

Intelligent Drivesystems, Worldwide Services



**ATEX**  
*konform*



GB

# BU 0180

SK 180E...190E

Manual for Frequency inverters

**NORD**  
DRIVESYSTEMS



## NORD frequency inverters



### Safety and operating instructions for drive power converters

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

#### 1. General

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

Unauthorised removal of covers, improper use, incorrect installation or operation causes a risk of serious personal injury or material damage.

Further information can be found in this documentation.

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

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

#### 2. Proper use in Europe

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

When installed in machines, the drive power converter cannot be commissioned (i.e. commencement of the proper use) until it has been ensured that the machine meets the provisions of the EC Directive 2006/42/EEC (Machine Directive); EN 60204 must also be complied with.

Commissioning (i.e. implementation of the proper use) is only permitted if the EMC directive (2004/108/EEC) is complied with.

Drive power converters with a CE label meet the requirements of the Low Voltage Directive 2006/95/EEC. The stated harmonized standards for drive current inverters 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 drive power converters 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 drive power converters must be protected against impermissible loads. Especially during transport and handling, components must not be deformed and/or insulation distances must not be changed. Touching of electronic components and contacts must be avoided.

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

#### 5. Electrical connection

When working on live drive power converters, 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 installation of cables – can be found in the drive power converter documentation. These instructions must be complied with even with CE marked drive power converters. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

#### 6. Operation

Systems in which drive power converters are installed must be equipped, where necessary, with additional monitoring and protective equipment as per the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

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

All covers must be kept closed during operation.

#### 7. Maintenance and repairs

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

Further information can be found in this documentation.

**These safety instructions must be kept in a safe place!**

## Documentation

Designation: BU 0180 GB  
 Part No.: 607 1801  
 Device series: SK 180E, SK 190E  
 Device types: **SK 1x0E-250-112-O ... SK 1x0E-750-112-O**, 0.25 - 0.75 kW, 1~ 100-120 V, Output. 230 V  
**SK 1x0E-250-323-B ... SK 1x0E-111-323-B**, 0.25 - 1.1 kW, 1/3~ 220-240 V  
**SK 1x0E-151-323-B**, 1.5 kW, 3~ 220-240 V  
**SK 1x0E-250-340-B ... SK 1x0E-221-340-B**, 0.25 – 2.20 kW, 3~ 380-480 V

## Version list

Designation of previous issues	Software Version	Comments
BU 0180 DE, June 2013 Part. No.607 1801 / 2313	V 1.0 R0	First version based on BU 0200 DE / 2011
BU 0180 EN, February 2014 Part No. 607 1801 / 0914	V 1.0 R1	Bus options supplemented (Section 3), Amendment of individual technical data (Section 8) 1.5 kW, 3~ 230V device added (Section 8.2.2) Revision of EMC section, incl. supplement to EC Declaration of Conformity (Section 9.3) Various other corrections

## Publisher

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## Intended use of the frequency inverter

**Compliance** with the operating instructions is **essential 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.

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

Frequency inverters are devices for fixed installation on motors or in systems in the vicinity of the motors to be operated. All details regarding technical data and permissible conditions at the installation site must be complied with.

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

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## 1 General

The SK 1x0E series is based on the tried and tested NORD platform. These devices feature a compact design with optimum control characteristics.

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

This series of devices can be adapted to individual requirements by means of extension modules.

Due to the numerous setting options, these inverters are capable of controlling all three-phase motors. The power range is from **0.25 kW to 2.2 kW**. The device is equipped with an integrated mains filter.

This manual is based on the device software V1.0 R1 (see P707) of the frequency inverter. If the frequency inverter used has a different version, this may lead to some differences. If necessary, you can download the current manual from the Internet ([www.nord.com](http://www.nord.com)).

For the various versions SK 180E / 190E there are also supplementary descriptions for the integrated AS interface (BU 0180, Section 5.4)

If a bus system is used for communication, a corresponding description (e.g. BU 0220 for PROFIBUS DP) is provided, or this can be downloaded from the Internet ([www.nord.com](http://www.nord.com)).

Typically, this series of devices is installed directly on a three-phase asynchronous motor. Alternatively, optional accessories are available for mounting the devices near to the motor, e.g. on the wall or on a machine frame.

In order to gain access to all parameters, the internal RS232 PC interface (RJ12) can be used, or an optional SimpleBox or ParameterBox may be used. In this case, the parameter settings which are changed by the operator are saved in the EEPROM which is integrated into the frequency inverter.

## 1.1 Overview

### Basic features of the SK 180E / SK 190E:

- High starting torque and precise motor speed control setting with sensorless current vector control
- Can be installed directly on, or near to the motor.
- Permissible ambient temperature -25°C to 50°C (please refer to the technical data)
- Integrated EMC line filter for limit curve category C1, motor-mounted (not for 115V devices)
- Automatic measurement of the stator resistance or determination of the precise motor data
- Programmable direct current braking
- Only size 2: Built-in brake chopper for 4 quadrant operation, optional brake resistors (internal/external)
- 2 analog inputs (switchable between current and voltage operation), which can also be used as digital inputs.
- 3 digital inputs
- 2 digital outputs
- Temperature sensor input (TF+/TF-)
- NORD system bus for connection of additional modules, with switchable termination resistor and address which can be set with DIP switches.
- Four separate online switchable parameter sets
- Diagnostic LEDs
- RS232/RS485 interface via RJ12 plug

### Additional features of the SK 190E:

- Integrated AS interface

## 1.2 Delivery

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

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

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

## 1.3 Scope of supply

Standard version: IP55 (optionally IP66)  
Operating instructions as PDF file on CD-ROM  
incl. NORD CON (PC-based parameterisation software)

### Available accessories:

NOTE: Only the options listed in this manual may be used with the frequency inverter. Options for other series (e.g. SK CSX-0) may destroy the device and its options.

Only Size 2: Braking resistor, required for energy feedback, Section 2.3

Matching RJ12 to SUB-D9 adapter cable to connection to a PC

**SK CSX-3H**, SimpleBox, 4-digit 7-segment LED display

**SK PAR-3H**, ParameterBox, plain text LCD display

Extension modules:

## internal

**SK CU4-IOE**, internal I/O extension  
**SK CU4-PBR**, internal PROFIBUS DP® module  
**SK CU4-CAO**, internal CANopen® module  
**SK CU4-DEV**, internal DeviceNet™ module  
**SK CU4-ECT**, internal EtherCAT® module (Note: Derating)  
**SK CU4-PNT**, internal PROFINET IO® module (Note: Derating)  
**SK CU4-POL**, internal POWERLINK module (Note: Derating)  
**SK CU4-EIP**, internal Ethernet/IP™ module (Note: Derating)  
**SK CU4-POT**, Potentiometer adapter: internal potentiometer/switch module  
**SK CU4-REL**, internal setpoint converter for bipolar analog signals, incl. 2 relays  
**SK CU4-MBR**, internal brake rectifier for controlling electromechanical brakes  
**SK TIE4-POT**, potentiometer module  
**SK TIE4-SWT**, direction selector switch module

## external

**SK TU4-IOE**, external I/O extension  
**SK TU4-PBR**, external PROFIBUS DP® module  
**SK TU4-CAO**, external CANopen® module  
**SK TU4-DEV**, external DeviceNet™ module  
**SK TU4-ECT**, external EtherCAT® module  
**SK TU4-PNT**, external PROFINET IO® module  
**SK TU4-POL**, external POWERLINK module  
**SK TU4-EIP**, external Ethernet/IP™ module  
**SK TI4-TU-BUS** or **NET** or **MSW**, connection unit TU4  
**SK TIE4-WMK-TU**, wall-mounting kit TU4  
**SK TU4 MSW**, external maintenance switch

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**NOTE:** Details for the use of the relevant bus systems can be found in the applicable supplementary bus manual or in the data sheets for the individual modules.

