Intelligent Drivesystems, Worldwide Services

EN

BU 0540

SK 500E

Brief instructions for frequency inverters

NORD DRIVESYSTEMS

Safety and usage instructions for electronic drive technology

(drive power controller, motor starter [1)] and field distributor)

(in accordance with: Low Voltage Directive 2006/95/EC (as of 20.04.2016: 2014/35/EU))

1. General

The devices may have live, bare, moving or rotating parts or hot surfaces during operation, depending on their protection class.

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

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

2. Proper use in Europe

The devices are components intended for installation in electrical systems or machines.

When the devices are installed in machines, they must not be started up (i.e. commencement of use for intended purpose) until it has been ensured that the machine meets the provisions of the EC Directive 2006/42/EC (Machinery Directive); EN 60204 must also be complied with.

Starting up (i.e. commencement of use for intended purpose) is only permitted if EMC directive (2004/108/EC (as of 20.04.2016: 2014/30/EU)) has been complied with.

CE-labelled devices fulfil the requirements of the Low Voltage Directive 2006/95/EC (as of 20.04.2016: 2014/35/EU). The stated harmonized standards for the devices are used in the declaration of conformity.

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

The devices may only be used for safety functions which are described and 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 devices 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.

The devices contain 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 Connection

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

The electrical installation must be implemented according to the applicable regulations (e.g. cable cross-section, fuses, earth lead connections). Further instructions can be found in the documentation.

Information regarding EMC-compliant installation (such as shielding, earthing, location of filters and routing of cables) can be found in the documentation for the devices. CE marked devices must also comply with these instructions. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Where necessary, systems in which the devices 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 parametrisation and configuration of the devices must be selected so that no hazards can occur.

All covers must be kept closed during operation.

7. Maintenance and repairs

Live equipment components and power connections should not be touched immediately after disconnecting the devices from the power supply because of possible charged capacitors. Observe the applicable information signs located on the device.

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

1) Direct starter, soft starter, reversing starter

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 and 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. 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 (from 04/20/2016: 2014/30/EU) and that the conformity of the end product meets the Machinery Directive 2006/42/EEC (observe EN 60204).

Documentation

Name:	BU 0540	
Part No.:	6075402	
Series:	SK 500E	
Device series:	SK 500E, SK 505E, SK 510E, SK 511E, SK 515E, SK 520E, SK 530E, SK 535E	
FI types:	SK 5xxE-250-112- ... SK 5xxE-750-112-	(0.25 – 0.75kW, 1~ 115V, output 3~ 230V)
	SK 5xxE-250-323- ... SK 5xxE-221-323-	0.25 - 2.2kW, 1/3~ 230V, output 3~ 230V)
	SK 5xxE-301-323- ... SK 5xxE-182-323-	(3.0 – 18.5kW, 3~ 230V, output 3~ 230V)
	SK 5xxE-550-340- ... SK 5xxE-163-340-	(0.55 – 160.0kW, 3~ 400V, output 3~ 400V)

Version list

Title, Date	Order number	Device software version	Remarks
BU 0540, July 2006	6075402 / 2006	V 1.1 R1	First issue, based on BU 0500 GB (March 2005)
BU 0540, June 2012	6075402 / 3811	V 2.0 R0	based on BU 0500 DE (Part No.: 6075001/3811)
BU 0540, March 2013	6075402 / 1013	V 2.0 R5	based on BU 0500 DE (Part No.: 6075001/1013)
BU 0540, February 2015	6075402 / 0715	V 3.0 R1	based on BU 0500 DE (Part No.: 6075001/0715)
BU 0540, April 2016	6075402 / 1516	V 3.1 R0	based on BU 0500 DE (Part No.: 6075001/1516)

Table 1: Version List BU0540

Validity

The following brief instructions are based on the main instructions (see version list) of the relevant inverter series, which is also definitive for commissioning. These brief instructions summarise the information which is required for the basic commissioning of a standard drive technology application. Detailed information, especially with regard to parameters, options and special functions can be obtained from the latest versions of the main instructions for the frequency inverter as well as any supplementary instructions for field bus options (e.g. PROFIBUS DP) or inverter functionalities (e.g.: PLC).

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Publisher

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1 General

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)
- Frequency inverters Type SK 5xxE … **-A**: Integrated **EMC mains filter** for limit curve A1 (and B1 for inverters Size 1 - 4) according to EN 55011, Category C2 (and C1 for inverters Size 1 - 4) according to EN 61800-3 (not for 115 V inverters)
- Frequency inverters Type SK 5xxE … **-O**: ***without*** integrated **EMC mains filter**.
- 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
- Integrated USS and Modbus RTU (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	x	x	BU 0550
Universal encoder interface (SSI, BISS, Hiperface, EnDat and SIN/COS)						x	BU 0510
Operation of PM synchronous motors (**P**ermanent **M**agnet **S**ynchronous **M**otors)	x	x	x	x	x	x	
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

1.2 Safety and installation notes

The devices are operating materials intended 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 device 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 device 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.

1.2.1 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.

1.2.2 List of safety and installation notes

DANGER! — **Electric shock**

The device 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 (if present), 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. Earthing and short circuiting, 5. Cover or fence off neighbouring live components).

DANGER! **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 **Electric shock**

The voltage supply of the device 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 **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 device is only intended for permanent connection and may not be operated without effective earthing connections which comply with local regulations for large leakage currents (> 3.5 mA).

EN 50178 / VDE 0160 stipulates the installation of a second earthing conductor or an earthing conductor with a cross-section of at least 10 mm^2. (📖 TI 80-0011), (📖 TI 80-0019)

WARNING **Danger of injury if motor starts**

With certain setting conditions, the device 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 a sufficient distance from adjacent components during installation, or install protection against contact.

NOTICE **Damage to the device**

For single phase operation (115 / 230 V) the mains impedance must be at least 100 µH 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 device due to impermissible currents in the components.

NOTICE **EMC - Interference**

The device 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. (📖 Document TI 80_0011)

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 capacitors), the devices generate leakage currents. For correct operation of the device 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.

Information **Operation on TN- / TT- / IT- networks**

The devices are suitable for operation on TN or TT networks as well as for IT networks with the configuration of the integrated mains filter. (📖 Section 2.2.2 "Adaptation to IT networks")

Information **Maintenance**

In normal use, soft starter are maintenance-free.

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

In the event of taking out of service or storage for long periods, special measures must be taken (📖 Section 8.1 "Maintenance Instructions").

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

1.3 Standards and approvals

All devices of the entire SK 200E series comply with the standards and directives listed below.

Standard / Directive	Logo	Comments
EMC	CE	EN 61800-3
UL	UL LISTED IND. CONT. EQ. 8D56	File No. E171342
cUL	c UL us LISTED IND. CONT. EQ. 8D56	File No. E171342
C-Tick		N 23134
EAC	EAC	N° TC RU C-DE.АЛ32.B.01859 N° 0291064
RoHS	RoHS 2011/65/EU	2011/65/EU

Table 3: Standards and approvals

1.4 Type code / nomenclature

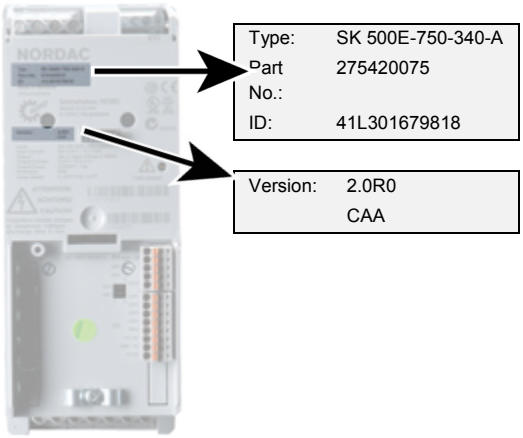
Unique type codes have been defined for the individual modules and devices. These provide individual details of the device type and its electrical data, protection class, fixing version and special versions. A differentiation is made according to the following groups:

	Frequency inverter

	Option module (Technology Unit)

1.4.1 Type plate

All of the information which is relevant for the device, including information for the identification of the device can be obtained from the type plate.



Type:	Type / designation
Part No.:	Part Number
ID:	Identification number
Version:	Software / Hardware version

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. 1 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 (chapter 7). 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, of for Size 5 to 7 four, suitable wall-mounting brackets are supplied, which must be pushed into the heat sink on the rear of the inverter. Above Size 8, the mounting device is already integrated.

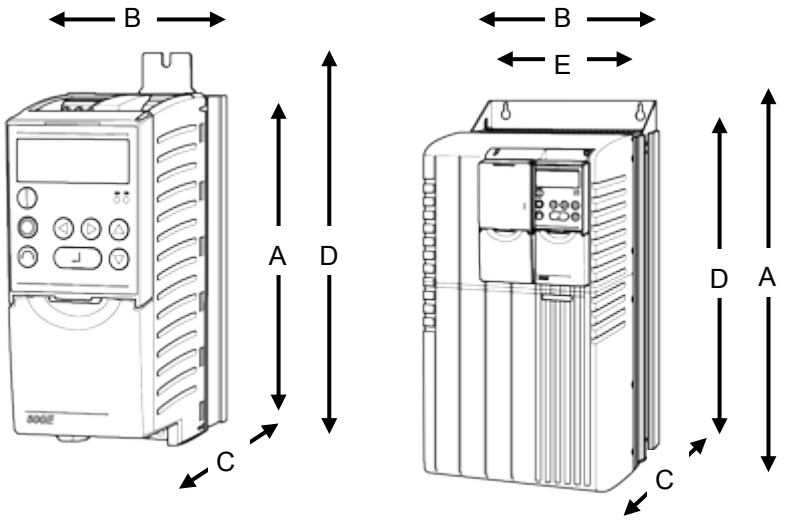
Alternatively, for Size 1 to 4 the wall mounting brackets can be inserted at the side of the cooling element in order to minimise the necessary depth of the control cabinet.

