Intelligent Drivesystems, Worldwide Services

GB

BU 0500

SK 500E

Users Manual for Frequency Inverters

NORD DRIVESYSTEMS

NORD frequency inverters

Safety and operating instructions for drive power converters

(as per: Low Voltage Directive 2006/95/EEC)

1. General

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

Unauthorised removal of covers, improper use, incorrect installation or operation causes a 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 (comply with IEC 364, CENELEC HD 384, DIN VDE 0100, IEC 664 and 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 assembly, installation, commissioning and operation of this product and who have the relevant qualifications for their work.

2. Proper use in Europe

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

When installed in machines, the drive power converter cannot be commissioned (i.e. commencement of the proper use) until it has been ensured that the machine meets the provisions of the EC Directive 2006/42/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 (2004/108/EEC) is complied with.

Drive power converters with the CE mark meet the requirements of the Low Voltage Directive 2006/95/EEC. The harmonized standards stated in the Declaration of Conformity are used for the drive power converters.

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

The drive power converters may only be used for the safety functions which are described and for which they have been explicitly approved.

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 according to the regulations in the corresponding documentation.

The drive power converter must be protected against impermissible loads. Especially during transport and handling, components must not be deformed and/or insulation distances must not be changed. Touching of electronic components and contacts must be avoided.

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

5. Electrical connections

When working on live drive power converters, the applicable national accident prevention regulations must be complied with (e.g. VBG A3, formerly VBG 4).

The electrical installation must be implemented according to the applicable regulations (e.g. cable cross-section, fuses, ground lead connections). Further instructions can be found 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 be complied with even with CE marked drive power converters. Compliance with the limiting values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Where necessary, systems where drive power converters are installed must be equipped with additional monitoring and protective equipment according to the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

The parameterisation and configuration of the drive power converter must be selected so that no hazards can occur.

All covers must be kept closed during operation.

7. Maintenance and repairs

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

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

Intended use of the frequency inverter

Compliance with the operating instructions is **necessary for fault-free** operation and the acceptance of any warranty claims. **These operating instructions must be read** before working with the device!

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

SK 500E series frequency inverters are devices for industrial an commercial systems used for the operation of three-phase asynchronous motors with squirrel-cage rotors and **P**ermanent **M**agnet **S**ynchronous **M**otors – PMSM *(SK 54xE and above)* These motors must be suitable for operation with frequency inverters, other loads must not be connected to the devices.

SK 5xxE 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 (commencement of the intended use) is not permitted until it has been ensured that the machine complies with the EMC Directive 2004/108/EEC and that the conformity of the end product meets the Machinery Directive 2006/42/EEC (observe EN 60204).

Documentation

Name:	BU 0500	
Part No.:	607 50 01	
Series:	SK 500E	
FI series:	SK 500E, SK 505E, SK 510E, SK 511E, SK 515E, SK 520E, SK 530E, SK 535E,	
FI types:	**SK 5xxE-250-112-O ... SK 5xxE-750-112-O**	(0.25 – 0.75kW, 1~ 115V, output 3~ 230V)
	SK 5xxE-250-323-A ... SK 5xxE-221-323-A	0.25 - 2.2kW, 1/3~ 230V, output 3~ 230V)
	SK 5xxE-301-323-A ... SK 5xxE-182-323-A	(3.0 – 18.0kW, 3~ 230V, output 3~ 230V)
	SK 5xxE-550-340-A ... SK 5xxE-902-340-A	(0.55 – 90.0kW, 3~ 400V, output 3~ 400V)

Version list

Name of previous issues	Software Version	Remarks
BU 0500 DE, March 2005	V 1.1 R1	First issue based on BU 0750 DE
Further revisions: May, June, August, December 2005, May, October 2006, May, August 2007, February, May 2008 (For an overview of the amendments to the above editions: please refer to the April 2009 version (Part No.: 6075001/1409))		
Further revisions: April 2009, November 2010, February, April 2011 (For an overview of the amendments to the above editions: please refer to the April 2011 version (Part No.: 6075001/1411))		
BU 0500 DE, September 2011 Part No. 607 5001 / 3811	V 2.0 R0	please refer to the September 2011 edition (Part No.: 6075001/3811)
BU 0500 DE, March 2013 Part No. 607 5001 / 1013	V 2.0 R5	These include: · Addition of size 8 and size 9 (45 kW ... 90 kW) · Modification of the UL data, mains fuses, e.g. RK types · Revision of section structure · Removal of the parameter summary list · Correction of the snap-on rail mounting kit SK DRK1-... · Description of control boxes SK TU3-CTR and SK TU3-PAR removed (see BU0040) · Addition of E004 in the description of errors · Removal of SK54xE devices and transfer to a new document (BU0505)

Table 1: Version list

Publisher

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1. General

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

These frequency inverters 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. For the drive unit, this means very high starting and overload torques with constant speed.

As standard, the frequency inverters are equipped with a fixed heat sink, via which the power losses are dissipated to the environment. Alternatively, for sizes 1 - 4 there is the ColdPlate version and for sizes 1 and 2 there is also an external heat sink version.

This series of frequency inverters can be adapted to individual requirements by means of the modular technology units.

Due to the wide range of setting options, these inverters can control all three-phase motors. The power range is from **0.25 kW to 90.0 kW** with integrated mains filter.

This manual is based on the device software as stated in the version list (see P707). If the frequency inverter uses a different software version, this may cause differences. If necessary, the current manual can be downloaded from the Internet (http://www.nord.com/).

There are additional descriptions for the optional functions "Functional Safety "(BU 0530) and the "POSICON" positioning system (BU 0510) and the memory programmable "PLC" control units (BU0550). Supplementary descriptions for the optional bus systems are also available http://www.nord.com/).

Note **Accessories**

The accessories mentioned in the manual (brake resistors, filters etc.) may also be subject to modifications. Current details of these are included in separate data sheets, which are listed under www.nord.com under the heading *Documentation → Manuals → Frequency inverters → Data sheets*. The data sheets available at the date of publication of this manual are listed by name in the relevant sections (TI ...).

1.1 Overview

Properties of the basic frequency inverter **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 EMC 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)
- Four separate online switchable parameter sets
- RS232/485 interface via RJ12 plug connector
- USS-integrated (see BU 0050)

Feature SK …	50xE	51xE	511E	520E	53xE	54xE	Additional options
Operating manual	**BU 0500**					**BU 0505**	
Safe pulse block (STO / SS1)*		x	x		x	x	BU 0530
2 x CANbus/CANopen interfaces via RJ45 plug			x	x	x	x	BU 0060
RS485 interface additionally via terminals				x	x	x	
Speed feedback via incremental encoder input				x	x	x	
Integrated “POSICON” positioning control					x	x	BU 0510
CANopen absolute encoder evaluation					x	x	BU 0510
PLC / SPS – functionality						x	BU 0550
Universal encoder interface (SSI, BISS, Hiperface, EnDat and SIN/COS)						x	BU 0510
Operation of PMSM (**P**ermanent **M**agnet **S**ynchronous **M**otors)						x	
Modbus RTU						x	BU 0050
Number of digital inputs / outputs**	5 / 0	5 / 0	5 / 0	7 / 2	7 / 2	5 / 3 6 / 2 7 / 1	
Additional potential-isolated PTC input***						x	
Number of analog inputs / outputs	2 / 1	2 / 1	2 / 1	2 / 1	2 / 1	2 / 1	
Number of relay messages	2	2	2	2	2	2	

* not with 115 V devices
** SK 54xE: 2 I/Os can be variably parameterised as inputs or outputs
*** alternative "thermistor" function on digital input 5 possible (above size 5 an additional thermistor input is available as standard)

Table 2: Overview of SK 500E performance grading features

Differing hardware features

Version	Description
SK 5xxE-…-CP compared with SK 5xxE	· ColdPlate or external heat sink
SK 5x5E compared with SK 5x0E	· External 24V supply voltage. Communication with the frequency inverter is possible even without a power connection
For size 5 and above in comparison with sizes 1 – 4 (> 4 kW, 230V or > 11 kW, 400V)	· 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 · 2 x CANbus/CANopen interfaces via RJ45 plug as standard

Table 3: Overview of differing hardware features

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 carry out a thorough assessment.

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

1.3 Scope of delivery

Standard version:

- IP20
- Integrated brake chopper
- Integrated EMC mains filter for limit curve A1 as per EN55011 devices)
- Blanking cover for technology unit slot
- Screening terminal for control terminals
- Covering for the control terminals
- Size 1 to Size 7: Accessory bag with wall mounting brackets
- Size 8 and above: miscellaneous electrical connection material
- Operating instructions on CD

Available accessories:

Braking resistor, mains filter, mains chokes, output chokes, link circuit choke (size 8 and above), EMC kit (SK EMV ...), electronic brake rectifier SK EBGR-1), IO extension for SK 54xE (SK EBIOE-2), interface converter RS232 ® RS485 (supplementary description BU 0010), NORD CON PC parameterisation software > www.nord.com <, ePlan macros for creating electrical circuit diagrams > www.nord.com <

Technology units for clipping onto the frequency inverter for control and parameterisation or as communication interface for various bus systems.

1.4 Safety and installation information

NORD 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.

The frequency inverter and its accessories must only be used for the purpose which is intended by the manufacturer. Unauthorised modifications and the use of spare parts and additional equipment which has not been purchased from or recommended by the manufacturer of the frequency inverter may cause fire, electric shock and injury.

All of the associated covers and protective devices must be used.

Installation and other work may only be carried out by qualified electricians with strict adherence to the operating instructions. Therefore keep these Operating Instructions at hand, together with all supplementary instructions for any options which are used, and give them to each user.

Local regulations for the installation of electrical equipment and accident prevention must be complied with.

1.4.1 Explanation of labels used

DANGER	Indicates an immediate danger, which may result in death or serious injury.
WARNING	Indicates a possibly dangerous situation, which may result in death or serious injury.
CAUTION	Indicates a possibly dangerous situation, which may result in slight or minor injuries.
NOTICE	Indicates a possibly harmful situation, which may cause damage to the product or the environment.
Note	Indicates hints for use and useful information.

1.4.2 List of Safety and installation information

DANGER

Danger of electric shock

The frequency inverter operates with a dangerous voltage. Touching certain conducting components (connection terminals, contact rails and supply cables as well as the PCBs) will cause electric shock with possibly fatal consequences.

Even when the motor is at a standstill (e.g. caused by an electronic block, blocked drive or output terminal short-circuit), the line connection terminals, motor terminals and braking resistor terminals, contact rails, PCBs and supply cables may still conduct hazardous voltages. A motor standstill is not identical to electrical isolation from the mains.

Only carry out installations and work if the device **is disconnected from the voltage** and **wait at least 5 minutes** after the mains have been switched off! (The equipment may continue to carry hazardous voltages for up to 5 minutes after being switched off at the mains).

Follow the **5 Safety Rules** (1. Switch off the power, 2. Secure against switching on, 3, Check for no voltage, 4. Earth and short circuit, 5. Cover or fence off neighbouring live components).

DANGER

Danger of electric shock

Even if the drive unit has been disconnected from the mains, a connected motor may rotate and possible generate a dangerous voltage. Touching electrically conducting components may then cause an electric shock with possible fatal consequences.

Therefore prevent connected motors from rotating.

WARNING — **Danger of electric shock**

The voltage supply of the frequency inverter may directly or indirectly put it into operation, or touching electrically conducting components may then cause an electric shock with possible fatal consequences.

Therefore, **all poles** of the voltage supply must be **disconnected**. For devices with a **3-phase** supply, **L1 / L2 / L3** must be disconnected. For devices with a **single phase** supply, **L1 / N** must be disconnected. For devices with a DC supply, **–DC / +B** must be disconnected. Also, the motor cables **U / V / W** must be disconnected.

WARNING — **Danger of electric shock**

In case of a fault, insufficient earthing may cause an electric shock with possibly fatal consequences if the device is touched.

Because of this, the frequency inverter is only intended for permanent connection and may not be operated without effective earthing connections which comply with local regulations for large leakage currents (> 3.5mA).

EN 50178 / VDE 0160 stipulates the installation of a second earthing conductor or an earthing conductor with a cross-section of at least 10mm^2.

WARNING — **Danger of injury if motor starts**

With certain setting conditions, the frequency inverter or the motor which is connected to it may start automatically when the mains are switched on. The machinery which it drives (press / chain hoist / roller / fan etc.) may then make an unexpected movement. This may cause various injuries, including to third parties.

Before switching on the mains, secure the danger area by warning and removing all persons from the danger area.

CAUTION — **Danger of burns**

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

Touching such components may cause local burns to the affected parts of the body (hands, fingers, etc.).

To prevent such injuries, allow sufficient time for cooling down before starting work - the surface temperature should be checked with suitable measuring equipment. In addition, keep sufficient distance from adjacent components during installation, or install protection against contact.

NOTICE — **Damage to the frequency inverter**

For single phase operation (115/230V) the mains impedance must be at least 100µH for each conductor. If this is not the case, a mains choke must be installed.

Failure to comply with this may cause damage to the frequency inverter due to impermissible currents in the components.

NOTICE — **EMC - Interference**

The frequency inverter is a product which is intended for use in an industrial environment and is subject to sales restrictions according to IEC 61800-3. Use in a residential environment may require additional EMC measures.

For example, electromagnetic interference can be reduced by the use of an optional mains filter.

NOTICE

Leakage and residual currents

Due to their principle of operation (e.g. due to integrated mains filters, mains units and capacitor banks), frequency inverters generate leakage currents. For the correct operation of the frequency inverter on a current-sensitive RCD, the use of an all-current sensitive earth leakage circuit breaker (Type B) compliant with EN 50178 / VDE 0160 is necessary.

Note

Operation on TN- / TT- / IT- networks

The frequency inverters are suitable for operation on TN or TT networks as well as for IT networks with the configuration of the integrated mains filter.

Note

Maintenance

In normal use, frequency inverters are maintenance free.

The cooling surfaces must be regularly cleaned with compressed air if the ambient air is dusty.

In case of long-term shut-down or long-term storage, the capacitors must be re-formed (refer to "Technical Data").

Failure to do this will damage these components and will cause a considerable reduction of the service life - including the immediate destruction of the frequency inverter.

1.5 Certifications

1.5.1 European EMC Directive

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

1.5.2 UL and cUL approvals for frequency inverters (CSA)

All SK 500E frequency inverters include motor overload protection. Further technical details can be found in Section 7.2.

NOTICE

"Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes."

The integral short-circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the manufacturer's instructions, the "National Electric Code" and all additional local regulations.

Note

“Use 75°C Copper Conductors Only" - *“Anschluss von Kupferkabel mit einer Isolationsfestigkeit von mind. 75°C“ (betrifft ausschließlich Anschlussleitungen (Netz- / Motorkabel aber nicht Steuerleitungen))*

„These products are intended for use in a pollution degree 2 environment“ - *„Das Produkt ist für den Betrieb in Umgebungen mit Verschmutzungsgrad 2 geeignet“*

"Maximum Surrounding Air Temperature 40°C" - *“Maximale Umgebungstemperatur 40°C”*

UL- Approval - File No. E171342

Frequency inverter				Fuses				Circuit Breaker	
SK 5xxE-xxx-	Size			Type			Circuit		Circuit
	1 … 4	5, 6	7	C,J,R,T	G, L	[V]	[A] rms	[V]	[A] rms
-112	X			X	X	300	100 000	480	10 000
-323	X			X	X	300	100 000	480	10 000
-323		X		X	-	300	65 000	480	65 000
-323			X	X	X	300	100 000	480	65 000
-340 (/ -350)	X			X	X	600	100 000	480	10 000
-340 (/ -350)		X		X	-	600	65 000	480	65 000
-340 (/ -350)			X	X	X	600	100 000	480	65 000

referring to the table above

"Suitable for use on a circuit capable of delivering not more than 65 000 or 100 000 rms symmetrical Amperes, and when protected by High-Interrupting Capacity, Current Limiting Fuses".

"Suitable for use on a circuit capable of delivering not more than 10 000 or 65 000 rms symmetrical Amperes, and when protected by a Circuit Breaker (inverse time trip type) in accordance with UL 489", having an interrupting rating of not less than 10 000 or 65 000 rms symmetrical Amperes, 480 Volts maximum.

The current ratings of the fuses and circuit breakers are stated in Section **0**.

bezugnehmend zur obigen Tabelle

Geeignet für den Einsatz am Netz mit einem max. Kurzschlussstrom von 65 000 A oder 100 000 A (symmetrisch), und bei Schutz über eine strombegrenzende Sicherung" mit hohem Ausschaltvermögen.

Geeignet für den Einsatz am Netz mit einem max. Kurzschlussstrom von 10 000 A oder 65 000 A (symmetrisch), und bei Schutz über Sicherungsautomaten nach UL Kategorie DIVQ (thermischer und elektromagnetischer Auslöser) gemäß UL 489, mit einem Mindestaus-schaltvermögen von 10 000 A oder 65 000 A, 480 V Maximum.

*Die Stromwerte der Sicherungen und Leistungsschalter sind im Kapitel **0** aufgeführt.*

Devices of size 5 and above - Use of terminals X12 or X8

"Intended to be connected only to isolated secondary sources rated 24Vdc. Fuse in accordance with UL 248 rated max. 4 A must be provided externally between the isolated source and this device input".

Wenn diese Klemmen genutzt werden um externe Spannungen (24V) einzuspeisen, so muss für einen UL konformen Anschluss folgendes berücksichtigt werden:

"Darf nur mit isoliertem Steuer-spannungskreis (24Vdc) verbunden werden. Eine Sicherung zwischen isoliertem Steuerspannungskreis und diesem Eingang muss gemäß UL 248 ausgeführt sein, darf maximal 4 A betragen und muss extern bereitgestellt werden."

Supplement for cUL

Compliance with the conditions described below fulfils the requirements for cUL approval as per CSA.

Frequency Inverters size 1 - 7	*Frequenzumrichter Baugröße 1 - 7*
"Suitable for use on a circuit capable of delivering not more than 5 000 rms symmetrical Amperes, • 240 Volts maximum (SK 5xxE-xxx-323) or • 500 Volts maximum (SK 5xxE-xxx-340 / SK 5xxE-xxx-350) and when protected by High-Interrupting Capacity, Current Limiting Fuses as described above".	*Geeignet für den Einsatz am Netz mit einem max. Kurzschlussstrom von 5 000 A (symmetrisch),* • 240 Volt Maximum (SK 5xxE-xxx-323) oder • 500 Volt Maximum (SK 5xxE-xxx-340 / SK 5xxE-xxx-350) *und bei Schutz über eine strombegrenzende Sicherung" mit hohem Ausschaltvermögen wie oben beschrieben.*
"Suitable for use on a circuit capable of delivering not more than 5 000 rms symmetrical Amperes, • 240 Volts maximum (SK 5xxE-xxx-323) or • 500 Volts maximum (SK 5xxE-xxx-340 / SK 5xxE-xxx-350) and when protected by a Circuit Breaker (inverse time trip type) in accordance with UL 489", having an interrupting rating of not less than 5 000 rms symmetrical Amperes, 480 Volts maximum.	*Geeignet für den Einsatz am Netz mit einem max. Kurzschlussstrom von 5 000 A (symmetrisch),* • 240 Volt Maximum (SK 5xxE-xxx-323) oder • 500 Volt Maximum (SK 5xxE-xxx-340 / SK 5xxE-xxx-350) *und bei Schutz über Sicherungsautomaten nach UL Kategorie DIVQ (thermischer und elektromagnetischer Auslöser) gemäß UL 489, mit einem Mindest-ausschaltvermögen von 5 000 A, 480 V Maximum.*
The current ratings of the fuses and circuit breakers are stated in Section **0**.	*Die Stromwerte der Sicherungen und Leistungsschalter sind im Kapitel **0** aufgeführt.*
Devices size 1 - 6	
"cUL only in combination with SK CIF-340-30 or SK CIF-340-60 for 380 - 500V models and SK CIF-323-20 or SK CIF-323-40 for 3 phase 200 - 240V rated models". The recognized transient surge suppression filter board has to be connected between supply and the input of the drive according to the instruction manual.	*cUL Konformität, nur in Kombination mit SK CIF-340-30 oder SK CIF-340-60 für 380 - 500V Typen und SK CIF-323-20 oder SK CIF-323-40 für 200 - 240V Typen.* *Das entsprechende Spannungs-begrenzungsfilter (SK CIF-xxx-xx) ist zwischen Einspeisung und Frequenzumrichter (eingangsseitig) nach Handbuchangaben anzuschließen.*

Note — SK CIF-xxx

The supplementary requirements as per the cUL listing are fulfilled by the use of an appropriate overvoltage filter **SK CIF-323-xx** or**. SK CIF-340-xx**.

For devices **larger than size 7 no SK CIF-3xx-xx overvoltage filter** is required.

Note — 1~115V devices: no cUL approval

For SK500E series frequency inverters, no suitable CSA filter can be provided for the voltage range 1~115V (SK 5xxE-xxx-112). For these types, (SK 5xxE-xxx-112) there is therefore **NO** cUL approval.

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 compliant

The frequency inverters and optional modules are designed to be RoHS compliant according to Directive 2002/95/EU.

1.6 Type codes / Device versions

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, x50 = 500V
- 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 up to 90 = 90.0kW
- Device series: **SK 500E** / SK 505E / SK 510E / SK 511E / SK 515E / SK 520E / SK 530E / SK 535E / SK 540E / SK 545E

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

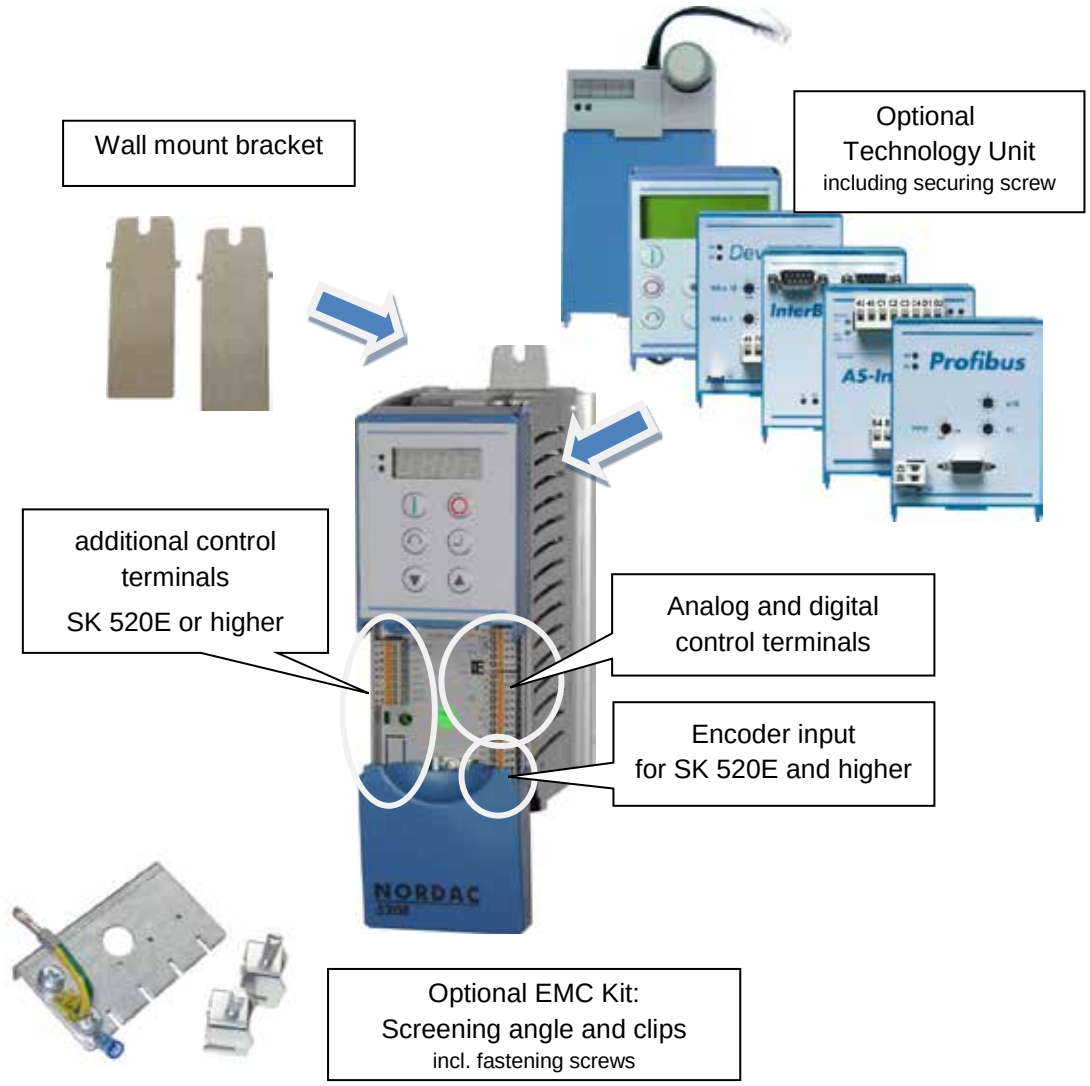


Fig. 1 SK 5xxE and accessories

The type designation resulting from this type code can be obtained from the name plate which is printed on the frequency inverter below the blank cover.

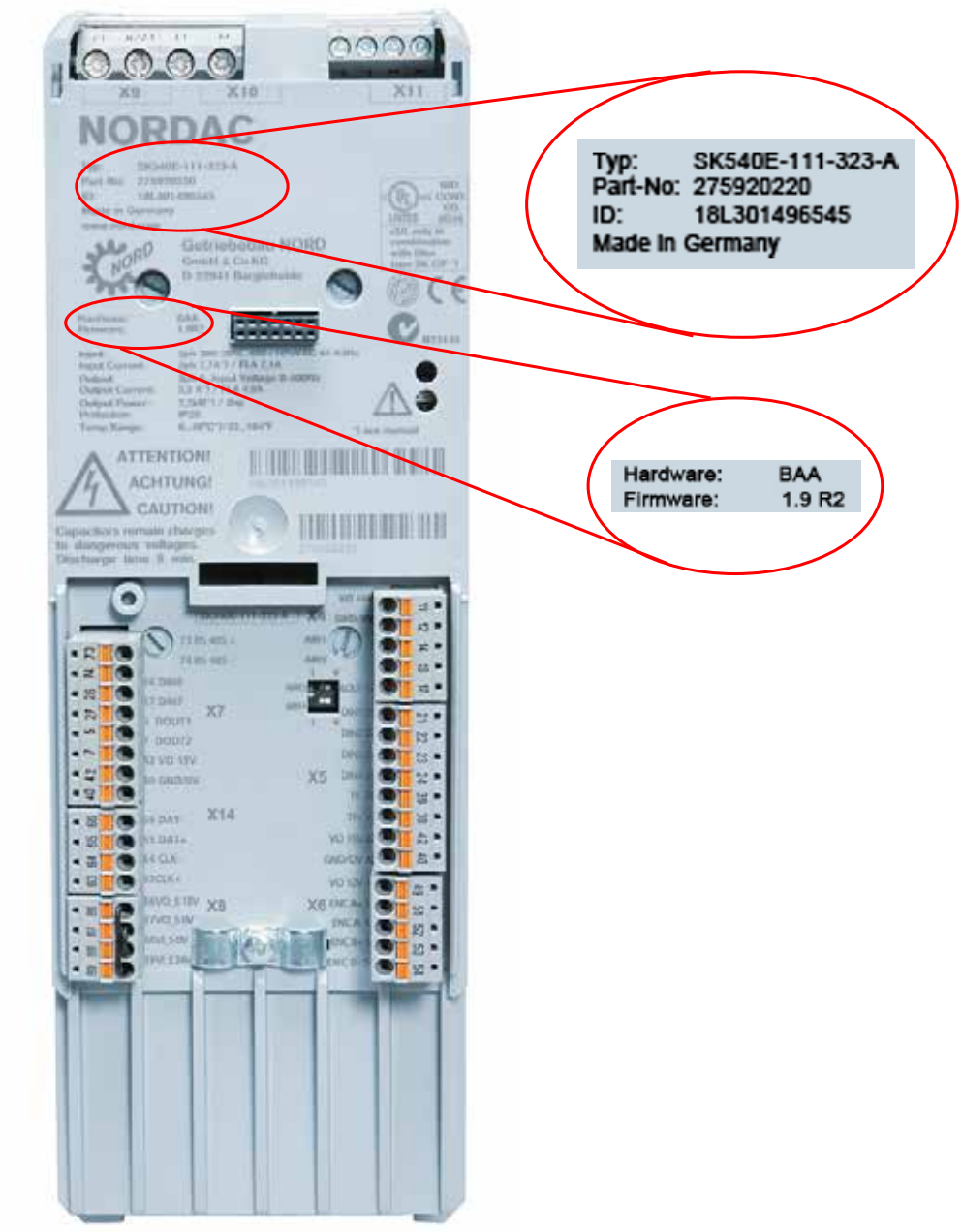


Fig. 2 Frequency inverter type plate (example)

2. Assembly and installation

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 frequency inverter (not possible with …-CP devices), the greater width 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 frequency inverter are covered with a flat surface to provide good convection.

Warm air must be vented above the device!

Fig. 3 Mounting distances for SK 5xxE

If several inverters are arranged above each other, it must be ensured that the upper air entry temperature limit is not exceeded. (See also Section **0**) 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 frequency inverter 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.

2.1 SK 5xxE, standard version

Normally, the frequency inverter is mounted directly on the rear wall of a control cabinet. For this, two, or for sizes 5 to 7, four matching wall mounting brackets are supplied, which are to be inserted into the heat sink at the rear of the device. For size 8 and above, the mounting device is integrated.

Alternatively, for sizes 1 ... 4 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.

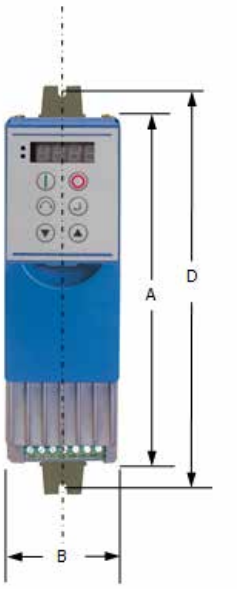
In general, care must be taken that the rear of the cooling element is covered with a flat surface and that the device is mounted vertically. This enables optimum convection, which ensures fault-free operation.

Frequency inverter type	Size	Housing dimensions			Wall-mounting			Weight Approx. [kg]
		A	B	C	D	E	Æ	
SK 5xxE-250- … to SK 5xxE-750- ...	Size 1	186	74*	153	220	/	5.5	1.4
SK 5xxE-111- … to SK 5xxE-221- …	Size 2	226	74*	153	260	/	5.5	1.8
SK 5xxE-301- … to SK 5xxE-401- …	Size 3	241	98	181	275	/	5.5	2.7
SK 5xxE-551- 340… to SK 5xxE-751- 340…	Size 4	286	98	181	320	/	5.5	3.1
SK 5xxE-551- 323… to SK 5xxE-751- 323…	Size 5	327	162	224	357	93	5.5	8.0
SK 5xxE-112- 340… to SK 5xxE-152- 340…	Size 5	327	162	224	357	93	5.5	8.0
SK 5xxE-112- 323…	Size 6	367	180	234	397	110	5.5	10.3
SK 5xxE-182- 340… to SK 5xxE-222- 340…	Size 6	367	180	234	397	110	5.5	10.3
SK 5xxE-152- 323… to SK 5xxE-182- 323…	Size 7	456	210	236	485	130	5.5	15
SK 5xxE-302- 340… to SK 5xxE-372- 340…	Size 7	456	210	236	485	130	5.5	16
SK 5xxE-452- 340… to SK 5xxE-552- 340…	Size 8	598	265	286	582	210	8.0	20
SK 5xxE-752- 340… to SK 5xxE-902- 340…	Size 9	636	265	286	620	210	8.0	25

400V (…-340…) and 500V (…-350…) - FI: identical dimensions and weights

All dimensions in [mm]

*) for the use of brake resistors mounted below the device = 88 mm



2.2 SK 5xxE…-CP in ColdPlate version

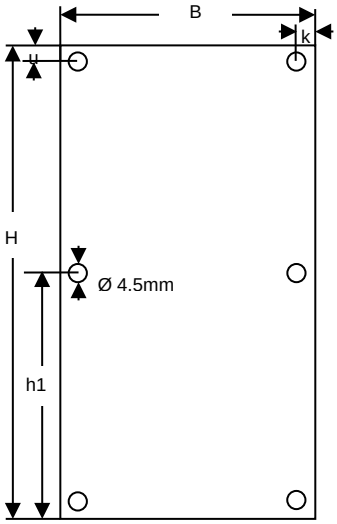
Instead of a cooling element/fan, ColdPlate versions of the frequency inverter have a flat metal plate on the rear side which is mounted on an existing mounting plate (e.g. the rear wall of the control cabinet) so as to provide thermal conduction. A liquid cooling medium (water, oil) may also be passed through the mounting surface. In this way, not only is the waste heat from the frequency inverter dissipated more effectively, but also the waste heat from the inverter is prevented from remaining inside the control cabinet. In addition to the optimisation of the power reserved and the service life of the inverter, this also causes less thermal load on the inside of the control cabinet.

A further advantage of the ColdPlate version is the reduced installation depth of the device and the fact that in general, there is no need for a fan on the frequency inverter.

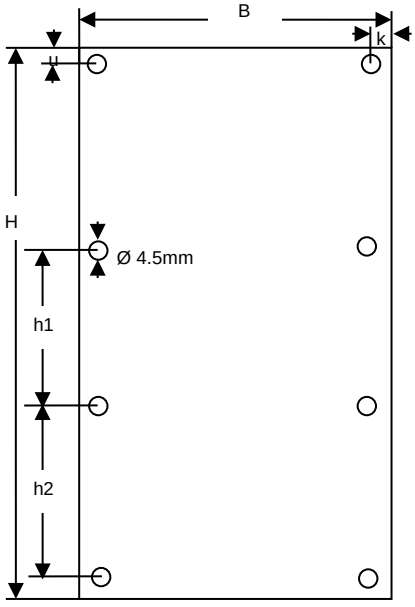
Bottom-mounted brake resistors (SK BR4-…) cannot be mounted directly.

Frequency inverter type	Size	Envelope dimensions [mm]			ColdPlate dimensions [mm]				Weight Approx. [kg]
		A / H	**B**	**C**	**h1**	**h2**	**u / k**	**Thickness**	
SK 5xxE-250- …-CP SK 5xxE-750- …-CP	1	182	95	119	91	-	5.5	10	1.3
SK 5xxE-111- …-CP SK 5xxE-221- …-CP	2	222	95	119	111	-	5.5	10	1.6
SK 5xxE-301- …-CP SK 5xxE-401- …-CP	3	237	120	119	75.33	75.33	5.5	10	1.9
SK 5xxE-551- 340…-CP SK 5xxE-751- 340…-CP	4	282	120	119	90.33	90.33	5.5	10	2.3

SK 5xxE-…CP



ColdPlate size 1 and size 2



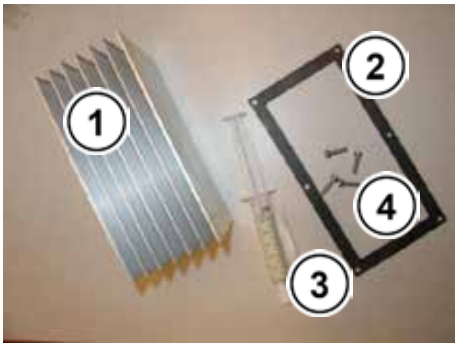
ColdPlate size 3 and size4

2.3 External heat sink kit

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.

Frequency inverter type	Size	Type External heat sink kit	Part. No.
SK 5xxE-250- …-CP SK 5xxE-750- …-CP	1	**SK TH1-1**	275999050
SK 5xxE-111- …-CP SK 5xxE-221- …-CP	2	**SK TH1-2**	275999060

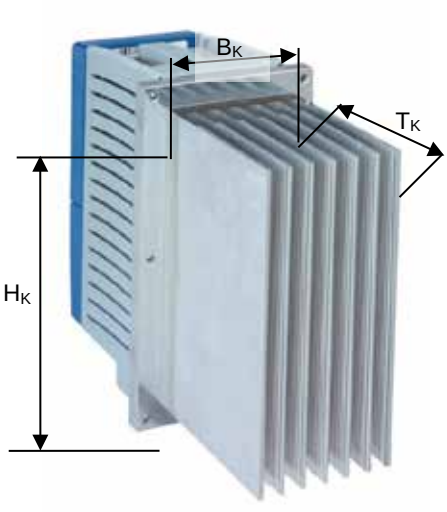
Scope of delivery



1= Heat sink
2= Gasket
3= Heat-conducting paste
4= Cylindrical-head screws with internal hexagon socket M4x16 (4x)

Dimensions

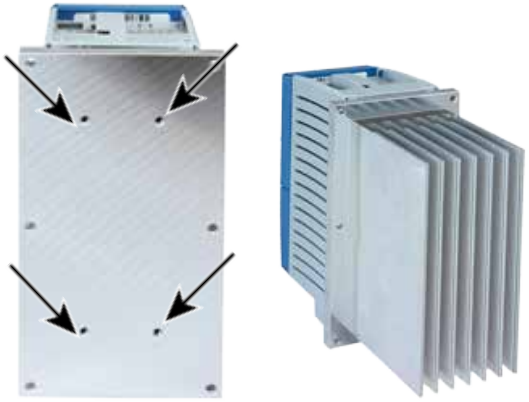
Type External heat sink kit	Heat sink dimensions [mm]			Weight Heat sink Approx. [kg]
	H_K	B_K	T_K	
SK TH1-1	157	70	100	1.5
SK TH1-2	200	70	110	1.7



Assembly

For installation, a hole with the size of the heat sink must be made in the wall of the control cabinet (note the load bearing capacity).