> [www.nord.com](http://www.nord.com) <

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## 1.4 Safety and installation information

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

- Installation and other work may only be carried out by qualified electricians and with the device disconnected. The operating instructions must always be available to these persons and must be strictly observed.
- Local regulations for the installation of electrical equipment and accident prevention must be complied with.
- The equipment continues to carry hazardous voltages for up to 5 minutes after being switched off at the mains.
- For single phase operation (115/230 V) the mains impedance must be at least 100  $\mu\text{H}$  for each conductor. If this is not the case, a mains choke must be installed.
- For safe isolation from the mains, all poles of the supply cable to the frequency inverter must be able to be disconnected.
- Even during motor standstill (e.g. caused by an electronic block, blocked drive or output terminal short circuit), the line connection terminals, motor terminals and braking resistor terminals may still conduct hazardous voltages. A motor standstill is not identical to electrical isolation from the mains.
- **Warning**, with certain settings, the frequency inverter/motor can start up automatically after the mains are switched on.
- The frequency inverter is primarily intended for permanent connection and may not be operated without effective earthing connections that comply with local regulations for large leakage currents ( $> 3.5 \text{ mA}$ ). VDE 0160 stipulates the installation of a second earthing conductor or an earthing conductor cross-section of at least  $10 \text{ mm}^2$ .  
However, connection via a plug connector is also permissible if local regulations are complied with.
- A **universal leakage current-sensitive circuit breaker** (type B) compliant with EN 50178/VDE 0160 must be used.
- In normal use, frequency inverters are maintenance-free. The cooling surfaces must be regularly cleaned with compressed air if the ambient air is dusty.
- The frequency inverters are suitable for operation on TN or TT networks and with observation of the measures described in Section 2.7.4, they are also suitable for IT networks.



---

**CAUTION**



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

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

Protection against accidental contact may need to be provided.

---

**ATTENTION**



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

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

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

**DANGER TO LIFE!**

---

**CAUTION**



Children and the general public must be kept away from the equipment!

The equipment may only be used for the purpose intended by the manufacturer. 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.

Keep these operating instructions in an accessible location and give them to all operators!

---

**WARNING**



This product is intended for use in an industrial environment and is subject to sales restrictions according to IEC 61800-3. Depending on the type of installation and the length of the motor connection cable this product can cause high frequency interference in a domestic environment, in which case the user may be required to take appropriate measures.

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

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## 1.5 Certifications

### 1.5.1 European EMC Directive

If the frequency inverter is installed according to the recommendations in this manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3. (See also Section 9.3 Electromagnetic Compatibility [EMC].)



### 1.5.2 UL and cUL approval (in preparation)

The section applies for all devices of sizes 1 – 2. All frequency inverters are equipped with motor overload protection. Further technical details can be found in Section 8.2.

#### NOTE



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

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

#### NOTE



"The device has to be mounted according to the manufacturer instructions."  
"Installation must be carried out according to the manufacturer's instructions."

"Use 80°C Copper Conductors Only"  
"Connection of copper cable with an insulation rating of at least 80°C"  
(only refers to connection cables (mains and motor cables))

"These products are intended for use in a pollution degree 2 environment"

### UL Approval - File No. E171342

*"Suitable For Use On A Circuit Capable Of Delivering Not More Than 100000 rms Symmetrical Amperes, 120 Volts maximum (SK 1x0E-xxx-112), 240 Volts maximum (SK 1x0E-xxx-323) or 480 Volts maximum (SK 1x0E-xxx-340) and when protected by RK5 class or faster fuses as indicated in chapter 8.2."*



*"Suitable For Use On A Circuit Capable Of Delivering Not More Than 10000 rms Symmetrical Amperes, 120 Volts maximum (SK 1x0E-xxx-112), 240 Volts maximum (SK 1x0E-xxx-323) or 480 Volts maximum (SK 1x0E-xxx-340) and when protected by Circuit Breaker (inverse time trip type) in accordance with UL 489", current and voltage ratings can be found in chapter 8.2.*

*„The torque value for the field wiring terminals for mains circuit terminals, motor terminals, break terminals and breaking resistor terminals must be 11 ... 15 lb-in (1.2 ... 1.5Nm). The torque value for the field wiring terminals for control circuit terminals must be 4.4 ... 5.3 lb-in (0.5 ... 0.6Nm)."*

**cUL Approval - File No. E171342**

“cUL only in combination with SK CIF-340-30 or SK CIF-340-60 for 380-480V models and SK CIF-323-20 or SK CIF-323-40 for 3 phase 200-240V rated models”. The recognized transient surge suppression filter board has to be connected between supply and the input of the drive according to the instruction manual.

Remarks:

- cUL approval for 110-120V models provided without filter board



“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 rms Symmetrical Amperes, 120 Volts maximum (SK 1x0E-xxx-112), 240 Volts maximum (SK 1x0E-xxx-323) or 480 Volts maximum (SK 1x0E-xxx-340) and when protected by RK5 class or faster fuses according to instruction manual chapter 8.2.”

“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 rms Symmetrical Amperes, 120 Volts maximum (SK 1x0E-xxx-112), 240 Volts maximum (SK 1x0E-xxx-323) or 480 Volts maximum (SK 1x0E-xxx-340) and when protected by Circuit Breaker (inverse time trip type) in accordance with UL 489”, current and voltage ratings according to instruction manual chapter 8.2.

**1.5.3 C-Tick labeling**

NORD frequency inverters fulfill all the relevant regulations in Australia and New Zealand.