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.

Device type	Size	Housing dimensions			Wall-mounting		
		A	B	C	D	E 1	∅
SK 5xxE-250- … to SK 5xxE-750- ...	Size 1	186	74 [2]	153	220	/	5.5
SK 5xxE-111- … to SK 5xxE-221- …	Size 2	226	74 [2]	153	260	/	5.5
SK 5xxE-301- … to SK 5xxE-401- …	Size 3	241	98	181	275	/	5.5
SK 5xxE-551- 340… to SK 5xxE-751- 340…	Size 4	286	98	181	320	/	5.5
SK 5xxE-551- 323… to SK 5xxE-751- 323…	Size 5	327	162	224	357	93	5.5
SK 5xxE-112- 340… to SK 5xxE-152- 340…	Size 5	327	162	224	357	93	5.5
SK 5xxE-112- 323…	Size 6	367	180	234	397	110	5.5
SK 5xxE-182- 340… to SK 5xxE-222- 340…	Size 6	367	180	234	397	110	5.5
SK 5xxE-152- 323… to SK 5xxE-182- 323…	Size 7	456	210	236	485	130	5.5
SK 5xxE-302- 340… to SK 5xxE-372- 340…	Size 7	456	210	236	485	130	5.5
SK 5xxE-452- 340… to SK 5xxE-552- 340…	Size 8	598	265	286	582	210	8.0
SK 5xxE-752- 340… to SK 5xxE-902- 340…	Size 9	636	265	286	620	210	8.0
SK 5xxE-113- 340… to SK 5xxE-133- 340…	Size 10	720	395	292	704	360	8.0
SK 5xxE-163- 340…	Size 11	799	395	292	783	360	8.0
400 V (…-340…) and 500 V (…-350…) - FI: identical dimensions and weights		All dimensions in [mm]					

1) Size 10 and 11: The stated value corresponds to the distance between the outer fasteners. A third fastening hole is provided in the middle

2) For the use of bottom-mounted brake resistors = 88 mm



A=	Total length [1]
B=	Total width [1]
C=	Total height [1]
D=	Longitudinal hole spacing [2]
E=	Lateral hole spacing [2]

1) Delivery condition

2) Fixing dimensions

2.2 Electrical connection

DANGER! **Danger due to electricity**

THE DEVICES MUST BE EARTHED.

Safe operation of the devices requires that it is installed and commissioned by qualified personnel in compliance with the instructions provided in this Manual.

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 mains input and the motor connection terminals even when the device is not in operation. Always use insulated screwdrivers on these terminal fields.

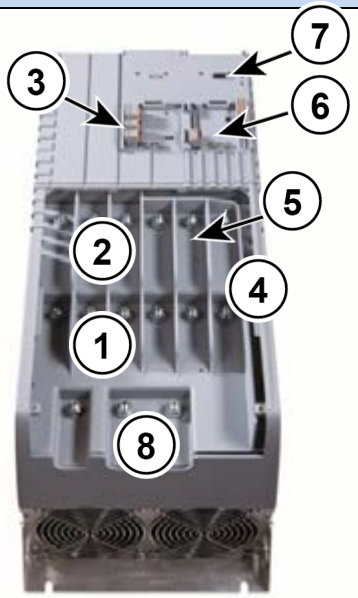
Ensure that the input voltage source is not live before setting up or changing an electrical connection to the unit.

Ensure that the device and the motor are specified for the correct supply voltage.

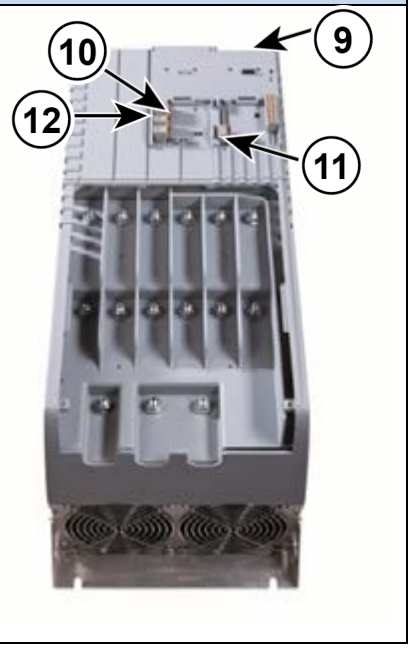
Information **Temperature sensor and PTC (TF)**

As with other signal cables, thermistor cables must be laid separately from the motor cables Otherwise the interfering signals from the motor winding that are induced into the line affect the device.

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	Above size 8:	X1.1, X1.2
2 =	Motor connection	U, V, W, PE	X2	Above size 8:	X2.1, X2.2
3 =	multi-function relay	1 - 4	X3		
4 =	Braking resistor	+B, -B	X2	Above size 8:	X30
5 =	DC - link circuit	-DC	X2	Above Size 8: + DC, - DC	X32
6 =	Control terminals	IOs, GND, 24Vout, IG, DIP for AIN	→	X4, X5, X6, X7, X14	
7 =	Technology unit				
8 =	Link circuit choke			Above size 8: -DC, CP, PE	X31

Size 1 - 4	Size 5 - 7	Above size 8
		

9 =	communication	CAN/CANopen; RS232/RS485	→	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

2.2.1 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.

2.2.2 Adaptation to IT networks

As delivered, the inverter is configured for operation in TN or TT networks. For operation in IT networks, simple adaptations must be made. However, these impair 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. Above Size 8 a DIP switch element is provided. According to the position of the DIP switch, the frequency inverter is configured for TN/TT network operation or for IT network operation.

Frequency inverter	Jumper A [1]	Jumper B	Comments	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 [2]	Reduced filtering effect [2]	<< 30 mA > 3. mA
Size 5 - 7	Position 0	Position 1	Operation in IT network	Not applicable
Size 5 - 7	Position 4	Position 2	Large filtering effect	< 6 mA
	DIP-Switch "EMC Filter"			
Size 8 – 11	OFF		Operation in IT network	< 30 mA
Size 8 – 11	ON		Large filtering effect	< 10 mA

1) Jumper "A" is only for type SK 5xxE-…-A inverters
2) Only valid for type SK 5xxE-…-A inverters. For type SK 5xxE-…-O inverters, this jumper position is similar to position 1

Table 4: Adaptation of integrated mains filter

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.

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' network input (only type SK 5xxE-…-A inverters)

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

Top side of device

Jumper 'B' motor output

Size 1 – 4

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

Normal position = Position 2

Reduced leakage current – Position 3
(The set pulse frequency (P504) only has a slight influence on the leakage current.)
(for type **SK 5xxE-…-O** inverters the function is identical to position 1))

Underside of the device

Size 5 – 7

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

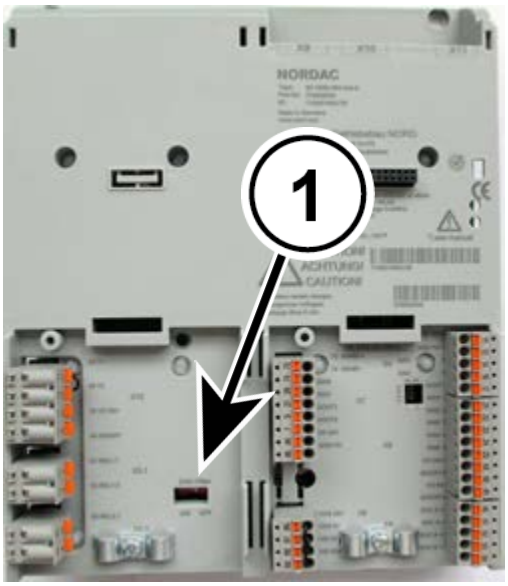
Normal position = Position 2

Underside of the device

Adaptation above size 8:

Adaptation to an 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 impairment of EMC compatibility.



2.2.3 Electrical connection of power unit

The following information relates to all power connections to the frequency inverter. This includes:

- Mains cable connection (L1, L2/N, L3, PE)
- Motor cable connection (U, V, W, PE)
- Brake resistor connection (B+, B-)
- Link circuit connection (-DC, (+DC))
- Link circuit choke connection (-DC, CP, PE)

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.

Information

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 - 11	Socket wrench	SW 13

Table 5: Tools

Connection data:

Frequency inverter	Cable Ø [mm²]		AWG	Tightening torque	
Size	rigid	flexible		[Nm]	[lb-in]
1 … 4	0.2 … 6	0.2 … 4	24-10	0.5 … 0.6	4.42 … 5.31
5	0.5 … 16	0.5 … 10	20-6	1.2 … 1.5	10.62 … 13.27
6	0.5 … 35	0.5 … 25	20-2	2.5 … 4.5	22.12 … 39.82
7	0.5 … 50	0.5 … 35	20-1	2.5 … 4	22.12 … 35.4
8	50	50	1/0	15	135
9	95	95	3/0	15	135
10	120	120	4/0	15	135
11	150	150	5/0	15	135

Table 6: 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.

2.2.4 Electrical connection of the 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 see chapter 2.2 "Electrical connection").

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.

Information — Total currents

5 V / 15 V (24 V) can be obtained from several terminals if required. This also includes e.g. digital outputs or a operating module connected via RJ45

With size 1 ... 4, the total output current must not exceed 250 mA / 150 mA (5 V / 15 V). Above Size 5 the limiting value is 250 mA / 200 mA (5 V/24 V).

NOTICE — Cable laying

All control cables (including thermistors) must be routed separately from the mains and the motor cables to prevent interference in the device.

If the cables are routed in parallel, a minimum distance of 20 cm must be maintained from cables which carry a voltage of > 60 V. 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.