1. Apply heat-conducting paste to the ColdPlate of the SK 5xxE;
2. firmly fasten the heat sink to the ColdPlate with the 4 enclosed screws;
3. remove any heat conducting paste which exudes;
4. Place the seal between the frequency inverter and the wall of the control cabinet (inside of the control cabinet);
5. Insert the frequency inverter and guide the external heat sink out of the control cabinet through the hole in the wall of the control cabinet;
6. Fasten the frequency inverter to the wall of the control cabinet though all of the 6 or 8 holes in the ColdPlate.



Information **Protection class IP54**

With correct installation, the control cabinet achieves IP54 from the outside at the point of installation.

2.4 Snap-on mounting rail kit SK DRK1-…

The snap-on mounting rail set SK DRK1-1 enables size 1 or 2 frequency inverters to be mounted on a standard TS35 (EN 50022) mounting rail.

Frequency inverter type	Size	Type Snap-on rail mounting kit	Part. No.
SK 5xxE-250- … SK 5xxE-750- …	1	**SK DRK1-1**	275999030
SK 5xxE-111- … SK 5xxE-221- …	2	**SK DRK1-2**	275999040

Scope of delivery

1= Adapter for snap-on rail mounting
2= Clamp
3= Spacer
4= Fastening plate
5= Screws(2x)

Assembly

1. Push the fastening plate (4) into the guide on the heat sink (arrow);
2. place the spacer plate (3) on the fastening plate (4);
3. connect the snap-on rail mounting adapter (1) and the components (3) + (4) with screws (5).

During assembly, take care that the stirrup (2) points upwards (mains connection side of the inverter).

Then the inverter can be clipped directly onto the snap-on rail. To release the frequency inverter, the stirrup (2) must be pulled a few millimetres out of the snap-on rail.

2.5 EMC Kit

For optimum EMC-compliant wiring, the optional EMC Kit must be used. This includes a shield bracket, two hammer clips, two fastening screws and a pre-assembled PE cable. The PE cable must be connected to the appropriate screw on the shielding bracket and to the PE terminal of the frequency inverter. The connection of further PE connections to the shield bracket is possible with additional ring cable lugs (SK EMC 2-1 and 2-2).

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 second hammer clip.

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.

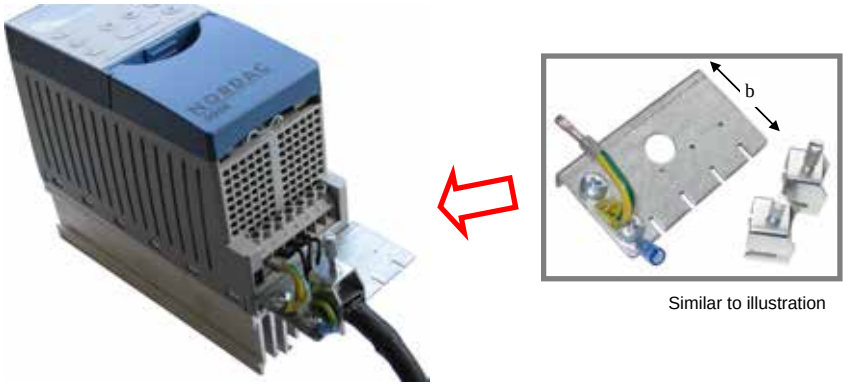


Fig. 4 EMC Kit SK EMC2-x

Device type	Size	EMC Kit	Dimension "b"
SK 5xxE-250- … SK 5xxE-750-	Size 1	SK EMC 2-1 **Part No. 275999011**	42 mm
SK 5xxE-111- … SK 5xxE-221-	Size 2		
SK 5xxE-301- … SK 5xxE-401-	Size 3	SK EMC 2-2 **Part No. 275999021**	42 mm
SK 5xxE-551-340- … SK 5xxE-751- 340-	Size 4		
SK 5xxE-551-323- … SK 5xxE-751- 323- SK 5xxE-112-340- … SK 5xxE-152- 340-	Size 5	SK EMC 2-3 **Part No. 275999031**	52 mm
SK 5xxE-112-323- SK 5xxE-182-340- … SK 5xxE-222- 340-	Size 6	SK EMC 2-4 **Part No. 275999041**	57 mm
SK 5xxE-152-323- … SK 5xxE-182- 323- SK 5xxE-302-340- … SK 5xxE-372- 340-	Size 7	SK EMC 2-5 **Part No. 275999051**	57 mm
SK 5xxE-452-340- … SK 5xxE-902- 340-	Size 8/9	SK EMC 2-6 **Part No. 275999061**	100 mm

Table 4: EMC Kit SK EMC2-x

Note

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

Alternatively, the EMC Kit can be simply used as a strain relief (e.g. for the connection cables of a bus system) (note the bending radii!).

2.6 Brake resistor (BR)

CAUTION **Danger of burns**

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

Touching such components may cause local burns to the affected parts of the body (hands, fingers, etc.).

To prevent such injuries, allow sufficient time for cooling down before starting work - the surface temperature should be checked with suitable measuring equipment. In addition, keep sufficient distance from adjacent components during installation, or install protection against contact.

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

For inverter powers **up to 7.5 kW** (230 V: up to 4.0 kW) 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 100 **°C), in order to i** 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

For frequency inverters **above 3kW** chassis resistors **(SK BR2-..., IP20)** are also available. 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 and above

Fig. 5: Top: bottom-mounted brake resistor SK BR4- Bottom: chassis brake resistor SK BR2-...

2.6.1 Electrical data, brake resistor

Inverter ID	Resistor type	Resistance	Continuous rating	Pulse energy*	Connecting cable / terminals
SK 5xxE-250-112-O … SK 5xxE-370-112-O	SK BR4-240/100 Part No. 275991110	240 W	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 Part No. 275991115	150 W	100 W	1.0 kWs	
SK 5xxE-250-323-A … SK 5xxE-370-323-A	SK BR4-240/100 Part No. 275991110	240 W	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 Part No. 275991115	150 W	100 W	1.0 kWs	
SK 5xxE-111-323-A … SK 5xxE-221-323-A	SK BR4- 75/200 Part No. 275991120	75 W	200 W	3.0 kWs	
SK 5xxE-301-323-A … SK 5xxE-401-323-A	SK BR4- 35/400 Part No. 275991140	35 W	400 W	6.0 kWs	2 x 2.5mm² AWG 14/19 L = 0.5m
SK 5xxE-301-323-A … SK 5xxE-401-323-A	SK BR2- 35/400-C Part No. 278282045	35 W	400 W	6.0 kWs	2 x 10mm²
SK 5xxE-551-323-A … SK 5xxE-751-323-A	SK BR2- 22/600-C Part No. 278282065	22 W	600 W	7.5 kWs	2 x 10mm²
SK 5xxE-112-323-A	SK BR2- 12/1500-C Part No. 278282015	12 W	1500 W	20 kWs	2 x 10mm²
SK 5xxE-152-323-A … SK 5xxE-182-323-A …	SK BR2- 9/2200-C Part No. 278282122	9 W	2200 W	28 kWs	2 x 10mm²
SK 5xxE-550-340-A … SK 5xxE-750-340-A	SK BR4-400/100 Part No. 275991210	400 W	100 W	1.0 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 Part No. 275991220	220 W	200 W	3.0 kWs	
SK 5xxE-301-340-A … SK 5xxE-401-340-A	SK BR4-100/400 Part No. 275991240	100 W	400 W	6.0 kWs	2 x 2.5mm² AWG 14/19 L = 0.5m
SK 5xxE-551-340-A … SK 5xxE-751-340-A	SK BR4-60/600 Part No. 275991260	60 W	600 W	12.0 kWs	
SK 5xxE-301-340-A … SK 5xxE-401-340-A	SK BR2-100/400-C Part No. 278282040	100 W	400 W	6.0 kWs	2 x 10mm²
SK 5xxE-551-340-A … SK 5xxE-751-340-A	SK BR2- 60/600-C Part No. 278282060	60 W	600 W	7.5 kWs	
SK 5xxE-112-340-A … SK 5xxE-152-340-A	SK BR2- 30/1500-C Part No. 278282150	30 W	1500 W	20 kWs	2 x 10mm²
SK 5xxE-182-340-A … SK 5xxE-222-340-A	SK BR2- 22/2200-C Part No. 278282220	22 W	2200 W	28 kWs	
SK 5xxE-302-340-A … SK 5xxE-372-340-A	SK BR2- 12/4000-C Part No. 278282400	12 W	4000 W	52 kWs	
SK 5xxE-452-340-A … SK 5xxE-552-340-A	SK BR2- 8/6000-C Part No. 278282600	8 W	6000 W	78 kWs	
SK 5xxE-752-340-A … SK 5xxE-902-340-A	SK BR2- 6/7500-C Part No. 278282750	6 W	7500 W	104 kWs	2 x 25mm²
*) Maximum once for 1.2s within 120s					

Table 5: Electrical data for brake resistor SK BR2-… and SK BR4-…

The chassis brake resistors (SK BR2-…) listed above are equipped with a temperature switch at the factory. An optional temperature switch is available for the bottom-mounted brake resistor (SK BR4-…). In order to use the signal from the temperature switch it must be connected to a free digital input of the frequency inverter and, for example, parameterised with the function "Voltage block" or "Fast stop".

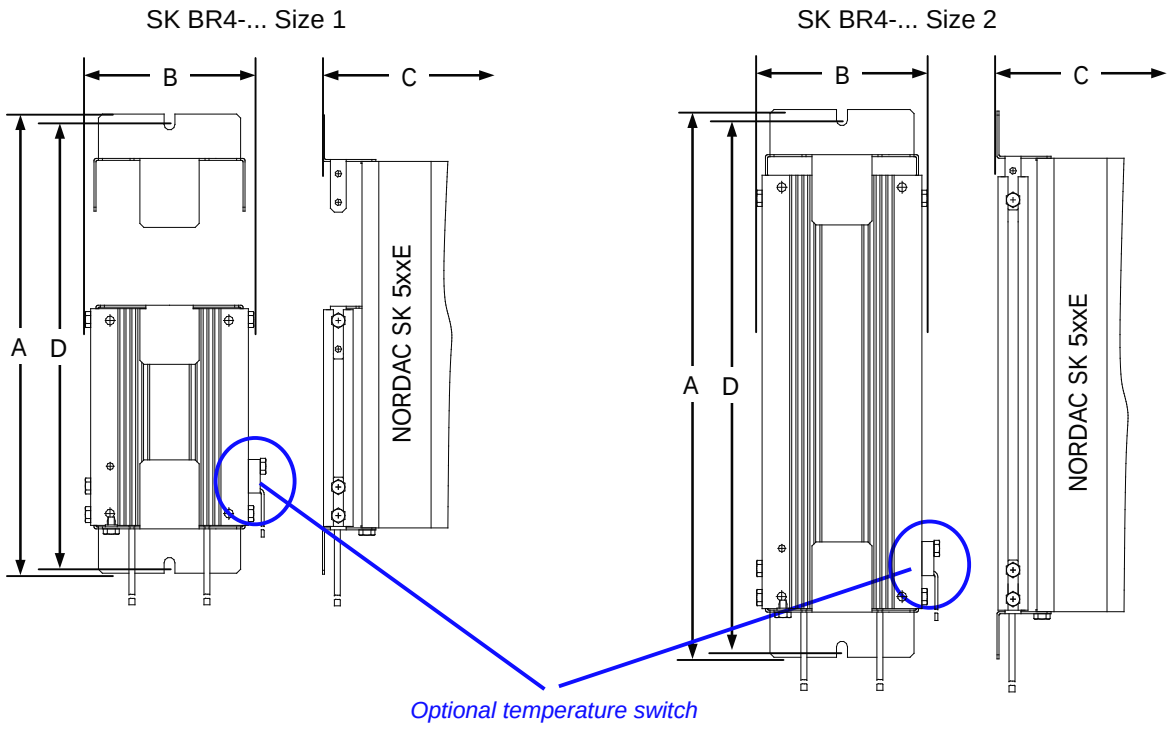
Bi-metal temperature switch							
for...	Part No.	Protection class	Voltage	Current	Nominal switching temperature	Dimensions	Connecting cable / terminals
SK BR4-...	275991200	IP40	250Vac	2.5A with cosj =1 1.6A with cosj =0.6	100 °C	Width +10mm (one side)	Flexible strand 2 x 0.8mm^2 AWG 18/19 L = 0.5m
SK BR2-...	integrated	IP00	250Vac 125Vac 30Vdc	10A 15A 5A	180°C ± 5K	Internal	terminals 2 x 4mm^2

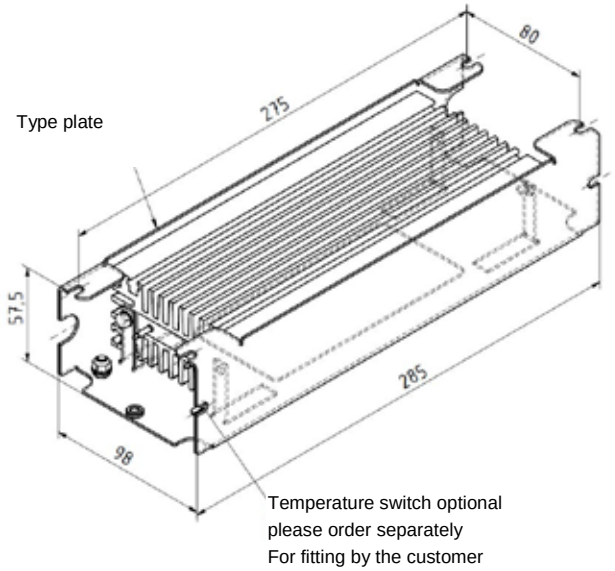
Table 6: Brake resistor temperature switch data

2.6.2 Dimensions of bottom-mounted BR SK BR4

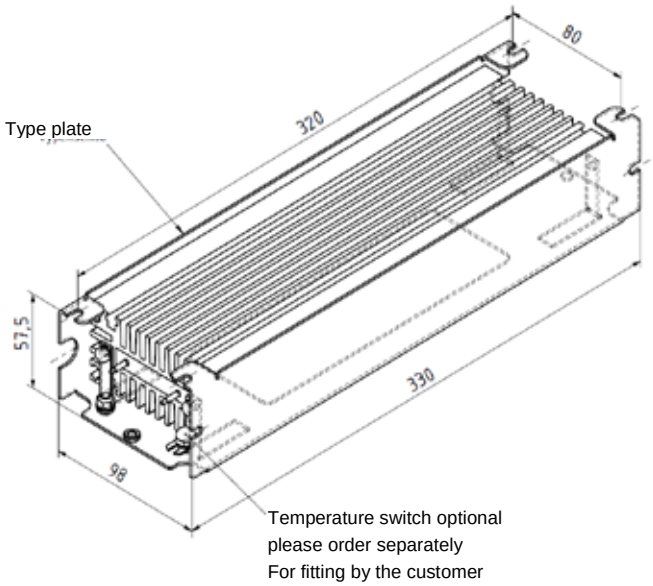
Resistor type	Size	A	B	C	Fixing dimensions	
					D	Æ
SK BR4-240/100 **SK BR4-150/100** **SK BR4-400/100**	Size 1	230	88	175	220	5.5
SK BR4- 75/200 **SK BR4-220/200**	Size 2	270	88	175	260	5.5
SK BR4-35/400 **SK BR4-100/400**	Size 3	285	98	239	275	5.5
SK BR4-60/600	Size 4	330	98	239	320	5.5
C = Installation depth of the frequency inverter + bottom-mounted brake resistor.						All dimensions in mm

Table 7: Dimensions of bottom-mounted brake resistor SK BR4-...





SK BR4-... Size 3



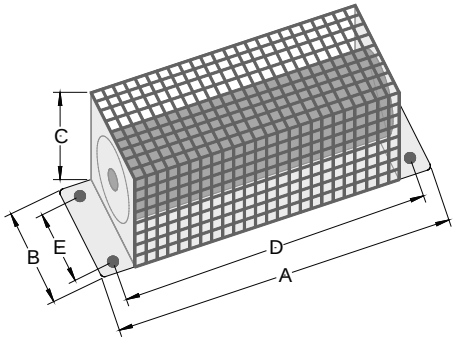
SK BR4-... Size 4

Separate data sheets are available for bottom-mounted brake resistors SK BR4 above size 3. These can be downloaded at www.nord.com.

Inverter ID	Brake resistor type	Part No.	Data sheet
SK 5xxE-301-323-A **...** -401-323-A	**SK BR4-35/400**	275991140	TI014 275991140
SK 5xxE-301-340-A **...** -401-340-A	**SK BR4-100/400**	275991240	TI014 275991240
SK 5xxE-551-340-A **...** -751-340-A	**SK BR4-60/600**	275991260	TI014 275991260

2.6.3 Dimensions, brake resistor chassis SK BR2

Resistor type	A	B	C	Fixing dimensions		
				D	E	Æ
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- 22/600-C						
SK BR2- 30/1500-C	560	185	120	530	150	6.5
SK BR2- 12/1500-C						
SK BR2- 22/2200-C	460	270	120	430	240	6.5
SK BR2- 9/2200-C						
SK BR2- 12/4000-C	560	270	240	530	240	6.5
SK BR2- 8/6000-C	470	600	300	440	2x220	6.5
SK BR2- 6/7500-C	570	600	300	540	2x220	6.5
All dimensions in mm						



SK BR2-... FI size 3 and above
(Schematic diagram, model varies according to power)

Table 8: Dimensions of chassis brake resistor SK BR2-...

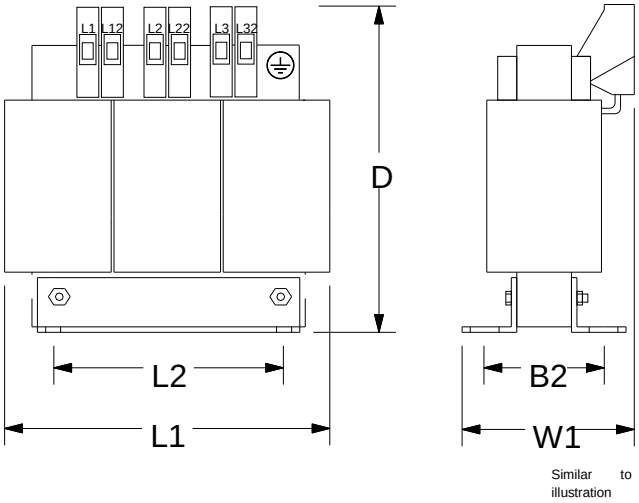
2.7 Mains choke SK CI1

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 230 V or 480 V at 50/60 Hz.

All chokes have a protection class corresponding to IP00. The choke used 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.



Similar to illustration

In addition, the charging currents (mains voltage fluctuations) are significantly reduced.

Inverter ID NORD SK 500E	Input choke 1 x 220 - 240 V			L1	W1	D	Detail: Mounting			Connection
	Type	Continuous current	Inductance				L2	B2	Installation	
0.25 ... 0.75hp	SK CI1-230/8-C Part. 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 Part. No.: 278999040	20 A	2 x 0.4 mH	96	90	106	84	65	M6	10
All dimensions in [mm]										[mm²]

Table 9: Mains choke data for SK CI1-..., 1~ 240 V

Inverter ID NORD SK 500E	Input choke 3 x 200 - 240 V			L1	W1	D	Detail: Mounting			Connection
	Type	Continuous current	Inductance				L2	B2	Installation	
0.25 ... 0.75hp	SK CI1-480/6-C Part. No.: 276993006	6 A	3 x 4.88 mH	96	60	117	71	45	M4	4
1.1 ... 1.5 kW	SK CI1-480/11-C Part. No.: 276993011	11 A	3 x 2.93 mH	120	85	140	105	70	M4	4
2.2 ... 3.0 kW	SK CI1-480/20-C Part. No.: 276993020	20 A	3 x 1.47 mH	155	110	177	135	95	M5	10
4.0 ... 7.5 kW	SK CI1-480/40-C Part. No.: 276993040	40 A	3 x 0.73 mH	155	115	172	135	95	M5	10
11 ... 15 kW	SK CI1-480/70-C Part. No.: 276993070	70 A	3 x 0.47 mH	185	122	220	170	77	M6	35
18 kW	SK CI1-480/100-C Part. No.: 276993100	100 A	3 x 0.29 mH	240	148	263	180	122	M6	35
All dimensions in [mm]										[mm²]

Table 10: Mains choke data for SK CI1-..., 3~ 240 V

Inverter ID NORD SK 500E	Input choke 3 x 380 - 480 V			L1	W1	D	Detail: Mounting			Connection
	Type	Continuous current	Inductance				L2	B2	Installation	
0.55 ... 2.2 kW	SK CI1-480/6-C Part. No.: 276993006	6 A	3 x 4.88 mH	96	60	117	71	45	M4	4
3.0 ... 4.0 kW	SK CI1-480/11-C Part. No.: 276993011	11 A	3 x 2.93 mH	120	85	140	105	70	M4	4
5.5 ... 7.5 kW	SK CI1-480/20-C Part. No.: 276993020	20 A	3 x 1.47 mH	155	110	177	135	95	M5	10
11 ... 15 kW	SK CI1-480/40-C Part. No.: 276993040	40 A	3 x 0.73 mH	155	115	172	135	95	M5	10
18 ... 30hp	SK CI1-480/70-C Part. No.: 276993070	70 A	3 x 0.47 mH	185	122	220	170	77	M6	35
37 ... 45 kW	SK CI1-480/100-C Part. No.: 276993100	100 A	3 x 0.29 mH	240	148	263	180	122	M6	35
55 ... 75 kW	SK CI1-480/160-C Part. No.: 276993160	160 A	3 x 0.18 mH	352	140	268	240	105	M8	M8*
90 kW	SK CI1-480/280-C Part. No.: 276993280	280 A	3 x 0.10 mH	352	169	268	240	133	M10	M16*
All dimensions in [mm]										[mm^2]
* Bolt for copper rail										

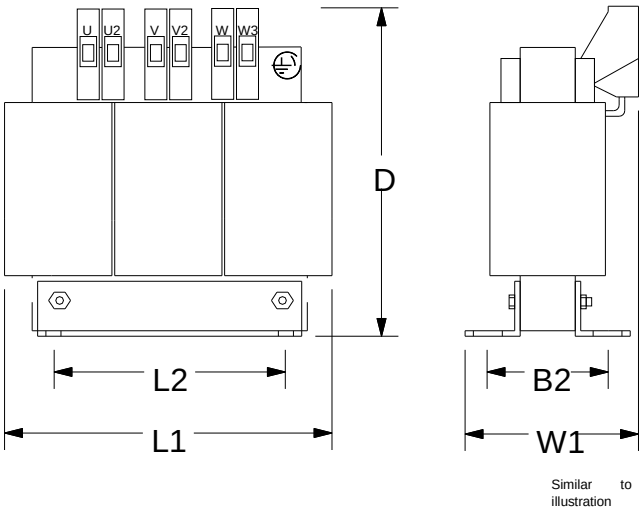
Table 11: Mains choke data for SK CI1-..., 3~ 480 V

2.8 Output choke SK CO1

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.

During installation take care 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 480 V at 0 - 100 Hz.



Similar to illustration

An output choke should be fitted for cable lengths over **100 m/30 m** (unshielded/shielded). All chokes have a protection class corresponding to **IP00**. The choke used must therefore be installed in a control cabinet.

Inverter ID NORD SK 5xxE	Output choke 3 x200 – 240 V			L1	W1	D	Detail: Mounting			Connection
	Type	Continuous current	Inductance				L2	B2	Installation	
0.25 … 0.75 kW	SK CI1-460/4-C Part. No.: 276996004	4 A	3 x 3.5 mH	120	104	140	84	75	M6	4
1.1 ... 1.5 kW	SK CI1-460/9-C Part. No.: 276996009	9 A	3 x 2.5 mH	155	110	160	130	71.5	M6	4
2.2 ... 4.0 kW	SK CI1-460/17-C Part. No.: 276996017	17 A	3 x 1.2 mH	185	102	201	170	57.5	M6	10
5.5 ... 7.5 kW	SK CI1-460/33-C Part. No.: 276996033	33 A	3 x 0.6 mH	185	122	201	170	77.5	M6	10
11 … 15 kW	SK CI1-480/60-C Part. No.: 276992060	60 A	3 x 0.33 mH	185	112	210	170	67	M8	16
18 kW	SK CI1-460/90-C Part. No.: 276996090	90 A	3 x 0.22 mH	352	144	325	224	94	M10	35
All dimensions in [mm]										[mm²]

Table 12: Output choke data for SK CO1-..., 3~ 240 V

Inverter ID NORD SK 5xxE	Output choke 3 x 380 – 480 V			L1	W1	D	Detail: Mounting			Connection
	Type	Continuous current	Inductance				L2	B2	Installation	
0.55 ... 1.5 kW	SK CI1-460/4-C Part. No.: 276996004	4 A	3 x 3.5 mH	120	104	140	84	75	M6	4
2.2 ... 3.0 kW	SK CI1-460/9-C Part. No.: 276996009	9 A	3 x 2.5 mH	155	110	160	130	71.5	M6	4
4.0 ... 7.5 kW	SK CI1-460/17-C Part. No.: 276996017	17 A	3 x 1.2 mH	185	102	201	170	57.5	M6	10
11 ... 15 kW	SK CI1-460/33-C Part. No.: 276996033	33 A	3 x 0.6 mH	185	122	201	170	77.5	M6	10
18 ... 30hp	SK CI1-480/60-C Part. No.: 276992060	60 A	3 x 0.33 mH	185	112	210	170	67	M8	16
37 … 45 kW	SK CI1-460/90-C Part. No.: 276996090	90 A	3 x 0.22 mH	352	144	325	224	94	M10	35
55 … 75 kW	SK CI1-460/170-C Part. No.: 276996170	170 A	3 x 0.13 mH	412	200	320	264	125	M10	M12*
90 kW	SK CI1-460/240-C Part. No.: 276996170	240 A	3 x 0.07 mH	412	225	320	388	145	M10	M16*
All dimensions in [mm]										[mm²]
* Bolt for copper rail										

Table 13: Output choke data for SK CO1-..., 3~ 480 V

2.9 Line filter

An additional external line filter can be installed into the line supply of the frequency inverter to maintain the increased noise suppression level (class B as per EN 55011).

Mains filter SK NHD (up to size 4)

SK NHD type mains filters are so-called bottom-mounted combination filters with integrated mains choke. The mains filter is only intended for three-phase operation.

This provides a compact unit to improve the level of radio interference suppression, which can also be mounted underneath the frequency inverter if there is a shortage of space.

For further information about the overvoltage filter, please refer to the relevant data sheet. These data sheets can be downloaded from www.nord.com.

Inverter ID	Filter type	Part No.	Data sheet
SK 5xxE-250-323-A ... -750-323-A	**SK NHD-480/6-F**	278273006	TI030 278273006
SK 5xxE-111-323-A ... -221-323-A	**SK NHD-480/10-F**	278273010	TI030 278273010
SK 5xxE-301-323-A ... -401-323-A	**SK NHD-480/16-F**	278273016	TI030 278273016
SK 5xxE-550-340-A ... -750-340-A	**SK NHD-480/3-F**	278273003	TI030 278273003
SK 5xxE-111-340-A ... -221-340-A	**SK NHD-480/6-F**	278273006	TI030 278273006
SK 5xxE-301-340-A ... -401-340-A	**SK NHD-480/10-F**	278273010	TI030 278273010
SK 5xxE-551-340-A ... -751-340-A	**SK NHD-480/16-F**	278273016	TI030 278273016

Table 14: Mains filter NHD-...

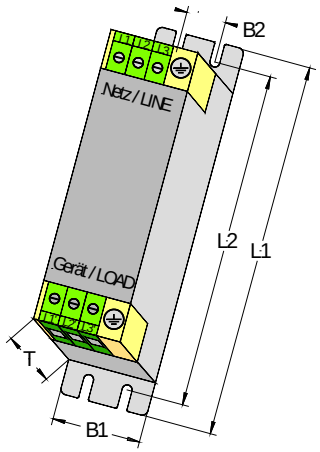
Mains filter SK LF2 (size 5 - 6)

SK LF2 type mains filters are mains filters which can be bottom mounted, and their dimensions are matched to those of the relevant frequency inverter. This enables space-saving installation.

Inverter ID	Filter type	Part No.	Data sheet
SK 5xxE-551-323-A **...** -751-323-A	**SK LF2-480/45-F**	278273045	TI030 278273045
SK 5xxE-112-323-A	**SK LF2-480/66-F**	278273066	TI030 278273066
SK 5xxE-112-340-A **...** -152-340-A	**SK LF2-480/45-F**	278273045	TI030 278273045
SK 5xxE-182-340-A **...** -222-340-A	**SK LF2-480/66-F**	278273066	TI030 278273066

Table 15: Mains filter LF2-...

Mains filter SK HLD (above size 5)



In addition, a chassis mains filter is available for inverters of size V and above. This enables **Class B**radio interference suppression up to a maximum motor cable length of 25 m.

When connecting the line filter, comply with "Wiring guidelines" Section 2.10.1 and "EMC" Section 8.3. In particular, care must be taken that the pulse frequency is set to the default value (P504 = 6kHz). The line filter should be placed as close to the side of the inverter as possible.

The connection is by means of screw connections on the upper (mains) and lower (inverter) ends of the filter

Inverter ID	Filter type [-V/A]	L1	W1	D	Detail: Mounting		Connection cross-section
					L2	B2	
SK 5xxE-551-323-A	**SK HLD 110-500/30**	270	55	95	255	30	10
SK 5xxE-751-323-A	**SK HLD 110-500/42**	310	55	95	295	30	10
SK 5xxE-112-323-A	**SK HLD 110-500/75**	270	85	135	255	60	35
SK 5xxE-152-323-A... SK 5xxE-182-323-A	**SK HLD 110-500/100**	270	95	150	255	65	50
SK 5xxE-112-340-A... SK 5xxE-152-340-A	**SK HLD 110-500/42**	310	55	95	295	30	10
SK 5xxE-182-340-A	**SK HLD 110-500/55**	250	85	95	235	60	16
SK 5xxE-222-340-A	**SK HLD 110-500/75**	270	85	135	255	60	35
SK 5xxE-302-340-A... SK 5xxE-372-340-A	**SK HLD 110-500/130**	270	95	150	255	65	50
SK 5xxE-452-340-A... SK 5xxE-552-340-A	**SK HLD 110-500/180**	380	130	181	365	102	95
SK 5xxE-752-340-A... SK 5xxE-902-340-A	**SK HLD 110-500/250**	450	155	220	435	125	150
						All dimensions in mm	mm^2

Table 16: Mains filter HLD-...

Voltage limitation filter SK CIF

Up to and including size 6, the use of a suitable overvoltage filter is mandatory (see also Section 1.5) in order to comply with cUL requirements. For further information about the overvoltage filter, please refer to the relevant data sheet. These data sheets can be downloaded from www.nord.com.

Inverter ID	Filter type	Part No.	Data sheet
SK 5xxE-250-323-A **...** -301-323-A*	**SK CIF-323-20**	276997070	TI030 276997070
SK 5xxE-401-323-A **...** -112-323-A*	**SK CIF-323-40**	276997071	TI030 276997071
SK 5xxE-550-340-A **...** -751-340-A	**SK CIF-340-30**	276997080	TI030 276997080
SK 5xxE-112-340-A **...** -222-340-A	**SK CIF-340-60**	276997081	TI030 276997081

* (only with suitable mains choke)

Table 17: Mains filter SK CIF-...

2.10 Electrical connections

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 installation and safety regulations for work on high voltage systems (e.g. VDE) must be complied with as must the regulations concerning correct 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.

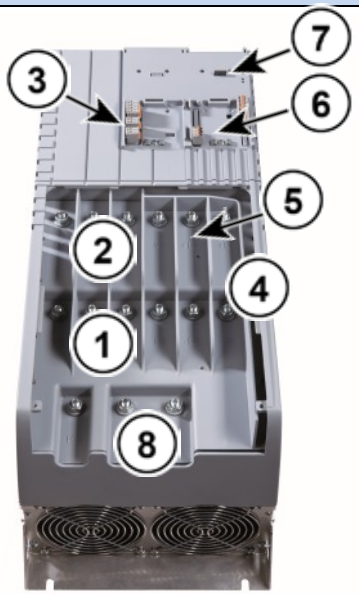
Ensure that the input voltage source is not live before setting up or changing connections to the unit.

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

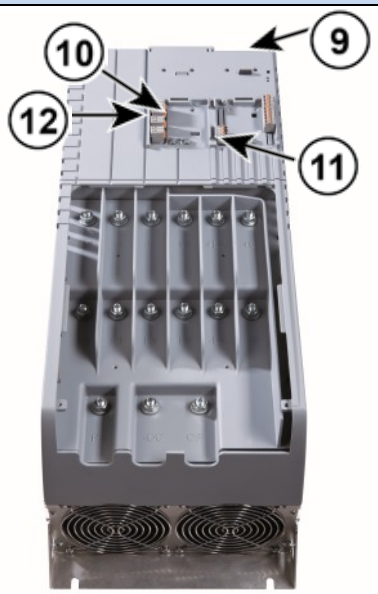
Note **Thermistor**

As with other signal cables, thermistor cables must be laid separately from the motor cables

Depending on the size of the frequency inverter, the connection terminals for the supply cables and the control cables are located in different positions. According to the configuration of the frequency inverter, various terminals are not present.

Size 1 - 4	Size 5 - 7	Above size 8
		

1 =	Mains connection	L1, L2/N, L3, PE	X1	
2 =	Motor connection	U, V, W, PE	X2	
3 =	multi-function relay	1 - 4	X3	
4 =	Braking resistor	+B, -B	X2	
5 =	DC - link circuit	-DC	X2	Above Size 8: + DC, - DC
6 =	Control terminals	IOs, GND, 24Vout, IG, DIP for AIN	à	X4, X5, X6, X7, X14
7 =	Technology unit			
8 =	Link circuit choke	-DC, CP, PE		Above size 8:

Size 1 - 4	Size 5 - 7	Above size 8
		

9 =	communication	CAN/CANopen; RS232/RS485	à	X9/X10; X11
10 =	Thermistor	T1/2 or TF+/-	X13	Up to size 4 (except SK 54xE): to DIN 5
11 =	Safe pulse block	86, 87, 88, 89	X8	
12 =	Control voltage VI 24V	40, 44	X12	Except SK 5x0E and SK 511E

2.10.1 Wiring guidelines

The frequency inverters have been developed for use in an industrial environment. In this environment, high levels of electromagnetic interference can act on the frequency inverter. In general, correct installation ensures safe and problem-free operation. To meet the limiting 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 which have large cross-sections and are connected to a common earthing point or earthing bar. It is especially important that each control unit which is connected to the electronic drive technology (e.g. an automatic device) has a short cable with a large cross-section, which is connected to the same earthing point as the dfrequency inverter itself. Flat cables (e.g. metal stirrups) 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 controller. 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.
3. Where possible, shielded cables should be used for control circuits. 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 device.
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. Shielded or armoured cables should be used for the load connections (motor cable). The shielding or armouring must be earthed 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.

In addition, EMC-compliant wiring must be ensured. If required, an optional output choke can be supplied

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

NOTICE **Interference and damage**

The control cables, mains cables and motor cables must be laid separately. Under no circumstances may they be installed in a common conduit or installation duct, in order to prevent interference.

The test equipment for high voltage insulations must not be used on cables that are connected to the motor controller. Failure to comply with this will cause damage to the drive electronics.

2.10.2 Adaptation to IT networks

As delivered, the device is configured for operation in TN or TT networks. Simple adaptations must be made for operation in an It network. However, these adaptations also cause a deterioration in the suppression of radio interference.

Up to and including size 7, the adaptation is made with jumpers. As delivered, the jumpers are set in the “normal position”. With this, the mains filter has its normal effect and leakage current. From size 8 and above there is a DIP switch element. According to the setting of the DIP switch, the frequency inverter is configured for TN/TT network operation or for operation in an IT network (also refer to Sections **Fehler! Verweisquelle konnte nicht gefunden werden.** and **0**).

Frequency inverter	Jumper A	Jumper B	Remarks	Leakage current
Size 1 - 4	Position 1	Position 1	Operation in IT network	Not applicable
Size 1 - 4	Position 3	Position 2	Large filtering effect	< 30 mA
Size 1 - 4	Position 3	Position 3	Limited effect of filter	<< 30 mA > 3.5 mA
Size 5 - 6	Position 0	Position 1	Operation in IT network	Not applicable
Size 5 - 6	Position 4	Position 2	Large filtering effect	< 6 mA
Size 7	Position 0	Position 1	Operation in IT network	Not applicable
Size 7	Position 4	Position 2	Large filtering effect	< 6 mA
	DIP switch "EMC-Filter"			
Size 8 - 9	OFF		Operation in IT network	< 30 mA
Size 8 - 9	ON		Large filtering effect	< 10 mA

Table 18: Integrated mains filter

Adaptation of sizes 1 - 7

NOTICE **Jumper positions**

Jumper positions which are not illustrated below must not be used, as these may cause the destruction of the frequency inverter.

Jumper “A” mains input

Size 1 - 4

= **Operation in IT network** = Position 1
(reduced leakage current)

= normal position = Position 3

Top side of device

Size 5 - 7

= **Operation in IT network** = Position 0
(reduced leakage current)

= normal position = Position 4

Geräte- Oberseite

Jumper 'B' motor output

Size 1 - 4

= **Operation in IT network** = Position 1

= normal position = Position 2

= reduced leakage current – Position 3

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

Underside of the device

Size 5 - 7

= **Operation in IT network** = Position 1
(reduced leakage current)

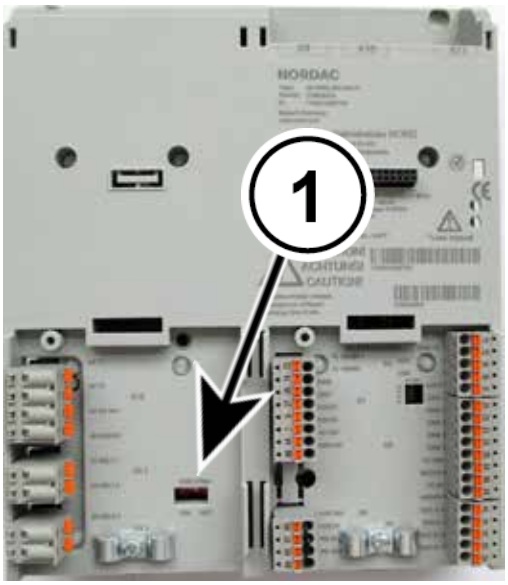
= normal position = Position 2

Underside of the device

Adaptation above size 8

The adaptation to the IT network is carried out via the DIP switch "EMC Filter" (1). As delivered, this switch is in the "ON" position.

