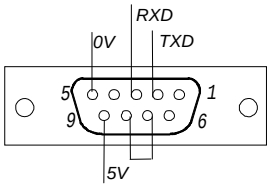
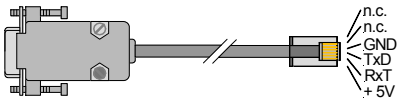
Terminal X5:44 (VO24V): Control voltage 24V internal! Here, the frequency inverter provides the power supply, which can either be supplied from the internal low voltage generator or optionally via the terminals X12:44/X12:40.

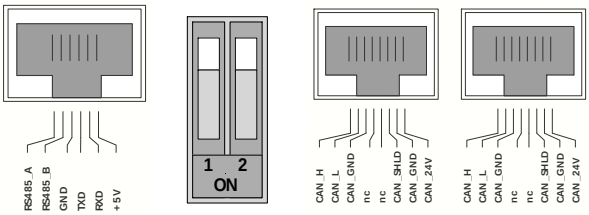
Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
Terminal block X3 (See also Chap. 2.12)				
1 K1.1 2 K1.2	Output 1 [Braking control]	Relay closing contact 230V AC / 24V DC, 2A	Braking control	P434...
3 K2.1 4 K2.2	Output 2 [Ready/Fault]		Fault / Ready	P441...
Terminal block X4				
11 VO 10V	10V Reference voltage	10V, 5mA	The analogue input controls the output frequency of the frequency inverter.  The possible digital functions are described in the parameters P420...P425.	
12 GND /0V	Reference potential for analogue signals	0V analogue		
14 AIN1	Analog input 1 [set point frequency]	V=0...10V, R_i=30kΩ, from size 5 and above, also -10V … +10V I=0/4...20mA, R_i=250Ω, can be switched over with DIP switch, reference voltage GND. For the use of digital functions 7.5...30V.		P400...
16 AIN2	Analog input 2 [no function]			P405...
17 AOUT1	Analogue output [no function]	0...10V Reference potential GND max. load current: 5mA analogue, 20mA digital	Can be used for an external display or for further processing in a following machine. Datails of analogue/digital can be found in Parameter P418	P418/419

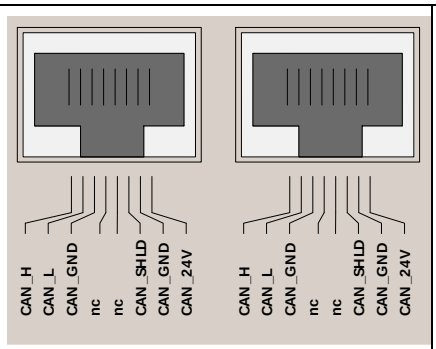
<table>
<tr><th>Terminal</th><th>Function
[factory setting]</th><th>Data</th><th>Description / wiring suggestion</th><th>Parameter</th></tr>
<tr><td colspan="5">Terminal block X5 For SK 5x5E, external 24V supply</td></tr>
<tr><td>21 DIN1</td><td>digital input 1
[ON right]</td><td rowspan="4">7.5...30V, R_i=6.1kΩ</td><td rowspan="4">Each digital input has a reaction time of 1 – 2ms.
 
</td><td>P420</td></tr>
<tr><td>22 DIN2</td><td>digital input 2
[ON left]</td><td>P421</td></tr>
<tr><td>23 DIN3</td><td>digital input 3
[parameter set bit0]</td><td>P422</td></tr>
<tr><td>24 DIN4</td><td>digital input 4
[fixed frequency 1, P429]</td><td>P423</td></tr>
<tr><td>25 DIN5</td><td>digital input 5
[no function]</td><td><u>Only S1 – S4</u>
2.5...30V, R_i=2.2kΩ, only this input is suitable for evaluation of the thermistor with 5V
<u>S5 and above</u>
thermistor to X13:T1 and T2!</td><td>NOTE: For the motor thermistor (DIN5) P424 = 13 must be set.
<u>(Only S1 – S4)</u></td><td>P424</td></tr>
<tr><td><u>S1 to S4</u>
44 VI 24V</td><td>24V supply voltage</td><td>18…30V
at least 800mA (input)</td><td>External voltage supply provided by customer for the control unit of the frequency inverter. Is essential for the function of the frequency inverter.
Also for the connection of the digital inputs or the supply of a 10-30V incremental rotation encoder</td><td></td></tr>
<tr><td><u>S5 to S6</u>
44 VO24V</td><td>24V supply voltage</td><td>24V ± 25%
max. 200mA (output)</td><td>Supply voltage provided by the frequency inverter for connection to the digital inputs or the supply of a 10-30V encoder.</td><td></td></tr>
<tr><td>40 GND /0V</td><td>Reference potential for digital signals</td><td>0V digital</td><td>Reference potential</td><td></td></tr>
<tr><td>41 VO 5V</td><td>5V supply voltage</td><td>5V ± 20%</td><td>Voltage supply for motor-PTC
<u>(only for S1 – S4)</u></td><td></td></tr>
</table>

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
Terminal block X6 (only 535E)				
40 GND /0V	Reference potential for digital signals	0V digital	The incremental encoder input can be used for the exact regualtion of speed of rotation, additional set point functions or positioning. An encoder system with 10-30V supply voltage must be used in order to compensate for voltage drop in long cable connections. **Note:** Encoders with 5V supply are not suitable in order to set up a system which operates reliably.	
51 ENCA+	Track A	TTL, RS422 500…8192Imp./Rpm.		P300 …P327
52 ENCA-	Track A inverse			
53 ENCB+	Track B			
54 ENCB-	Track B inverse			
Terminal block X7 (only SK 535E)				
73 RS485 +	Data cable RS485	Baudrate 9600…38400Baud Terminal resistance R=120Ω	BUS connection parallel to RS485 on RJ12 plug **NOTE:** The terminal resistance of DIP switch 1 (see RJ12/RJ45) can also be used for Kl. 73/74.	P502 …P513
74 RS485 -				
26 DIN6	digital input 6 [no function]	7.5...30V, R_i=3.3kΩ	As described for terminal block X5, DIN1 to DIN5. Not suitable for the evaluation of a motor thermistor.	P425
27 DIN7	digital input 7 [no function]			P470
5 DOUT1	Output 3 [no function]	digital output S1 to S4: 18-30V, each to VI 24V max. 20mA S5 to S6: 24V, max. 200mA max. 100kΩ load	For evaluation in a control system. The scope of functions corresponds to the relay (P434/441).	P450 …P452
7 DOUT2	Output 4 [no function]			P455 …P457
44 VI 24V	24V supply voltage	18…30V at least 800mA	External voltage supply provided by customer for the control unit of the frequency inverter. Is essential for the function of the frequency inverter. Internally in parallel with Kl.44 to X5!	
S5 to S6 44 VO24V	24V supply voltage	24V ± 25% max. 200mA (output)	Supply voltage provided by the frequency inverter for connection to the digital inputs or the supply of a 10-30V encoder.	
40 GND /0V	Reference potential for digital signals	0V digital	Reference potential	
Terminal block X8 (only SK 511/515/535E (S5 and above: Location of **X8** differs (See Section 2.11.7))				
86 VO_S 24V	Supply voltage	18-30V, each to VI 24V	When setting-up without using a safety function, wire directly to V_IS 24V.	P420 …P426, P470
87 VO_S 0V	Reference potential			
88 VI_S 0V	Reference potential	24V ± 25%, 100mA Refer to technical data!	Fail-safe input	
89 VI_S 24V	Input safe pulse block			

<table>
<tr><th>Terminal</th><th>Function
[factory setting]</th><th>Data</th><th>Description / wiring suggestion</th><th>Parameter</th></tr>
<tr><td colspan="5">Plug block X11 (1x RJ12), RS485/RS232
Note: Coupling of two frequency inverters via the RJ12 socket must only be made via the USS BUS (RS485). Care must be taken that no connection to the data cable <u>is possible via RS232</u>, in order to prevent damage to this interface.</td></tr>
<tr><td>1 RS485 A</td><td rowspan="2">Data cable RS485</td><td>Baudrate
9600…38400Baud
Terminal resistance
R=120Ω DIP 1 (see below)</td><td rowspan="4"> 

RJ12: Pin No. 1 … 6</td><td rowspan="4">P502...P513</td></tr>
<tr><td>2 RS485 B</td></tr>
<tr><td>3 GND</td><td>Reference potential for Bus signals</td><td>0V digital</td></tr>
<tr><td>4 232 TXD</td><td rowspan="2">Data cable RS232</td><td rowspan="2">Baudrate
9600…38400Baud</td></tr>
<tr><td>5 232 RXD</td><td></td></tr>
<tr><td>6 +5V</td><td>internal 5V supply voltage</td><td>5V ± 20%</td><td></td><td></td></tr>
<tr><td>optional</td><td>Adapter cable RJ12 to SUB-D9
... for direct connection to a PC with NORD CON</td><td>Length 3m
Assignment of the SUB-D9 plug socket:
 
</td><td> 

Mat. No. 278910240</td><td></td></tr>
<tr><td colspan="5">DIP switches 1/2 (top side of SK 5xxE)</td></tr>
<tr><td></td><td colspan="2">Plug designation</td><td colspan="2" rowspan="3">X11 X10 X9
 

RS232/485 DIP CAN/CANopen</td></tr>
<tr><td>DIP switch 1</td><td colspan="2">Terminal resistor for RS485 interface (RJ12); ON = switched in</td></tr>
<tr><td>DIP switch 2</td><td colspan="2">Terminal resistor for CAN/CANopen interface (RJ12); ON = switched in</td></tr>
<tr><td colspan="5">Plug block X9 and X10 (2x RJ45), CAN/CANopen (only SK 515E and SK 535E)</td></tr>
<tr><td>1 CAN_H</td><td rowspan="2">CAN/CANopen signal</td><td rowspan="8">Baudrate …500kBaud
2x RJ45 sockets are connected in parallel internally.
Terminal resistance
R=120Ω DIP 2 (see below)
NOTE: To operate CANbus/CANopen the interface must be externally supplied with 24V (capacity 30mA).
NOTE: Further details about the connection can be found in Chapter 2.14 RJ45 WAGO connection module.</td><td rowspan="8"> 

2x RJ45: Pin No. 1 … 8
NOTE: For SK 53xE frequency inverters this CANopen interface can be used for the evaluation of an absolute value encoder. Further details can be found in Manual BU 0510.
Recommendation: Provide strain relief (e.g. with EMC Kit)</td><td rowspan="8">P502...P515</td></tr>
<tr><td>2 CAN_L</td></tr>
<tr><td>3 CAN_GND</td><td>CAN GND</td></tr>
<tr><td>4 nc</td><td rowspan="2">No function</td></tr>
<tr><td>5 nc</td></tr>
<tr><td>6 CAN_SHD</td><td>Cable shield</td></tr>
<tr><td>7 CAN_GND</td><td>GND/0V</td></tr>
<tr><td>8 CAN_24V</td><td>External 24V DC supply voltage</td></tr>
</table>

2.13 Colour and contact assignments for the incremental encoder.

Function	Cable colours, for incremental encoder	Assignment for SK 52xE/53xE
15V (/ 24V) supply	brown / green	X5:**42/44** VO 15V (/ VI / VO 24V)
0V supply	white / green	X6:**40** GND/0V
Track A	brown	X6:**51** ENC A+
Track A inverse	green	X6:**52** ENC A-
Track B	gray	X6:**53** ENC B+
Track B inverse	pink	X6:**54** ENC B-
Track 0	red	--
Track 0 inverse	black	--
Cable shield	connected to a large area of the frequency inverter housing or shielding angle	

NOTE: If there are deviations from the standard equipment (Type 5820.0H40, 10-30V encoder, TTL/RS422) for the motors, please note the accompanying data sheet or consult your supplier.

RECOMMENDATION: For high reliability of operation, particularly with long connecting cables, an incremental rotation encoder for 10-30V supply voltage must be used. An external 24V or internal 15V (/24V) voltage from the frequency inverter can be used as the voltage supply. 5V encoders should not be used!

ATTENTION

The rotation of the incremental encoder must correspond to that of the motor. Therefore, depending on the rotation direction of the encoder to the motor (possibly reversed), a negative number must be set in parameter P301.

2.14 RJ45 WAGO connection module

This connection module can be used for simple cabling of the RJ45 connection functions (24V voltage supply, CANopen absolute encoder, CANbus) with normal cables.

Pre-fabricated RJ45 patch cables are transferred with this adapter to spring terminals (1-8 + S).

To ensure correct shield connection and strain relief, the shield U-bolt must be used.

Supplier	Description	Article No.
WAGO Kontakttechnik GmbH	Ethernet connection module with CAGE-CLAMP connection Transfer module RJ-45	289-175
WAGO Kontakttechnik GmbH	Accessories: WAGO shield U-bolt	790-108
Alternative, complete connection module and shield U-bolt		**Mat. Nr.**
Getriebebau NORD GmbH & Co.KG	Connection module RJ45/Terminal	278910300

2.15 Setpoint card ± 10V for NORDAC SK 500E

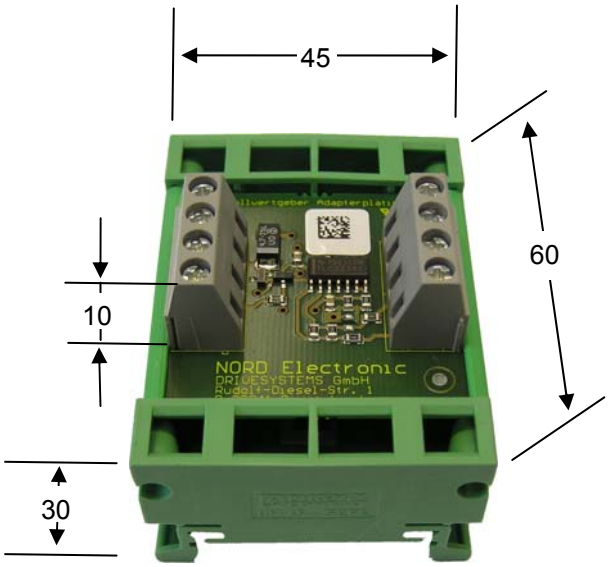
The analog inputs of series SK 500E frequency inverters size S1 to S4 can only process unipolar setpoints (0 … 10V; 0/4 20mA) with reference to GROUND.

If a bipolar setpoint (analog difference signal (-10V … + 10V)) is available, this must be converted to a 0 … 10V signal by means of a setpoint converter. In this case, the appropriate module is available from NORD. This module is suitable for snap-on rail-mounting and should be installed near to the frequency inverter in the control cabinet. For further details, please refer to the supplementary instructions for the setpoint converter.

Note: Frequency inverters of size S5 and above can process both unipolar and bipolar setpoints by means of configuration with DIP switches.

Supplier	Designation	Part no.
Getriebebau NORD GmbH & Co.KG	Setpoint converter ±10V → 0 … 10V	278910320

Dimensions



3 Display and operation

In the delivery condition (without technology unit) 2 LEDs (green/red) are visible externally. These indicate the current status of the device.

The **green LED** indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output.

The red LED signals actual error by flashing with a frequency which corresponds to the number code of the error (Section. 6).

3.1 Modular modules

By combining different modules for display, control and parameterisation, the NORDAC SK 5xxE can be easily adapted to various requirements.

Alphanumerical display and operating modules can be used for simple start-up. For more complex tasks, various connections to a PC or an automation system can be selected.

The **technology unit (Technology Unit, SK TU3-...)** is connected externally to the frequency inverter and is therefore easy to access and replace at any time.

WARNING

Modules should not be inserted or removed unless the device is free of voltage. The slots may only be used for the applicable modules.

NOTE:

Installation of a technology unit **separate from the frequency inverter** is not possible. It must be connected directly to the frequency inverter.

Further detailed information can be found in the Options manuals.
- www.nord.com -

3.2 Technology unit overview

Module	Description	Data
SimpleBox **SK CSX-0**	For the commissioning, parameterisation, configuration and control of the frequency inverter. Storage of the parameters is not possible.	4-digit 7 segment LED display, single button operation Mat. No. 275900095
ControlBox **SK TU3-CTR**	For the commissioning, parameterisation, configuration and control of the frequency inverter. Storage of the parameters is possible by means of P550.	4-digit, 7-segment LED display, keyboard Mat. No. 275900090
ParameterBox **SK TU3-PAR**	For the commissioning, parameterisation, configuration and control of the frequency inverter. Up to 5 parameter sets can be stored.	4 digit back-lit LCD display, keyboard Mat. No. 275900100
Profibus module **SK TU3-PBR**	This option enables control of the SK 5xxE via the Profibus DP serial port	Baud rate: 1.5 MBaud Connector: Sub-D9 Mat. No. 275900030
Profibus module **SK TU3-PBR-24V**	This option enables control of the SK 5xxE via the Profibus DP serial port	Baud rate: 12 MBaud Connector: Sub-D9 ext. 24V voltage supply, 2 pin connector Mat. No. 275900160
CANopen module **SK TU3-CAO**	This option enables control of the SK 5xxE via the CANbus serial port, using the CANopen protocol	Baud rate: up to 1 MBit/s Connector: Sub-D9 Mat. No. 275900075
DeviceNet module **SK TU3-DEV**	This option enables control of the SK 5xxE via the DeviceNet serial port using the DeviceNet protocol.	Baud rate: 500 KBit/s 5 pin screw connector Mat. No. 275900085
InterBus module **SK TU3-IBS**	This option enables control of the SK 5xxE via the InterBus serial port.	Baud rate: 500 kBit/s (2Mbit/s) Connector: 2 x Sub-D9 Mat. No. 275900065
AS interface **SK TU3-AS1**	Actuator-sensor interface is a bus system for the lower field bus level, used for simple control tasks.	4 sensors / 2 actuators 5 / 8 pin screw connector Mat. No. 275900170
PotentiometerBox **SK TU3-POT**	The Potentiometer Box is used for the direct control of the frequency inverter, without external components.	ON, OFF, R/L, 0…100% Mat. No. 275900110

Installing the technology unit

The technology units must be installed as follows:

1. Switch off the mains.
2. Push the control terminals cover down slightly or remove.
3. Remove the **blind cover** by loosening the release on the lower edge and pulling off with an upward turning movement. If necessary, the fixing screw next to the release must be removed.
4. Hook the technology unit onto the upper edge and press in lightly until engaged. Ensure full contact with the connector strip and fasten with the screws if necessary (separate packet).
5. Close the control terminal cover again.

3.2.1 SimpleBox, SK CSX-0

This option is used as a simple parameterisation, display and control tool for the frequency inverter SK 5xxE. With this, even in active BUS operation, data can be read out and parameterisation made especially if the frequency inverter slot is occupied with a BUS unit.

Features

- 4-digit, 7-segment LED display
- Single button operation
- Display of the active parameter set and operating values

After the SimpleBox has been attached, the cable connectors plugged in and the mains has been switched on, horizontal lines appear in the 4-digit 7-segment display. This display signals the operational readiness of the frequency inverter.

If a jog frequency value is pre-set in parameter P113, or a minimum frequency is pre-set in P104, the display flashes with this value.

If the frequency inverter is enabled, the display changes automatically to the operating value selected in parameter >Selection Display value< P001 (factory setting = current frequency).

The actual parameter set is shown by the 2 LEDs next to the display on the left in binary code.

NOTE

Settings should only be implemented by qualified personnel, strictly in accordance with the warning and safety information.

Installation

The SimpleBox can be attached to any technology unit (SK TU3-…) or to the blind cover. To remove it, simply pull it off after the RJ12 connection has been detached (press in the latching lever on the RJ12 connector).

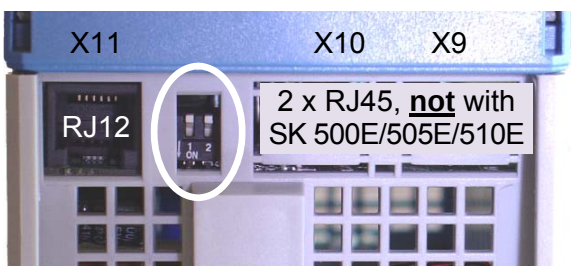
Connection

The SimpleBox is connected to the socket at the upper edge of the frequency inverter using the RJ12 connector/cable.

If necessary DIP switch 1 (left) can be used to activate a BUS connection resistor for the RS485 interface. This may be necessary if the frequency inverter is to be connected to an overriding control unit from a great distance.

Further details can be found in Section 2.12.1.

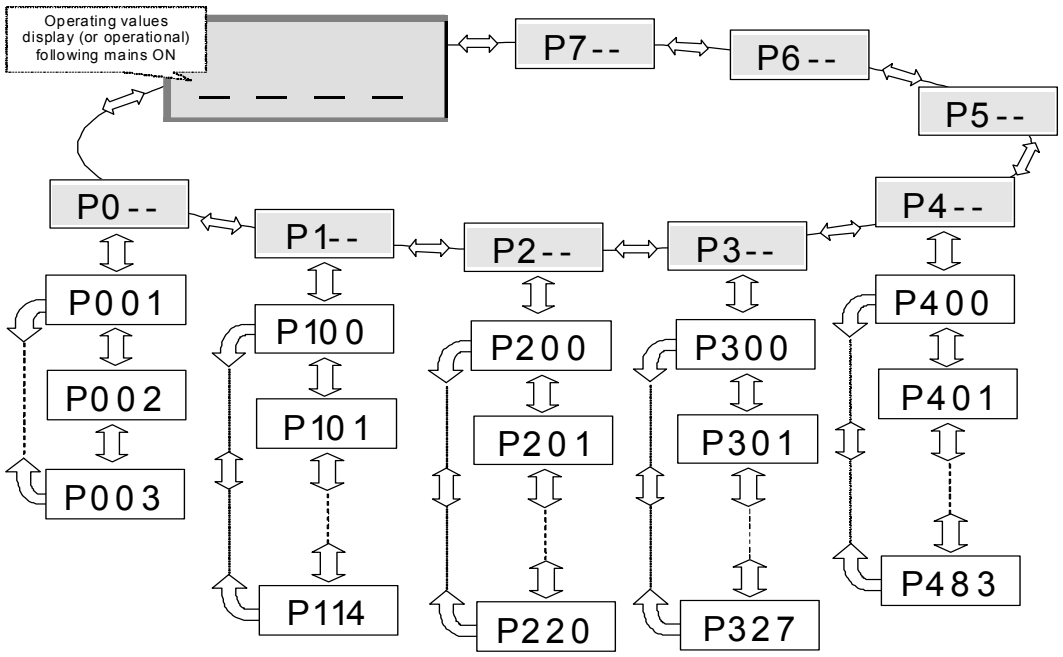
Top side of device



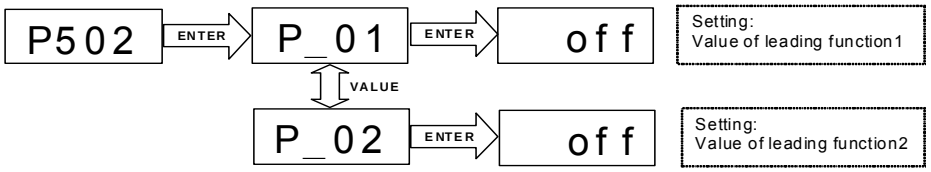
Functions of the SimpleBox:

7 Segment LED display	When the frequency inverter is ready for operation any initial value (P104/P113 for keyboard operation) is indicated by a flashing display. This frequency is immediately used on being enabled. During operation, the currently set operating value (selection in P001) or an error code (Section 6) is displayed. During parameterisation, the parameter numbers or the parameter values are shown.
LEDs 1 2	The LEDs indicate the actual operating parameter set in the operating display (P000) and the current parameter set being parameterised. The display is in binary code. 1 2 = P1 1 2 = P2 1 2 = P3 1 2 = P4
Turn the knob to the **right**	Turn the knob to the right in order to increase the parameter number or the parameter value.
Turn the knob to the **left**	Turn the knob to the left in order to reduce the parameter number or the parameter value.
Briefly press the knob	Briefly pressing the knob = “ENTER” function in order to store a changed parameter or to change from parameter number to parameter value.
Press the knob for **longer**	If the knob is pressed for a longer period, the display changes to the next higher level, if necessary without storing a parameter change.

Menu structure with the SimpleBox



NOTE: Some parameters P465, P475, P480…P483, P502, P510, P534, P701…P706, P707, P718, P740/741 and P748 have additional levels (arrays), in which further adjustments can be made, e.g.:



3.2.2 ControlBox, SK TU3-CTR

This option is used as a simple parameterisation, display and control tool for the frequency inverter SK 5xxE.

Features

- 4-digit, 7-segment LED display
- Direct control of a frequency inverter
- Display of the active parameter set and operating values
- Storage of a complete inverter data set (P550),
  e.g. for transfer of data to other frequency inverters.

After the ControlBox has been attached, the cable connectors plugged in and the mains has been switched on, horizontal lines appear in the 4-digit 7-segment display. This display signals the operational readiness of the frequency inverter.

If a creep frequency value is pre-set in parameter P113, or a minimum frequency is pre-set in P104, the display flashes with this initial value.

If the frequency inverter is enabled, the display changes automatically to the operating value selected in parameter >Selection Display value< P001 (factory setting = current frequency).

The actual parameter set in use is shown by the 2 LEDs next to the display on the left in binary code.

NOTE

The digital frequency setpoint is factory set to 0Hz. To check whether the motor is working, a frequency setpoint must be entered with the ▲ or ▼ key or a jog frequency via the respective parameter >Jog frequency< (P113).

Settings should only be implemented by qualified personnel, strictly in accordance with the warning and safety information.

ATTENTION : The motor may start immediately after pressing the START key!

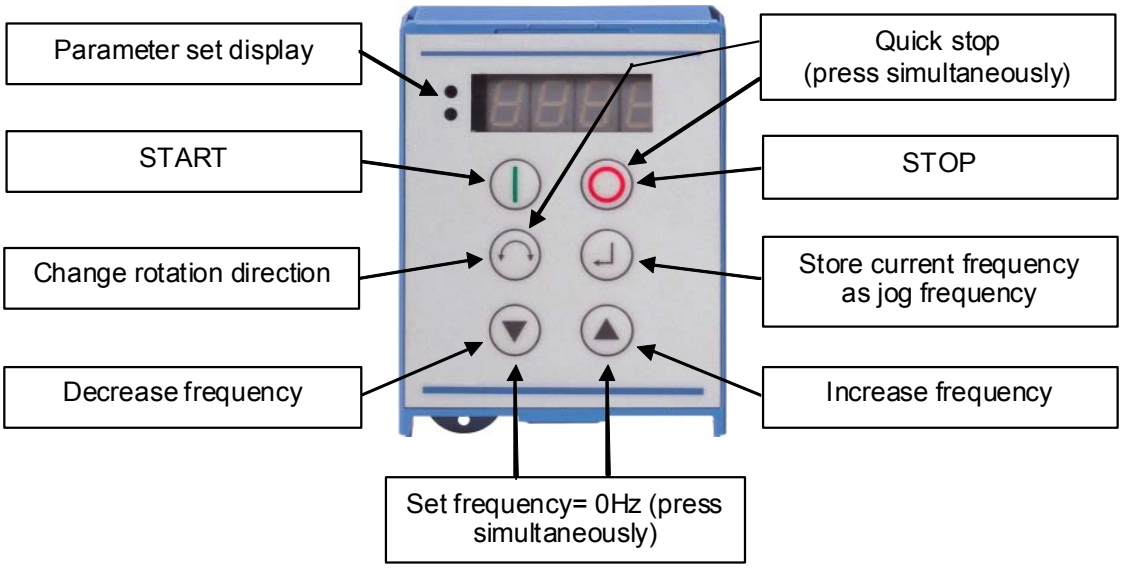
ControlBox functions:

	Switching on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A preset minimum frequency (P104) may at least be provided. Parameter >Interface< P509 and P510 must = 0.
	Switching off the frequency inverter. The output frequency is reduced to the absolute minimum frequency (P505) and the frequency inverter shuts down.
7 Segment LED display 4-digit	4 permanently displayed underscores (_ _ _ _) indicate readiness for operation if there is no setpoint. If these underscores are flashing, the frequency inverter is not ready for operation (switch-on lock, e.g. function “safe pulse block”), or there is, or was, an error. This must first be rectified. When the frequency inverter is ready for operation any initial value (P104/P113 for keyboard operation) is indicated by a flashing display. This frequency is immediately used on being enabled. During operation, the currently set operating value (selection in P001) or an error code (Section 6) is displayed. During parameterisation, the parameter numbers or the parameter values are shown.
LEDs 1 2	The LEDs indicate the actual operating parameter set in the operating display (P000) and the actual parameter set being parameterised during parameterisation. Tin this case the display is coded in binary form. 
	The motor rotation direction changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Attention!** Take care when operating pumps. screw conveyors, ventilators, etc. Block the key with parameter P540.
	Press key to increase the frequency. During parameterisation, the parameter number or parameter value is increased
	Press the key to reduce the frequency. During parameterisation, the parameter number or parameter value is reduced.
	Press "ENTER" to store an altered parameter value, or to switch between parameter number or parameter value. **NOTE**: If a changed value is not to be stored, the  key can be used to exit the parameter without storing the change.

Parameterisation with the ControlBox

The frequency inverter can only be controlled via the ControlBox, if it has not previously been enabled via the control terminals or via a serial interface (P509 = 0 and P510 = 0). In addition, for this the parameter “PotentiometerBox Function” (P549) must not be set to function {4} “Frequency addition” or function {5} “Frequency subtraction”.

If the "START" key is pressed, the frequency inverter in the operating display changes (selection P001). The frequency inverter supplies 0Hz or a higher minimum frequency (P104) or jog frequency (P113) which has been set.



Parameter set display:

The LEDs indicate the actual operating parameter set in the operating display (P000) and the current parameter set being parameterised (≠ P000). There, the display appears in binary form.

The parameter set can also be changed during operation via the parameter P100 (control via ControlBox).

Frequency setpoint:

The current frequency setpoint depends on the setting in the parameters jog frequency (P113) and minimum frequency (P104). This value can be altered during keyboard operation with the value keys and permanently stored in P113 as the jog frequency by pressing the ENTER key.

Quick stop:

By simultaneously pressing the STOP key and the "Change direction key”, an quick stop can be initiated.

Frequency addition:

If the parameter “PotentiometerBox Function” (P549) has been set to function {4}”Frequency addition” or function {5} “Frequency subtraction”, as of software version 1.7 a setpoint can be added via the Control Box, even if enabling and other setpoints are provided from another source (control terminals, BUS).

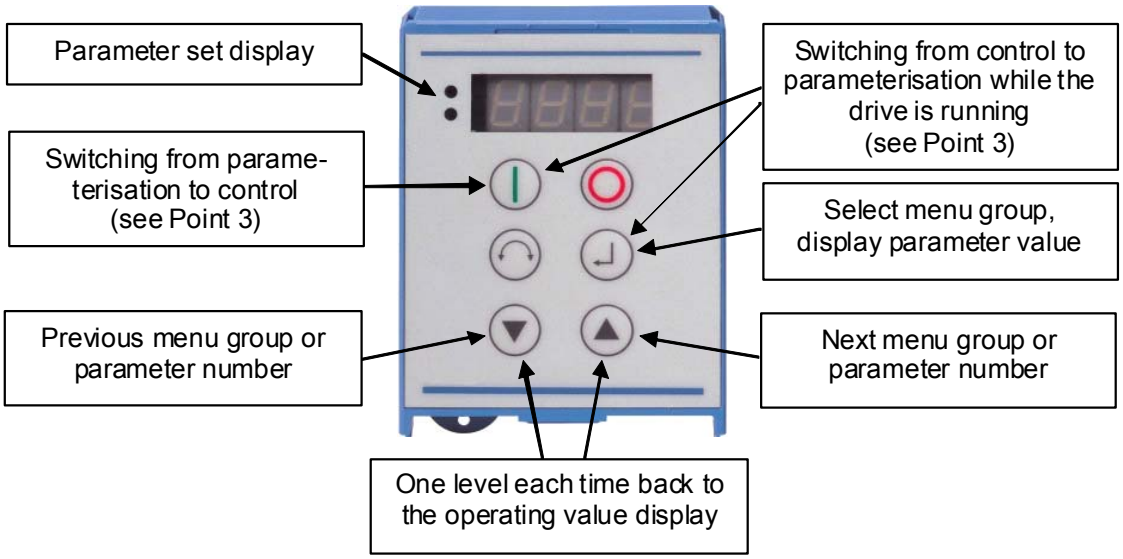
However, after the drive unit has been shut down, this additive setpoint is reset to zero.

By pressing the ENTER key however, the set value is permanently stored in parameter P113 as the jog frequency, and continues to be available as a setpoint value on re-enabling after shutdown.

Parameterisation with the ControlBox

The **parameterisation** of the frequency inverter can be performed in the various operating states. All parameters can always be changed online. Switching to the parameter mode occurs in different ways depending upon the operating states and the enabling source.

1. If there is no enable (if necessary, press the STOP key ⊙) via the ControlBox, control terminals or a serial interface, it is still possible to switch to the parameterisation mode directly from the operating value display with the value keys ▲ or ▼. → p0__ / p7__
2. If an enable is present via the control terminals or a serial interface and the frequency inverter is producing an output frequency, it is also possible to switch to the parameterisation mode directly from the operating value display using the value keys ▲ and ▼. → p0__ / p7__
3. If the inverter is enabled via the ControlBox (START key I), the parameterisation mode can be reached by pressing the START and ENTER keys I + ↵ simultaneously.
4. Switching back to the control mode is achieved by pressing the START key I.



Exception: If the parameter “PotentiometerBox Function” (P549) has been set to function {4} "Frequency addition" or function {5} "Frequency subtraction", as of software version 1.7 an online parameterisation via the ControlBox can no longer be carried out. i.e. the drive unit must be shut down for parameterisation via the ControlBox.

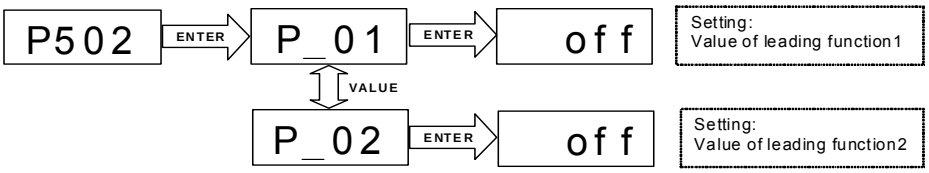
Changing parameter values

To access the parameter section, one of the value keys, ▲ or ▼ must be pressed. The display changes to the menu group display [p0__] ... [p7__]. After pressing the ENTER key ↵ access to the menu group is obtained and the required parameter can be selected with the value keys.

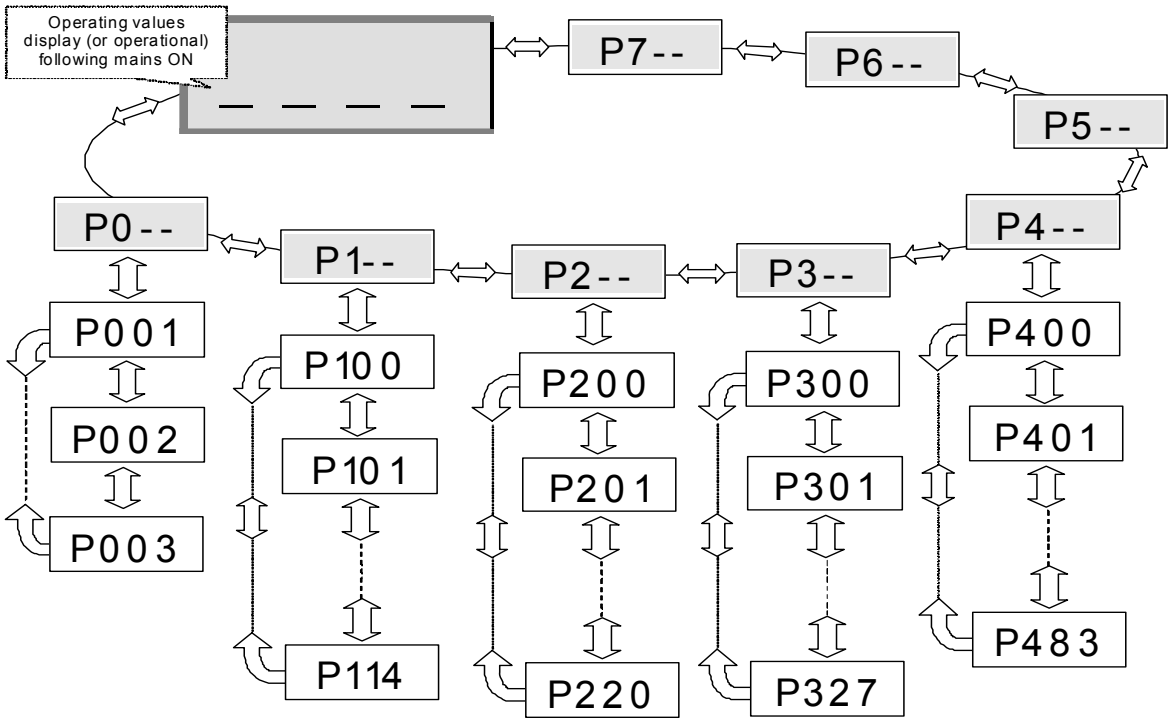
All parameters are arranged in order in the individual menu groups in a continuous scroll pattern. It is therefore possible to scroll forwards and backwards within this section.