**1.5.4 RoHS compliance**

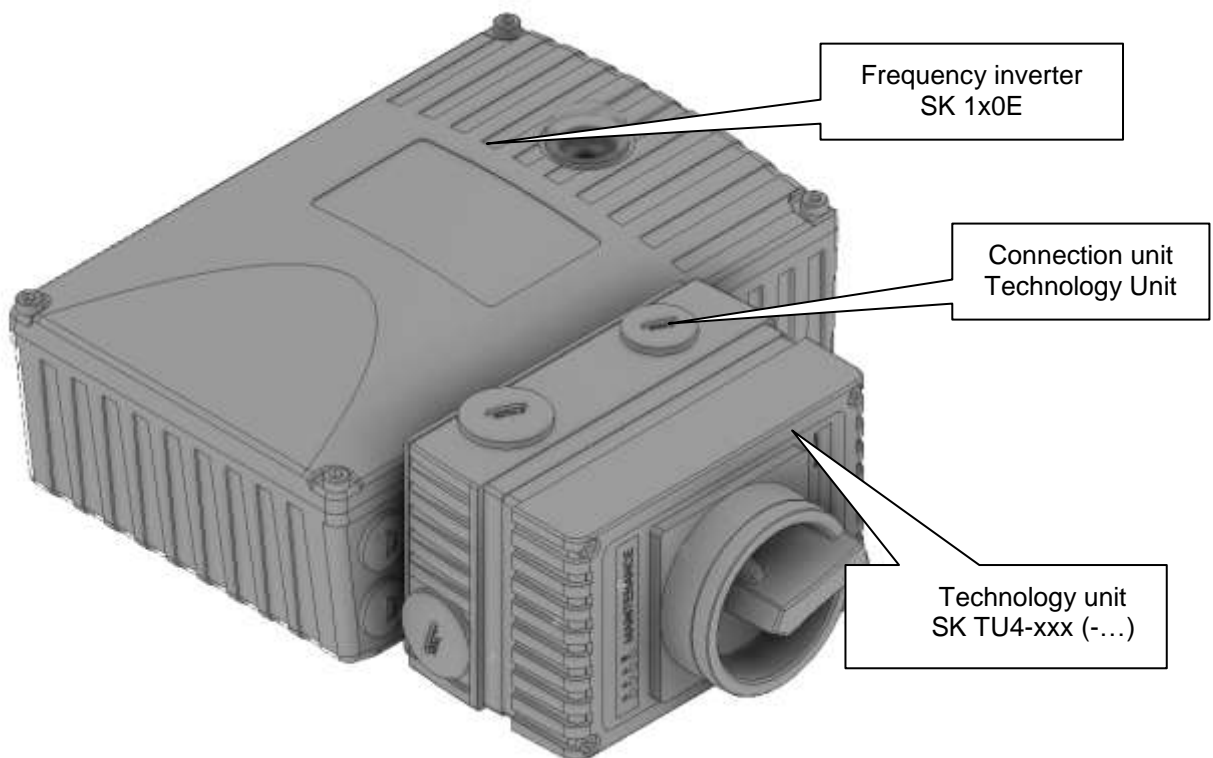
NORD frequency inverters are designed to be RoHS compliant according to Directive 2002/95/EEC.



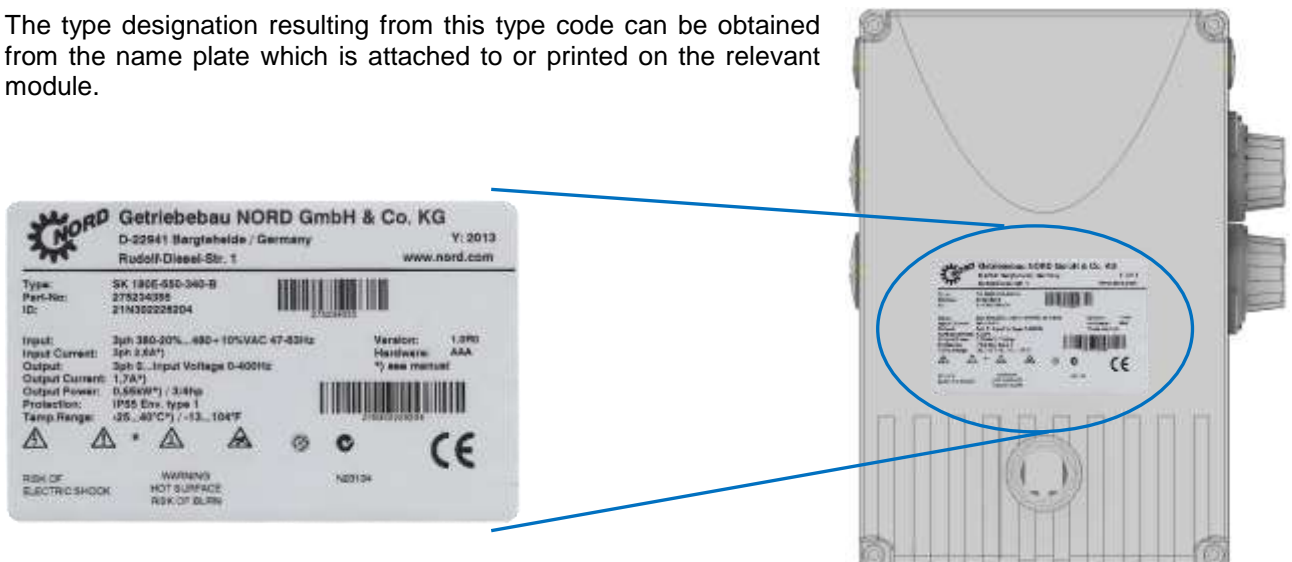
## 1.6 Nomenclature / type codes

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

Group	Example of type code
Basic unit	SK 180E-370-340-A (-C)
Connection unit - Technology Unit	SK T14-TU-MSW (-C-WMK-TU)
Optional modules	SK TU4-MSW (-C)
Extension modules	SK TIE4-M12-INI

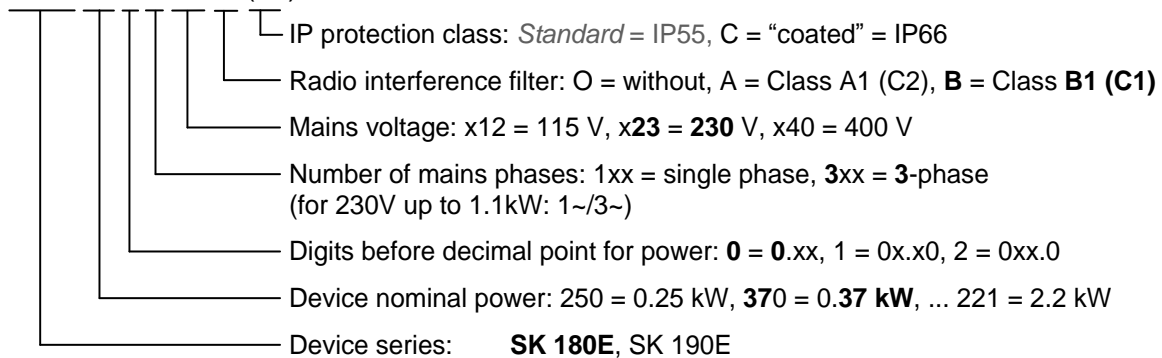


The type designation resulting from this type code can be obtained from the name plate which is attached to or printed on the relevant module.



### 1.6.1 Type code / Frequency inverter - Basic device

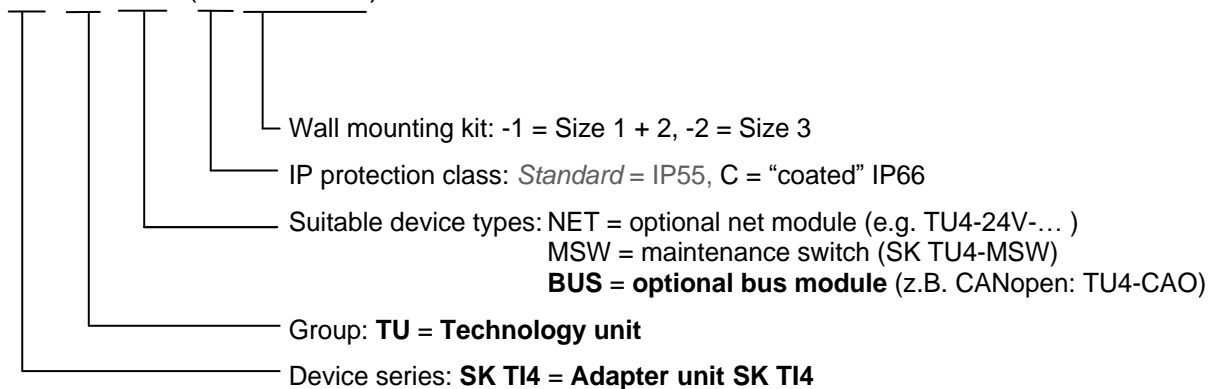
#### SK 180E-370-323-B (-C)



(...) Options, only implemented if required.