For operation in an IT network the switch must be set to the "OFF" position. The leakage current is reduced, with a deterioration in the EMC compatibility.



2.10.3 DC-coupling

NOTICE

Overload of link circuits

It is essential to note the following summary of criteria for the setup of a DC supply or the coupling of the link circuits of frequency inverters.

Errors in the link circuit coupling have especially negative effects on the charging circuits in the inverters or on the life span of the link circuits - including their complete destruction.

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. In addition, the energy balance can be made even more efficient with the use of a regenerative feedback unit or an input/feedback unit. *In general, in case of DC coupling, wherever possible, devices with the same power should be connected together. Furthermore, only operational devices (whose link circuits are charged) must be coupled.*

Connection

Size 1 … 7	+B, - DC
Above size 8:	+ DC, - DC

NOTICE

DC coupling for single phase devices

For direct current coupling of single-phase devices, care must be taken that the coupling to the same external conductor is used. Otherwise the device may be destroyed.

For the 115V devices (SK 5xx-xxx-112-O), no DC coupling is possible.

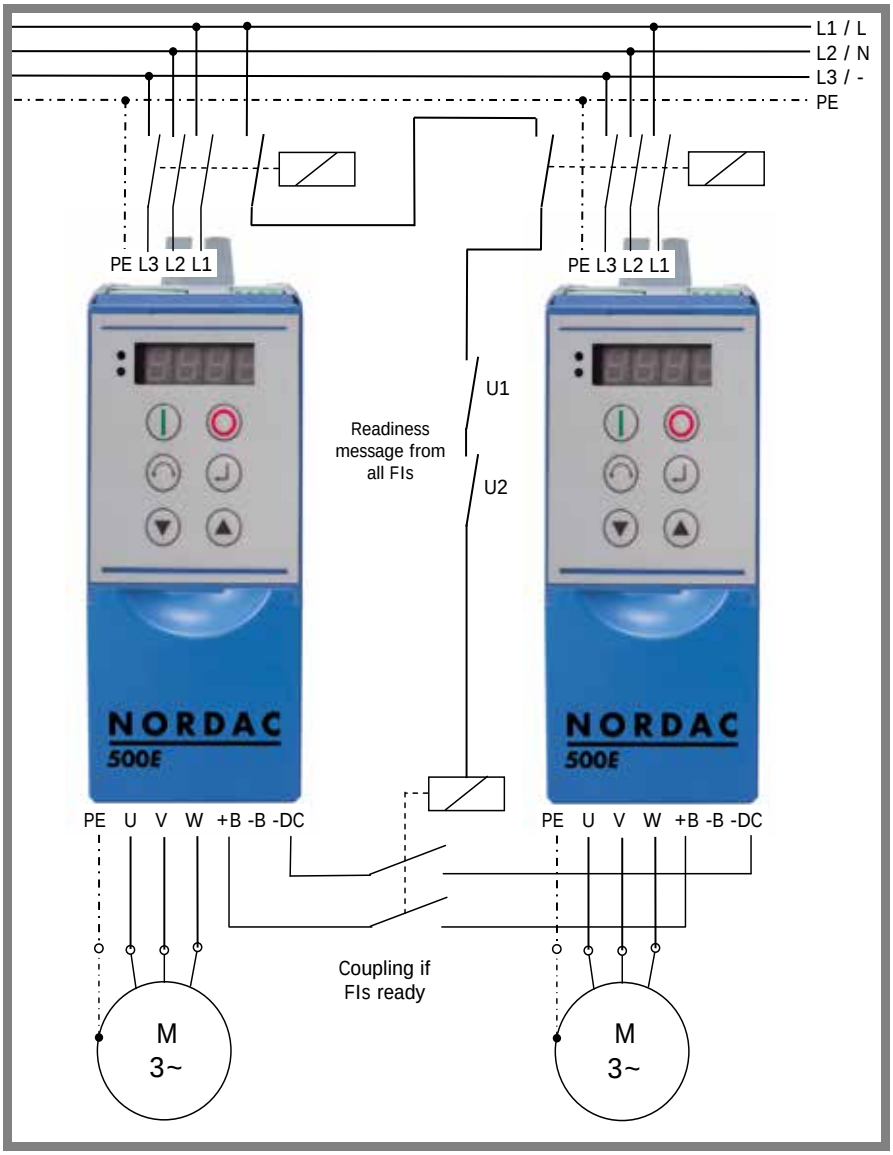


Fig. 6 Diagram of a DC-coupling

1 The link circuits of the individual frequency inverters must be protected with suitable fuses.

2 The frequency inverters only obtain their power supply via the link circuit. Electrical isolation is carried out via the power circuit breakers which must be provided in the supplies to the devices.

3 **CAUTION!** Ensure that the coupling is only made after readiness is reported. Otherwise, there is a danger that all the frequency inverters will be charged by a single one.

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 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.

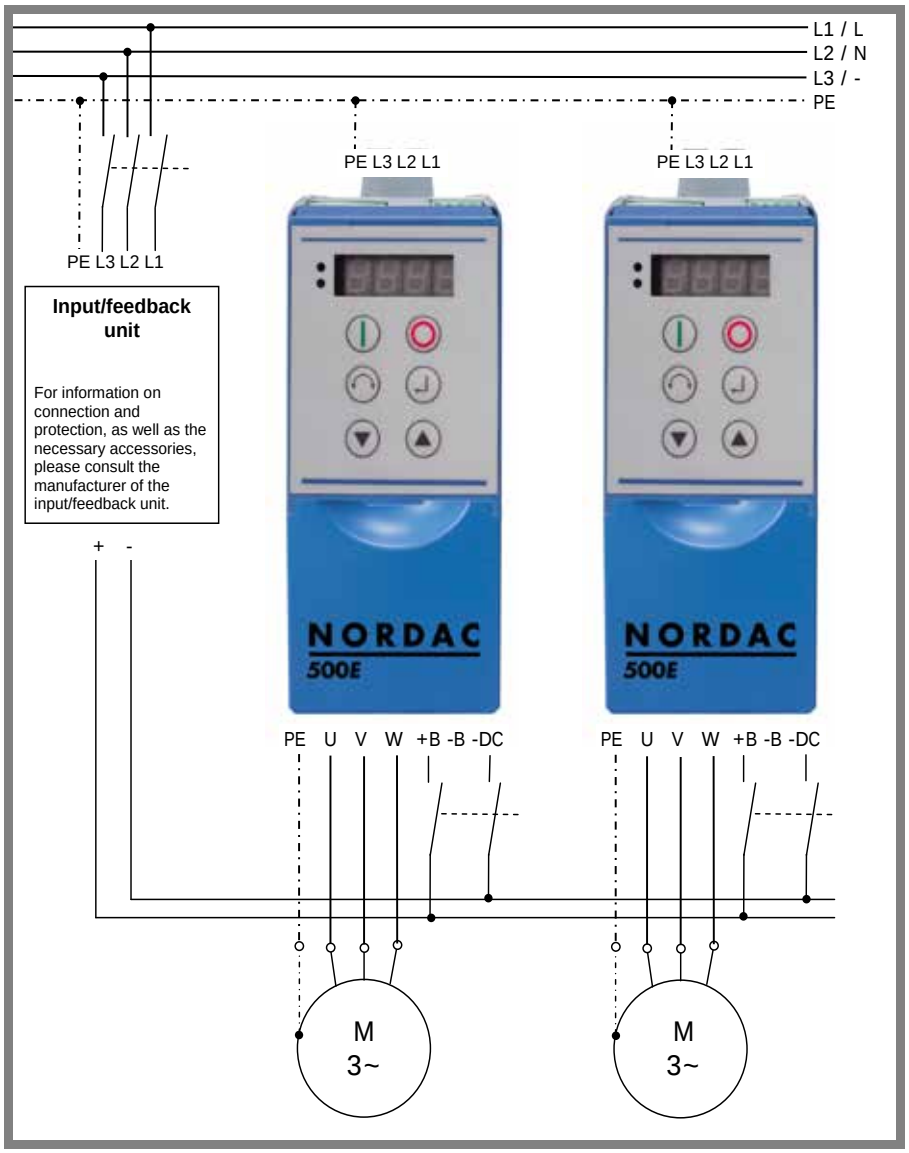


Fig. 7 Diagram of a DC coupling with an input/feedback unit

The following points must be taken into consideration in association with a DC supply:

1 Use a connecting cable which is as short as possible between the DC bus and the equipment to be connected. The connection and protection of the devices in the DC circuit must be carried out for cable protection and the maximum cross-section of the device.

2 The link circuits of the individual frequency inverters must be protected with suitable fuses.

3 The frequency inverters only obtain their supply via the link circuit. Electrical isolation is carried out via the power circuit breakers which must be provided in the supplies to the devices.

4 For frequency inverters above size 8, a DC supply is only permissible with an external charging device.

2.10.4 Electrical connections, power unit

Before connecting the frequency inverter, the following must be observed:

1. Ensure that the mains supply provides the correct voltage and is suitable for the current required.
2. Ensure that suitable circuit breakers with the specified nominal current range are installed between the voltage source and the inverter.
3. Connect the mains voltage directly to the mains terminals L1-L2/N-L3-PE (for each device)
4. A four-core cable must be used to connect the motor. The cable is connected to the motor terminals PE-U-V-W.
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, however, at least to the electrically conducting mounting surface of the control cabinet.
6. Above size 8, the cable lugs which are included in the scope of delivery must be used. After crimping, these must be insulated with shrink hose.

Note

The use of shielded cables is essential in order to maintain the specified radio interference suppression level.

If certain wire end sleeves are used, the maximum cross-section which can be connected can be reduced.

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

Frequency inverter	Tools	Type
Size 1 - 4	Screwdriver	SL / PZ1; SL / PH1
Size 5 - 7	Screwdriver	SL / PZ2; SL / PH2
Size 8 - 9	Socket wrench	SW 13

Table 19: Tools

Connection data:

Frequency inverter		BG 1 ... 4	Size 5	Size 6	Size 7	Size 8	Size 9
Rigid cable Ø	[mm²]	0.2 … 6	0.5 … 16	0.5 … 35	0.5 … 50	50	95
Flexible cable Ø	[mm²]	0.2 … 4	0.5 … 10	0.5 … 25	0.5 … 35	50	95
AWG standard		24-10	20-6	20-2	20-1	1/0	3/0
Starting torque	[Nm]	0.5 … 0.6	1.2 … 1.5	2.5 … 4.5	2.5 … 4	15	15
	[lb-in]	4.42 … 5.31	10.62 … 13.27	22.12 … 39.82	22.12 … 35.4	135	135

Table 20: Connection data

NOTICE **Brake voltage supply**

The voltage supply for an electro-mechanical brake (or its brake rectifier) must be via the mains.

Connection to the output side (connection to the motor terminals) may cause the destruction of the brake or the frequency inverter.

Mains connections (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.

Frequency inverter data		Permissible mains data			
Voltage	**Power**	**1 ~ 115 V**	**1 ~ 230 V**	**3 ~ 230 V**	**3 ~ 400 V**
115 VAC	0.25 ... 0.75 kW	X			
230 VAC	0.25 ... 2.2 kW		X	X	
230 VAC	≥ 3.0 kW			X	
400 VAC	≥ 0.37 kW				X
Connections		L/N = L1/L2	L/N = L1/L2	L1/L2/L3	L1/L2/L3

Isolation from or connection to the mains must always be carried out for all the poles and synchronously (L1/L2/L2 or. L1/N).

NOTICE

Operation in IT networks

The use of this frequency inverter on an **IT network** is possible after modification of the integrated mains filter.

It is urgently recommended that the frequency inverter is only operated on a IT network if a braking resistor is connected. If an earthing fault occurs in the IT network, this measure prevents an impermissible charging of the link circuit capacitor and the associated destruction of the frequency inverter.

For operation with an insulation monitor, the insulation resistance of the frequency inverter must be taken into account.

Motor cable (X2 - U, V, W, PE)

The motor cable may have a **total length of 100m** if this is a standard cable (take EMC into consideration). 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.

For multiple motor operation the total motor cable length consists of the sum of the individual cable lengths.

NOTICE

Output switching

The motor cable must not be switched as long as the inverter is pulsing (The inverter must be in "Standby" or "Starting disabled" status).

Otherwise the inverter nay be damaged.

Breake resistor (X2 - +B, -B)

The terminals +B/ -B are intended for the connection of a suitable braking resistor. A short screened connection should be selected. For the installation of a braking resistor, the large amount of heat which is generated due to its operation (> 70°C) must be taken into account.

2.10.5 Electrical connections, control unit

The control connections are located under the front cover (above size 8 under the two front covers) of the frequency inverter. The configuration differs according to the size. Up to size 7, the individual control terminals (X3, X8, X13) are in staggered positions (please also refer to Section 2.10).

Connection data:

Frequency inverter		**All**	**Size 1 … 4**	**Size 5 … 7**	**Above size 8:**
Terminal block		**Typically**	**X3**	**X3, X8, X12, X13**	**X3.1/2, X15**
Rigid cable Ø	[mm²]	0.14 … 1.5	0.14 … 2.5	0.2 … 6	0.2 … 2.5
Flexible cable Ø	[mm²]	0.14 … 1.5	0.14 … 1.5	0.2 … 4	0.2 … 2.5
AWG standard		26-16	26-14	24-10	24-12
Starting torque	[Nm]	Clamping	0.5 … 0.6	0.5 … 0.6	Clamping
	[lb-in]		4.42 … 5.31	4.42 … 5.31	

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

Furthermore, it must be taken into account that with **SK 5x5E** size 1 ... 4 frequency inverters, terminal 44 is used to feed in the control voltage. However with devices of size 5 and above, this terminal provides a 24V control voltage.

NOTICE

Cable laying

All control cables (including the thermistor) must be laid separately from the mains and the motor cables, in order to prevent interference to the inverter.

If the cable are laid in parallel, a minimum distance of 20cm must be maintained from cables which carry a voltage >60V The minimum distance may be reduced by screening the cables which carry a voltage, or by the use of earthed metal partitions within the cable conduits.

NOTICE

Total currents

5V / 15V (24V) can be obtained from several terminals if required. With size 1 ... 4, the total output current must not exceed 250mA/150mA (5V/15V). Above Size 5 the limiting value is 250mA/200mA (5V/24V).

Terminal block X3, (above size 8: X3.1 and X3.2) - Relay

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	SK 535E
	√	√	√	√	√	√	√	√

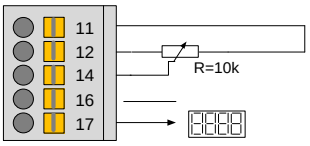
Terminals X3:	1	2	3	4
Name	K1.1	K1.2	K2.1	K2.2

Terminal	Function [Factory setting]	Data	Description / wiring suggestion	Parameter
1 2	Output 1 [Braking control]	Relay closing contact 230 VAC, 24 VDC, < 60 VAC in circuits with safe isolation, ≤ 2 A	Brake control (closes on enabling)	P434
3 4	Output 2 [Ready/Fault]		Fault / Ready (closes when FI ready / no fault)	P441

Terminal block X4 – Analog I/O

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	SK 535E
	√	√	√	√	√	√	√	√

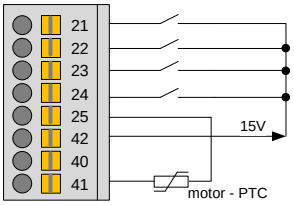
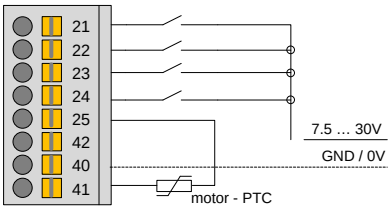
Terminals X4:	11	12	14	16	17
Name	VO 10V	GND/0V	AIN1	AIN2	AOUT1

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
11	10V Reference voltage	10V, 5mA	The analog input controls the output frequency of the frequency inverter.  The possible digital functions are described in Parameter P420. <u>Above Size 5:</u> Configuration of analog input with DIP switch (see below)	
12	Reference potential for analog signals	0V analog		
14	Analog input 1 [set point frequency]	V=0...10V, R_i=30kW, I=0/4...20mA, R_i=250W, can be switched over with DIP switch, reference voltage GND. For the use of digital functions 7.5...30V. <u>Above Size 5:</u> also -10 … + 10 V signals		P400
16	Analog input 2 [no function]			P405
17	Analog output [no function]	0...10V Reference potential GND Max. load current: 5mA analog, 20mA digital	Can be used for an external display or for further processing in a following machine.	P418

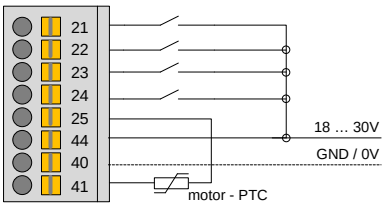
Terminal block X5 – Digital In

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	SK 535E
	√		√	√		√	√	

Terminals X5:	21	22	23	24	25	42	40	41
Name	DIN1	DIN2	DIN3	DIN4	DIN5	VO 15V	GND/0V	VO 5V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
21	Digital input 1 [ON right]	7.5...30V, R_i=6.1kW **Not** suitable for thermistor evaluation. HTL encoders can only be connected to DIN2 and DIN4 Limiting frequencies: max. 10 kHz min. 15 Hz	Each digital input has a reaction time of ≤ 5ms. <u>Connection with internal 15V</u>:  <u>Connection with external 7,5-30V</u>:  	P420
22	Digital input 2 [ON left]			P421
23	Digital input 3 [parameter set bit0]			P422
24	Digital input 4 [Fixed frequency 1, P429]			P423
25	Digital input 5 [no function]	2.5...30V, R_i=2.2kW **Not** suitable for evaluation of a safety device. Suitable for thermistor evaluation with 5V. **NOTE:** For the motor thermistor P424 = 13 must be set.		P424
42	15V **output** power supply	15V ± 20%	Supply voltage provided by the frequency inverter for connection to the digital inputs or the supply of a 10-30V encoder.	
40	Reference potential for digital signals	0V digital	Reference potential	
41	5V **output** power supply	5V ± 20%	Voltage supply for motor-PTC	

Relevance	SK 500E	**SK 505E**	SK 510E	SK 511E	**SK 515E**	SK 520E	SK 530E	**SK 535E**	
		√			√			√	
Terminals X5:	**21**	**22**	**23**	**24**	**25**	**44***	**40**	**41**	* Terminal 44: up to Size 4: VI Size 5 and above: VO
Name	DIN1	DIN2	DIN3	DIN4	DIN5	V…24V	GND/0V	VO 5V	

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
21	Digital input 1 [ON right]	7.5...30V, R_i=6.1kW **Not** suitable for thermistor evaluation. HTL encoders can only be connected to DIN2 and DIN4 Limiting frequencies: max. 10 kHz min. 15 Hz	Each digital input has a reaction time of ≤ 5ms. 	P420
22	Digital input 2 [ON left]			P421
23	Digital input 3 [parameter set bit0]			P422
24	Digital input 4 [Fixed frequency 1, P429]			P423
25	Digital input 5 [no function]	<u>Only S1 – S4</u> 2.5...30V, R_i=2.2kW **Not** suitable for evaluation of a safety device. Suitable for thermistor evaluation with 5V. **NOTE:** For the motor thermistor P424 = 13 must be set. <u>Above Size 5</u> Thermistor on X13:T1/T2		P424
44	<u>Size 1 to Size 4</u> **VI 24V** supply voltage **input**	18…30V at least 800mA (input)	Voltage supply for the FI control unit. Is essential for the function of the frequency inverter.	
	<u>Size 5 and above</u> **VO 24V** supply voltage **output**	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. The 24V control voltage is generated by the FI, however it can alternatively be supplied via the terminals X12:44/40 (size 8 and above: X15:44/40). Supply via terminal X5:44 is not possible.	
40	Reference potential for digital signals	0V digital	Reference potential	
41	5V **output** power supply	5V ± 20%	Voltage supply for motor-PTC	

Terminal block X6 – Encoder

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	**SK 520E**	**SK 530E**	**SK 535E**
						√	√	√

Terminals X6:	**40**	**51**	**52**	**53**	**54**
Name	GND/0V	ENC A+	ENC A-	ENC B+	ENC B-

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
40	Reference potential for digital signals	0V digital	The incremental encoder input can be used for the exact regulation of the speed of rotation, additional set point functions or positioning (SK530E and above). 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	Track A	TTL, RS422 500…8192Imp./Rpm. Limiting frequencies: max. 205 kHz min. 250 Hz		P300
52	Track A inverse			
53	Track B			
54	Track B inverse			

Terminal block X7 – Digital I/O

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	**SK 520E**	**SK 530E**	SK 535E
						√	√	

Terminals X7:	**73**	**74**	**26**	**27**	**5**	**7**	**42**	**40**
Name	RS485 +	RS485 -	DIN6	DIN7	DOUT1	DOUT2	VO 15V	GND/0V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
73 74	Data cable RS485	Baud rate 9600…38400Baud Termination resistance R=120W	BUS connection parallel to RS485 on RJ12 plug **NOTE:** The termination resistance of DIP switch 1 (see RJ12/RJ45) can also be used for terminal 73/74.	P503 P509
26	Digital input 6 [no function]	7.5...30V, R_i=3.3kW	As described for terminal block X5, DIN1 to DIN5. Not suitable for the evaluation of a motor thermistor.	P425
27	Digital input 7 [no function]			P470
5	Output 3 (DOUT1) [no function]	Digital output 15V, max. 20mA For inductive loads: provide protection with a free-wheeling diode.	For evaluation in a control system. The scope of functions corresponds to that of the relay (P434).	P450
7	Output 4 (DOUT2) [no function]			P455
42	15V **output** power supply	15V ± 20%	Voltage supply for connection to the digital inputs or the supply of a 10-30V encoder	
40	Reference potential for digital signals	0V digital		

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	**SK 535E**	
								√	
Terminals X7:	**73**	**74**	**26**	**27**	**5**	**7**	**44***	**40**	* Terminal 44: up to Size 4: VI Size 5 and above: VO
Name	RS485 +	RS485 -	DIN6	DIN7	DOUT1	DOUT2	V…24V	GND/0V	

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
73 74	Data cable RS485	Baud rate 9600…38400Baud Termination resistance R=120W	BUS connection parallel to RS485 on RJ12 plug **NOTE:** The termination resistance of DIP switch 1 (see RJ12/RJ45) can also be used for terminal 73/74.	P503 P509
26	Digital input 6 [no function]	7.5...30V, R_i=3.3kW	As described for terminal block X5, DIN1 to DIN5. Not suitable for the evaluation of a motor thermistor.	P425
27	Digital input 7 [no function]			P470
5	Output 3 (DOUT1) [no function]	Digital output S1 to S4 18-30V, according to VI 24V, max. 20mA size 5 and above **DOUT1 and DOUT2:** 24V, max. 200mA For inductive loads: provide protection with a free-wheeling diode.	For evaluation in a control system. The scope of functions corresponds to that of the relay (P434).	P450
7	Output 4 (DOUT2) [no function]			P455
44	Size 1 to Size 4 **VI 24V** supply voltage **input**	18…30V at least 800mA (input)	Voltage supply for the FI control unit. Is essential for the function of the frequency inverter.	
	Size 5 and above **VO 24V** supply voltage **output**	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. The 24V control voltage is generated by the FI, however it can also be supplied via the terminals X12:44/40. Supply via terminal X7:44 is not possible.	
40	Reference potential for digital signals	0V digital		

Terminal block X8 – Safe pulse lock (not with 115V devices)

Relevance	SK 500E	SK 505E	**SK 510E**	**SK 511E**	SK 515E	SK 520E	**SK 530E**	SK 535E
			√	√			√	

Terminal X8:	**86**	**87**	**88**	**89**
Name	VO_S 15V	VO_S 0V	VI_S 0V	VI_S 24V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
86	Supply voltage	Details: BU0530!	When setting-up without using a safety function, wire directly to V_IS 24V.	P420 et seq.
87	Reference potential			
88	Reference potential	Details: BU0530!	Fail-safe input	
89	Input 'safe pulse block'			

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	**SK 515E**	SK 520E	SK 530E	**SK 535E**
					√			√

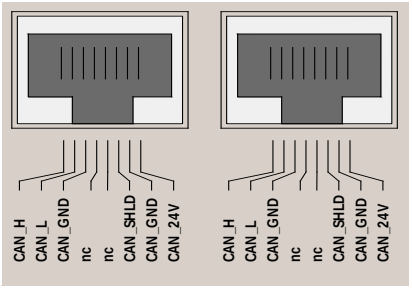
Terminal X8:	**86**	**87**	**88**	**89**
Name	VO_S 24V	VO_S 0V	VI_S 0V	VI_S 24V

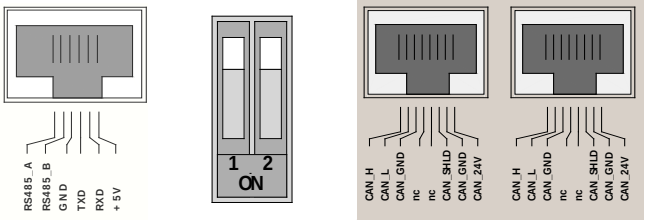
Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
86	Supply voltage	Details: BU0530!	When setting-up without using a safety function, wire directly to V_IS 24V.	P420 et seq.
87	Reference potential			
88	Reference potential	Details: BU0530!	Fail-safe input	
89	Input 'safe pulse block'			

Control block X9 and X10 – CAN / CANopen

Relevance	SK 500E	SK 505E	SK 510E	**SK 511E**	**SK 515E**	**SK 520E**	**SK 530E**	**SK 535E**
				√	√	√	√	√

Terminals X9: / X10:	1	2	3	4	5	6	7	8
Name	CAN_H	CAN_L	CAN_GND	nc	nc	CAN_SHD	CAN_GND	CAN_24V

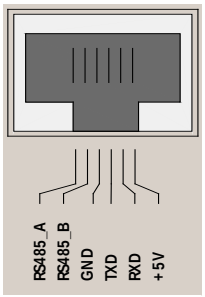
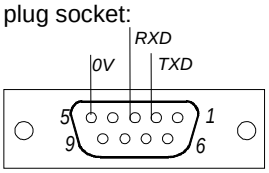
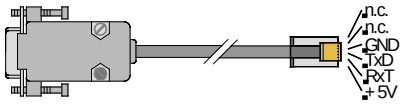
Contact	Function [factory setting]	Data	Description / wiring suggestion	Parameter
1	CAN/CANopen signal	Baud rate …500kBaud RJ45 sockets are connected in parallel internally. Terminal resistance R=120W DIP 2 (see below) **NOTE:** To operate CANbus/CANopen the interface must be externally supplied with 24V (capacity at least 30 mA).	**X10** **X9**  2x RJ45: Pin No. 1 … 8 **NOTE:** For frequency inverters **SK 530E** and above, this CANopen interface can be used for the evaluation of an absolute encoder. Further details can be found in manual BU 0510. **Recommendation:** Provide strain relief (e.g. with EMC Kit)	P503 P509
2				
3	CAN GND			
4	No function			
5				
6	Cable shield			
7	GND/0V			
8	External 24VDC voltage supply			

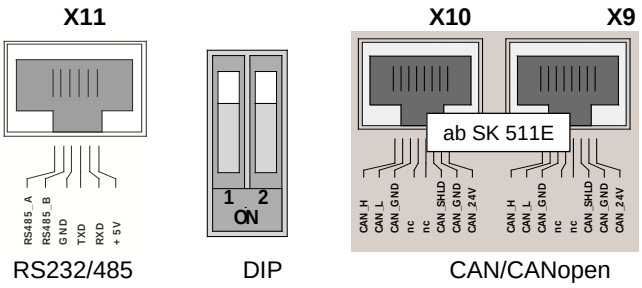
DIP switch 1/2 (top side of frequency inverter)		
DIP-1	Termination resistor for RS485 interface (RJ12); ON = switched in [Default = "OFF"] For RS232 communication DIP1 to "**OFF**"	**X11** **X10** **X9**  RS232/485 DIP CAN/CANopen
DIP 2	Terminal resistor for CAN/CANopen interface (RJ12); ON = switched in [Default = "OFF"]	

Plug connector block X11 – RS485 / RS232

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	SK 535E
	√	√	√	√	√	√	√	√

Terminals X11:	1	2	3	4	5	6
Name	RS485 A +	RS485 A-	GND	232 TXD	232 RXD	+5V

Contact	Function [factory setting]	Data	Description / wiring suggestion	Parameter
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 **is possible via RS232**, in order to prevent damage to this interface.				
1 2	Data cable RS485	Baud rate 9600…38400Baud Terminal resistance R=120W DIP 1 (see below)	 RJ12: Pin No. 1 … 6	P503 P509
3	Reference potential for bus signals (must always be wired!)	0V digital		
4 5	Data cable RS232	Baud rate 9600…38400Baud		
6	Internal 5V supply voltage	5V ± 20%		
optional	Adapter cable RJ12 to SUB-D9 for RS232 communication for direct connection to a PC with NORD CON	Length 3m Assignment of the SUB-D9 plug socket: 	 Part No. 278910240	
DIP switch 1/2 (top side of frequency inverter)				
DIP-1	Termination resistor for RS485 interface (RJ12); ON = switched in [Default = "OFF"] For RS232 communication DIP1 to "**OFF**"			
DIP 2	Terminal resistor for CAN/CANopen interface (RJ12); ON = switched in [Default = "OFF"]			



RS232/485 DIP CAN/CANopen

Terminal block X12 – 24 VDC input (only size 5 … 7)

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	**SK 515E**	SK 520E	SK 530E	**SK 535E**
					√			√

Terminals X12:	**40**	**44**
Name	GND	VI 24V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
44	Voltage supply **input**	24V … 30V min. 1000mA	Voltage supply for the FI control unit. Is essential for the function of the frequency inverter.	
40	Reference potential for digital signals	GND/0V	Reference potential	

Terminal block X13 – motor PTC (only size 5 … 7)

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	**SK 515E**	SK 520E	SK 530E	**SK 535E**
					√			√

Terminals X13:	**T1**	**T2**
Name	T1	T1

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
T1	Thermistor input +	EN 60947-8 On: >3.6 kΩ Off: < 1.65 kΩ Measurement voltage 5 V at R < 4 kΩ	The function cannot be switched off, set a jumper if no PTC is present.	
T2	Thermistor input -			

Terminal block X15 – motor PTC and 24V input (above size 8)

Relevance	SK 500E	SK 505E	SK 510E	SK 511E	**SK 515E**	SK 520E	SK 530E	**SK 535E**
					√			√

Terminals X15:	**38**	**39**	**44**	**40**
Name	T1	T2	VI 24V	GND

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
38	Thermistor input +	EN 60947-8 On: >3.6 kΩ Off: < 1.65 kΩ Measurement voltage 5 V at R < 4 kΩ	The function cannot be switched off, set a jumper if no PTC is present.	
39	Thermistor input -			
44	Voltage supply **input**	24V … 30V min. 3000mA	Voltage supply for the FI control unit. Is essential for the function of the frequency inverter.	
40	Reference potential for digital signals	GND/0V	Reference potential	

2.11 Colour and contact assignments for encoders

The incremental encoder connection is an input for a type with two tracks and TTL-compatible signals for EIA RS 422-compliant drivers. The maximum current consumption of incremental encoders must not exceed 150 mA.

The pulse number per rotation can be between 500 and 8192 increments. This is set with the normal scaling via parameter P301 "Incremental encoder pulse number" in the menu group "Control parameters". For cable lengths > 20 m and motor speeds above 1500 rpm the encoder should not have more than 2048 pulses/revolution.

For longer cable lengths the cable cross-section must be selected large enough so that the voltage drop in the cable is not too great. This particularly affects the supply cable, in which the cross-section can be increased by connecting several conductors in parallel.

Unlike incremental encoders, for sine encoders or SIN/COS encoders the signals are not in the form of pulses, but rather in the form of sine signals (shifted by 90°).

Note — **Encoder counting direction**

The counting direction 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.

Note — **Rotary encoder function test**

The voltage difference between tracks A and B can be measured with the aid of parameter P709 [-09] and [-10]. If the incremental encoder is rotated, the value of both tracks must jump between -0.8V and 0.8V. If the voltage only jumps between 0 and 0.8V the relevant rack is faulty. The position can no longer be determined via the incremental encoder. We recommend replacement of the encoder!

Incremental encoder

According to the resolution (pulse number), incremental encoders generate a defined number of pulses for each rotation of the encoder shaft (Track A / Track A inverse) With this, the precise speed of the encoder or motor can be measured by the frequency inverter. By the use of a second track (B / B inverse) shifted by 90° (¼ period), the direction of rotation can also be determined.

The supply voltage for the encoder is 10-30V. The voltage source can be an external source or the internal voltage (according to the frequency inverter version: 12V /15V /24V).

Function	Cable colours, for incremental encoder	Connections for SK 53xE Terminal block X5 or X6
10-30V supply	brown / green	**42(/44 /49)** 15V (/24V /12V)
0V supply	white / green	**40** GND/0V
Track A	brown	**51** ENC A+
Track A inverse	green	**52** ENC A-
Track B	grey	**53** ENC B+
Track B inverse	pink	**54** ENC B-
Cable shield	connected to a large area of the frequency inverter housing or shielding angle	

Table 21: Colour and contact assignments for NORD TTL incremental encoders

Note — **Incremental encoder data sheet**

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.

2.12 RJ45 WAGO- Connection module

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

Pre-assembled RJ45 patch cables are connected to the spring-loaded terminals (1-8 + S) with this adapter.

Contact	1	2	3	4	5	6	7	8	S
Meaning	CAN_H	CAN_L	CAN_GND	nc.	nc.	CAN_SHD	CAN_GND	CAN_24V	Shield

The shield clamp should be used in order to ensure the correct connection and relief of tension on the shield.

Supplier	Name	Article number
WAGO Kontakttechnik GmbH	Ethernet connection module with CAGE CLAMP connection RJ45 transfer module	289-175
WAGO Kontakttechnik GmbH	Accessories: WAGO shield clamp	790-108
Alternative, complete connection module and shield clamp		**Part No.**
Getriebebau NORD GmbH & Co.KG	Adapter module RJ45/terminal	278910300

Table 22: RJ45 WAGO connection module

2.13 Setpoint card ± 10V

The analog inputs of series SK 500E frequency inverters size 1 to 4 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	Name	Article number
Getriebebau NORD GmbH & Co.KG	Setpoint converter ±10V → 0 … 10V	278910320

Table 23: Setpoint card ± 10V

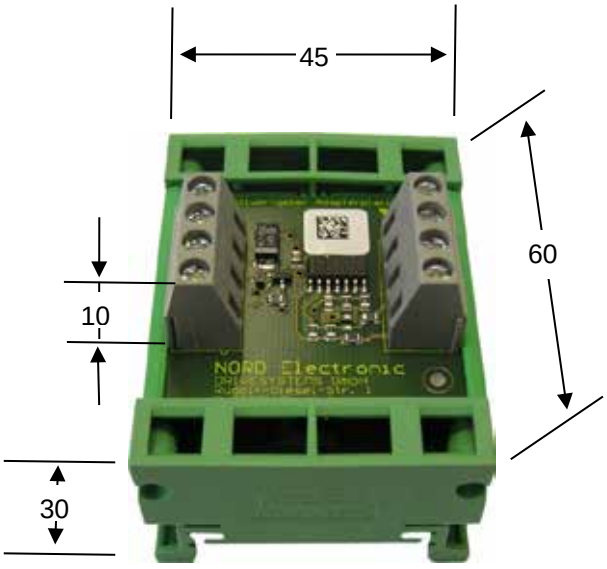


Fig. 8: Dimensions of setpoint card± 10V

3. Displays and control

As delivered, without the technology unit, 2 LEDs (green/red) are visible externally. These indicate the actual device status.

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 fault (Section **Fehler! Verweisquelle konnte nicht gefunden werden.**).

3.1 Modular assemblies SK 5xxE

By the use of various modules for display, control and parameterisation, the SK 5xxE can be easily adapted to a wide range of requirements.