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
	√	√	√	√	√	√	√	√

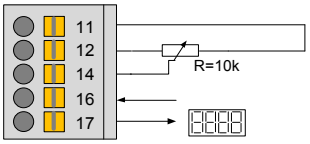
Terminals X3:	1	2	3	4
Name	K1.1	K1.2	K2.1	K2.2

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

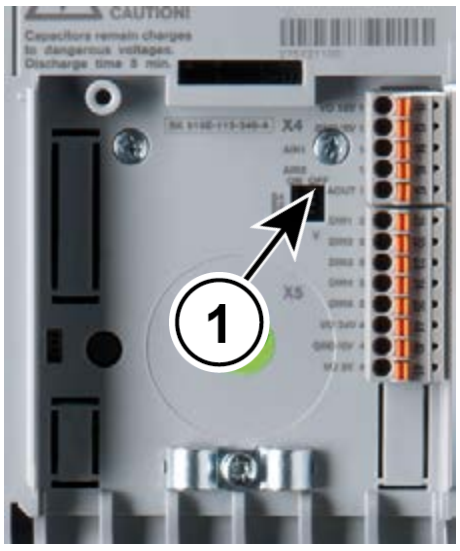
Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
11	10V Reference voltage	10V, 5mA, Not short circuit resistant	The analog input controls the output frequency of the frequency inverter.  The possible digital functions are described in Parameter P420. <u>Above Size 5:</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=30kΩ, I=0/4...20mA, R_i=250Ω, can be switched over with DIP switch, reference voltage GND. For the use of digital functions 7.5...30V. <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

Analog signal configuration

Size 1 … 4

1 = DIP switch: left = I / right = V

AIN2:	I	= Current 0/4 … 20 mA
	V	= Voltage
AIN1:	I	= Current 0/4 … 20 mA
	V	= Voltage



Above Size 5:

1 = DIP switch: left = ON / right = OFF

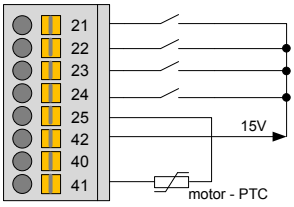
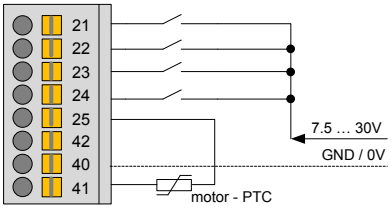
S4:	**AIN2:**	ON	= ± 10 V
		OFF	= 0 … 10 V
S3:	**AIN1:**	ON	= ± 10 V
		OFF	= 0 … 10 V
S2:	**AIN2:**	I	= ON = current 0/4...20 mA
		V	= OFF = voltage
S1:	**AIN1:**	I	= ON = current 0/4...20 mA
		V	= OFF = voltage

Note:
If S2 = ON (AIN2 = Current input), S4 must be = OFF.
If S1 = ON (AIN1 = Current input), S3 must be = OFF.

Terminal block X5 – Digital In

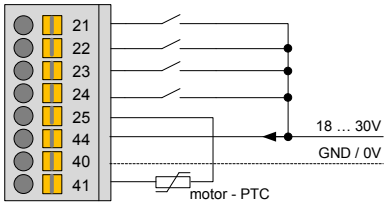
Relevance	SK 500E	SK 505E	SK 510E	SK 511E	SK 515E	SK 520E	SK 530E	SK 535E
	√		√	√		√	√	

Terminals X5:	21	22	23	24	25	42	40	41
Designation	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=6.1kΩ **Not** suitable for thermistor evaluation. HTL encoders can only be connected to DIN2 and DIN4 Limiting frequency: max. 10 kHz	Each digital input has a reaction time of ≤ 5ms. Connection with internal 15V: 	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=2.2kΩ **Not** suitable for evaluation of a safety device. Suitable for thermistor evaluation with 5V. **NOTE:** For the motor thermistor P424 = 13 must be set.	Connection with external 7.5-30V: 	P424
42	15V supply voltage **output**	15V ± 20% max. 150 mA (output)	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 supply voltage **output**	5V ± 20% max. 250 mA (output) short-circuit resistant	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
Designation	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=6.1kΩ **Not** suitable for thermistor evaluation. HTL encoders can only be connected to DIN2 and DIN4 Limiting frequency: max. 10 kHz	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=2.2kΩ **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>Size 5 and above</u> Thermistor on X13:T1/T2		P424
44	<u>Size 1 to Size 4</u> **VI 24V** supply voltage **input**	18…30V min. 800 mA (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. 200 mA (output) short circuit resistant	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 (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 supply voltage **output**	5V ± 20% max. 250 mA (output) short-circuit resistant	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		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**
Designation	RS485 +	RS485 -	DIN6	DIN7	DOUT1	DOUT2	VO 15V	GND/0V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
73	Data cable RS485	Baud rate 9600…38400Baud Termination resistor R=120Ω	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
74				
26	Digital input 6 [no function]	7.5...30V, R_i=3.3kΩ	As described for terminal block X5, DIN1 to DIN5. Not suitable for the evaluation of a motor thermistor.	P425
27	Digital input 7 [no function]			P470
5	Output 3 (DOUT1) [no function]	Digital output 15V, max. 20 mA With inductive loads: provide protection via 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 supply voltage **output**	15V ± 20% max. 150 mA (output) short-circuit resistant	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**
								√

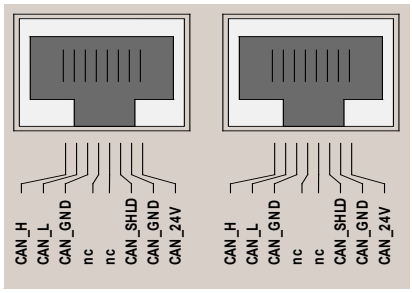
Terminals X7:	**73**	**74**	**26**	**27**	**5**	**7**	**44***	**40**	* Terminal 44: up to Size 4: VI Size 5 and above: VO
Designation	RS485 +	RS485 -	DIN6	DIN7	DOUT1	DOUT2	V…24V	GND/0V	

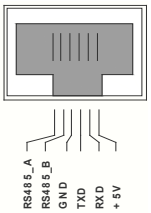
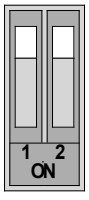
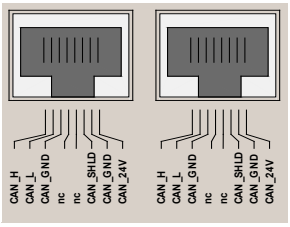
Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
73 74	Data cable RS485	Baud rate 9600…38400Baud Termination resistor R=120Ω	BUS connection parallel to RS485 on RJ12 plug **NOTE:** The termination resistance of DIP switch 1 (see RJ12/RJ45) can also be used for terminal 73/74.	P503 P509
26	Digital input 6 [no function]	7.5...30V, R_i=3.3kΩ	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. 20 mA above Size 5 **DOUT1 and DOUT2:** 24V, max. 200 mA With inductive loads: provide protection via 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 min. 800 mA (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. 200 mA (output) short circuit resistant	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		

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

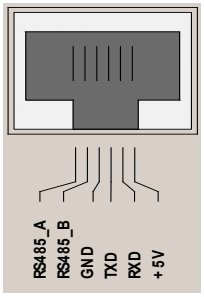
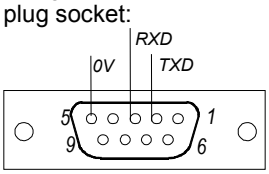
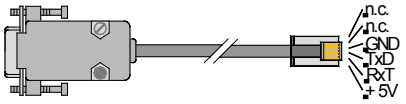
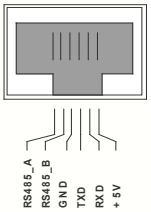
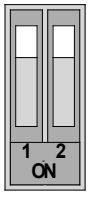
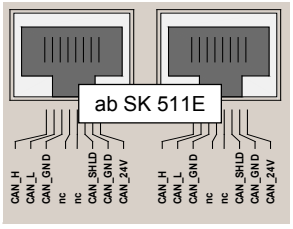
Contact	Function [factory setting]	Data	Description / wiring suggestion	Parameter
1	CAN/CANopen signal	Baud rate …500 kBaud RJ45 sockets are connected in parallel internally. Terminal resistance R=240 Ω DIP 2 (see below) **NOTE:** To operate CANbus/CANopen the interface must be externally supplied with 24 V (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**  RS232/485
DIP 2	Terminal resistor for CAN/CANopen interface (RJ12); ON = switched in [Default = "OFF"]	 DIP
		X10 **X9**  CAN/CANopen

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…38400 Baud Terminal resistance R=240 Ω DIP 1 (see below)	 RJ12: Pin No. 1 … 6	P503 P509
3	Reference potential for bus signals (must always be wired!)	0 V digital		
4 5	Data cable RS232	Baud rate 9600…38400 Baud		
6	Internal 5V supply voltage	5 V ± 20 %		
optional	Adapter cable RJ12 to SUB-D9 for RS232 communication for direct connection to a PC with NORD CON	Length 3 m 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**"	**X11**	**X10** **X9**	
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**
					√			√

Terminal X12:	**40**	**44**
Designation	GND	VI 24V

Terminal	Function [factory setting]	Data	Description / wiring suggestion	Parameter
44	Supply voltage **input**	24V … 30V min. 1000mA	Connection optional If no control voltage is available, the control voltage can be supplied via an internal mains unit.	
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	

2.3 Colour and contact assignments for encoders

Encoder input X6

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 the incremental encoder 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°).

Information — **Rotary encoder counting direction**

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

Information — **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 reliably 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: 12 V /15 V /24 V).

Special terminals are available for connection of a rotary encoder with TTL signals. Parameterisation of the corresponding functions is made with the parameters from the group "Control parameters" (P300 et seq.) TTL encoders enable the best performance for control of a drive unit with frequency inverters SK 520E and above.