Each parameter has a parameter number → [pxxx]. The significance and description of the parameters starts in Section 5 "Parameterisation"

NOTE: Some parameters P465, P475, P480…P483, P502, P510, P534, P701…P706, P707, P718, P740/741 and P748 have additional levels (arrays), in which further adjustments can be made, e.g.:



Menu structure with the SimpleBox



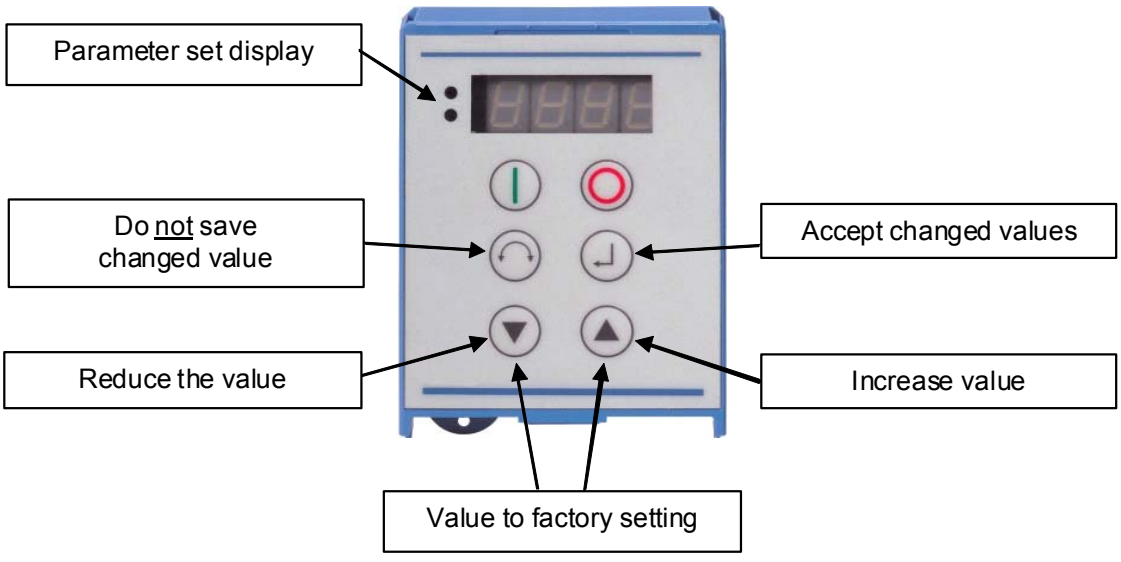
To **change a parameter value**, the ENTER key must be pressed when the applicable parameter number is displayed.

Changes can then be made using the VALUE keys or and must be confirmed with to save them and leave the parameter.

As long as a changed value has not been confirmed by pressing ENTER, the value display will flash; this value has not yet been stored in the frequency inverter.

During parameter changes, the display does not blink so that the display is more legible.

If a change is not to be saved, the "DIRECTION" key can be pressed to leave the parameter.



3.2.3 ParameterBox, SK TU3-PAR

This option is for simple parameterisation and control of the frequency inverter, as well as the display of current operating settings and states.

Up to 5 data sets can be stored and managed, stored and transferred in this device. This enables an efficient start-up for serial applications.

NOTE: In order to be able to use the ParameterBox SK PAR-2H /-2E (external manual control / switching cabinet unit) on the SK 5xxE, this must at least be equipped with **software version 3.5 R1.** To ensure reliable operation the SK PAR-2H /-2E must be connected to a stable 5V supply.

(For further information, see Handbook BU 0040)

Features of the ParameterBox

- Illuminated, high resolution LCD graphics screen
- Large-screen display of individual operating parameters
- 6 language display
- Help text for error diagnosis
- 5 complete inverter data sets can be stored in the memory, loaded and processed
- For use as a display for various operating parameters
- Standardisation of individual operating parameters to display specific system data
- Direct control of a frequency inverter

Information from the ParameterBox

After lugging the ParameterBox onto the frequency inverter and switching on the mains for the first time, there is initially an **enquiry as the menu language, German or English.**

Then the ParameterBox automatically carried out a "**bus scan**", during which the connected frequency inverters are identified.

In the following display, the type of frequency inverter, its actual operating condition and the current status can be seen.

After the inverter has been enabled, the display mode changes to the 3 current operate values (frequency, voltage, current). The operating values displayed can be selected from a list of 19 possible values (in the >Display< / > Values< menu).

NOTE

The digital frequency setpoint is factory set to 0Hz. To check whether the motor is working, a frequency setpoint must be entered with the ▲ or ▼ key or a jog frequency via the respective menu level >Parameterise<, >Base parameters< and the respective parameter >Jog frequency< (P113)

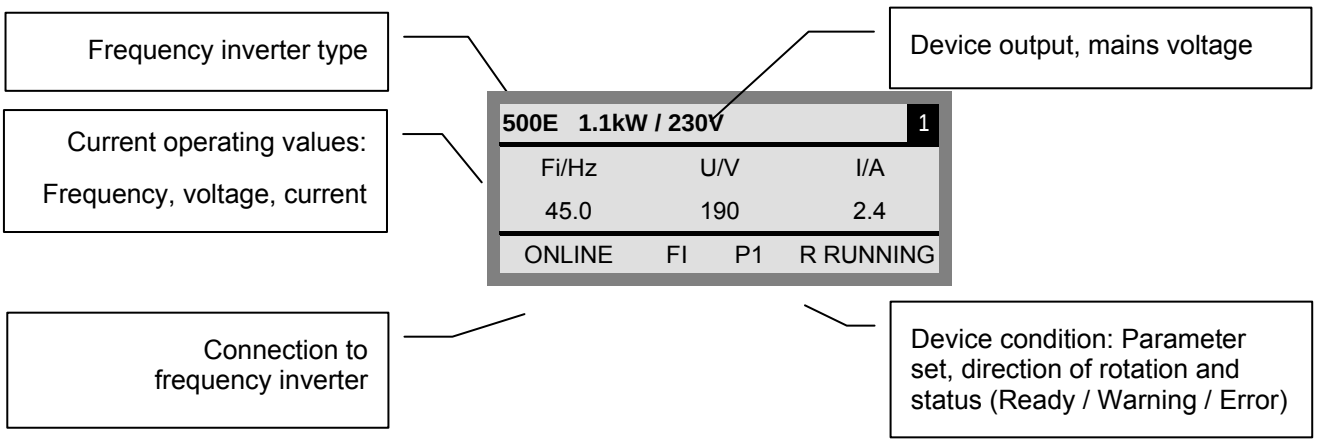
Settings should only be implemented by qualified personnel, strictly in accordance with the warning and safety information.

ATTENTION : The motor may start immediately after pressing the START key ⏻!

Functions of the ParameterBox

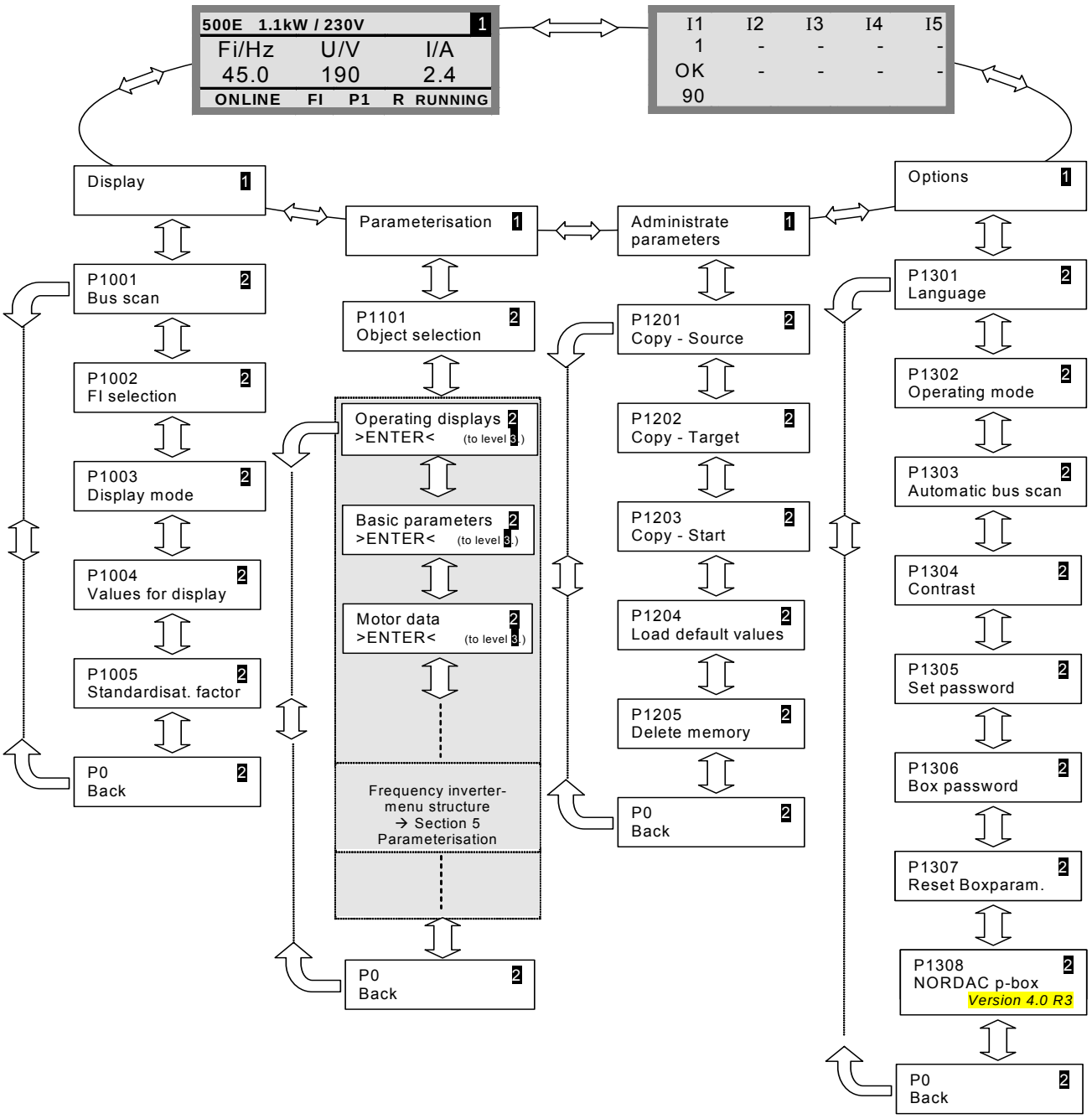
LCD Display	Graphic-capable, backlit LCD display for displaying operational values and parameters for the connected frequency inverter and ParameterBox parameters.	
 	Using the **SELECTION keys** enables toggling between the menu levels and menu items. Press the ◀ and ▶ keys together to go back one level.	
 	The contents of individual parameters can be altered with the **VALUES keys.** Press the ▲ and ▼ keys together to load the default values of the parameter selected. When controlling the inverter using the keyboard, the frequency setpoint is set using the VALUE keys. Here the ramp time is limited to 0.17s/Hz, if small values are set in P002/P003.	
	Press the ENTER key to select a menu group or accept the changed menu item or parameter value. **NOTE:** If a parameter is to exited, without a new value being stored, then one of the SELECTION keys can be used for the purpose. If the inverter is to be controlled directly from the keyboard (not control terminals), then the current setpoint frequency can be stored under the Jog Frequency parameter (P113).	
	**START key** for switching on the frequency inverter.	**NOTE:** can only be used with the external SK PAR-2H/ -2E if this function is enabled in Parameter P509 or P540.
	**STOP key** for switching off the frequency inverter.	
	The direction of rotation of the motor changes when the **DIRECTION key** is pressed. Rotation direction left is indicated by a minus sign. Attention! Take care when operating pumps, screw conveyors, ventilators, etc.	
LEDs DS DE	The LED's indicate the current status of the ParameterBox. DS (ON (green)) Device State — The ParameterBox is connected to the power supply and is operational. DE (ERROR (red)) Device Error — An error has occurred while processing data or in the connected frequency inverter.	

LCD-Display



Menu structure

The menu structure consists of various levels that are each arranged in a ring structure. The ENTER key moves the menu on to the next level. Simultaneous operation of the SELECTION keys moves the menu back a level.



>Display< (P11xx), **>Administer Parameters<** (P12xx) and **>Options<** (P13xx) are purely ParameterBox-parameters and do not have direct influence on frequency inverter parameters.

Via the menu **>Parametrerising<** the frequency inverter structure can be accessed, if necessary after selection of the object, if frequency inverter data sets are already stored in the ParameterBox.

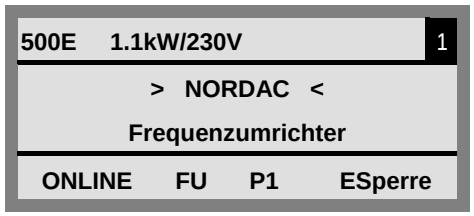
The description of the frequency inverter parameters is in Section 5 of this description.

Select language, *short description*

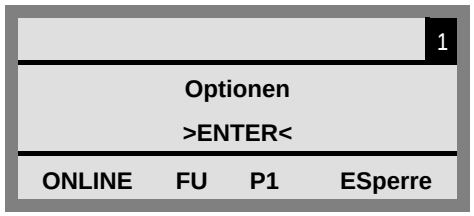
The following steps must be carried out to change the menu language used in the ParameterBox display. On switching on the ParameterBox for the first time, “German” or “English” will be offered for selection. The selection is made by pressing the selection keys (arrow R/L) and confirming with the ENTER key.

In the following, “German” was selected on switching on for the first time. After this selection the following displays should appear (varies depending upon output and options).

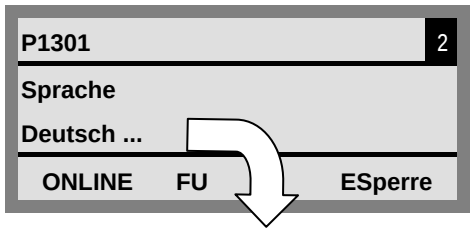
Initial display



Use the **Selection keys** ◀ or ▶, to scroll to the **Optionen** menu

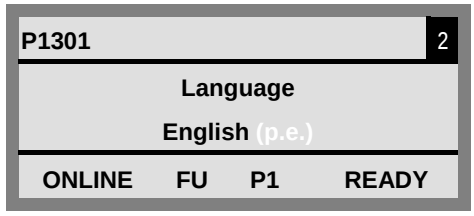


then press **>ENTER<** ↵

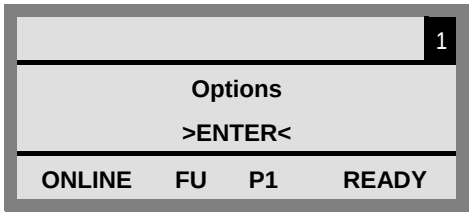


Using the **Value key** ▲ or ▼, select the required **language**

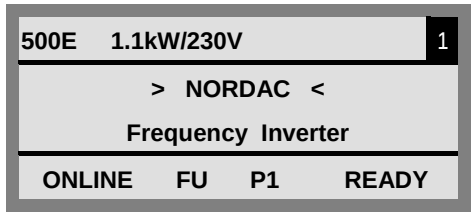
After selection press **>ENTER<** ↵



Press both **Selection keys** (◀ and ▶) simultaneously

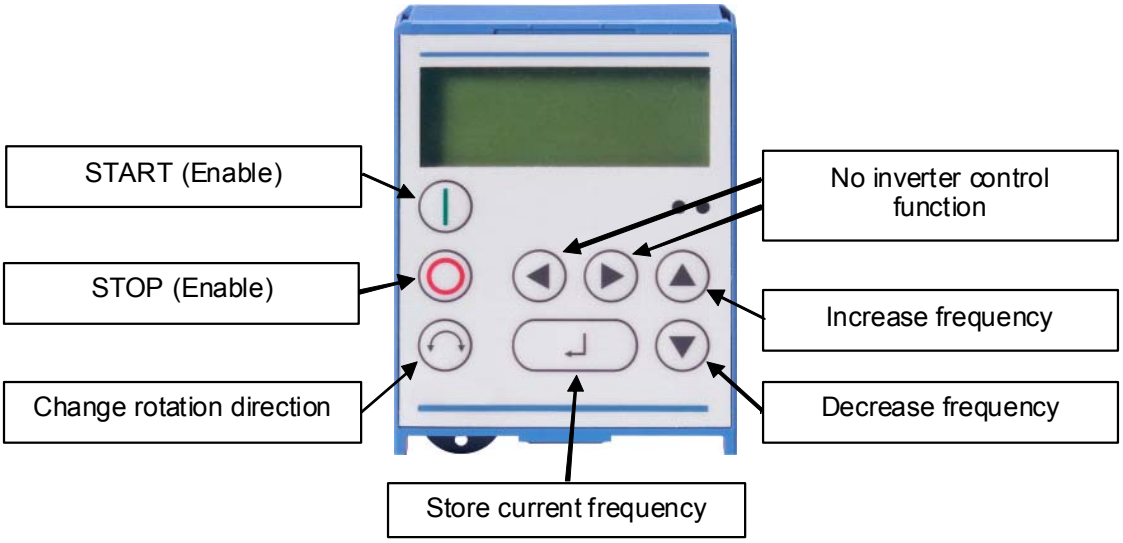


Press both **Selection keys** (◀ and ▶) simultaneously



Controlling the frequency inverter with the ParameterBox

The frequency inverter can only be completely controlled via the ParameterBox if the parameter >Interface< (P509) is set to the >Control terminal or Keyboard< function (=0) (factory setting) and the inverter is not enabled via the control terminal.



Note: If the frequency inverter is enabled in this mode, then the parameter set is used, which is selected for this frequency inverter in the Menu >Parameterisation< ... >Basic parameters< ... under Parameters >Parameter set<.

Attention: Following the START command, the frequency inverter may start up immediately with a pre-programmed frequency (minimum frequency P104 or jog frequency P113).

Frequency addition:

If the parameter “Potentiometer Box Function” (P549) has been set to function {4}”Frequency addition” or function {5} “Frequency subtraction”, as of software version 1.7 a setpoint can be added via the Control Box, even if enabling and other setpoints are provided from another source (control terminals, BUS).

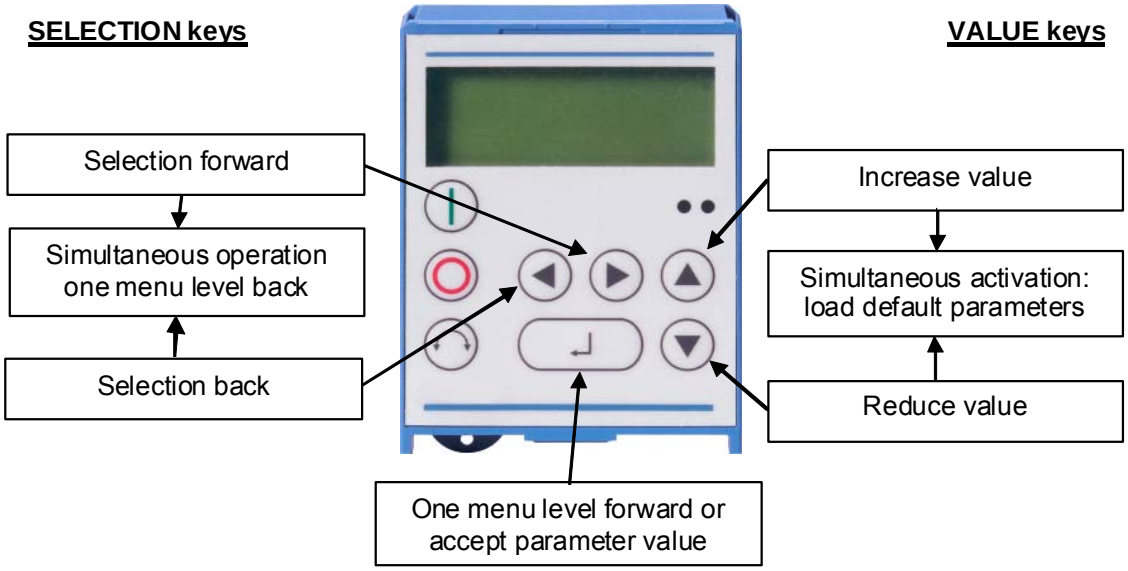
To activate this function, the STOP key on the ParameterBox must also be pressed.

Pressing the **value keys** or increases or decreases the present frequency.

Pressing the STOP key or the ENTER key saves the additive value set via the value keys as the jog frequency in parameter P113.

Parameterising with the ParameterBox

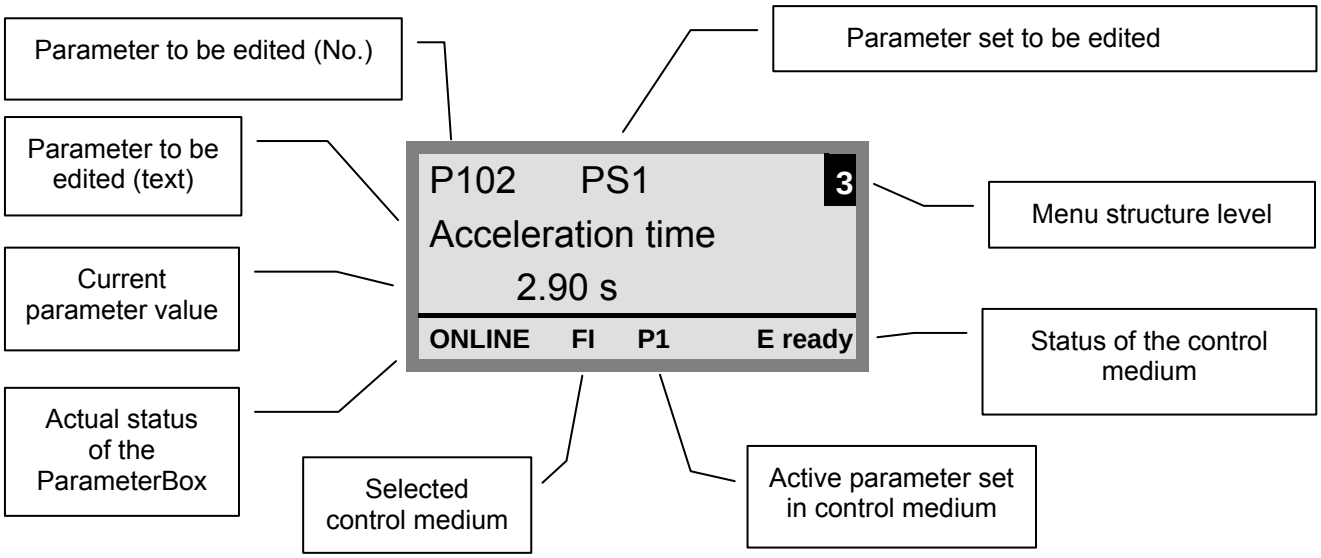
The parameterising mode is entered by selecting the menu group >Parameterising< in level 1 of the ParameterBox and confirming this with the ENTER key. The parameter level of the connected frequency inverter is now visible.



Screen layout during parameterisation

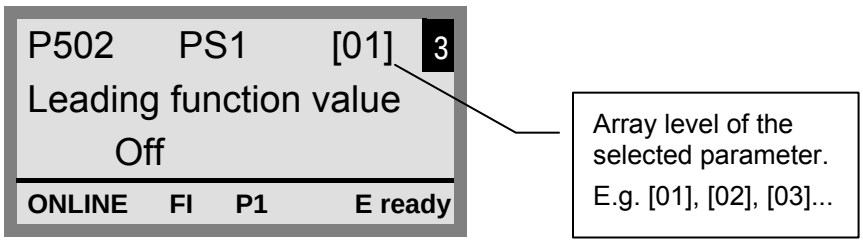
If the setting of a parameter is changed, then the value flashes intermittently until confirmed with the ENTER key. In order to retain the factory settings for the parameter being edited, both VALUE keys must be operated simultaneously. Even in this case, the setting must be confirmed with the ENTER key in order for the change to be stored.

If the change is not to be stored, then pressing one of the SELECTION keys will call up the previously stored value and pressing a SELECTION key again will exit the parameter.



NOTE: The lowest line in the display is used to display the current status of the box and the frequency inverter being controlled.

NOTE: Some parameters P502, P701 to 706, P707, P718, P741/742 and P745/746 also have an array-level in which further settings can be made. The required array level must first be selected (see parameterisation, Section 5) and confirmed with ENTER. The required parameter setting can now be made.



3.2.4 ParameterBox parameters

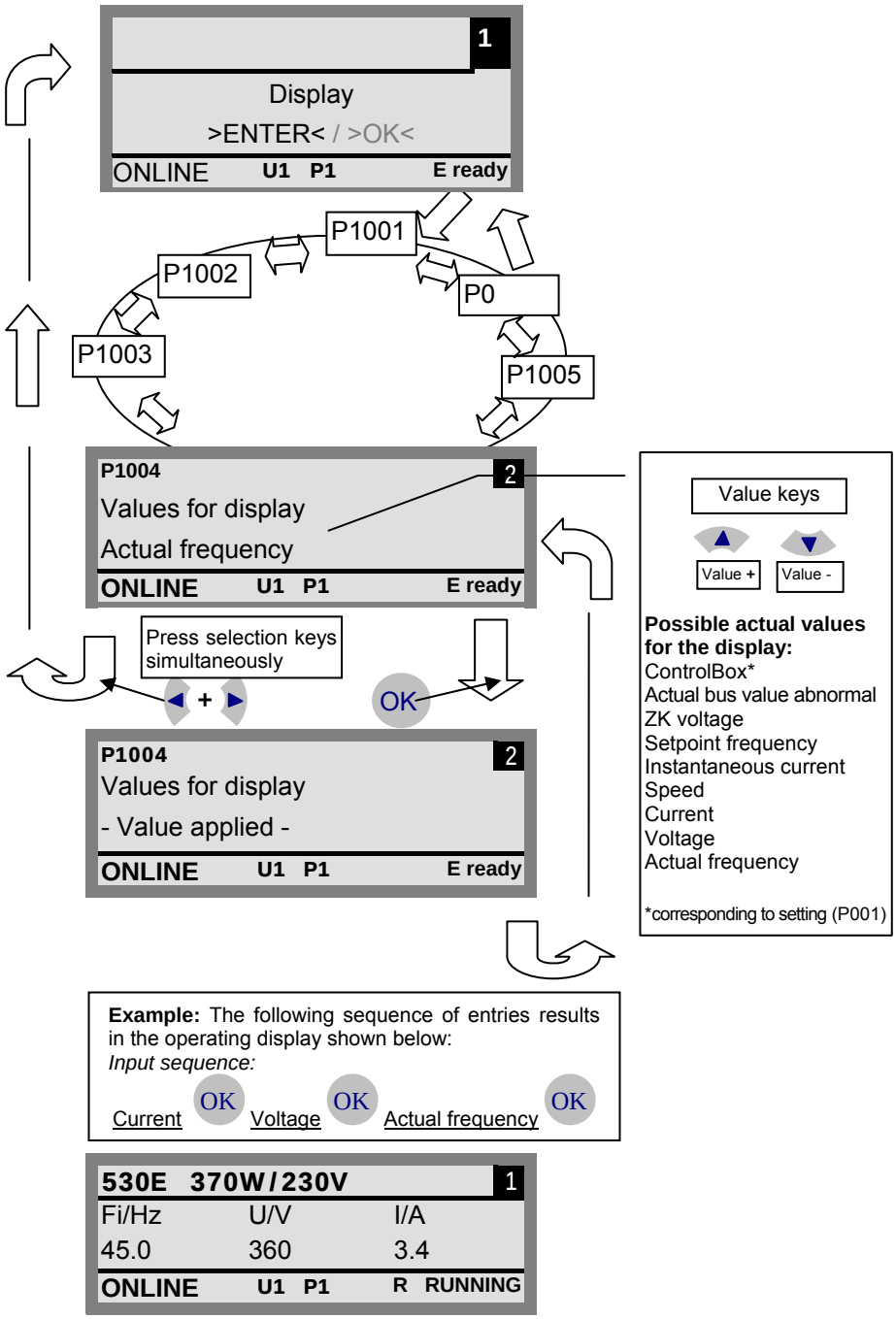
The following main functions are assigned to the menu groups:

Menu group	No.	Master function
Display	(P10xx):	Selection of operating values and display layout
Parametrierung	(P11xx):	Programming of the connected inverter and all storage media
Parameter administration	(P12xx):	Copying and storage of complete parameter sets from storage media and inverters
Options	(P14xx):	Setting the ParameterBox functions and all automatic processes

Parameter display

Parameter	Setting value / Description / Note
P1001	**Bus scan**
Off / Start [Off]	A bus scan is initiated with this parameter. During this process a progress indicator is shown in the display. After a bus scan, the display reverts to the basic menu. Parameter P1001 is reset to “Off”. Depending on the result of this process, the ParameterBox goes into the "ONLINE" or "OFFLINE" operating mode.
P1002	**FI selection**
FI and S1 … S5 [FI]	Selection of the current item to be parameterised/controlled. The display and further operating actions refer to the item selected. In the inverter selection list, only those devices detected during the bus scan are shown. The current object appears in the status line.
P1003	**Display mode**
Value range: *see right hand column* [Standard]	Selection of the operating values display for the ParameterBox Standard — any 3 values next to each other List — Any 3 values with units below each other Large display — 1 value with unit ControlBox — 1 value without unit
P1004	**Values for display**
Value range: *see right hand column* [Actual frequency]	Selection of a display value for the actual value display of the ParameterBox. The value selected is placed in the first position of an internal list for the display value and is then also used in the Large Display mode. According to the setting in parameter 8P1003) up to 3 operating values can be selected for display. The selection is made in sequence, whereby the last selected value is inserted from the left or at the top of the display.

Parameter	Setting value / Description / Note



Note: According to the version, the display or keyboard symbols vary between “OK” “ENTER” or “⏲“.

P1005	Standardisation factor
-327.67 … +327.67 [1.00]	The first value on the display list is scaled with the standardisation factor. If this standardisation factor deviates from 1.00, the unit of the scaled value is no longer displayed.

Parameterisation

Parameter	Setting value / Description / Note
P1101	**Object selection**
FI and S1 … S5 […]	Selection of the object to be parameterised. The ongoing parameterisation process relates to the object selected. Only the devices and storage objects recognised during the bus scan are available in the selection list. This **parameter is not shown** if only one device is recognised and there is no storage object available.

Parameter administration

Parameter	Setting value / Description / Note
P1201	**Copy - Source**
FI and S1 … S5 […]	Selection of the current source object to be copied. In the selection list, only the frequency inverters and storage objects detected during the bus scan are shown.
P1202	**Copy - Target**
FI and S1 … S5 […]	Selection of current target object to copy. In the selection list, only the frequency inverters and storage objects detected during the bus scan are shown.
P1203	**Copy - Start**
Start / Off [Off]	This parameter triggers a process, whereby all the parameters selected in >Copy – Source< are transferred to the object specified in the >Copy – Target< parameter. If there is a possibility of overwriting data (e.g. for the transfer of data from a memory to a connected inverter) an additional confirmation window is displayed. The transfer starts after confirmation.
P1204	**Load default values**
FI and S1 … S5 […]	In this parameter, the default settings are written to the parameters of the selected item. This function is particularly important when editing storage objects. It is only via this parameter that a hypothetical inverter can be loaded and processed with the ParameterBox.
P1205	**Delete memory**
S1 ... S5 [S1]	In this parameter the data in the selected storage medium is deleted.

Options

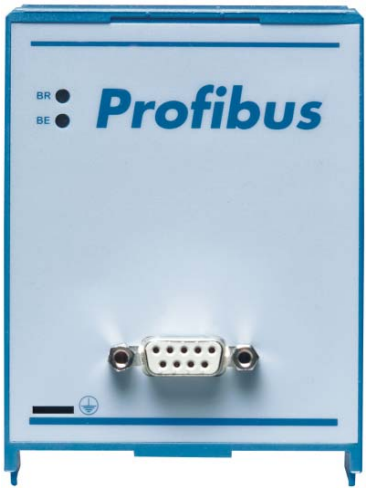
Parameter	Setting value / Description / Note
P1301	**Language**
Value range: *see right hand column* […]	Selection of languages for operation of the ParameterBox Available languages: German, English, Dutch, French, Spanish, Swedish
P1302	**Operating mode**
Value range: *see right hand column* [Online]	Selection of the operating mode for the NORDAC ParameterBox • **Offline:** The *ParameterBox* is operated autonomously. No PC or frequency inverter is connected. The storage objects of the ParameterBox can be parameterised and administrated. • **Online:** One or more inverters are located at the interface of the *ParameterBox*. The frequency inverter can be parameterised and controlled. When changing to the “ONLINE” operating mode, a bus scan is started automatically. • **PC slave:** Only possible with ParameterBox SK PAR-2H/ -2E or SK PAR-3H.
P1303	**Automatic bus scan**
On, Off [On]	Setting the switch-on characteristics. • **Off** No bus scan is carried out, the frequency inverters connected before the switch-off are located after switching on. If the connection configuration has been changed (e.g. a different inverter has been connected), error 223 is generated. • **On** A bus scan is automatically implemented when the ParameterBox is switched on.
P1304	**Contrast**
0 ... 100 % [50]	Contrast setting of the ParameterBox display
P1305	**Set password**
0 ... 9999 [0]	The user can set up a password in this parameter. If a value other than 0 has been entered in this parameter, then the settings of the ParameterBox or the parameters of the connected frequency inverter cannot be altered.
P1306	**Box password**
0 ... 9999 [0]	If the password function is to be reset, the password selected in the >Set Password< parameter must be entered here. If the correct password is selected, all of the ParameterBox functions and the parameters of the connected frequency inverter can be used again. **NOTE:** In case the password is not known and parameterisation of the inverter needs to be carried out, please contact our Technical Support.
P1307	**Reset Box parameter**
Start, Off [Off]	With this parameter the *ParameterBox* can be reset to the default setting. All ParameterBox settings and the data in the storage media will be deleted.
P1308	**NORDAC p-box**
Version ... R … […]	Displays the software version of the ParameterBox. Please keep to hand.

3.2.5 ParameterBox error messages

Display Error number	Fault text in the Parameter Box	Cause • Remedy
Communication error		
200	Illegal parameter number	These error messages are due to EMC interferences or differing software versions of the participants. • Check the software version of the ParameterBox and that of the connected frequency inverter. • Check the cabling of all components, regarding possible EMC interference
201	Parameter value cannot be changed	
202	Parameter value out of range	
203	Faulty SUB Index	
204	No Array parameter	
205	Incorrect parameter type	
206	Incorrect response identifier USS interface	
207	Checksum error of USS interface	Communication between frequency inverter and ParameterBox is faulty (EMC), safe operation cannot be guaranteed. • Check the connection to the frequency inverter. Use a shielded cable between the devices. Route the BUS leads separately from the motor cables.
208	Incorrect status identifier USS interface	Communication between frequency inverter and ParameterBox is faulty (EMC), safe operation cannot be guaranteed. • Check the connection to the frequency inverter. Use a shielded cable between the devices. Route the BUS leads separately from the motor cables.
209	Inverter not responding	The ParameterBox is waiting for a response from the connected frequency inverter. The waiting time has elapsed without a response being received. 5. Check the connection to the frequency inverter. The settings of the USS parameters for the frequency inverter were changed during operation.
Identification errors		
220	Unknown device	Device ID not found. The connected inverter is not listed in the database of the ParameterBox; no communication can be established. • Please contact your Getriebebau Nord Representative.
221	Software version not recognised	The software of the connected frequency inverter is not listed in the ParameterBox database, no communication can be set up. • Please contact your Getriebebau Nord Representative.
222	Inverter extension level not recognised	An unknown module has been detected in the frequency inverter (Customer interface / Special extension). • Please check the modules installed in the frequency inverter • If necessary, check the software version of the ParameterBox and the frequency inverter.
223	Bus configuration has changed	After restoring the last Bus configuration, a device is reported that is different from the one stored. This error can only occur if the parameter >Auto. Bus Scan< is set to OFF and another device has been connected to the ParameterBox. • Activate the automatic Bus scan function.
224	Device is not supported	The inverter type entered in the ParameterBox is not supported! The ParameterBox cannot be used with this frequency inverter.
225	The connection to the inverter is blocked	Access to a device that is not online (previous Time Out error). **0 =** Carry out a bus scan via the parameter >Bus Scan< (P1001).