### 1.6.2 Type codes / Adapter unit - Technology Unit

#### SK TI4-TU-BUS (-C-WMK-TU)

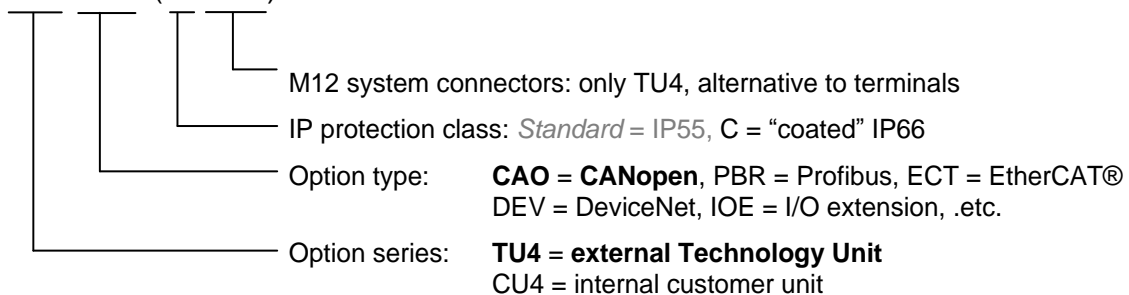


(...) Options, only implemented if required.

### 1.6.3 Type codes / Optional modules

#### For bus module or I/O extension

#### SK TU4-CAO (-C-M12)



(...) Options, only implemented if required.

## 1.7 Version with protection class IP55 / IP66

The frequency inverters and additional modules are available in protection classes IP55 (standard) or IP66 (optional). The protection class IP66 must always be stated when ordering!

There are no restrictions or differences to the scope of functions in either protection class. In order to differentiate the protection classes, modules with protection class IP66 are given an extra “-C” (coated → coated PCBs) in their type designation.

e.g. SK 180E-750-340-B-C

### IP55 version:

The IP55 version of the external frequency inverter is the **standard** version. Both versions (motor-mounted, installed on the motor or wall mounted on the wall bracket) are available. In addition, all adapter units, technology units and customer units are available for this design.

### IP66 version:

In contrast to the IP55 version the IP66 version is a modified **option**. Both versions (motor-integrated, close to motor) are also available. The modules available to the IP66 design (adapter units, technology units and customer units) have the same functionalities as the corresponding IP55 design modules.

---

#### NOTE



The modules for the IP66 design are identified by an additional “-C” and are modified according to the following **special measures!**

---

#### Special measures:

impregnated PCBs,  
Powder coating RAL 9006 (white aluminium) for housing  
Low pressure test

---

#### NOTE



For all versions, care must be taken that the cable and the cable gland are carefully matched. Wherever possible, the cables should be inserted so that water is deflected away from the device (if necessary use loops). This is essential to ensure that the required protection class is maintained.

---

## 2 Assembly and installation

### 2.1 Installation and assembly

The frequency inverters are available in various sizes depending on their output. They can be mounted on the terminal box of a motor or in its immediate vicinity.

Motor-mounted version



Wall-mounted version



#### NOTE



The equipment requires sufficient ventilation to protect against overheating. Details of power reductions and possible ambient temperatures as well as other details can be found in the section 8 "Technical Data".

### 2.1.1 Mounting the housing box

On delivery of a complete drive unit (gear unit + motor + frequency inverter) the frequency inverter is always fully installed and tested.

#### NOTE



Installation of an IP66-compliant frequency inverter must be carried out by NORD, as special measures have to be implemented. IP66 components retrofitted on site cannot ensure that this protection class is guaranteed.

When delivered separately, the frequency inverter includes the following components:

- Frequency inverters
- Screws and contact washers for mounting the motor terminal box.
- Pre-fabricated cable for motor and PTC connections

#### **Procedures:**

1. If necessary, remove the original terminal box from the NORD motor, so that only the base of the terminal box and the terminal strip remain.
2. Set the jumpers for the correct motor circuit and connect the pre-fabricated cables for motor and PTC connections to the respective connection points on the motor.
3. Mount the cast housing on the terminal box base of the NORD motor using the existing screws and seal as well as the enclosed lock washers. Position the cast housing with the cooling fins towards the fan end of the motor. Check the adaptability for different motor manufacturers.
4. Connect the motor cables U, V, W to the power terminal block and the PTC cable TF+, TF- to the control terminal block 38, 39.



## 2.1.2 Adapters for different motors

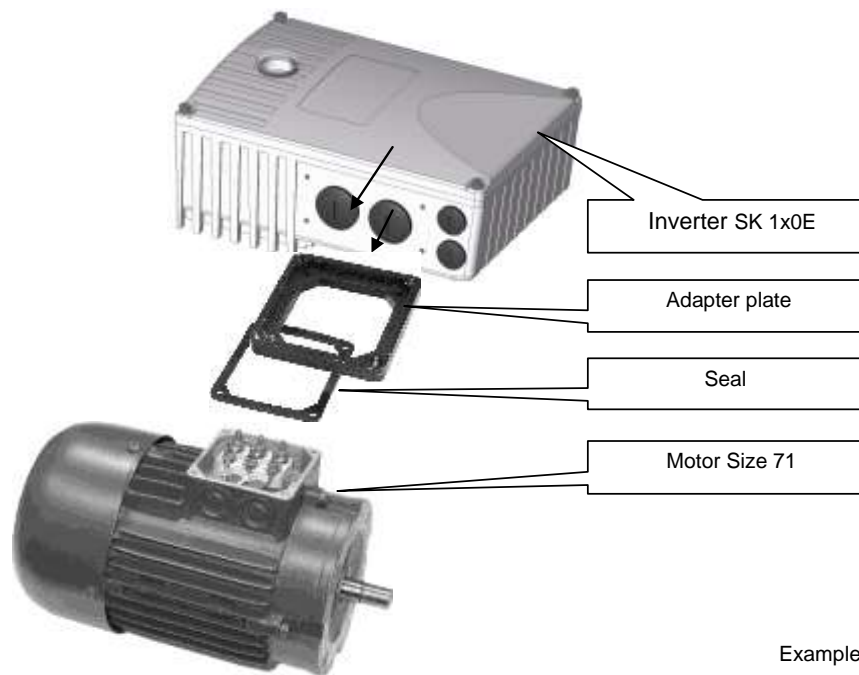
In some cases, the terminal box attachments are different for different sizes of motor. Therefore, it may be necessary to use an adapter to mount the frequency inverter.

In order to guarantee the maximum protection class IP55 / IP66 of the entire unit, motor must also have a corresponding protection class.