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

The **Technology Unit (Technology Unit, SK TU1-...)** is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

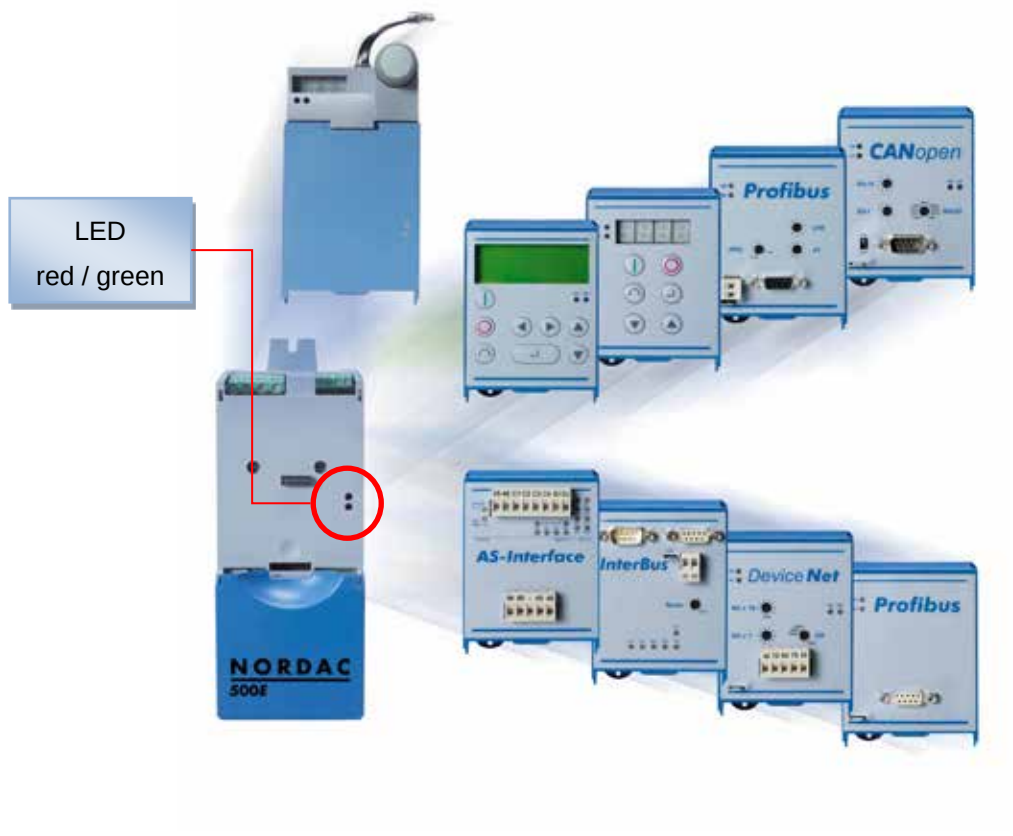


Fig. 9: Modular assemblies SK 5xxE

3.2 Overview of technology units

Detailed information about the options listed below can be found in the relevant documentation.

Control boxes

Module	Name	Description	Data	Part No.	Document
SK CSX-0	SimpleBox	Commissioning, parameterisation and control of the frequency inverter	7-segment, 4-digit LED display, single button control	275900095	BU 0500
SK TU3-CTR	ControlBox	As for SK CSX-0 + saving of the parameters of an inverter	7-segment, 4-digit LED display, keyboard	275900090	BU 0040
SK TU3-PAR	ParameterBox	As for SK CSX-0 + saving of parameters from up to 5 inverters	4-line LCD display (illuminated), keyboard	275900100	BU 0040
SK TU3-POT	PotentiometerBox	Direct contol of the FI	ON, OFF, R/L, 0…100%	275900110	BU 0500

Table 24: Overview of Technology Units and Control Boxes

Interfaces

Module	Interface	Data	Part No.	Document
Normal field bus protocols				
SK TU3-AS-1	AS Interface	4 sensors / 2 actuators 5/8 pin screw terminals	275900170	BU 0090
SK TU3-CAO	CANopen	Baud rate 1 Mbit/s Connector: Sub-D9	275900075	BU 0060
SK TU3-DEV	DeviceNet	Baud rate: 500 KBit/s 5-pole screw terminal	275900085	BU 0080
SK TU3-IBS	InterBus	Baud rate: 500 kBit/s (2Mbit/s) Connector: 2 x Sub-D9	275900065	BU 0070
SK TU3-PBR	Profibus DP	Baud rate: 1.5 MBaud Connector: Sub-D9	275900030	BU 0020
SK TU3-PBR-24V	Profibus DP	Baud rate: 12 MBaud Connector: Sub-D9 24V DC connection via terminal	275900160	BU 0020
Ethernet-based Bus systems				
SK TU3-ECT	EtherCAT	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900180	BU 0570
SK TU3-PNT	PROFINET IO	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900190	BU 0590
SK TU3-POL	POWERLINK	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900140	BU 0580

Table 25: Overview of Technology Units and Bus Systems

Note — **USS Bus modules and Modbus RTU**

No optional modules are required for communication via USS or Modbus RTU.

The USS protocol is integrated into all SK 5xxE series devices. An interface is available via terminal X11, or if present, also via X7:73/74.

Modbus RTU is only available with version SK 54xE or higher. For this, the same interfaces as for USS apply.

A detailed description of both of these protocols can be found in Manual BU 0050.

Other optional modules

Module	Interface	Data	Part No.	Document
SK EBGR-1	Electronic brake rectifier	Extension for direct control of an electro-mechanical brake, IP20, snap-on rail mounting	19140990	TI 19140990
SK EBIOE-2	IO extension	Extension with 4 DIN, 2 AIN, 2 DOUT and 1 AOUT, IP20, snap-on rail mounting, SK 54xE and higher	275900210	TI 275900210

Table 26: Overview of technology units, other optional modules

Installing

Note — **Installing the technology unit**

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

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

The technology units must be **installed** as follows:

1. Switch off the mains voltage, observe the waiting period.
2. Push the control terminals cover down slightly or remove.
3. Remove the **blank cover**, by loosening the release on the lower edge and pulling off with an upward turning movement. If necessary, the attachment screw next to the release must be removed.

4. Hook the **technology unit** onto the upper edge slots and press in lightly until it engages. Ensure full contact with the connector strip and fasten with the screws if necessary (separate packet).
5. Close the control terminal cover again.

3.3 SimpleBox, SK CSX-0

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

Fig. 10 SimpleBox SK CSX-0

Features

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

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.

NOTICE **Parallel operation of control elements**

The SimpleBox *SK CSX 0* must **not** be used in combination with the *SK TU3-POT, SK TU3-CTR, SK TU3-PAR, the handheld control units SK …- 3H* or their *built-in versions SK …-3E* or the *Remote control window of the NORD CON software*. As all of these elements use the same communication channel, this may cause communication errors.

Assembly

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.

The Bus termination resistor for the RS485 interface must be set with DIP switch 1 (left).

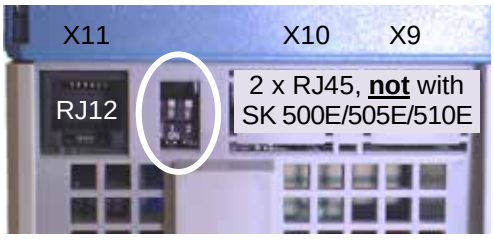


Fig. 11 Top side of FI with RJ12 / RJ45 connection

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  	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. 
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.

Table 27: SimpleBox SK CSX-0, functions

Control with the SimpleBox

If P549=1 is set and the operating value display P000 is selected, the drive can be controlled with the SimpleBox 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.

Note — **Stopping the drive**

In this operating mode, the drive can only be stopped with the button in the operating value display (short press) or by switching off the mains voltage.

Menu structure with the SimpleBox

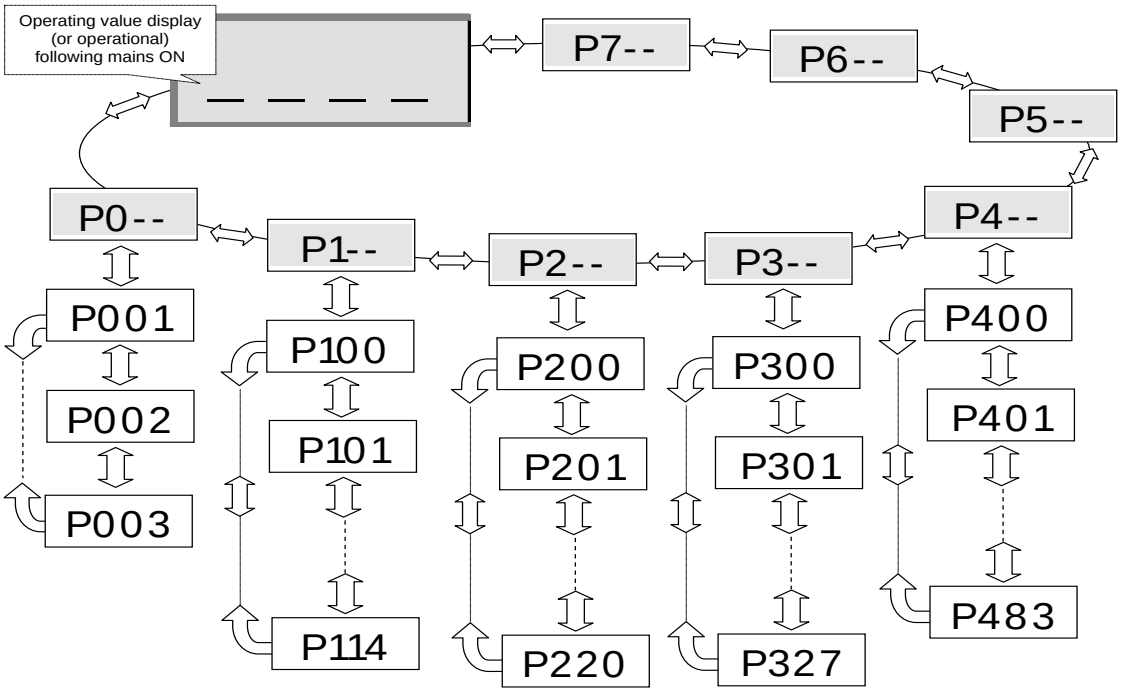
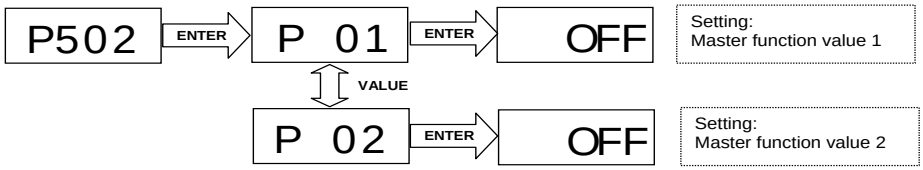


Fig. 12: SimpleBox, SK CSX-0 menu structure

NOTE: Some parameters, e.g. 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.:



4. Commissioning

Once the power supply has been connected to the frequency inverter, it will be operational within 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.

DANGER **Danger to life!**

The frequency inverter is not equipped with a line main 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 IE1 three-phase 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 data for IE1 motors can be pre-set with 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.

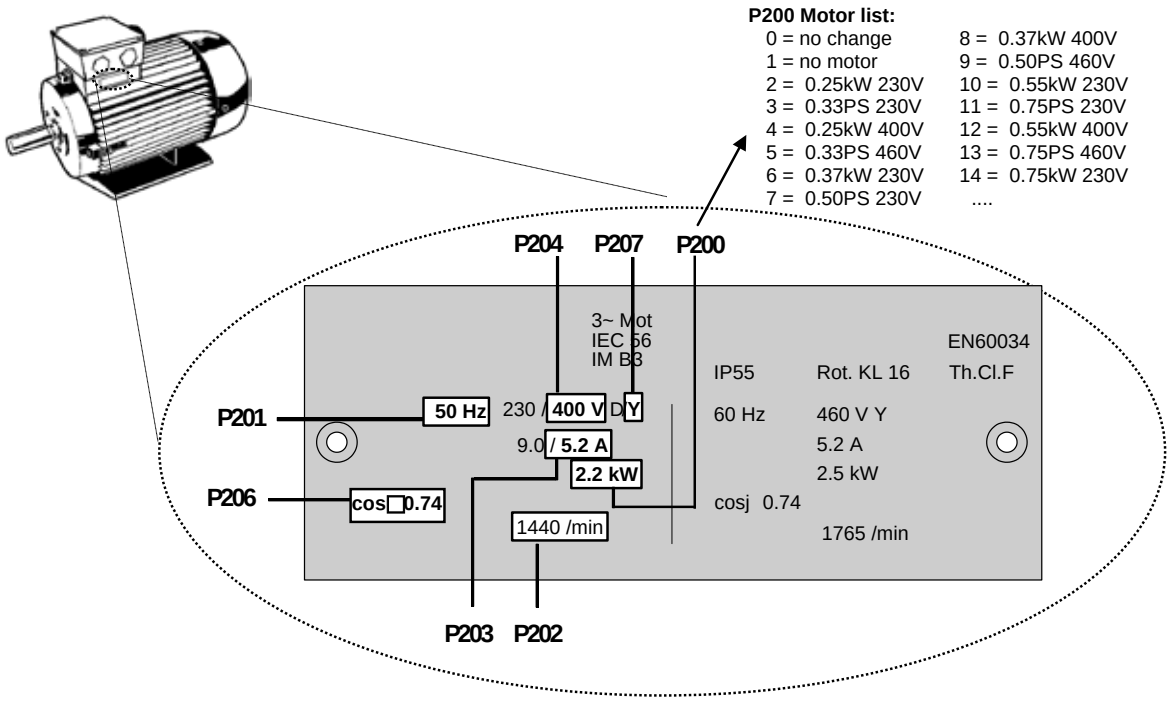


Fig. 13 Motor type plate

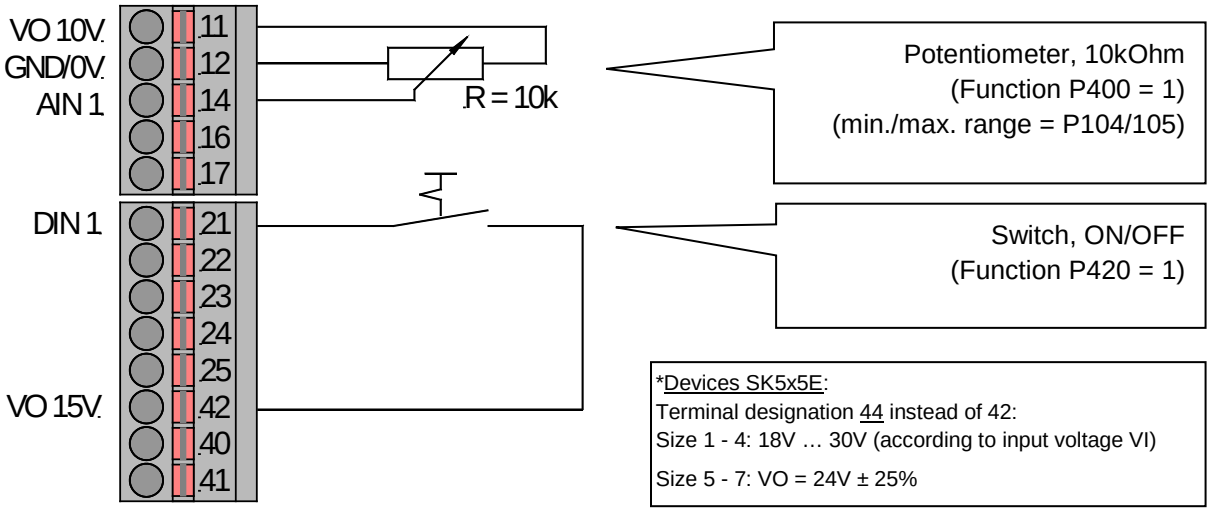
RECOMMENDATION: For the correct operation of the drive unit, it is necessary to input the motor data (rating plate) as precisely as possible. In particular, an automatic stator resistance measurement using parameter P220 is recommended.

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

4.2 Minimal configuration of control connections

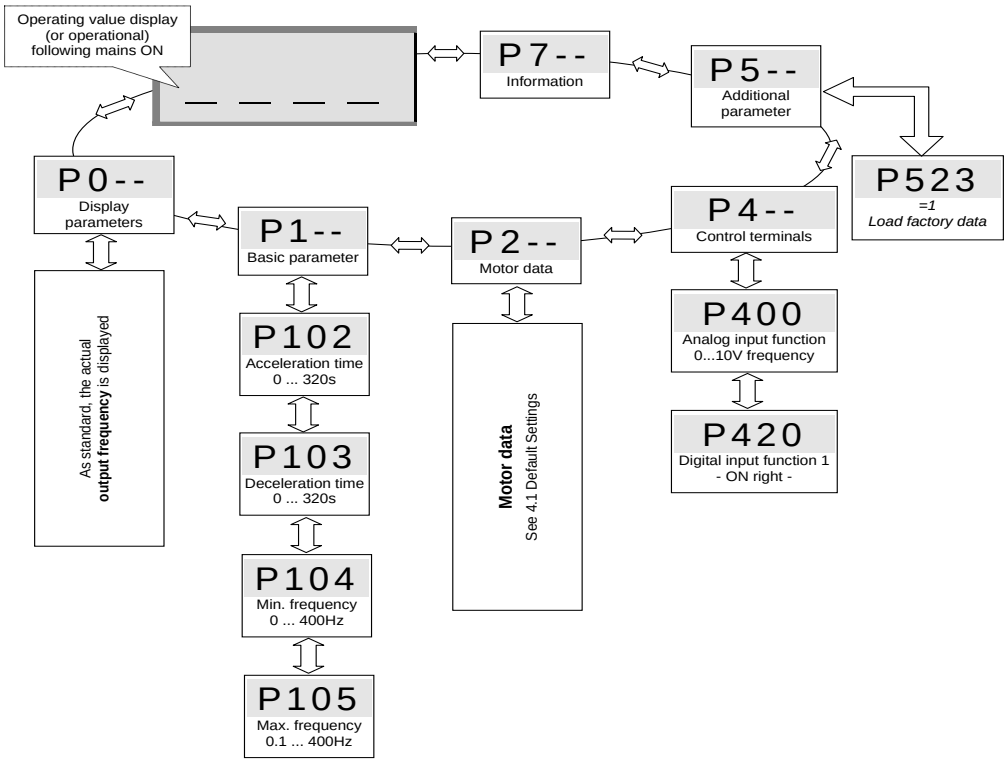
If the frequency inverter is to be controlled via the digital and analog inputs, this can be implemented immediately in the condition as delivered. Settings are not necessary for the moment.

Minimum connections



Basic parameters

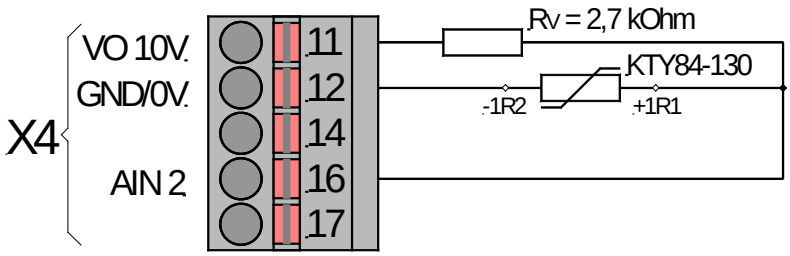
If the current setting of the frequency inverter is not known, loading the default setting is recommended à P523 = 1. The inverter is pre-programmed for standard applications in this configuration. If necessary, the following parameters can be adjusted with the optional SimpleBox SK CSX-0 or ControlBox TU3-CTR.



4.3 KTY84-130 connection (above software version 1.7)

The current vector control of the SK 500E series can be further optimised by the use of a KTY84-130 temperature sensor ($R_{th(0°C)}$=500W, $R_{th(100°C)}$=1000W). 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 optimum speed precision.

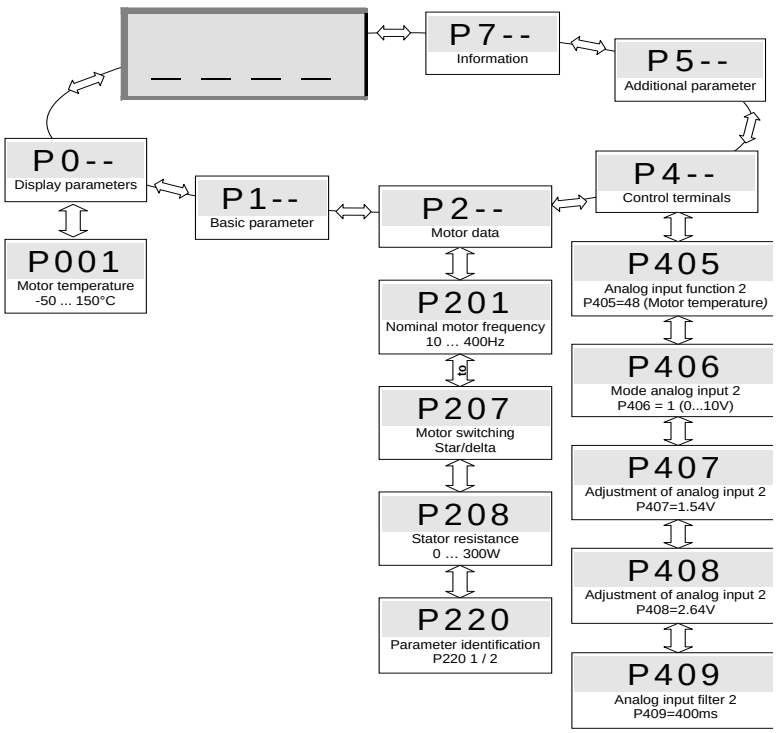
Connections (Example SK 500E, analog input 2)



Parameter settings (ExampleSK 500E, analog input 2)

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

1. Set the motor data **P201-P207** according to the type plate
2. Determine the motor stator resistance P208 at 20°C with **P220=1**.
3. Analog input 2 function, **P405=48** (Motor temperature)
4. Analog input 2 mode 2, **P406=1** (taking negative temperatures into account)
5. Matching of analog input 2: **P407= 1.54 V** and **P408= 2.64 V** (with R_V= 2.7 kΩ)
6. Adjust time constants: **P409=400ms** (Maximum value of filter time constant)
7. Motor temperature control: P001=23 (Temperature display, operation display SK TU3-CTR / SK CSX-0)



Note — **Temperature ranges**

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.

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. Parameters

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.

NOTICE — **Operating faults**

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 into various groups. 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 behaviour and, along with the motor data, and 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.
Speed control (SK 520E or higher)	(P3--)	Settings for the control parameters (current controller, speed controller, etc.) with speed feedback.
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 (SK 52xE and higher)	(P6--)	Setting of the positioning function. Details: please refer to BU 0510.
Information	(P7--)	Display of e.g. actual operating values, old error messages, equipment status reports or software version.
Array parameters	-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**

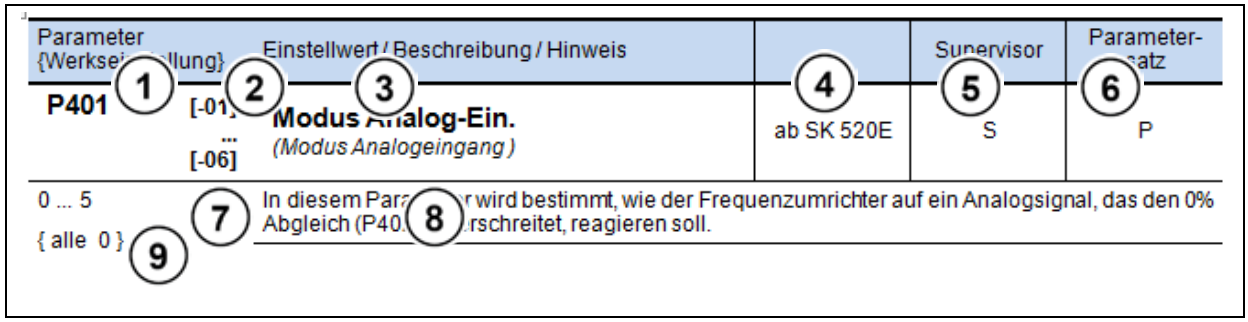
Parameter P523 can be used to load the factory settings for all parameters at any time. This can be helpful, e.g. during the commissioning of a frequency inverter whose parameters no longer correspond with the factory settings.

All actual parameter settings will be overwritten, 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 parameters

Due to certain configurations, the parameters are subject to certain conditions. The following tables list all parameters together with the particular information.



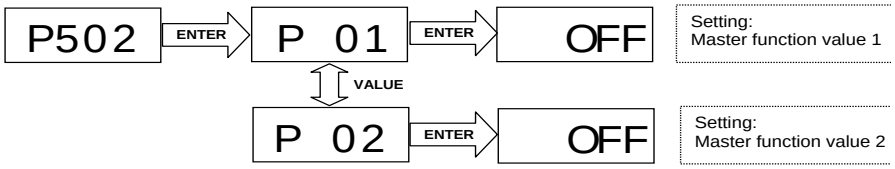
1 Parameter number
2 Array values
3 Parameter text; Top: P-Box display, bottom: Meaning
4 Special features (e.g.: only available for SK 520E and above)
5 Supervisor parameters (S) are dependent on the settings in P003
6 Parameter set dependent (P) parameter selections in P100
7 Parameter value range
8 Description of the parameter
9 Default values (factory settings) of the parameter

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.

For parameterisation with ControlBox SK TU3-CTR:



Operating displays

Abbreviations used:

- **FI** = Frequency inverter
- **SW** = Software version, stored in P707.
- **S = Supervisor parameters** are visible or hidden depending on P003.

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set
P000	**Operating display** *(Operating parameter display)*			
0.01 ... 9999	In ParameterBoxes with 7-segment displays (e.g. SimpleBox) the operating value which is selected in P001 is displayed *online*. Important information about the operating status of the drive can be read out as required.			
P001	**Selection of disp.value** *(Selection of display value)*			
0 ... 65 { 0 }	Selection of the operating display of a ParameterBox with 7-segment display (e.g.: SimpleBox)			

0 =	**Actual frequency [Hz]:**	Actually supplied output frequency
1 =	**Speed [rpm]**	Calculated actual speed
2 =	**Setpoint frequency [Hz]:**	Output frequency equivalent to the actual setpoint. This need not match the actual output frequency.
3 =	**Current [A]**	Actual, measured output current
4 =	**Torque current [A]:**	Output current which causes torque
5 =	**Voltage [V AC]:**	The Actual AC voltage delivered to the output of the FI
6 =	**DC link voltage [V DC]**	The "*Link voltage*" is the internal DC voltage of the FI. Amongst other things, this depends on the level of the mains voltage.
7 =	**cos phi**	Actual calculated value of the power factor
8 =	**Apparent power [kVA]**	Actual calculated apparent power
9 =	**Effective power [kW]**	Actual calculated effective power
10 =	**Torque [%]**	Actual calculated torque
11 =	**Field [%]**	Actual calculated field in the motor
12 =	**Hours of operation [h]:**	Time for which the FI has been connected to mains voltage
13 =	**Operating time enable [h]**	"*Operating time enable*" is the time for which the FI was enabled.
14 =	**Analog input 1 [%]:**	actual value present at analog input 1 of the FI.
15 =	**Analog input 2 [%]:**	actual value present at analog input 2 of the FI.
16 =	**… 18**	*reserved for Posicon*
19 =	**Heat sink temperature [°C]:**	actual temperature of the FI heat sink.
20 =	**Actual utilisation of motor [%]**	average motor load, based on the known motor data (P201...P209).
21 =	**Actual utilisation of brake resistor [%]**	"*Utilisation of brake resistor*" is the average braking resistor load, based on the known resistance data (P556...P557).
22 =	**Internal temperature [°C]**	Actual internal temperature of the FI *(SK 54xE / SK 2xxE)*
23 =	**Motor temperature**	Measured via KTY-84
24 =	**… 29**	*reserved for Posicon*
30 =	**Actual Setpoint MP-S [Hz]**	"*Actual setpoint of motor parameter function with saving*": (P420…=71/72). The nominal value can be read out with this function or pre-set (without the drive running).
31 =	**… 59**	*reserved for POSICON or PLC*
60 =	**R stator ident:**	the stator resistance determined by measurement (P220)
61 =	**R rotor ident:**	the rotor resistance determined by measurement ((P220) Function 2)
62 =	**L stray stator ident**:	the stray inductance determined by measurement ((P220) Function 2)
63 =	**L stator ident:**	the inductance determined by measurement ((P220) Function 2)
65 =		*Reserved*

P002	Display factor *(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 *(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 and P003) is visible. **3 =** ... ... 9999, as for setting value 2.			

Basic parameters

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set

P100	Parameter set *(Parameter set)*		S	
0 ... 3 { 0 }	Selection of the parameters sets to be parameterised. 4 parameter 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 inputfunction [8]	Digital inputfunction [17]	LEDs olBox
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 (SimpleBox, ControlBox, PotentiometerBox or ParameterBox), the operating parameter set will match the settings in P100.

P101	Copy parameter set *(Copy parameter set)*		S	

0 ... 4
{ 0 }

After confirmation with the OK / 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 = Copy actual to P1**: Copies the active parameter set to parameter set 1
- **2 = Copy actual to P2**: Copies the active parameter set to parameter set 2
- **3 = Copy actual to P3**: Copies the active parameter set to parameter set 3
- **4 = Copy actual to P4**: Copies the active parameter set to parameter set 4

P102	Acceleration time *(Acceleration time)*			P

0 ... 320.00 sec
{ 2.00 }
{ 5.00 } above size 8

The 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.

NOTE:

Care must be taken that the parameter values are realistic. A setting of P102 = 0 is not permissible for drive units!

Information on ramp gradient:

Ultimately, the moment of inertia of the rotor determines the possible ramp gradient.

If the ramp is too steep, the motor may "break down".

Extremely steep ramps (e.g.: 0 - 50Hz in < 0.1 s) should generally be avoided, as these may cause damage to the frequency inverter.

P103	Braking time *(Deceleration time)*			P

0 ... 320.00 sec
{ 2.00 }
{ 5.00 } above size 8

The braking time is the time corresponding to the linear frequency reduction from the set maximum frequency (P105) to 0Hz (P105). If an actual setpoint <100% is being used, the deceleration time reduces accordingly.

The braking time can be extended by certain circumstances, e.g. by the selected >Switch-off mode< (P108) or >Ramp smoothing< (P106).

NOTE:

Care must be taken that the parameter values are realistic. A setting of P103 = 0 is not permissible for drive units!

For information about ramp gradients: please refer to parameter (P102)

P104	**Minimum frequency** *(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 reverses. 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** *(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** *(Ramp smoothing)*			P

0 ... 100 %
{ 0 }

This parameter enables a smoothing of the acceleration and deceleration ramps. This is necessary for applications where gentle, but dynamic speed change is important.

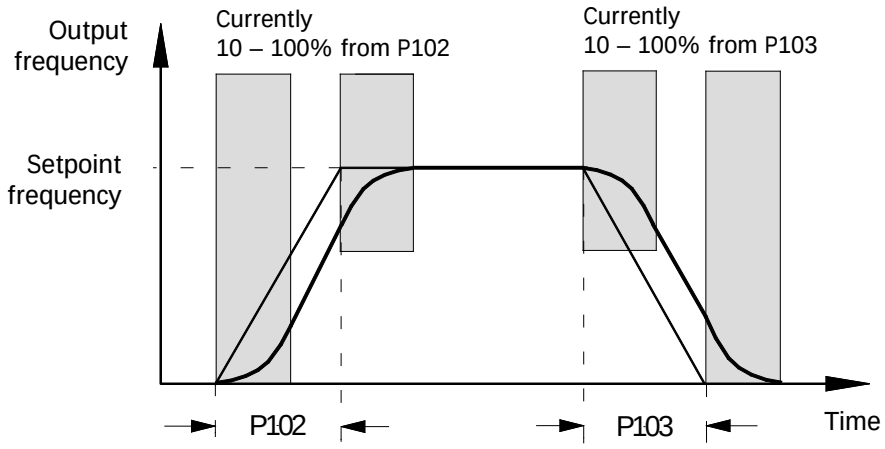
Ramp smoothing is carried out for every setpoint change.

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:

$$t_{tot\ \text{ACCELERATION TIME}} = t_{P102} + t_{P102} \times \frac{P106\,[\%]}{100\%}$$

$$t_{tot\ \text{DECELERATION TIME}} = t_{P103} + t_{P103} \times \frac{P106\,[\%]}{100\%}$$



P107	**Brake reaction time** *(Brake reaction time)*			P

0 ... 2.50 s
{ 0.00 }

Electromagnetic brakes have a physically-dependent delayed reaction time when actuated. 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 with parameter P107 (Brake control).

Within the adjustable reaction 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 magnetising 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.

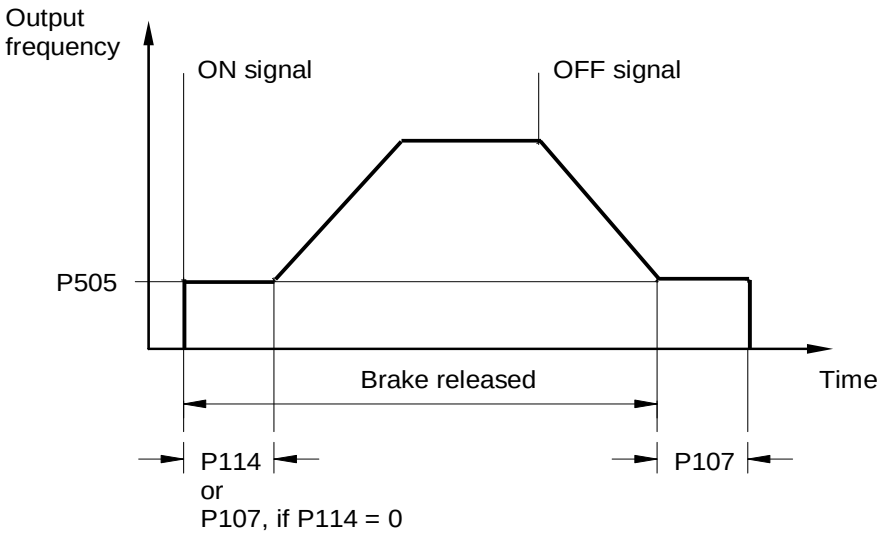
Recommendation for applications:
Lifting equipment with brake, without speed feedback

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 = 150%
P539 = 2/3 (I_{SD} monitoring)

to prevent load drops
P214 = 50...100% (precontrol)

* Setting values (P107/114) depending on the brake type and the size of the motor. For lower powers (< 1.5 kW) the values also tend to be lower. For larger powers (>4.0 kW) the values tend to be larger than those stated.



P108	**Disconnection mode** *(Disconnection mode)*		S	P

0 ... 13
{ 1 }

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

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

1 = **Ramp down:** The current output frequency is reduced in proportion to the remaining deceleration time, from P103/P105. The DC run-on follows the end of the ramp (if programmed in P559).

2 = **Delayed ramping:** as for 1 **"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 = **Instant 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. frequency (P105), the >Time DC brake on< 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 = **Const. brake distance,** *"Constant brake 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 = **Combi. braking,** *"Combined braking"*: Dependent on the actual link voltage (UZW), a high frequency voltage is switched to the basic frequency (only for linear characteristic curves, P211 = 0 and P212 = 0). The deceleration time is retained where possible (P103). à additional motor warming!

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

7 = **Quad. ramp with delay,** *"Quadratic ramp with delay"*: Combination of functions 2 and 6.

8 = **Quad. ramp w. braking,** *"Quadratic combined braking"*: Combination of functions 5 and 6.

9 = **Constant accn.,** *"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 actual frequency / speed and the set minimum output frequency (P104).

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

12 = **Const. accn. mode 3,** *"Constant acceleration power mode 3"*: as for 11, however with additional chopper relief.

13 = **Switch off delay,** *"Ramp with switch-off delay"*:As for 1 "**Ramp**", however, before the brake is applied, the drive unit remains at the absolute minimum frequency set in parameter (P505) for the time specified in parameter (P110).
Application example: Re-positioning for crane control.

P109	DC brake current *(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 **0**, column: 0Hz. In the basic setting this limiting value is about 110%.

P110	DC braking time on *(DC braking time on)*		S	P

0.00 ... 60.00 sec
{ 2.00 }

The time during which the motor has the current selected in parameter P108 "DC brake current" applied to it during the DC braking functions (P108 = 3).

Depending on the ratio of the actual output frequency to the max. frequency (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 *(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 *(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 blockages (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 current torque cannot be undershot by a smaller analog setpoint (P400/405 = 2). However, in **servo mode** with P300 = 1:

- up to SW version 1.9: not less than 10%
- SW version 2.0 and above: no restriction (motor torques from 0% are possible)!

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 *(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.

NOTE: **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.

P114	Brake delay off *(Brake release time)*		S	P

0 ... 2.50 s

{ 0.00 }

Electromagnetic brakes have a delayed reaction time during ventilation, 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 (Brake control).

During the adjustable ventilation 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 ventilation and reaction time.

Motor data / Characteristic curve parameters

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set

P200	Motor list *(Motor list)*			P

0 ... 73

{ 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 IE-1 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 j =0.90 / Star / R_S 0.01W / I_{LEER} 6.5A

2 = 0.25kW 230V	**20 =** 1.1 kW 400V	**38 =** 5.5 kW 400V	**56 =** 45.0 kW 400V
3 = 0.33 Hp 230V	**21 =** 1.5 Hp 460V	**39 =** 7.5 PS 460V	**57 =** 60.0 PS 460V
4 = 0.25kW 400V	**22 =** 1.5 Hp 230V	**40 =** 7.5 kW 230V	**58 =** 55.0 kW 400V
5 = 0.33 Hp 460V	**23 =** 2.0 Hp 230V	**41 =** 10.0 PS 230V	**59 =** 75.0 PS 460V
6 = 0.37kW 230V	**24 =** 1.5 Hp 400V	**42 =** 7.5 kW 400V	**60 =** 75.0 kW 400V
7 = 0.50 Hp 230V	**25 =** 2.0 Hp 460V	**43 =** 10.0 PS 460V	**61 =** 100.0 PS 460V
8 = 0.37kW 400V	**26 =** 2.2 kW 230V	**44 =** 11.0 kW 400V	**62 =** 90.0 kW 400V
9 = 0.50 Hp 460V	**27 =** 3.0 Hp 230V	**45 =** 15.0 PS 460V	**63 =** 120.0 PS 460V
10 = 0.55kW 230V	**28 =** 2.2 kW 400V	**46 =** 15.0 kW 400V	**64 =** 110.0 kW 400V
11 = 0.75 Hp 230V	**29 =** 3.0 Hp 460V	**47 =** 20.0 PS 460V	**65 =** 150.0 PS 460V
12 = 0.55kW 400V	**30 =** 3.0 Hp 230V	**48 =** 18.5 kW 400V	**66 =** 132.0 kW 400V
13 = 0.75 Hp 460V	**31 =** 3.0 Hp 400V	**49 =** 25.0 PS 460V	**67 =** 180.0 PS 460V
14 = 0.75 Hp 230V	**32 =** 4.0 kW 230V	**50 =** 22.0 kW 400V	**68 =** 160.0 kW 400V
15 = 1.0 Hp 230V	**33 =** 5.0 PS 230V	**51 =** 30.0 PS 460V	**69 =** 220.0 PS 460V
16 = 0.75 Hp 400V	**34 =** 4.0 kW 400V	**52 =** 30.0 kW 400V	**70 =** 200.0 kW 400V
17 = 1.0 Hp 460V	**35 =** 5.0 PS 460V	**53 =** 40.0 PS 460V	**71 =** 270.0 PS 460V
18 = 1.1 kW 230V	**36 =** 5.5 kW 230V	**54 =** 37.0 kW 400V	**72 =** 250.0 kW 400V
19 = 1.5 Hp 230V	**37 =** 7.5 PS 230V	**55 =** 50.0 PS 460V	**73 =** 340.0 PS 460V

NOTE:

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

Information **IE2 motors**

For the use of IE2 motors, after the selection of an IE1 motor (P200) the motor data in P201 ... P209 must be adapted to the data on the motor type plate.