Display Error number	Fault text in the Parameter Box	Cause • Remedy
ParameterBox operating error		
226	Source and target are different devices	Copying objects of different types (from / to different inverters) is not possible.
227	Source is empty	Copying of data from a deleted (empty) storage medium
228	This combination is not permitted	Target and source for the copying function are the same. The command cannot be carried out.
229	Object selected is empty	Parameterisation attempt of a deleted storage medium
230	Different software versions	Warning Copying objects with different software versions can lead to problems when transferring parameters.
231	Invalid password	Attempt to alter a parameter without a valid Box password being entered in parameter >Box Password< P 1306.
232	Bus scan only during operation: online	• A bus scan (search for a connected frequency inverter) is only possible when in ONLINE mode.
Warnings		
240	Overwrite data? ☐ Yes No	These warnings indicate that there is a possibly significant change which needs additional confirmation. Once the next procedure has been selected, it must be confirmed with the "ENTER" key.
241	Delete data? ☐ Yes No	
242	Move SW version? ☐ Next Cancel	
243	Move series? ☐ Next Cancel	
242	Delete all data? ☐ Yes No	
Inverter control error		
250	This function is not enabled	The function requested is not enabled at the frequency inverter parameter interface. • Change the value of the parameter >Interface< of the connected inverter to the required function. More detailed information can be obtained from the operating instructions for the frequency inverter.
251	Control command was not successful	The control command cannot be implemented by the frequency inverter, as a higher priority function, e.g. Quick stop or an OFF signal to the control terminals of the frequency inverter is present.
252	Control is not possible offline	Call up of a control function in Offline mode. • Change the operating mode of the ParameterBox in the parameter >Operating Mode< P1302 to Online and repeat the action.
253	Error acknowledgement not successful	The acknowledgement of an error at the frequency inverter was not successful, the error message remains.
Error message from inverter		
Inverter error number	Inverter error text	A fault has occurred in the inverter with the number displayed. The inverter error number and text are displayed.

3.2.6 Profibus module, SK TU3-PBR, …-24V



A large number of different automation devices can exchange data using Profibus. PLC's, PC's, operating and monitoring devices can all communicate via a uniform bus in serial bit mode.

Data exchange is specified in DIN 19245 Part 1 and 2 and application specific upgrades in Part 3 of this standard. Within the European field bus standardisation process, Profibus is integrated into the European field bus standard pr EN 50170.

The termination resistor for the last bus participant is located in the Profibus standard plug.

The module SK TU3-PBR does not require an external supply voltage, as it is supplied internally by the frequency inverter. Because of this, bus communication is only possible if the frequency inverter is connected to the mains, or for devices with an external low voltage supply (SK 5x5E), the 24V control voltage is available.

The module SK TU3-BPR-24V requires an external 24V supply, and can therefore be operated even if the frequency inverter is not connected to the mains, or the module is not plugged into the inverter.

Detailed information can be found in the operating instructions **BU 0020** or contact the supplier of the frequency inverter.

Profibus status LEDs	BR (green)	BUS ready
	BE (red)	BUS error

3.2.7 CANopen module, SK TU3-CAO

The CANopen interface on the NORDAC frequency inverter enables the parameterisation and control of the devices in accordance with standardised CANopen specifications

Up to 127 participants can be addressed on a single Bus. A termination resistor is integrated and can be switched on.

The transfer rate (10kBaud and 500kBaud) and the Bus addresses are set using rotary coding switches or the applicable parameters.

Detailed information can be found in the operating instructions **BU 0060,** or contact the supplier of the frequency inverter.

CANopen Status LEDs	CR (green)	CANopen RUN LED
	CE (red)	CANopen ERROR LED
Module status LEDs	DR (green)	Module status
	DE (red)	Module error

3.2.8 DeviceNet module, SK TU3-DEV

DeviceNet is an open communication profile for distributed industrial automation systems. It is based on the CANbus system.

Up to 64 participants can be linked to one Bus system.

The transfer rate (125. 250. 500 kBit/s) and the Bus addresses are set using rotary coding switches or the applicable parameters.

Detailed information can be found in the operating instructions **BU 0080**, or contact the supplier of the frequency inverter.

DeviceNet status LEDs	MS (red/green)	Module status
	MS (red/green)	Mains (bus) status
Module status LEDs	DS (green)	Module status
	DE (red)	Module error

3.2.9 InterBus module, SK TU3-IBS

With InterBus up to 256 participants with different automation devices can exchange data. PLC's, PC's, operating and monitoring devices can all communicate via a uniform bus in serial bit mode.

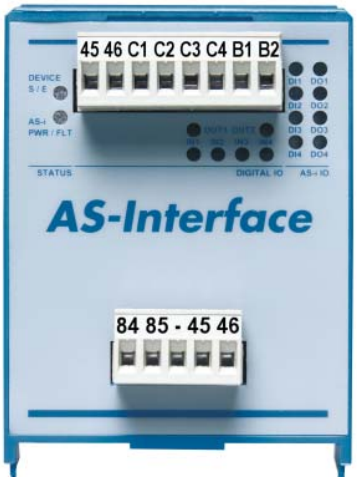
NORDAC frequency inverters are remote bus participants. The data width is variable (3 words; 5 words), at a baud rate of 500kBit/s (optional 2Mbit/s). An additional termination resistor is not necessary as it is already integrated. Addressing is carried out automatically by means of the physical arrangement of the participants.

An external 24V supply is required for uninterrupted Bus operation.

Detailed information can be found in the operating instructions **BU 0070**, or contact the supplier of the frequency inverter.

Module status LEDs	ST (red/green)	Module error/ready
InterBus status LEDs	UL (green)	Supply voltage applied
	RC (green)	Remote Check, remote bus to previous InterBus device is OK.
	BA (green)	Bus Active, InterBus data are being exchanged (Bus running).
	RD (yellow)	Remotebus Disabled, remote bus to next InterBus device is switched off.
	TR (green)	Transmit, data is being transferred from/to participants

3.2.10 SK TU3-AS1, AS interface



The **A**ctuator-**S**ensor-**Interface** (AS interface) is a bus system for the simple field bus level. The transmission principle is a single master system with cyclical polling. A maximum of 31 slaves (or 62 A/B slaves) can be operated on an up to 100m long unshielded two-wire cable in any network structure (tree/line/star).

The AS interface cable (yellow) transmits data and energy while a second two-wire cable can be used for a small auxiliary voltage (24V). Addressing is implemented via the master, which can also provide other management functions, or via a separate addressing device. The 4 bit reference data (per direction) are cyclically transmitted with an effective error protection at a maximum cycle time of 5ms. Transmission of larger data volumes is also possible with some slave profiles (e.g. slave profile 7.4). The bus system is defined in the *AS Interface Complete Specification*.

Detailed information can be found in the operating instructions **BU 0090**, or contact the supplier of the frequency inverter.

Status LEDs	**Device S/E** (red/green)	Module status/error
	AS- Int. PWR/FLT (red/green)	Standard status display for AS interface slaves
Digital I/O LEDs	**OUT 1 … 2** (yellow)	Status of the AS interface bits, which are received/transmitted from the Master.
	IN 1 ... 4 (yellow)	
AS-i I/O LEDs	**DI 1 ...** 4 (yellow)	Status at digital input/output.
	DO 1 ... 4 (yellow)	

3.2.11 PotentiometerBox, SK TU3-POT

The frequency inverter can be controlled directly from the device using the PotentiometerBox. No additional external components are required.

The motor can be started, stopped and the direction of rotation changed by means of the buttons. The LEDs indicate the status of the inverter.

The required setpoint value of the frequency is adjusted with the potentiometer after it has been enabled (green button).

If an inactive error of the frequency inverter is present (red LED flashing), this can be acknowledged by pressing the STOP key

Note: The PotentiometerBox must be activated via parameter P549 “PotentiometerBox Function” using the setting {4} “Frequency addition”.

I/O key	**START/STOP** (green/red)	To enable or block the output signal.	
Potentiometer	**0…100%**	Sets the output frequency beween f_{min} (P104) and f_{max} (P105).	
Red LED	off		No error
	flashing		Inactive error
	on		Active error
Green LED	off		Frequency inverter switched off, enabled with rotation direction to the right
	flashing 1: briefly on, longer period off		Frequency inverter switched off, enabled with rotation direction to the left
	flashing 2: briefly on, briefly off		Inverter switched on with direction of rotation to the left
	on		Inverter switched on with direction of rotation to the right

4 Commissioning

Once the voltage supply has been connected to the frequency inverter, it will be operational after a few moments. In this state, the frequency inverter can be set to the requirements of the application, i.e. it can be configured. A completely comprehensive description of all the parameters is set out in Section 5.

The connected motor may only be started after the parameters specific to the application in question have been set by qualified personnel.

ATTENTION

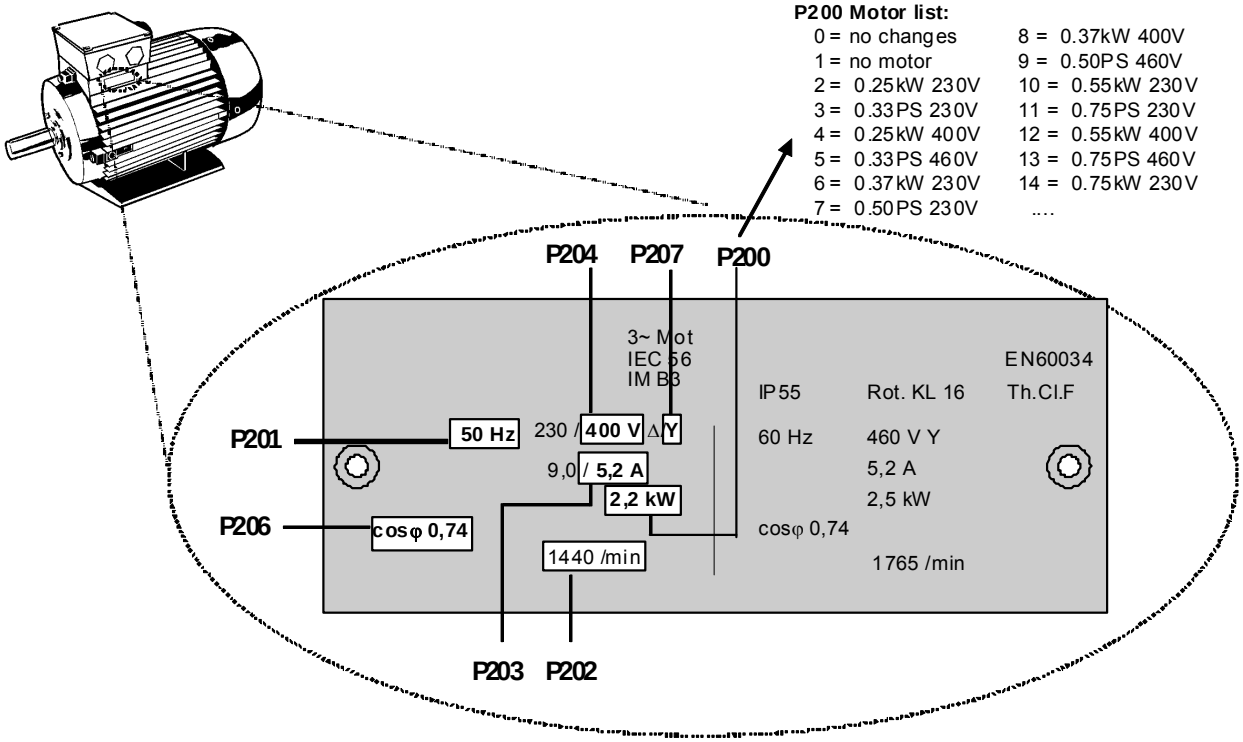
DANGER TO LIFE!

The frequency inverter is not equipped with a line master switch and is therefore always live when connected to the power supply. Live voltages may therefore be connected to a connected motor at standstill.

4.1 Factory settings

All frequency inverters supplied by Getriebebau NORD are pre-programmed with the default setting for standard applications with 4 pole standard motors (same voltage and power). For use with motors with other powers or number of poles, the data from the rating plate of the motor must be input into the parameters P201...P207 under the menu item >Motor data< <.

NOTE: All motor data can be pre-set using the parameter P200. After use of this function has been successful, this parameter is reset to *0 = no change*! The data is loaded automatically into parameters P201...P209 – and can be compared again with the data on the motor rating plate.



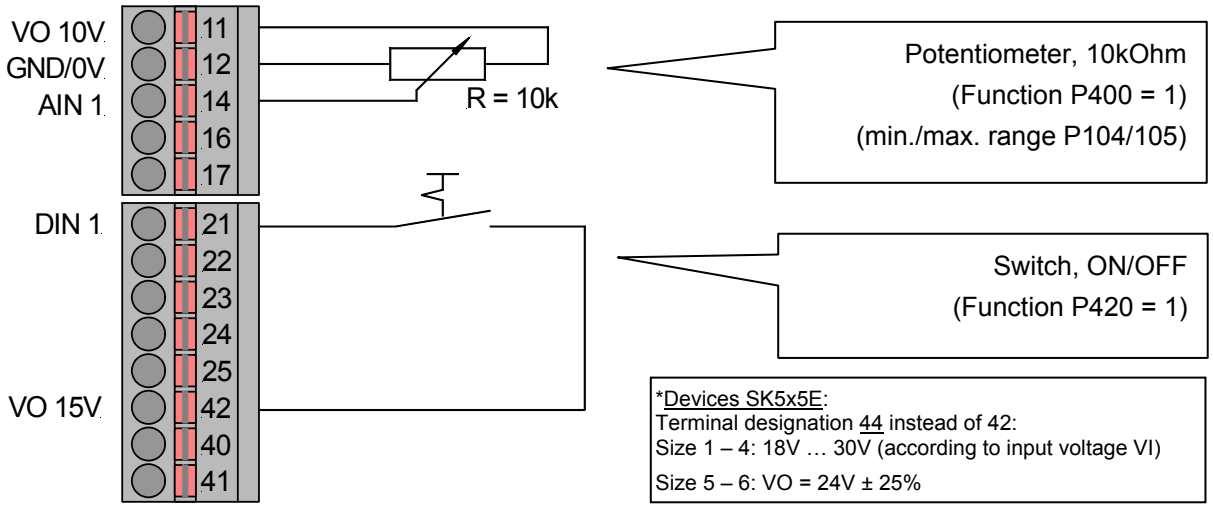
RECOMMENDATION: For the correct operation of the drive unit, it is necessary to input the motor data (rating plate) as precisely as possible. In particular, an automatic stator resistance measurement using parameter P220 is recommended.

In order to automatically determine the stator resistance, set P220 = 1 and confirm by pressing "ENTER". The value calculated for the line resistance (dependent upon P207) will be saved in P208.

4.2 Minimum configuration of control connections

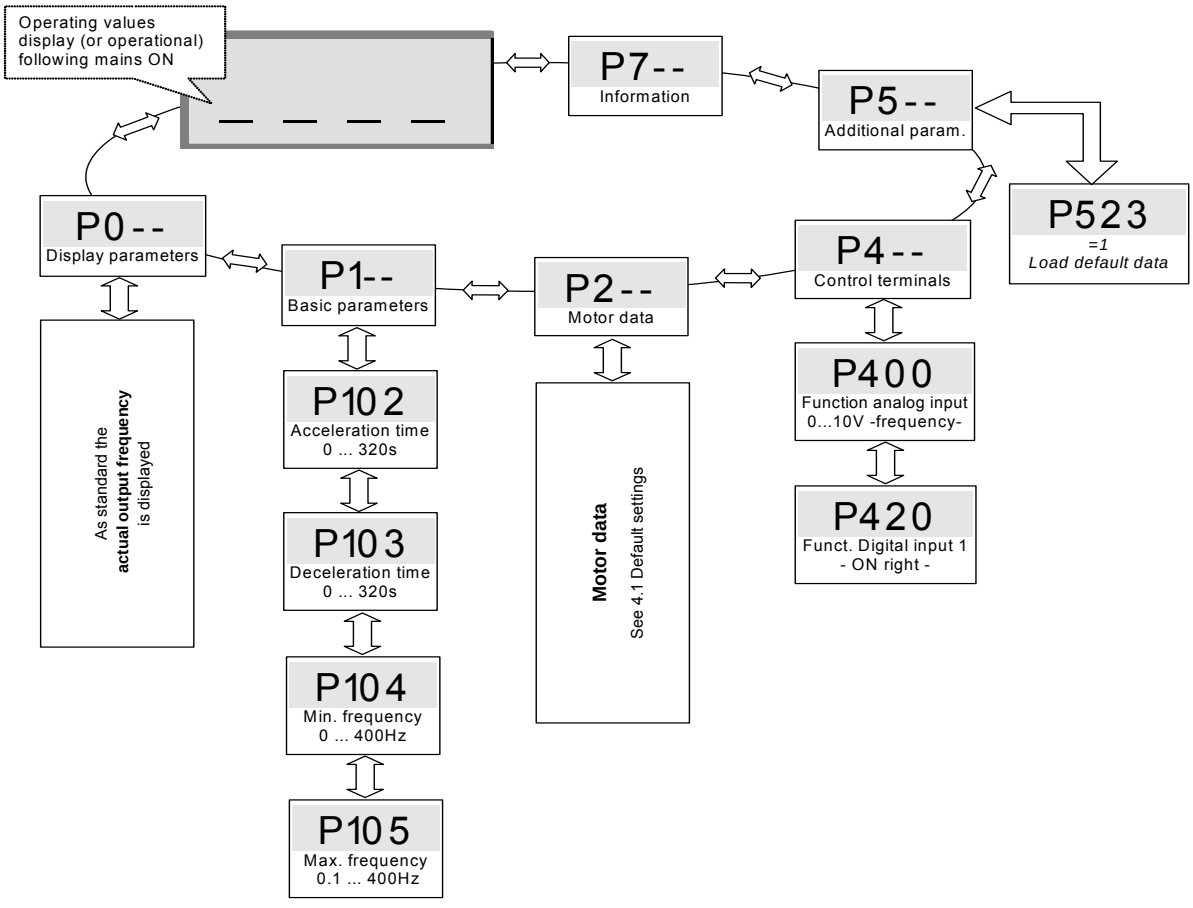
If the frequency inverter is to be controlled via the digital and analog inputs, this can be implemented immediately in the condition as delivered. Settings are not necessary for the moment.

Minimum circuitry



Basic parameters

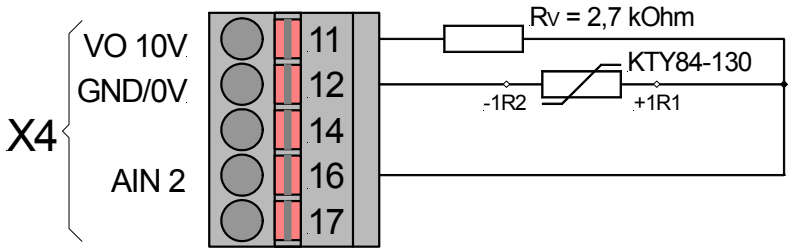
If the current setting of the frequency inverter is not known, loading the default setting is recommended → P523 = 1. The inverter is pre-programmed for standard applications in this configuration. If necessary, the following parameters can be adjusted with the optional SimpleBox SK CSX-0 or ControlBox TY3-CTR:



4.3 KTY84-130 Connection (software version 1.7 and above)

The current vector regulation of the SK 500E series can be further optimised by the use of a KTY84-130 temperature sensor ($R_{th(0°C)}$=500Ω, $R_{th(100°C)}$=1000Ω). In particular there is the advantage that after an intermediate mains switch-off during operation the temperature of the motor is measured directly and therefore the actual value is always available to the frequency inverter. With this, the regulator can always achieve an optimum precision of speed.

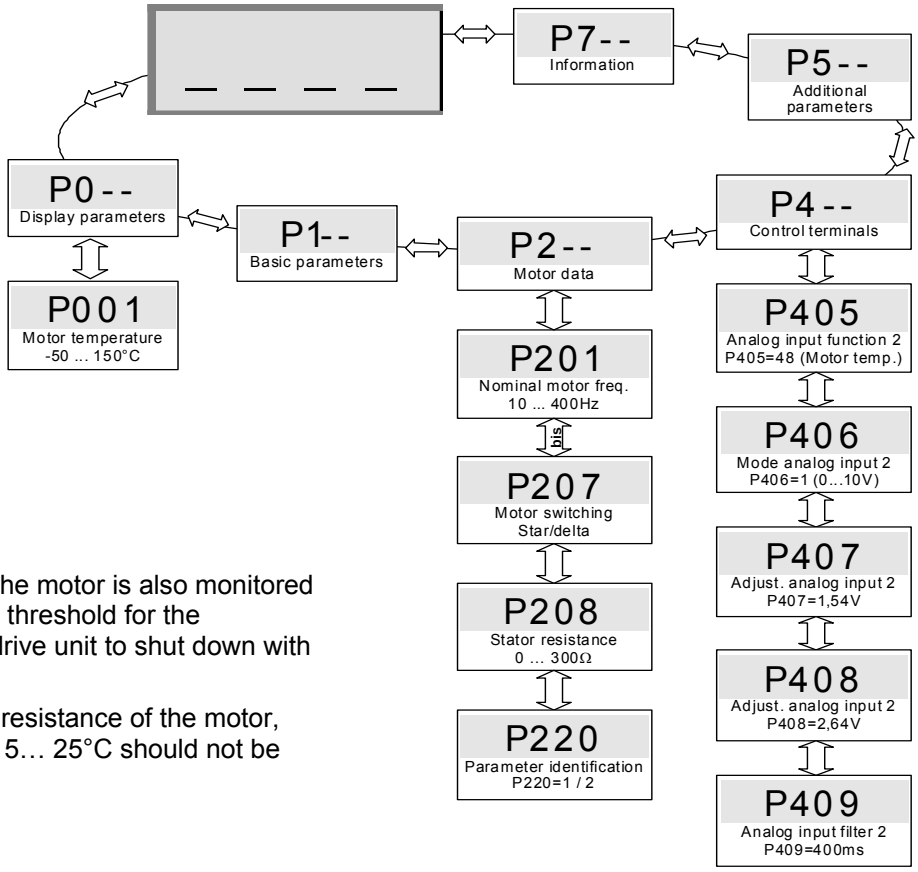
Connections (Analog input 2)



Parameter settings (Analog input 2)

The following parameters must be set for the function of the KTY84-130.

1. The motor data **P201-P207** must be set according to the rating plate.
2. The motor stator resistance P208 is determined at 20°C with **P220=1**.
3. Function analog input 2, **P405=48** (Motor temperature)
4. The mode for analog input 2, **P406=1** (negative temperatures are also measured)
5. Adjustment of analog input 2: **P407=1,54V** and **P408=2,64V** (for R_V= 2.7 kOhm)
6. Adjust time constants: **P409=400ms** (Filter time constant is a maximum)
7. Motor temperature control: P001=23 (Temperature display, operation display SK TU3-CTR / SK CSX-0



Note

1. Excess temperature of the motor is also monitored and at 155°C (switching threshold for the thermistor) causes the drive unit to shut down with error message E002.
2. To determine the stator resistance of the motor, the temperature range 15… 25°C should not be exceeded.

4.4 Frequency addition and subtraction via operating boxes

(Software version 1.7 and above)

If the parameter P549 (PotentiometerBox Function) is set to 4 “Frequency addition” or 5 “Frequency subtraction”, a value can be added or subtracted via the **value keys** or with the ControlBox or the ParameterBox.

If the ENTER key is confirmed, the value is saved in P113. The next time the device is started, the value will be added or subtracted immediately.

As soon as the inverter is enabled, the ControlBox switches to the operating display. With the ParameterBox, a change of value can only be made in the operating display. If the ControlBox is enabled, parameterisation is no longer possible. Enabling via the ControlBox or ParameterBox is also no longer possible in this mode, even if P509 = 0 and P510 = 0.

Note: In order to safely activate the ParameterBox in this mode, the STOP key must be pressed once.

5 Parameterisation

Every frequency inverter is factory-set for a motor of the same power. All parameters can be adjusted "online". There are four switchable parameter sets available during operation. As delivered, all parameters are visible; however, some can be hidden with parameter P003.

NOTE: As there are dependencies between parameters, it is possible for invalid internal data and operating faults to be generated briefly. Only the inactive or non-critical parameter sets should be adjusted during operation.

The individual parameters are combined in various parameter sets. The first digit of the parameter number indicates the assignment to a **Menu Group**.

Menu group	No.	Master function
Operating displays	**(P0--):**	For the selection of the physical units of the display value.
Basic parameters	**(P1--):**	Contain the basic inverter settings, e.g. switch on and switch off procedures and, along with the motor data, are sufficient for standard applications.
Motor data	**(P2--):**	Settings for the motor-specific data, important for ISD current control, and selection of characteristic curve during the setting of dynamic and static boost.
Control parameters **(only with SK 520E/53xE)**	**(P3--):**	Settings for the control parameters (current controller, speed controller etc.) with speed feedback in SK 520E/53xE.
Control terminals	**(P4--):**	Analog input and output scaling, specification of digital input and relay output functions, as well as PID controller parameters.
Additional parameters	**(P5--):**	Functions dealing with e.g. the interface, pulse frequency or error acknowledgement.
Positioning **(only with SK 53xE)**	**(P6--):**	Adjustment of the positioning function in SK 53xE. Additional information is contained in the manual **BU 0510**.
Information	**(P7--):**	Display of e.g. actual operating values, old error messages, equipment status reports or software version.
Array parameter:	**-01** **...** **-xx**	Some parameters in these groups can be programmed and read in several levels (arrays). After the parameter is selected, the array level must also be selected.

NOTE: Parameter P523 can be used to load the factory settings for all parameters at any time. This can be helpful, e.g. during the commissioning of a frequency inverter whose parameters no longer correspond with the factory settings.

ATTENTION

All parameter settings will be lost, if P523= 1 is set and confirmed with "ENTER".

To safeguard the actual parameter settings, these can be transferred to the ControlBox (P550=1) or ParameterBox memories

Availability of the parameters

Due to certain configurations, the parameters are subject to certain conditions. The following tables (from Section. 5.1 onwards) list all parameters together with the particular information.

example

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P000 ... - 01 **... - 02** **...**	**Operating parameter display**	**520E**	**S**	**P**
0.01 ... 9999 [0]	In the display of the SimpleBox (SK CSX-0) or the ControlBox (SK TU3-CTR, the operating value selected in parameter P001 is displayed *online*. Information about the operating status of the drive can be read out as required.			

Parameter Text

Array values

Parameter number

Parameter value range

Factory settings of parameter

Only available with types > SK 500E

Supervisor parameters (S) are dependent on the settings in P003

Parameter selection in P100 dependent on the parameter set

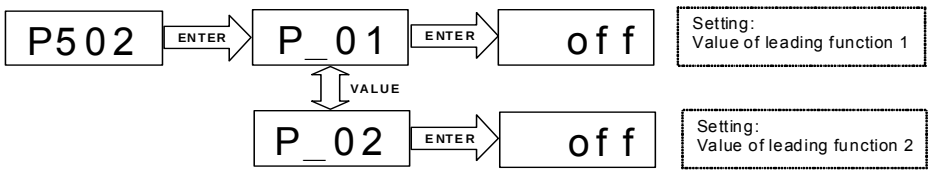
Array parameter display

Some parameters have the option of displaying settings and views in several levels (arrays). After the parameter is selected, the array level is displayed and must then also be selected.

If the ControlBox is used, the array level is shown by _ - 0 1. With the ParameterBox (picture on right) the selection options for the array level appear at the top left of the display.

ParameterBox SK TU3-PAR

For parameterisation with ControlBox SK TU3-CTR:



5.1 Operating display

Abbreviations used: **FI =** Frequency inverter

SW = Software version, stored in P707.

S = Supervisor parameters are visible or hidden dependent on P003.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P000	**Operating parameter display**			
0.01 ... 9999	In the display of the SimpleBox (SK CSX-0) or the ControlBox (SK TU3-CTR, the operating value selected in parameter P001 is displayed *online*. Information about the operating status of the drive can be read out as required.			
P001	**Select of display**			
0 ... 65 [0]	**1 =** **Actual frequency [Hz]:** the current output frequency being supplied by the FI. **2 =** **Rotation speed [1/min]:** the current rotation speed as calculated by the FI. **3 =** **Set frequency [Hz]:** the output frequency equivalent to the actual setpoint. This need not match the actual output frequency. **4 =** **Current [A]:** the actual output current measured by the FI. **5 =** **Torque current [A]:** the torque developing output current of the FI. **6 =** **Voltage [Vac]:** the actual alternating voltage being output by the FI. **7 =** **Link voltage [Vdc]:** the FI-internal DC voltage. Amongst other things, this depends on the level of the mains voltage. **8 =** **cos φ**: the current calculated value of the power factor. **9 =** **Apparent power [kVA]:** the current apparent power calculated by the FI. **10 =** **Effective power [kW]:** the current effective power calculated by the FI. **11 =** **Torque [%]:** the current torque calculated by the FI. **12 =** **Field [%]:** the current field in the motor calculated by the FI. **13 =** **Operating hours:** time that voltage is applied to the FI network. **14 =** **Operating hours enabled:** time the FI is enabled. **15 =** **Analog input 1 [%]:** current value present at analog input 1 of the FI. **16 =** **Analog input 2 [%]:** current value present at analog input 2 of the FI. **17 =** **... 18 reserved for SK 530E → BU 0510** **19 =** **Heat sink temperature [°C]: current temperature of the FI heat sink.** **20 =** **Motor load [%]: average motor load, based on the known motor data (P201...P209).** **21 =** **Braking resistor load [%]: average braking resistor load, based on the known resistance data (P556...P557).** **22 =** reserved **23 =** **Motor temperature,** measured via KTY-84. Details in Section 4.3 **24 =** **... 29 reserved for SK 530E → BU 0510** **30 =** **Current nominal value MP-S [Hz]:** current nominal value of the motor potentiometer function (saved) (P420…P426=71/72). The nominal value can be read out with this function or pre-set (without the drive running). **31 =** **…65 reserved for SK 530E → BU 0510**			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P002	**Display factor**		**S**	
0.01 ... 999.99 [1.00]	The selected operating value in parameter P001 >Select of display< is multiplied with the scaling factor in P000 and displayed in >Operating parameter display<. It is therefore possible to display system-specific operating such as e.g. the throughput quantity			
P003	**Supervisor code**			
0 ... 9999 [1]	**0 =** **The Supervisor** parameters are **not** visible. **1 =** **All parameters** are visible. **2 =** **Only the menu group 0** > Operating display< (P001 … P003) is visible. **3 =** ... 9999, as for setting value 2.			

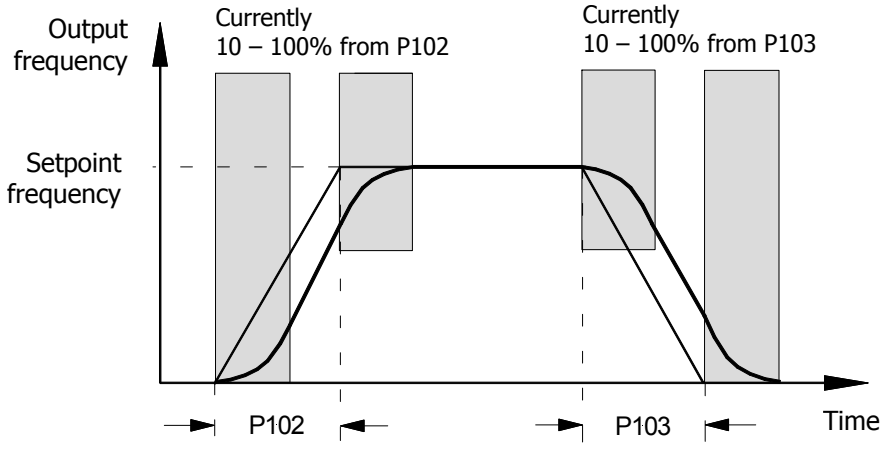
5.2 Basic parameters

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P100	**Parameter set**		**S**	
0 ... 3 [0]	Selection of the parameters sets to be parameterised. Four parameters sets are available. All parameter set-dependent parameters are identified by **P**. The selection of the operating parameter set is performed via a digital input or the Bus control. Switching can take place during operation (online).			

Setting	Digital input function [8]	Digital input function [17]	LEDs ControlBox
0 = Parameter set 1	LOW	LOW	1 ● 2 ●
1 = Parameter set 2	HIGH	LOW	1 ☀ 2 ●
2 = Parameter set 3	LOW	HIGH	1 ● 2 ☀
3 = Parameter set 4	HIGH	HIGH	1 ☀ 2 ☀

If enabled via the keyboard (ControlBox, PotentiometerBox or ParameterBox), the operating parameter set will match the settings in P100.

P101	**Copy parameter set**		**S**	
0 ... 4 [0]	After confirmation with the ENTER key, a copy of the parameter set selected in P100 >Parameter set< is written to the parameter set dependent on the value selected here **0 =** Do not copy **1 =** Copies the active parameter set to parameter set 1 **2 =** Copies the active parameter set to parameter set 2 **3 =** Copies the active parameter set to parameter set 3 **4 =** Copies the active parameter set to parameter set 4			
P102	**Acceleration time**			**P**
0 ... 320.00 s [2.00]	Acceleration time is the time corresponding to the linear frequency rise from 0Hz to the set maximum frequency (P105). If an actual setpoint of <100% is being used, the acceleration time is reduced linearly according to the setpoint set. The acceleration time can be extended by certain circumstances, e.g. FI overload, setpoint lag, smoothing, or if the current limit is reached.			
P103	**Deceleration time**			**P**
0 ... 320.00 s [2.00]	Deceleration time is the time corresponding to the linear frequency reduction from the set maximum frequency (P105) to 0Hz. If a current nominal value <100% is used, the deceleration time reduces accordingly. The deceleration time can be extended by certain circumstances, e.g. by the selected >Switch-off mode< (P108) or >Ramp smoothing< (P106).			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P104	**Minimum frequency**			**P**
0.0 ... 400.0 Hz [0.0]	The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set. In combination with other setpoints (e.g. analog setpoint of fixed frequencies) these are added to the set minimum frequency. This frequency is undershot when a. the drive is accelerated from standstill. b. the FI is blocked. The frequency then reduces to the absolute minimum (P505) before it is blocked. c. the FI is reversing. The reverse in the rotation field takes place at the absolute minimum frequency (P505). This frequency can be continuously undershot if, during acceleration or braking, the function "Maintain frequency" (Function Digital input = 9) is executed.			
P105	**Maximum frequency**			**P**
0.1 ... 400.0 Hz [50.0]	The frequency supplied by the FI after being enabled and once the maximum setpoint is present, e.g. analog setpoint as per P403, a correspondingly fixed frequency or maximum via the ControlBox. This frequency can only be overshot by the slip compensation (P212), the function "Maintain frequency" (function digital input = 9) or a change to another parameter set with lower maximum frequency.			
P106	**Ramp smoothing**		**S**	**P**
0 ... 100 % [0]	This parameter enables a smoothing of the acceleration and braking ramps. This is necessary for applications where gentle, but dynamic speed change is important. Ramp smoothing is carried out for every setpoint change. The value to be set is based on the set acceleration and deceleration time, however values <10% have no effect. The following then applies for the entire acceleration or deceleration time, including rounding: $t_{tot\ \text{ACCELERATION TIME}} = t_{P102} + t_{P102} \cdot \frac{P106\,[\%]}{100\%}$ $t_{tot\ \text{DECELERATION TIME}} = t_{P103} + t_{P103} \cdot \frac{P106\,[\%]}{100\%}$ 			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P107	**Brake reaction time**			**P**

0 ... 2.50 s

[0.00]

Electromagnetic brakes have a physically-dependent delayed reaction time when applied. This can cause a dropping of the load for lifting applications, as the brake only takes over the load after a delay.

This reaction time can be taken into account under parameter P107 (Braking control).

Within the adjustable application time, the FI supplies the set absolute minimum frequency (P505) and so prevents movement against the brake and load drop when stopping.

See also the parameter >Release time< P114

NOTE: For the control of electromagnetic braking (especially for lifting operations) an internal relay should be used, see Function 1, external brake (P434/441). The minimum absolute frequency (P505) should never be less than 2.0Hz.

NOTE: **If a time > 0 is set in P107 or P114**, at the moment the FI is switched on, the level of the excitation current (field current) is checked. If no megnetising current is present, the FI remains in magnetising mode and the motor brake is not released.

In order to achieve a shut-down and an error message (E016) in this case, P539 must be set to 2 or 3.

Recommendation for applications:
Lifting equipment with brake, without speed

P114 = 0.2...0.3sec.

P107 = 0.2...0.3sec.