NORD motor sizes	Add-on SK 1x0E Size 1	Add-on SK 1x0E Size 2
Size 63 – 71	with adapter kit I	with adapter kit I
Size 80 – 112	Direct mounting	Direct mounting

### Overview of adapter kits

Designation	Add-on SK 1x0E	Part No.
Adapter kit size 63-71 to KK80-112 (Adapter kit I)	Adapter plate, terminal box frame seal and screws	<b>275119050</b>



Example

### NOTE



The adaptability of motors from other manufacturers must be checked individually!  
Information for the conversion of inverter-controlled drive units to the SK 1xxE can be found in BU0320.

### 2.1.3 Installation of the frequency inverter

The housing cover must first be removed in order to make the electrical connections to the frequency inverter. To do this, unscrew the 4 fastening screws, so that the housing cover can be removed upwards.

After the electrical connections of the supply cables have been made, the housing cover can be replaced.

To achieve the maximum protection class IP55/IP66, care must be taken that all the fastening screws of the housing cover are tightened diagonally, step-by-step and with the torques stated in the table below.

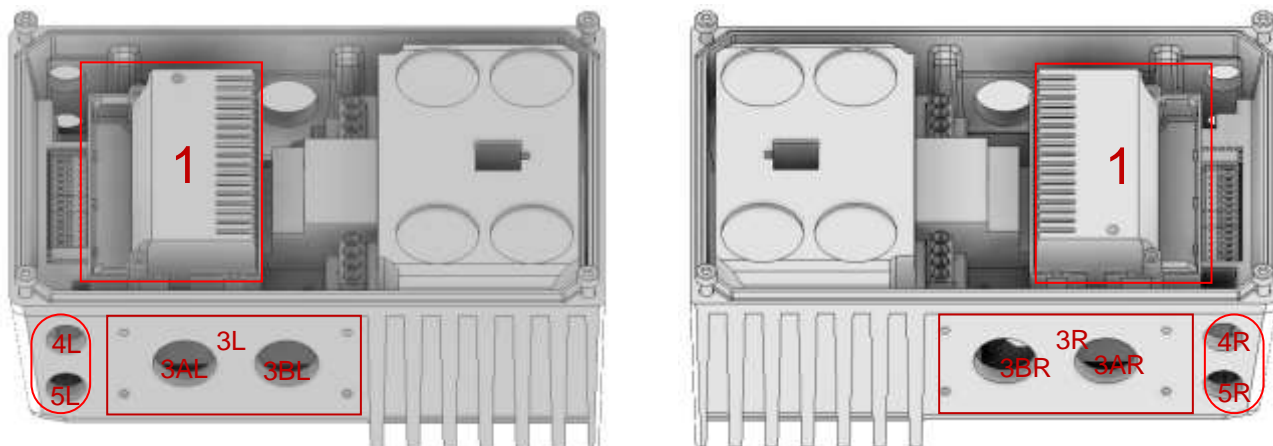
For the cable gland of the connecting cable, appropriate screwed connections for cable cross-section must be used.



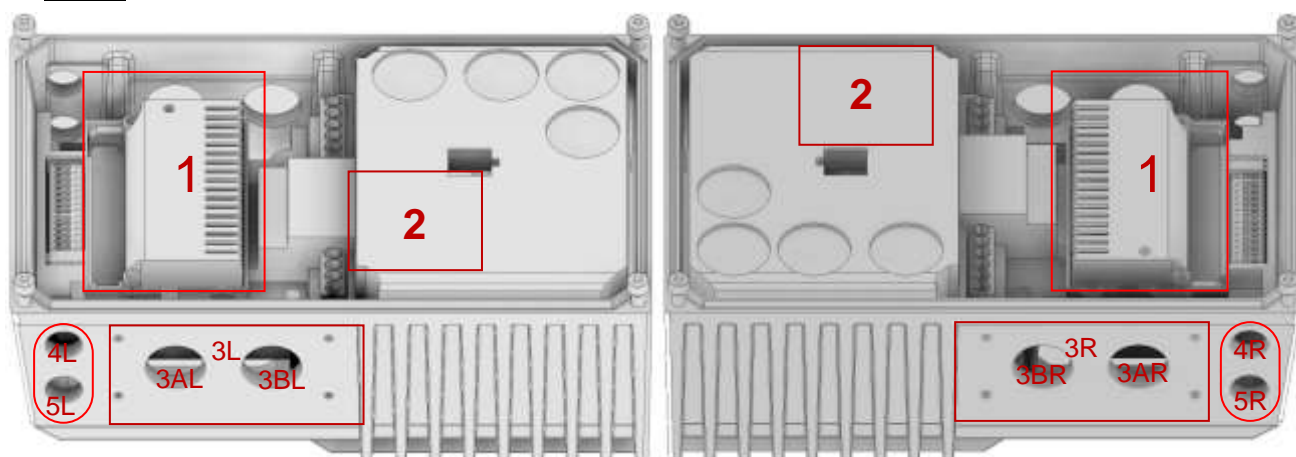
Frequency inverter size	Screw size	Tightening torque
Size I	M5 x 25	3.5 Nm $\pm$ 20%
Size II	M5 x 25	3.5 Nm $\pm$ 20%

## 2.1.4 Option slots in the device

### Size 1:



### Size 2:



The above drawings indicate the different installation locations for optional modules. Option slot 1 is used for the mounting of an internal customer interface (e.g. bus module). Option location 2 for installing an internal brake resistor is only present in size 2. **The brake resistor may only be installed at the factory and must therefore be taken into account in the order.** External bus modules, 24 V power supplies can be implemented at option locations 3L or 3R. Option locations 4 and 5 are used for the installation of M12 sockets or plug connectors or for cable glands. Only one option per option location is possible.

Option location	Position	Meaning	Size Sizes 1 - 2	Comments
1	Internal	Mounting location for customer units SK CU4-...		
2	Internal	Installation location for internal brake resistor		Only for size 2
3*	on side	Mounting location for <ul style="list-style-type: none"> <li>external technology units SK TU4-...</li> <li>Power plug connector (e.g. HARTING)</li> </ul>		
3 A/B*	on side	Cable gland	M25	Not available if location 3 is occupied or SK TU4-... is fitted.
4 *, 5 *	on side	Cable gland	M16	Not available if SK TU4-... is fitted.
* R and L (right and left side) – for motor installation: viewed from the fan wheel toward the motor shaft				