The digital inputs DIN 2 and DIN 4 are used to connect an encoder with an HTL signal. Parameterisation of the corresponding functions is carried out with parameters P420 [-02/-04] or P421 and P423 as well as P461 – P463. In contrast to TTL encoders, HTL encoders only enable restricted performance for speed control (lower limit frequencies). However, they can be used with a considerably lower resolution and also for SK 500E

Function	**Cable colours,for incremental encoder**	**Signal type TTL**		**Signal type HTL**	
		Assignment for SK 5xxE Terminal block X5 or X6			
10-30 V supply	brown / green	**42(/44 /49)**	15V (/24V /12V)	**42(/44 /49)**	15V (/24V /12V)
0 V supply	white / green	**40**	GND/0V	**40**	GND/0V
Track A	brown	**51**	ENC A+	**22**	DIN2
Track A inverse	green	**52**	ENC A-	-	-
Track B	grey	**53**	ENC B+	**24**	DIN4
Track B inverse	pink	**54**	ENC B-	-	-
Track 0	red	**-**	-	-	-
Track 0 inverse	black	**-**	-	-	-
Cable shield	Connected to a large area of the frequency inverter housing or shielding angle				

Table 7: Colour and contact assignments for NORD – TTL / HTL incremental encoders

Information **Incremental encoder data sheet**

If the equipment deviates from the standard equipment (Type 5820.0H40, 10-30V encoder, TTL/RS422 or encoder type 5820.0H30, 10-30V encoder, HTL) for the motors, please note the accompanying data sheet or consult your supplier.

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 (please see chapter 6 "Operating status messages").

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.

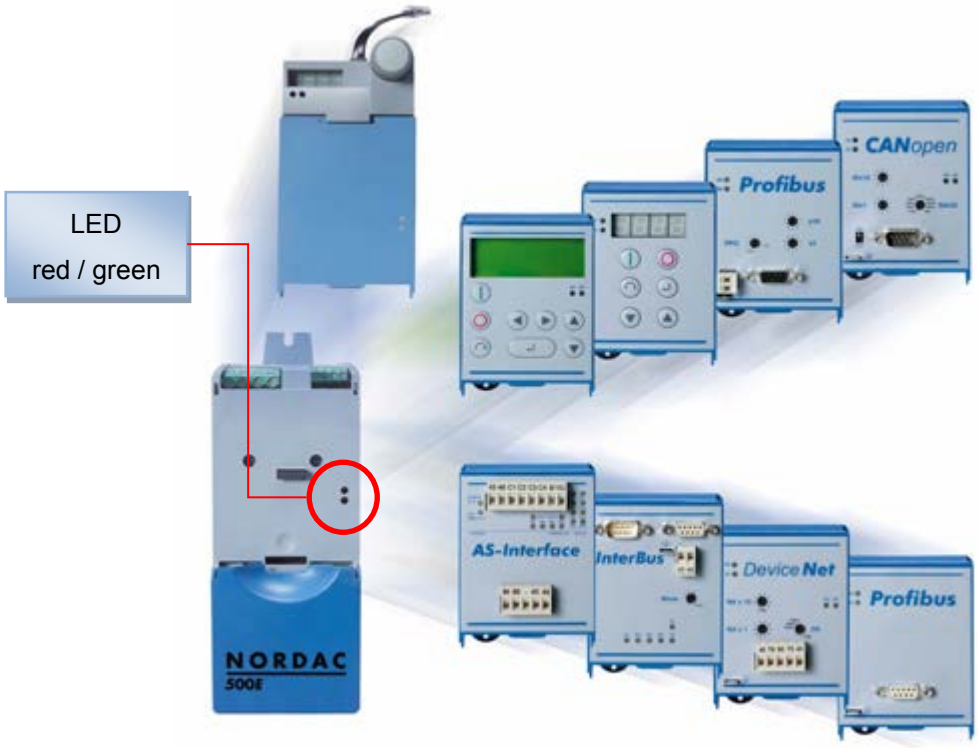


Fig. 2: Modular assemblies SK 5xxE

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 8: Overview of Technology Units and Control Boxes

Interfaces

Module	Interface	Data	Part No.	Document
Normal field bus protocols				
SK TU3-AS1	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

Module	Interface	Data	Part No.	Document
Ethernet-based Bus systems				
SK TU3-ECT	EtherCAT	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900180	BU 0570 and TI 275900180
SK TU3-EIP	EtherNet IP	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900150	BU 2100 and TI 275900150
SK TU3-PNT	PROFINET IO	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900190	BU 0590 and TI 275900190
SK TU3-POL	POWERLINK	Baud rate: 100 MBaud Connector: 2 x RJ45 24V DC connection via terminal	275900140	BU 2200 and TI 275900140

Table 9: 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 protocoles are integrated into all SK 5xxE series devices. An interface is available via terminal X11, or if present, also via X7:73/74.

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 10: Overview of technology units, other optional modules

Installation

Information

Installing the SK TU4-PNT-... 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.
4. Hook the **technology unit** onto the upper edge and press in lightly until it engages.

   Take care that the plug connection bar is properly contacted and if necessary fix it with a suitable screw (self-tapping screw 2.9 mm x 9.5 mm, included in the scope of delivery of the frequency inverter).

5. Close the control terminal cover again.

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 parameterised (please see chapter 5 "Parameters").

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.

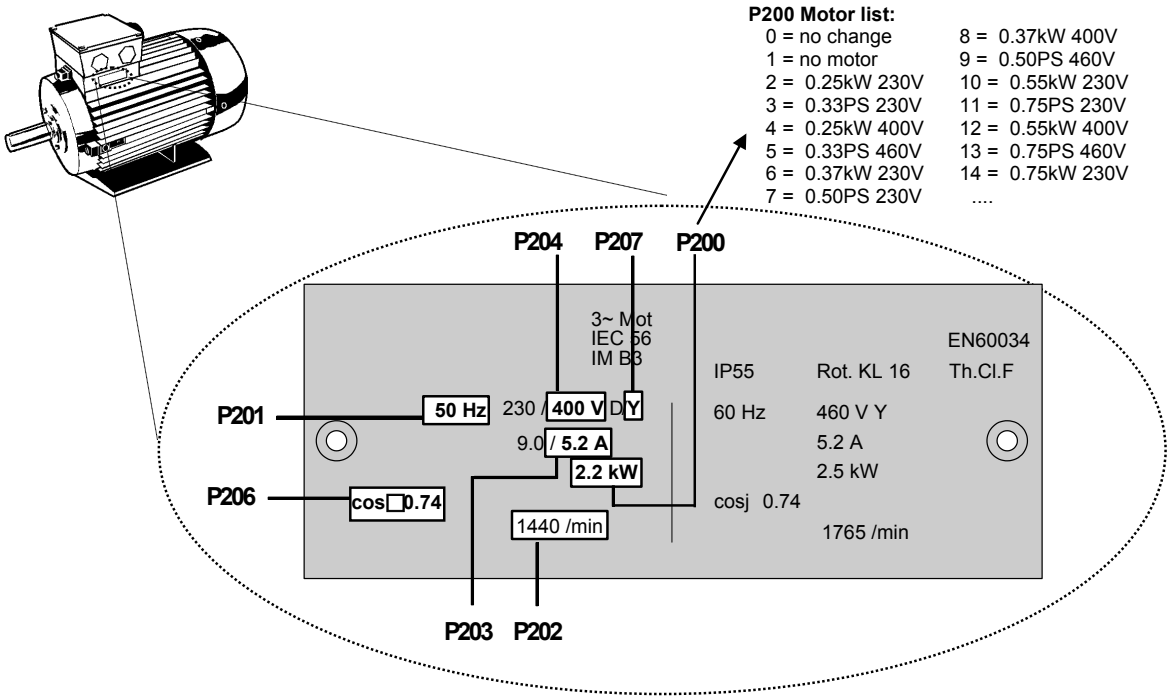


Fig. 3 Motor type plate

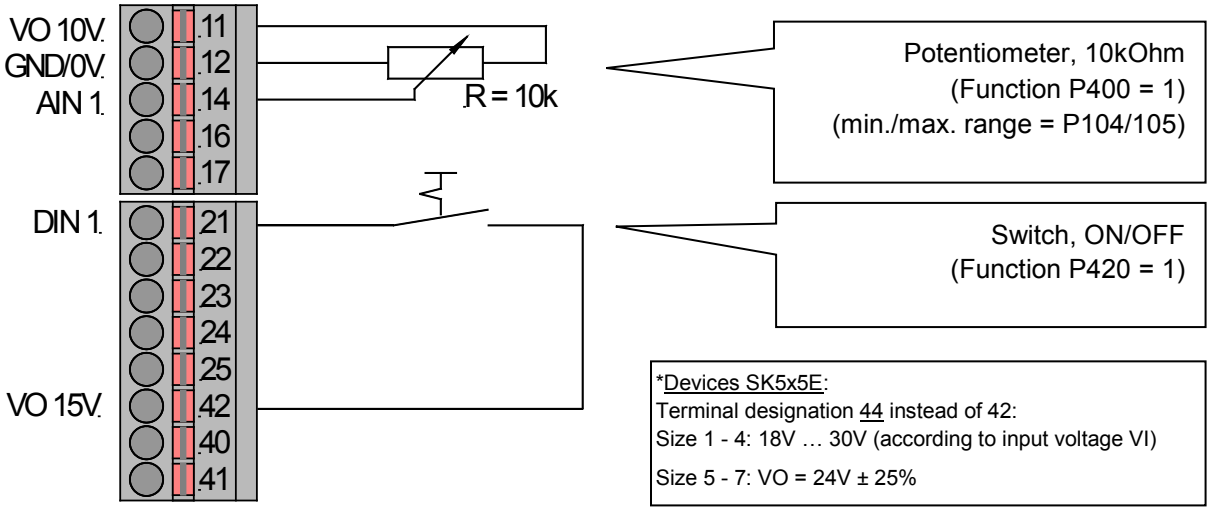
RECOMMENDATION: For the correct operation of the drive unit, it is necessary to input the motor data (rating plate) as precisely as possible. In particular, an automatic stator resistance measurement using parameter P220 is recommended.