P201…P208 = Motor data

P434 = 1 (ext. brake)

P505 = 2...4Hz

for safe start-up

P112 = 401 (off)

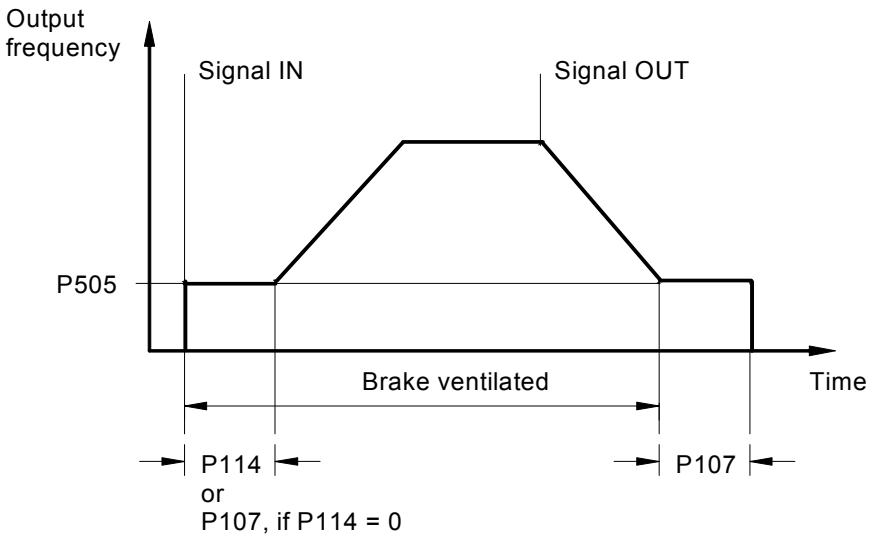
P536 = 2.1 (off)

P537 = 201 (off)

P539 = 2/3 (I_{SD} monitoring)

against load drops

P214 = 50...100% (precontrol)



Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P108	**Disconnection mode**		**S**	**P**

0 ... 12

[1]

This parameter determines the manner in which the output frequency is reduced after "Blocking" (controller enable → low).

0 = **Voltage block:** The output signal is switched off immediately. The FI no longer supplies an output frequency. In this case, the motor is braked only by mechanical friction. Immediately switching the FI on again can lead to an error message.

1 = **Ramp:** The current output frequency is reduced in proportion to the remaining deceleration time, from P103/P105.

2 = **Ramp with delay:** as with ramp, however for generational operation the brake ramp is extended, or for static operation the output frequency is increased. Under certain conditions, this function can prevent overload switch off or reduce brake resistance power dissipation.

NOTE: This function must not be programmed if defined deceleration is required, e.g. with lifting mechanisms.

3 = **Immediate DC braking:** The FI switches immediately to the preselected DC current (P109). This DC current is supplied for the remaining proportion of the >DC brake time< (P110). Depending on the relationship, actual output frequency to max. quency (P105), the >DC braking time< is shortened. The time taken for the motor to stop depends on the application. The time taken to stop depends on the mass inertia of the load and the DC current set (P109).
With this type of braking, no energy is returned to the FI; heat loss occurs mainly in the motor rotor.

4 = **Constant braking distance:** The brake ramp is delayed in starting if the equipment is not being driven at the maximum output frequency (P105). This results in an approximately similar braking distance for different frequencies.

NOTE: This function cannot be used as a positioning function. This function should not be combined with ramp smoothing (P106).

5 = **Combined braking:** Dependent on the actual link voltage, a high frequency voltage is switched to the basic frequency (linear characteristic curves only, P211 = 0 and P212 = 0). The deceleration time is retained where possible (P103). → additional motor warming!

6 = **Quadratic ramp:** The brake ramp does not follow a linear path, but rather a decreasing quadratic one.

7 = **Quadratic ramp with delay:** Combination of functions 2 and 6

8 = **Quadratic combined braking:** Combination of functions 5 and 6

9 = **Constant acceleration power:** Only applies in field weakening range! The drive is accelerated or braked using constant electrical power. The course of the ramps depends on the load.

10 = **Distance calculator:** Constant distance between current frequency / speed and the set minimum output frequency (P104).

11 = **Constant acceleration power with delay: Combination of functions 2 and 9.**

12 = **Constant acceleration power with delay (as 11) with additional brake chopper support**

13 = **Ramp with switch-off delay** As for -1- **ramp**, however, after enabling has been removed, the drive unit remains at the set absolute minimum frequency (P505) for the time set in parameter P110 before the brake is applied and the usual braking procedure comes into effect.
Application example: Re-positioning for crane control *(Software version 1.7 R0 or higher)*

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P109	**DC brake current**		**S**	**P**
0 ... 250 % [100]	Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5). The correct setting value depends on the mechanical load and the required deceleration time. A higher setting brings large loads to a standstill more quickly. The 100% setting relates to a current value as stored in the >Nominal current< parameter P203. **NOTE:** The amount of DC current (0Hz) which the FI can supply is limited. For this value, plese refer to the table in Section 8.5.3, column: 0Hz. In the basic setting this limiting value is about 110%.			
P110	**Time DC brake on**		**S**	**P**
0.00 ... 60.00 s [2.00]	The time during which the motor has the current selected in parameter >DC brake current< applied to it during the DC braking functions (P108 = 3). Depending on the relationship, actual output frequency to max. quency (P105), the >Time DC brake on< is shortened. The time starts running with the removal of the enable and can be interrupted by fresh enabling.			
P111	**P factor torque limit**		**S**	**P**
25 ... 400 % [100]	Directly affects the behaviour of the drive at torque limit. The basic setting of 100% is sufficient for most drive tasks. If values are too high the drive tends to vibrate as it reaches the torque limit. If values are too low, the programmed torque limit can be exceeded .			
P112	**Torque current limit**		**S**	**P**
25 ... 400 % / 401 [401]	With this parameter, a limit value for the torque generating current can be set. This can prevent mechanical overloading of the drive. It cannot provide any protection against mechanical obstruction (movement to stops). A slipping clutch which acts as a safety device must be provided. The torque current limit can also be set over an infinite range of settings using an analog input. The maximum setpoint (compare adjustment 100%, P403/P408) then corresponds to the value set in P112. The limit value 20% of torque current cannot be undershot by a smaller analog setpoint (P400/405 = 2) (in servo mode with P300 = 1, not below 10%)! **401 = OFF** means the switch-off of the torque current limit! This is also the basic setting for the FI. **Note:** For lifting gear applications, a torque limit must not be used!			
P113	**Jog frequency**		**S**	**P**
-400.0 ... 400.0 Hz [0.0] *Change of function as of software version 1.7*	When using the **ControlBox or ParameterBox** to control the FI, the jog frequency is the initial value following successful enabling. Alternatively, when control is via the control terminals, the jog frequency can be activated via one of the digital inputs. The setting of the jog frequency can be done directly via this parameter or, if the FI is enabled via the keyboard, by pressing the ENTER key. In this case, the actual output frequency is set in parameter P113 and is then available for the next start. **NOTES:** **Software version V1.7 R0 and higher:** The activation of the jog frequency via one of the digital inputs causes the remote control to be switched off in case of bus operation. In addition, any setpoint frequencies present are not taken into account. Exception: analog setpoint values which are processed via the functions *Frequency addition* or *Frequency subtraction*. **Up to software version V1.6 R1:** Specified setpoints via the control terminals, e.g. jog frequency, fixed frequencies or analog setpoints, are generally added with the correct sign. The set maximum frequency (P105) cannot be exceeded, and the minimum frequency (P104) cannot be undershot.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P114	**Brake ventilation time**		**S**	**P**
0 ... 2.50 s [0.00]	Electromagnetic brakes have a delayed reaction time during release, which depends on physical factors. This can lead to the motor running while the brake is still applied, which will cause the inverter to switch off with an overcurrent report. This release time can be taken into account in parameter P114 (Braking control). During the adjustable release time, the FI supplies the set absolute minimum frequency (P505) thus preventing movement against the brake. See also the parameter >Brake reaction time< P107 (setting example). **NOTE:** If the brake ventilation time is set to "0", then P107 is the brake release and application time.			

5.3 Motor / characteristic curve parameters

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P200	**Motor list**			**P**
0 ... 53 [0]	The factory settings for the motor data can be edited with this parameter. The factory setting in parameters P201...P209 is a 4-pole DS standard motor with the nominal FI power setting. By selecting one of the possible digits and pressing the ENTER key, all motor parameters (P201…P209) are adjusted to the selected standard power. The basis for the motor data is a 4-pole DS standard motor			

0 = No change to data

1 = No motor: In this setting, the FI operates without current control, slip compensation and pre-magnetising time, and is therefore not recommended for motor applications. Possible applications are induction furnaces or other applications with coils and transformers. The following motor data is set here: 50.0Hz / 1500rpm / 15.0A / 400V / 0.00kW / cos φ=0.90 / Star / R_S 0,01Ω / I_{EMPTY} 6.5A

2 = 0.25kW 230V	**14 =** 0.75kW 230V	**26 =** 2.2 kW 230V	**40 =** 7.5 kW 230V
3 = 0.33HP = 230V	**15 =** 1.0 HP 230V	**27 =** 3.0 HP 230V	**41 =** 10.0 HP 230V
4 = 0.25kW 400V	**16 =** 0.75kW 400V	**28 =** 2.2 kW 400V	**42 =** 7.5 kW 400V
5 = 0.33HP = 460V	**17 =** 1.0 HP 460V	**29 =** 3.0 HP 460V	**43 =** 10.0 HP 460V
6 = 0.37kW 230V	**18 =** 1.1 kW 230V	**30 =** 3.0 kW 230V	**44 =** 11.0 kW 400V
7 = 0.50HP = 230V	**19 =** 1.5 HP 230V	**31 =** 3.0 kW 400V	**45 =** 15.0 HP 460V
8 = 0.37kW 400V	**20 =** 1.1 kW 400V	**32 =** 4.0 kW 230V	**46 =** 15.0 kW 400V
9 = 0.50HP = 460V	**21 =** 1.5 HP 460V	**33 =** 5.0 HP 230V	**47 =** 20.0 HP 460V
10 = 0.55kW 230V	**22 =** 1.5 kW 230V	**34 =** 4.0 kW 400V	**48 =** 18.5 kW 400V
11 = 0.75HP 230V	**23 =** 2.0 HP 230V	**35 =** 5.0 HP 460V	**49 =** 25.0 HP 460V
12 = 0.55kW 400V	**24 =** 1.5 kW 400V	**36 =** 5.5 kW 230V	**50 =** 22.0 kW 400V
13 = 0.75HP 460V	**25 =** 2.0 HP 460V	**37 =** 7.5 HP 230V	**51 =** 30.0 HP 460V
		38 = 5.5 kW 400V	**52 =** 30.0 kW 400V
		39 = 7.5 HP 460V	**53 =** 40.0 HP 460V

NOTE: As P200 returns to = 0 after the input confirmation, the control of the set motor can be implemented via parameter P205.

P201	**Nominal motor frequency**		**S**	**P**
10.0 ... 400.0 Hz [***]	The motor nominal frequency determines the rev/f break point at which the FI supplies the nominal frequency (P204) at the output.			
P202	**Nominal motor speed**		**S**	**P**
150 ... 24000 rpm [***]	The nominal motor speed is important for the correct calculation and control of the motor slip and the speed display (P001 = 1).			

****These settings are dependent on the nominal power of the FI or the selection in parameter P200.*

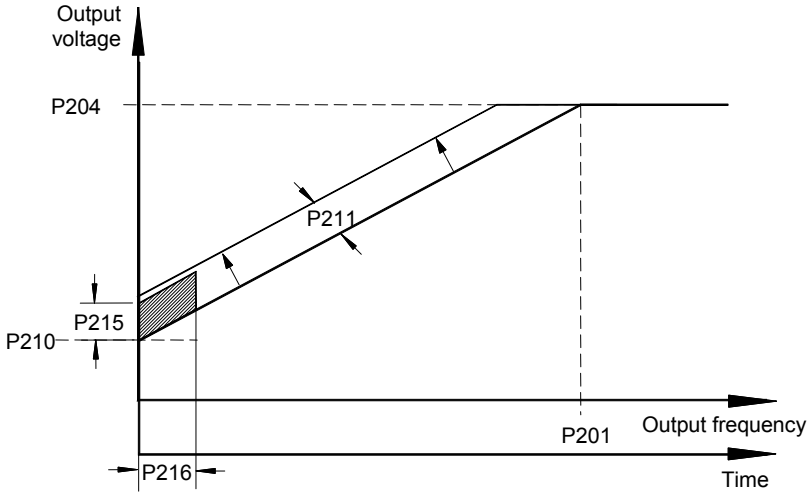
Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P203	**Nominal motor current**		**S**	**P**
0.1 ... 300.0 A [***]	The nominal motor current is a decisive parameter for the current vector control.			
P204	**Nominal motor voltage**		**S**	**P**
100 ... 800 V [***]	The >Nominal voltage< matches the mains voltage to the motor voltage. In combination with the nominal frequency, the voltage/frequency characteristic curve is produced.			
P205	**Nominal motor power**			**P**
0.00 ... 150.00 kW [***]	The motor nominal power controls the motor set via P200.			
P206	**Motor cos φ**		**S**	**P**
0.50 ... 0.90 [***]	The motor cos φ is a decisive parameter for the current vector control.			
P207	**Motor circuit**		**S**	**P**
0 ... 1 [***]	**0 =** Star **1 =** Delta The motor circuit is decisive for stator resistance measurement (P220) and therefore for current vector control.			
P208	**Stator resistance**		**S**	**P**
0.00 ... 300.00 Ω [***]	Motor stator resistance ⇒restistance of a phase winding with a DC motor. Has a direct influence on the current control of the FI. Too high a value will lead to a possible overcurrent; too low a value to a motor torque that is too low. The parameter P220 can be used for simple measurement. Parameter P208 can be used for manual setting or as information about the result of an automatic measurement. **NOTE:** For optimum functioning of the current vector control, the stator resistance must be automatically measured by the FI.			
P209	**No load current**		**S**	**P**
0.1 ... 300.0 A [***]	This value is always calculated automatically from the motor data if there is a change in the parameter >cos φ< and the parameter >Nominal current<. **NOTE:** If the value is to be entered directly, then it must be set as the last motor data. This is the only way to ensure that the value will not be overwritten.			
P210	**Static boost**		**S**	**P**
0 ... 400 % [100]	The static boost affects the current that generates the magnetic field. This is equivalent to the no load current of the respective motor and is therefore load-independent. The no load current is calculated using the motor data. The factory setting of 100% is sufficient for normal applications.			

*** *These settings are dependent on the nominal power of the FI or the selection in parameter P200.*

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P211	**Dynamic boost**		**S**	**P**
0 ... 150 % [100]	The dynamic boost affects the torque generating current and is therefore a load-dependent parameter. The factory 100% setting is also sufficient for typical applications. Too high a value can lead to overcurrent in the FI. Under load therefore, the output voltage will be raised too sharply. Too low a value will lead to insufficient torque.			
P212	**Slip compensation**		**S**	**P**
0 ... 150 % [100]	The slip compensation increases the output frequency, dependent on load, to keep the DC asynchronous motor speed approximately constant. The factory setting of 100% is optimal when using DC asynchronous motors and correct motor data has been set. If several motors (different loads or outputs) are operated with one FI, the slip compensation P212 must be set to 0%. This rules out a negative influence. This is equally valid for synchronous motors that do not have slip due to their design.			
P213	**ISD control loop gain**		**S**	**P**
25 ... 400 % [100]	This parameter influences the control dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower. Dependent on application type, this parameter can be altered, e.g. to avoid unstable operation			
P214	**Torque precontrol**		**S**	**P**
-200 ... 200 % [0]	This function allows a value for the expected torque requirement to be set in the controller. This function can be used in lifting applications for a better load transfer during start-up. **NOTE:** Motor torques (with rotation field R) are entered with a positive sign, generator torques (with rotation field L) are entered with a negative sign. The reverse applies for the counter clockwise rotation.			
P215	**Boost precontrol**		**S**	**P**
0 ... 200 % [0]	Only with linear characteristic curve (P211 = 0% and P212 = 0%). For drives that require a high starting torque, this parameter provides an option for switching in an additional current during the start phase. The application time is limited and can be selected at parameter >Time boost precontrol< P216. All current and torque current limits that may have been set (P112 and P536, P537) are deactivated during the boost lead time.			
P216	**Time boost precontrol**		**S**	**P**
0.0 ... 10.0 s [0]	Only with linear characteristic curve (P211 = 0% and P212 = 0%). Application time for increased starting current.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P217	**Oscillation damping**		**S**	**P**
0 ... 400 % [10] *SW1.6 and above*	With the oscillation damping, idling current harmonics can be damped. Parameter 217 is a measure of the damping power. For oscillation damping the oscillation component is filtered out of the torque current by means of a high pass filter. This is amplified by P217, inverted and switched to the output frequency. The limit for the value switched is also proportional to P217. The time constant for the high pass filter depends on P213. For higher values of P213 the time constant is lower. With a set value of 10% for P217, a maximum of ± 0.045Hz are switched in. At 400% in P217, this corresponds to ± 1.8Hz The function is not active in “Servo mode, P300”.			
P218	**Modulation depth**		**S**	
50 ... 110 % [100] *from SW1.5 and above*	This setting influences the maximum possible output voltage of the FI in relation to the mains voltage. Values <100% reduce the voltage to values below that of the mains voltage if this is required for motors. Values >100% increase the output voltage to the motor increased the harmonics in the current, which may cause swinging in some motors. Normally, 100% should be set.			
P219	**Automatic magnetizing adjustment**		**S**	
25 ... 100 % / 101 [100] *SW1.6 and above*	With this parameter, an automatic adjustment of the magnetizing to the motor load can be made. P219 is a limiting value, to which the field in the motor can be reduced. As standard, the value is set to 100%, and therefore no reduction is possible. As minimum, 25% can be set. The reduction of the field is performed with a time constant of approx. 7.5 sec. On increase of load the field is built up again with a time constant of approx. 300 ms. The reduction of the field is carried out so that the magnetisation current and the torque current are approximately equal, so that the motor is operated with “optimum efficiency”. An increase of the field above the setpoint value is not intended. This function is intended for applications in which the required torque only changes slowly (e.g. pumps and fans). Its effect therefore replaces a quadratic curve, as it adapts the voltage to the load. **NOTE:** This must not be used for lifting or applications where a more rapid build-up of the torque is required, as otherwise there would be overcurrent switch-offs or inversion of the motor on sudden changes of load, because the missing field would have be compensated by a disproportionate torque current. **101 = automatic,** with the setting P219=101 an automatic magnetisation current controller is activated. The ISD controller then operates with a subordinate magnetizing controller, which improves the slippage calculation, especially at higher loads. The control tomes are considerably faster compared to the Normal ISD control (P219 = 100)			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P2xx	**Control/characteristic curve parameters**			



NOTE:

"typical"

Settings for the...	**Current vector control** (factory setting)	**Linear rev./f. characteristic curve**
	P201 to P209 = Motor data	P201 to P209 = Motor data
	P210 = 100%	P210 = 100% (static boost)
	P211 = 100%	P211 = 0%
	P212 = 100%	P212 = 0%
	P213 = 100%	P213 = no significance
	P214 = 0%	P214 = no significance
	P215 = no significance	P215 = 0% (dynamic boost)
	P216 = no significance	P216 = 0s (time dyn. boost)

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P220	**Parameter identification**			**P**
... up to 240s [0]	The motor data is automatically determined by the FI with this parameter. In most cases this leads to considerably better drive characteristics, as DC asynchronous motors are subject to manufacturing tolerances which are not documented on the rating plate. The identification of all parameters takes some time. Do not switch off the mains voltage during this time. The identification can only be carried out in an “operative” condition. This must be particularly taken into account in BUS operation. If unfavourable operating characteristics result, select a suitable motor in P200 or set the parameters P201 … P208 manually. **0 = No identification** **1 = Identification R_S:** only the stator resistance (display in P208) is determined by multiple measurements. **2 = Motor identification:** all motor parameters (P202, P203, P206, P208, P209) are determined. Procedure: a) The identification should be made with the motor cold. Warming up of the motor during operation is taken into account. b) The FI must be in an “operative condition” For BUS operation, the Bus must be operating without error. c) The motor power may only be one power level greater or 3 power levels lower than the nominal power of the FI. d) The motor data should be set according to the rating plate or P200. However, at least the nominal frequency (P201), the nominal speed (P202), the voltage (P204), the power (P205) and the motor circuit (P207) should be known. e) If the identification cannot be concluded successfully, the error message E019 is generated. See also Section 6, Error messages. f) Reliable identification can be made with motor cables up 20m in length. **NOTE:** After identification of parameters, P220 is again = 0. Care must be taken that the connection to the motor is not interrupted during the entire measuring process.			

5.4 Control parameters

Only available in SK 520E/53xE with the use of an incremental encoder. Connection, see Section 2.13.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P300	**Servo mode**	**SK 520E and above**		**P**
0 ... 1 [0]	This parameter activates speed control with speed measurement via an incremental encoder. This leads to a very stable speed behaviour up to motor standstill. **0 = off** **1 = on** **NOTE:** For correct function, an incremental encoder must be connected (see control connections, Section 2.13) and the correct pulse number must be entered in parameter P301.			
P301	**Incremental encoder**	**SK 520E and above**		
0 ... 17 [6]	Input of the pulse-count per rotation of the connected encoder. If the encoder rotation direction is not the same as the FI, (depending on installation and wiring), this can be compensated for by selecting the corresponding negative pulse numbers 8...16. **0 =** 500 pulses **1 =** 512 pulses **2 =** 1000 pulses **3 =** 1024 pulses **4 =** 2000 pulses **5 =** 2048 pulses **6 =** 4096 pulses **7 =** 5000 pulses **8 =** -500 pulses **9 =** - 512 pulses **10 =** - 1000 pulses **11 =** - 1024 pulses **12 =** - 2000 pulses **13 =** -2048 pulses **14 =** -4096 pulses **15 =** -5000 pulses **16 =** -8192 pulses **17 =** + 8192 pulses **NOTE:** P301 is important for the positioning control in SK 530E If an incremental encoder is used for positioning (P604=1), the setting of the pulse number is made here. (see manual BU 0510)			
P310	**Speed controller P**	**SK 520E and above**		**P**
0 ... 3200 % [100]	P-component of the encoder (proportional amplification). Amplification factor, with which the speed difference is multiplied from the setpoint and actual frequency. A value of 100% means that a speed difference of 10% produces a setpoint of 10%. Values that are too high can cause the output speed to oscillate.			
P311	**Speed controller I**	**SK 520E and above**		**P**
0 ... 800 % / ms [20]	I-component of the encoder (Integration component). The integration component of the controller completely eliminates any control deviation. The value indicates how large the setpoint change is per ms. Values that are too small cause the controller to slow down (reset time is too long).			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P312	**Torque current controller P**	**SK 520E and above**	**S**	**P**
0 ... 800 % [200]	Current controller for the torque current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. Excessively high values in P312 generally lead to high-frequency oscillations at low speeds; on the other hand, excessively high values in P313 generally produce low frequency oscillations across the whole speed range. If the value "Zero" is entered in P312 and P313, then the torque current control is switched off. In this case, only the motor model lead is used.			
P313	**Torque current controller I**	**SK 520E and above**	**S**	**P**
0 ... 800 % / ms [125]	I-component of the torque current controller. (See also P312 >Torque current controller P<)			
P314	**Torque current controller limit**	**SK 520E and above**	**S**	**P**
0 ... 400 V [400]	Determines the maximum voltage increase of the torque current controller. The higher the value, the greater the maximum effect that can be exercised by the torque current controller. Excessive values in P314 can specifically lead to instability during transition to the field weakening zone (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced.			
P315	**Field current controller P**	**SK 520E and above**	**S**	**P**
0 ... 800 % [200]	Current controller for the field current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. Excessively high values for P315 generally lead to high frequency vibrations at low speeds. On the other hand, excessively high values in P316 generally produce low frequency vibrations across the whole speed range If the value "Zero" is entered in P315 and P316, then the field current controller is switched off. In this case, only the motor model lead is used.			
P316	**Field current controller I**	**SK 520E and above**	**S**	**P**
0 ... 800 % / ms [125]	I-component of the field current controller. See also P315 >Field current controller P<			
P317	**Field current controller limit**	**SK 520E and above**	**S**	**P**
0 ... 400 V [400]	Determines the maximum voltage increase of the torque current controller. The higher the value, the greater is the maximum effect that can be exercised by the field current controller. Excessive values in P317 can specifically lead to instability during transition to the field reduction range (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced.			
P318	**Weak field control P**	**SK 520E and above**	**S**	**P**
0 ... 800 % [150]	The weak field control reduces the field setpoint when the synchronous speed is exceeded. Generally, the weak field control has no function; for this reason, the field reduction controller only needs to be set if speeds are set above the nominal motor speed. Excessive values for P318 / P319 will lead to controller oscillations. The field is not reduced sufficiently if the values are too small or during dynamic acceleration and/or delay times. The downstream current controller can no longer read the current setpoint.			
P319	**Weak field control I**	**SK 520E and above**	**S**	**P**
0 ... 800 % / ms [20]	Affects only the field reduction range, see P318 >Field reduction controller P<			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P320	**Weak field control limit**	**SK 520E and above**	**S**	**P**
0 ... 110 % [100]	The weak field limit determines at which speed / current the controller will begin to weaken the field. At a set value of 100% the controller will begin to reduce the field at approximately the synchronous speed. If values much larger than the standard values have been set in P314 and/or P317, then the field weak limit should be correspondingly reduced, so that the control range is actually available to the current controller.			
P321	**Speed control I brake off**	**SK 520E and above**	**S**	**P**
0 ... 4 [0]	During brake ventilation time (P107/P114), the I-component of the rotation speed control is increased. This leads to better load take-up, especially with vertical movements. **0 =** P311 x 1 **1 =** P311 x 2 **2 =** P311 x 4 **3 =** P311 x 8 **4 =** P311 x 16			
P325	**Encoder function**	**SK 520E and above**		
0 ... 4 [0]	The actual speed list value supplied by an incremental encoder to the FI can be used for various functions in the FI. **0 =** **Rotation speed measurement Servo mode:** The actual motor speed list value is used for the FI servo mode. The ISD control cannot be switched off in this function. **1 =** **PID actual frequency value:** The actual rotation speed of a system is used for rotation speed control. This function can also be used for controlling a motor with a linear characteristic curve. It is also possible to use an incremental encoder for speed control that is not mounted directly onto the motor. P413 – P416 determine the control. **2 =** **Frequency addition:** The rotation speed deduced is added to the current setpoint value. **3 =** **Frequency subtraction:** The determined speed is subtracted from the actual setpoint. **4 =** **Maximum frequency:** The maximum possible output frequency / speed is limited by the speed of the encoder.			
P326	**Encoder transformation ratio**	**SK 520E and above**		
0.01 ... 100.0 [1.00]	If the incremental encoder is not mounted directly onto the motor shaft, then the respectively correct transformation ratio of motor speed to encoder speed must be set. $P326 = \frac{\text{motor speed}}{\text{encoder speed}}$ Only when P325 = 1, 2, 3 or 4, therefore not in Servo mode (motor speed control)			
P327	**Slip error, speed control**	**SK 520E and above**		
0 ... 3000 rpm [0]	The limit value for a permitted maximum slip error can be set. If this value is reached, the FI switches off and indicates error E013.1. **0 =** OFF Only when P325 = 0, therefore in Servo mode (motor speed control)			

5.5 Control terminals

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P400	**Analog input function 1**			**P**

0 ... 82

[1]

The FI analog input can be used for various functions. It must be noted that only one of the functions given below is possible at any time.

If, for example, an actual PID frequency is selected, the frequency setpoint cannot be an analog signal. The setpoint can, e.g., be specified via a fixed frequency.

Analog functions:

0 = **Off,** the analog input has no function. After the FI has been enabled via the control terminals, it will supply the set minimum frequency (P104).

1 = **Set frequency,** the given analog range (P402/P403) varies the output frequency between the set minimum and maximum frequencies (P104/P105).

2 = **Torque current limit,** based on the set torque current limit (P112), this can be altered by means of an analog value. 100% setpoint here corresponds to the set torque current limit P112. 20% cannot be undershot (with P300=1, not below 10%)!

3 = **Actual PID frequency *,** is required to build up a control loop. The analog input (actual value) is compared with the setpoint (e.g. fixed frequency). The output frequency is adjusted as far as possible until the actual value equals the setpoint. (see control variables P413...P415)

4 = **Frequency addition **,** the supplied frequency value is added to the setpoint.

5 = **Frequency subtraction**,** the supplied frequency value is subtracted from the setpoint.

6 = **Current limit,** based on the set current limit (P536), this can be altered by means of an analog value.

7 = **Maximum frequency,** the maximum frequency of the FI is varied. 100% corresponds to the setting in parameter P411. 0% corresponds to the setting in parameter P410. The values for the min/max output frequency (P104/P105) cannot be exceeded or undershot.

8 = **Actual frequency PID limited *,** like function 3, actual frequency PID, however the output frequency cannot fall below the programmed minimum frequency value in Parameter P104. (no change to rotation direction)

9 = **Actual frequency PID monitored *,** as function 3, actual frequency PID, however the FI switches the output frequency off when the minimum frequency P104 is reached.

10 = **Servo mode torque,** in servo mode P300 the motor torque can be set using this function. Here the encoder P300 is switched off and a torque control activated. The analog input is then the source of the setpoint value.

11 = **Torque precontrol,** function that enables a value for the anticipated torque requirement to be entered in the controller (interference factor switching). This function can be used to improve the load take-up of lift equipment with separate load detection.

12 = reserved

13 = **Multiplication**, the setpoint is multiplied with the analog value supplied. The analog value adjusted to 100% then corresponds to a multiplication factor of 1.

... continued on the next page

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set

14 = **Actual value process controller *,** activates the process controller, analog input 1 is connected to the actual value encoder (compensator, air can, flow volume meter, etc.). **The mode (0-10 V or 0/4-20 mA) is set in P401.**

15 = **Setpoint process controller *,** as function 14, however the setpoint is specified (e.g. by a potentiometer). **The actual value must be specified using another input.**

16 = **Lead process controller *,** adds an adjustable additional setpoint after the process controller.

46 = **Setpoint torque process controller**

48 = **Motor temperature measurement with KTY-84**, details in section 4.3

***) further details regarding the process controller can be found in Section . 8.2 and P400**

**) The limits of these values are set by the parameters >Minimum frequency auxiliary setpoints< P410 and >Maximum frequency auxiliary setpoints< P411.

Digital functions:

21 = **Enabled right**
22 = **Enabled left**
23 = **Change rotation direction**
24 = **Fixed frequency 1**
25 = **Fixed frequency 2**
26 = **Fixed frequency 3**
27 = **Fixed frequency 4**
28 = reserved
29 = **Hold frequency**
30 = **Block voltage**
31 = **Quick stop**
32 = **error acknowledgement**
33 = reserved
34 = reserved
35 = **Jog frequency**
36 = **Maintain frequency "Motorpoti"**
37 = reserved
38 = **Watchdog**
39 = reserved
40 = reserved
41 = **Fixed frequency 5**
42 = ... 45/47/49 reserved SK 530E → BU 0510
50 = **PID controller on/off**
51 = **Enable right blocked**
52 = **Enable left blocked**
53 = ... 66 reserved
67 = **Increase motor poti jog frequency**
68 = **Reduce motor poti jog frequency**
69 = reserved
70 = **Bit 0 fixed frequency array**
71 = **Bit 1 fixed frequency array**
72 = **Bit 2 fixed frequency array**
73 = **Bit 3 fixed frequency array**
74 = **Bit 4 fixed frequency array**
75 = …82 reserved **for SK 530E → BU 0510**

A detailed description of the digital functions can be found after parameters P420 … P425. The functions of the digital inputs are identical to the digital functions of the analog inputs.

Permissible voltage when using digital functions: 7.5...30V.

NOTE: The analog inputs with digital functions do not comply with EN61131-2 (Type 1 digital inputs) as the idling currents are too low.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P401	**Mode analog input 1**		**S**	

0 ... 3

[0]

0 = **limited to 0 – 10V:** An analog setpoint smaller than the programmed adjustment 0% (P402) does not lead to undershooting of the programmed minimum frequency (P104). Therefore does not lead to any rotation direction reversal.

---

1 = **0 - 10V:** If a setpoint smaller than the programmed adjustment 0% (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

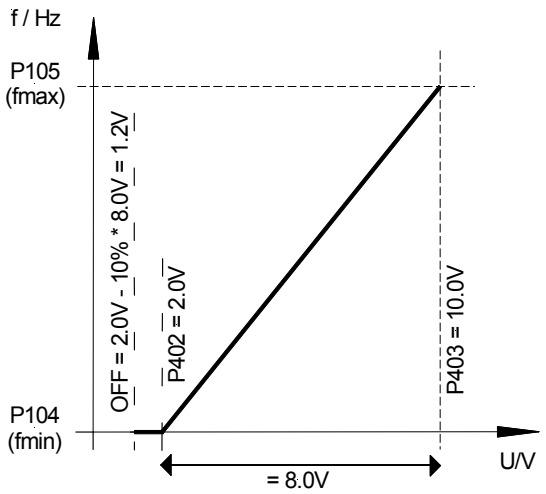
E.g. internal setpoint with rotation direction change: P402 = 5V, P104 = 0Hz, Potentiometer 0–10V → Rotation direction change at 5V in mid-range setting of the potentiometer.

During the reversing moment (hysteresis = ± P505), the drive stands still when the minimum frequency (P104) is smaller than the absolute minimum frequency (P505). A brake that is controlled by the FI will have entered the hysteresis range.

If the minimum frequency (P104) is greater than the absolute minimum frequency (P505), the drive reverses when the minimum frequency is reached. In the hysteresis range ± P104, the FI supplies the minimum frequency (P104), the brake controlled by the FI is not applied.

---

2 = **0 – 10V monitored:** if the minimum adjusted setpoint (P402) is undershot by 10% of the difference value from P403 and P402, the FI output switches off. Once the setpoint is greater than [*P402 - (10% * (P403 - P402))*], it will deliver an output signal again.



e.g. setpoint 4-20mA P402: Adjustment 0% = 1V; P403: Adjustment 100% = 5V; -10% corresponds to -0.4V; i.e. 1...5V (4...20mA) normal operating zone, 0.6...1V = minimum frequency setpoint, below 0.6V (2.4mA) output switches off.

---

3 = **- 10V – 10V:** If a setpoint smaller than the programmed adjustment 0% (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

E.g. internal setpoint with rotation direction change: P402 = 5V, P104 = 0Hz, Potentiometer 0–10V → Rotation direction change at 5V in mid-range setting of the potentiometer.

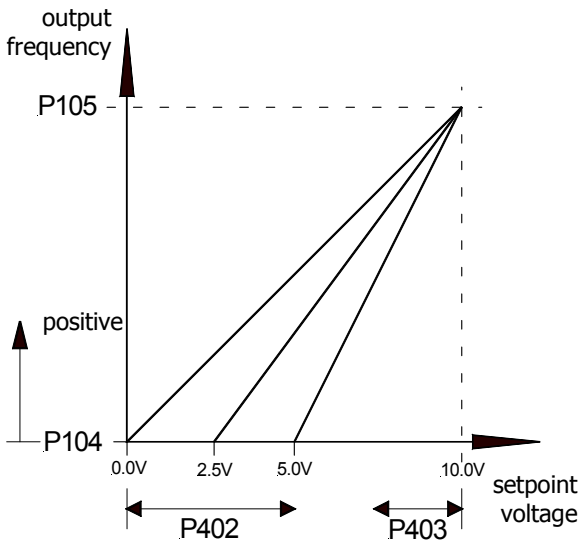
During the reversing moment (hysteresis = ± P505), the drive stands still when the minimum frequency (P104) is smaller than the absolute minimum frequency (P505). A brake that is controlled by the FI will not have entered the hysteresis range.

If the minimum frequency (P104) is greater than the absolute minimum frequency (P505), the drive reverses when the minimum frequency is reached. In the hysteresis range (P104, the FI supplies the minimum frequency ±P104), the brake controlled by the FI does is not applied.

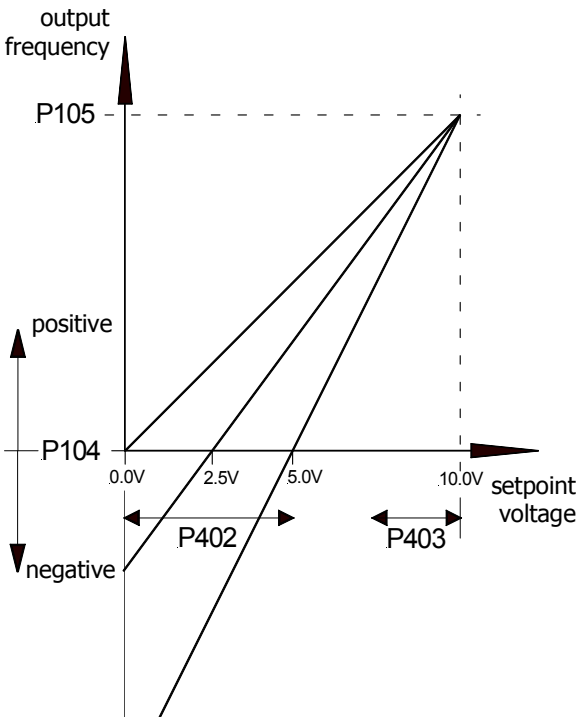
Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P402	**Analog input adjustment 1: 0%**		**S**	
-50.00 ... 50.00 V [0.00]	This parameter sets the voltage that should correspond with the minimum value of the selected function for the analog input 1. In the factory setting (setpoint) this value is equivalent to the setpoint set via P104 >Minimum frequency<. Typical setpoints and corresponding settings: 0 - 10 V → 0.00 V 2 - 10 V → 2.00 V (for function 0-10 V monitored) 0 - 20 mA → 0.00 V (internal resistance approx. 250Ω) 4 - 20 mA → 1.00 V (internal resistance approx. 250Ω)			
P403	**Analog input adjustment 1: 100%**		**S**	
-50.00 ... 50.00 V [10.00]	This parameter sets the voltage that should correspond with the maximum value of the selected function for the analog input 1. In the factory setting (setpoint) this value is corresponds with the setpoint set via P105 >Maximum frequency<. Typical setpoints and corresponding settings: 0 - 10 V → 10.00 V 2 - 10 V → 10.00 V (for function 0-10 V monitored) 0 - 20 mA → 5.00 V (internal resistance approx. 250Ω) 4 - 20 mA → 5.00 V (internal resistance approx. 250Ω)			

P400 ... P403

P401 = 0 → 0 - 10V limited



P401 = 1 → 0 - 10V not limited



P404	Filter analog input 1		S	
1 ... 400 ms [100]	Adjustable digital low-pass filter for the analog signal. Interference peaks are hidden, the reaction time is extended.			