## 2.2 Dimensions of the frequency inverter

### 2.2.1 Power rating / Motor size

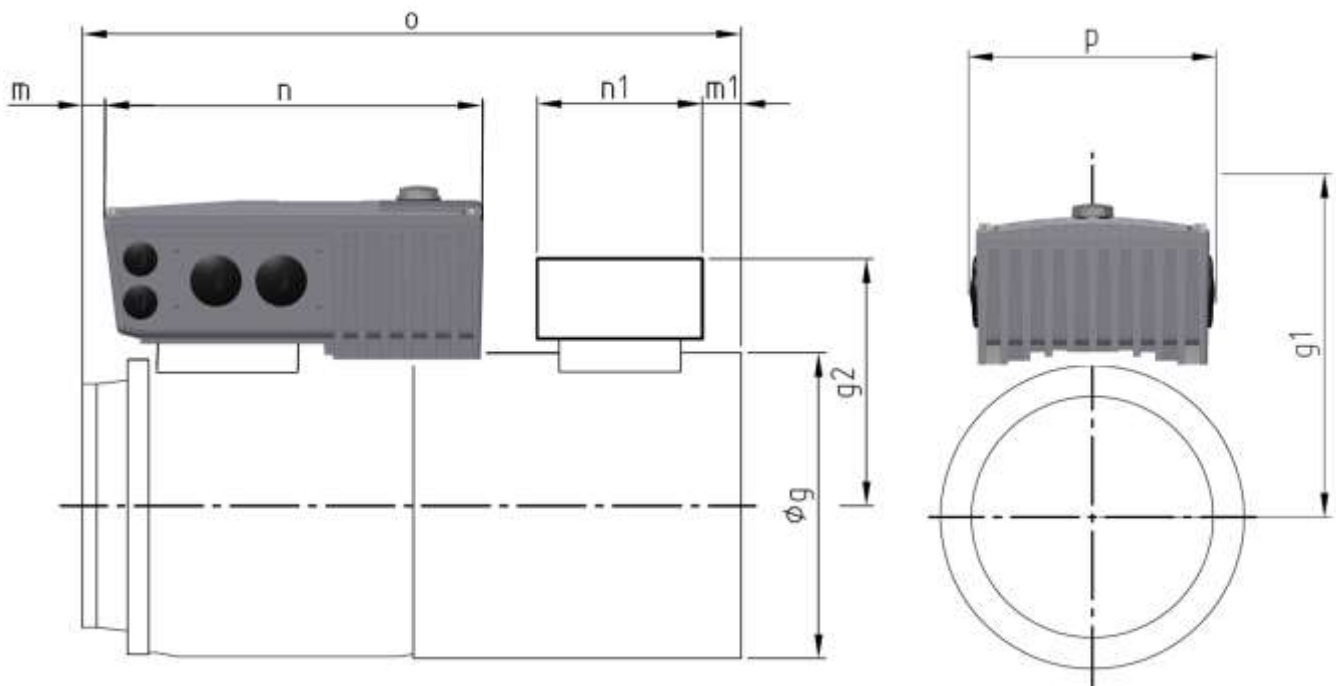
Size	Mains / Power category SK 1x0E		
	1~ 110-120 V	1~, 3~ 200-240 V	3~ 380-480 V
<b>Size I</b>	0.25 ... 0.75 kW	0.25 ... 0.55 kW	0.25 ... 1.1 kW
<b>Size II</b>	-	0.75 ... 1.5 kW	1.5 ... 2.2 kW

\* 1.5 kW only 3~

### 2.2.2 Motor-mounted frequency inverter

Size		Housing dimensions SK 1x0E / Motor					Weight of SK 2xxE without motor Approx. [kg]
FI	Motor	$\varnothing g$	g 1	n	o	p	
<b>Size I</b>	Size 71 *	145	177.5	221	214	154	2.0
	Size 80	165	171.5		236		
	Size 90 S / L	183	176.5		251 / 276		
<b>Size II</b>	Size 80	165	196.5	255	236	165	3.3
	Size 90 S / L	183	201.5		251 / 276		
	Size 100	201	210.5		306		

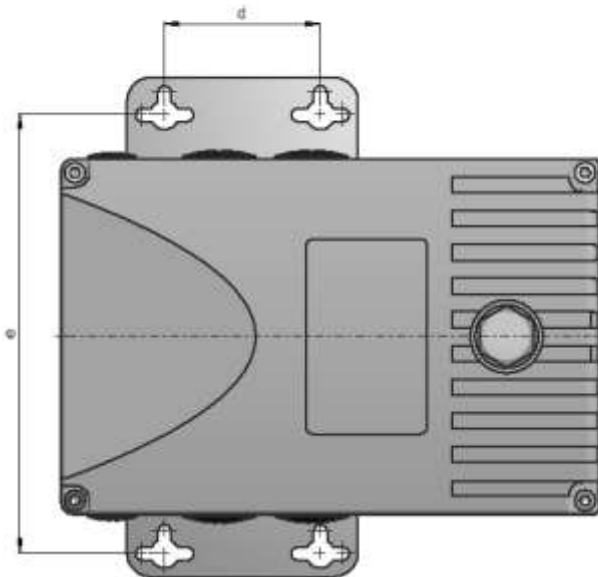
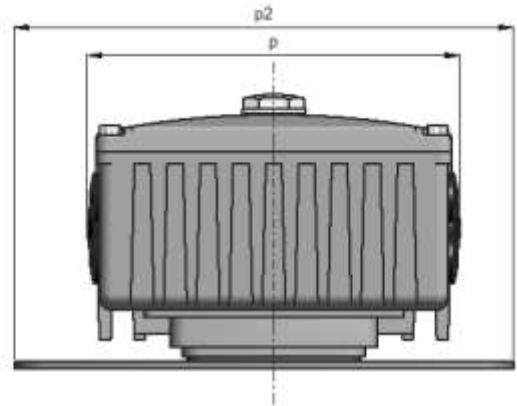
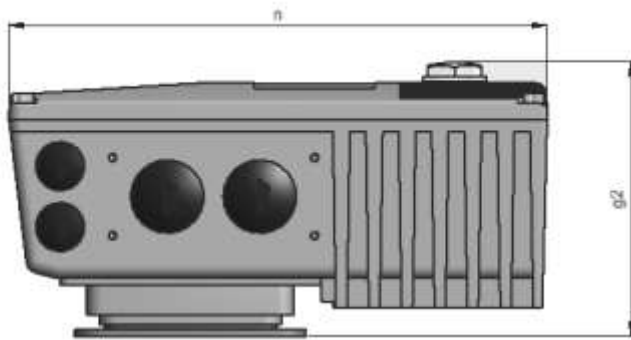
All dimensions in [mm]  
\*) including additional adapter and seal (18mm) [275119050]



### 2.2.3 Wall-mounted frequency inverter

The frequency inverter can be installed in the vicinity of the motor by means of an optional wall mounting kit.

Device type Size	Housing dimensions				Wall-mounting SK TIE4-WMK-L-1			total weight Approx. [kg]
	g2	n	p	p2	d	e	∅	
<b>Size 1</b> → SK TIE4-WMK-1 Part No. 275 274 000	113	221	154	205	64	180	5.5	2.6
<b>Size 2</b> → SK TIE4-WMK-1 Part No. 275 274 000	115,5	255	165	205	64	180	5.5	3.9
All dimensions in [mm]								



All possible installation orientations are permissible for wall mounting. Please also note Section 8.

## 2.3 Brake resistor (BR) (only size 2)

During dynamic braking (frequency reduction) of a three phase motor, electrical energy is returned to the frequency inverter. From Size II or larger, an internal or external brake resistor may be used to prevent the FI from shutting down in case of overvoltage. With this, the integrated brake chopper (electronic switch) pulses the link circuit voltage (switching threshold approx. 420V/720V DC, according to the mains voltage) into the braking resistor. The brake resistor ultimately converts the excess energy into heat.

For input voltages >460V the use of a brake resistor is generally recommended in order to compensate for the reduced storage capacity of the link circuit due to the higher voltage.

### CAUTION



The braking resistance and all other metal components can heat up to temperatures above 70°C. When mounting, sufficient distance from neighbouring components must be maintained. When working on the components, allow sufficient cooling time beforehand.