P201	**Nominal motor frequency** *(Nominal motor frequency)*		**S**	**P**
10.0 ... 399.9 Hz {***}	The motor nominal frequency determines the V/f break point at which the FI supplies the nominal voltage (P204) at the output.			

P202	**Nominal speed** *(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).			

P203	**Nominal current** *(Nominal motor current)*		**S**	**P**
0.1 ... 1000.0 A {***}	The nominal motor current is a decisive parameter for the current vector control.			

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

P204	Nominal voltage *(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 power *(Nominal motor power output)*			P
0.00 ... 250.00 kW {***}	The motor nominal power controls the motor set via P200.			

P206	Cos phi *(Motor cos j)*		S	P
0.50 ... 0.90 {***}	The motor cos j is a decisive parameter for the current vector control.			

P207	Star Delta con. *(Star Delta connection)*		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 *(Stator resistance)*		S	P
0.00 ... 300.00 W {***}	Motor stator resistance Þ resistance 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 *(No load current)*		S	P
0.1 ... 1000.0 A {***}	This value is always calculated automatically from the motor data if there is a change in the parameter >cos j < P206 and the parameter >Nominal current< P203. **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.			

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

P210	Static boost *(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.			

P211	Dynamic boost *(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 *(Slip compensation)*		S	P
0 ... 150 % { 100 }	The slip compensation increases the output frequency, dependent on load, to keep the 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 ctrl. loop gain *(Amplification of ISD control)*		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 *(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 right) are entered with a positive sign, generator torques are entered with a negative sign. The reverse applies for the counter clockwise rotation.			

P215	Boost precontrol *(Boost precontrol)*		S	P
0 ... 200 % { 0 }	Only advisable 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. **NOTE:** With active ISD control (P211 and / or P212 ≠ 0%), parameterisation of P215 ≠ 0 results in incorrect control.			

P216	Time boost prectrl. *(Time boost precontrol)*		S	P
0.0 ... 10.0 sec { 0 }	Only advisable with linear characteristic curve (P211 = 0% and P212 = 0%). Application time for increased starting current. **NOTE:** With active ISD control (P211 and / or P212 ≠ 0%), parameterisation of P216 ≠ 0 results in incorrect control.			

P217	Oscillation damping *(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 *(Modulation depth)*		S	
50 ... 110 % { 100 } *SW 1.5 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	Auto. magn. adjustment *(Automatic magnetisation adjustment)*		S	

25 ... 100 % / 101
{ 100 }
SW 1.6 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.

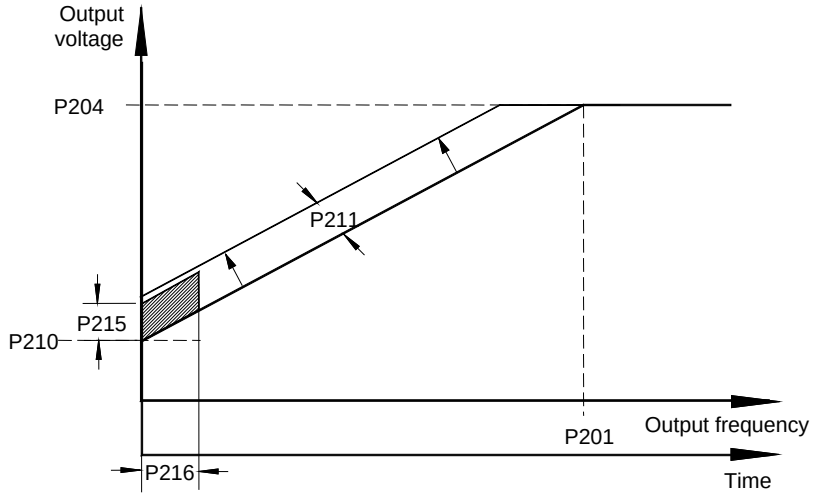
The reduction of the field is performed with a time constant of approx. 7.5 sec. On increase of load the field is built up again with a time constant of approx. 300 ms. The reduction of the field is carried out so that the magnetisation current and the torque current are approximately equal, so that 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 times are considerably faster compared to the Normal ISD control (P219 = 100)

P2xx Control/characteristic curve parameters



NOTE:
"typical"

Settings for the...

Current vector control (factory setting)
P201 to P209 = Motor data
P210 = 100%
P211 = 100%
P212 = 100%
P213 = 100%
P214 = 0%
P215 = no significance
P216 = no significance

Linear V/f characteristic curve
P201 to P209 = Motor data
P210 = 100% (static boost)
P211 = 0%
P212 = 0%
P213 = no significance
P214 = no significance
P215 = 0% (boost precontrol)
P216 = 0s (time dyn. boost)

P220	Para. identification *(Parameter identification)*			P

0 … 2
{ 0 }

For devices with powers up to 7.5 kW, the motor data is automatically determined by the FI via this parameter. In many cases, a better drive behaviour is possible with the measured motor data.

The identification of all parameters takes some time. **Do not switch off the mains voltage** during this time. If unfavourable operating characteristics result after identification, select a suitable motor in P200 or set the parameters P201 … P208 manually.

- **0 = No identification**
- **1 = R_S identification**: 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. This function can only be used with devices up to 7.5 kW (230 V to 4.0 kW).

Note! Only carry out the identification of motor data when the motor is cold (15 … 25°C) Warming up of the motor during operation is taken into account.

The FI must be in a “Standby” status For BUS operation, the BUS must be operating without error.

The motor power may only be one power level greater or 3 power levels lower than the nominal power of the FI.

In order to enable reliable identification, the motor cable length must not exceed 20m.

Before starting the motor identification, the motor data according to the type plate or P200 must be pre-set. At least the nominal frequency (P201), the nominal speed (P202), the voltage (P204), the power (P205) and the motor circuit (P207) should be known.

Care must be taken that the connection to the motor is not interrupted during the entire measuring process.

If the identification cannot be concluded successfully, the error message E019 is generated.

After identification of parameters, P220 is again = 0.

Control parameters

Only available above SK 520E with the use of an incremental encoder.

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set

P300	Servo mode *(Servo Mode)*			P

0 ... 1
{ 0 }

This parameter activates speed control with speed measurement via an incremental encoder. This results in a very stable speed behaviour down to the standstill of the motor.

- **0 = Off**
- **1 = No**

NOTE:

For correct function, an incremental encoder must be connected and the correct pulse number must be entered in parameter P301.

P301	**Rotary encoder res.** *(Rotary encoder resolution)*			

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	**8 =**	-500 pulses
1 =	512 pulses	**9 =**	-512 pulses
2 =	1000 pulses	**10 =**	-1000 pulses
3 =	1024 pulses	**11 =**	-1024 pulses
4 =	2000 pulses	**12 =**	-2000 pulses
5 =	2048 pulses	**13 =**	-2048 pulses
6 =	4096 pulses	**14 =**	-4096 pulses
7 =	5000 pulses	**15 =**	-5000 pulses
		16 =	-8192 pulses
17 =	+ 8192 pulses		

NOTE:

(P301) is also significant for position control via incremental encoders. If an incremental encoder is used for positioning (P604=1), the setting of the pulse number is made here. (Please refer to POSICON Supplementary Manual)

P310	**Speed controller P** *(Speed controller P)*			**P**

0 ... 3200 %
{ 100 }

P-component of the speed encoder (proportional amplification).

Amplification factor, by which the speed difference between the setpoint and actual frequency is multiplied. 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** *(Speed controller I)*			**P**

0 ... 800 % / ms
{ 20 }

I-component of the encoder (Integration component).

The integration component of the controller enables the complete elimination of 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).

P312	**Torque current controller P** *(Torque current controller P)*		**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 pre-control is used.

P313	**Torque current controller I** *(Torque current controller I)*		**S**	**P**

0 ... 800 % / ms
{ 125 }

I-proportion of the torque current controller. (See also P312 >Torque current controller P<)

P314	Torque current controller limit *(Torque current controller limit)*		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 *(Field current controller P)*		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 pre-control is used.			

P316	Field current controller I *(Field current controller I)*		S	P
0 ... 800 % / ms { 125 }	I-proportion of the field current controller. See also P315 >Field current controller P<			

P317	Field current controller limit *(Field current controller limit)*		S	P
0 ... 400 V { 400 }	Determines the maximum voltage increase of the field 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	Field weakening controller P *(Field weakening controller P)*		S	P
0 ... 800 % { 150 }	The field weakening controller reduces the field setpoint when the synchronous speed is exceeded. Generally, the field weakening controller has no function; for this reason, the field weakening 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 weakened 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	Field weakening controller I *(Field weakening controller I)*		S	P
0 ... 800 % / ms { 20 }	Only affects the field weakening range, see P318 >Field weakening controller P<			

P320	Field weakening limit *(Field weakening limit)*		S	P

0 ... 110 %
{ 100 }

The field weakening 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 weaken 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 weakening limit should be correspondingly reduced, so that the control range is actually available to the current controller.

P321	Speedctr. I Release time *(Speed controller I brake release time)*		S	P

0 ... 4
{ 0 }

During the brake release time (P107/P114), the I-component of the 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	Rotary encoder function *(Rotary encoder function)*			

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 = **Speed measurement Servo mode,** *"Servo mode speed measurement"*: 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 speed of a system is used for 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 which is not mounted directly onto the motor. P413 – P416 determine the control.

2 = **Frequency addition**: The determined speed is added to the actual 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	Ratio encoder *(Encoder transformation ratio)*			

0.01 ... 100.00
{ 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	Speed slip error *(Speed slip error, speed control)*			

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)

P328	Speed slip delay *(Speed slip error delay)*			
0.0 ... 10.0 sec { 0.0 } *above SW 2.0*	If the permissible speed slip error defined in (P327) is exceeded the error message E013.1 is suppressed within the time limits which are set here. **0.0 = OFF**			

Control terminals

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set
P400	**Digital analog input 1** *(Analog input 1 function)*			**P**
0 ... 82 { 1 }	The analog input of the FI can be used for various functions. Setting of an analog or digital function is possible, whereby the selection of the function type is made in parameter P400. The possible functions are listed in the following tables.			

List of possible analog functions of the analog inputs

Value	Function	Description
00	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).
01	Setpoint frequency	The specified analog range (matching of analog input) varies the output frequency between the set minimum and maximum frequencies (P104/P105).
02	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%)!
03	Actual frequency PID*	Is required in order to set up a control circuit. 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 values P413...P415).
04	Frequency addition **	The supplied frequency value is added to the setpoint.
05	Frequency subtraction**	he supplied frequency value is subtracted from the setpoint.
06	Current limit	Based on the set current limit (P1536), this can be altered via the analog input.
07	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 minimum/maximum output frequencies (P104/P105) cannot be undershot/exceeded
08	Actual PID frequency 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)
09	Actual frequency PID monitored*	Like 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) = "1") the motor torque can be set or limited using this function. Here the speed controller is switched off and a torque control is activated. The analog input is then the source of the setpoint value. Above firmware version SW 2.0, this function can be also be used with reduced control precision without servo mode or for ((P300) = "0").

Value	Function	Description
11	Torque precontrol	A function which 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 lifting equipment with separate load detection.
12	Reserved	
13	Multiplication	The setpoint is multiplied by the stated analog value. The analog value adjusted to 100% then corresponds to a multiplication factor of 1.
14	Actual value process controller *	Activates the process controller, analog input 1 is connected to the actual value sensor (compensator, air can, flow volume meter, etc.). The mode (0-10 V or 0/4-20 mA) is set in P401.
15	Process controller setpoint *	as function 14, however the setpoint is specified (e.g. by a potentiometer). The actual value must be specified using another input.
16	Process controller precontrol *:	adds an adjustable additional setpoint after the process controller.
46	Setpoint Torque Process controller	Process controller torque setpoint
48	Motor temperature	Motor temperature measurement with KTY-84, details in Section 0
53	d-correction F process	"Diameter correction for PID process controller frequency"
54	d-correction Torque	"Diameter correction of torque"
55	d-correction F + Torque	"Diameter correction for PID process controller frequency and torque"
*) further details regarding the process controller can be found in Section **0**and P400 **) The limits of these values are set by the parameters >Minimum frequency auxiliary setpoints< P410 and >Maximum frequency auxiliary setpoints< P411.		

Further analog functions (47/49/56/57/58) are only relevant for POSICON.

NOTE: An overview of the scaling of the various setpoints can be found in Section **0**.

List of possible functions of the analog inputs

The analog inputs of the frequency inverter can also be parameterised to process digital signals.

The digital functions are set in the parameter of the relevant analog input according to the following assignment.

Value	Function	Value	Function
21	Enable right	42	*... 45 POSICON à BU 0510*
22	Enable left	46	Setpoint Torque Process controller
23	Change of rotation direction	48	Motor temperature
24	Fixed frequency 1	50	Disable PID
25	Fixed frequency 2	51	Disable right rotation
26	Fixed frequency 3	52	Disable left rotation
27	Fixed frequency 4	53	d-correction F process
28	*... Reserved*	54	d-correction Torque
29	Hold frequency	55	d-correction F + Torque
30	Disable voltage	67	Motorpot. Freq. +
31	Emergency stop	68	Motorpot. Freq. -
32	Error acknowledgement	69	*... Reserved*
33	*... 34 Reserved*	70	Bit 0 fixed freq. array
35	Jog frequency	71	Bit 1 fixed freq. array
36	Motor potentiometer	72	Bit 2 fixed freq. array
37	*... Reserved*	73	Bit 3 fixed freq. array
38	Watchdog	74	Bit 4 fixed freq. array
39	*... 40 Reserved*	75	*… 82 POSICON à BU 0510*
41	Fixed frequency 5		

If a digital function is assigned to an analog input, the analog function of the relevant input must be set to {0} "Off" in order to prevent misinterpretation of the signals.

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...30 V.

NOTE:

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

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set
P401	**Mode analog in. 1** *(Analog input 1 mode)*		**S**	
0 ... 5 { 0 }	This parameter determines how the FI reacts to an analog signal which is less than the 0 % adjustment (P402).			

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

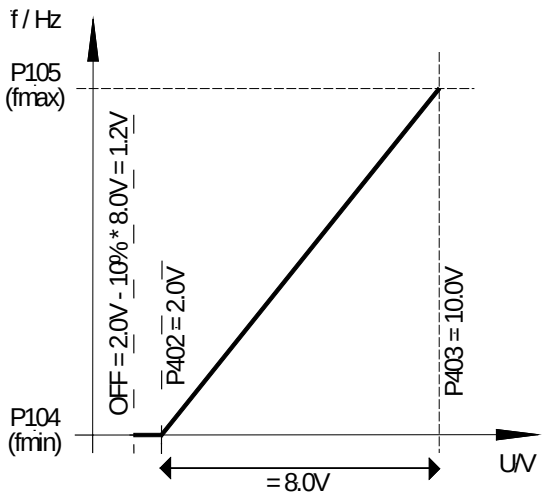
1 = **0 - 10V:** If a setpoint smaller than the programmed adjustment 0% (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

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

At the moment of reversal (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 4-20 mA: P402: Adjustment 0 % = 1 V; P403: Adjustment 100 % = 5 V; -10 % corresponds to -0.4 V; i.e. 1...5 V (4...20 mA) normal operating zone, 0.6...1 V = minimum frequency setpoint, below 0.6 V (2.4 mA) 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 = 5 V, P104 = 0 Hz, Potentiometer 0-10 V à Rotation direction change at 5 V in mid-range setting of the potentiometer.

At the moment of reversal (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 is not applied.

NOTE: The function -10 V – 10 V is a description of the method of function and not a reference to a physical bipolar signal (see example above).

4 = **0 – 10V with error 1,** "*0 – 10V with switch-off on error 1*":
If the 0% adjustment value in (P402) is undershot, the error message 12.8 "Analog In Min Undershot" is activated.
If the 100% adjustment value in (P402) is exceeded, the error message 12.9 "Analog In Max Exceeded" is activated.
Even if the analog value is outside the limits defined in (P402) and (P403), the setpoint is limited to 0 - 100%.

The monitoring function only becomes active if there is an enabling signal present and the analog value has reached the valid range (≥(P402) or ≤(P403)) for the first time (example: build-up of pressure after a pump is switched on).

5 = **0 – 10V with error 2,** "*0 – 10V with switch-off on error 2*":
See setting 4 ("0 - 10V with error switch off 1“), however:

In this setting the monitoring function only becomes active if an enable signal is present and the time during which the error monitoring is suppressed has elapsed. This suppression time is set in parameter (P216).

P402	**Adjustment 1: 0%** *(Analog input 1 adjustment: 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 à 0.00 V 2 – 10 V à 2.00 V (monitored for function 0-10 V) 0 – 20 mA à 0.00 V (internal resistance approx. 250 W) 4 – 20 mA à 1.00 V (internal resistance approx. 250 W)			

P403	Adjustment 1: 100% *(Analog input 1 adjustment: 100%)*		S	

-50.00 ... 50.00 V
{ 10.00 }

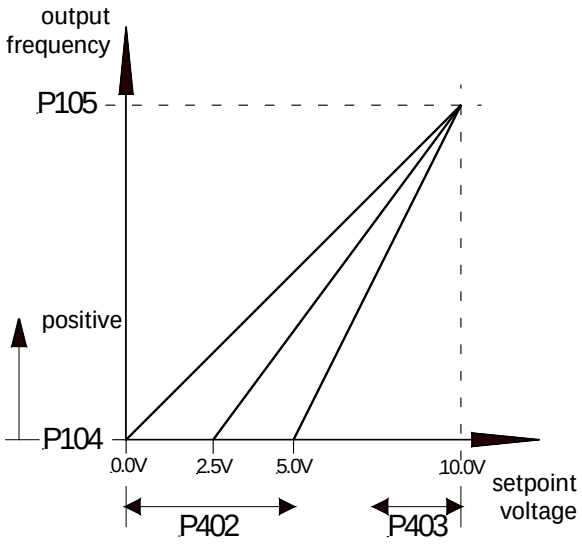
This parameter sets the voltage that should correspond with the maximum value of the selected function for the analog input 1. In the factory setting (setpoint) this value is corresponds with the setpoint set via P105 >Maximum frequency<.

Typical setpoints and corresponding settings:

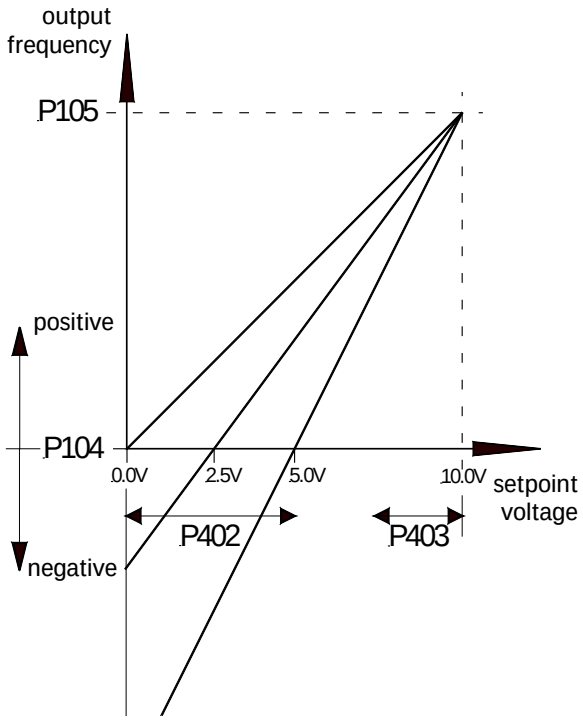
0 – 10 V	à	10.00 V
2 – 10 V	à	10.00 V (monitored for function 0-10 V)
0 – 20 mA	à	5.00 V (internal resistance approx. 250 W)
4 – 20 mA	à	5.00 V (internal resistance approx. 250 W)

P400 ... P403

P401 = 0 à 0 - 10V limited



P401 = 1 à 0 - 10V not limited



P404	Analog input filter 1 *(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	Digital input 2 function *(Analog input 2 function)*			P

0 ... 82
{ 0 }

This parameter is identical to P400.

P406	**Analog input 2 mode** *(Analog input 2 mode)*		S	
0 ... 5 { 0 }	**0 = 0 – 10V limited** **1 = 0 – 10V** **2 = 0 – 10V monitored** **3 = - 10V – 10V** **4 = 0 – 10V with Error 1** **5 = 0 – 10V with Error 2** *This parameter is identical to P401. P402 changes to P407.*			

P407	**Adjustment 2: 0%** *(Analog input 2 adjustment: 0%)*		S	
-50.00 ... 50.00 V { 0.00 }	*This parameter is identical to P402.*			

P408	**Adjustment 2: 100%** *(Analog input 2 adjustment: 100%)*		S	
-50.00 ... 50.00 V { 10.00 }	*This parameter is identical to P403.*			

P409	**Analog input filter 2** *(Filter analog input 2)*		S	
1 ... 400 ms { 100 }	*This parameter is identical to P404.*			

P410	**Min. freq. a-in 1/2** *(Minimum frequency a-in 1/2 (auxiliary setpoint value))*			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	**Max. freq. a-in 1/2** *(Maximum frequency a-in 1/2 (auxiliary setpoint value))*			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 Min. frequency above analog setpoint (potentiometer)			

P412	**Nom. val. process ctrl.** *(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 Chap. 8.2			

P413	PID control P comp. *(P-component of PID controller)*		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 control deviation based on the control difference. E.g.: At a setting of P413 = 10% and a rule difference of 50%, 5% is added to the actual setpoint.			

P414	PID control I comp. *(I-component of PID controller)*		S	P
0.0 ... 3,000.0 %/s { 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.			

P415	PID control D comp. *(D-component of PID controller)*		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 *(Ramp time PI setpoint value)*		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			

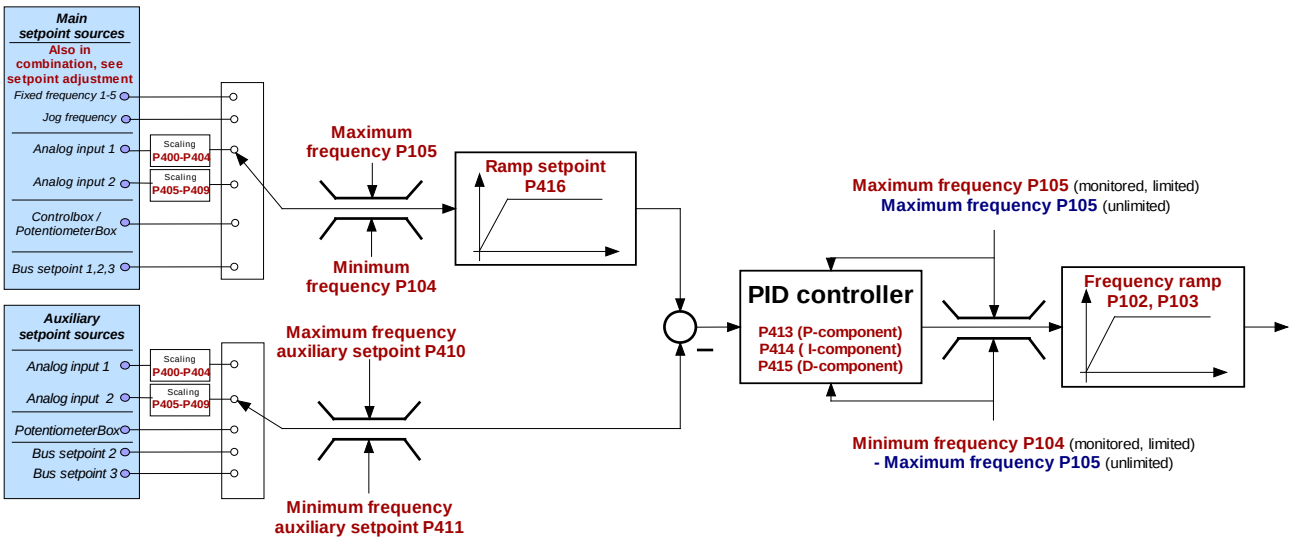


Fig.: Flow diagram for PID controller

P417	Analog output offset 1 *(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).

P418	Function analog output 1 *(Function analog output 1)*			P

0 ... 52
{ 0 }

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

An analog (0 ... +10V) voltage can be obtained from the control terminals (max. 5 mA). 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.:

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

The possible functions are listed in the following tables.

List of possible analog functions of the analog outputs

Value	Function	Description
00	No function	No output signal at terminals.
01	Actual frequency	The analog voltage is proportional to the output frequency of the device
02	Actual speed	Is the synchronous speed calculated by the device, based on the present setpoint value. Load-dependent speed fluctuations are not taken into account. If Servo mode is being used, the measured speed will be output via this function.
03	Current	Is the effective value of the output current delivered by the device.
04	Torque current	Indicates the motor load torque calculated by the device. (100 % = P112)
05	Voltage	Is the output voltage delivered by the device.
06	DC link voltage	Is the DC voltage in the device. This is not based on the motor rated data. 10 V Volt, standardised at 100 %, is equivalent to 450V DC (230 V mains) or 850 Volt DC (480 V mains)!
07	Value of P542	The analog output can be set with parameter P542, regardless of the actual operating status of the device. With bus control, e.g. an analog value from the control unit can be tunnelled directly to the analog output of the FI.
08	Apparent power	The actual apparent power of the motor as calculated by the device
09	Effective power	The actual effective power calculated by the device
10	Torque [%]	The actual torque calculated by the device
11	Field [%]	The actual field in the motor, as calculated by the device
12	Actual frequency ±	The analog voltage is proportional to the output frequency of the device, whereby the null point is shifted to 5 V. For rotation to the right, values between 5 V and 10 V are output, and for rotation to the left values between 5 V and 0 V.
13	Actual speed ±	This is the synchronous rotation speed calculated by the FI, based on the current setpoint, where the null point has been shifted to 5 V. For rotation to the right, values from 5 V to 10 V are output and for rotation to the left, values from 5 V to 0 V. The measured speed is output via this function if servo mode is used.
14	Torque [%] ±	Is the actual torque calculated by the FI, whereby the null point is shifted to 5 V. For drive torques, values between 5 V and 10 V are output, and for generator torque, values between 5 V and 0 V.
30	Setpoint freq. before 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	Output via BUS PZD	the analog output is controlled via a bus system. The process data is directly transferred (P546, P547, P548).
33	Freq. of setpt. source,	"Frequency of setpoint source" (above SW version 1.6)
60	*Reserved*	*(above SK540E à BU 0550)*

NOTE: An overview of the scaling of the various setpoints can be found in Section 8.8.

List of possible digital functions of the analog outputs

All relay functions described in parameter P434 can also be transferred via the analog output. If a condition has been fulfilled, then there will be 10 V at the output terminals. Negation of the function can be specified in parameter P419.

Value	Function	Value	Function
15	External brake	**32**	FI ready
16	Inverter working	**33**	Frequency and setpoint source
17	Current limit	**34**	... 40 reserved (POSICON à BU 0510)
18	Torque current limit	**41**	... 43 reserved
19	Frequency limit	**44**	BusIO In Bit 0
20	Setpoint reached	**45**	BusIO In Bit 1
21	Fault	**46**	BusIO In Bit 2
22	Warning	**47**	BusIO In Bit 3
23	Overcurrent warning	**48**	BusIO In Bit 4
24	Motor overtemperature warning	**49**	BusIO In Bit 5
25	Torque current limit active	**50**	BusIO In Bit 6
26	Value of P541	**51**	BusIO In Bit 7
27	Generator torque current limit	**52**	Value from Bus setpoint Output via Bus (if P546, P547 or P548 = 19), BUS Bit 4 then controls the analog output.
28	... 29 reserved	**60**	reserved (PLC à BU 0550)

Parameter {factory setting}	**Setting value / Description / Note**		**Supervisor**	**Parameter set**
P419	**Scaling of analog output 1** *(Scaling of analog output 1)*			**P**
-500 ... 500 % { 100 }	**<u>Analog functions P418</u> (= 0 ... 6 and 8 … 14, 30)** With this parameter an adjustment can be made to the analog output for the selected working range. The maximum analog output (10 V) corresponds to the scaling value of the appropriate selection. Therefore, if this parameter is raised from 100 % to 200 % at a constant working point, the analog output voltage is halved. The 10 Volt output signal then corresponds to twice the nominal value. For negative values the logic is reversed. An actual value of 0 % will then produce 10 V at the output and -100 % will produce 0 V. **<u>Digital functions P418</u> (= 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).			
P420	**Digital input 1** *(Digital input 1)*			
0 ... 74 { 1 }	**Enable right** as factory setting, control terminal 21 (DIN1) Various functions can be programmed. These can be seen in the following table.			

P421	Digital input 2 *(Digital input 2)*			
0 ... 74	**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 *(Digital input 3)*			
0 ... 74	**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 *(Digital input 4)*			
0 ... 74	**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	input function 5 *(Digital input 5)*			
0 ... 74	**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 *(Digital input 6)*	**SK 520E or higher**		
0 ... 74	**No function** as factory setting, control terminal 26 (DIN6)			
{ 0 }	Various functions can be programmed. These can be seen in the following table.			

(SK 520/53xE) Function of digital input 7 = P470 , Control terminal 27 (DIN7)

... For a description of functions, see the following table(s).

List of the possible functions of digital inputs

Value	Function	Description	Signal
00	No function	Input switched off.	---
01	Enable right	The device delivers an output signal with the rotation field right if a positive setpoint is present. 0 ® 1 Flank (P428 = 0)	High
02	Enable left	The device 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 (bridge between DIN1 and the control voltage output). If the functions "Enable right" and "Enable left" are actuated simultaneously, the FI is blocked. If the frequency controller is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a 1 ® 0 flank .		
03	Change of rotation direction	Causes the rotation field to change direction, combined with Enable right or left.	High

Value	Function	Description	Signal
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	Switchover of parameter sets	First Bit of the parameter set switch over, selection of the active parameter set 1…4 (P100).	High
09	Hold frequency	During the acceleration or deceleration phase, a low level will cause the actual output frequency to be "held". A high level allows the ramp to proceed.	Low
10	Block voltage [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 fast stop time from P426.	Low
12	Error acknowledgement [2]	Error acknowledgement with an external signal. If this function is not programmed, an fault can also be acknowledged by a low enable setting (P506).	0 à 1 Flank
13	PTC input [2]	Analog evaluation of signal present. Switching threshold approx. 2.5 V, Switch-off delay = 2 sec, warning after 1 sec. NOTE: Fnct. 13 can only be used via DIN 5 up to SK 535E, sizes 1 - 4! For SK 54xE and sizes above Size 5, there is a separate connection which cannot be deactivated. If the motor is equipped with a thermistor, for these devices both terminals must be bridged in order to deactivate the function (status as delivered).	level
14	Remote control [2, 4]	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	Motor potentiometer	As in setting 09, however, the frequency is not maintained below the minimum frequency P104 and above the maximum frequency P105.	Low
17	Para. Set Switchovr. 2	Second Bit of the parameter set switch over, 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 à 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		
21	Fixed frequency 5 [1]	The frequency from P433 is added to the actual setpoint value.	High
22	... 25	*reserved POSICON (BU 0510)*	
26	... 29 impulse functions:	*Description below:*	
30	Disable PID	Switching the PID controller / process controller function on and off (high = ON)	High
31	Disable right running [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	Disable left running [2]		Low
33	... 42 impulse functions:	*Description below (only SK 500E … 535E).*	
43	... 44 Speed measurement with HTL encoder	*Description below:*	
44	3-Wire Direction (Direction reversal button)	3-Wire-Control, 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. Control of the FI can therefore be performed entirely with buttons. A pulse on the function "Reverse direction of rotation" inverts the present direction of rotation. This function is reset with a "Stop signal" or by activating a button for the functions 45, 46, 49.	0 à 1 Flank
45	3-W-Ctrl.Start-Right (Closing button)		0 à 1 Flank
46	3-W-Ctrl.Start-Left (Closing button)		0 à 1 Flank
49	3-Wire-Ctrl.Stop (Opening button)		1 à 0 Flank
47	Motorpot.Freq.+	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 0.5 s. This value then applies as the next starting value for the same direction of rotation (Enable R/L) otherwise start at f_{MIN}. Values from other setpoint sources (e.g. fixed frequencies) are not taken into account.	High
48	Motorpot.Freq.-		High
50	Bit 0 Fixed. freq.Array	Fixed frequency array, binary coded digital inputs to generate up to 32 fixed	High

Value	Function	Description	Signal
51	Bit 1 Fixed. freq.Array	frequencies. (P465: -01...-31)	High
52	Bit 2 Fixed. freq.Array		High
53	Bit 3 Fixed. freq.Array		High
54	Bit 4 Fixed. freq.Array		High
55	… 64	*reserved POSICON (BU 0510)*	
65	… 69	*Reserved*	
70	Evacuation runs SW 1.7 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. CAUTION! There is no overload monitoring! (e.g. lifting gear)	High
71	Motorpot.F+ & Save [3] SW 1.6 and above	Motor potentiometer function frequency +/- with automatic saving, 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.	High
72	Motorpot.F- & Save [3] SW 1.6 and above	The frequency setpoint value can also be displayed or set in the operating value display (P001=30, actual setpoint MP-S) or in P718 and can be preset in the "Standby" operating mode. 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
73[2]	Right disable +fast	As for setting 31, however coupled to the function "Fast Stop"	Low
74[2]	Left disable+fast	As for setting 32, however coupled to the function "Fast Stop"	Low
77		*reserved POSICON (BU 0510)*	
80		*reserved PLC (BU 0550)*	

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 (z.B. RS232, RS485, CANbus, CANopen, …)

3 With SK 5x5 E devices the frequency inverter control unit must be supplied with power for a further 5 minutes after the last change of the motor potentiometer in order to permanently save the data.

4 Function cannot be selected via BUS IO In Bits

Pulse input functions: 2...22kHz (only DIN2/3)

Digital inputs 2 and 3 can be used indirectly for the evaluation of analog signals. 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 this 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 setpoint frequencies	Impulse
29	Frequency subtraction [2 3]	Subtraction of other setpoint frequencies	Impulse
33	Current limit [2]	Based on the set current limit (P536), this can be changed using the digital/analog input.	Impulse

Value	Function	Description	Signal
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 minimum/maximum output frequencies (P104/P105) cannot be undershot/exceeded	Impulse
35	Act.freq PID limited [2 3]	*Actual PID frequency limited*, is required to set 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	Act. freq. PID controlled [2 3]	As function 35, >Actual frequency PID limited< but the FI switches the output frequency off when the >Minimum frequency< P104 is reached.	Impulse
37	Servo mode torque [2]	The motor torque can be set or limited via this function in Servo mode.	Impulse
38	Torque precontrol [2]	A function which 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 lifting equipment with separate load detection. ® P214	Impulse
39	Multiplication [3]	This factor multiplies the master setpoint value.	Impulse
40	Actual value process controller	As for P400 = 14-16	Impulse
41	Setpoint process controller		Impulse
42	Process controller lead		Impulse

[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.

HTL encoder function (only DIN2/4)

For the evaluation of an HTL encoder, the digital inputs DIN2 and DIN4 must be parameterised with the following functions.

Value	Function		Description	Signal
43	Track A HTL encoder	This function can only be used for digital inputs 2 (DIN2) and 4 (DIN4) !	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

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set

P426	**Quick stop time** *(Quick stop time)*			P

0 ... 320.00 sec
{ 0.10 }

Setting of the stop time for the fast stop function which can be triggered either via a digital input, the bus control, the keyboard or automatically in case of a fault.

Emergency 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 emergency stop time is reduced correspondingly.

P427	**Emergency stop on error** *(Emergency stop on error)*		S	

0 ... 3
{ 0 }

Activation of automatic emergency stop following error

- **0 = OFF:** Automatic emergency stop following error is deactivated
- **1 = Mains supply failure:** Automatic emergency stop following mains supply failure
- **2 = In case of faults:** Automatic emergency stop following fault
- **3 = Fault or mains failure:** Automatic emergency stop in case of fault or mains failure

An emergency stop can be triggered by the errors**E2.x, E7.0, E10.x, E12.8, E12.9** and **E19.0**.

P428	**Automatic starting** *(Automatic starting)*		S	P

0 ... 1
{ 0 }

In the standard setting (P428 =**0 à Off**) the inverter requires a flank to enable (signal change from "low à high") at the relevant digital input.

In the setting **On à 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. For this P428 = **1 à On** can be set. If the enable signal is permanently switched on, or equipped with a cable jumper, the FI starts up immediately.

NOTE: (P428) not "ON" if (P506) = 6, **Danger!** (See note on (P506))

P429	**Fixed frequency 1** *(Fixed frequency 1)*			P

-400.0 ... 400.0 Hz
{ 0.0 }

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 results in an enable. A positive fixed frequency corresponds to a right enable, a negative to a left enable.