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

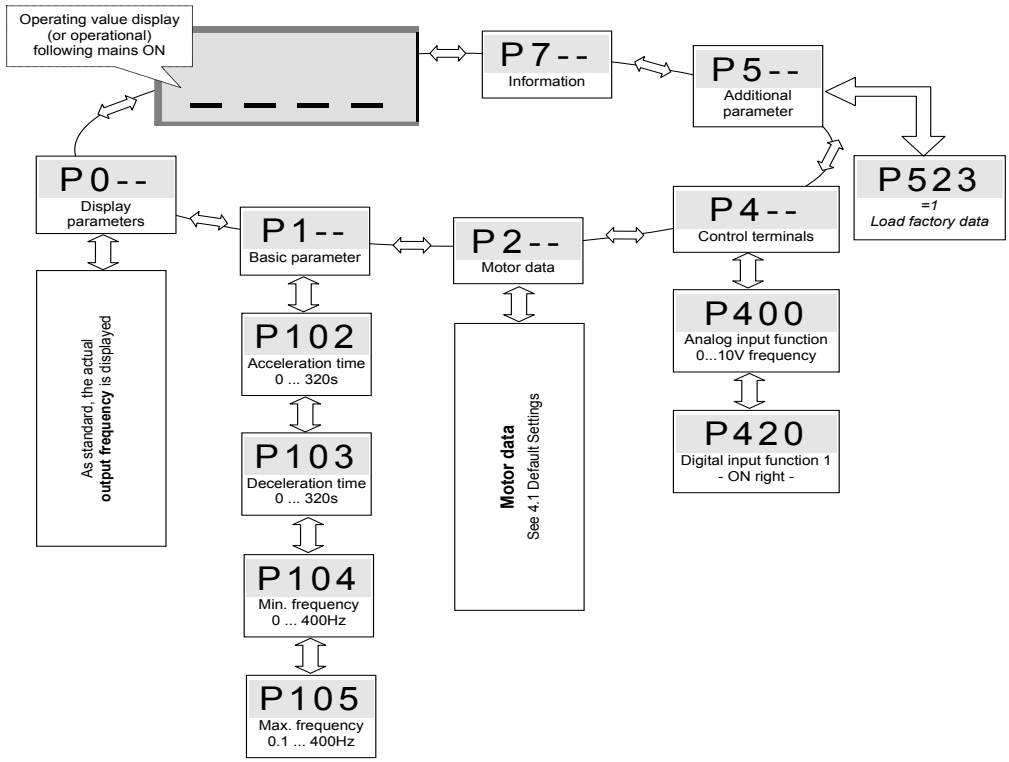
If the frequency inverter is to be controlled via the digital and analog inputs, this can be implemented immediately in the condition as delivered. Settings are not necessary for the moment.

Minimum connections



Basic parameters

If the current setting of the frequency inverter is not known, loading the default setting is recommended → 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.



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

Parameter overview, User settings

(P) ⇒ Parameter set dependent, these parameters can be set in various ways in the four parameter sets.

[- xx] ⇒ Array parameter, a parameter can be set in different subgroups.

S ⇒ Supervisor parameter, visibility depends on P003.

Parameter overview, user-defined settings SK 500E … SK 535E

Parameter No. [Array]		Designation	Factory setting	Supervisor	Setting after commissioning			
					P 1	P 2	P 3	P 4
OPERATING DISPLAYS								
P000		Operating display						
P001		Display selection	0					
P002		Display factor	01:00	S				
P003		Supervisor code	1		0= S parameters are hidden 1= All parameters are visible			
Basic parameters								
P100		Parameter set	0	S				
P101		Copy parameter set	0	S				
P102	(P)	Start-up time [s]	2.0/5.0					
P103	(P)	Deceleration time [s]	2.0/5.0					
P104	(P)	Minimum frequency [Hz]	0.0					
P105	(P)	Maximum frequency [Hz]	50.0					
P106	(P)	Ramp smoothing [%]	0	S				
P107	(P)	Brake reaction time [s]	0.00					
P108	(P)	Disconnection mode	1	S				
P109	(P)	DC brake current [%]	100	S				
P110	(P)	DC braking time on [s]	2.0	S				
P111	(P)	P factor torque limit [%]	100	S				
P112	(P)	Torque current limit [%]	401 (Off)	S				
P113	(P)	Jog frequency [Hz]	0.0	S				
P114	(P)	Brake ventilation time [s]	0.00	S				
MOTOR DATA / CHARACTERISTIC CURVE PARAMETERS								
P200	(P)	Motor list	0					
P201	(P)	Nominal motor frequency [Hz]	*50.0**	S				
P202	(P)	Nominal speed [rpm]	*1385**	S				
P203	(P)	Nominal motor current [A]	*4.8**	S				
P204	(P)	Nominal motor voltage [V]	*230**	S				
P205	(P)	Nominal power [kW]	*1.10 **					
P206	(P)	Cos phi	*0.78**	S				
P207	(P)	Motor circuit0 [star=0/delta=1]	*1**	S				
P208	(P)	Stator resistance [W]	*6.28**	S				
P209	(P)	No load current [A]	*3.0**	S				
P210	(P)	Static boost [%]	100	S				
P211	(P)	Dynamic boost [%]	100	S				
P212	(P)	Slip compensation [%]	100	S				
P213	(P)	Amplification ISD control [%]	100	S				
P214	(P)	Torque precontrol [%]	0	S				
P215	(P)	Boost precontrol [%]	0	S				
P216	(P)	Time boost precontrol [s]	0.0	S				
P217	(P)	Oscillation damping [%]	10	S				
P218	(P)	Modulation depth [%]	100	S				
P219		Auto. Flux optimisation [%]	100	S				
P220	(P)	Parameter identification	0					
P240	(P)	EMF voltage PMSM [V]	0	S				
P241	[-01] (P)	Inductivity PMSM (d axis) [mH]	20	S				
P241	[-01] (P)	Inductivity PMSM (q axis) [mH]	20	S				
P243	(P)	Reluctance angle IPMSM [°]	0	S				

Parameter No. [Array]		Designation	Factory setting	Supervisor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P244	(P)	Peak current [A]	5	S				
P245	(P)	Oscillation damping PMSM VFC [%]	25	S				
P246	(P)	Mass Inertia PMSM [kg*cm²]	5	S				
P247	(P)	Switch-over freq. VFC PMSM [%]	25	S				
			*) dependent on FI power or P200/P220					
CONTROL PARAMETERS, encoder input, only SK 520E/53xE								
P300	(P)	Servo Mode [On / Off]	0					
P301		Rotary encoder resolution	6					
P310	(P)	Speed controller P [%]	100					
P311	(P)	Speed controller I [%/ms]	20					
P312	(P)	Torque current controller P [%]	400	S				
P313	(P)	Torque current controller I [%/ms]	50	S				
P314	(P)	Torq. curr. ctrl. limit [V]	400	S				
P315	(P)	Field current controller P [%]	400	S				
P316	(P)	Field current controller I [%/ms]	50	S				
P317	(P)	Limit, field current controller [V]	400	S				
P318	(P)	Weak field controller P [%]	150	S				
P319	(P)	Weak field controller I [%/ms]	20	S				
P320	(P)	Weak field limit [%]	100	S				
P321	(P)	Speed control I release time	0	S				
P325		Function encoder	0					
P326		Encoder conversion	01:00					
P327		Speed slip error [rpm]	0 (off)					
P328		Speed slip delay [rpm]	0 (off)					
P330		Regulation PMSM	0	S				
P331		Switchover freq. PMSM [%]	15	S				
P332		Hyst. Switchover PMSM [%]	5	S				
P333		Flux feedback factor PMSM [%]	25	S				
P334		Encoder offset PMSM [rev]	0	S				
P350		PLC functionality	0 (off)					
P351		PLC setpoint selection	0					
P353		Bus status via PLC	0					
P355 [-01]		PLC integer setpoint	0					
P355 [-02]		PLC integer setpoint	0					
P355 [-03]		PLC integer setpoint	0					
P355 [-04]		PLC integer setpoint	0					
P355 [-05]		PLC integer setpoint	0					
P355 [-06]		PLC integer setpoint	0					
P355 [-07]		PLC integer setpoint	0					
P355 [-08]		PLC integer setpoint	0					
P355 [-09]		PLC integer setpoint	0					
P355 [-10]		PLC integer setpoint	0					
P356 [-01]		PLC long setpoint	0					
P356 [-02]		PLC long setpoint	0					
P356 [-03]		PLC long setpoint	0					
P356 [-04]		PLC long setpoint	0					
P356 [-05]		PLC long setpoint	0					
P360 [-01]		PLC display value	0					
P360 [-02]		PLC display value	0					
P360 [-03]		PLC display value	0					
P360 [-04]		PLC display value	0					
P360 [-05]		PLC display value	0					
P370		PLC status						
CONTROL TERMINALS								
P400	(P)	Function Analogue input 1	1					
P401		Analog input mode 1	0	S				
P402		Adjustment 1: 0% [V]	0.0	S				
P403		Adjustment 1: 100% [V]	10.0	S				
P404		Filter On input 1 [ms]	100	S				