P405	Analog input function 2			P
0 ... 82 [0]	*This parameter is identical to P400.*			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P406	**Analog input mode 2**		**S**	
0 ... 3 [0]	**0 = limited to 0 – 10V** **1 = 0 - 10V** **2 = 0 – 10V monitored** **3 = - 10V – 10V** *This parameter is identical to P401. P402/403 change to P406/407.*			
P407	**Analog input adjustment 2: 0%**		**S**	
-50.00 ... 50.00 V [0.00]	*This parameter is identical to P402.*			
P408	**Analog input adjustment 2: 100%**		**S**	
-50.00 ... 50.00 V [10.00]	*This parameter is identical to P403.*			
P409	**Filter analog input 2**		**S**	
1 ... 400 ms [100]	*This parameter is identical to P404.*			
P410	**Minimum frequency auxiliary setpoints**			**P**
-400.0 ... 400.0 Hz [0.0]	The minimum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: Actual frequency PID — Frequency addition — Frequency subtraction Auxiliary setpoints via BUS — Process controller Min. frequency above analog setpoint (potentiometer)			
P411	**Maximum frequency auxiliary setpoints**			**P**
-400.0 ... 400.0 Hz [50.0]	The maximum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: Actual frequency PID — Frequency addition — Frequency subtraction Auxiliary setpoints via BUS — Process controller Max. frequency above analog setpoint (potentiometer)			
P412	**Nominal value process controller**		**S**	**P**
-10.0 ... 10.0 V [5.0]	Fixed specification of a setpoint for the process controller that will only occasionally be altered. Only with P400 = 14 ... 16 (Process controller). Further details can be found in Section 8.2			
P413	**PID control P-component**		**S**	**P**
0.0 ... 400.0 % [10.0]	This parameter is only effective when the function PID actual frequency is selected. The P-component of the PID controller determines the frequency jump if there is a rule deviation based on the rule difference. For example: At a setting of P413 = 10% and a rule difference of 50%, 5% is added to the actual setpoint.			
P414	**PID control I-component**		**S**	**P**
0.0 ... 3000.0 % [10.0]	This parameter is only effective when the function PID actual frequency is selected. The I-component of the PID controller determines the frequency change, dependent on time. Up to SW 1.5 the setting range was 0.00 to 300.00 ‰/ms! This can cause incompatibilities in the transfer of data sets between FIs with different software versions.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P415	**PID control D-component**		**S**	**P**
0 ... 400.0 %ms [1.0]	This parameter is only effective when the **function PID actual frequency** is selected. If there is a rule deviation, the D-component of the PID controller determines the frequency change multiplied by time (%ms). If one of the analog inputs is set in the **function actual value process controller**, this parameter determines the controller limitation (%) after the PI controller. For further details, see Section 8.2.			
P416	**Ramp time PI setpoint.**		**S**	**P**
0.00 ... 99.99s [2.00]	This parameter is only effective when the function PID actual frequency is selected. Ramp for PI setpoint			

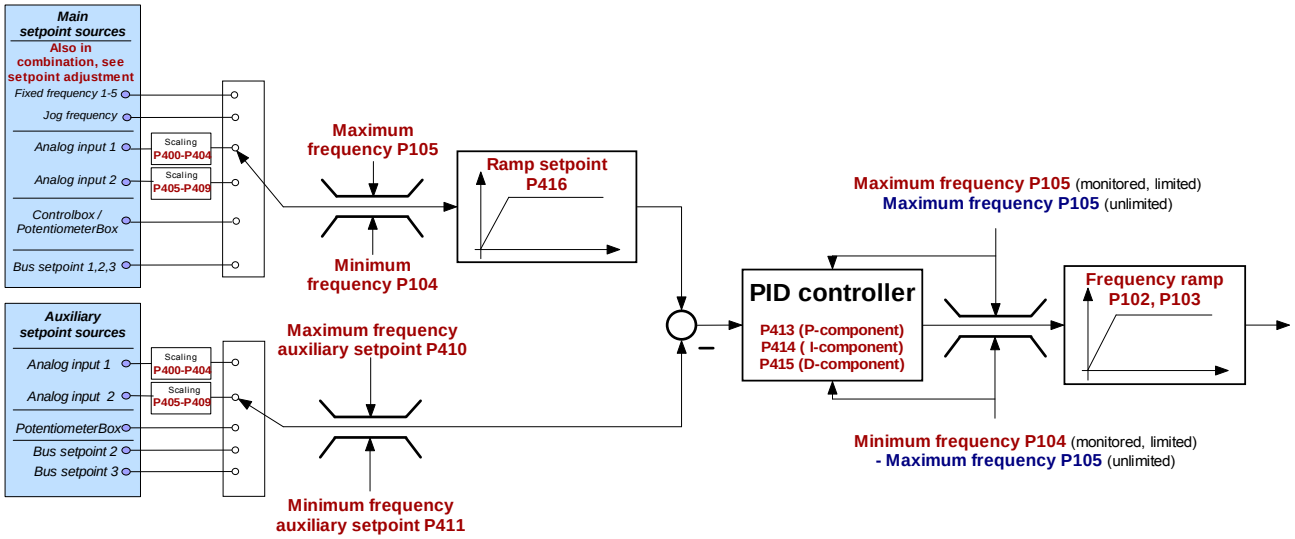


Fig.: Flow diagram for PID controller

P417	Offset analog output 1		S	P
-10.0 ... 10.0 V [0.0]	In the analog output function an offset can be entered to simplify the processing of the analog signal in other equipment. If the analog output has been programmed with a digital function, then the difference between the switch-on point and the switch-off point can be set in this parameter (hysteresis).			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P418	**Analog output function**			**P**

0 ... 52

[0]

Analog functions (max. load: 5mA analog, 20mA digital)**:**

An analog voltage (0 ... +10 Volt) can be taken from the control terminals (max. 5mA). Various functions are available, whereby:

0 Volt analog voltage always corresponds to 0% of the selected value.

10 V always corresponds to the motor nominal values (unless otherwise stated) multiplied by the P419 standardisation factor, e.g.:

$$\Rightarrow 10\text{Volt} = \frac{\text{motor nominal value} \cdot \text{P419}}{100\%}$$

0 = **No function,** no output signal at the terminals.

1 = **Actual frequency,** the analog voltage is proportional to the FI output frequency.

2 = **Actual speed,** this is the synchronous speed calculated by the FI based on the existing setpoint. Load-dependent speed fluctuations are not taken into account.
If Servo mode is being used, the measured speed will be output via this function.

3 = **Current**, the effective value of the output current supplied by the FI.

4 = **Torque current,** displays the motor load torque calculated by the FI. (100% = P112)

5 = **Voltage**, the output voltage supplied by the FI.

6 = **Link voltage,** the DC voltage in the FI. This is not based on the nominal motor data. 10V Volt, standardised at 100%, is equivalent to 450V DC (230V mains) or 850 Volt DC (480V mains)!

7 = **Value from P542,** the analog output can be set using parameter P542 independently of the actual operating status of the FI For example, with Bus switching (parameter command) this function can supply an analog value from the FI, which is triggered by the control unit.

8 = **Apparent power:** the actual apparent power calculated by the FI.

9 = **Effective power:** the actual effective power calculated by the FI.

10 = **Torque [%]:** the current torque calculated by the FI.

11 = **Field [%]:** the current field in the motor calculated by the FI.

12 = **Output frequency ±,** the analog voltage is proportional to the output frequency of the FI, whereby the zero point is shifted to 5V. For rotation to the right, values between 5V and 10V are output, and for rotation to the left values between 5V and 0V.

13 = **Motor rotation speed ±,** is the synchronic rotation speed calculated by the FI, based on the current setpoint, where the null point has been shifted to 5V. For rotation to the right, values between 5V and 10V are output, and for rotation to the left values between 5V and 0V.
If Servo mode is being used, the measured speed will be output via this function.

14 = **Torque [%] ±,** is the actual torque calculated by the FI, whereby the zero point is shifted to 5V. For drive torques, values between 5V and 10V are output, and for generator torque, values between 5V and 0V.

30 = **Setpoint frequency before frequency ramp,** displays the frequency produced by any upstream controllers (ISD, PID, etc.). This is then the setpoint frequency for the power stage after it has been adjusted by the acceleration or braking ramp (P102, P103).

31 = **Value via BUS,** the analog output is controlled via a bus system. The process data is directly transferred (P546, P547, P548).

33 = **Frequency from setpoint source,** “Frequency from setpoint source” (SW 1.6 and above)

... continued on the next page

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set

Digital functions:

All relay functions described in Parameter >Function Relay 1< P434 can also be transferred via the analog output. If a condition has been fulfilled, then there will be 10V at the output terminals. Negation of the function can be set in the parameter >Norm. analog output< P419.

15 = External brake
16 = Inverter working
17 = Current limit
18 = Torque current limit
19 = Frequency limit
20 = Setpoint reached
21 = Error
22 = Warning
23 = Overcurrent warning
24 = Overtemperature warning motor
25 = Torque current limit active
26 = Value from P541, external control
27 = Drive torque current limit
28 = ... 29 reserved
32 = FI ready
34 = ... 43 reserved *for SK 530 → BU 0510*
44 = Bus In Bit 0
45 = Bus In Bit 1
46 = Bus In Bit 2
47 = Bus In Bit 3
48 = Bus In Bit 4
49 = Bus In Bit 5
50 = Bus In Bit 6
51 = Bus In Bit 7
52 = Output via Bus (if P546, P547 or P548 = 19), BUS Bit 4 then controls the analog output.

P419	Analog output standardisation			P

-500 ... 500 %

[100]

Analog functions P418 (= 0 ... 6 and 8 … 14, 30)

Using this parameter an adjustment can be made to the analog output for the selected operating zone. The maximum analog output (10V) corresponds to the standardisation value of the appropriate selection.

If therefore, at a constant working point, this parameter is raised from 100% to 200%, the analog output voltage is halved. 10 Volt output signal then corresponds to twice the nominal value.

For negative values the logic is reversed. A setpoint value of 0% will then produce 10V at the output and -100% will produce 0V.

Digital functions P418 (= 15 ... 28, 34...52)

The switching threshold can be set using this parameter for the functions Current limit (= 17), Torque current limit (= 18) and Frequency limit (= 19). A value of 100% refers to the corresponding motor nominal value (see also P435).

With a negative value, the output function is output negated (0/1 → 1/0).

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P420	**Digital input 1**			
0 ... 72	**Enable right** as factory setting, control terminal 21 (DIN1)			
[1]	Various functions can be programmed. These can be seen in the following table.			
P421	**Digital input 2**			
0 ... 72	**Enable left** as factory setting, control terminal 22 (DIN2)			
[2]	Various functions can be programmed. These can be seen in the following table.			
P422	**Digital input 3**			
0 ... 72	**Parameter set switching Bit 0** as factory setting, control terminal 23 (DIN3)			
[8]	Various functions can be programmed. These can be seen in the following table.			
P423	**Digital input 4**			
0 ... 72	**Fixed frequency 1** (P429) as factory setting, control terminal 24 (DIN4)			
[4]	Various functions can be programmed. These can be taken from the following table.			
P424	**Digital input 5**			
0 ... 72	**No function** as factory setting, control terminal 25 (DIN5)			
[0]	Various functions can be programmed. These can be seen in the following table.			
P425	**Digital input 6**	**SK 520E and above**		
0 ... 72	**No function** as factory setting, control terminal 26 (DIN6)			
[0]	Various functions can be programmed. These can be seen in the following table.			

Digital input 7 function = P470 (only SK 520/53xE), control terminal 27 (DIN7)

... Function descriptions follow on the next pages.

List of the possible functions of the digital inputs P420 ... P425, P470

Value	Function	Description	Signal
00	No function	Input switched off.	---
01	Enabled right	The FI delivers an output signal with the rotation field right if a positive setpoint is present. 0 → 1 Flank (P428 = 0)	High
02	Enabled left	The FI delivers an output signal with the rotation field left if a positive setpoint is present. 0 → 1 Flank (P428 = 0)	High
	If the drive is to start up automatically when the mains is switched on (P428 = 1) a permanent High level for enabling must be provided (connect control terminals 21-42). If the functions "Enabled right" and "Enabled left" are actuated simultaneously, the FI is blocked.		
03	Change rotation direction	Causes the rotation field to change direction, combined with Enable right or left.	High
04	Fixed frequency 1 [1]	The frequency from P429 is added to the actual setpoint value.	High
05	Fixed frequency 2 [1]	The frequency from P430 is added to the actual setpoint value.	High
06	Fixed frequency 3 [1]	The frequency from P431 is added to the actual setpoint value.	High
07	Fixed frequency 4 [1]	The frequency from P432 is added to the actual setpoint value.	High
	If several fixed frequencies are actuated at the same time, then they are added with the correct sign. In addition, the analog setpoint (P400) and possibly the minimum frequency (P104) are added.		
08	Parameter set switch Bit 0	Selection of the active parameter set 1…4 (P100)	High
09	Hold frequency	During the acceleration or braking phase, a low level will cause the actual output frequency to be "held". A high level allows the ramp to proceed.	Low
10	Voltage block [2]	The FI output voltage is switched off; the motor runs down freely.	Low
11	Quick stop [2]	The FI reduces the frequency according to the programmed quick stop time (P426).	Low
12	Error acknowledgement [2]	Error acknowledgement with an external signal. If this function is not programmed, an error can also be acknowledged by a low enable setting (P506).	0→1 Flank
13	Thermistor input [2]	Analog evaluation of signal present. Switching threshold at approx. 2.5 V Switch-off delay = 2sec, warning after 1sec. **NOTE:** Function 13 can only be used with sizes 1 - 4 via DIN 5, terminal 25! For sizes 5 – 6 there is a separate connection (X13:T1/T2), which cannot be deactivated. If the motor is equipped with a thermistor, both terminals must be bridged in order to deactivate the function (status as delivered).	level
14	Remote control [2]	With Bus system control, low level switches the control to control via control terminals.	High
15	Jog frequency [1]	The fixed frequency value can be adjusted using the HIGHER/LOWER and ENTER keys (P113), if control is via the ControlBox or ParameterBox.	High
16	Maintain frequency "Motorpoti"	As for setting **09**, however, below the minimum frequency P104 and above the maximum frequency P105 the frequency is not maintained.	Low
17	Parameter set switch Bit 1	Selection of the active parameter set 1…4 (P100)	High
18	Watchdog [2]	Input must see a high flank cyclically (P460); otherwise error E012 will cause a shutdown. Function starts with the 1st high flank.	0→1 Flank
19	Setpoint 1 on/off	Analog input switch-on and switch-off 1/2 (high = ON) The low signal sets the analog input to 0% which does not lead to shutdown when the minimum frequency (P104) > than the absolute minimum frequency (P505).	High
20	Setpoint 2 on/off		

... continued on the next page

Value	Function	Description	Signal
21	Fixed frequency 5 [1]	The frequency from P433 is added to the actual setpoint value.	High
22	... 25 reserved		
26	**... 29 impulse functions:** Descriptions on next page.		
30	PID controller On/Off	Switching the PID controller / process controller function on and off (high = ON)	High
31	Enable right blocked [2]	Blocks the >Enable right/left< via a digital input or Bus control. Does not depend on the actual direction of rotation of the motor (e.g. following negated setpoint).	Low
32	Enable left blocked [2]		Low
33	**... 42 impulse functions:** Descriptions on next page.		
43	**... 44 Speed measurement** with HTL encoder: Descriptions on next page.		
45	3-Wire-Control Start-Right (Closing button)	This control function provides an alternative to enable R/L (01, 02), in which a permanently applied level is required. Here, only a control impulse is required to trigger the function. The control of the FI can therefore be performed entirely with buttons. (software version 1.5 and above)	0→1 Flank
46	3-Wire-Control Start-Right (Closing button)		0→1 Flank
49	3-Wire-Control Stop (Opening button)		1→0 Flank
47	Increase frequency	In combination with enable R/L the output frequency can be continuously varied. To save a current value in P113, both inputs must be at a High voltage for 0.5s. This value then applies as the next starting value for the same direction of rotation (Enable R/L) otherwise start at f_{MIN}.	High
48	Decrease frequency		High
50	Bit 0 fixed frequency array	Binary coded digital inputs to generate up to 32 fixed frequencies. (P465: -01...-31)	High
51	Bit 1 fixed frequency array		high
52	Bit 2 fixed frequency array		high
53	Bit 3 fixed frequency array		high
54	Bit 4 fixed frequency array		high
55	…64 reserved for SK 530E → BU 0510		
65	…69 reserved		
70	Activate evacuation run *SW1.7 and above*	Only for devices with external 24V control voltage SK 5x5E. There is therefore also the possibility of operation with a very low link circuit voltage. With this function the charging relay is activated and the undervoltage and phase error detection are deactivated.	High
71	Motor potentiometer function Frequency + with automatic saving *SW1.6 and above*	With this motor pot. function (SW 1.6 and above) a setpoint value (sum) is set via the digital inputs, which is simultaneously stored. With control enabling R/L this is then started up in the correspondingly enabled direction. On change of direction the frequency is retained. Simultaneous activation of the +/- function causes the frequency setpoint value to be set to zero. The frequency setpoint value can also be displayed or set in the operating value display (P001=30, current setpoint MP-S') or in P718. Any minimum frequency set (P104) is still effective. Other setpoint values, e.g. analog or fixed frequencies can be added or subtracted. The adjustment of the frequency setpoint value is performed with the ramps from P102/103.	high
72	Motor potentiometer function Frequency - with automatic saving *SW1.6 and above*		high

[1] If neither of the digital inputs is programmed for left or right enable, then the actuation of a fixed frequency or jog frequency will enable the frequency inverter. The rotation field direction depends on the sign of the setpoint.

[2] Also effective for Bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)

Impulse input functions: 2...22kHz (only for DIN2 and DIN3 or 4)

For these functions the particular input evaluates the impulse frequency present. The frequency range 2kHz to 22kHz thereby covers the range of values from 0 to 100%. The inputs operate up to a maximum impulse frequency of 32kHz. The voltage level may be between 15V and 24V and the switch-on cycle between 50 and 80%.

Value	Function	Description	Signal
26	Torque current limit[2]	Adjustable load limit, the output frequency is reduced when it is reached. → P112	Impulse
27	Actual PID frequency [2 3]	Possible feedback of actual value for the PID controller	Impulse
28	Frequency addition [2 3]	Addition to other frequency setpoint values	Impulse
29	Frequency subtraction [2 3]	Subtraction from other frequency setpoint values	Impulse
33	Current limit [2]	Based on the set current limit (P536), this can be changed using the digital/analog input.	Impulse
34	Maximum frequency [2 3]	The maximum frequency of the FI is set in the analog range. 100% corresponds to the setting in parameter P411. 0% corresponds to the setting in parameter P410. The values for the min/max output frequency (P104/P105) cannot be exceeded or undershot.	Impulse
35	Actual frequency of PID controller limited [2 3]	Needed to build up a control loop. The digital/analog input (actual value) is compared with the setpoint (e.g. other analog input or fixed frequency). The output frequency is adjusted as far as possible until the actual value equals the setpoint. (see control variables P413 – P416) The output frequency cannot fall below the programmed minimum frequency value in parameter P104. (No rotation direction change!)	Impulse
36	Actual frequency of PID controller monitored [2 3]	As function 35, >Actual frequency PID< but the FI switches the output frequency off when the >Minimum frequency< P104 is reached.	Impulse
37	Torque servo mode [2]	The motor torque can be set or limited via this function in Servo mode.	Impulse
38	Torque precontrol [2]	Function that enables a value for the anticipated torque requirement to be entered in the controller (interference factor switching) This function can be used to improve the load take-up of lift equipment with separate load detection. → P214	Impulse
39	Multiplication [3]	This factor multiplies the master setpoint value.	Impulse
40	PI process controller actual value	As for P400 = 14-16 further details regarding the process controller can be found in Section 8.2	Impulse
41	PI process controller setpoint		Impulse
42	PI process controller lead		Impulse
43	Track A HTL encoder	This function can only be used for the digital inputs 2 (P421) and 4 (P423) *Only for SW 1.7 or higher and HW CAA!*	A 24V HTL encoder can be connected to **DIN 2** and **DIN 4** in order to measure the speed. The maximum frequency at the DIN is limited to 10kHz. Accordingly, a suitable encoder (low pulse number) or suitable mounting (slow speed) SHOULD BE USED. The direction of counting can be changed by exchanging the functions on the digital inputs. Further settings are in P461, P462, P463.	Impulse <10kHz
44	Track B HTL encoder			Impulse <10kHz

[2] Also effective for Bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)

[3] The limits of these values are set by the parameters >Minimum frequency auxiliary setpoints< P410 and >Maximum frequency auxiliary setpoints< P411.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P426	**Quick stop time**			**P**
0 ... 320.00 s [0.10]	Setting of the stop time for the fast stop function that can be triggered either via a digital input, the bus control, the keyboard or automatically in case of a fault. Quick stop time is the time for the linear frequency decrease from the set maximum frequency (P105) to 0Hz. If an actual setpoint <100% is being used, the quick stop time is reduced correspondingly.			
P427	**Quick stop on Error**		**S**	
0 ... 3 [0]	Activation of automatic quick stop following error **0 = OFF:** Automatic quick stop following error is deactivated **1 = Mains supply failure:** Automatic quick stop following mains supply failure **2 = Error:** Automatic quick stop following fault **3 = Mains supply failure and error:** Automatic quick stop following mains supply failure and error			
P428	**Automatic starting**		**S**	**P**
0 ... 1 [0]	In the standard setting (P428 = **0 → Off**) the inverter requires a flank for enable (signal change from "low → high") at the applicable digital input. In the setting **On → 1** the FI reacts to a high level. This function is only possible if the FI is controlled using the digital inputs. (see P509=0/1) In certain cases, the FI must start up directly when the mains are switched on. This means that P428 = **1 → On** can be set. If the enable signal is permanently switched on, or equipped with a cable jumper, the FI starts up immediately.			
P429	**Fixed frequency 1**			**P**
-400 ... 400 Hz [0]	Following actuation via a digital input and enabling of the FI (right or left), the fixed frequency is used as a setpoint. A negative setting value will cause a direction change (based on the *Enable rotation direction* P420 – P425, P470). If several fixed frequencies are actuated at the same time, then the individual values are added with the correct sign. This also applies to combinations with the jog frequency (P113), analog setpoint (if P400 = 1) or minimum frequency (P104). The frequency limits (P104 = f_{min}, P105 = f_{max}) cannot be over or undershot. If none of the digital inputs are programmed for enable (right or left), the simple fixed frequency signal leads to an enable. A positive fixed frequency corresponds to a right enable, a negative to a left enable.			
P430	**Fixed frequency 2**			**P**
-400 ... 400 Hz [0]	Function description of parameter, see **P429 >Fixed frequency 1<**			
P431	**Fixed frequency 3**			**P**
-400 ... 400 Hz [0]	Function description of parameter, see **P429 >Fixed frequency 1<**			
P432	**Fixed frequency 4**			**P**
-400 ... 400 Hz [0]	Function description of parameter, see **P429 >Fixed frequency 1<**			
P433	**Fixed frequency 5**			**P**
-400 ... 400 Hz [0]	Function description of parameter, see **P429 >Fixed frequency 1<**			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P434	**Function output 1 (K1)**			**P**

0 ... 38

[1]

Control terminals 1/2: The settings 3 to 5 and 11 work with 10% hysteresis, i.e. the relay contact closes (fct. 11 opens) when the limit value is reached and opens (fct. 11 closes) when a 10% smaller value is undershot. This behaviour can be inverted with a negative value in P435.

Setting / Function		Relay contact ... for limit value or function (see also P435)
0 =	**No function**	open
1 =	**External brake,** to control a mechanical brake on the motor. The relay switches at a programmed absolute minimum frequency (P505). For typical brakes a setpoint delay of 0.2 … 0.3 seconds should be programmed. A mechanical brake can be directly AC switched. (Please note the technical specifications of the relay contacts)	Closes
2 =	**Inverter operating,** the closed relay contact indicates voltage FI output (U - V - W).	Closes
3 =	**Current limit,** based on the setting of the motor rated current in P203. This value can be adjusted with the standardisation (P435).	Closes
4 =	**Torque current limit,** based on motor data settings in P203 and P206. Signals a corresponding torque load on the motor. This value can be adjusted with the standardisation (P435).	Closes
5 =	**Frequency limit,** based on motor nominal frequency setting in P201. This value can be adjusted with the standardisation (P435).	Closes
6 =	**Setpoint reached,** indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz → *Setpoint value not achieved – contact opens.*	Closes
7 =	**Error,** general error message, error is active or not yet acknowledged. →*Error – contact opens (ready – contact closes)*	Opens
8 =	**Warning:** general warning, a limit value was reached that could lead to a later shutdown of the FI.	Opens
9 =	Overcurrent warning: At least 130% of the nominal FI current was supplied for 30 seconds.	Opens
10 =	**Overtemperature motor (warning):** The motor temperature is evaluated via a digital input. → Motor is too hot. Warning occurs after 2 seconds, overheating switch-off after seconds.	Opens
11 =	**Torque current limit/Current limit active (warning):** The limiting value in P112 or P536 has been reached. A negative value in P435 inverts the reaction. Hysteresis = 10%.	Opens
12 =	**Relay via P541 – external control,** the relay can be controlled with parameter P541 (Bit 0) independently of the actual operating status of the FI.	Closes
13 =	**Torque limit gen. active** Limit value in P112 has been reached in the generator range. Hysteresis = 10%.	Closes
18 =	**FI ready:** The FI is in operative condition. Following successful enabling, it will deliver an output signal.	Closes

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
	14 = ... 29 reserved (excluding 18)			---
	30 = Bus IO In Bit 0 / Bus In Bit 0 *			Closes
	31 = Bus IO In Bit 1 / Bus In Bit 1 *			Closes
	32 = Bus IO In Bit 2 / Bus In Bit 2 *			Closes
	33 = Bus IO In Bit 3 / Bus In Bit 3 *			Closes
	34 = Bus IO In Bit 4 / Bus In Bit 4 *			Closes
	35 = Bus IO In Bit 5 / Bus In Bit 5 *			Closes
	36 = Bus IO In Bit 6 / Bus In Bit 6 *			Closes
	37 = Bus IO In Bit 7 / Bus In Bit 7 *			Closes
	38 = Value from Bus setpoint *			Closes
	39 = STO inactive: The relay / bit deactivates if STO or the Safe Stop are active.			Closes

Further details in the BUS manuals

*) P546...P548 = 17 or 19

P435	Standardisation output 1			P
-400 ... 400 % [100]	Adjustment of the limit values of the relay function. For a negative value, the output function will be output negative. Reference to the following values: Current limit (3) = x [%] · P203 >Motor nominal current< Torque current limit (4) = x [%] · P203 · P206 (calculated nominal motor torque) Frequency limit (5) = x [%] · P201 >Nominal motor frequency<			

P436	Hysteresis output 1		S	P
1 ... 100 % [10]	Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

P441	Function output 2 (K2)			P
0 ... 39 [7]	**Control terminals 3/4:** Functions are identical to P434!			

P442	Standardisation output 2			P
-400 ... 400 % [100]	Functions are identical to P435!			

P443	Hysteresis output 2		S	P
1 ... 100 % [10]	Functions are identical to P436!			

P450	Function output 3 (DOUT1)	SK 520E and above		P
0 ... 39 [0]	**Control terminals 5/40:** Functions are identical to P434! Digital output, 15V to DGND (for SK 5x5E devices, deviations of the signal level are possible (See section 2.12.3)).			

P451	Standardisation output 3	SK 520E and above		P
-400 ... 400 % [100]	Functions are identical to P435!			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P452	**Hysteresis output 3**	**SK 520E and above**	**S**	**P**
1 ... 100 % [10]	Functions are identical to P436!			
P455	**Function output 4 (DOUT2)**	**SK 520E and above**		**P**
0 ... 39 [0]	**Control terminals 7/40:** Functions are identical to P434! Digital output, 15V to DGND (for SK 5x5E devices, deviations of the signal level are possible (See section 2.12.3)).			
P456	**Standardisation output 4**	**SK 520E and above**		**P**
-400 ... 400 % [100]	Functions are identical to P435!			
P457	**Hysteresis output 4**	**SK 520E and above**	**S**	**P**
1 ... 100 % [10]	Functions are identical to P436!			
P460	**Time Watchdog**		**S**	
0.0 / 0.1 ... 250.0 s [10.0]	**0.1 ... 250.0** = The time interval between the expected Watchdog signals (programmable function of the digital inputs P420 – P425). If this time interval elapses without an impulse being registered, a switch-off and error message E012 are actuated. **0.0 = customer error:** As soon as a high-low flank or a low signal is detected at a digital input (function 18) the FI switches off with error message E012.			
P461	**Function 2 Encoder**			
0 ... 4 [0] *SW 1.7 or higher and hardware status CAA*	The actual speed list value supplied by an incremental encoder to the FI can be used for various functions in the FI. (Settings are identical to P325) **0 =** **Rotation speed measurement Servo mode:** The actual motor speed list value is used for the FI servo mode. The ISD control cannot be switched off in this function. Here P413 and P414 determine the P and I proportion of the control. **1 =** **PID actual frequency value:** The actual rotation speed of a system is used for rotation speed control. This function can also be used for controlling a motor with a linear characteristic curve. Here P413 and P414 determine the P and I proportion of the control. **2 =** **Frequency addition:** The rotation speed deduced is added to the current setpoint value. **3 =** **Frequency subtraction:** The determined speed is subtracted from the actual setpoint. **4 =** **Maximum frequency:** The maximum possible output frequency / speed is limited by the speed of the encoder.			
P462	**Pulse number 2 Encoder**			
16 ... 8192 [1024] *SW1.7 and above*	Input of the pulse-count per rotation (16-8192) of the connected encoder. If the encoder rotation direction is not the same as the FI, (depending on installation and wiring), it can be compensated for by selecting the corresponding negative pulse numbers.			
P463	**2. Encoder conversion**			
0.01 ... 100.0 [1.00] *SW1.7 and above*	If the incremental encoder is not mounted directly onto the motor shaft, then the respectively correct transformation ratio of motor speed to encoder speed must be set. $P463 = \frac{\text{motor speed}}{\text{encoder speed}}$ only when P461 = 1, 2, 3 or 4, therefore not in Servo mode (motor speed control)			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P464	**Fixed frequency modes**			
0 ... 1 [0] ***SW1.7 and above***	This parameter determines the form in which fixed frequencies are to be processed. **0 =** **Addition to main setpoint:** Fixed frequencies and the fixed frequency array are added to each other. I.e. they are added together, or added to an analog setpoint to which limits are assigned according to P104 and P105. **1 =** **Main setpoint:** Fixed frequencies are not added - neither together, nor to analog setpoints. If for example, a fixed frequency is switched to an existing analog setpoint, the analog setpoint will no longer be considered. A programmed frequency addition or subtraction to one of the analog inputs or bus setpoints is still possible and valid. If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (E.g.: 20>10 or 20>-30)			
P465 **... - 01** **...** **... - 31**	**Fixed frequency, field**			
-400.0 ... 400.0 Hz [0]	In the array levels, up to 31 different fixed frequencies can be set, which in turn can be encoded for the functions 50…54 in binary code for the digital inputs.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P466	**Minimum frequency process controller**			**P**
-400.0 ... 400.0 Hz [0.0]	With the aid of the minimum frequency process controller the control ratio can also be kept to a minimum ratio, even with a master value of “zero”, in order to enable adjustment of the compensator. Further details in P400 and Section 8.2.			
P470	**Digital input 7**	**SK 520E**		
0 ... 72 [0]	**No function** as factory setting, control terminal 27 (DIN7) Various functions can be programmed. These can be taken from tables for P420…P425.			
P475 **... - 01** **...** **... - 09**	**Switch on/off delay**		**S**	
-30.000 ... 30.000 s [0.000]	Adjustable switch-on/off delay for the digital inputs and the digital functions of the analog inputs. Use as a switch-on filter or simple process control is possible. **[01] =** Digital input 1 **[02] =** Digital input 2 **[03] =** Digital input 3 **[04] =** Digital input 4 **[05] =** Digital input 5 **[06] =** Digital input 6 (only SK 52x/53xE) **[07] =** Digital input 7 (only SK 52x/53xE) **[08] =** Digital function, analog input 1 **[09] =** Digital function, analog input 2 **Positive values =** switch-on delayed **Negative values =** switch-off delayed			
P480 **... - 01** **...** **... - 12**	**Function Bus I/O In Bits**		**S**	
0 ... 72 [0]	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420...425). **[01] =** Bus I/O In Bit 0 **[02] =** Bus I/O In Bit 1 **[03] =** Bus I/O In Bit 2 **[04] =** Bus I/O In Bit 3 **[05] =** Bus I/O In Bit 4 **[06] =** Bus I/O In Bit 5 **[07] =** Bus I/O In Bit 6 **[08] =** Bus I/O In Bit 7 **[09] =** Flag 1 **[10] =** Flag 2 **[11] =** Bit 8 BUS control word **[12] =** Bit 9 BUS control word The possible functions for the Bus In Bits can be found in the table of functions for the digital inputs P420...425. For further details, please refer to the manual for the AS interface, BU 0090.			