P430	**Fixed frequency 2** *(Fixed frequency 2)*			P

-400.0 ... 400.0 Hz
{ 0.0 }

For a description of the function of the parameter, see **P429** >**Fixed frequency 1**<

P431	Fixed frequency 3 *(Fixed frequency 3)*			P
-400.0 ... 400.0 Hz { 0.0 }	For a description of the function of the parameter, see **P429** >**Fixed frequency 1**<			

P432	Fixed frequency 4 *(Fixed frequency 4)*			P
-400.0 ... 400.0 Hz { 0.0 }	For a description of the function of the parameter, see **P429** >**Fixed frequency 1**<			

P433	Fixed frequency 5 *(Fixed frequency 5)*			P
-400.0 ... 400.0 Hz { 0.0 }	For a description of the function of the parameter, see **P429** >**Fixed frequency 1**<			

P434	Relay 1 function *(Function of output 1 (Relay 1 – MFR1))*			P
0 ... 39 { 1 }	**Control terminals 1/2:** The settings 3 to 5 and 11 work with a 10% hysteresis, i.e. the relay contact closes (Function 11 opens) when the limit value is reached and opens (function 11 closes) when a 10% smaller value is undershot. This behaviour can be inverted with a negative value in P435. Various functions can be programmed. These can be seen in the following table.			

List of possible functions of the relays and digital outputs

Value	Function	Description	Signal*
00	No function	Input switched off.	Low
01	External brake	For the control of 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 (see also P107). A mechanical brake may be directly switched by AC current. (Note the technical specification of the relay contacts!)	High
02	Inverter working	the closed relay contact indicates voltage at the inverter output (U - V - W) (also DC run-on(→ P559)).	High
03	Current limit	Based on the setting of the motor rated current in P203. This value can be adjusted with the standardisation (P435).	High
04	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).	High
05	Frequency limit	Based on motor nominal frequency setting in P201. This value can be adjusted with the standardisation (P435).	High
06	Setpoint reached	indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz à Setpoint not reached - contact opens.	High
07	Fault	General fault message, fault is active or not yet acknowledged. à Error – contact opens (ready – contact closes)	Low
08	Warning	General warning - a limit value was reached that could lead to a later shutdown of the FI.	Low
09	Overcurrent warning	At least 130% of the nominal FI current was supplied for 30 seconds.	Low
10	Motor overtemperature warning	Motor overtemperature (warning): The motor temperature is evaluated via the PTC input or a digital input. à Motor is too hot. This warning is given immediately, overheating switch-off after 2 seconds.	Low

Value	Function	Description	Signal*
11	Torque current limit active	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 %.	Low
12	Value of P541	The output can be set using parameter P541 independently of the actual operating status of the FI.	High
13	Generator torque current limit	Limit value in P112 was reached in the generator range. Hysteresis = 10 %.	High
14		*... 17 Reserved*	--
18	FI ready	The FI is ready for operation. After being enabled it delivers an output signal.	High
19		*… 29 reserved POSICON (BU 0510)*	--
30	BusIO In Bit 0	Control by Bus In Bit 0 (P546 …)	High
31	BusIO In Bit 1	Control by Bus In Bit 1 (P546 …)	High
32	BusIO In Bit 2	Control by Bus In Bit 2 (P546 …)	High
33	BusIO In Bit 3	Control by Bus In Bit 3 (P546 …)	High
34	BusIO In Bit 4	Control by Bus In Bit 4 (P546 …)	High
35	BusIO In Bit 5	Control by Bus In Bit 5 (P546 …)	High
36	BusIO In Bit 6	Control by Bus In Bit 6 (P546 …)	High
37	BusIO In Bit 7	Control by Bus In Bit 7 (P546 …)	High
38	Value from Bus setpoint	Value from bus setpoint (P546 …)	High
	Details can be found in the bus manuals		
39	STO inactive	The relay / bit deactivates if STO or the Safe Stop are active.	High
40		*reserved PLC (BU 0550)*	
* For relay contacts (High = "Contact closed", Low = "Contact open")			

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set

P435	**Relay 1 scaling** *(Scaling of output 1 (Relay 1 – MFR1))*			**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 >Rated motor current Torque current limit (4) = x [%] ×P203 ×P206 (calculated rated motor torque) Frequency limit (5) = x [%] ×P201 >Rated motor frequency<			

P436	**Relay 1 hysteresis** *(Hysteresis of output 1 (Relay 1 – MFR1))*		**S**	**P**
1 ... 100 % { 10 }	Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

P441	**Relay 2 function** *(Function of output 2 (Relay 2 – MFR2))*			**P**
0 ... 39 { 7 }	**Control terminals 3/4:** Functions are identical to P434!			

P442	Relay 2 scaling *(Scaling of output 2 (Relay 2 – MFR1))*			P
-400 ... 400 % { 100 }	Functions are identical to P435!			

P443	Relay 2 hysteresis *(Hysteresis of output 2 (Relay 2 – MFR1))*		S	P
1 ... 100 % { 10 }	Functions are identical to P436!			

P450	Relay 3 function *(Function of output 3 (DOUT1))*	SK 520E or higher		P
0 ... 39 { 0 }	**Control terminals 5/40:** Functions are identical to P434! Digital output, 15V against DGND (for SK 5x5E devices, deviations of the signal level are).			

P451	Relay 3 scaling *(Scaling of output 3 (DOUT1))*	SK 520E or higher		P
-400 ... 400 % { 100 }	Functions are identical to P435!			

P452	Relay 3 Hyst. *(Output 3 hysteresis (DOUT1))*	SK 520E or higher	S	P
1 ... 100 % { 10 }	Functions are identical to P436!			

P455	Relay 4 function *(Function of output 4 (DOUT2))*	SK 520E or higher		P
0 ... 39 { 0 }	**Control terminals 7/40:** Functions are identical to P434! Digital output, 15V against DGND (for SK 5x5E devices, deviations of the signal level are possible).			

P456	Relay 4 scaling *(Scaling of output 4 (DOUT2))*	SK 520E or higher		P
-400 ... 400 % { 100 }	Functions are identical to P435!			

P457	Relay 4 Hyst. *(Output 4 hysteresis (DOUT2))*	SK 520E or higher	S	P
1 ... 100 % { 10 }	Functions are identical to P436!			

P460	Time Watchdog *(Time Watchdog)*		S	

-250.0 ... 250.0 sec
{ 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 a pulse being registered, 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.

-250.0 … -0.1 = Rotor running watchdog: In this setting the rotor running watchdog is active. The time is defined by the number of the value which has been set. When the FI is switched off, there is no watchdog message. After each enable, a pulse must first be received before the watchdog is activated.

P461	Function 2 Encoder *(Encoder function 2)*		S	

0 ... 5
{ 0 }
from hardware status CAA

The actual speed list value supplied to the FI by an HTL incremental encoder can be used for various functions in the FI. (The settings are identical to (P325)). The HTL encoder is connected via digital inputs 2 and 4. The parameters **(P421)** and **(P423)** must be set accordingly to functions 43 "Track A" and 44 "Track B". Due to the frequency limit (max. 10 kHz) only restricted encoder solutions **(P462)** are possible with these digital inputs. The mounting location (motor shaft or output side) of the encoders is taken into account by the parameterisation of an appropriate speed ratio **(P463)**.

0 = Speed measurement Servo mode: The actual motor speed list value is used for the servo mode. The ISD control cannot be switched off in this function.

1 = PID actual frequency value: The actual speed of a system is used for 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 determined speed is added to the actual 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.

5 = Reserved: *see BU510*

P462	Pulse number 2 Rotary encoder *(Pulse number of function 2)*		S	

16 ... 8192
{ 1024 }

Input of the pulse-count per rotation (16 - 8192) of the connected HTL incremental encoder.

If the direction of rotation of the encoder is not the same as that of the motor controller, (depending on installation and wiring), it can be compensated for by selecting the corresponding negative pulse numbers.

P463	2. Encoder ratio *(2nd encoder speed ratio)*		S	

0.01 ... 100.0
{ 1.00 }

If the HTL incremental encoder is not mounted directly on the motor shaft, the correct speed ratio for the motor speed and the encoder speed must be set.

$$P463 = \frac{\text{Motor speed}}{\text{Encoder speed}}$$

Only if P461 = 1, 2, 3 4 or 5, therefore not in Servo mode (motor speed control)

P464	Fixed frequencies mode *(Fixed frequencies mode)*		S	

0 ... 1
{ 0 }
above SW 1.7

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.
Programmed frequency addition or subtraction with an analog input value or a bus setpoint is still possible and valid, as is the addition to the setpoint of a motor potentiometer function (function of digital inputs: 71/72)
If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (E.g.: 20>10 or 20>-30).

Note:
The highest active fixed frequency is added to the setpoint value of the motor potentiometer if the functions 71 or 72 are selected for 2 digital inputs.

P465 [-01] ... [-31]	Fixed freq. Array *(Fixed frequency / Array)*			

-400.0 ... 400.0 Hz
{ 0.0 }

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.

P466	Min. Freq. Process Controller *(Minimum frequency process controller)*		S	P

0.0 ... 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 *(Digital input 7)*	SK 520E or higher		

0 ... 74
{ 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] ... [-10]	**delay on/off switch** *(Digital function switch on/off delay)*		S	

-30,000 ... 30,000 sec
{ all 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] = input function 1
[-02] = input function 2
[-03] = input function 3
[-04] = input function 4
[-05] = input function 5
[-06] = Digital input 6 (above SK 520E)
[-07] = Digital input 7 (above SK 520E)
[-08] = Digital function, analog input 1
[-09] = Digital function, analog input 2
[-10] = Digital input 8 (above SK 540E)

Positive values = switch-on delayed **Negative values =** switch-off delayed

P480	[-01] ... [-12]	**Function BusIO In Bits** *(Bus I/O In Bits function)*		S	

0 ... 80
{ all 0 }

The Bus I/O In Bits are perceived as digital inputs (P420). They can be set to the same functions.
In order to use this function, one of the bus setpoints (P546) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit.
With the SK 54xE in association with IO extension modules these I/O bits can also process their input signals.

[-01] = Bus I/O In Bit 0 (or SK54xE and above: + **DI1** of the **second IOE**)
[-02] = Bus I/O In Bit 1 (or SK54xE and above: + **DI2** of the **second IOE**)
[-03] = Bus I/O In Bit 2 (or SK54xE and above: + **DI3** of the **second IOE**)
[-04] = Bus I/O In Bit 3 (or SK54xE and above: + **DI4** of the **second IOE**)
[-05] = Bus I/O In Bit 4 (or SK54xE and above: + **DI1** of the **first IOE**)
[-06] = Bus I/O In Bit 5 (or SK54xE and above: + **DI2** of the **first IOE**)
[-07] = Bus I/O In Bit 6 (or SK54xE and above: + **DI3** of the **first IOE**)
[-08] = Bus I/O In Bit 7 (or SK54xE and above: + **DI4** of the **first IOE**)
[-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. Function {14} "Remote control" is not possible.

P481	[-01] ... [-10]	Function BusIO Out Bits *(Function of Bus I/O Out Bits)*		S	

0 ... 39
{ all 0 }

The bus I/O Out bits are perceived as digital outputs (P434). They can be set to the same functions.

In order to use this function, one of the bus setpoints (P543) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit.

With the SK 54xE in association with IO extension modules these I/O bits can also process their input signals.

[-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 (or SK54xE and above: + **DO1** of the **first IOE**)
[-06] = Bus I/O Out Bit 5 (or SK54xE and above: + **DO2** of the **first IOE**)
[-07] = Bus I/O Out Bit 6 / Flag 1 (or SK54xE and above: + **DO1** of the **second IOE**)
[-08] = Bus I/O Out Bit 7 / Flag 2 (or SK54xE and above: + **DO2** of the **second IOE**)
[-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 digital outputs or the relays.

For further details, please refer to the manual for the AS interface, BU 0090.

P482	[-01] ... [-10]	Norm. BusIO Out Bits *(Scaling of bus I/O Out bits)*		S	

-400…400 %
{ all 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.

The assignment of the arrays correspond to those of parameter (P481).

P483	[-01] ... [-10]	Hyst. BusIO Out Bits *(Hysteresis of bus I/O Out bits)*		S	

1…100 %
{ all 10 }

Difference between switch-on and switch-off point to prevent oscillation of the output signal.

The assignment of the arrays correspond to those of parameter (P481).

Additional parameters

Parameter {factory setting}	Setting value / Description / Note		Supervisor	Parameter set
P501 **[-01] ... [-20]**	**Inverter name** *(Inverter name)*			
A…Z (char) { 0 }	Free input of a designation (name) for the device (max. 20 characters). With this, the frequency inverter can be uniquely identified for setting with NORD CON software or within a network.			
P502 **[-01] ... [-05]**	**Value Masterfunction** *(Value master function)*		**S**	**P**
0 ... 57 { all 0 }	Selection of the master value of a Master for output to a bus system (see P503) - (up to SK 535E: max. 3 master values, SK 540 and above: max. 5 master values). The assignment of these master values to the slave is carried out via (P546) (...(P548)):			

[-01] = Master value 1 **[-02] =** Master value 2 **[-03] =** Master value 3

SK 540E and above: **[-04] =** Master value 4 **[-05] =** Master value 5

Selection of possible setting values for master values:

00 = Off
01 = Actual frequency
02 = Actual speed
03 = Electricity
04 = Torque current
05 = State of digital inputs and outputs
06 = *Reserved*
07 = *Reserved*
08 = Setpoint frequency
09 = 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 = Setpoint frequency master value
20 = Setpoint freq. after master val ramp
21 = Actual freq. without master value slip
22 = Speed encoder
23 = Actual freq. with slip (SW V2.0 and above)
24 = Master value, act. freq. with slip (SW V2.0 and above)
53 = *... 57 Reserved*

NOTE: For details regarding the processing of setpoints and actual values, pleas refer to Section 8.9.

P503	Master function output *(Master function output)*		S	

0 ... 5
{ 0 }

For master-slave applications this parameter specifies on which bus system the master transmits the control word and the master values (P502) for the slave. On the slave, parameters (P509), (P510), (P546 ...) define the source from which the slave obtains the control word and the master values from the master and how these are to be processed by the slave.

0 = Off:	no output of control word and master values.
1 = USS:	output of control words and master values to USS.
2 = CAN:	output of control words and master values to CAN (up to 250 kBaud).
3 = CANopen:	output of control words and master values to CANopen.
4 = System bus active:	no output of control word and master values, however via the ParameterBox or NORD CON, all participants which are set to ***System bus active*** are visible.
5 = CANopen+Sys.bus active:	output of control word and master values on CAN open via the ParameterBox or NORD CON, all participants which are set to ***system bus active*** are visible.

P504	Pulse frequency *(Pulse frequency)*		S	

3.0 ... 16.0 kHz
{ 6.0 / 4.0 }

The internal pulse frequency for controlling the power unit 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 limit curve A 1 according to EN 55011 is complied with using the standard value (FI output power ≤ 37 kW: 6.0 kHz, otherwise 4.0 kHz) and taking the wiring guidelines into account.

NOTE: Raising the pulse frequency leads to a reduction of the possible output current, depending on the time (I^2t curve). When the temperature warning limit (C001) is reached, the pulse frequency is gradually reduced to the standard value If the inverter temperature reduces sufficiently, the pulse frequency is increased to the original value.

P505	Absolute mini. freq. *(Absolute minimum frequency)*		S	P

0.0 ... 10.0 Hz
{ 2.0 }

States 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) 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 without speed feedback, this value should be set to a minimum of 2Hz. From 2Hz and higher, the current control of the FI operates and a connected motor can supply sufficient torque.

NOTE:
Output frequencies < 4.5 Hz lead to current limitation. For further details, see Section 8.5„ **Reduced output power**“.

P506	**Automatic error acknowledgement** *(Automatic error acknowledgement)*		S	

0 ... 7
{ 0 }

In addition to the manual error acknowledgement, an automatic one can also be selected.

- **0 =** **No automatic** error acknowledgement.
- **1 ... 5 =** **Number** of permissible automatic error acknowledgements 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 =** **Via Deactivate enable:** acknowledgement is only possible using the OK / ENTER key or by mains switch-off. No acknowledgement is implemented by removing the enable!

NOTE: If (P428) is parameterised to "ON", parameter (P506) "Automatic error acknowledgement" must not be parameterised to setting 6 "Always" as otherwise the device or system is endangered due to the possibility of continuous restarting in the case of an active error (e.g. short-circuit to earth / short circuit).

P507	**PPO-Type** *(PPO-Type)*			

1 ... 4
{ 1 }

This parameter can only be used with the technology unit Profibus, DeviceNet or InterBus.
See also the relevant section of the corresponding supplementary BUS manual.

P508	**Profibus address** *(Profibus address)*			

1 ... 126
{ 1 }

Profibus address, only with the technology unit Profibus
See also the additional description for the Profibus control BU 0020

P509	Source Control Word *(Source control word)*			

0 ... 10
{ 0 }

Selection of the interface via which the FI is controlled.

- **0 =** **Control terminals or keyboard control** ** with the ControlBox (if P510=0), the ParameterBox (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 inputs or via the bus I/O Bits.
- **2 =** **USS** control word *, the control signals (enable, direction of rotation, ...) are transferred via the RS485 interface. The setpoint is transferred via the analog input or the fixed frequencies.
  Above SK 540E this setting should also be selected if communication via Modbus RTU is intended. The frequency inverter automatically detects whether this is a USS protocol or a Modbus protocol.
- **3 =** **CAN** control word *
- **4 =** **Profibus** control word *
- **5 =** **InterBus** control word *
- **6 =** **CANopen** control word *
- **7 =** **DeviceNet** control word *
- **8 =** **Ethernet TU*** ** control word*
- **9 =** **CAN Broadcast** *
- **10 =** **CANopen Broadcast ***

NOTE:
For details about the respective Bus systems please refer to the respective Options descriptions.
www.nord.com -

*) Keyboard control (ControlBox, ParameterBox, PotentiometerBox) 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.

***) The **Ethernet TU** setting must be used for all NORD Ethernet-based bus systems (e.g.: EtherCAT: SK TU3-ECT, PROFINET: SK TU3-PNT).

Note: Parameterisation of a frequency inverter via a field bus connection requires parameter (P509) "Control Terminals" to be set to the appropriate bus system

P510	[-01] [-02]	Setpoint source *(Setpoint source)*		S	

0 ... 10
{ all 0 }

Selection of the setpoint source to be parameterised.

[-01] = Main **setpoint source** **[-02] =** Auxiliary **setpoint source**

Selection of the interface via which the FI receives the setpoint.

- **0 =** **Auto (=P509):** 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 (**or Modbus RTU SK 540E and above**)**
- **3 =** **CAN**
- **4 =** **Profibus**
- **5 =** **InterBus**
- **6 =** **CANopen**
- **7 =** **DeviceNet**
- **8 =** **Ethernet TU**
- **9 =** **CAN Broadcast**
- **10 =** **CANopen Broadcast**

P511	USS baud rate *(USS baud rate)*		S	

0 ... 8
{ 3 }

Setting of the transfer rate (transfer speed) via the RS485 interface. All bus participants must have the same baud rate setting.

		SK 54xE and above:	
0 =	4,800 Baud	**4 =**	57,600 Baud
1 =	9,600 Baud	**5 =**	115,200 Baud
2 =	19,200 Baud	**6 =**	187,750 Baud
3 =	38,400 Baud	**7 =**	230,400 Baud
		8 =	460,800 Baud

NOTE: For communication via Modbus (available for SK 540E and above) a transfer rate of maximum 38400 Baud must be set.

P512	USS address *(USS address)*			

0 ... 30
{ 0 }

Setting of the FI bus address for USS communication.

P513	Telegram time-out *(Telegram time out)*		S	

-0.1 / 0.0 /
0.1 ... 1000 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 ***(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. With the use of the CANopen technology unit, settings from this parameter are only valid if the *BAUD* rotary coding switch on the technology unit has been set to **PGM**.

0 = 10kBaud	**3 =** 100kBaud	**6 =** 500kBaud
1 = 20kBaud	**4 =** 125kBaud	**7 =** 1MBaud * (for test purposes only)
2 = 50kBaud	**5 =** 250kBaud	

*) Reliable operation cannot be guaranteed

Information **Data takeover**

The baud rate is only read after a Power On, a Reset Node message or a Power On of the 24V bus supply.

P515	[-01] ... [-03]	CAN address *(CAN address)*			

0 ... 255
{ all 50 }

Setting of the basic CANbus address for CAN and CANopen. With the use of the CANopen technology unit, settings from this parameter are only valid if the BAUD rotary coding switch on the technology unit has been set to PGM.

Information **Data takeover**

The baud rate is only read after a Power On, a Reset Node message or a Power On of the 24V bus supply.

From software version 1.6 and above, this can be set in three levels:

[-01] = Slave address, Receipt address for CAN and CANopen (as before)
[-02] = Broadcast slave address, Broadcast – receipt address for CANopen (Slave)
[-03] = Master address, Broadcast – Transmission address for CANopen (Master)

P516	Skip frequency 1 *(Skip frequency 1)*		S	P

0.0 ... 400.0 Hz
{ 0.0 }

The output frequency around the frequency value (P517) set here is not shown.
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 = Skip frequency inactive

P517	Skip freq. area 1 *(Skip frequency area 1)*		S	P

0.0 ... 50.0 Hz
{ 2.0 }

Skip range for the >Skip frequency 1< P516. This frequency value is added and subtracted from the skip frequency.
Skip frequency range 1: P516 - P517 ... P516 + P517

P518	Skip frequency 2 *(Skip frequency 2)*		S	P

0.0 ... 400.0 Hz
{ 0.0 }

The output frequency around the set frequency value (P519) is skipped.
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 = Skip frequency inactive

P519	Skip freq. area 2 *(Skip frequency area 2)*		S	P

0.0 ... 50.0 Hz
{ 2.0 }

Skip range for the >Skip frequency 2< P518. This frequency value is added and subtracted from the skip frequency.
Skip frequency range 2: P518 - P519 ... P518 + P519

P520	Flying start *(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.

1 = Both directions, the FI looks for a speed in both directions.

2 = Setpoint value direction, searches only in the direction of the setpoint val. which is present.

3 = Both directions after failure, as for { 1 }, however only after mains failure or fault

4 = Setpoint direction after fail, as for{ 2 }, however only after mains failure or fault

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 with 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	Fly. start resol. *(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 message. If the values are too small, the search time is greatly extended.

P522	Fly. start offset *(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.

P523	Factory setting *(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.

P525	[-01] ... [-03]	Load control max *(Load monitoring maximum value)*		S	P

1 ... 400 % / 401
{ all 401 }

Selection of up to 3 auxiliary values:

[-01] = Auxiliary value 1 **[-02] = Auxiliary value 2** **[-03] = Auxiliary value 3**

Maximum load torque value.

Setting of the upper limit of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) … (P527), or the entries which are made there always belong together.

401 = OFF Means that the function is switched off. No monitoring is performed. This is also the basic setting for the FI.

P526	[-01] ... [-03]	Load control min *(Load monitoring, minimum value)*		S	P

0 ... 400 %
{ all 0 }

Selection of up to 3 auxiliary values:

[-01] = Auxiliary value 1 **[-02] = Auxiliary value 2** **[-03] = Auxiliary value 3**

Minimum load torque.

Setting of the lower limit value of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) … (P527), or the entries which are made there always belong together.

0 = OFF Means that the function is switched off. No monitoring is performed. This is also the basic setting for the FI.

P527	[-01] ... [-03]	Load control freq. *(Load monitoring frequency)*		S	P

0.0 ... 400.0 Hz
{ all 25.0 }

Selection of up to 3 auxiliary values:

[-01] = Auxiliary value 1 **[-02] = Auxiliary value 2** **[-03] = Auxiliary value 3**

Auxiliary frequency values

Definition of up to 3 frequency points, which define the monitoring range for load monitoring. The auxiliary frequency values do not need to be entered in order of size. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) … (P527), or the entries which are made there always belong together.

P528	Load control delay *(Load monitoring delay)*		S	P

0.10 ... 320.00 s
{ 2.00 }

Parameter (P528) defines the delay time for which an error message ("E12.5") is suppressed on infringement of the defined monitoring range ((P525) … (P527)). A warning ("C12.5") is triggered after half of this time has elapsed.

According to the selected monitoring mode (P529) an error message can also be generally suppressed.

P529	**Mode Load control** *(Load monitoring mode)*		S	P

0 ... 3
{ 0 }

The reaction of the frequency inverter to an infringement of the defined monitoring range ((P525) … (P527)) after the elapse of the delay time (P528) is specified by parameter (P529).

0 = **Fault and warning**, After the elapse of the time defined in (P528), an infringement of the monitoring range produces a fault ("E12.5"). A warning ("C12.5") is given after the elapse of half of this time.

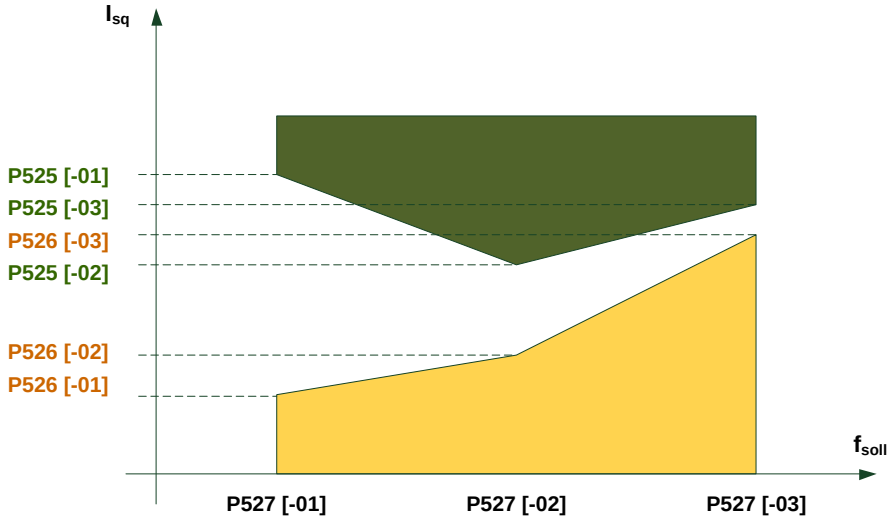
1 = **Warning**, After the elapse of half of the time defined in (P528) and infringement of the monitoring range produces a warning ("C12.5").

2 = **Error and warning, constant travel**, *"Error and warning during constant travel"*, as for setting "0" however monitoring is inactive during acceleration phases.

3 = **Warning constant travel,** *"Only warning during constant travel"*, as for setting "1", however monitoring is inactive during acceleration phases.

P525 … P529 Load monitoring

With the load monitoring, a range can be specified within which the load torque may change depending on the output frequency. There are three auxiliary values for the maximum permissible torque and three auxiliary values for the minimum permissible torque. A frequency is assigned to each of these auxiliary values. No monitoring is carried out below the first and above the third frequency. In addition, the monitoring can be deactivated for minimum and maximum values. As standard, monitoring is deactivated.



The time after which a fault is triggered can be set with parameter (P528). If the permissible range is exceeded *(Example diagram: Example diagram: Infringement of the area marked in yellow or green*), the error message **E12.5** is generated unless parameter (P529) does not suppress the triggering of an error.

A warning **C12.5** is always given after the elapse of half of the set error triggering time (P528). This also applies if a mode is selected for which no error message is generated. If only a maximum or minimum value is to be monitored, the other limit must be deactivated or must remain deactivated. The torque current and no the calculated torque is used as the reference value. This has the advantage that monitoring in the "non field weakened range" without servo mode is usually more accurate. Naturally however, it cannot display more than the physical torque in the weakened field range.

All parameters depend on parameter sets. No differentiation is made between motor and generator torque, therefore the value of the torque is considered. As well as this, there is no differentiation between "left" and "right" running. The monitoring is therefore independent of the prefix of the frequency. There are four different load monitoring modes (P529).

The frequencies, and the minimum and maximum values belong together within the various array elements. The frequencies do not need to be sorted according to their magnitude in the elements 0, 1 and 2, as the frequency inverter does this automatically.

P533	Factor I^2t-Motor *(Factor I^2t-Motor)*		S	
50 ... 150 % { 100 }	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 disconn. limit *(Torque disconnection limit)*		S	P

0 ... 400 % / 401
{ all 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 *(I^2t motor)*			

0 ... 1
{ 0 }

The motor temperature is calculated according to the output current, time and the output frequency (cooling). 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.

0 = Switched off

1 = Switched on

0 … 24
{ 0 }
SW 1.6 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

P536	Current limit *(Current limit)*		S	

0.1 ... 2.0 / 2.1
(x nominal current of FI)
{ 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 represents the disabling of this limit value.

P537	**Pulse disconnection** *(Pulse disconnection)*		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 = The function is so to speak **disabled,** the FI supplies the maximum possible current. However, in spite of this the pulse switch-off *(SW 2.0 or above)* can become active at the current limit.

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	**Check input voltage** *(Mains voltage monitoring)*		S	

0 ... 4
{ 3 }

For reliable 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 modified.

0 = Switched off: No monitoring of the supply voltage.

1 = Phase error: an error message is only produced by phase errors.

2 = Mains voltage: an error message is only produced by a low voltage.

3 = Phase err. + mains voltage: A phase error or undervoltage produce an error message.

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** *(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 = Only motor phases: 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 = Only magnetisation: 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 + Magnet: Monitoring of the motor phases and magnetisation as in 1 and 2 are 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.

P540	**Mode phase sequence** *(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 operate with active position control (SK 53xE and above, P600 ≠ 0).

0 = No restriction, no restriction of the direction of rotation

1 = Dir. key disabled, the direction key of the ControlBox SK TU3-CTR is disabled.

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.

5 = CW only monitored *, *only the clockwise direction is monitored,* only a clockwise field 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 the counter-clockwise direction is monitored*, only a counter-clockwise field 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 = Only enabled direction monitored, *only the enabled direction is monitored*, rotation 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 relays** *(Set relays and digital outputs)*		S	

0000 ... 3FFF(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 = Output 5 (DOUT3) *(SK 540E and above)*
Bit 6 = *reserved*
Bit 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

	Bits 13-12	Bits 11-8	Bits 7-4	Bits 3-0	
Min. value	00 **0**	0000 **0**	0000 **0**	0000 **0**	Binary **hex**
Max. value	11 **3**	1111 **F**	1111 **F**	1111 **F**	Binary **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.

NOTE: The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off!

P542	Set analog output *(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.

NOTE: The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off!

P543	Actual bus value 1 *(Actual bus value 3)*		S	P

0 ... 24
{ 1 }

The return value 1 can be selected for bus actuation in this parameter.

The possible analog functions can be found in the following table.

NOTE: For further details please refer to the manual for the frequency inverter (P418, P543), the relevant BUS operating instructions or BU 0510.

0 =	Off	**13 =**	... 16 Reserved
1 =	Actual frequency	**17 =**	Value analog input 1
2 =	Actual speed	**18 =**	Value analog input 2
3 =	Current	**19 =**	Setpoint frequency master value*(P503)*
4 =	Torque current (100% = P112)	**20 =**	Setpoint frequency master value after ramp *"Setpoint frequency master value after ramp"*
5 =	Digital IO status [1]	**21 =**	Act. freq. without slip master value *"Actual frequency without slip master value"*
6 =	... 7 Reserved	**22 =**	Speed encoder *(only possible with SK 520E and encoder feedback)*
8 =	Setpoint frequency	**23 =**	Actual frequency with slip, *"Actual frequency with slip"* *(SW V2.0 and above)*
9 =	Error number	**24 =**	Master value, actual freq. with slip, *"Master value, actual freq. with slip"* *(SW V2.0 and above)*
10 =	... 11 Reserved	**53 =**	*... 57 Reserved*
12 =	BusIO Out Bits 0...7		

Scaling details: Section: 8.8

P544	Actual bus value 2 *(Actual bus value 2)*		S	P

0 ... 24
{ 0 }

This parameter is identical to P543.

Condition is PPO 2 or PPO 4 type (P507).

[1] The assignment of the digital 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 520E and above)	Bit 6 = DigIn 7 (SK 520E and above)	Bit 7 = Dig. func. AIN1
Bit 8 = Dig. func. AIN1 AIN2	Bit 9 = DigIn 8 (SK 540E and above)	Bit 10 = DigIn 1, 1.IOE (SK 540E and above)	Bit 11 = DigIn 2, 1.IOE (SK 540E and above)
Bit 12 = Out 1/ MFR1	Bit 13 = Out 2/ MFR2	Bit 14 = Out 3/ DOUT1 (SK 520E and above)	Bit 15 = Out 4/ DOUT2 (SK 520E and above)

P545	**Actual bus value 3** *(Actual bus value 3)*		S	P

0 ... 24
{ 0 }

This parameter is identical to P543.
Condition is PPO 2 or PPO 4 type (P507).

P546	**Digital Bus setpoint 1** *(Function of bus setpoint 1)*		S	P

0 ... 55
{ 1 }

In this parameter, a function is allocated to the output setpoint 1 during bus actuation.
The possible analog functions can be found in the following table.

NOTE: For further details please refer to the manual for the frequency inverter (P400, P546), the relevant BUS operating instructions or the manuals BU 0510 / BU0550.

0 =	Off	**16 =**	Process controller lead
1 =	Setpoint frequency	**17 =**	BusIO In Bits 0...7
2 =	Torque current limit *(P112)*	**18 =**	Curve travel calculator
3 =	Actual frequency PID	**19 =**	Set relays, "*Output status"* (P434/441/450/455=38)
4 =	Frequency addition	**20 =**	Set analog output (P418=31)
5 =	Frequency subtraction	**21 =**	*... 45 reserved from SK 530E and above à BU 0510*
6 =	Current limit *(P536)*	**46 =**	Setpoint Torque processreg., *"Setpoint torque process controller"*
7 =	Maximum frequency *(P105)*	**47 =**	*reserved from SK 530E and above à BU 0510*
8 =	Actual PID frequency limited	**48 =**	Motor temperature *(SK 540E and above)*
9 =	Actual PID frequency monitored	**49 =**	*reserved from SK 540E and above à BU 0510*
10 =	Torque servo mode *(P300)*	**53 =**	d-correction F process *(SK 540E and above)*
11 =	Torque precontrol *(P214)*	**54 =**	d-correction Torque *(SK 540E and above)*
12 =	*Reserved*	**55 =**	d-correction F+torque *(SK 540E and above)*
13 =	Multiplication	**56 =**	*reserved from SK 540E and above à BU 0510*
14 =	Process controller actual value	**57 =**	*reserved from SK 540E and above à BU 0510*
15 =	Process controller setpoint		

Scaling details: See Section 8.8

P547	**Digital Bus setpoint 2** *(Function of bus setpoint 2)*		S	P

0 ... 55
{ 0 }

This parameter is identical to P546.

P548	**Digital Bus setpoint 3** *(Function of bus setpoint 3)*		S	P

0 ... 55
{ 0 }

This parameter is identical to P546.

P549	Pot Box function *(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 **0**)

- **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 =** Servo mode torque
- **11 =** Torque precontrol
- **12 =** *Reserved*
- **13 =** Multiplication
- **14 =** Process controller actual value
- **15 =** Process controller setpoint
- **16 =** Process controller lead

P550	Back up data record *(Back up data record)*			

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 change

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

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

3 = FI ß à 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.

P551	Drive profile *(Drive profile)*		S	

0 … 1
{ 0 }

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

System	**CANopen**	**DeviceNet**	**InterBus**
Technology module	SK TUx-CAO	SK TUx-DEV	SK TUx-IBS
Setting			
0 = OFF =	USS protocol (Profile "Nord")		
1 = ON =	DS402 profile	AC Drives profile	Drivecom profile

Note **Activation of profiles**

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

P552	[-01] [-02]	CAN master circle *(CAN master cycle time)*		S	

0 … 100 ms
{ all 0 }

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

[-01] = CAN Master function, cycle time for CAN/CANopen Master functionality

[-02] = CANopen absolute encoder, cycle time of CANopen absolute encoder

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 encoder no longer triggers at 50ms, but rather at 150ms.

P554	Chopper min. threshold *(Minimum chopper threshold)*		S	

65 ... 101 %
{ 65 }

The switching threshold of the brake chopper can be influenced with this parameter. An optimized 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 switch off of the FI.

The setting **101%** also switches off the brake chopper at the 65% switching threshold. In addition, with this setting, monitoring is also active if the FI has not been enabled. I.e. for example if the link circuit voltage in the FI increases above the threshold in "Standby" status (e.g. due to a mains fault), the brake chopper is activated. However, in case of an FI fault, the brake chopper is generally inactive.

P555	P - limit chopper *(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, the inverter switches off the current to the resistor, irrespective of the level of the link voltage.

The result would be an overvoltage switch-off of the FI.

$$k[\%] = \frac{R * P_{\max BR}}{U_{\max}^{2}} * 100\%$$

The correct percentage value is calculated as follows:

R = Resistance of the brake resistor
P_{maxBR} = Momentary peak power of the brake resistor
U_{max} = Chopper switching wave of the FI
1~ 115/230V Þ 440V=
3~ 230V~ Þ 500V=
3~ 400V~ Þ 1000V=

P556	Braking resistor *(Brake resistor)*		S	

1 ... 400 W
{ 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	Brake resistor type *(Brake resistor power)*		S	

0.00 ... 320.00 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	Flux delay *(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 = Switched off

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 *(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	Parameter, Saving mode *(Saving mode parameter)*		S	

0 ... 2
{ 1 }

0 = **Only in RAM**, 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 = **RAM and EEPROM**, all parameter changes are automatically written to the EEPROM and remain stored there even if the FI is disconnected from the mains supply.

2 = **OFF**, no saving in RAM and EEPROM possible (no parameter changes are accepted)

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.

Positioning

The parameter group P6xx is used to set the POSICON positioning control and is included above the version SK 530E.

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

Information

Parameter	Setting value / Description / Note		Supervisor	Parameter set

P700 [-01] ... [-03]	Present operating status *(Present operating status)*			

0.0 ... 25.4

Display of current messages for the actual operating status of the frequency inverter such as errors, warnings or the cause of a switch-on block. For details of the messages.