Parameter No. [Array]		Designation	Factory setting	Supervisor	Setting after commissioning			
					P 1	P 2	P 3	P 4
P405	(P)	Function Analogue input 2	0					
P406		Analog input mode 2	0	S				
P407		Adjustment 2: 0% [V]	0.0	S				
P408		Adjustment 2: 100% [V]	10.0	S				
P409		Filter On input 2 [ms]	100	S				
P410	(P)	Min. Freq. Auxiliary setpoint [Hz]	0.0					
P411	(P)	Max. Freq. Auxiliary setpoint [Hz]	50.0					
P412	(P)	Setpoint process controller [V]	5.0	S				
P413	(P)	PID control P comp [%].	10.0	S				
P414	(P)	PID control I-component [%/ms]	10.0	S				
P415	(P)	PID control D-component [%/ms]	1.0	S				
P416	(P)	Ramp time PI setpoint [s]	2.0	S				
P417	(P)	Analog output offset 1 [V]	0.0	S				
P418	(P)	Function Analogue output 1	0					
P419	(P)	Standard Analogue output 1 [%]	100					
P420		Digital input 1 (DIN1)	1					
P421		Digital input 2 (DIN2)	2					
P422		Digital input 3 (DIN3)	8					
P423		Digital input 4 (DIN4)	4					
P424		Digital input 5 (DIN5)	0					
P425		Digital input 6 (DIN6)	0					
P426	(P)	Emergency stop time [s]	00:10					
P427		Emerg. stop Fault	0	S				
P428	(P)	Automatic starting	0 (off)	S				
P429	(P)	Fixed frequency 1 [Hz]	0.0					
P430	(P)	Fixed frequency 2 [Hz]	0.0					
P431	(P)	Fixed frequency 3 [Hz]	0.0					
P432	(P)	Fixed frequency 4 [Hz]	0.0					
P433	(P)	Fixed frequency 5 [Hz]	0.0					
P434	(P)	Relay 1 function (K1)	1					
P435	(P)	Relay 1 scaling [%]	100					
P436	(P)	Relay 1 hysteresis [%]	10	S				
P441	(P)	Relay 2 function (K2)	7					
P442	(P)	Relay 2 scaling [%]	100					
P443	(P)	Relay 2 hysteresis [%]	10	S				
P450	(P)	Relay 3 function (DOUT1)	0					
P451	(P)	Relay 3 scaling [%]	100					
P452	(P)	Relay 3 hysteresis [%]	10	S				
P455	(P)	Relay 4 function (DOUT2)	0					
P456	(P)	Relay 4 scaling [%]	100					
P457	(P)	Relay 4 hysteresis [%]	10	S				
P460		Watchdog time [s]	10.0	S				
P461		Function 2 Encoders	0					
P462		Pulse number 2 Encoder [Imp.]	1024					
P463		2nd rotary encoder ratio	01:00					
P464		Fixed frequency mode	0					
P465 [-01]		Fixed frequency / Array 01	0					
P465 [-02]		Fixed frequency / Array 02	0					
P465 [-03]		Fixed frequency / Array 03	0					
P465 [-04]		Fixed frequency / Array 04	0					
P465 [-05]		Fixed frequency / Array 05	0					
P465 [-06]		Fixed frequency / Array 06	0					
P465 [-07]		Fixed frequency / Array 07	0					
P465 [-08]		Fixed frequency / Array 08	0					
P465 [-09]		Fixed frequency / Array 09	0					
P465 [-10]		Fixed frequency / Array 10	0					
P465 [-11]		Fixed frequency / Array 11	0					
P465 [-12]		Fixed frequency / Array 12	0					
P465 [-13]		Fixed frequency / Array 13	0					
P465 [-14]		Fixed frequency / Array 14	0					
P465 [-15]		Fixed frequency / Array 15	0					
P465 [-16]		Fixed frequency / Array 16	0					

Parameter No. [Array]	Designation	Factory setting	Supervisor	Setting after commissioning			
				P 1	P 2	P 3	P 4
P465 [-17]	Fixed frequency / Array 17	0					
P465 [-18]	Fixed frequency / Array 18	0					
P465 [-19]	Fixed frequency / Array 19	0					
P465 [-20]	Fixed frequency / Array 20	0					
P465 [-21]	Fixed frequency / Array 21	0					
P465 [-22]	Fixed frequency / Array 22	0					
P465 [-23]	Fixed frequency / Array 23	0					
P465 [-24]	Fixed frequency / Array 24	0					
P465 [-25]	Fixed frequency / Array 25	0					
P465 [-26]	Fixed frequency / Array 26	0					
P465 [-27]	Fixed frequency / Array 27	0					
P465 [-28]	Fixed frequency / Array 28	0					
P465 [-29]	Fixed frequency / Array 29	0					
P465 [-30]	Fixed frequency / Array 30	0					
P465 [-31]	Fixed frequency / Array 31	0					
P466 (P)	Min. Freq. process cont.	0.0					
P470	Digital input 7 (DIN7)	0					
P475 [-01]	Switch-on/off delay [s]	0.000	S				
P475 [-02]	Switch-on/off delay [s]	0.000	S				
P475 [-03]	Switch-on/off delay [s]	0.000	S				
P475 [-04]	Switch-on/off delay [s]	0.000	S				
P475 [-05]	Switch-on/off delay [s]	0.000	S				
P475 [-06]	Switch-on/off delay [s]	0.000	S				
P475 [-07]	Switch-on/off delay [s]	0.000	S				
P475 [-08]	Switch-on/off delay [s]	0.000	S				
P475 [-09]	Switch-on/off delay [s]	0.000	S				
P480 [-01]	Function Bus I/O In Bits	0	S				
P480 [-02]	Function Bus I/O In Bits	0	S				
P480 [-03]	Function Bus I/O In Bits	0	S				
P480 [-04]	Function Bus I/O In Bits	0	S				
P480 [-05]	Function Bus I/O In Bits	0	S				
P480 [-06]	Function Bus I/O In Bits	0	S				
P480 [-07]	Function Bus I/O In Bits	0	S				
P480 [-08]	Function Bus I/O In Bits	0	S				
P480 [-09]	Function Bus I/O In Bits	0	S				
P480 [-10]	Function Bus I/O In Bits	0	S				
P480 [-11]	Function Bus I/O In Bits	0	S				
P480 [-12]	Function Bus I/O In Bits	0	S				
P481 [-01]	Function Bus I/O Out Bits	0	S				
P481 [-02]	Function Bus I/O Out Bits	0	S				
P481 [-03]	Function Bus I/O Out Bits	0	S				
P481 [-04]	Function Bus I/O Out Bits	0	S				
P481 [-05]	Function Bus I/O Out Bits	0	S				
P481 [-06]	Function Bus I/O Out Bits	0	S				
P481 [-07]	Function Bus I/O Out Bits	0	S				
P481 [-08]	Function Bus I/O Out Bits	0	S				
P481 [-09]	Function Bus I/O Out Bits	0	S				
P481 [-10]	Function Bus I/O Out Bits	0	S				
P482 [-01]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-02]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-03]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-04]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-05]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-06]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-07]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-08]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-09]	Standard Bus I/O Out Bits [%]	100	S				
P482 [-10]	Standard Bus I/O Out Bits [%]	100	S				
P483 [-01]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-02]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-03]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-04]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-05]	Hyst. Bus I/O Out Bits [%]	10	S				

Parameter No. [Array]	Designation	Factory setting	Supervisor	Setting after commissioning			
				P 1	P 2	P 3	P 4
P483 [-06]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-07]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-08]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-09]	Hyst. Bus I/O Out Bits [%]	10	S				
P483 [-10]	Hyst. Bus I/O Out Bits [%]	10	S				
Extra functions							
P501	Inverter name	0					
P502 [-01]	Master function value 1	0	S				
P502 [-02]	Master function value 2	0	S				
P502 [-03]	Master function value 3	0	S				
P503	Leading function output	0	S				
P504	Pulse frequency [kHz]	6.0/4.0	S				
P505 (P)	Abs. minimum frequency [Hz]	2.0	S				
P506	Auto. Fault acknowledgement	0	S				
P507	PPO-Type	1					
P508	Profibus address	1					
P509	Control word source	0					
P510 [-01]	Setpoint source (Main Setpoint)	0 (auto)	S				
P510 [-02]	Setpoint source (Auxiliary Setpoint)	0 (auto)	S				
P511	USS baud rate	3	S				
P512	USS address	0					
P513	Telegram time-out [s]	0.0	S				
P514	CAN bus baud rate	4					
P515 [-01]	CAN address (reception)	50					
P515 [-02]	CAN address (BC - reception)	50					
P515 [-03]	CAN address (BC - transmission)	50					
P516 (P)	Skip frequency 1 [Hz]	0.0	S				
P517 (P)	Skip frequency range 1 [Hz]	2.0	S				
P518 (P)	Skip frequency 2 [Hz]	0.0	S				
P519 (P)	Skip frequency range 2 [Hz]	2.0	S				
P520 (P)	Flying start	0	S				
P521 (P)	Flying start resolution [Hz]	00:05	S				
P522 (P)	Flying start offset [Hz]	0.0	S				
P523	Factory setting	0					
P525 [-01] (P)	Max. load monitoring max. 1 [%]	401 (Off)	S				
P525 [-02] (P)	Max. load monitoring max. 2 [%]	401 (Off)	S				
P525 [-03] (P)	Max. load monitoring max. 3 [%]	401 (Off)	S				
P526 [-01] (P)	Min. load monitoring 1 [%]	0 (off)	S				
P526 [-02] (P)	Min. load monitoring 2 [%]	0 (off)	S				
P526 [-03] (P)	Min. load monitoring 3 [%]	0 (off)	S				
P527 [-01] (P)	Load monitoring Freq. 1 [Hz]	25	S				
P527 [-02] (P)	Load monitoring Freq. 2 [Hz]	25	S				
P527 [-03] (P)	Load monitoring Freq. 3 [Hz]	25	S				
P528 (P)	Load monitoring delay [s]	02:00	S				
P529 (P)	Mode Load control	0	S				
P533	Factor I^2t-Motor [%]	100	S				
P534 [-01] (P)	Torque disconnection limit [%]	401 (Off)	S				
P534 [-02] (P)	Torque disconnection limit [%]	401 (Off)	S				
P535	I^2t-Motor	0	S				
P536	Current limit	1.5	S				
P537	Pulse switch-off [%]	150	S				
P538	Mains voltage Monitoring	3	S				
P539 (P)	Output monitoring	0	S				
P540	Mode phase sequence	0	S				
P541	Set relay [hex]	0000	S				
P542	Set analog output [V]	0.0	S				
P543 (P)	Actual bus value 1	1	S				
P544 (P)	Actual bus value 2	0	S				
P545 (P)	Actual bus value 3	0	S				
P546 (P)	Function Bus setpoint 1	1	S				
P547 (P)	Function Bus setpoint 2	0	S				