Parameter		Set value / Description / Note	Device	Supervisor	Parameter set
P481	**... - 01 ... ... - 10**	**Function Bus I/O Out Bits**		**S**	
0 ... 38 [0]		The Bus I/O Out Bits are perceived as multi-function relay outputs. They can be set to the same functions (P434; P441; P450; P455). **[01] =** Bus I/O Out Bit 0 **[02] =** Bus I/O Out Bit 1 **[03] =** Bus I/O Out Bit 2 **[04] =** Bus I/O Out Bit 3 **[05] =** Bus I/O Out Bit 4 **[06] =** Bus I/O Out Bit 5 **[07] =** Flag 1 **[08] =** Flag 2 **[09] =** Bit 10 BUS status word **[10] =** Bit 13 BUS status word The possible functions for the Bus Out Bits can be found in the table of functions for the relay P434. For further details, please refer to the manual for the AS interface, BU 0090.			
P482	**... - 01 ... ... - 10**	**Standardisation Bus I/O Out Bits**		**S**	
-400 … 400 % [100]		Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative. When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens.			
P483	**... - 01 ... ... - 10**	**Hysteresis Bus I/O Out Bits**		**S**	
1 … 100 % [10]		Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

5.6 Additional parameters

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P502 ... - 01 ... ... - 03	**Leading function value**		**S**	**P**
0 ... 21 [0]	Selection of up to 3 master values: **[01] =** Master value 1 **[02] =** Master value 2 **[03] =** Master value 3 Selection of possible setting values for master values: **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current **5 =** State of digital inputs and outputs **6 =** reserved **7 =** reserved **8 =** Setpoint frequency **9 =** Error message **10 =** reserved **11 =** reserved **12 =** Digital Out Bit 0…7 **13 =** reserved **14 =** reserved **15 =** reserved **16 =** reserved **17 =** Value analog input 1 **18 =** Value analog input 2 **19 =** Desired frequency master value **20 =** Desired frequency after master value ramp **21 =** Actual frequency without master value slip			
P503	**Leading function output**		**S**	
0 ... 3 [0]	To use the Leading function output, the inverter controller source must be selected in P509. The master value to be transmitted is determined via the BUS interface in parameter P502. **0 = Off** **1 = USS** **2 = CAN** (up to 250kBaud) **3 = CANopen**			
P504	**Pulse frequency**		**S**	
3.0 ... 16.0 kHz [6.0]	The internal pulse frequency for actuating the power component can be changed with this parameter. A higher setting reduces motor noise, but leads to increased EMC emissions and reduction of the possible motor nominal torque. **NOTE:** The radio interference suppression limiting curve A1 according to EN55011 is complied with at a setting of 6.0kHz on condition that the wiring guidelines are complied with. For further details, see Section 8.4. EMC limit value classes. **NOTE:** Raising the pulse frequency leads to a reduction of the possible output current, depending on the time (I^2t curve). For further details, see Section 8.5. Power de-rating.			
P505	**Absolute minimum frequency**		**S**	**P**
0.0 ... 10.0 Hz [2.0]	Gives the frequency value that cannot be undershot by the FI. If the setpoint becomes smaller than the absolute minimum frequency, the FI switches off or changes to 0.0Hz. At the absolute minimum frequency, braking control (P434 or P441) and the setpoint delay (P107) are actuated. If a setting value of "Zero" is selected, the brake relay does not switch during reversing. When controlling lift equipment, this value should be set at a minimum of 2Hz. From 2Hz, the current control of the FI operates and a connected motor can supply sufficient torque. **NOTE:** Output frequencies < 2Hz lead to current limitation. For further details, see Section 8.5. Power de-rating.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P506	**Automatic error acknowledgement**		**S**	
0 ... 7	In addition to the manual error acknowledgement, an automatic one can also be selected.			
[0]	**0 =** **No automatic** error acknowledgement			
	1 ... 5 = **Number** of permissible automatic malfunction acknowledgments within one mains-on cycle. After mains off and switch on again, the full amount is again available.			
	6 = **Always,** an error message will always be acknowledged automatically if the cause of the error is no longer present.			
	7 = **ENTER key,** acknowledgement is only possible using the ENTER key or by mains switch-off. No acknowledgement is implemented by removing the enable!			
P507	**PPO Type**			
1 ... 4	This parameter can only be used with the technology unit Profibus, DeviceNet or InterBus			
[1]	See also additional descriptions BU 0020, BU 0080, BU 0070			
P508	**Profibus address**			
1 ... 126	Profibus address, only with the technology unit Profibus			
[1]	See also the additional description for the Profibus control BU 0020			
P509	**Control word source**			
0 ... 10	Selection of the interface via which the FI is controlled.			
[0]	**0 =** **Control terminals or keyboard control **** with the Control Box (when P510=0), the Parameter Box (not ext. p-box) or via Bus I/O Bits.			
	1 = **Only control terminals *,** the FI can only be controlled via the digital and analog input signals or via the Bus I/O Bits.			
	2 = **USS control word *,** the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies.			
	3 = **CAN** control word *			
	4 = **Profibus** control word *			
	5 = **InterBus** control word *			
	6 = **CANopen** control word *			
	7 = **DeviceNet** control word *			
	8 = reserved			
	9 = **CAN Broadcast ***			
	10 = **CANopen Broadcast ***			
	*) Keyboard control (ControlBox, ParameterBox) is blocked, parameterisation is still possible.			
	**) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will block without an error message.			

NOTE:

For details about the respective Bus systems please refer to the respective Options descriptions:

BU 0020 = Profibus	BU 0050 = USS
BU 0060 = CAN/CANopen	BU 0070 = InterBus
BU 0080 = DeviceNet	BU 0090 = AS Interface

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Parameter		Set value / Description / Note	Device	Supervisor	Parameter set
P510	**... - 01** **... - 02**	**Setpoint source**		**S**	
0 ... 10 [0]		Selection of the setpoint source to be parameterised. **[01] = Master setpoint value** source **[02] = Auxiliary setpoint value** source			
		Selection of the interface via which the FI receives the setpoint. **0 = Auto:** The source of the auxiliary setpoint is automatically derived from the setting in the parameter P509 >Interface< **1 = Control terminals,** digital and analog inputs control the frequency, including fixed frequencies **2 = USS** **3 = CAN** **4 = Profibus** **5 = InterBus** **6 = CANopen** **7 = DeviceNet** **8 =** reserved **9 = CAN Broadcast** **10 = CANopen Broadcast**			
P511		**USS Baud rate**		**S**	
0 ... 3 [3]		Setting of the transfer rate (transfer speed) via the RS485 interface. All bus participants must have the same baud rate setting. **0 =** 4800 baud **2 =** 19200 baud **1 =** 9600 baud **3 =** 38400 baud			
P512		**USS address**			
0 ... 30 [0]		Setting the FI Bus address.			
P513		**Telegram down time**		**S**	
-0.1 / 0.0 / 0.1 ... 100.0 s [0.0]		Monitoring function of the active bus interface. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the FI reports an error and switches off with the error message E010 >Bus Time Out<. 0.0 = Off: Monitoring is switched off. -0.1 = no error: Even if communication between BusBox and FI is interrupted (e.g. 24V error, Box removed, etc.), the FI will continue to operate unchanged.			
P514		**CAN Baud rate**			
0 ... 7 [4]		Used to set the transfer rate (transfer speed) via the CANbus interface. All bus participants must have the same baud rate setting. Additional information is contained in the manual BU 0060 CAN/CANopen. **0 =** 10kBaud **3 =** 100kBaud **6 =** 500kBaud **1 =** 20kBaud **4 =** 125kBaud **7 =** 1Mbaud * (test purposes only) **2 =** 50kBaud **5 =** 250kBaud *) Safe operation cannot be guaranteed			
P515	**... - 01** **...** **... - 03**	**CAN address**			
0 ... 255 [50]		Setting for the CANbus address. From SW 1.6 and above, can be set in three levels: **[01] =** Receipt address for CAN and CANopen (as before) **[02] =** Broadcast – receipt address for CANopen (Slave) **[03] =** Broadcast –Transmission address for CANopen (Master)			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P516	**Masking frequency 1**		**S**	**P**
0.0 ... 400.0 Hz [0.0]	The output frequency around the frequency value (P517) set here is masked. This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set. **0 =** Masking frequency inactive			
P517	**Masking frequency range 1**		**S**	**P**
0.0 ... 50.0 Hz [2.0]	Masking range for the >Masking frequency 1< P516. This frequency value is added and subtracted from the masking frequency. Masking frequency range 1: P516 - P517 ... P516 + P517			
P518	**Masking frequency 2**		**S**	**P**
0.0 ... 400.0 Hz [0.0]	The output frequency around the frequency value (P519) set here is masked. This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set. **0 =** Masking frequency inactive			
P519	**Masking frequency range 2**		**S**	**P**
0.0 ... 50.0 Hz [2.0]	Masking range for the >Masking frequency 2< P518. This frequency value is added and subtracted from the masking frequency. Masking frequency range 2: P518 - P519 ... P518 + P519			
P520	**Flying start**		**S**	**P**
0 ... 4 [0]	This function is required to connect the FI to already rotating motors, e.g. in fan drives. Motor frequencies >100Hz are only picked up in speed controlled mode (Servo mode P300 = ON). **0 = Switched off,** no flying start circuit. **1 = Both directions,** the FI looks for a speed in both directions. **2 = Setpoint value direction,** searches only in the direction of the setpoint value present. **3 = Both directions,** only following mains supply failure and error **4 = In setpoint direction,** only following mains supply failure and error **NOTE:** For physical reasons, the flying start circuit only operates above 1/10 of the nominal motor frequency (P201), however not below 10Hz.			

	Example 1	**Example 2**
(P201)	**50Hz**	**200Hz**
f=1/10*(P201)	f=5Hz	f=20Hz
Comparison of f vs. f_{min} with: f_{min} =10Hz **Result f_{Fang}=**	5Hz < 10Hz The flying start circuit functions above **f_{Fang}=10Hz.**	20Hz < 10Hz The flying start circuit functions above **f_{Fang}=20Hz.**

P521	**Flying start resolution**		**S**	**P**
0.02... 2.50 Hz [0.05]	Using this parameter, the flying start circuit search increment size can be adjusted. Values that are too large affect accuracy and causes the FI to cut out with an overcurrent report. If the values are too small, the search time is greatly extended.			
P522	**Flying start offset**		**S**	**P**
-10.0 ... 10.0 Hz [0.0]	A frequency value that can be added to the frequency value found, e.g. to remain in the motor range and so avoid the generator range and therefore the chopper range.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P523	**Factory setting**			
0 ... 2 [0]	By selecting the appropriate value and confirming it with the ENTER key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0. **0 =** **No change:** Does not change the parameterisation. **1 =** **Load factory settings:** The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost. **2 =** **Factory settings without bus:** All parameters of the frequency inverter, with the exception of the bus parameter, are reset to the factory setting.			
P533	**Factor I^2t-Motor**		**S**	
50 ... 150 % [100] *SW1.6 and above*	The motor current for the I^2t motor monitoring P535 can be weighted with the parameter P533. Larger factors permit larger currents.			
P534 **... - 01** **... - 02**	**Torque-based disconnection limit**		**S**	
0 ... 400 % / 401 [401]	Via this parameter both the **drive** [-01] and the **generator** [-02] switch-off value can be adjusted. If 80% of the set value is reached, a warning status is set. At 100% switch-off is performed with an error message. Error 12.1 is given on exceeding the drive switch-off limit and 12.2on exceeding the generator switch-off limit. **[01] =** drive switch-off limit **[02] =** generator switch-off limit 401 = OFF, means that this function has been disabled.			
P535	**I^2t-Motor**			
0 ... 1 [0]	When calculating the motor temperature, the output current, time and the output frequency (cooling) are taken into account. If the temperature limit value is reached then switch off occurs and error message E002 (motor overheating) is output. Possible positive or negative effects of ambient conditions cannot be taken into account here. **0 =** disabled **1 =** Switched on			
0 … 24 [0] *SW1.6 and above*	The I^2t motor function can now be set in a differentiated manner. Up to four curves with three different triggering times can be set. The trigger times are based on classes 5, 10 and 20 for semiconductor switching devices. **Setting 5 corresponds to the previous setting "ON".** All curves run from 0Hz to half of the nominal frequency (P201). From half of the nominal frequency upwards, the full nominal current is available.			

Switch-off class 5, 60s at 1.5x I_N		Switch-off class 10, 120s at 1.5x I_N		Switch-off class 20, 240s at 1.5x I_N	
I_N at 0Hz	**P535**	**I_N at 0Hz**	**P535**	**I_N at 0Hz**	**P535**
100%	1	100%	9	100%	17
90%	2	90%	10	90%	18
80%	3	80%	11	80%	19
70%	4	70%	12	70%	20
60%	5	60%	13	60%	21
50%	6	50%	14	50%	22
40%	7	40%	15	40%	23
30%	8	30%	16	30%	24

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P536	**Current limit**		S	
0.1 ... 2.0 / 2.1 (x nominal FI current) [1.5]	The inverter output current is limited to the set value. If this limit value is reached, the inverter reduces the actual output frequency. Multiplier with the inverter nominal current, gives the limit value 2.1 = OFF, OFF represents the disabling of this limit value.			
P537	**Pulse switch-off**		S	
10 ... 200 % / 201 [150]	This function prevents rapid shutdown of the FI according to the load. With the pulse switch-off enabled, the output current is limited to the set value. This limitation is implemented by brief switching off of individual output stage transistors, the actual output frequency remains unchanged. **10...200% = Limit value related to the nominal FI current** **201 = Function is disabled** **NOTE:** The value set here can be undershot by a smaller value in P536. For smaller output frequencies (<4.5Hz) or higher pulse frequencies (>6kHz or 8kHz, P504) the pulse switch-off by the power reduction (see Section 8.5) can be undershot. **NOTE:** If the pulse switch-off is disabled (P537=201) and a high pulse frequency is selected in parameter P504, the FI automatically reduces the pulse frequency when the power limit is reached. If the load on the FI is again reduced, the pulse frequency increases to the original value again.			
P538	**Mains voltage monitoring**		S	
0 ... 4 [3]	For safe operation of the inverter the power supply must meet a certain quality. If there is a brief interruption of a phase or the voltage supply sinks below a particular limit value, the inverter will output an error. Under certain operating conditions, it may be necessary to suppress this error message. In this case, the input monitoring can be adjusted. **0 = Disabled**: No monitoring of the supply voltage. **1 = Only phase errors:** only phase errors will produce an error message. **2 = Only low voltage**: only low voltage will produce an error message. **3 = Phase error and low voltage**: Phase errors and low voltage generate error messages. **4 = DC supply**: The input voltage is fixed at 480V for the direct supply of direct current. Phase error and low mains voltage monitoring are deactivated. **NOTE:** Operation with an impermissible mains voltage can destroy the frequency inverter! With 1/3~230V or 1~115V devices, the phase error monitoring does not function!			
P539	**Output monitoring**		S	P
0 ... 3 [0]	This protective function monitors the output current at the U-V-W terminals and checks for plausibility. In cases of error, the error message E016 is output. **0 = Disabled:** Monitoring is not active. **1 = Motor phase error only:** The output current is measured and checked for symmetry. If an imbalance is present, the FI switches off and outputs the error message E016. **2 = Excitation monitoring only:** At the moment the FI is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the FI switches off with the error message E016. A motor brake is not released in this phase. **3 = Motor phase and excitation monitoring:** as 1 and 2 combined **NOTE:** This function can be used as an additional protective function for lifting applications, but is not permissible on its own as protection for persons.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P540	**Rotation direction mode**		**S**	**P**

0 ... 7

[0]

For safety reasons this parameter can be used to prevent a rotation direction reversal and therefore the incorrect rotation direction.

This function does not work with active position control (SK 53xE only, P600 ≠ 0).

0 = No rotation direction limitation

1 = Block direction reversal, the direction reverse button of the ControlBox SK TU3-CTR is blocked.

2 = CW only*, only clockwise direction is possible. The selection of the "incorrect" rotation direction leads to the output of the minimum frequency P104 with the field of rotation R.

3 = CCW only*, only counter-clockwise direction is possible. The selection of the "incorrect" rotation direction leads to the output of the minimum frequency P104 with the field of rotation L.

4 = Enable direction only, rotation direction is only possible according to the enable signal, otherwise 0Hz is output.

5 = CW only monitored*, only CW rotation is possible. The selection of the "incorrect" rotation direction leads to the FI switching off (control block). If necessary, an adequately large setpoint value (>f_{min}) must be observed.

6 = CCW only monitored*, only CCW rotation is possible. The selection of the "incorrect" rotation direction leads to the FI switching off (control block). If necessary, an adequately large setpoint value (>f_{min}) must be observed.

7 = Enable direction only monitored, Rotation direction is only possible according to the enable signal, otherwise the FI is switched off.

*) Applies to keyboard (SK TU3-) and control terminal actuation, in addition, the direction key on the ControlBox is blocked.

P541	Set Output		S	

0000 ... 3F1F (hex)

[0000]

This function provides the opportunity to control the relay and the digital outputs independently of the frequency inverter status. To do this, the relevant output must be set to the function "External control".

This function can either be used manually or in combination with a bus control.

Bit 0 = Output 1 (K1)
Bit 1 = Output 2 (K2)
Bit 2 = Output 3 (DOUT1)
Bit 3 = Output 4 (DOUT2)
Bit 4 = Dig. AOut 1 (Analog output 1)
Bit 5 … 7 = reserved
Bit 8 = Bus Out Bit 0
Bit 9 = Bus Out Bit 1
Bit 10 = Bus Out Bit 2
Bit 11 = Bus Out Bit 3
Bit 12 = Bus Out Bit 4
Bit 13 = Bus Out Bit 5

	Bit 13 -12	Bit 11 -8	Bit 7 -4	Bit 3 -0	
Min. Value	00	0000	0000	0000	Binary
	0	**0**	**0**	**0**	**hex**
Max. Value	11	1111	0001	1111	Binary
	3	**F**	**1**	**F**	**hex**

BUS: The corresponding hex value is written into the parameter, thereby setting the relay and digital outputs.

ControlBox: The hexadecimal code is entered directly when the ControlBox is used.

ParameterBox: Each individual output can be separately called up in plain text and activated.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P542	**Set analog output**		**S**	
0.0 ... 10.0 V [0.0]	The analog output of the FI can be set with this function, independently of the actual operating state. To do this, the relevant analog output must be set to the function "External control" (P418 = 7). This function can either be used manually or in combination with a bus control. The value set here will, once confirmed, be produced at the analog output.			
P543	**Actual bus value 1**		**S**	**P**
0 ... 22 [1]	The return value 1 can be selected for bus actuation in this parameter. **NOTE:** Further details can be found in the respective BUS operating instructions or in the description of P418. **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current (100% = P112) **5 =** State of digital inputs and outputs [1] **6 =** … 7 reserved **8 =** Setpoint frequency **9 =** Error number **10 =** … 11 reserved **12 =** Bus IO Out Bits 0...7 **13 =** … 16 reserved **17 =** Value analog input 1 (P400) **18 =** Value analog input 2 (P405) **19 =** Desired frequency master value (P503) **20 =** Desired frequency after master value ramp **21 =** Actual frequency without master value slip **22 =** Speed I from encoder (only possible with SK 520/53xE and encoder feedback)			
P544	**Actual bus value 2**		**S**	**P**
0 ... 22 [0]	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			
P545	**Actual bus value 3**		**S**	**P**
0 ... 22 [0]	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			

[1] The assignment of the dig. inputs in P543/ 544/ 545 = 5

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = DigIn 5	Bit 5 = DigIn 6 (SK 520/53xE)	Bit 6 = DigIn 7 (SK 520/53xE)	Bit 7 = reserved
Bit 8 = reserved	Bit 9 = reserved	Bit 10 = reserved	Bit 11 = reserved
Bit 12 = Out 1	Bit 13 = Out 2	Bit 14 = Out 3 (SK 520/53xE)	Bit 15 = Out 4 (SK 520/53xE)

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P546	**Bus setpoint 1**		**S**	**P**
0 ... 47 [1]	In this parameter, a function is allocated to the output setpoint 1 during bus actuation. **NOTE:** Further details can be found in the respective BUS operating instructions or in the description of P400. **0 =** Off **1 =** Setpoint frequency (16 Bit) **2 =** Torque current limit (P112) **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit (P536) **7 =** Maximum frequency (P105) **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque servo mode (P300) **11 =** Torque precontrol (P214) **12 =** reserved **13 =** Multiplication **14 =** PI process controller actual value **15 =** PI process controller setpoint **16 =** PI process controller lead **17 =** Bus In Bits 0...7 **18 =** reserved **19 =** Status output (P434/441/450/455=38) **20 =** Value analog output (P418=31) **21 =** …45 reserved for SK 530E → BU 0510 **46 =** Setpoint torque process controller **47 =** reserved			
P547	**Bus setpoint 2**		**S**	**P**
0 ... 47 [0]	This parameter is identical to P546.			
P548	**Bus setpoint 3**		**S**	**P**
0 ... 47 [0]	This parameter is identical to P546.			
P549	**PotentiometerBox function**		**S**	
0 ... 16 [0]	In this parameter, the setpoint of the PotentiometerBox (SK TU3-POT) is assigned with a function. (An explanation can be found in the description of P400) As of software version 1.7 R0, on setting 4 or 5, the ControlBox or the ParameterBox are also set to function as suppliers of auxiliary setpoints. (See Section 4.4) **0 =** Off **1 =** Setpoint frequency **2 =** Torque current limit **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit **7 =** Maximum frequency **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque **11 =** Torque precontrol **12 =** reserved **13 =** Multiplication **14 =** PI process controller actual value **15 =** PI process controller setpoint **16 =** PI process controller lead **Controlling the FI with the SK CSX-0:** If P549=1 is set and the operating value display P000 is selected, the drive can be controlled with the SimpleBox (see Section 3.2.1) on the FI. Depressing the button for a long time starts the drive, pressing briefly stops it. The speed of rotation can be controlled in the positive and negative range by means of the rotating knob. Control of the FI with the SimpleBox is not possible in combination with the ParameterBox SK TU3-PAR. **NOTE:** Please note that in this operating mode the drive can only be stopped with the button in the operating value display (brief press) or by switching off the mains supply.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P550	**ParameterBox Orders**			

0 ... 3

[0]

Within the optional ControlBox it is possible to save a data set (parameter set 1 … 4) of the connected FI. This is saved in a non-volatile memory within the Box, and can therefore be transferred for other SK 5xxE units with the same database version (see P742).

0 = No function

1 = FI → ControlBox, dataset is written from the connected FI to the ControlBox.

2 = ControlBox → FI, dataset is written from the ControlBox to the connected FI.

3 = FI ←→ ControlBox, the FI dataset is exchanged with the ControlBox dataset. With this variant, no data is lost. It is continuously exchangeable.

NOTE: If parameterisation from old FI's need to be loaded into FIs with new software (P707), then the ControlBox must previously be written to by the new FI (P550 = 1). The dataset to be copied from the old FI can then be read out and copied to the new FI.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P551	**Drive profile**		**S**	

0 … 1

[0]

According to the option the relevant process data profiles can be activated with this parameter.

This parameter is only effective for pluggable technology modules (SK TU3-…).

System	**CANopen***	**DeviceNet**	**InterBus**
Technology modules	SK TU3-CAO	SK TU3-DEV	SK TU3-IBS
Setting			
0 =	USS protocol (Profile “Nord”)		
1 =	DS402 profile	AC Drives profile	Drivecom profile

Note: With the use of the internal CANbus (CANnord/CANopen) via the integrated customer interface (RJ45, X9/10, SK 520/53xE) the settings in this parameter have no effect. The DS402 profile cannot be activated.

Parameter		Set value / Description / Note	Device	Supervisor	Parameter set
P552	**... -01** **... -02**	**CAN cycle time**		**S**	

0 … 100 ms

[0]

SW1.6 and above

In this parameter, the cycle time for the CAN/CANopen master mode and the CAN open encoder is set (see P503/514/515):

[01] = Cycle time CAN/CANopen master functions

[02] = Cycle time CANopen absolute value encoder (SK 53xE)

According to the Baud rate set, there are different minimum values for the actual cycle time:

Baud rate	Minimum value t_Z	Default CAN Master	Default CANopen Abs.
10kBaud	10ms	50ms	20ms
20kBaud	10ms	25ms	20ms
50kBaud	5ms	10ms	10ms
100kBaud	2ms	5ms	5ms
125kBaud	2ms	5ms	5ms
250kBaud	1ms	5ms	2ms
500kBaud	1ms	5ms	2ms
1000kBaud:	1ms	5ms	2ms

The range of values which can be set is between 0 and 100ms. With the setting 0 “Auto” the default value (see table) is used. The monitoring function for the CANopen absolute value encoder no longer triggers at 50ms, but rather at 150ms.

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P554	**Min. chopper trigger point**		S	
65 ... 100 % [65]	The switching threshold of the brake chopper can be influenced with this parameter. An optimised value for numerous applications is set in the factory setting. This parameter can be increased for applications where pulsating energy is returned (crank drives) to minimise brake resistance power dissipation. An increase in this setting leads to a faster overvoltage FI switch off.			
P555	**Chopper power limit**		S	
5 ... 100 % [100]	With this parameter it is possible to program a manual (peak) power limit for the brake resistor. The switch-on delay (modulation level) for the chopper can only rise to a certain maximum specified limit. Once this value has been reached, irrespective of the level of the link voltage, the inverter switches off the current to the resistor. The result would be an overvoltage switch-off of the FI.			
P556	**Braking resistor**		S	
20 ... 400 Ω [120]	Value of the brake resistance for the calculation of the maximum brake power to protect the resistor. Once the maximum continuous output (P557) including overload (200% for 60s) is reached, an I^2t limit error (E003.1) is triggered. Further details in P737.			
P557	**Braking resistor power**		S	
0.00 ... 20.00 kW [0.00]	Continuous power (nominal power) of the resistor, to display the actual utilisation in P737. For a correctly calculated value, the correct value must be entered into P556 and P557. **0.00 =** Monitoring disabled			
P558	**Magnetizing time**		S	P
0 / 1 / 2 ... 500 ms [1]	The ISD control can only function correctly if there is a magnetic field in the motor. For this reason, a DC current is applied before starting the motor. The duration depends on the size of the motor and is automatically set in the factory setting of the FI. For time critical applications, the magnetizing time can be set or deactivated. **0 =** disabled **1 =** automatic calculation **2 ... 500 =** Time set in [ms] **NOTE:** Setting values that are too low can reduce the dynamics and starting torque.			
P559	**DC run-on time**		S	P
0.00 ... 30.00 s [0.50]	Following a stop signal and the braking ramp, a direct current is briefly applied to the motor to fully bring the drive to a stop. Depending on the inertia, the time for which the current is applied can be set in this parameter. The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic).			
P560	**Save on EEPROM**		S	
0 ... 1 [1]	**0 =** Changes to the parameter settings are no longer saved on the EEPROM. All previously saved settings are retained, even if the FI is disconnected from the mains. **1 =** All parameter changes are automatically written to the EEPROM and remain stored there even if the FI is disconnected from the mains supply. **NOTE:** If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles (100,000 x) in the EEPROM is not exceeded.			

5.7 Positioning

The parameter group P6xx is only included in SK 53xE frequency inverters. These are used to set the positioning control of the SK 53xE

A detailed description of these parameters can be found in manual BU 0510. (www.nord.com)

5.8 Information

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P700	**Current fault**			
0.0 ... 21.4	Current pending fault. Further details in Section 6 Error messages. **SimpleBox/ControlBox:** Descriptions of the individual error numbers can be found in the point Error messages. **ParameterBox:** Errors are displayed in plain text, further information can be found in the point Error messages.			
P701 ... - 01 ... ... - 05	**Last fault 1...5**			
0.0 ... 21.4	This parameter stores the last 5 faults. Further details in Section 6 Error messages. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			
P702 ... - 01 ... ... - 05	**Freq. previous fault 1...5**		**S**	
-400.0 ... 400.0 Hz	This parameter stores the output frequency that was being delivered at the time the fault occurred. The values of the last 5 faults are stored. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			
P703 ... - 01 ... ... - 05	**Current previous fault 1...5**		**S**	
0.0 ... 999.9 A	This parameter stores the output current that was being delivered at the time the fault occurred. The values of the last 5 errors are stored. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			
P704 ... - 01 ... ... - 05	**Voltage previous fault 1...5**		**S**	
0 ... 500 V AC	This parameter stores the output voltage that was being delivered at the time the fault occurred. The values of the last 5 faults are stored. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P705 **... - 01 ... ... - 05**	**UZW previous fault 1...5**		**S**	
0 ... 1000 V DC	This parameter stores the link voltage that was being delivered at the time the error occurred. The values of the last 5 errors are stored. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			
P706 **... - 01 ... ... - 05**	**Parameter set previous fault 1...5**		**S**	
0 ... 3	This parameter stores the parameter set code that was active when the error occurred. Data for the previous 5 faults are stored. The ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the ENTER key to read the stored error code.			
P707 **... - 01 ... ... - 03**	**Software version/ revision**			
0.0 ... 9999.9	This parameter shows the software and revision numbers in the FI. This can be significant when different FIs are assigned the same settings. Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version. **... - 01 =** Version number (1.7) **... - 02 =** Revision number (R0) **... - 03 =** Special version of hardware/software (0.0)			
P708	**Status of digital inputs**	**(SK 520E)**		
000000000 ... 111111111 (binary) (Display with *SK-TU3-PAR) *or* 0000 ... 01FF (hex) (Display with *SK-TU3-CTR *SK-CSX-0)	Displays the status of the digital inputs in binary/hexadecimal code. This display can be used to check the input signals. **Bit 0 =** Digital input 1 **Bit 1 =** Digital input 2 **Bit 2 =** Digital input 3 **Bit 3 =** Digital input 4 **Bit 4 =** Digital input 5 **Bit 5 =** Digital input 6 (SK 520/53xE) **Bit 6 =** Digital input 7 (SK 520/53xE) **Bit 7 =** Digital function analog input 1 **Bit 8 =** Digital function analog input 2			
P709	**Voltage analog input 1**			
0.00 ... 10.00 V	Displays the measured analog input value 1.			
P710	**Voltage analog output**			
0.0 ... 10.0 V	Displays the delivered value of analog output 1. (0.0 ... 10.0V)			

	Bit 11-8	Bit 7-4	Bit 3-0	
Minimum value	0000 **0**	0000 **0**	0000 **0**	binary **hex**
Maximum value	0001 **1**	1111 **F**	1111 **F**	binary **hex**

ControlBox: the binary Bits are converted into a hexadecimal value and displayed.

ParameterBox: the Bits are displayed increasing from right to left (binary).

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P711	**Output status**	**(SK 520E)**		
00000000 ... 11111111 (binary) (Display with *SK-TU3-PAR) *or* 0000 ... 01FF (hex) (Display with *SK-TU3-CTR *SK-CSX-0)	Displays the actual status of the signal relays. **Bit 0 =** Output 1 (K1) **Bit 1 =** Output 2 (K2) **Bit 2 =** Output 3 (DOUT1) **Bit 3 =** Output 4 (DOUT2) } only with SK 520/53xE			
P712	**Voltage analog input 2**			
0.00 ... 10.00 V	Displays the measured analog input value 2.			
P714	**Operating time**			
0.10 ... ___ h	This parameter shows the time for which the FI was connected to the mains and was ready for operation.			
P715	**Enablement time**			
0.00 ... ___ h	This parameter shows the time for which the FI was enabled and supplied current to the output.			
P716	**Current frequency**			
-400.0 ... 400.0 Hz	Displays the current output frequency.			
P717	**Current rotation speed**			
-9999 ... 9999 rpm	Displays the actual motor speed calculated by the FI.			
P718 **... - 01** **... - 02** **... - 03**	**Current set frequency**			
-400.0 ... 400.0 Hz	Displays the frequency specified by the set point. (see also 8.1 Set point processing) **... - 01 =** current set frequency from the setpoint source **... - 02 =** actual setpoint frequency after processing in the FI status engine **... - 03 =** actual setpoint frequency after the frequency ramp			
P719	**Actual current**			
0.0 ... 999.9 A	Displays the actual output current.			
P720	**Current torque current**			
-999.9 ... 999.9 A	Displays the actual calculated torque-developing output current (active current). Basis for calculation are the motor data P201...P209 ... . → negative values = generator, → positive values = drive			
P721	**Actual field current**			
-999.9 ... 999.9 A	Displays the actual calculated field current (reactive current). Basis for calculation are the motor data P201...P209			
P722	**Actual voltage**			
0 ... 500 V	Displays the actual AC voltage supplied by the FI output.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P723	**Actual voltage components Ud**			
0 ... 500 V	Displays the actual field voltage component.			
P724	**Actual voltage components Uq**			
0 ... 500 V	Displays the actual torque voltage component.			
P725	**Actual cosφ?**			
0.00 ... 1.00	Displays the actual calculated cos φ of the drive.			
P726	**Apparent power**			
0.00 ... 99.99 kVA	Displays the actual calculated apparent power. Basis for calculation are the motor data P201...P209			
P727	**Mechanic power**			
-99.99 ... 99.99 kW	Displays the actual calculated effective power of the motor. Basis for calculation are the motor data P201...P209			
P728	**Mains voltage**			
0 ... 1,000 V	Displays the actual mains voltage at the FI input.			
P729	**Torque**			
0 ... 400 %	Displays the actual calculated torque. Basis for calculation are the motor data P201...P209			
P730	**Field**			
0 ... 400 %	Displays the actual field in the motor as calculated by the inverter. Basis for calculation are the motor data P201...P209			
P731	**Current parameter set**			
0 ... 3	Shows the actual operating parameter set. **0 =** Parameter set 1 **2 =** Parameter set 3 **1 =** Parameter set 2 **3 =** Parameter set 4			
P732	**U phase current**		**S**	
0.0 ... 999.9 A	Displays the actual U phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			
P733	**V phase current**		**S**	
0.0 ... 999.9 A	Displays the actual V phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P734	**W phase current**		**S**	
0.0 ... 999.9 A	Displays the actual W phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			
P735	**Rotation speed encoder**	**SK 520E**	**S**	
-999 ... 9999 rpm	Displays the actual rotation speed supplied by the incremental encoder. For this, P301 must be correctly set.			
P736	**DC link current**			
0 ... 1000 V DC	Displays the actual link voltage.			
P737	**Current braking resistor load**			
0 ... 1000 %	This parameter provides information about the actual degree of modulation of the brake chopper or the current utilisation of the braking resistor in generator mode. If parameters P556 and P557 are correctly set, the utilisation related to P5567, the resistor power, is displayed. If only P556 is correctly set (P557=0), the degree of modulation of the brake chopper is displayed. Here, 100 means that the brake resistor is fully switched. On the other hand, 0 means that the brake chopper is not active at present. If P556 = 0 and P557 = 0, this parameter also provides information about the degree of modulation of the brake chopper in the FI.			
P738	**Current motor load**			
0 ... 1000 %	Shows the actual motor load. Basis for calculation is the motor data P203. The actually recorded current is related to the nominal motor current.			
P739	**Current heat sink temperature**			
0 ... 100 □	Displays the actual FI heat sink temperature.			
P740 **... - 01** **...** **... - 13**	**Bus In process data**		**S**	
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems. For display, a BUS system must be selected in P509	**... - 01** = Control Word	Control word, source from P509.	
		... - 02 = setpoint value 1 **... - 03** = setpoint value 2 **... - 04** = setpoint value 3	Setpoint data from master setpoint P510 - 01.	
		... - 05 = Bus I/O In Bits (P480)	The displayed value depicts all Bus In Bit sources linked with OR.	
		... - 06 = Parameter data In 1 **... - 07** = Parameter data In 2 **... - 08** = Parameter data In 3 **... - 09** = Parameter data In 4 **... - 10** = Parameter data In 5	Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)	
		... - 11 = setpoint value 1 **... - 12** = setpoint value 2 **... - 13** = setpoint value 3	Setpoint data from the leading function value (Broadcast), if P509 = 9/10	

Parameter	Set value / Description / Note		Device	Supervisor	Parameter set
P741 **... - 01** ... **... - 13**	**Bus Out process data**			**S**	
0000 ... FFFF (hex)	This parameter informs about the actual status word and the actual values that are transferred via the bus systems.	**... - 01 =** Status Word		Status word, source from P509.	
		... - 02 = Actual value 1 (P543) **... - 03 =** Actual value 2 (P544) **... - 04 =** Actual value 3 (P545)			
		... - 05 = Bus I/O Out Bit (P481)		The displayed value depicts all Bus Out Bit sources linked with OR.	
		... - 06 = Parameter data Out 1 **... - 07 =** Parameter data Out 2 **... - 08 =** Parameter data Out 3 **... - 09 =** Parameter data Out 4 **... - 10 =** Parameter data Out 5		Data during parameter transfer.	
		... - 11 = Actual value 1 leading function **... - 12 =** Actual value 2 leading function **... - 13 =** Actual value 3 leading function		Actual value of leading function P502/P503.	

P742	Database version			S	
0 ... 9999	Displays the internal database version of the FI.				

P743	Inverter type				
0.25 ... 11.00	Displays the inverter output in kW, e.g. "1.50" ⇒ FI with 1.5kW Nominal power.				

P744	Configuration level				
0000 ... FFFF (hex)	This parameter displays the special devices integrated in the FI. Display is in hexadecimal code (SimpleBox, ControlBox, Bus system). The display is in plain text when the ParameterBox is used. **SK 500E/505E = 0000** **SK 520E = 0101** **SK 530E/535E = 0201** **SK 510E/511E/515E = 0000**				

P745	Module version				
0.0 ... 999.9	Design status (software version) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. Have this data ready if you have a technical query.				

P746	Module status			S	
0000 ... FFFF (hex)	Actual status (readiness, error, communication) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. Code details can be found in the respective BUS module manual. Different contents are shown depending on the modules.				

P747	Inverter voltage range				
0 ... 2	Indicates the mains voltage range for which this device is specified. **0 =** 100..0.120V **1 =** 200..0.240V **2 =** 380...480V				

Parameter	Set value / Description / Note	Device	Supervisor	Parameter set
P748 **... - 01** **...** **... - 03**	**Status CANopen**	**SK 520E and above**	**S**	
0000 ... FFFF (hex)	**[01] =** CANbus/CANopen Status Bit 0 = 24V Bus supply voltage Bit 1 = CANbus in status “Bus Warning” Bit 2 = CANbus in status “Bus Off” Bit 3 ... 5 = free Bit 6 = Protocol of the CAN module is 0 = CAN or 1 = CANopen Bit 7 = free Bit 8 = „Bootsup Message“ sent Bit 9 = CANopen NMT State Bit 10 = CANopen NMT State Bit 11 = free Bit 12 ... 14 = reserved Bit 15 = free	**[02] =** reserved	**[03] =** reserved	

CANopen NMT State	Bit 10	Bit 9
Stopped =	0	0
Pre-Operational =	0	1
Operational =	1	0

P750	**Overcurrent statistic**		**S**	
0 ... 9999	Number of overcurrent messages during the operating period P714.			
P751	**Over voltage statistic**		**S**	
0 ... 9999	Number of overvoltage messages during the operating period P714.			
P752	**Mains supply faults**		**S**	
0 ... 9999	Number of mains faults during the operating period P714.			
P753	**Overheating statistics**		**S**	
0 ... 9999	Number of overtemperature faults during the operating period P714.			
P754	**Parameter loss statistic**		**S**	
0 ... 9999	Number of parameters lost during the operating period P714.			
P755	**System faults statistic**		**S**	
0 ... 9999	Number of system faults during the operating period P714.			
P756	**Time out statistics**		**S**	
0 ... 9999	Number of Time out errors during the operating period P714.			
P757	**Customer faults statistic**		**S**	
0 ... 9999	Number of Customer Watchdog faults during the operating period P714.			
P799 **... - 01** **...** **... - 05**	**Operating hours, latest fault 1…5**			
0.1 ... ___ h	This parameter shows the operating hours counter status (P714) at the moment of the previous fault. Array 01…05 corresponds to the lastest fault 1…5.			