### 2.3.1 Internal brake resistor SK BRI4-...

#### NOTE



The internal brake resistor may only be installed at the factory and can not be retrofitted. It is essential that this is taken into account for the configuration and ordering of the device.

The internal brake resistor can be used if only slight, short braking phases are to be expected.



The output power of the SK BRI4 is limited (see also the following note field) and can be calculated as follows.

$$P = P_n * (1 + \sqrt{(30 / t_{brakes})})^2, \text{ however, } P < P_{max}$$

(P=Brake power (W), P<sub>n</sub>= Continuous brake power of resistor (W), P<sub>max</sub>. peak brake power, t<sub>brakes</sub> = duration of braking process (s))

The permissible continuous brake power P<sub>n</sub> must not be exceeded in the long-term average.

(For details of P<sub>n</sub> and P<sub>max</sub> see Section 2.3.4)

#### NOTE



If internal brake resistors are used, a suitable power limit must be set in P555, P556 and P557. This is important in order to activate a peak and continuous power limit for the brake resistor. Otherwise, the brake resistor may be damaged during operation.

### 2.3.2 External brake resistor SK BRE4-...

The external brake resistor (available for SK 1x0E, Size 2) is intended for energy feedback, e.g. in pulse drives or lifting gear. Here, it may be necessary to plan for the exact brake resistor required.

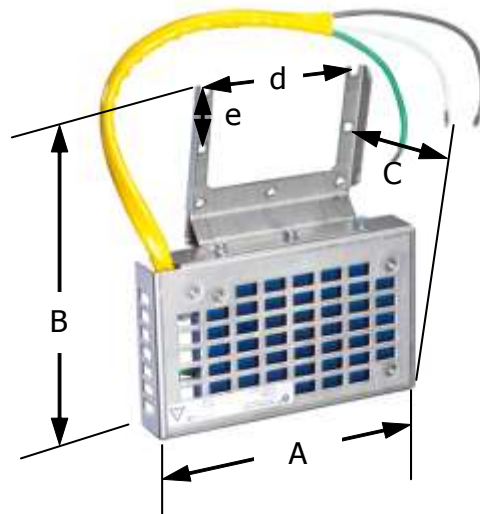
For installation, an M20 screw connection with an adapter for M25 is supplied. The connecting wires for the brake resistor are fed through this into the connection unit. Because of the cable gland the brake resistor and an optional SK TU4-technology unit must not be mounted on the same side of the frequency inverter.



The brake resistor is attached to the side of the connection unit using 4 suitable M4 x 10 screws. Installation of an SK BRE4... is not possible in combination with the wall-mounting kit SK TIE4-WMK(-L).

### 2.3.3 External brake resistor dimensions

Resistor type	A	B	C	Fixing dimensions		
				d	e	∅
SK BRE4-1-100-100 SK BRE4-1-200-100	150	178	61	83	32	4.3
All dimensions in mm						



## 2.3.4 Electrical data BR

### Internal

Inverter ID SK 1x0E-...	Resistor type (IP54)	Resistance	Max. continuous output / limit** (P <sub>n</sub> )	Energy consumption* (P <sub>max</sub> )	Connecting cable or terminals
750...111-323-A	<b>SK BRI4-1-200-100</b> Part. No. 275272008	200 Ω	100 W / 25%	1.0 kW	Silicone conductor 2x 0.75 mm <sup>2</sup> approx. 275 mm
151...221-340-A	<b>SK BRI4-1-400-100</b> Part. No. 275272012	400 Ω	100 W / 25%	1.0 kW	
*) Maximum once within 10 s**					
**) In order to prevent impermissible heating of the device, the continuous power is limited to 1/4 of the rated power of the brake resistor. This also has a limiting effect on the power consumption.					

### External

Inverter ID SK 1x0E-...	Resistor type (IP67)	Resistance	Max. continuous power (P <sub>n</sub> )	Energy consumption* (P <sub>max</sub> )	Connecting cable or terminals
750...111-323-A	<b>SK BRE4-1-100-100</b> Part. No. 275273005	100 Ω	100 W	2.2 kW	FEP flex 3x 1.9 mm <sup>2</sup> AWG 14/19 approx. 350 mm
151...221-340-A	<b>SK BRE4-1-200-100</b> Part. No. 275273008	200 Ω	100 W	2.2 kW	
*)Maximum once within 120 s					

## 2.4 Overvoltage filter SK CIF

The use of a suitable ("CSA-") overvoltage filter is mandatory (see also Section 1.5) in order to comply with cUL requirements. For 230V devices, operation of the frequency inverter with a suitable overvoltage filter is only permissible if a mains choke is used in addition.

For further information about the overvoltage filter, please refer to the relevant data sheet. These data sheets can be downloaded at [www.nord.com](http://www.nord.com).

Inverter ID	Filter type	Data sheet
SK 1x0E-250-323-A... SK 1x0E-111-323-A*	<b>SK CIF-323-20</b> (alternatively SK CIF-323-40)	TI 030 276997070 (TI 030 276997071)
SK 1x0E-250-340-A... SK 1x0E-221-340-A	<b>SK CIF-340-30</b> (alternatively SK CIF-340-60)	TI 030 276997080 (TI 030 276997081)
* (only with suitable mains choke)		

Without an overvoltage filter, frequency inverters for 1~ 115V mains (SK1x0E-xxx-112-O) cannot be approved according to cUL.

### CAUTION!



Modules SK CIF-323-x0 may **only be used in combination with a suitable mains choke**

( $L_{\min} = 3 \times 0,73 \text{ mH}$ ) (see connection diagram).

For SK CIF-340-x0 modules the use of a mains input choke is not mandatory, but is recommended.

#### Note

With the use of a mains choke, the effective input currents of the 1~ 230V frequency inverter reduce to approximately the values of the output currents. Several frequency inverters can be connected to a choke - filter combination. In this case, the total input currents must not exceed the current rating of the filter.

## 2.5 Wiring guidelines

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

- (1) Ensure that all equipment in the control cabinet or field is securely earthed using short earthing cables which have large cross-sections and are connected to a common earthing point or earthing rail. It is especially important that all control devices connected to the frequency inverters (e.g. an automation device) are connected to the same earthing point as the inverter itself, using a short cable with large cross-section. Flat conductors (e.g. metal clamps) are preferable, as they have a lower impedance at high frequencies.
- (2) The bonding cable of the motor controlled by the frequency inverter should be connected directly to the earthing terminal of the associated frequency inverter. The presence of a central earthing bar in the control cabinet and the grouping together of all bonding conductors to this bar normally ensures safe operation. (see also Section. 9.3 / 9.3.3 (EMC))
- (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 frequency inverter.

- (4) The control cables should be installed as far as possible from power cables, using separate cable ducts, etc. Where cables cross, an angle of 90° should be ensured as far as possible.
- (5) Ensure that the contactors and brake chokes in the cabinet are interference protected, either by RC circuits in the case of AC contactors, or by “free-wheeling” diodes for DC contactors, **whereby the interference protectors must be positioned on the contactor coils**. Varistors for over-voltage limitation are also effective. This interference suppression is particularly important when the contactors are controlled by the relay in the frequency inverter.
- (6) Use screened or armoured cable for the load connections (motor cable) and earth the screening/armour at both ends, if possible to the frequency inverter bonding.