Parameter No. [Array]	Designation	Factory setting	Supervisor	Setting after commissioning			
				P 1	P 2	P 3	P 4
P548 (P)	Function Bus setpoint 3	0	S				
P549	Pot Box function	0	S				
P550	ControlBox orders	0					
P551	Drive profile	0	S				
P552 [-01]	CAN master cycle (Master)	0	S				
P552 [-02]	CAN master cycle (AG)	0	S				
P553 [-01]	PLC setpoint 1	1	S				
P553 [-02]	PLC setpoint 2	0	S				
P553 [-03]	PLC setpoint 3	0	S				
P553 [-04]	PLC setpoint 4	0	S				
P553 [-05]	PLC setpoint 5	0	S				
P554	Min. chopper deployment point [%]	65	S				
P555	P - limit chopper [%]	100	S				
P556	Brake resistance [Ω]	120	S				
P557	Brake resistor type [kW]	0	S				
P558 (P)	Magnetisation time [ms]	1	S				
P559 (P)	DC run-on time [s]	00:50	S				
P560	Parameter, saving mode	1	S				
Positioning							
P600 (P)	Position control	0 (off)	S				
P601	Actual position [rev]	---					
P602	Actual Ref. Pos. [rev]	---					
P603	Actual Pos. diff. [rev]	---	S				
P604	Encoder type	0	S				
P605 [-01]	Absolute encoder (Multi)	10	S				
P605 [-02]	Absolute encoder (Single)	10	S				
P607 [-01]	Ratio (IG)	1	S				
P607 [-02]	Ratio (AG)	1	S				
P607 [-03]	Ratio (Setpoint/Actual value)	1	S				
P608 [-01]	Reduction ratio (IG)	1	S				
P608 [-02]	Reduction ratio (AG)	1	S				
P608 [-03]	Reduction ratio (Setpoint/Actual value)	1	S				
P609 [-01]	Offset Position (IG) [rev]	0	S				
P609 [-02]	Offset Position (AG) [rev]	0	S				
P610	Setpoint Mode	0	S				
P611	Position controller P [%]	5	S				
P612	Pos. Window [rev]	0	S				
P613 [-01]	Position 1 [rev]	0	S				
P613 [-02]	Position 2 [rev]	0	S				
P613 [-03]	Position 3 [rev]	0	S				
P613 [-04]	Position 4 [rev]	0	S				
P613 [-05]	Position 5 [rev]	0	S				
P613 [-06]	Position 6 [rev]	0	S				
P613 [-07]	Position 7 [rev]	0	S				
P613 [-08]	Position 8 [rev]	0	S				
P613 [-09]	Position 9 [rev]	0	S				
P613 [-10]	Position 10 [rev]	0	S				
P613 [-11]	Position 11 [rev]	0	S				
P613 [-12]	Position 12 [rev]	0	S				
P613 [-13]	Position 13 [rev]	0	S				
P613 [-14]	Position 14 [rev]	0	S				
P613 [-15]	Position 15 [rev]	0	S				
P613 [-16]	Position 16 [rev]	0	S				
P613 [-17]	Position 17 [rev]	0	S				
P613 [-18]	Position 18 [rev]	0	S				
P613 [-19]	Position 19 [rev]	0	S				
P613 [-20]	Position 20 [rev]	0	S				
P613 [-21]	Position 21 [rev]	0	S				
P613 [-22]	Position 22 [rev]	0	S				
P613 [-23]	Position 23 [rev]	0	S				
P613 [-24]	Position 24 [rev]	0	S				

Parameter No. [Array]	Designation	Factory setting	Supervisor	Setting after commissioning			
				P 1	P 2	P 3	P 4
P613 [-25]	Position 25 [rev]	0	S				
P613 [-26]	Position 26 [rev]	0	S				
P613 [-27]	Position 27 [rev]	0	S				
P613 [-28]	Position 28 [rev]	0	S				
P613 [-29]	Position 29 [rev]	0	S				
P613 [-30]	Position 30 [rev]	0	S				
P613 [-31]	Position 31 [rev]	0	S				
P613 [-32]	Position 32 [rev]	0	S				
P613 [-33]	Position 33 [rev]	0	S				
P613 [-34]	Position 34 [rev]	0	S				
P613 [-35]	Position 35 [rev]	0	S				
P613 [-36]	Position 36 [rev]	0	S				
P613 [-37]	Position 37 [rev]	0	S				
P613 [-38]	Position 38 [rev]	0	S				
P613 [-39]	Position 39 [rev]	0	S				
P613 [-40]	Position 40 [rev]	0	S				
P613 [-41]	Position 41 [rev]	0	S				
P613 [-42]	Position 42 [rev]	0	S				
P613 [-43]	Position 43 [rev]	0	S				
P613 [-44]	Position 44 [rev]	0	S				
P613 [-45]	Position 45 [rev]	0	S				
P613 [-46]	Position 46 [rev]	0	S				
P613 [-47]	Position 47 [rev]	0	S				
P613 [-48]	Position 48 [rev]	0	S				
P613 [-49]	Position 49 [rev]	0	S				
P613 [-50]	Position 50 [rev]	0	S				
P613 [-51]	Position 51 [rev]	0	S				
P613 [-52]	Position 52 [rev]	0	S				
P613 [-53]	Position 53 [rev]	0	S				
P613 [-54]	Position 54 [rev]	0	S				
P613 [-55]	Position 55 [rev]	0	S				
P613 [-56]	Position 56 [rev]	0	S				
P613 [-57]	Position 57 [rev]	0	S				
P613 [-58]	Position 58 [rev]	0	S				
P613 [-59]	Position 59 [rev]	0	S				
P613 [-60]	Position 60 [rev]	0	S				
P613 [-61]	Position 61 [rev]	0	S				
P613 [-62]	Position 62 [rev]	0	S				
P613 [-63]	Position 63 [rev]	0	S				
P615	Maximum position [rev]	0	S				
P616	Minimum position [rev]	0	S				
P625	Hysteresis output [rev]	1	S				
P626	Comparative Position Output [rev]	0	S				
P630	Position slip error [rev]	0	S				
P631	Abs/Inc slip error [rev]	0	S				
P640	Unit of pos. value	0	S				

Parameter No. [Array]	Designation	Actual status and displayed values				
INFORMATION, read only						
P700 [-01]	Actual error					
P700 [-02]	Actual warning					
P700 [-03]	Reason for switch-on block					
P701	Last error 1...5					
P702	Freq. previous fault 1...5					
P703	Current, previous fault 1...5					
P704	Voltage, previous fault 1...5					
P705	UZW, previous fault 1...5					
P706	P-set last error 1...5					
P707	Software version (/Revision) 1…3					

Parameter No. [Array]	Designation	Actual status and displayed values
INFORMATION, read only		
P708	Status of digital input (bin/hex)	
P709	Voltage, analog input 1 [V]	
P710	Analogue output volt. [V]	
P711	Relay status [hex]	
P712	Voltage, analog input 2 [V]	
P714	Operating period [h]	
P715	Enable period [h]	
P716	Actual frequency [Hz]	
P717	Actual speed [rpm]	
P718	Present Setpoint frequency 1..3 [Hz]	
P719	Actual current [A]	
P720	Present Actual torque current [A]:	
P721	Actual field current [A]	
P722	Actual voltage [V]	
P723	Voltage-d [V]	
P724	Voltage-q [V]	
P725	Actual cos phi	
P726	Apparent power [kVA]	
P727	Mechanical power [kW]	
P728	Input voltage [V]	
P729	Torque [%]	
P730	Field [%]	
P731	Parameter set	
P732	U phase current [A]	
P733	V phase current [A]	
P734	W phase current [A]	
P735	Speed encoder [rpm]	
P736	Link voltage [V]	
P737	Current utilisation of brake resistor [%]	
P738	Actual utilisation of motor [%]	
P739	Heat sink temperature [°C]	
P740	Process data Bus In 1...13 [hex]	
P741	Process data Bus Out 1...13 [hex]	
P742	Data base version	
P743	Inverter ID	
P744	Configuration	
P745	Module version	
P746	Module status	
P747	Inverter voltage range 230/400V	
P748	CANopen status	
P750	Stat. overcurrent	
P751	Stat. overvoltage	
P752	Stat. Mains fault	
P753	Stat. overtemperature	
P754	Stat. Param. loss	
P755	Stat. System error	
P756	Stat. timeout	
P757	Stat. customer error	
P799	Op.-time last error 1...5	

6 Operating status messages

The device 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 device is in the status "Start disabled", the reason for this can also be displayed.

The messages generated for the device are displayed in the corresponding array of parameter (**P700**). The display of the messages for technology units is described in the respective additional instructions and data sheets for the modules concerned.

Start disabled

If the device 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.

Error messages

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

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

- Switching the mains off and on again,
- By an appropriately programmed digital input (**P420**),
- By switching off the “enable” on the device (if no digital input is programmed for acknowledgement),
- By Bus acknowledgement
- By (**P506**), 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 / 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 / ControlBox.

ParameterBox display

The ParameterBox displays the messages in plain text.