5.9 Parameter monitoring, User settings

(P) ⇒ Parameter set dependent, these parameters can be differently adjusted in 4 parameter sets.

S ⇒ Supervisor parameter, visibility depends on P003.

Parameter No.		Name	Factory setting	Super-visor	Setting after commissioning			
					P 1	P 2	P 3	P 4
OPERATING DISPLAYS (5.1)								
P000		Operating display						
P001		Selection display	0					
P002		Factor display	1.00	S				
P003		Supervisor code	1		0= S parameters are hidden 1= all parameters are visible			
BASIC PARAMETERS (5.2)								
P100		Parameter set	0	S				
P101		Copy parameter set	0	S				
P102	(P)	Acceleration time [s]	2.0					
P103	(P)	Deceleration time [s]	2.0					
P104	(P)	Minimum frequency [Hz]	0.0					
P105	(P)	Maximum frequency [Hz]	50.0					
P106	(P)	Ramp smoothing [%]	0	S				
P107	(P)	Brake reaction time [s]	0.00					
P108	(P)	Disconnection mode	1	S				
P109	(P)	DC brake current [%]	100	S				
P110	(P)	DC braking time on [s]	2.0	S				
P111	(P)	P factor torque limit [%]	100	S				
P112	(P)	Torque current limit [%]	401 (off)	S				
P113	(P)	Jog frequency [Hz]	0.0	S				
P114	(P)	Brake ventilation time [s]	0.00	S				
MOTOR DATA / CHARACTERISTIC CURVE PARAMETERS (5.3)								
P200	(P)	Motor list	0					
P201	(P)	Nominal motor frequency [Hz]	*50.0 **	S				
P202	(P)	Nominal motor speed [rpm]	*1385 **	S				
P203	(P)	Nominal motor current [A]	*4.8 **	S				
P204	(P)	Nominal motor voltage [V]	*230 **	S				
P205	(P)	Nominal motor power [kW]	*1.10 **					
P206	(P)	Motor cos phi	*0.78 **	S				
P207	(P)	Motor circuit [star=0/delta=1]	*1 **	S				
P208	(P)	Stator resistance [?]	*6.28**	S				
P209	(P)	No load current [A]	*3.0 **	S				
P210	(P)	Static boost [%]	100	S				
P211	(P)	Dynamic boost [%]	100	S				
P212	(P)	Slip compensation [%]	100	S				

Parameter No.		Name	Factory setting	Super-visor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P213	(P)	ISD ctrl loop gain [%]	100	S				
P214	(P)	Torque precontrol [%]	0	S				
P215	(P)	Boost precontrol [%]	0	S				
P216	(P)	Time boost precontrol [s]	0.0	S				
P217	(P)	Oscillation damping [%]	10	S				
P218	(P)	Modulation depth [%]	100	S				
P219		Auto. excitation [%]	100	S				
P220	(P)	Parameter identification	0					
			*) dependent on FI power or P200/P220					
CONTROL PARAMETERS (5.4) Encoder input, only SK 520E/530E								
P300	(P)	Servo Mode [On / Off]	0					
P301		Incremental encoder	6					
P310	(P)	Speed controller P [%]	100					
P311	(P)	Speed controller I [%/ms]	20					
P312	(P)	Torque current controller P [%]	200	S				
P313	(P)	Torque current controller I [%/ms]	125	S				
P314	(P)	Limit torque current controller [V]	400	S				
P315	(P)	Field current controller P [%]	200	S				
P316	(P)	Field current controller I [%/ms]	125	S				
P317	(P)	Limit field current controller [V]	400	S				
P318	(P)	Weak field control P [%]	150	S				
P319	(P)	Weak field control I [%/ms]	20	S				
P320	(P)	Weak field control limit [%]	100	S				
P321	(P)	Speed control I brake off	0	S				
P325		Encoder function	0					
P326		Encoder conversion	1.00					
P327		Speed slip error [rpm]	0 (off)					
CONTROL TERMINALS (5.5)								
P400		Analog input function 1	1					
P401		Analog on mode. 1	0	S				
P402		Adjustment 1: 0% [V]	0.0	S				
P403		Adjustment 1: 100% [V]	10.0	S				
P404		Filter analogue input 1 [ms]	100	S				
P405		Analog input function 2	0					
P406		Mode analog input 2	0	S				
P407		Adjustment 2: 0% [V]	0.0	S				
P408		Adjustment 2: 100% [V]	10.0	S				
P409		Filter analogue input 2 [ms]	100	S				
P410	(P)	Min. freq. aux. setpoint [Hz]	0.0					
P411	(P)	Max. freq. aux. setpoint [Hz]	50.0					
P412	(P)	Nom.val process ctrl [V]	5.0	S				

Parameter No.		Name	Factory setting	Super-visor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P413	(P)	P-component PID control [%]	10.0	S				
P414	(P)	I-component PID control [%/ms]	10.0	S				
P415	(P)	D-component PID control [%ms]	1.0	S				
P416	(P)	Ramp time PI setpoint. [s.]	2.0	S				
P417	(P)	Offset analog output [V]	0.0	S				
P418	(P)	Functions: analog output	0					
P419	(P)	Norm. analogue output [%]	100					
P420		Digital input 1 (DIN1)	1					
P421		Digital input 2 (DIN2)	2					
P422		Digital input 3 (DIN3)	8					
P423		Digital input 4 (DIN4)	4					
P424		Digital input 5 (DIN5)	0					
P425		Digital input 6 (DIN6)	0					
P426	(P)	Quick stop time [s]	0.10					
P427		Emerg. stop error	0	S				
P428	(P)	Automatic starting	0 (off)	S				
P429	(P)	Fixed frequency 1 [Hz]	0.0					
P430	(P)	Fixed frequency 2 [Hz]	0.0					
P431	(P)	Fixed frequency 3 [Hz]	0.0					
P432	(P)	Fixed frequency 4 [Hz]	0.0					
P433	(P)	Fixed frequency 5 [Hz]	0.0					
P434	(P)	Function output 1 (K1)	1					
P435	(P)	Output 1 standardisation [%]	100					
P436	(P)	Output 1 hysteresis [%]	10	S				
P441	(P)	Function output 2 (K2)	7					
P442	(P)	Output 2 standardisation [%]	100					
P443	(P)	Output 2 hysteresis [%]	10	S				
P450	(P)	Output 3 function (DOUT1)	0					
P451	(P)	Output 3 standardisation [%]	100					
P452	(P)	Output 3 hysteresis [%]	10	S				
P455	(P)	Output 4 function (DOUT2)	0					
P456	(P)	Output 4 standardisation [%]	100					
P457	(P)	Output 4 hysteresis [%]	10	S				
P460		Watchdog time [s]	10.0	S				
P461		Function 2 Encoder	0					
P462		Pulse number 2 Encoder [Imp.]	1024					
P463		2. Encoder conversion	1.00					
P465		Fixed frequency, field [-01…-31]	0					
P466	(P)	Min. process controller freq.	0.0					
P470		Digital input 7 (DIN7)	0					
P475		Switch-on/off delay [s.]	0.000	S				

Parameter No.		Name	Factory setting	Super-visor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P480		Function Bus I/O In Bits	0	S				
P481		Function Bus I/O Out Bits	0	S				
P482		Norm. Bus I/O Out Bits [%]	100	S				
P483		Hyst. Bus I/O Out Bits [%]	10	S				
ADDITIONAL PARAMETERS (5.6)								
P502		Leading function value	0	S				
P503		Leading function output	0	S				
P504		Pulse frequency [kHz]	6.0	S				
P505	(P)	Abs. minimum frequency [Hz]	2.0	S				
P506		Auto. fault acknowledgement.	0	S				
P507		PPO Type	1					
P508		Profibus address	1					
P509		Source control word	0					
P510		Setpoint source	0 (auto)	S				
P511		USS baud rate	3	S				
P512		USS address	0					
P513		Telegram time-out [s]	0.0	S				
P514		CAN baud rate	4					
P515		CAN address	50					
P516	(P)	Skip frequency 1 [Hz]	0.0	S				
P517	(P)	Skip frequency area 1 [Hz]	2.0	S				
P518	(P)	Skip frequency 2 [Hz]	0.0	S				
P519	(P)	Skip frequency area 2 [Hz]	2.0	S				
P520	(P)	Flying start	0	S				
P521	(P)	Flying start resolution [Hz]	0.05	S				
P522	(P)	Flying start offset [Hz]	0.0	S				
P523		Factory setting	0					
P533		Factor I^2t-Motor [%]	100	S				
P534		Torque-based disconn. Limit [%]	401 (off)	S				
P535		I^2t motor	0	S				
P536		Current limit	1.5	S				
P537		Pulse switch-off [%]	150	S				
P538		Mains voltage monitoring	3	S				
P539	(P)	Output monitoring	0	S				
P540		Rotation direction mode	0	S				
P541		Set output [hex]	0000	S				
P542		Set analog output [V]	0.0	S				
P543	(P)	Bus - actual value 1	1	S				
P544	(P)	Bus - actual value 2	0	S				
P545	(P)	Bus - actual value 3	0	S				
P546	(P)	Function Bus - set point 1	1	S				

Parameter No.		Name	Factory setting	Super-visor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P547	(P)	Function Bus - set point 2	0	S				
P548	(P)	Function Bus - set point 3	0	S				
P549		PotentiometerBox function	0	S				
P550		ParameterBox Orders	0					
P551		Drive profile	0	S				
P552		CAN cycle time	0	S				
P554		Min. chopper trigger point [%]	65	S				
P555		P chopper limit [%]	100	S				
P556		Braking resistance [Ω]	*120*	*S*				
P557		Braking resistance power [kW]	0	S				
P558	(P)	Magnetisation time [ms]	1	S				
P559	(P)	DC lag period [s]	0.50	S				
P560		Storage in EEPROM	1	S				
POSITIONING (5.7)			**NOTE:**	Further details are listed and described in manual BU 0510. (www.nord.com)				
P600	(P)	Position control	0 (off)	S				
P601		Actual position [rev]	---					
P602		Actual Ref. Pos. [rev]	---					
P603		Curr. position. diff. [rev]	---	S				
P604		Encoder type	0	S				
P605		Absolute encoder	10	S				
P607		Ratio	1	S				
P608		Reduction ratio	1	S				
P609		Offset position [rev]	0	S				
P610		Sollwert-Modus	0	S				
P611		Lageregeler P [%]	5	S				
P612		Pos. Window [rev]	0	S				
P613		Position [rev]	0	S				
P615		Maximum position [rev]	0	S				
P616		Minimum position [rev]	0	S				
P625		Hysteresis output [rev]	1	S				
P626		Relais position [rev]	0	S				
P630		Position slip error [rev]	0	S				
P631		Abs/Inc slip error [rev]	0	S				
P640		Unit of pos. value	0	S				

Parameter No.	Name	Actual status and displayed values				
INFORMATION (5.8), read only						
P700	Current error					
P701	Last error 1...5					
P702	Freq. previous fault 1...5					
P703	Current previous fault 1...5					
P704	Voltage previous fault 1...5					
P705	UZW previous fault 1...5					
P706	P-set last error 1...5					
P707	Software version (/-revision)					
P708	Status digital input (bin/hex)					
P709	Voltage analog input 1 [V]					
P710	Voltage analog output [V]					
P711	Output status [hex]					
P712	Voltage analog input 2 [V]					
P714	Operating period [h]					
P715	Enable period [h]					
P716	Actual frequency [Hz]					
P717	Actual speed [rpm]					
P718	Actual set frequency 1..3 [Hz]					
P719	Actual current [A]					
P720	Actual torque current [A]					
P721	Actual field current [A]					
P722	Actual voltage [V]					
P723	Voltage-d [V]					
P724	Voltage-q [V]					
P725	Actual cos phi					
P726	Apparent power [kVA]					
P727	Mechanical power [kW]					
P728	Input voltage [V]					
P729	Torque [%]					
P730	Field [%]					
P731	Parameter set					
P732	U phase current [A]					
P733	V phase current [A]					
P734	W phase current [A]					
P735	Speed encoder [rpm]					
P736	Link voltage [V]					
P737	Current utilisation of brake resistor [%]					
P738	Actual utilisation of motor [%]					
P739	Heat sink temperature [°C]					
P740	Process data Bus In [hex]					

Parameter No.	Name	Actual status and displayed values				
INFORMATION (5.8), read only						
P741	Process data Bus Out [hex]					
P742	Database version					
P743	Inverter type					
P744	Configuration level					
P745	Module version					
P746	Module status					
P747	Inverter voltage range 230/400V					
P748	Status CANopen					
P750	Stat. overcurrent					
P751	Stat. Overvoltage					
P752	Stat. mains failure					
P753	Stat. overtemperatur					
P754	Stat. parameter loss					
P755	Stat. system error					
P756	Stat. timeout					
P757	Stat. customer error					
P799	Error duration 1…5					

6 Error messages

Errors cause the frequency inverters to switch off, in order to prevent a device fault.

The following options are available to reset an error (acknowledge):

1. Switching the mains off and on again,
2. By an appropriately programmed digital input (P420 ... P425 / P470 = Function 12),
3. By switching of the “enable” on the frequency inverter (if no digital input is programmed for acknowledgement),
4. By Bus acknowledgement or
5. by P506, automatic error acknowledgement.

Device LEDs:	In the delivery condition (without technology unit) 2 LEDs (green/red) are visible externally. These indicate the current status of the device. The **green LED** indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output. The red LED signals actual error by flashing with a frequency which corresponds to the number code of the error (Section. 6.2).

6.1 SimpleBox / ControlBox display

The **SimpleBox** or **ControlBox** display an error with its number and the prefix "E". In addition, the actual error is displayed in parameter P700. The last error messages are stored in parameter P701. Further information on inverter status when errors occur can be found in parameters P702 to P706 / P799.

If the cause of the error is no longer present, the error display in the SimpleBox/ControlBox flashes and the error can be acknowledged with the Enter key.

6.2 Table of possible error messages

Display in the ControlBox		**Error**	**Cause**
Group	**Detail in P700 / P701**	**text in the Parameter Box**	• **Remedy**
E001	**1.0**	**Inverter overtemperature**	Error signal from output stage module (static) • Reduce ambient temperature <50°C (see also Section 7, technical details). • Check control cabinet ventilation • Increase ambient temperature, >0°C
E002	**2.0**	**Motor overtemperature** (PTC resistor) Only if a digital input is programmed (Function 13).	Motor temperature sensor has triggered • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Motor overtemperature** (I^2t) Only if I^2t - Motor (P535) is programmed.	I^2t - Motor has triggered • Reduce motor load • Increase motor speed

Display in the ControlBox		Error	Cause	
Group	Detail in P700 / P701	text in the Parameter Box	• Remedy	
E003	**3.0**	**Inverter overcurrent**	I^2t limit has triggered, e.g. > 1.5 x I_n for 60s (please also note P504) • Continuous overload at inverter output	
	3.1	**Chopper overcurrent**	U^2t-limit for brake chopper has triggered (please also see P554, P555, P556, P557) • Avoid overcurrent in braking resistance	
	3.2	**Overcurrent IGBT** monitoring 125%	De-rating (power reduction) • 125% overcurrent for 50ms • Brake chopper current too high • for fan drives: enable flying start circuit (P520)	See also Section 8.5
	3.3	**Overcurrent IGBT rapid** monitoring 150%	De-rating (power reduction) • 150% overcurrent • Brake chopper current too high	
E004	**4.0**	**Overcurrent module**	Error signal from module (short duration) • Short circuit or earthing at FI output • Use external output choke (motor cable is too long) • Braking resistor defective or too small (See Section 7)	
	4.1	**Overcurrent pulse switch-off**	P537 (pulse current switch-off) was reached 3x within 50ms (only possible if P112 and P536 are disabled) • Fi is overloaded • Check motor data (P201 … P209)	
E005	**5.0**	**Overvoltage link circuit**	FI link voltage is too high • Reduce energy return by means of a braking resistance • Extend braking time (P103) • If necessary, set switch-off mode (P108) with delay (not for lifting equipment) • Extend emergency stop time (P426)	
	5.1	**Overvoltage mains**	Mains voltage is too high • Please check 380V-20% ... 480V+10% or 200 ... 240V ± 10%	
E006	**6.0**	**Link circuit undervoltage** (charging error))	Inverter mains/link voltage too low • Check mains voltage 380V-20% ... 480V+10% or 200 ... 240V ± 10%	
	6.1	**Mains undervoltage**		
E007	**7.0**	**Mains phase failure**	One of the three mains input phases was or is interrupted. • Check mains phases 380V-20% ... 480V+10% or 200 ... 240V ± 10%, possibly too low? • All three mains phases must be symmetrical.	
	OFF	**NOTE:** OFF appears in the display when the three mains phases are uniformly reduced, i.e. when a normal mains switch off occurs during operation.		

Display in the ControlBox		Error	Cause
Group	**Detail in P700 / P701**	**text in the Parameter Box**	• **Remedy**
E008	**8.0**	**EEPROM parameter loss** (maximum value exceeded))	Error in EEPROM data • Software version of the stored data set not compatible with the software version of the FI. **NOTE:** Faulty parameters are automatically reloaded (factory setting). • EMC interferences (see also E020)
	8.1	**Invalid inverter type**	• EEPROM faulty
	8.2	**External EEPROM copy error** (ControlBox)	• Check ControlBox for correct position. • ControlBox EEPROM faulty (P550 = 1).
	8.3	**Customer interface incorrectly identified** (customer's interface equipment)	The upgrade level of the frequency inverter was not correctly identified. • Switch mains voltage off and on again.
	8.4	**Database version incorrect**	
	8.7	**Original and mirror not identical**	
E009	**---**	**ControlBox error/ SimpleBox error**	SPI Bus faulty, no communication with ControlBox / SimpleBox. • Check ControlBox for correct position. • Check correct cabling of SimpleBox. • Switch mains voltage off and on again.
E010	**10.0**	**Telegram downtime**	Data transfer is faulty. Check P513 • Check external Bus connection. • Check Bus Protocol program process. • Check Bus master. • Check 24V supply of internal CAN/CANopen Bus. • *Nodeguarding* error (internal CANopen) • *Bus Off* error (internal CAN Bus)
	10.2	**External bus module telegram time-out**	Telegram transfer is faulty. • Check external connection. • Check Bus Protocol program process. • Check Bus master.
	10.4	**External bus module initialisation failure**	• Check P746. • Bus module not correctly plugged in. • Check Bus module current supply.
	10.1 **10.3** **10.5** **10.6** **10.7**	**External Bus module system failure**	Further details can be found in the respective additional BUS operating instructions.
	10.8	**External module communication failure**	• Connection fault / error in the external component • Brief interruption (<1sec) of the 24V supply of the internal CAN/CANopen bus

Display in the ControlBox		Error	Cause
Group	Detail in P700 / P701	text in the Parameter Box	• Remedy
E011	**11.0**	**Customer unit** (AnalogDigital converter error)	Internal customer unit (internal databus) faulty or damaged by radio radiation (EMC) • Check control terminals connection for short-circuit. • Minimize EMC interference by laying control and power cables separately. • Earth the devices and shields well.
E012	**12.0**	**Watchdog customer /** customer error	The Watchdog function is selected at a digital input and the impulse at the corresponding digital input is not present for longer than the time set in parameter P460 >Watchdog time<.
	12.1	**Drive switch-off limit exceeded**	The drive switch-off limit P534 [01] has triggered. • Reduce load on motor • Set a higher value in P534 [01].
	12.2	**Generator switch-off value exceeded**	The generator switch-off limit P534 [02] has triggered. • Reduce load on motor • Set a higher value in P534 [02].
E013	**13.0**	**Encoder error**	No signal from encoder • Check 5V sensor if available. • Check supply voltage of encoder.
	13.1	**Speed slip error**	The slip speed error limit was reached. • Increase setting in P327.
	13.2	**Slip error switch-off monitoring**	The slip error monitoring was triggered; the motor could not follow the setpoint. • Check motor data P201-P209! This data is very important for the current control • Check motor circuit. • If necessary, check the encoder setting P3xx in Servo mode. • Increase setting value for torque limit in P112. • Increase setting value for current limit in P536.
E016	**16.0**	**Motor phase error**	A motor phase is not connected. • Check P539 • Check motor connections
	16.1	**Motor current monitoring for braking mode**	Required exciting current not achieved at moment of switch-on. • Check P539 • Check motor connections
E018	**18.0**	**Safety circuit**	The *safe pulse block* was triggered while the frequency inverter was being enabled. • Only available in SK 51xE and SK 53xE. Details in manual BU 0530 (www.nord.com).

Display in the ControlBox		Error	Cause
Group	**Detail in P700 / P701**	**text in the Parameter Box**	• **Remedy**
E019	**19.0**	**Parameter identification error**	Automatic identification of the connected motor was unsuccessful • Check motor connections • Check pre-set motor data (P201 ... P209)
	19.1	**Motor star/delta circuit is not correct**	
E020	**20.0**	reserved	System error in program execution, triggered by EMC interference. Please comply with wiring guidelines in Section 2.6. Use additional external mains filter. (Section. 8.3 / 8.4 EMC) FI must be very well "earthed".
E021	**20.1**	**Watchdog**	
	20.2	**Stack overflow**	
	20.3	**Stack underflow**	
	20.4	**Undefined opcode**	
	20.5	**Protected Instruction**	
	20.6	**Illegal word access**	
	20.7	**Illegal instruction access**	
	20.8	**EPROM error**	
	20.9	reserved	
	21.0	**NMI** error (not used by hardware)	
	21.1	**PLL** Error	
	21.2	**ADU** Overrun	
	21.3	**PMI** Access Error	

7 Technical data

7.1 SK 500E: General Data

Function	Specification
Output frequency	0.0 ... 400.0Hz
Pulse frequency	3.0 ... 16.0kHz, standard setting = 6kHz Power reduction > 8kHz for 230V device, >6kHz for 400V device.
Typical overload capacity	150% for 60s, 200% for 3.5s
Protective measures against	Over-heating of the frequency inverter, overvoltage and undervoltage Short-circuit, earthing fault, overload, idling
Regulation and control	Non-sensor vector current control (ISD), linear V/f characteristic
Analog setpoint input / PID input	2x (S5 and 6: - 10V…) 0...10V, 0/4...20mA, scalable, digital 7.5...30V
Analog setpoint resolution	10 bit based on measurement range
Analog output	0 ... 10V scalable
Setpoint consistency	Analog < 1% Digital < 0.02%
Motor temperature monitoring:	I^2t-Motor (UL approval), PTC / Bi-metal switch (no UL approval)
Digital input	5x (2.5V) 7.5...30V, R_i = (2.2kΩ) 6.1kΩ, cycle time = 1...2ms in addition, with SK 52xE/53xE: 2x 7.5...30V, R_i = 6.1kΩ, cycle time = 1...2ms
Electrical isolation	Control terminals (digital and analog inputs)
Control outputs	2x relay 28V DC / 230V AC, 2A (output 1/2 - K1/K2) in addition, with SK 520E/530E: 2x digital outputs 15V, 20mA or in addition, with SK 535E: 2x digital outputs 18…30V (according to VI), 20mA, or 2x digital outputs 30V, 200mA from S5 (output 3/4 - DOUT1/2)
Interfaces	Standard: RS 485 (USS), RS 232 (single slave), CANbus (except SK 50xE), CANopen (except SK 50xE) Option: Profibus DP, InterBus, CANopen, DeviceNet, AS Interface
Efficiency of frequency inverter	ca. 95% according to size
Ambient temperature	0□ ... +40°C (S1-100% ED), 0°C ... +50°C (S3-70% ED 10min)
Storage and transport temperature	-20°C ... +60 /70□
Long-term storage	Connect the frequency inverter to the mains voltage for 60 minutes at the latest after one year. Maintain this cycle throughout the storage period.
Protection class	IP20
Max. mounting altitude above sea level	up to 1000m: No power reduction 1000...4000m: 1%/ 100m power reduction (up to 2000m overvoltage cat. 3) 2000...4000m: Only overvoltage category 2 is maintained, external overvoltage protection at the mains input is necessary
Waiting period between two power-up cycles	60 sec for all devices in normal operating cycle
Connection terminals – Mains/motor/brake resist.	According to size 25mm² flexible with wiring sleeves, 35mm² with rigid cable Details / Terminal screw tightening torque 0.5...0.6Nm: see Section 2.11
Connection terminals – Control unit	1.0mm² with wiring sleeves
Connection terminals – Relay 1 / 2	1.5mm² with wiring sleeves (S 1 – 4) 4.0mm² with wiring sleeves (S 5 – 6)
Connection terminals – RS485 / RS232	1x RJ12 (6-pin)
Connection terminals – CANbus / CANopen	2x RJ45 (8-pin) (except SK 50xE and SK510E)
External supply voltage, control unit SK 5x5E	S 1-4: 18…30V DC, min. 800mA S 5-6: 24…30V DC, min. 1000mA

7.2 Electrical data 115V

Size 1					
Device type:	**SK 5xxE…**	**-250-112-O**	**-370-112-O**	**-550-112-O**	**-750-112-O**
Nominal motor power	230V	0.25 kW	0.37 kW	0.55 kW	0.75 kW
(4–pole standard motor)	240V	1/3 hp	½ hp	¾ hp	1 hp
Mains phases	Number	1 AC			
Mains voltage	**1~ 115V**	110 ... 120V, ± 10%, 47 ... 63Hz			
Output voltage	**3~ 230V**	3 AC 0 – 220 ... 240V			
Nominal output current at 230V	rms [A]	1.7	2.2	3.0	4.0
Min. braking resistor	Accessories	240 Ω	190 Ω	140 Ω	100 Ω
Typical current at 230V	1 AC rms [A]	8 A	10 A	13 A	18 A
Rec. mains fuse	1 AC slow-blow [A]	16 A	16 A	16 A	20 A
Type of ventilation		Free convection		Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C	
Weight	approx. [kg]	1.4			

7.3 Electrical data 230V

Size 1					
Device type:	**SK 5xxE…**	**-250-323-A**	**-370-323-A**	**-550-323-A**	**-750-323-A**
Nominal motor power	230V	0.25 kW	0.37 kW	0.55 kW	0.75 kW
(4–pole standard motor)	240V	1/3 hp	½ hp	¾ hp	1 hp
Mains phases	Number	1 / 3 AC			
Mains voltage		200 ... 240V, ± 10%, 47 ... 63 Hz			
Output voltage		3 AC 0 - Mains voltage			
Nominal output current at 230V	rms [A]	1.7	2.2	3.0	4.0
Min. braking resistor	Accessories	240 Ω	190 Ω	140 Ω	100 Ω
Typical current at 230V	1 / 3 AC rms [A]	3.7 / 2.4	4.8 / 3.1	6.5 / 4.2	8.7 / 5.6
Rec. mains fuse	1 / 3 AC slow-blow [A]	10 / 10	10 / 10	16 / 10	16 / 10
Type of ventilation		Free convection			
Weight	approx. [kg]	1.4			

Size 2 / 3						
Device type:	**SK 5xxE...**	**-111-323-A**	**-151-323-A**	**-221-323-A**	**-301-323-A**	**-401-323-A**
Nominal motor power	230V	1.1 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW
(4–pole standard motor)	240V	1½ hp	2 hp	3 hp	4 hp	5 hp
Mains phases	Number	1 / 3 AC			3 AC	
Mains voltage		200 ... 240V, ± 10%, 47 ... 63 Hz				
Output voltage		3 AC 0 - Mains voltage				
Nominal output current at 230V	rms [A]	5.5	7.0	9.0	12.5	16.0
min. brake resistor	Accessories	75 Ω	62 Ω	46 Ω	35 Ω	26 Ω
Typical input current at 230V	1 / 3 AC rms [A]	12.0 / 7.7	15.2 / 9.8	19.6 / 13.3	17.5	22.4
Recommended mains fuse	1 / 3 AC slow-blowing [A]	16 / 16	20 / 16	25 / 20	20	25
Type of ventilation		Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C				
Weight	approx. [kg]	1.8			2.7	

Size 5 / 6				
Device type:	**SK 5x5E...**	**-551-323-A**	**-751-323-A**	**-112-323-A**
Nominal motor power	230V	5.5 kW	7.5 kW	11.0 kW
(4–pole standard motor)	240V	7½ hp	10 hp	15 hp
Mains phases	Number	3 AC		
Mains voltage		200 ... 240V, ± 10%, 47 ... 63 Hz		
Output voltage		3 AC 0 - Mains voltage		
Nominal output current at 230V	rms [A]	20.0	27.0	40.0
min. brake resistor	Accessories	19 Ω	14 Ω	10 Ω
Typical input current at 230V	3 AC rms [A]	28.0	38.0	56.0
Recommended mains fuse	3 AC slow-blowing [A]	35	50	63
Type of ventilation		Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C		
Weight	approx. [kg]	8		10.3

7.4 Electrical data 400V

Size 1 / 2						
Device type:	**SK 5xxE...**	**-550-340-A**	**-750-340-A**	**-111-340-A**	**-151-340-A**	**-221-340-A**
Nominal motor power	400V	0.55 kW	0.75 kW	1.1 kW	1.5 kW	2.2 kW
(4–pole standard motor)	480V	¾ hp	1 hp	1½ hp	2 hp	3 hp
Mains phases	Number	3 AC				
Mains voltage		380 ... 480V, -20% / +10%, 47 ... 63 Hz				
Output voltage		3 AC 0 - Mains voltage				
Nominal output current at 400V	rms [A]	1.7	2.3	3.1	4.0	5.5
Min. braking resistor	Accessories	390 Ω	300 Ω	220 Ω	180 Ω	130 Ω
Typical input current at 400V	rms [A]	2.4	3.2	4.3	5.6	7.7
Recommended mains fuse	slow-blowing [A]	10	10	10	10	10
Type of ventilation		Free convection			Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C	
Weight	approx. [kg]	1.4		1.8		

Size 3 / 4					
Device type:	**SK 5xxE...**	**-301-340-A**	**-401-340-A**	**-551-340-A**	**-751-340-A**
Nominal motor power	400V	3.0 kW	4.0 kW	5.5 kW	7.5 kW
(4–pole standard motor)	480V	4 hp	5 hp	7½ hp	10 hp
Mains phases	Number	3 AC			
Mains voltage		380 ... 480V, -20% / +10%, 47 ... 63 Hz			
Output voltage		3 AC 0 - Mains voltage			
Nominal output current at 400V	rms [A]	7.5	9.5	12.5	16.0
min. brake resistor	Accessories	91 Ω	75 Ω	56 Ω	43 Ω
Typical input current at 400V	rms [A]	10.5	13.3	17.5	22.4
Recommended mains fuse	slow-blowing [A]	16	16	20	25
Type of ventilation		Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C			
Weight	approx. [kg]	2.7		3.1	

Size 5 / 6					
Device type:	**SK 5x5E…**	**-112-340-A**	**-152-340-A**	**-182-340-A**	**-222-340-A**
Nominal motor power	400V	11.0 kW	15.0 kW	18.0 kW	22.0 kW
(4–pole standard motor)	480V	15 hp	20 hp	25 hp	30 hp
Mains phases	Number	3 AC			
Mains voltage		380 ... 480V, -20% / +10%, 47 ... 63 Hz			
Output voltage		3 AC 0 - Netzspannung			
Nominal output current at 400V	rms [A]	23.0	30.0	37.0	45.0
min. brake resistor	Accessories	29 Ω	23 Ω	18 Ω	15 Ω
Typical input current at 400V	rms [A]	32.0	42.0	52.0	63.0
Recommended mains fuse	slow-blowing [A]	35	50	63	63
Type of ventilation		Fan cooling (temperature-controlled) Switching thresholds: ON= 57°C OFF=47°C			
Weight	approx. [kg]	8		10.3	

7.5 Electrical data for UL certification

The data given in this section must be taken into account to comply with UL certification.

“Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical Amperes, 120 Volts maximum (SK 5xxE-xxx-112), 240 Volts maximum (SK 5xxE-xxx-323), or 480 Volts maximum (SK 5xxE-xxx-340), or 500 Volts maximum (SK 5xxE-xxx-350) and minimum one of the two following alternatives.”

Electrical data 115V

Size 1 - 115V mains						
Device type:		**SK 5xxE…**	**-250-112-O**	**-370-112-O**	**-550-112-O**	**-750-112-O**
Nominal motor power		110V	0.25 kW	0.37 kW	0.55 kW	0.75 kW
(4–pole standard motor)		120V	1/3 hp	½ hp	¾ hp	1 hp
FLA	**1 AC**	[A]	7.7 A	9.5 A	12.5 A	17.3 A
Recommended mains fuse		J Class Fuse, 600V	10 A	13 A	20 A	25 A
		Bussmann B or G	LPJ-10SP	LPJ-13SP	LPJ-20SP	LPJ-25SP

Electrical data 230V

Size 1 - 230V mains					
Device type:	**SK 5xxE…**	**-250-323-A**	**-370-323-A**	**-550-323-A**	**-750-323-A**
Nominal motor power	220V	0.25 kW	0.37 kW	0.55 kW	0.75 kW
(4–pole standard motor)	240V	1/3 hp	½ hp	¾ hp	1 hp
FLA **3 / 1 AC**	[A]	3 / 4	4 / 5	5 / 7	6 / 9
Recommended mains fuse	J Class Fuse, 600V	2½ A / 4 A	3½ A / 5 A	4½ A / 7 A	6 A / 9 A
	Bussmann B or G	LPJ-2½SP / LPJ-4SP	LPJ-3½SP / LPJ-5SP	LPJ-4½SP / LPJ-7SP	LPJ-6SP / LPJ-9 SP

Size 2 / 3 – 230V mains						
Device type:	**SK 5xxE…**	**-111-323-A**	**-151-323-A**	**-221-323-A**	**-301-323-A**	**-401-323-A**
Nominal motor power	220V	1.1 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW
(4–pole standard motor)	240V	1½ hp	2 hp	3 hp	4 hp	5 hp
FLA **3 / 1 AC**	[A]	8 / 12	10 / 15	13 / 19	17	21
Recommended mains fuse	J Class Fuse, 600V	8 /13 A	10 A / 17½ A	15 A / 20 A	17½ A / -	25 A / -
	Bussmann B or G	LPJ-8SP / LPJ-13SP	LPJ-10SP / LPJ-17½SP	LPJ-15SP / LPJ-20SP	LPJ-17½SP / -	LPJ-25SP / -

Size 5 / 6 – 230V mains						
Device type:	**SK 5xxE…**	**-551-323-A**	**-751-323-A**	**-112-323-A**		
Nominal motor power	220V	5.5 kW	7.5 kW	11,0 kW		
(4–pole standard motor)	240V	7½ hp	10 hp	15 hp		
FLA **3 / 1 AC**	[A]					
Recommended mains fuse	J Class Fuse, 600V					
	Bussmann B or G					

Electrical data 400V

Size 1 / 2 - 400V Netz							
Device type:		**SK 5xxE…**	**-550-340-A**	**-750-340-A**	**-111-340-A**	**-151-340-A**	**-221-340-A**
Nominal motor power		380V	0.55 kW	0.75 kW	1.1 kW	1.5 kW	2.2 kW
(4–pole standard motor)		460…480V	¾ hp	1 hp	1½ hp	2 hp	3 hp
FLA	**3 AC**	[A]	3	4	5	6	8
Recommended mains fuse	J Class Fuse, 600V		2 ½ A	3 ½ A	4 ½ A	6 A	8 A
	Bussmann B or G		LPJ-2 ½ SP	LPJ-3 ½ SP	LPJ-4 ½ SP	LPJ-6 SP	LPJ-8 SP

Size 3 / 4 - 400V Netz						
Device type:		**SK 5xxE…**	**-301-340-A**	**-401-340-A**	**-551-340-A**	**-751-340-A**
Nominal motor power		380V	3.0 kW	4.0 kW	5.5 kW	7.5 kW
(4–pole standard motor)		460…480V	4 hp	5 hp	7½ hp	10 hp
FLA	**3 AC**	[A]	11	13	17	21
Recommended mains fuse	J Class Fuse, 600V		12 A	15 A	20 A	25 A
	Bussmann B or G		LPJ-12 SP	LPJ-15 SP	LPJ- 20 SP	LPJ-25 SP

Size 5 / 6 - 400V Netz						
Device type:		**SK 5xxE…**	**-112-340-A**	**-152-340-A**	**-182-340-A**	**-222-340-A**
Nominal motor power		380V	11.0 kW	15.0 kW	18.5 kW	22.0 kW
(4–pole standard motor)		460…480V	15 hp	20 hp	25 hp	30 hp
FLA	**3 AC**	[A]				
Recommended mains fuse	J Class Fuse, 600V					
	Bussmann B or G					

7.6 General conditions for ColdPlate technology

The standard frequency inverter is supplied with a smooth flat mounting surface instead of a heat sink. This means that the FI must be cooled via the mounting surface, but has a low installation depth.