[-01] = Present fault, shows the currently active (unacknowledged) fault (Section **0**).

[-02] = Present warning, indicates a current warning message .

[-03] = Reason for disabled starting, indicates the reason for an active start disable.

NOTE

SimpleBox/ControlBox: with the SimpleBox or ControlBox only warning messages and errors can be displayed. Display of the messages is in encoded form. For the description of the codes (warning/error numbers), please refer to the tables in Sections **0** and 6.3.

ParameterBox: with the ParameterBox the messages are displayed in plain text. In addition, the reason for a possible disabling of starting can also be displayed.

Bus: The display of bus-level error messages is made in decimal integer format. If this value is divided by 10, the display corresponds to that which is listed in Section **0**.

Example: Display: 20 → Error number 2.0

P701	[-01] ... [-05]	**Last fault** *(Last fault 1...5)*			

0.0 ... 25.4

This parameter stores the last 5 faults.

The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.

P702	[-01] ... [-05]	**Last frequency error** *(Last frequency error 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 errors are stored.

The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK- / ENTER key to read the stored error code.

P703	[-01] ... [-05]	**Current last error** *(Last current error 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 SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.

P704	[-01] ... [-05]	**Volt. last error** ***(Last voltage error 1...5)***		**S**	

0 ... 600 V AC

This parameter stores the output voltage that was being delivered at the time the fault occurred. The values of the last 5 errors are stored.

The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.

P705	[-01] ... [-05]	**Last link circuit error** *(Last link circuit error 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 SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.

P706 [-01] ... [-05] P set last error

(Parameter set, last error 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 SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.

P707 [-01] ... [-03] Software-Version

(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 State of digital in.

(Status of digital inputs)

000000000 ... 111111111 (binary) (Display with *SK-TU3-PAR)

or

0000 ... 01FF (hex) (Display with *SK-TU3-CTR -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 520E and above)*
Bit 6 = Digital input 7 *(SK 520E and above)*
Bit 7 = Analog input 1 *(digital function)*
Bit 8 = Analog input 2 *(digital function)*
Bit 9 = Digital input 8 *(SK 540E and above)*
Bit 10 = Digital input 1/1 IOE *(SK 540E and above)*
Bit 11 = Digital input 2/1 IOE *(SK 540E and above)*
Bit 12 = Digital input 3/1 IOE *(SK 540E and above)*
Bit 13 = Digital input 4/1 IOE *(SK 540E and above)*
Bit 14 = Digital input 1/2 IOE *(SK 540E and above)*
Bit 15 = Digital input 2/2 IOE *(SK 540E and above)*

	Bits 11-8	Bits 7-4	Bits 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).

P709 Voltage analog input 1

(Voltage analog input 1)

-10.00 ... 10.00 V

Displays the measured analog input value 1.

P710	**Analog output voltage** *(Analog output voltage)*			
0.0 ... 10.0 V	Displays the value which is output from analog output 1.			

P711	**State of relays** *(State of digital outputs)*			
000000000 ... 111111111 (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 =** Relay 1 **Bit 1 =** Relay 2 **Bit 2 =** Digital output 1 *(SK 520E and above)* **Bit 3 =** Digital output 2 *(SK 520E and above)* **Bit 4 =** Analog output 1 *(digital function)*		**Bit 5 =** Digital output 3 *(SK 540E and above)* **Bit 6 =** Digital output 1/1 IOE *(SK 540E and above)* **Bit 7 =** Digital output 2/1 IOE *(SK 540E and above)* **Bit 8 =** Digital output 1/2 IOE *(SK 540E and above)* **Bit 9 =** Digital output 2/2 IOE *(SK 540E and above)*	

P712	**Voltage analog input 2** *(Voltage analog input 2)*			
-10.00 ... 10.00 V	Displays the measured analog input value 2.			

P714	**Operating time** *(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	**Running time** *(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** *(Actual frequency)*			
-400.0 ... 400.0 Hz	Displays the actual output frequency.			

P717	**Current speed** *(Actual rotation speed)*			
-9999 ... 9999 rpm	Displays the actual motor speed calculated by the FI.			

P718 [-01] ... [-03]	**Current set freq.** *(Actual setpoint frequency)*			
-400.0 ... 400.0 Hz	Displays the frequency specified by the setpoint. (See also Section **0 Setpoint processing**) **[-01] =** Actual setpoint frequency from the setpoint source **[-02] =** Actual setpoint frequency after processing in the FI status machine **[-03] =** Actual setpoint frequency after frequency ramp			

P719	**Actual current** *(Actual current)*			
0.0 ... 999.9 A	Displays the actual output current.			

P720	**Act. torque current** *(Actual 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. à negative values = generator, à positive values = drive			

P721	**Actual field current** *(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	**Current voltage** *(Actual voltage)*			
0 ... 500 V	Displays the actual AC voltage supplied by the FI output.			

P723	**Voltage -d** *(Actual voltage component dU)*		**S**	
-500 ... 500 V	Displays the actual field voltage component.			

P724	**Voltage -q** *(Actual voltage component Uq)*		**S**	
-500 ... 500 V	Displays the actual torque voltage component.			

P725	**Current Cos phi** *(Actual cosj)*			
0.00 ... 1.00	Displays the actual calculated cos j of the drive.			

P726	**Apparent power** *(Apparent power)*			
0.00 ... 300.00 kVA	Displays the actual calculated apparent power. The basis for calculation are the motor data P201...P209.			

P727	**Mechanical power** *(Mechanical 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	**Input voltage** *(Mains voltage)*			
0 ... 1000 V	Displays the actual mains voltage at the FI input.			

P729	**Torque** *(Torque)*			
-400 ... 400 %	Displays the actual calculated torque. Basis for calculation are the motor data P201...P209.			

P730	**Field** *(Field)*			
0 ... 100 %	Displays the actual field in the motor calculated by the FI. The basis for calculation are the motor data P201...P209.			

P731	**Parameter set** *(Actual parameter set)*			
0 ... 3	Shows the actual operating parameter set. 0 = Parameter set 1 1 = Parameter set 2 2 = Parameter set 3 3 = Parameter set 4			

P732	**Phase U current** *(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	Phase V current *(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.			

P734	Phase W current *(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	Speed encoder *(Speed encoder)*	SK 520E or higher	S	
-9999 ... 9999 rpm	Displays the actual rotation speed supplied by the incremental encoder. For this, P301 must be correctly set.			

P736	D.c. link voltage *(DC link voltage)*			
0 ... 1000 V DC	Displays the actual link voltage.			

P737	Usage rate brakeres. *(Actual brake resistor usage rate)*			
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 P557, 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	Usage rate motor *(Actual utilisation of motor)*			
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	Heat sink temp. *(Actual temperature of heat sink)*			
0 ... 150 °C.	Displays the actual temperature of the FI heat sink. This value is used for overtemperature switch-off (E001).			

P740	[-01] ... [-13]	Process Data Bus In *(Process data Bus In)*		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 main 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 master function value (Broadcast), if P509 = 9/10 (P510 [-02])	

P741	[-01] ... [-13]	Process Data Bus Out *(Process data Bus Out)*		S	
0000 ... FFFF (hex)	This parameter provides information 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 master function **[-12] =** Actual value 2 master function **[-13] =** Actual value 3 master function		Actual value of master function P502 / P503.	

P742	Data base version *(Database version)*		S	
0 ... 9999	Displays the internal database version of the FI.			

P743	Inverter type *(Inverter type)*			
0.00 ... 250.00	Displays the inverter power in kW, e.g. "1.50" Þ FI with 1.5 kW nominal power.			

P744 Configuration
(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 … 515E	**= 0000**	**SK 530E … 535E**	**= 0201**
SK 520E	**= 0101**	**SK 540E … 545E**	**= 0301**

P745 Module version
(Module version)

-3276.8 ... 3276.8

Version status (software version) of the technology unit (SK TU3-xxx), but only when own processor is present, i.e. not for SK TU3-CTR.

Have this data available if you have a technical query.

P746 Module status
(Module status)

S

0000 ... FFFF (hex)

Shows the actual status (readiness, error, communication) of the technology unit (SK TU3-xxx), but only when own processor is present, i.e. 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 Volt. Range
(Inverter voltage range)

0 ... 2

Indicates the mains voltage range for which this device is specified.

0 = 100...120V **1 =** 200...240V **2 =** 380...480V

P748 [-01] ... [-03] Status CANopen
(CANopen status)

SK 520E or higher

S

0000 ... FFFF (hex)

[01] = CANbus/CANopen status

Bit 0 = 24V bus voltage supply
Bit 1 = CANbus in "Bus Warning" status
Bit 2 = CANbus in "Bus Off" status
Bit 3 ... Bit 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

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

[-02] = reserved

[-03] = reserved

P750	Stat. overcurrent *(Overcurrent statistics)*		S	
0 ... 9999	Number of overcurrent messages during the operating period P714.			

P751	Stat. Overvoltage *(Overvoltage statistics))*		S	
0 ... 9999	Number of overvoltage messages during the operating period P714.			

P752	Stat. mains failure *(Mains failure statistics)*		S	
0 ... 9999	Number of mains faults during the operating period P714.			

P753	Stat. overtemperature *(Overheating statistics)*		S	
0 ... 9999	Number of overtemperature faults during the operating period P714.			

P754	Stat. parameter lost *(Parameter loss statistics)*		S	
0 ... 9999	Number of parameters lost during the operating period P714.			

P755	Stat. system error *(System fault statistics)*		S	
0 ... 9999	Number of system faults during the operating period P714.			

P756	Stat. Timeout *(Time out statistics)*		S	
0 ... 9999	Number of Time out errors during the operating period P714.			

P757	Stat. Customer error *(Customer fault statistics)*		S	
0 ... 9999	Number of Customer Watchdog faults during the operating period P714.			

P799 [-01] ... [-05]	Op.-time last error *(Operating time, last 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.			

6. Operating status messages

According to the cause, motor controllers and technology units generate appropriate messages if they deviate from their normal operating status. There is a differentiation between warning and error messages. If the frequency inverter is in the status "Start disabled", the reason for this can also be displayed.

The messages generated for the motor controller are displayed in the corresponding array of parameter (P700). The message displays for technology units are described in the relevant supplementary instructions.

Frequency inverter switch-on block

If the frequency inverter is in the status "Not Ready" or "Start Disabled", the reason for this is indicated in the third array element of parameter (P700).

Display is only possible with the NORD CON software or the ParameterBox.

Warning messages

Warning messages are generated as soon as a defined limit is reached. However this does not cause the frequency inverter to switch off. These messages can be displayed via the array element [-02] in parameter (P700) until either the reason for the warning is no longer present or the frequency inverter has gone into a fault state with an error message.

Fault messages

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

The following options are available to reset a fault (acknowledge):

- by switching the mains off and on again,
- by an appropriately programmed digital input (P420 = Function 12),
- by switching off the “enable” on the frequency inverter
  (if no digital input is programmed for acknowledgement),
- by Bus acknowledgement or
- by P506, the automatic error acknowledgement.

6.1 Display of messages

LED displays

The status of the FI is indicted by integrated status LEDs, which are visible from the outside in the state as delivered. According to the type of FI, this is a two-colour LED (DS = DeviceState) or two single-colour LEDs (DS DeviceState and DE = DeviceError).

Meaning:	**Green** indicates readiness and the present of mains voltage. In operation, the level of overload at the FI output is shown with an increasingly rapid flashing code. **Red** Signals the presence of an error by flashing according to the number code of the error. This flashing code (e.g.: E003 = 3x flashing) indicates the error groups.

SimpleBox / ControlBox display

The **SimpleBox** or **ControlBox** displays an error with its number and the prefix "E". In addition, the current fault can be displayed in array element [-01] of parameter (P700). The last error messages are stored in parameter P701. Further information on inverter status at the time that the error occurs 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.

In contrast, warning messages are prefixed with "C" ("Cxxx") and cannot be acknowledged. They disappear automatically when the reason for them is no longer present or the frequency inverter has switched to the "Error" state. Display of the message is suppressed if the warning appears during parameterisation.

The present warning message can be displayed in detail at any time in array element [-02] of parameter (P700).

The reason for an existing disabled switch on cannot be displayed with the SimpleBox or the ControlBox.

ParameterBox display

The ParameterBox displays the messages in plain text.

6.2 Messages

Fault messages

Display in the SimpleBox / ControlBox		**Fault**	**Cause**
Group	**Details in P700[-01] / P701**	**Text in the ParameterBox**	• **Remedy**
E001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring measurements are outside of the permissible temperature range, i.e. the error is triggered if the permissible lower limit is undershot or the permissible upper temperature limit is exceeded. • Depending on the cause: Reduce or increase the ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
	1.1	**Overtemp. FI internal** *"Internal FI overtemperature"* (interior of FI)	
E002	**2.0**	**Overtemp. Motor PTC** *"Overtemperature motor thermistor "* Up to SK 535E, up to size 4: Only if digital input 5 is parameterised to function "13"	Motor temperature sensor (PTC) has triggered • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Overtemp. Motor I²t** *"Motor overtemperature I²t"* Only if I^2t motor (P535) is programmed.	I^2t motor has triggered (calculated overtemperature of motor) • Reduce motor load • Increase motor speed
E003	**3.0**	**Overcurrent, I^2t limit**	Inverter: I^2t limit has triggered, e.g. > 1.5 x I_n for 60s (please also note P504) • Continuous overload at FI output

	3.1	**Overcurrent, chopper I^2t**	Brake chopper: I^2t limit has triggered, 1.5x value attained for 60s (also note P554, if present, as well as P555, P556, P557) • Avoid overload of brake 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)
	3.3	**Overcurrent IGBT** 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 • Motor cable is too long • Use external output choke • Brake resistor defective or resistance too low **The occurrence of the error can greatly reduce the service life of the FI and even cause its destruction.**
	4.1	**Overcurrent measurement** *"Overcurrent measurement"*	P537 (pulse current switch-off) was reached 3x within 50ms (only possible if P112 and P536 are disabled) • FI is overloaded • Drive sluggish, under-dimensioned, • Ramps (P102/P103) too steep -> Increase ramp time • Check motor data (P201 … P209)
E005	**5.0**	**Overvoltage UZW**	Inverter link voltage is too high • Extend deceleration time (P103) • If necessary, set switch-off mode (P108) with delay (not for lifting equipment) • Extend emergency stop time (P426) FIs with brake chopper: • Reduce energy return by means of a braking resistance • Check the function of the connected brake resistor (broken cable?) • The resistance of the connected brake resistor is too high
	5.1	**Mains overvoltage**	Mains voltage is too high • See technical data
E006	**6.0**	**Charging error**	Link circuit voltage is too low • Mains voltage too low • See technical data
	6.1	**Mains undervoltage**	Mains voltage too low • See technical data
E007	**7.0**	**Mains phase error**	Mains connection fault • A mains phase is not connected • Mains asymmetrical
	OFF	**---**	The FI switches off normally (mains switch-off)

E008	**8.0**	**Parameter loss** (maximum EEPROM value exceeded)	Error in EEPROM data • The software version of the stored data set is not compatible with the software version of the FI. **NOTE:** Faulty parameters are automatically reloaded (default setting). • EMC faults (see also E020)
	8.1	**Inverter type incorrect**	• EEPROM faulty
	8.2	**External copying error** (ControlBox)	• Check ControlBox for correct position. • ControlBox EEPROM faulty (P550 = 1).
	8.3	**EEPROM KSE error** (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	**Internal EEPROM error** (Database version incorrect)	
	8.7	**EEPR copy not the same**	
E009	**---**	*Display in ParameterBox not required*	*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**	**Bus Timeout**	Telegram time-out / Bus off 24V int. CANbus) Data transfer is faulty. Check P513. • Check external Bus connection. • Check the program sequence of the Bus protocol • Check Bus Master. • Check 24V supply of internal CAN/CANopen Bus. • *Nodeguarding* error (internal CANopen) • *Bus Off* error (internal CANbus)
	10.2	**Bus Timeout Option**	Bus module telegram timeout • Telegram transfer is faulty. • Check external connection. • Check bus protocol program sequence. • Check Bus Master.
	10.4	**Init error Option**	Bus module initialisation failure • Check Bus module power supply. • Check P746. • Bus module not correctly plugged in.
	10.1	**System error option**	Bus module system error • Further details can be found in the respective supplementary Bus operating instructions.
	10.3		
	10.5		
	10.6		
	10.7		
	10.8	**Option error**	External module communication failure • Connection fault / error in the external module • Brief interruption (<1sec) of the 24 V supply of the internal CAN/CANopen bus

E011	**11.0**	**Customer interface**	Error in analog-digital converter • Internal customer unit (internal data bus) 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**	**External watchdog**	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<. • Check connections • Check P460 setting
	12.1	**Motor limit** *"Motor switch-off limit"*	The motor switch-off limit P534 [-01] has triggered. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Generator limit** *"Generator switch-off limit"*	The generator switch-off limit P534 [-02] has triggered. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.5	**Load limit**	Switch-off due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528). • Change monitoring mode (P529).
	12.8	**Analog In minimum**	Switch-off due to undershooting of the 0% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2"
	12.9	**Analog In maximum**	Switch-off due to overshooting of the 100% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2"
E013	**13.0**	**Encoder error**	No signal from encoder • Check 5V sensor if present. • Check supply voltage of encoder.
	13.1	**Speed slip error** *"Speed slip error"*	The slip speed error limit was reached. • Increase setting in P327.
	13.2	**Shut-down monitoring**	The slip error monitoring has triggered; the motor could not follow the setpoint. • Check motor data P201-P209! (Important for the current controller) • Check motor circuit. • In servo mode, check the encoder setting P300 and check the following • Increase setting value for torque limit in P112. • Increase setting value for current limit in P536. • Check deceleration time P103 and extend if necessary
	13.5	**Reserved**	Error message for POSICON à see supplementary instructions
	13.6	**Reserved**	Error message for POSICON à see supplementary instructions

E014	**---**	**Reserved**	Error message for POSICON à see supplementary instructions
E015	**---**	**Reserved**	
E016	**16.0**	**Motor phase error**	A motor phase is not connected. • Check P539 • Check motor connection
	16.1	**Magnetisation current monitoring** *"Magnetisation current monitoring"*	Required exciting current not achieved at moment of switch-on. • Check P539 • Check motor connection
E018	**18.0**	**Reserved**	Error message for "Safe Pulse Block" à see supplementary instructions
E019	**19.0**	**Parameter identification** *"Parameter identification"*	Automatic identification of the connected motor was unsuccessful • Check motor connection • Check pre-set motor data (P201 ... P209)
	19.1	**Star / Delta circuit incorrect** *"Star / delta motor circuit incorrect*	
E020 E021	**20.0**	**Reserved**	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use additional external mains filter. • Earth the FI very well.
	20.1	**Watchdog**	
	20.2	**Stack Overflow**	
	20.3	**Stack underflow**	
	20.4	**Undefined Opcode**	
	20.5	**Protected Instruct.** *„Protected Instruction“*	
	20.6	**Illegal Word Access**	
	20.7	**Illegal Inst. Access** *“Illegal Instruction Access”*	
	20.8	**Program Memory Error** *"Program memory error"* **(**EEPROM error)	
	20.9	**Memory Protection Error**	
	21.0	**NMI Error** (not used by hardware)	
	21.1	**PLL Error**	
	21.2	**ADU Error** "Overrun"	
	21.3	**PMI Error** "Access Error"	
	21.4	**Userstack Overflow**	
E022	**---**	**Reserved**	Error message for PLC à see supplementary instructions
E023	**---**	**Reserved**	Error message for PLC à see supplementary instructions

Warning messages

Display in the SimpleBox / ControlBox		Warning Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-02]**		
C001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring Warning: permissible temperature limit reached. • Reduce ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
C002	**2.0**	**Overtemp. Motor PTC** *"Overtemperature motor thermistor "*	Warning from motor temperature sensor (triggering threshold reached) • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Overtemp. Motor I²t** *"Motor overtemperature I²t"* Only if I^2t motor (P535) is programmed.	Warning: I2t- motor monitoring (1.3 times the rated current reached for the time period specified in (P535)) • Reduce motor load • Increase motor speed
C003	**3.0**	**Overcurrent, I^2t limit**	Warning: Inverter: I^2t limit has triggered, e.g. > 1.3 x I_n for 60s (please also note P504) • Continuous overload at FI output
	3.1	**Overcurrent, chopper I^2t**	Warning: I^2t limit for the brake chopper has triggered, 1.3x value attained for 60s (also note P554, if present, as well as P555, P556, P557) • Avoid overload of brake resistance
	3.5	**Torque current limit**	Warning: Torque current limit reached • Check (P112)
	3.6	**Current limit**	Warning: Current limit reached • Check (P536)
C004	**4.1**	**Overcurrent measurement** *"Overcurrent measurement"*	Warning: pulse switch off is active The limit for activation of pulse switch off (P537) has been reached (only possible if P112 and P536 are switched off) • FI is overloaded • Drive sluggish, insufficiently sized • Ramps (P102/P103) too steep -> Increase ramp time • Check motor data (P201 … P209) • Switch off slip compensation (P212)

C008	**8.0**	**Parameter loss**	Warning: One of the cyclically saved messages such as *operating hours* or *enabling time* could not be saved successfully. The warning disappears as soon as saving can be successfully performed.
C012	**12.1**	**Motor limit** *"Motor switch-off limit"*	Warning: 80 % of the drive torque switch-off limit (P534 [-01]) has been exceeded. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Generator limit** *"Generator switch-off limit"*	Warning: 80 % of the generator switch-off limit (P534 [-02]) has been exceeded. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.5	**Load limit**	Warning due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528).

Switch-on block messages

Display in the SimpleBox / ControlBox		Reason: Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-03]**		
I000	**0.1**	**Disable voltage from IO**	If the function "disable voltage"is parameterised, input (P420 / P480) is at Low • Set "input high" • Check signal cable (broken cable)
	0.2	**IO fast stop**	If the function "fast stop"is parameterised, input (P420 / P480) is at Low • Set "input high" • Check signal cable (broken cable)
	0.3	**Disable voltage from bus**	• For bus operation (P509): control word Bit 1 "Low"
	0.4	**Bus fast stop**	• For bus operation (P509): control word Bit 2 "Low"
	0.5	**Enable on start**	Enable signal (control word, Dig I/O or Bus I/O) was already applied during the initialisation phase (after mains "ON", or control voltage "ON"). • Only issue enable signal after completion of initialisation (i.e. when the FI is ready) • Activation of "Automatic Start" (P428)
I006	**6.0**	**Charging error**	Charging relay not energised, because: • Mains / link voltage too low • Mains failure • Evacuation run activated ((P420) / (P480))
I011	**11.0**	**Analog Stop**	If an analog input of the frequency inverter or a connected IO extension is configured to detect cable breaks (2-10V signal or 4-20mA signal), the frequency inverter switches to the status "Not ready for switch-on" if the analog signal undershoots the value **1V** or **2mA** This also occurs if the relevant analog input is parameterised to function "0" ("no function"). • Check connections
I014	**14.4**	**Reserved**	Error message for POSICON à see supplementary instructions
I018	**18.0**	**Reserved**	Information message for "Safe Stop" function à see supplementary instructions

7. Technical data

7.1 General Data SK 500E

Function	Specification	
Output frequency	0.0 ... 400.0Hz	
Pulse frequency	3.0 ... 16.0kHz, standard setting = 6kHz (from size 8 and above = 4kHz) Power reduction > 8kHz for 230V devices, >6kHz for 400V devices.	
Typical overload capacity	150% for 60s, 200% for 3.5s	
Efficiency of frequency inverter	approx. 95% according to size	
Insulation resistance	> 5MΩ	
Ambient temperature	0°C ... +40°C (S1-100% ED), 0°C ... +50°C (S3-70% ED 10min)	
Storage and transport temperature	-20°C ... +60 /70°C	
Long-term storage	See Section 9.1	
Protection class	IP20	
Max. installation altitude above sea level	- up to 1000m: no reduction in power - 1000...4000m: 1%/ 100m power reduction *Up to 2000m: Overvoltage category 3 *up to 4,000m: Overvoltage category 2, mains input: Overvoltage protection required	
Ambient conditions	Transport (IEC 60721-3-2): Vibration: 2M1 Operation (IEC 60721-3-3): Vibration: 3M4; climate: 3K3;	
Waiting period between 2 x "Mains on"	60 sec for all devices in normal operating cycle	
Protective measures against	Overtemperature of the frequency inverter, overvoltage and undervoltage	Short-circuit, earthing fault, overload
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic	
Motor temperature monitoring	I^2t-Motor (UL approval), PTC / Bi-metal switch (no UL approval)	
Interfaces (integrated)	RS 485 (USS) RS 232 (single slave)	CANbus (except SK 50xE) CANopen (except SK 50xE) Modbus RTU (SK 540E and above)
Electrical isolation	Control terminals (digital and analog inputs)	
Connection terminals	For details of tightening torques for the terminals: see Section 2.10.4 and 2.10.5.	
External supply voltage, control unit SK 5x5E	Size 1-4: 18…30V DC, at least 800mA Size 5-7: 24…30V DC, at least 1000mA size 8-9: 24…30V DC, at least 3000mA	
Analog setpoint input / PID input	2x (size 5 and above: - 10V…) 0...10V, 0/4...20mA, scalable, digital 7.5...30V	
Analog setpoint resolution	10 bit based on measurement range	
Setpoint consistency	analog < 1%digital < 0.02%	
Digital input	5x (2.5V) 7.5...30V, R_i = (2.2kW) 6.1kW, cycle time = 1...2ms Additionally for SK 520E and above: 2x 7.5...30V, R_i = 6.1kW, cycle time = 1...2ms	
Control outputs	2x relay 28V DC / 230V AC, 2A (output 1/2 - K1/K2) Additionally, with SK 520E/530E: 2x DOUT 15V, 20mA or Additionally, with SK 535E/545E: 2x DOUT 18…30V (depending on VI), 20mA, or 2x DOUT 18…30V, 200mA Size 5 and above (Output 3/4 - DOUT1/2)	
Analog output	0 ... 10V scalable	

7.2 Electrical data

The following tables include the data relevant for UL.

Details of the UL /cUL approval conditions can be found in Section **0** Use of mains fuses which are faster than those stated is permissible.

7.2.1 Electrical data 115V

FI type (size 1):		SK 5xxE…	-250-112-O	-370-112-O	-550-112-O	-750-112-O	-111-112-O
Nominal motor power (4-pole standard motor)		230V	0.25hp	0.37 kW	0.55 kW	0.75hp	1.10 kW**
		240V	1/3 hp	½ hp	¾ hp	1 hp	1 ½ hp**
Input	Mains voltage	**1~ 115V**	**1 AC** 110 … 120V, ± 10%, 47 … 63Hz				
	Input current	**1~** rms	8.9 A	11.0 A	13.1 A	20.1 A	23.5 A
		1~ FLA	8.9 A	10.8 A	13.1 A	20.1 A	23.5 A
	Recommended mains fuse*	1 AC slow-acting	10 A	15 A	15 A	20 A	25 A
		CB	10 A	15 A	25 A	20 A	25 A
	Permissible mains fuses for UL*	Fuse, 300V	10 A	20 A	20 A	25 A	25 A
		Bussmann	FRS-R-10	FRS-R-15	FRS-R-20	FRS-R-25	FRS-R-25
		CB	10 A	15 A	20 A	25 A	25 A
Output	Output voltage	**3~ 230V**	3 AC 0 – 2x mains voltage				
	Output current	rms	1.7 A	2.2 A	3.0 A	4.0 A	5.3 A
		FLA	1.7 A	2.1 A	3.0 A	4.0 A	5.3 A
Min. braking resistor		Accessories	240 W	190 W	140 W	100 W	75 W
Type of ventilation			Free convection		Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C		
Weight		Approx. [kg]	1.4				

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

** S3 / 80 % 10 Min.

7.2.2 Electrical data 230V

FI type (size 1):		SK 5xxE…	-250-323-A	-370-323-A	-550-323-A	-750-323-A
Nominal motor power (4-pole standard motor)		230V	0.25hp	0.37 kW	0.55 kW	0.75hp
		240V	1/3 hp	½ hp	¾ hp	1 hp
Input	Mains voltage	**1~ /3~ 230V**	**1 / 3 AC** 200 … 240V, ± 10%, 47 … 63Hz			
	Input current	**1~ /3~** rms	3.7 A / 2.4 A	4.8 A / 3.1 A	6.5 A / 4.2 A	8.7 A / 5.6 A
		1~ /3~ FLA	3.7 A / 2.4 A	4.8 A / 3.1 A	6.4 A / 4.1 A	8.6 A / 5.5 A
	Recommended mains fuse*	**1~ /3~** 1 AC slow-acting	6 A / 6 A	6 A / 6 A	10 A / 10 A	15 A / 10 A
		CB	5 A / 5 A	5 A / 5 A	10 A / 10 A	10 A / 10 A
	Permissible mains fuses for UL*	Fuse, 300V	6 A / 6 A	6 A / 6 A	10 A / 10 A	25 A / 10 A
		Bussmann	FRS-R-6	FRS-R-6	FRS-R-10	FRS-R-15 /-10
		CB	5 A / 5 A	5 A / 5 A	10 A / 10 A	10 A / 10 A
Output	Output voltage	**3~ 230V**	3 AC 0 - Mains voltage			
	Output current	rms	1.7 A	2.2 A	3.0 A	4.0 A
		FLA	1.7 A	2.2 A	2.9 A	3.9 A
Min. braking resistor		Accessories	240 W	190 W	140 W	100 W
Type of ventilation			Free convection			
Weight		Approx. [kg]	1.4			

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

FI type (size 2/ 3):		SK 5xxE…	-111-323-A	-151-323-A	-221-323-A	-301-323-A	-401-323-A
Nominal motor power (4-pole standard motor)		230V	1.1 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW
		240V	1½ hp	2 hp	3 hp	4 hp	5 hp
Input	Mains voltage	**1~ /3~ 230V**	**1 / 3 AC** 200 … 240V, ± 10%, 47 … 63Hz			**3 AC** 200 … 240V, ± 10%, 47 … 63Hz	
	Input current	**1~ /3~** rms	12.0 A / 7.7 A	15.2 A / 9.8 A	19.6 A/ 13.3 A	- / 17.5 A	- / 22.4 A
		1~ /3~ FLA	11.9 A / 7.6 A	15.0 A / 9.7 A	19.4 A/ 13.1 A	- / 17.2 A	- / 22.0 A
	Recommended mains fuse*	**1~ /3~** 1 AC slow-acting	15 A / 10 A	20 A / 10 A	25 A / 20 A	- / 20 A	- / 25 A
		CB	- / 10 A	- / 10 A	- / -	- / 20 A	- / 25 A
	Permissible mains fuses for UL*	Fuse, 300V	30 A / 10 A	30 A / 10 A	30 A / 30 A	- / 30 A	- / 30 A
		Bussmann	FRS-R-15 /-10	FRS-R-20 /-10	FRS-R-25 /-20	- / FRS-R-20	- / FRS-R-25
		CB	- / 10 A	- / 10 A	- / -	- / 25 A	- / 25 A
Output	Output voltage	**3~ 230V**	3 AC 0 - Mains voltage				
	Output current	rms	5.5 A	7.0 A	9.5 A	12.5 A	16.0 A
		FLA	5.4 A	6.9 A	9.3 A**	12.3 A	15.7 A
Min. braking resistor		Accessories	75 W	62 W	46 W	35 W	26 W
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C				
Weight		Approx. [kg]	1.8			2.7	

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

** for single-phase mains supply of SK 5xxE-221-323-A: FLA Output = 8.8 A

FI type (size 5/ 6 / 7):		SK 5xxE…	-551-323-A	-751-323-A	-112-323-A	-152-323-A	-182-323-A
Nominal motor power (4-pole standard motor)		230V	5.5 kW	7.5 kW	11.0 kW	15.0 kW	18.5 kW
		240V	7½ hp	10 hp	15 hp	20 hp	25 hp
Input	Mains voltage	**3~ 230V**	**3 AC** 200 … 240V, ± 10%, 47 … 63Hz				
	Input current	rms	30.8 A	39.2 A	64.4 A	84.0 A	102 A
		FLA	30.8 A	39.2 A	58.8 A	75.6 A	95.2 A
	Recommended mains fuse*	1 AC slow-acting	30hp	40 A	60 A	100 A	100 A
		CB	35 A	50 A	60 A	100 A	100 A
	Permissible mains fuses for UL*	Fuse, 300V	30hp	40 A	60 A	100 A	100 A
		Bussmann	FRS-R-30	FRS-R-40	FRS-R-60	FRS-R-100	FRS-R-100
		CB	60 A	60 A	60 A	100 A	100 A
Output	Output voltage	**3~ 230V**	3 AC 0 - Mains voltage				
	Output current	rms	22.0 A	28.0 A	46.0 A	60.0 A	73.0 A
		FLA	22.0 A	28.0 A	42.0 A	54.0 A	68.0 A
Min. braking resistor		Accessories	19 W	14 W	10 W	7 W	6 W
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C				
Weight		Approx. [kg]	8		10.3	15	

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

7.2.3 Electrical data 400V

FI type (size 1/ 2):		SK 5xxE…	-550-340-A	-750-340-A	-111-340-A	-151-340-A	-221-340-A
Nominal motor power (4-pole standard motor)		400V	0.55 kW	0.75hp	1.1 kW	1.5 kW	2.2 kW
		480V	¾ hp	1 hp	1½ hp	2 hp	3 hp
Input	Mains voltage	**3~ 400V**	**3 AC 3**80 … 480V, -20% / +10%, 47 … 63 Hz				
	Input current	rms	2.4 A	3.2 A	4.3 A	5.6 A	7.7 A
		FLA	2.2 A	3.0 A	4.0 A	5.2 A	7.1 A
	Recommended mains fuse*	1 AC slow-acting	5 A	5 A	10 A	10 A	10 A
		CB	5 A	5 A	10 A	10 A	10 A
	Permissible mains fuses for UL*	Fuse, 600V	6 A	6 A	10 A	10 A	10 A
		Bussmann	FRS-R-5	FRS-R-5	FRS-R-10	FRS-R-10	FRS-R-10
		CB	5 A	5 A	10 A	10 A	10 A
Output	Output voltage	**3~ 400V**	3 AC 0 - Mains voltage				
	Output current	rms	1.7 A	2.3 A	3.1 A	4.0 A	5.5 A
		FLA	1.5 A	2.1 A	2.8 A	3.6 A	4.9 A
Min. braking resistor		Accessories	390 W	300 W	220 W	180 W	130 W
Type of ventilation			Free convection		Free convection	Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C	
Weight		Approx. [kg]	1.4		1.8		

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

FI type (size 3/ 4):		SK 5xxE…	-301-340-A	-401-340-A	-551-340-A	-751-340-A
Nominal motor power (4-pole standard motor)		400V	3.0 kW	4.0 kW	5.5 kW	7.5 kW
		480V	4 hp	5 hp	7½ hp	10 hp
Input	Mains voltage	**3~ 400V**	**3 AC 3**80 … 480V, -20% / +10%, 47 ... 63 Hz			
	Input current	rms	10.5 A	13.3 A	17.5 A	22.4 A
		FLA	9.7 A	12.3 A	16.0 A	20.4 A
	Recommended mains fuse*	1 AC slow-acting	15 A	15 A	20 A	25 A
		CB	15 A	15 A	20 A	25 A
	Permissible mains fuses for UL*	Fuse, 600V	25 A	30hp	30hp	30hp
		Bussmann	FRS-R-15	FRS-R-15	FRS-R-20	FRS-R-25
		CB	25 A	25 A	25 A	25 A
Output	Output voltage	**3~ 400V**	3 AC 0 - Mains voltage			
	Output current	rms	7.5 A	9.5 A	12.5 A	16.0 A
		FLA	6.7 A	8.5 A	11.0 A	14.0 A
Min. braking resistor		Accessories	91 W	74 W	60 W	44 W
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C			
Weight		Approx. [kg]	2.7		3.1	

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

FI type (size 5/ 6):		SK 5xxE…	-112-340-A	-152-340-A	-182-340-A	-222-340-A
Nominal motor power (4-pole standard motor)		400V	11.0 kW	15.0 kW	18.5 kW	22.0 kW
		480V	15 hp	20 hp	25 hp	30 hp
Input	Mains voltage	**3~ 400V**	**3 AC 3**80 ... 480V, -20% / +10%, 47 ... 63 Hz			
	Input current	rms	33.6 A	43.4 A	53.2 A	64.4 A
		FLA	29.4 A	37.8 A	47.6 A	56.0 A
	Recommended mains fuse*	1 AC slow-acting	40 A	50 A	60 A	60 A
		CB	40 A	50 A	60 A	60 A
	Permissible mains fuses for UL*	Fuse, 600V	60 A	60 A	60 A	60 A
		Bussmann	FRS-R-40	FRS-R-50	FRS-R-60	FRS-R-60
		CB	60 A	60 A	60 A	60 A
Output	Output voltage	**3~ 400V**	3 AC 0 - Mains voltage			
	Output current	rms	24.0 A	31.0 A	38.0 A	46.0 A
		FLA	21.0 A	27.0 A	34.0 A	40.0 A
Min. braking resistor		Accessories	29 W	23 W	18 W	15 W
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C			
Weight		Approx. [kg]	8		10.3	

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

FI type (size 7/ 8):		SK 5xxE…	-302-340-A	-372-340-A	-452-340-A	-552-340-A
Nominal motor power (4-pole standard motor)		400V	30.0 kW	37.0 kW	45.0 kW	55.0 kW
		480V	40 hp	50 hp	60 hp	75 hp
Input	Mains voltage	**3~ 400V**	**3 AC 3**80 ... 480V, -20% / +10%, 47 ... 63 Hz			
	Input current	rms	84.0 A	105.0 A	126.0 A	154 A
		FLA	72.8 A	91.0 A	107.8 A	134.4 A
	Recommended mains fuse*	1 AC slow-acting	100 A	100 A	125 A	160 A
		CB	100 A	100 A	-	-
	Permissible mains fuses for UL*	Fuse, 600V	100 A	100 A	125 A	150 A
		Bussmann	FRS-R-100	FRS-R-100	FRS-R-125	FRS-R-150
		CB	100 A	100 A	-	-
Output	Output voltage	**3~ 400V**	3 AC 0 - Mains voltage			
	Output current	rms	60.0 A	75.0 A	90.0 A	110.0 A
		FLA	52.0 A	65.0 A	77.0 A	96.0 A
Min. braking resistor		Accessories	9 W	9 W	8 W	8 W
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C			
Fan speed control					between 47°C and approx. 70°C	
Weight		Approx. [kg]	16		20	

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

FI type (size 9 /):		SK 5xxE…	-752-340-A	-902-340-A		
Nominal motor power (4-pole standard motor)		400V	75.0 kW	90.0 kW		
		480V	100 hp	125 hp		
Input	Mains voltage	**3~ 400V**	**3 AC 3**80 ... 480V, -20% / +10%, 47 ... 63 Hz			
	Input current	rms	210 A	252 A		
		FLA	173.6 A	218.4 A		
	Recommended mains fuse*	1 AC slow-acting	200 A	250 A		
		CB	-	-		
	Permissible mains fuses for UL*	Fuse, 600V	200 A	225 A		
		Bussmann	FRS-R-200	FRS-R-225		
		CB	-	-		
Output	Output voltage	**3~ 400V**	3 AC 0 - Mains voltage			
	Output current	rms	150.0 A	180.0 A		
		FLA	124.0 A	156.0 A		
Min. braking resistor		Accessories	6 W	6 W		
Type of ventilation			Fan cooling, temperature-controlled Switching thresholds: ON= 57°C OFF=47°C			
Fan speed control			between 47°C and approx. 70°C			
Weight		Approx. [kg]	25			

* see also Section 1.5.2. Fuses: High-Interrupting Capacity, Current Limiting Classes (z.B. R, J, …), circuit breaker (CB): Inverse Time Trip Type

7.3 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.		