6.2 Messages

Error messages

Display in the SimpleBox / ControlBox		**Fault** **Text in the ParameterBox**	**Cause** • **Remedy**
Group	**Details in P700 [-01] / P701**		
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 "*	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
	2.2	**Overtemp. Brake r.ext** *"Overtemperature of external brake resistor "* Overtemperature via digital input (P420 […])={13}	Temperature monitor (e.g. brake resistor) has activated • Digital input is Low • Check connection, temperature sensor

E003	**3.0**	**I^2t overcurrent limit**	a.c. inverter: I^2t limit has triggered, e.g. > 1.5 x I_n for 60s (also note P504) • Continuous overload at inverter output • Possible encoder fault (resolution, defect, connection)
	3.1	**Chopper overtemperature I^2t**	Brake chopper: I^2t limit has activated, 1.5 times values reached for 60s (please also pay attention to P554, if present, and P555, P556, P557) • Avoid overcurrent in brake resistance
	3.2	**IGBT overcurrent** 125% monitoring	De-rating (power reduction) • 125% overcurrent for 50ms • Brake chopper current too high • for fan drives: enable flying start circuit (P520)
	3.3	**IGBT overcurrent fast** 150% monitoring	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 fault at FI output • Motor cable is too long • Use external output choke • Brake resistor faulty or resistance too low **→ Do not shut off P537!** **The occurrence of a fault can significantly shorten the service life of the device, or even destroy it.**
	4.1	**Overcurrent measurement** *"Overcurrent measurement"*	P537 (pulse current switch-off) was reached 3x within 50 ms (only possible if P112 and P536 are disabled) • FI is overloaded • Drive sluggish, insufficiently sized • Ramps (P102/P103) too steep -> Increase ramp time • Check motor data (P201 … P209)
E005	**5.0**	**Overvoltage UZW**	Link circuit voltage too high • Increase deceleration time (P103) • If necessary, set switch-off mode (P108) with delay (not with lifting equipment) • Extend emergency stop time (P426) • Fluctuating speed (e.g. due to high centrifugal masses) → adjust U/f characteristic curve if necessary (P211, P212) Devices with brake chopper: • Reduce energy return using a braking resistor • Check the function of the connected braking resistor (broken cable) • Resistance value of connected braking resistor too high
	5.1	**Mains overvoltage**	Mains voltage is too high • See technical data (🕮 Section 7)
E006	**6.0**	**Charging error**	Link circuit voltage is too low • Mains voltage too low • See technical data (🕮 Section 7)
	6.1	**Mains undervoltage**	Mains voltage too low • See technical data (🕮 Section 7)

E007	**7.0**	**Mains phase error**	Error at terminal connection side • a network phase is not connected • network is non-symmetrical
E008	**8.0**	**Parameter loss** (maximum EEPROM value exceeded)	Error in EEPROM data • Software version of the stored data set not compatible with the software version of the FI. **NOTE:** Faulty parameters are automatically reloaded (default data). • EMC interferences (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)	
	8.5	**No EEPROM recognised**	
	8.6	**EEPROM copy used**	
	8.7	**EEPROM copy not the same**	
	8.8.	**EEPROM is empty**	
	8.9	**EEPROM Ctrlbox too small**	• The EEPROM of the ControlBox is too small to completely save the data set for the frequency inverter
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

	10.3		• Further details can be found in the respective supplementary Bus operating instructions.
	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 → see supplementary instructions
	13.6	**Reserved**	Error message for POSICON → see supplementary instructions
E014	**---**	**Reserved**	Error message for POSICON → 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" → see supplementary instructions
E019	**19.0**	**Parameter identification** *"Parameter identification"*	Automatic identification of the connected motor was unsuccessful • Check motor connection • Check preset motor data (P201 … P209) • PMSM – CFC Closed Loop Operation: Rotor position of motor incorrect in relation to incremental encoder Perform determination of rotor position (initial enable after a "Mains on" only with motor stationary (P330)
	19.1	**Star / Delta circuit incorrect** *"Motor star / delta circuit incorrect"*	

E020 E021	**20.0**	**Reserved**	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use additional external mains filter. • FI must be very well earthed.
	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	**Dual-ported RAM**	
	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 → see supplementary instructions BU 0550
E023	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E024	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550

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

	2.2	**Overtemp. Brake r.ext** *"Overtemperature of external brake resistor "* Overtemperature via digital input (P420 […])={13}	Warning: Temperature monitor (e.g. brake resistor) has activated • Digital input is Low
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 / Customer** *"Motor switch-off limit"*	Warning: 80 % of the drive 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 reached. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.5	**Load monitor**	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	**Block voltage from bus**	• For bus operation (P509): control word Bit 1 is "Low"
	0.4	**Bus fast stop**	• For bus operation (P509): control word Bit 2 is "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"). Or electrical phase is missing. • Only issue enable signal after completion of initialisation (i.e. when the FI is ready) • Activation of "Automatic Start" (P428)
	0.6 – 0.7	**Reserved**	Information message for PLC → see supplementary instructions
	0.8	**Right direction blocked**	Switch-on block with inverter shut-off activated by: **P540** or by "Enable right block" **(P420** = 31, 73) or "Enable left block" (**P420** = 32, 74), The frequency inverter switches to "Ready for switching on" status
	0.9	**Left direction blocked**	
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 "ready for switch-on" if the analog signal undershoots the value **1 V** or **2 mA** 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 → see supplementary instructions
I018	**18.0**	**Reserved**	Information message for "Safe Stop" function → see supplementary instructions

7 Technical data

7.1 General Data SK 500E

Function	Specification
Output frequency	0.0 ... 400.0 Hz
Pulse frequency	3.0 ... 16.0 kHz, standard setting = 6 kHz (Size 8 and above = 4 kHz) Power reduction > 8 kHz for 230 V inverter, > 6 kHz for 400 V - inverter
Typical overload capacity	150 % for 60 s 200 % for 3.5 s
Efficiency of frequency inverter	Size 1 – 4: approx. 95 %, Size 5 – 7: approx. 97 %, Size 8 and above: approx. 98 %
Insulation resistance	> 5 MΩ
Ambient temperature	0°C ... +40°C (S1-100 % ED), 0°C ... +50°C (S3-70 % ED 10 min)
Storage and transport temperature	-20°C ... +60 /70°C
Long-term storage	(chapter 8.1)
Protection class	IP20
Max. installation altitude above sea level	- up to 1000 m without power reduction - 1000...4000 m: 1 %/ 100 m power reduction * Up to 2000 m: 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 s 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 VFC open-loop, CFC open-loop, CFC closed-loop (above SK 520E)
Motor temperature monitoring	I^2t-Motor (UL approved), PTC / Bi-metal switch
Interfaces (integrated)	RS 485 (USS) RS 232 (single slave) Modbus RTU CANbus (except SK 50xE) CANopen (except SK 50xE)
Electrical isolation	Control terminals (digital and analog inputs)
Connection terminals	For details and tightening torques of the screw terminals: refer to (chapter 2.2.3) and (chapter 2.2.4).
External supply voltage, control unit SK 5x5E	Size 1 - 4: 18…30 V DC, ≥ 800 mA Size 5 - 7: 24…30 V DC, ≥ 1000 mA Size 8 - 11: 24…30 V DC, ≥ 3000 mA
Analogue setpoint input / PID input	2x (above Size 5: - 10 V…) 0...10V, 0/4...20 mA, scalable, digital 7.5...30 V
Analogue setpoint resolution	10 bit based on measurement range
Setpoint consistency	analog < 1 %, digital < 0.02 %
Digital input	5x (2,5 V) 7,5...30 V, R_i = (2,2 kΩ) 6,1 kΩ, cycle time = 1...2 ms + for SK 520E and above: 2x 7.5...30 V, R_i = 6.1 kΩ, cycle time = 1...2 ms
Control outputs	2x Relay 28 VDC / 230 VAC, 2 A (output 1/2 - K1/K2) Additionally, with SK 520E/530E: 2x DOUT 15 V, 20 mA or Additionally, with SK 535E/545E: 2x DOUT 18…30 V (depending on VI), 20 mA, or 2x DOUT 18…30 V, 200 mA Size 5 and above (Output 3/4 - DOUT1/2)
Analogue output	0 ... 10 V scalable

8 Maintenance and servicing information

8.1 Maintenance Instructions

NORD frequency converters are *maintenance free* provided that they are properly used (please see chapter 7.1 "General Data SK 500E").

Dusty environments

If the device is being used in a dusty environment, the cooling-vane surfaces should be regularly cleaned with compressed air.

Long-term storage

The device 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 device may be destroyed.

If a device is to be stored for longer than one year, it must be recommissioned 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).

Information — **Control voltage with SK 5x5E**

With devices of type SK 5x5E, a 24 V control voltage supply must be provided for Sizes 1 – 4 in order to make the regeneration process possible.

8.2 Service notes

Out technical support is available to reply to technical queries.

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.

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

NORD Electronic DRIVESYSTEMS GmbH

Tjüchkampstraße 37

26605 Aurich, Germany

Please remove all non-original parts from the device.

No guarantee is given for any attached parts such as power cables, switches or external displays.

Please back up the parameter settings before sending in the device.

Information — **Reason for return**

Please note the reason for sending in the component/device and specify a contact for any queries that we might have.

You can obtain a return note from our web site (Link) or from our technical support.

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.

Contacts (Phone)

Technical support	During normal business hours	+49 (0) 4532-289-2125
	During normal business hours	+49 (0) 180-500-6184
Repair inquiries	During normal business hours	+49 (0) 4532-289-2115

The manual and additional information can be found on the Internet under www.nord.com.

Key word index

NORD DRIVESYSTEMS Group

Headquarters and Technology Center
in Bargteheide close to Hamburg, Germany

Innovative drive solutions
for more than 100 branches of industries

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