For all devices there is no fan.

In the selection of a suitable cooling system (e.g. liquid-cooled mounting plate) the thermal resistance R_{th} and the heat to be dissipated from the P_V modulus of the frequency inverter must be taken into account. For example, the supplier of the appropriate control cabinet system can provide details for the correct selection of the mounting plate.

The mounting plate has been correctly selected if its R_{th} value is less than the values stated below.

NOTE: Before the device is fitted to the mounting plate, any protective film must be removed. A suitable heat-conducting paste must be used.

1~ 115V- devices	P_v modulus [W]	Max. R_{th} [K/W]
SK 5xxE-250-112-O-CP	8.51	3.29
SK 5xxE-370-112-O-CP	11.29	2.48
SK 5xxE-550-112-O-CP	15.98	1.75
SK 5xxE-750-112-O-CP	22.27	1.26

1/3~ 230V devices	P_v modulus [W]	Max. R_{th} [K/W]
SK 5xxE-250-323-A-CP	10.48	2.67
SK 5xxE-370-323-A-CP	14.11	1.98
SK 5xxE-550-323-A-CP	20.38	1.37
SK 5xxE-750-323-A-CP	29.09	0.96
SK 5xxE-111-323-A-CP	44.04	0.48
SK 5xxE-151-323-A-CP	55.08	0.38
SK 5xxE-221-323-A-CP *	67.96	0.31
SK 5xxE-301-323-A-CP	83.37	0.25
SK 5xxE-401-323-A-CP	113.88	0.18

***) NOTE:** In contrast to the standard device, SK 500E-221-323-A-CP for S1 operation can only be supplied in size 3.

3~ 400V- devices	P_v modulus [W]	Max. R_{th} [K/W]
SK 5xxE-550-340-A-CP	11.88	2.36
SK 5xxE-750-340-A-CP	16.57	1.69
SK 5xxE-111-340-A-CP	23.22	1.21
SK 5xxE-151-340-A-CP	31.24	0.90
SK 5xxE-221-340-A-CP	45.91	0.46
SK 5xxE-301-340-A-CP	64.60	0.33
SK 5xxE-401-340-A-CP	86.61	0.24
SK 5xxE-551-340-A-CP	101.73	0.21
SK 5xxE-751-340-A-CP	134.95	0.16

The following points must be complied with to ensure the R_{th}:

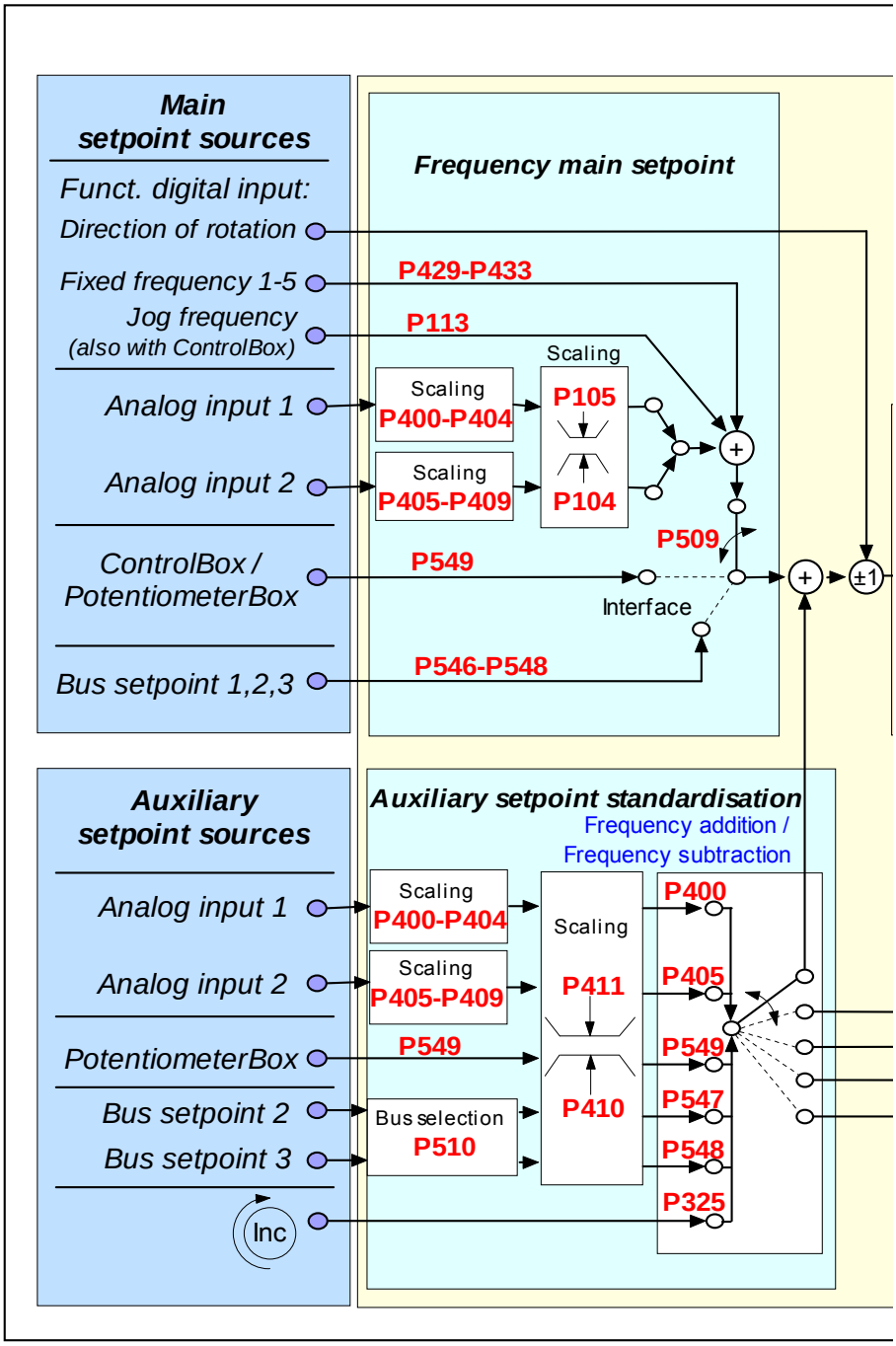
- The maximum heat sink temperature (T_{kk}) of 80°C and the maximum internal temperature of the control cabinet (T_{amb}) of 40°C must not be exceeded.
- The ColdPlate and the mounting plate must lie flat against each other (max.air gap 0.05mm).
- The contact area of the mounting plate must be at least as large as the area of the ColdPlate
- A suitable heat conducting paste must be applied between the ColdPlate and the mounting plate.

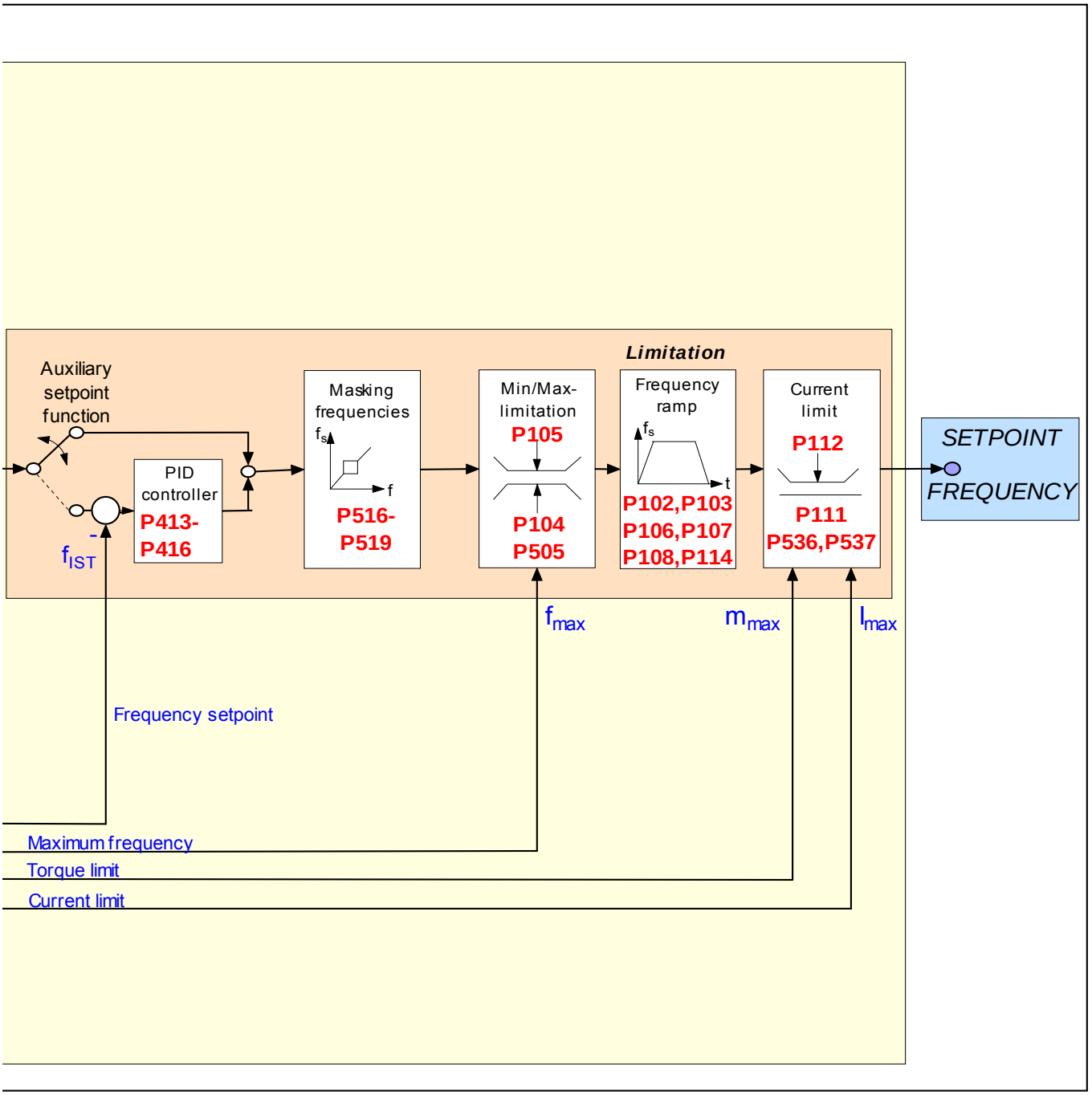
  The heat conducting paste is not included in the scope of delivery! First remove any protective film.
- All screw connections must be tightened.
- When designing a cooling system the heat to be dissipated by the ColdPlate device, P_v-modulus must be taken into account. For the design of the control cabinet the heat production of the device of approx 5% of the nominal power must be taken into consideration.

In case of any further queries, please contact Getriebebau NORD.

8 Additional information

8.1 Setpoint processing in the SK 500E




Limitation
Auxiliary setpoint function
PID controller
P413-P416
-
f_{IST}
Masking frequencies
f_s
f
P516-P519
Min/Max-limitation
P105
P104
P505
Frequency ramp
f_s
t
P102,P103
P106,P107
P108,P114
Current limit
P112
P111
P536,P537
SETPOINT FREQUENCY
f_{max}
m_{max}
I_{max}
Frequency setpoint
Maximum frequency
Torque limit
Current limit

8.2 Process controller

The process controller is a PI controller which can be used to limit the controller output. In addition, the output is scaled as a percentage of a master setpoint. This provides the option of controlling any downstream drives with the master setpoint and readjusting using the PI controller.

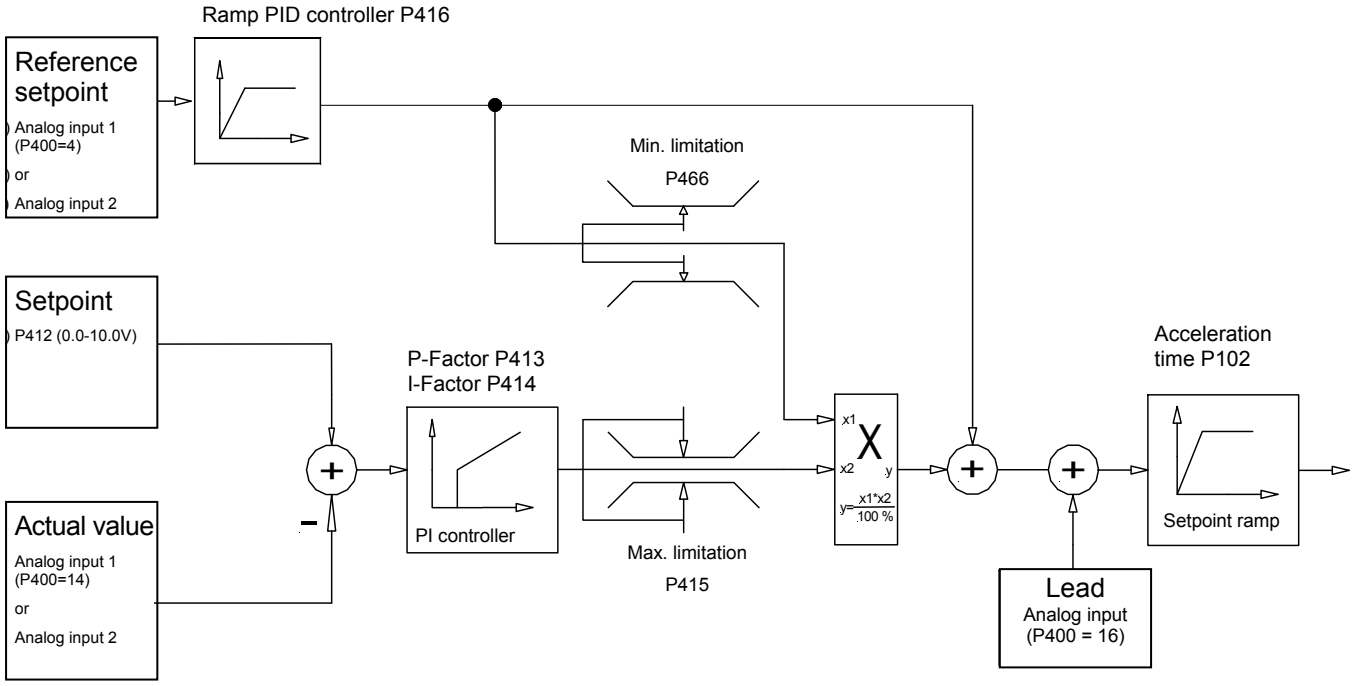
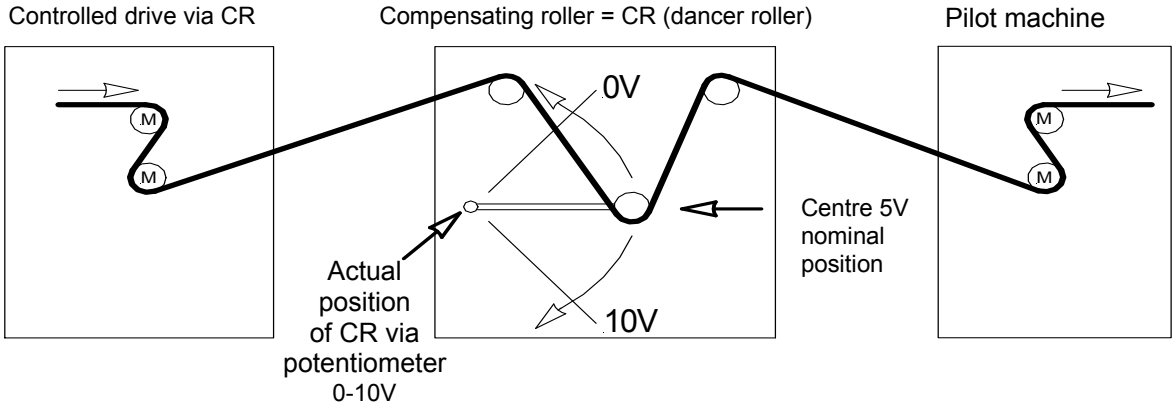
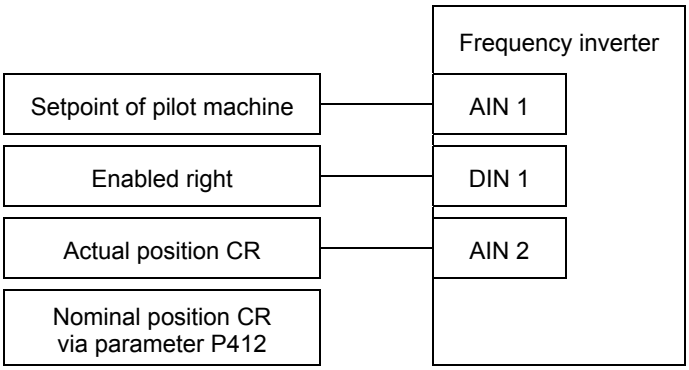
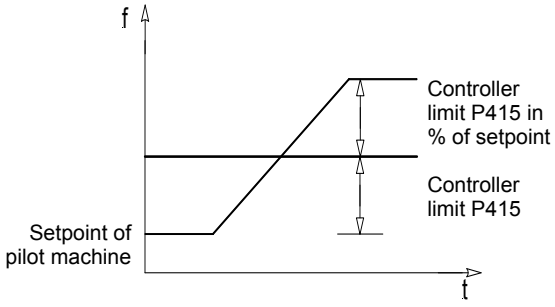


Fig.: Flow diagram process controller

8.2.1 Process controller application example







8.2.2 Process controller parameter settings

(Example: setpoint frequency: 50 Hz, control limits: +/- 25%)

P105 (maximum frequency) [Hz] : $\geq Setpointfrq.\,[\mathrm{Hz}] + \left(\frac{Setpointfrq.\,[Hz] \times P415[\%]}{100\%} \right)$

Example: $\geq 50Hz + \frac{50Hz \times 25\%}{100\%} =$ **62.5Hz**

P400 (Funct. analog input) : **“4”** (frequency addition)

P411 (setpoint frequency) [Hz] : Set frequency with 10 V at analog input 1

Example: **50 Hz**

P412 (Process controller setpoint) : CR middle position / Default setting **5V** V (adapt if necessary)

P413 (P controller) [%] : Default setting **10%** (adapt if necessary)

P414 (I-controller) [% / ms] : recommended **100**%/s

P415 (limitation +/-) [%] : Controller limitation (see above)

Note: In the function process controller, parameter P415 is used as a controller limiter downstream from the PI controller. This parameter therefore has a double function.

Example: **25%** of setpoint

P416 (ramp before controller) [s] : Default setting **2s** (if necessary, adjust to controller behaviour)

P420 (Funct. digital input 1) : **“1”** Enable right

P405 (Funct. Analoginput 2) : **"14"** actual value PID process controller

8.3 Electromagnetic compatibility Abbreviation: EMC)

All electrical equipment that have an intrinsic, independent function and are placed on the market as individual units for users from January 1996 must comply with the EEC directive EEC/89/336EEC . There are three different ways for manufacturers to display compliance with this directive:

1. *EC declaration of conformity*

   This is a declaration from the manufacturer stating that the requirements in the applicable European standards for the electrical environment of the equipment have been met. Only those standards which are published in the Official Journal of the European Community can be cited in the manufacturer's declaration.

2. *Technical documentation*

   Technical documentation can be produced which describes the EMC characteristics of the device. This documentation must be authorised by one of the "Responsible bodies" named by the responsible European government. This makes it possible to use standards that are still under preparation.

3. *EC type test certificate* (This method only applies to radio transmitter equipment.)

   SK 500E frequency inverters only have an intrinsic function when they are connected to other equipment (e.g. with a motor). The base units cannot therefore carry the CE mark that would confirm compliance with the EMC directive. Precise details are therefore given below about the EMC behaviour of this product, based on the proviso that it is installed according to the guidelines and instructions described in this documentation.

Class A, Group 2: General, for industrial environments

Complies with the EMC standard for power drives EN 61800-3, for use in **secondary environments (industrial)** and if **not generally available.**

Class A, Group 1: Interference suppressed, for industrial environments

In this operating class, the manufacturer can certify that his equipment meets the requirements of the EMC directive for industrial environments with respect to their EMC behaviour in power drives. The limit values correspond to the basic standards EN 61000--62 and EN 61000-6-4 for interference immunity and interference emissions in industrial environments.

Class B, Group 1: Interference suppressed for domestic, commercial and light industry environments

In this operating class, the manufacturer can certify that his equipment meets the requirements of the EMC directive for domestic, commercial and light industry environments with respect to their EMC behaviour in power drives. The limit values correspond to the basic standards EN 61000--62 and EN 61000-6-4 for interference immunity and interference emissions.

ATTENTION

NORDAC SK 500E Frequency inverters are intended **exclusively for commercial use.** They are therefore not subject to the requirements of the standard EN 61000-3-2 for radiation of harmonics.

This device produces high frequency interference, which may make additional suppression measures necessary in **domestic environments**. (Details in Section 8.4)

8.4 EMC limit value classes

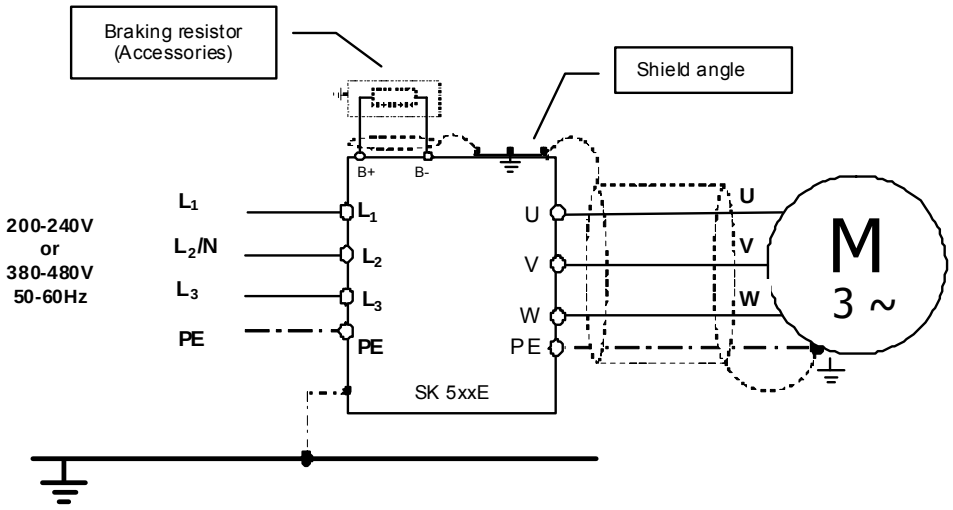
Please note that these limit value classes are only reached if the standard pulse frequency (6kHz) is being used and the length of the shielded motor cable does not exceed the permissible limits.

In addition, it is essential to use wiring suitable for EMC. The motor cable shielding must be applied on both sides (frequency inverter shield angle and the metal motor terminal box).

Device type **Max. motor cable, shielded**	Jumper position See Section 2.8.6 - 2.8.7	Cable emissions 150kHz - 30 MHz	
		Class A 1	Class B 1
SK 5xxE-250-323-A … SK 5xxE-401-323-A	2 - 1	20m	5m
	2 - 2	5m	-
SK 5xxE-550-340-A … SK 5xxE-751-340-A	2 - 1	20m	5m
	2 - 2	5m	-

Overview of the standards, which according to product standard EN 61800-3 are applicable as testing and measuring methods for electric drives whose speed can be altered:		
Interference emission		
Emission from cables (interference voltage)	***EN 55011***	A 1
		B 1
Radiated emissions (Interference field strength)	***EN 55011***	A 1
		-
Interference immunity EN 61000-6-1, EN 61000-6-2		
ESD, discharge of static electricity	EN 61000-4-2	6kV (CD), 8kV (AD)
EMF, high frequency electro-magnetic fields	EN 61000-4-3	10V/m; 80 - 1000MHz
Burst on control cables	EN 61000-4-4	1kV
Burst on mains and motor cables	EN 61000-4-4	2kV
Surge (phase-phase / phase-ground)	EN 61000-4-5	1kV / 2kV
Cable-led interference due to high frequency fields	EN 61000-4-6	10V, 0.15 - 80MHz
Voltage fluctuations and drops	EN 61000-2-1	+10%, -15%; 90%
Voltage asymmetries and frequency changes	EN 61000-2-4	3%; 2%

Wiring recommendations



8.5 Reduced output power

The SK 5xxE frequency inverter series is designed for certain overload situations. For example, 1.5x overcurrent can be used for 60 sec. For approx. 3.5 sec a 2x overcurrent is possible. A reduction of the overload capacity or its time must be taken into account in the following circumstances:

- Output frequencies < 2Hz and constant voltages (needle stationary)
- Pulse frequencies greater than the nominal pulse frequency (P504)
- Increased mains voltage > 400V
- Increased heat sink temperature

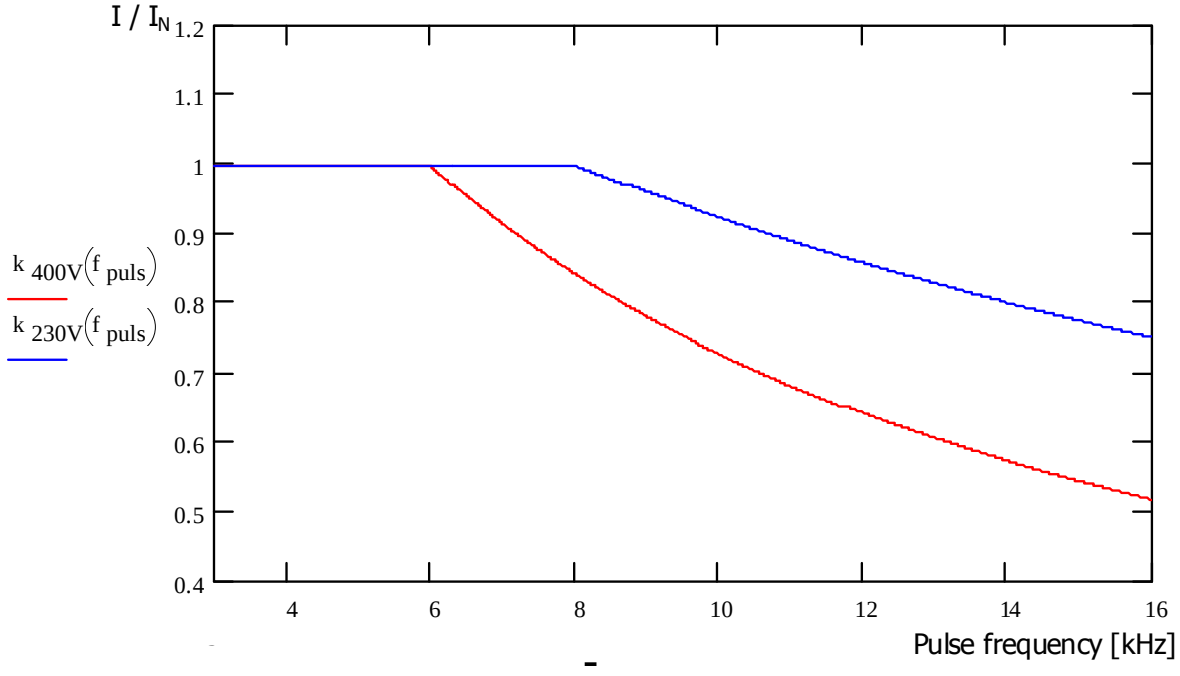
On the basis of the following characteristic curves, the particular current / power limitation can be read off.

8.5.1 Increased heat dissipation due to pulse frequency

This illustration shows how the output current must be reduced, depending on the pulse frequency for 230V and 400V devices, in order to avoid excessive heat dissipation in the frequency inverter.

For 400V devices, the reduction begins at a pulse frequency above 6kHz. For 230V devices, the reduction begins at a pulse frequency above 8kHz.

Even with increased pulse frequencies the frequency inverter is capable of supplying its maximum peak current, however only for a reduced period of time. The diagram shows the possible current load capacity for continuous operation.



8.5.2 Reduced overcurrent due to time

The possible overload capacity changes depending on the duration of an overload. Several values are cited in this table. If one of these limiting values is reached, the frequency inverter must have sufficient time (with low utilisation or without load) in order to regenerate itself.

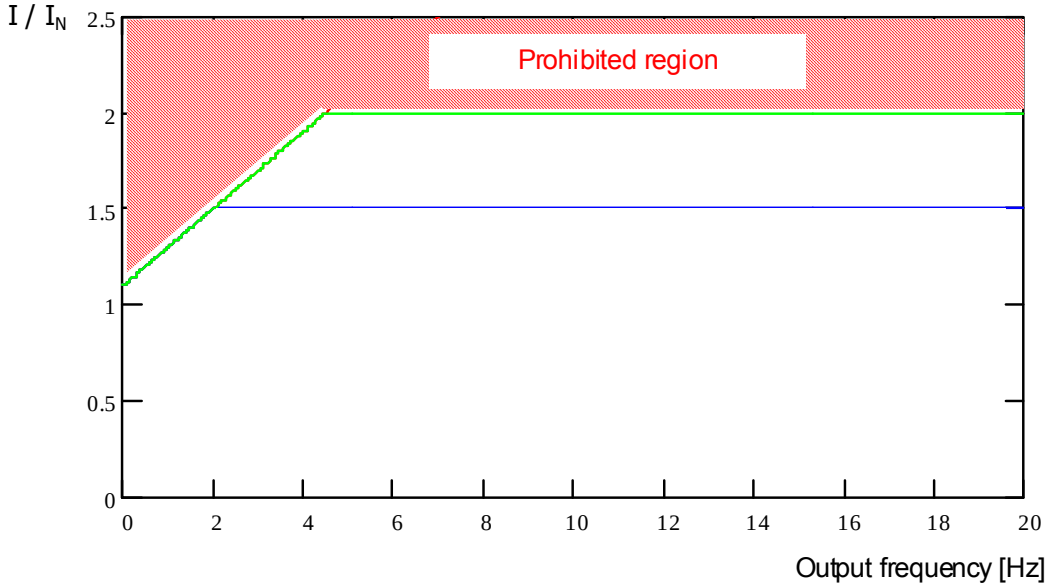
If operated repeatedly in the overload region at short intervals, the limiting values stated in the tables are reduced.

230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...8	110%	150%	170%	180%	180%	200%
10	103%	140%	155%	165%	165%	180%
12	96%	130%	145%	155%	155%	160%
14	90%	120%	135%	145%	145%	150%
16	82%	110%	125%	135%	135%	140%

400V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...6	110%	150%	170%	180%	180%	200%
8	100%	135%	150%	160%	160%	165%
10	90%	120%	135%	145%	145%	150%
12	78%	105%	120%	125%	125%	130%
14	67%	92%	104%	110%	110%	115%
16	57%	77%	87%	92%	92%	100%

8.5.3 Reduced overcurrent due to output frequency

To protect the power unit at low output frequencies (<4.5Hz) a monitoring system is provided, with which the temperature of the IGBTs (*integrated gate bipolar transistor)* due to high current is determined. In order to prevent current being taken off above the limit shown in the diagram, a pulse switch-off (P537) with a variable limit is introduced. At a standstill, with 6kHz pulse frequency, current above 1.1x the nominal current cannot be taken off.



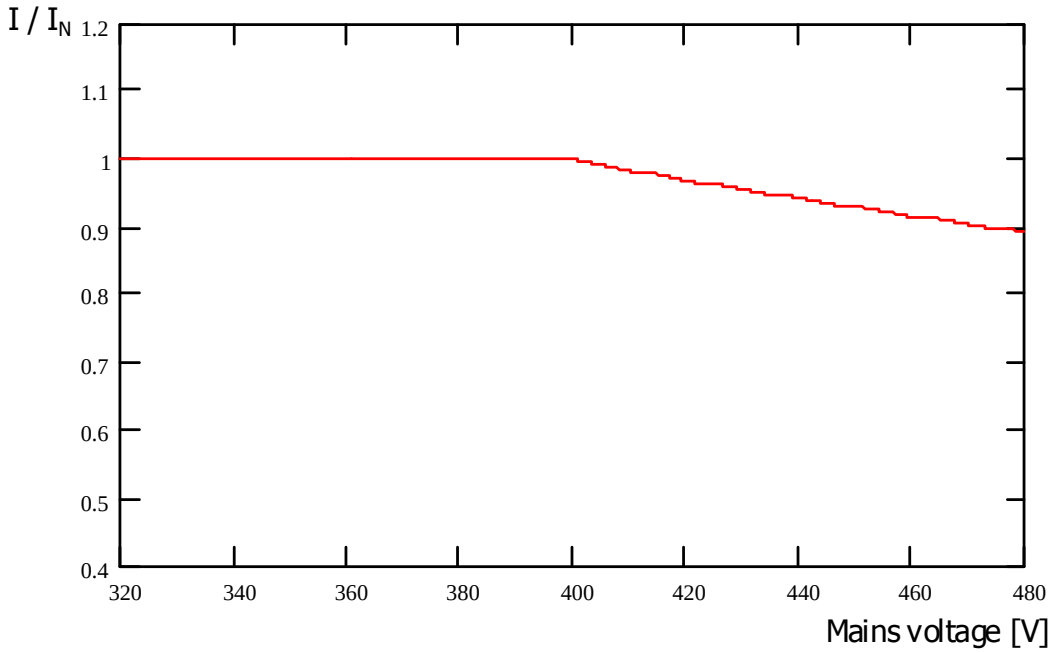
The upper limiting values for the various pulse frequencies can be obtained from the following tables. In all cases, the value (0.1…1.9) which can be set in parameter P537, is limited to the value stated in the tables according to the pulse frequency. Values below the limit can be set as required.

230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and output frequency							
Pulse frequency [kHz]	Output frequency [Hz]						
	4.5	3.0	2.0	1.5	1.0	0.5	0
3...8	200%	170%	150%	140%	130%	120%	110%
10	180%	153%	135%	126%	117%	108%	100%
12	160%	136%	120%	112%	104%	96%	95%
14	150%	127%	112%	105%	97%	90%	90%
16	140%	119%	105%	98%	91%	84%	85%

400V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and output frequency							
Pulse frequency [kHz]	Output frequency [Hz]						
	4.5	3.0	2.0	1.5	1.0	0.5	0
3...6	200%	170%	150%	140%	130%	120%	110%
8	165%	140%	123%	115%	107%	99%	90%
10	150%	127%	112%	105%	97%	90%	82%
12	130%	110%	97%	91%	84%	78%	71%
14	115%	97%	86%	80%	74%	69%	63%
16	100%	85%	75%	70%	65%	60%	55%

8.5.4 Reduced output current due to mains voltage

The devices are designed with thermal characteristics according to the nominal output currents. Accordingly, for lower mains voltages, higher currents cannot be taken off in order to maintain the stated power constant. For mains voltages above 400v there is a reduction of the permissible continuous output current, which is inversely proportional to the mains voltage, in order to compensate for the increased switching losses.



8.5.5 Reduced output current due to the heat sink temperature

The temperature of the heat sink in included in the calculation of the reduction of output current, so that at low heat sink temperatures, a higher load capacity can be permitted, especially for higher pulse frequencies. At high heat sink temperatures, the reduction is increased correspondingly. The ambient temperature and the ventilation conditions for the device can therefore be optimally exploited.

8.6 Operation with FI circuit breakers

SK 500E frequency inverters are designed for operation with a 30mA all-current sensitive FI circuit breaker. If several frequency inverters are operated on a single FI circuit breaker, the leakage currents to earth must be reduced. Further details can be found in Section 2.11.9 - 2.11.10.

8.7 Maintenance and servicing information

In normal use, NORDAC 500E frequency inverters are maintenance free. Please note the "general data" in Section 7.1.

If the frequency converter is being used in a dusty environment, then the cooling-vane surfaces should be regularly cleaned with compressed air. If air intake filters have been built into the control cabinet, then these should also be regularly cleaned or replaced.

If you contact our technical support, please have the precise device type (rating plate/display), accessories and/or options, the software version used (P707) and the series number (rating plate) at hand.

Repairs

The device must be sent to the following address if it needs repairing:

NORD Electronic DRIVESYSTEMS GmbH

Tjüchkampstraße 37

26605 Aurich, Germany

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG

Telephone: 04532 / 401-515

Fax: 04532 / 401-555

If a frequency inverter is sent in for repair, no liability can be accepted for any added components, e.g. such as mains cables, potentiometer, external displays, etc.!

Please remove all non-original parts from the frequency inverter.

NOTE

If possible, the reason for returning the component/device should be stated. If necessary, at least one contact should be stated in case of queries.

This is important in order to keep repair times as short and efficient as possible.

On request you can also obtain a suitable return good voucher from Getriebebau NORD.

Internet information

You can find the comprehensive manuals in German and in English on our Internet site.

www.nord.com

You can also obtain this manual from your local representative if necessary.

9 Keyword index