Table 28: Technical data, ColdPlate 115V / 230V devices

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

Table 29: Technical data, ColdPlate 400V devices

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.

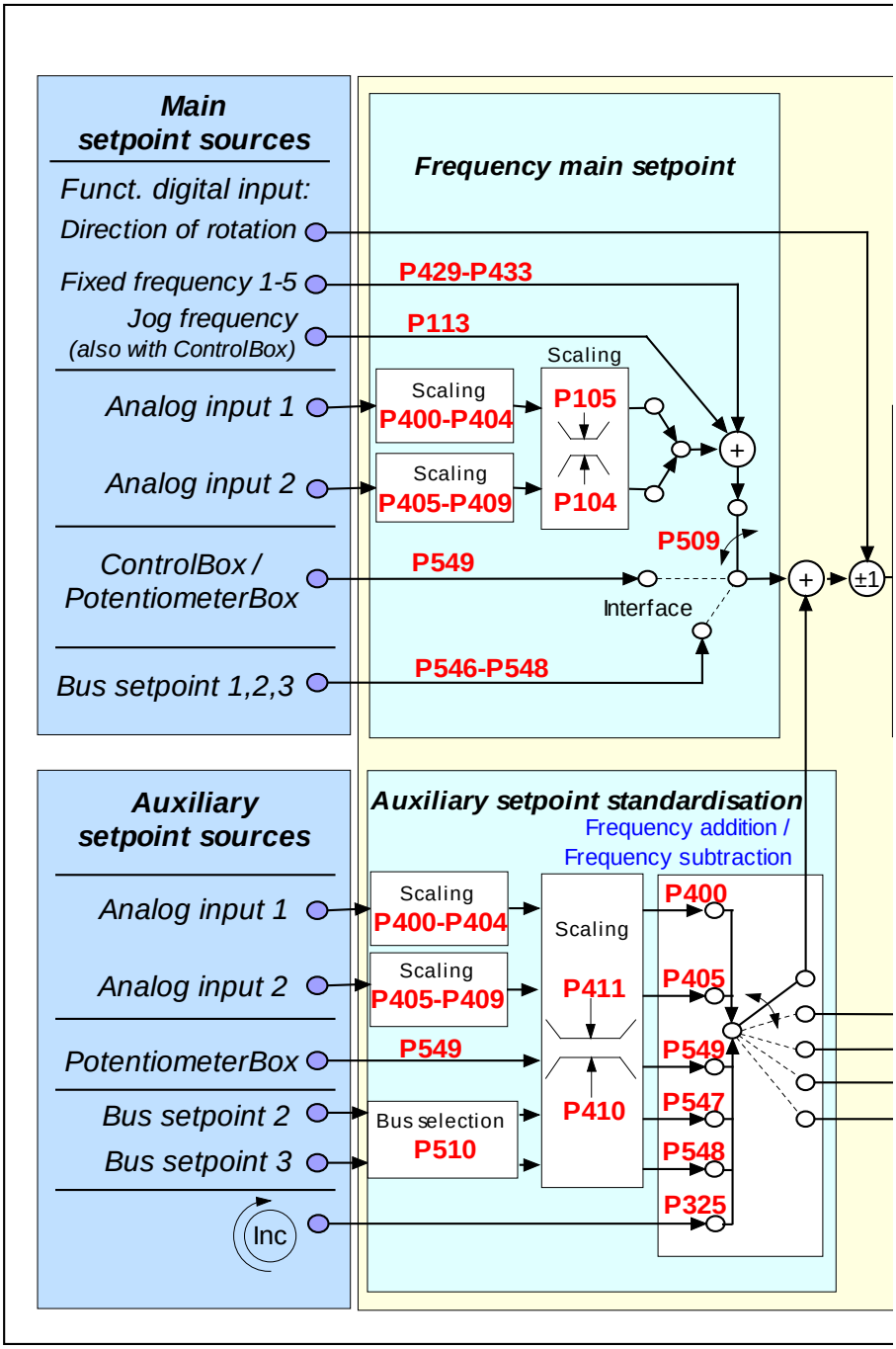
  The heat conducting paste is not included in the scope of delivery! First remove any protective film.
- All screw connections must be tightened.
- When designing a cooling system the heat to be dissipated by the ColdPlate device, Pv-module must be taken into account. For the design of the control cabinet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

Illustration of setpoint processing for SK 500E…SK 535E devices. This should be used analogously for SK 540E devices.



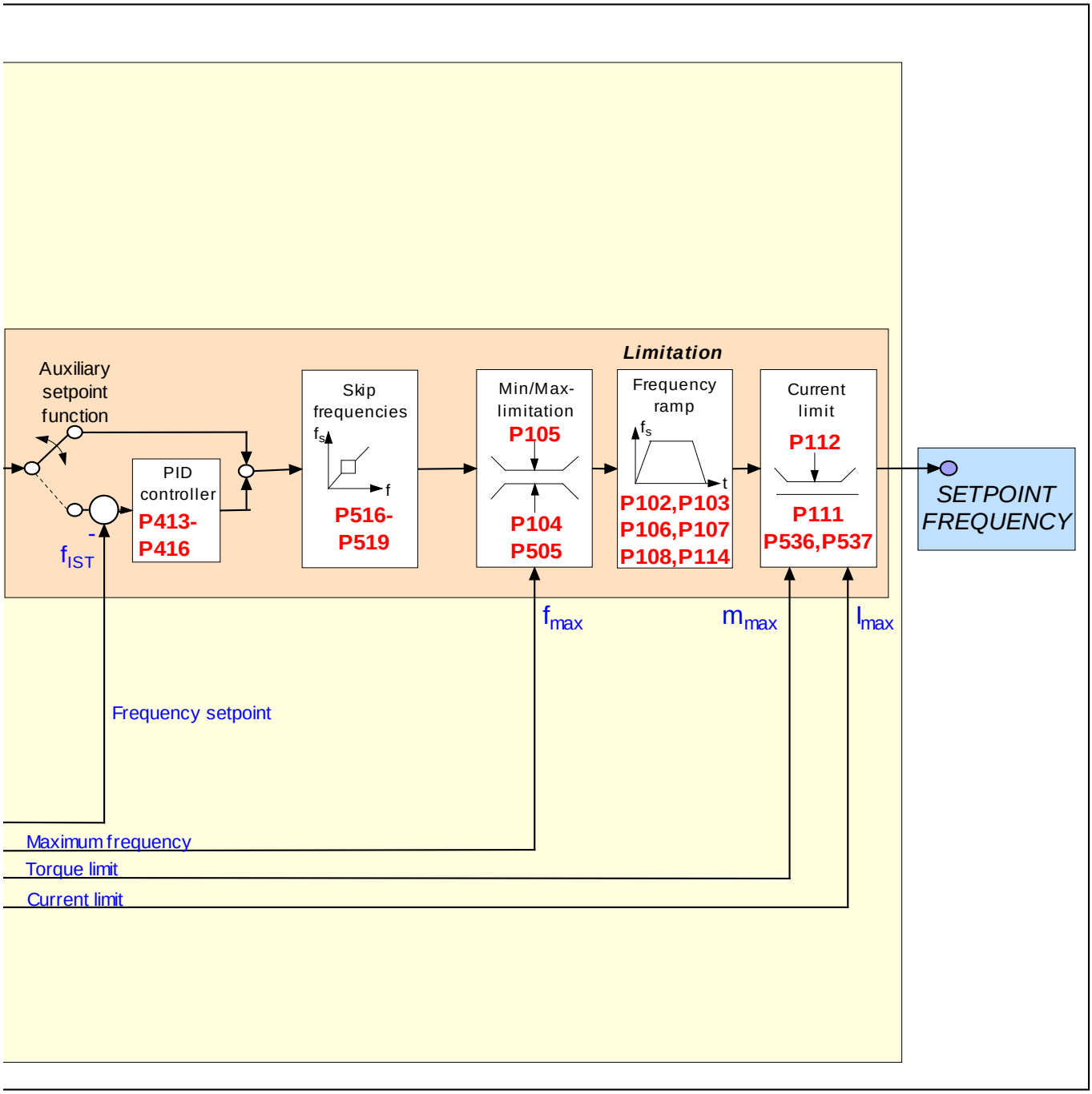


Fig. 14: Setpoint processing

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.

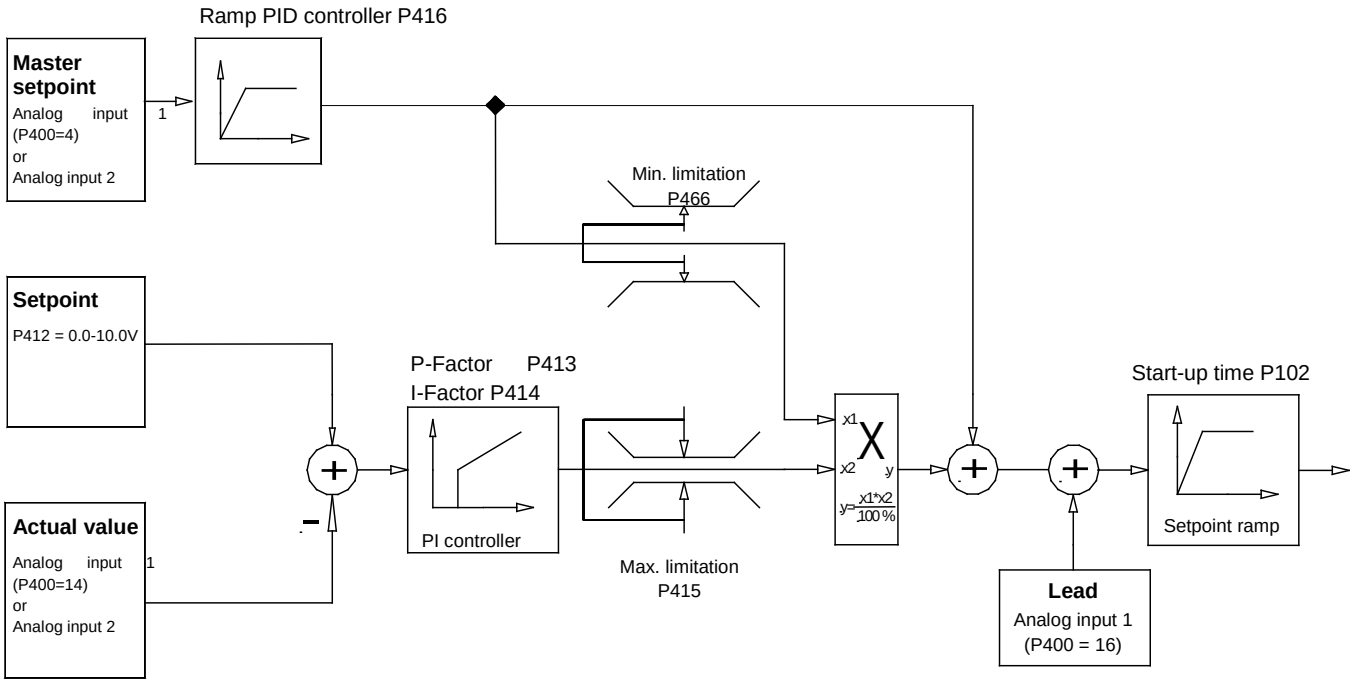
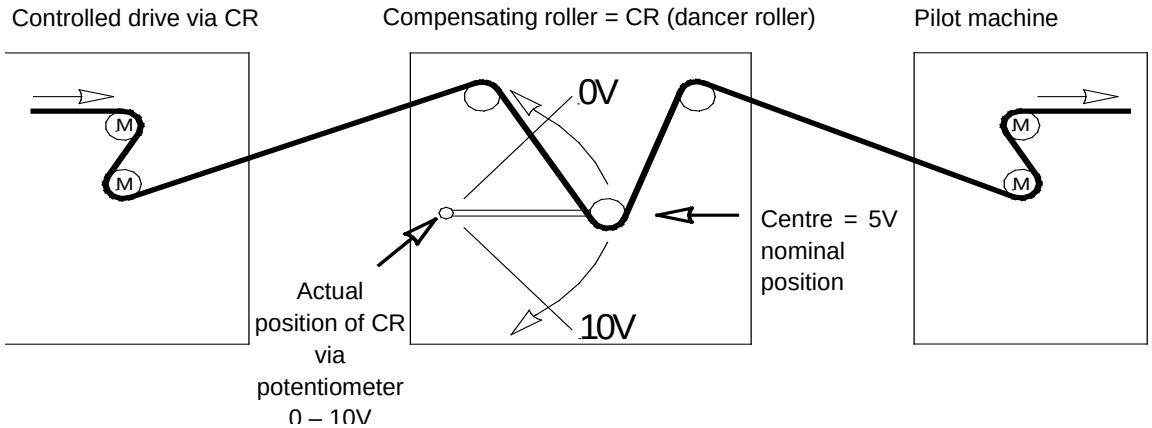
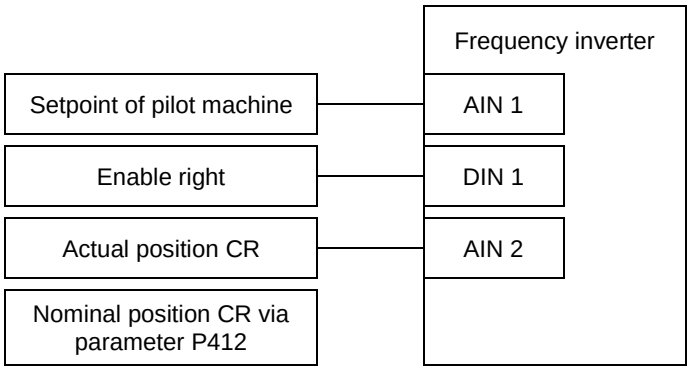
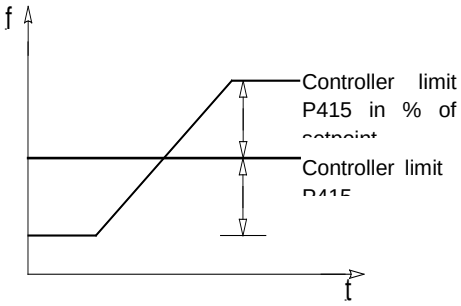


Fig. 15: Process controller flow diagram

8.2.1 Process controller application example







8.2.2 Process controller parameter settings

Example: SK 500E, setpoint frequency: 50 Hz, control limits: +/- 25%

P105 (maximum frequency) [Hz]

$$\geq Setpointfrq.[\text{Hz}] + \left(\frac{Setpointfrq.[Hz] \times P415[\%]}{100\%}\right)$$

Example:

$$\geq 50Hz + \frac{50Hz \times 25\%}{100\%} = \mathbf{62.5Hz}$$

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** (adjust if necessary)

P413 (P controller) [%]: Factory setting **10%** (adjust 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]: Factory setting **2s** (if necessary, adjust to match 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)

As of July 2007, all electrical equipment which has an intrinsic, independent function and which is sold as an individual unit for end users, must comply with Directive 2004/108/EEC (formerly Directive EEC/89/336). There are three different ways for manufacturers to indicate 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. *EU Type test certificate* (This method only applies to radio transmitter equipment.)

NORD frequency inverters only have an intrinsic function when they are connected to other equipment (e.g. with a motor). The basic 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 EMC standard for power drives EN 61800-3, for use in **secondary environments (industrial)** and if **not generally available.**

Class A, Group 1 (Þ C2): Interference suppressed, for industrial 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 comply with the basic standards EN 61000-6-2 and EN 61000-6-4 for interference immunity and interference emissions in an industrial environment.

Class B, Group 1 (Þ C1): 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 61000-6-2 and EN 61000-6-4 for interference immunity and interference emissions.

NOTICE **EMC interference**

NORD frequency inverters are **exclusively intended 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 **0**)

8.4 EMC limit value classes

Please note that these limit value classes are only reached if the standard pulse frequency (6 kHz / from BG8: 4 kHz) is being used and the length of the shielded motor cable does not exceed the permissible limits.

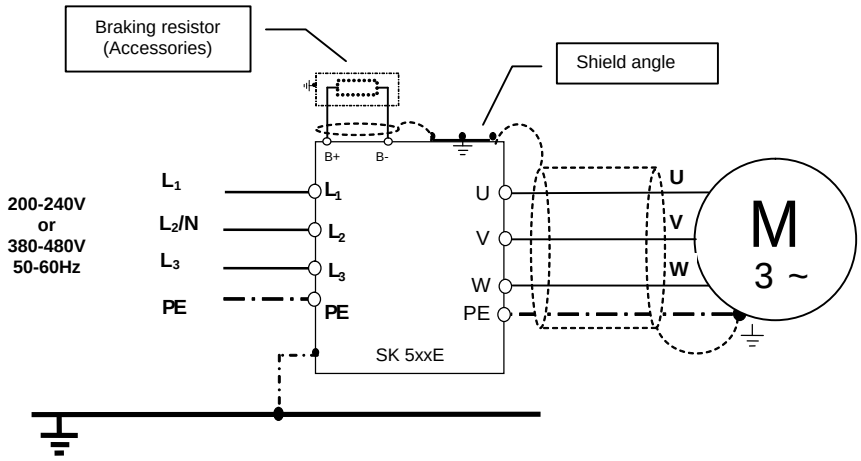
In addition, it is essential to use wiring suitable for EMC. The motor cable shielding must be applied on both sides (frequency inverter shield angle and the metal motor terminal box).

Device type max. cable length, shielded	Jumper position / DIP: "EMC-Filter" see Section 2.10.2	Conducted emissions 150kHz – 30MHz	
		Class A 1 (C2)	Class B 1 (C1)
SK 5xxE-250-323-A … SK 5xxE-401-323-A	3 – 2	20 m	5 m
	3 – 3	5 m	-
SK 5x5E-551-323-A … SK 5x5E-182-323-A	4 – 2	20 m	-
SK 5xxE-550-340-A … SK 5xxE-751-340-A	3 – 2	20 m	5 m
	3 – 3	5 m	-
SK 5x5E-112-340-A … SK 5x5E-372-340-A	4 – 2	20 m	-
SK 5x5E-452-340-A … SK 5x5E-902-340-A	DIP: ON	20 m	-

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:		
Emission of interference		
Emission from cables (interference voltage)	EN 55011	A 1 or C2
		B 1 or C1
Radiated emissions (Interference field strength)	EN 55011	A 1 or C2
		-
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%

Table 30: Overview of standards according to product standard EN 61800-3

Wiring recommendations



8.5 Reduced output power

The frequency inverters are 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 < 4.5 Hz 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.

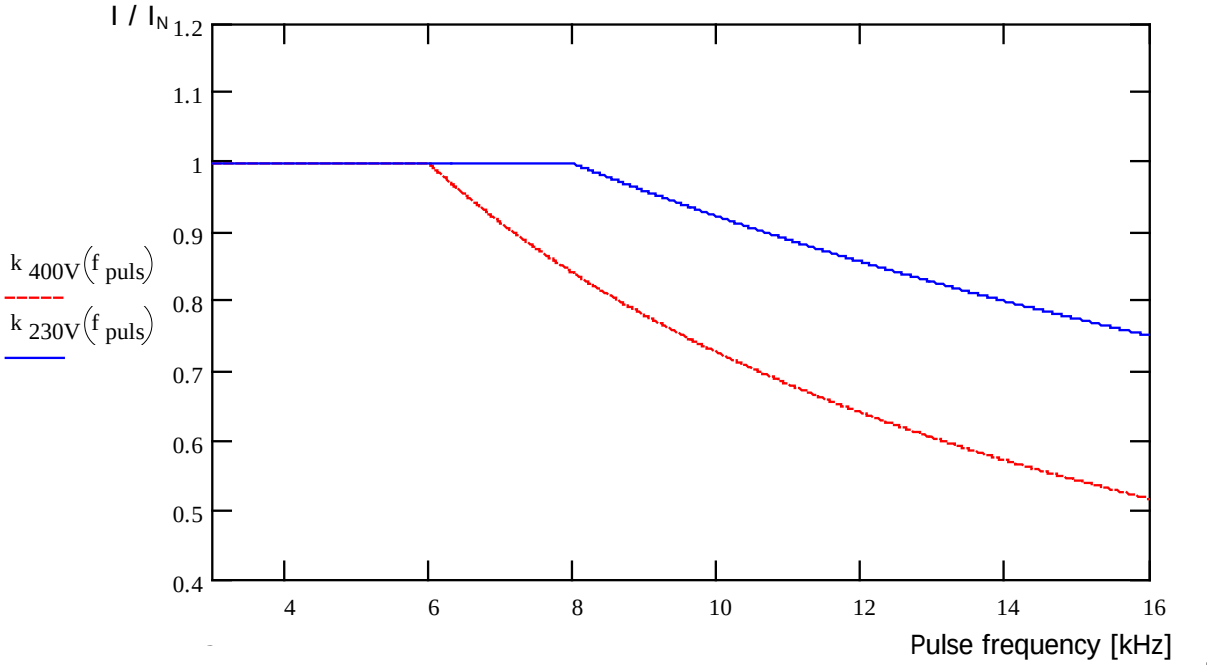


Fig. 16: Heat losses due to pulse frequency

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.

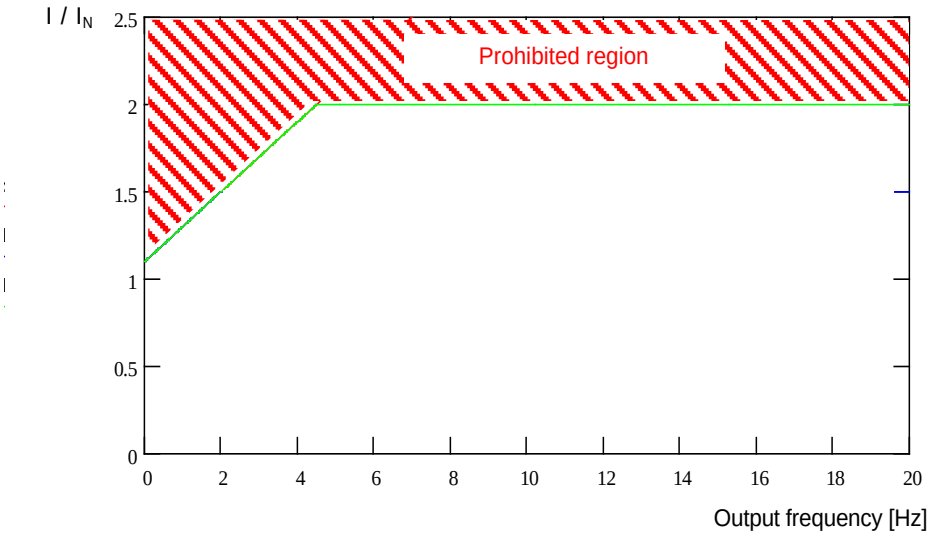
230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...8	110%	150%	170%	180%	180%	200%
10	103%	140%	155%	165%	165%	180%
12	96%	130%	145%	155%	155%	160%
14	90%	120%	135%	145%	145%	150%
16	82%	110%	125%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

Table 31: Overcurrent relative to time

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%

Table 32: Overcurrent relative to pulse and output frequency

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.

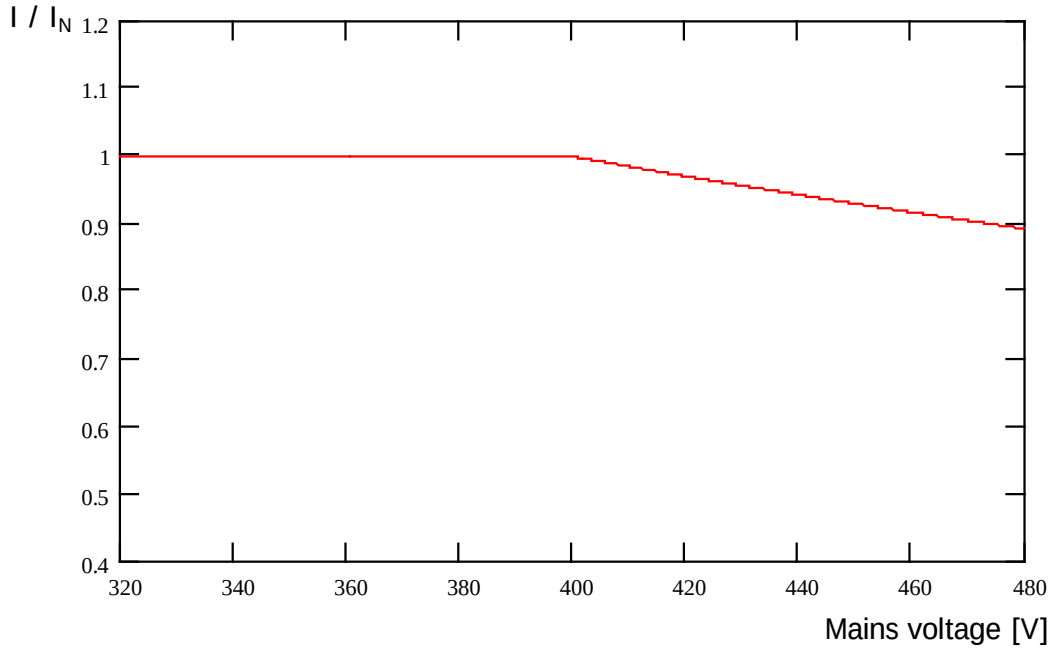


Fig. 17: Output current due to mains voltage

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

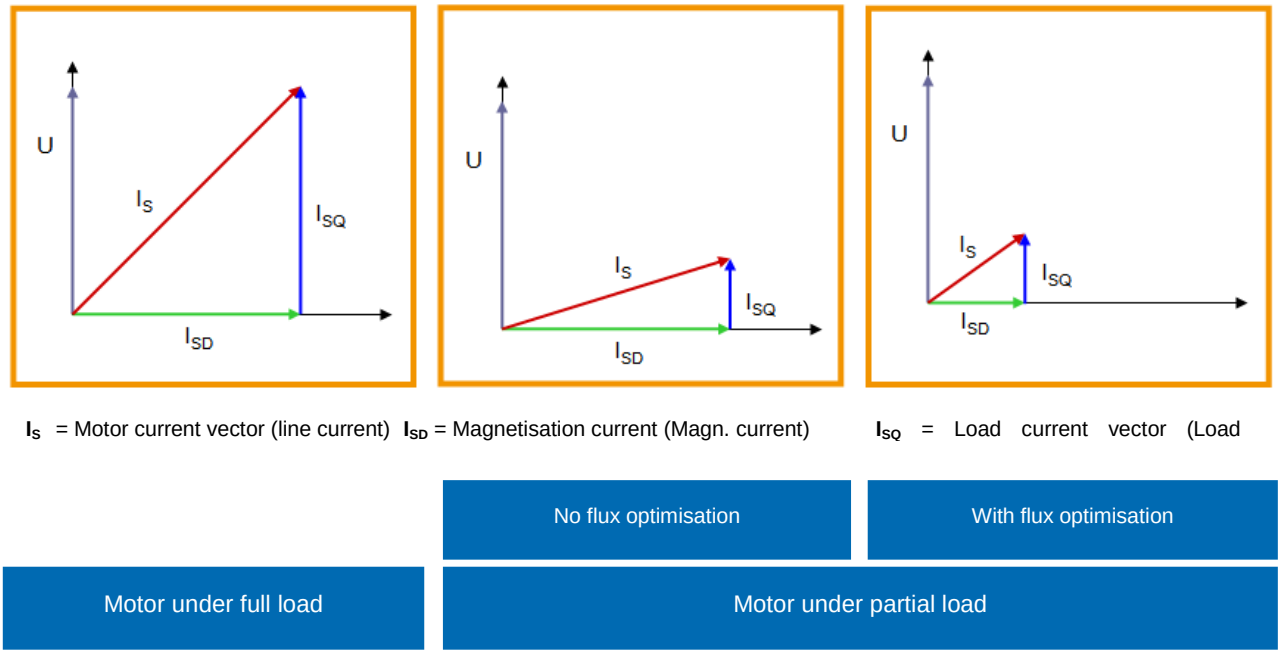
SK 5xxE frequency inverters are designed for operation with a 30mA all-current sensitive FI circuit breakerFI circuit breaker. If several frequency inverters are operated on a single FI circuit breaker, the leakage currents to earth must be reduced. For further details, please refer to Section 2.10.2.

8.7 Energy Efficiency

NORD frequency inverters have a low power consumption and are therefore highly efficient. In addition, with the aid of "Automatic flux optimisation" (Parameter (P219)) the frequency inverter provides a possibility for increasing the overall efficiency of the drive in certain applications (in particular applications with partial load).

According to the torque required, the magnetisation current through the frequency inverter or the the motor torque is reduced to the level which is required for the present drive power. The resulting reduction in power consumption, as well as the optimisation of the cos φ factor of the motor rating in the partial load range contributes to creating optimum conditions both with regard to energy consumption and mains characteristics.

A parameterisation which is different from the factory setting (Factory setting = 100%) is only permissible for applications which do not require rapid torque changes. (For details, see parameter (P219))



I_S = Motor current vector (line current) I_{SD} = Magnetisation current (Magn. current) I_{SQ} = Load current vector (Load

Fig. 18 Energy efficiency due to automatic flux optimisation

WARNING **Overload**

This function is not suitable for lifting applications or applications with frequent, large changes in load and parameter (P219) MUST be left in the factory setting (100%). If this is not complied with, there is a danger that the motor will break down if a sudden peak load occurs.

8.8 Standardisation of setpoint / target values

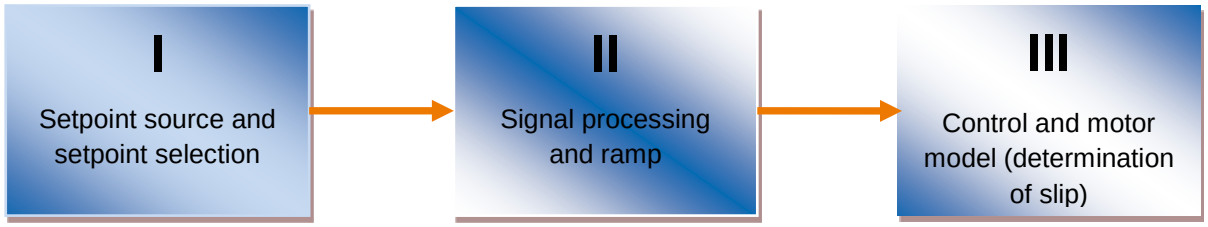
The following table contains details for the standardisation of typical setpoint and actual values. These details relate to parameters (P400), (P418), (P543), (P546), (P740) or (P741).

Name	**Analog signal**		**Bus signal**						
Setpoint values {Function}	Value range	Standardisation	Value range	Max.value	Type	100% =	-100% =	Standardisation	Limitation absolute
Setpoint frequency {01}	0-10V (10V=100%)	P104 … P105 (min - max)	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Frequency addition {04}	0-10V (10V=100%)	P410 … P411 (min - max)	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P411	P105
Frequency subtraction { 05 }	0-10V (10V=100%)	P410 … P411 (min - max)	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P411	P105
Max. frequency {07}	0-10V (10V=100%)	P411	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * f_{soll}[Hz]/P411	P105
Actual valueProcess controller {14}	0-10V (10V=100%)	P105* U_{AIN}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Setpoint process controller { 15 }	0-10V (10V=100%)	P105* U_{AIN}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Torque current limit {2}	0-10V (10V=100%)	P112* U_{AIN}(V)/10V	0-100%	16384	INT	4000_{hex} 16384_{dez}	/	4000_{hex} * I[A]/P112	P112
Current limit {6}	0-10V (10V=100%)	P536* U_{AIN}(V)/10V	0-100%	16384	INT	4000_{hex} 16384_{dez}	/	4000_{hex} * I[A]/P536	P536
Actual values {Function}									
Actual frequency {01}	0-10V (10V=100%)	P201* U_{AOut}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * f[Hz]/P201	
Actual speed {02}	0-10V (10V=100%)	P202* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * n[rpm]/P202	
Current {03}	0-10V (10V=100%)	P203* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * f[Hz]/P105	
Torque current {04}	0-10V (10V=100%)	P112* 100/ $\sqrt{((P203)^2-(P209)^2)}$* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * I_q[A]/(P112)*100/ $\sqrt{((P203)^2-(P209)^2)}$	
Master value Setpoint frequency {19} … {24}	0-10V (10V=100%)	P105* U_{AOut}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * f[Hz]/P105	
Speed from rotary encoder {22}	/	/	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ 16385_{dez}	4000_{hex} * n[rpm]/ P201*60/Number of pairs of poles or 4000_{hex} *n[rpm]/P202	

Table 33: Scaling of setpoints and actual values (Selection)

8.9 Definition of setpoint and actual value processing (frequencies)

The frequencies used in parameters (P502) and (P543) are processed in various ways according the following table.



Function	Name	Meaning	Output to ...			without Right/ Left	with Slip
			I	II	III		
8	Setpoint frequency	Setpoint frequency from setpoint source	X				
1	Actual frequency	Setpoint frequency for motor model		X			
23	Actual frequency with slip	Actual frequency at motor			X		X
19	Setpoint frequency master value	Setpoint frequency from setpoint source Master value (free from enable correction)	X			X	
20	Setpoint frequency n R master value	Setpoint frequency for motor model Master value (free from enable correction)		X		X	
24	Master value of actual frequency with slip	Actual frequency at motorMaster value (free from enable correction)			X	X	X
21	Actual frequency without slip master value	Actual frequency without master value slip Master value			X		

Table 34: Processing of setpoints and actual values in the frequency inverter

9. Maintenance and servicing information

9.1 Maintenance Instructions

In normal use, frequency inverters are maintenance free if used correctly. Please note the "General data" in Chap. 7.1.

Dusty environments

If the frequency converter is used in a dusty environment, the cooling 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.

Long-term storage

The frequency inverter must be regularly connected to the supply network for at least 60 min.

If this is not carried out, there is a danger that the frequency inverter may be destroyed.

If a device is to be stored for longer than one year, it must be re-commissioned with the aid of an adjustable transformer before normal connection to the mains.

Long-term storage for 1 - 3 years

30 min with 25% mains voltage

30 min with 50% mains voltage

30 min with 75% mains voltage

30 min. with 100% mains voltage

Long-term storage for >3 years or if the storage period is not known:

120 min with 25% mains voltage

120 min with 50% mains voltage

120 min with 75% mains voltage

120 min. with 100% mains voltage

The device must not be subject to load during the regeneration process.

After the regeneration process, the regulations described above apply again (at least 60 min on the mains 1x per year).

NOTICE	**24 V control voltage**

The 24 V control voltage supply must also be connected for SK 5x5E devices up to size 4.

9.2 Repair information

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 (name plate) at hand.

9.2.1 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

Tel.: 04532 / 289-2515

Fax: 04532 / 289-2555

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 — **Reason for return**

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

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

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

Unless otherwise agreed, the device is reset to the factory settings after inspection or repair.

NOTICE — **Possible Consequential Damage**

In order to rule out the possibility that the cause of a device fault is due to an optional module, the connected optional modules should also be returned in case of a fault.

9.2.2 Internet information

You can also find the comprehensive manual in German and in English on our Internet site. www.nord.com

9.3 Abbreviations

AIN	Analog input
AOUT	Analogue output
BR	Braking resistor
DI (DIN)	Digital input
DO (DOUT)	Digital output
I / O	Input /Output
EEPROM	Non-volatile memory
EMKF	Electromotive force (induction voltage)
EMC	Electromagnetic compatibility
FI-(Switch)	Leakage current circuit breaker
FI	Frequency inverter
I/O	In / Out (Input / Output)
ISD	Field current (Current vector control)
LED	Light-emitting diode
PMSM	Permanent Magnet Synchronous motor (permanently excited synchronous motor)
S	Supervisor Parameter, P003
SH	"Safe stop" function
SW	Software version, P707
TI	Technical information / Data sheet (Data sheet for NORD accessories)

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