In addition, an EMC-compliant cabling must be ensured (see also Section. 9.3 / 9.3.3 (EMC)).

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

### NOTE



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

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

### ATTENTION



With the use of a ParameterBox SK PAR-3H this must never be simultaneously connected to the frequency inverter and the PC, as potential shifts may cause damage, especially to the PC. (See also Manual BU0040)

## 2.6 Electrical connection

### WARNING

THE DEVICES MUST BE EARTHED.



Safe operation of the devices requires that 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 motor connection terminals even when the inverter is switched off. Always use insulated screwdrivers on these terminal fields!

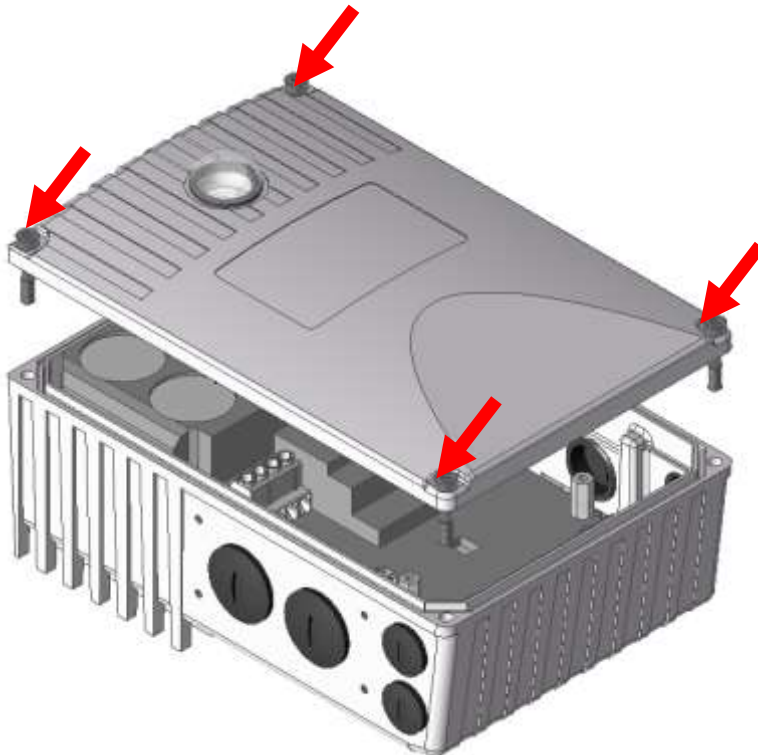
Ensure that the input voltage source is not live before setting up or changing connections to the unit.

Make sure that the inverter and motor are specified for the correct supply voltage.

**NOTE:** As with other signal cables, thermistor cables must be laid separately from the motor cables.

The housing cover must be removed from the SK 1x0E in order to make the electrical connections. Proceed as follows:

1. Switch off the mains supply and if necessary check and observe the waiting period.
2. Loosen the 4 Allen screws (4 mm).
3. Carefully lift the housing cover vertically from off the housing box.
4. The electrical connections and the option slots are now freely accessible.



5. Replace the cover
6. Evenly tighten the Allen screws in a cross-wise direction (for tightening torques, please refer to Section 2.1.3).

## 2.7 Electrical connection of power unit

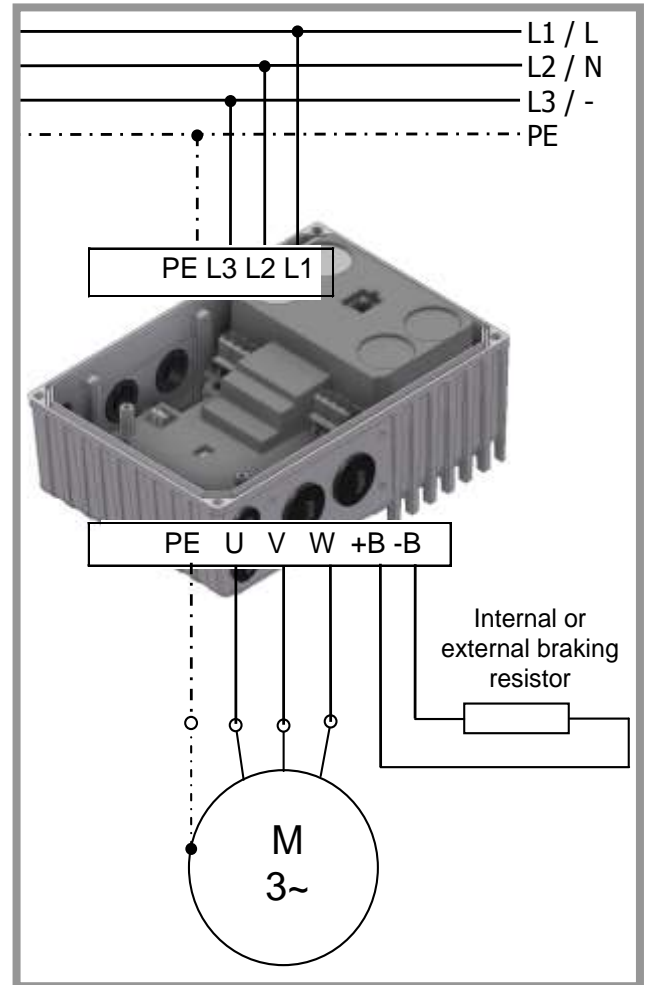
All connection terminals are located in the connection unit of the frequency inverter.

Separate terminal bars are provided for the power connections and the control connections, as well as a further terminal bar for the connection of the thermistor.

The PE connections (device earth) are located on the power connections for the motor and the mains, as well as on the base in the cast housing.

Before and while the device is connected, the following must be observed:

1. Ensure that the mains supply provides the correct voltage and is suitable for the current required (see Section 8 Technical Data).
2. Ensure that suitable circuit breakers with the specified nominal current range are installed between the voltage source and the inverter.
3. Connect the mains voltage directly to the terminals **L<sub>1</sub>-L<sub>2</sub>/N-L<sub>3</sub>** and **PE** (according to the device).
4. To connect the motor, three flexible wires **U-V-W** should be used when mounting the motor.
5. For wall-mounting a 4-conductor shielded motor cable (recommended) to the terminals **U-V-W** and **earth** should be used. In this case the cable shielding should be connected to a large area of the metallic screw connector.



**NOTE:** if certain **wire end sleeves** are used, the maximum cross-section which can be connected may be reduced.

**Screwdriver:** Use a 5.5mm slot-head screwdriver to connect the power unit.

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

**NOTE:** Only use copper cables with temperature class 80°C or equivalent for connection. Higher temperature classes are permissible.

**NOTE:** The use of shielded cables is essential in order to maintain the specified radio interference suppression level. (See also Section 9.3.3 (EMC))

**CAUTION:** This device produces high frequency interference, which may make additional suppression measures necessary in **domestic environments**. (Details in Section 9.3 / 9.3.3 (EMC))



## 2.7.1 Mains supply (L1, L2, L3, PE)

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

**115V devices** may only be used with a 110...120V (L/N = L1/L2) single phase supply.

**230V devices** can optionally be used for single phase or three-phase operation.

**400V devices** are designed for three phase mains voltage 380...480V (L1/L2/L3).

For the exact specification, please refer to the technical data in Section 8.

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

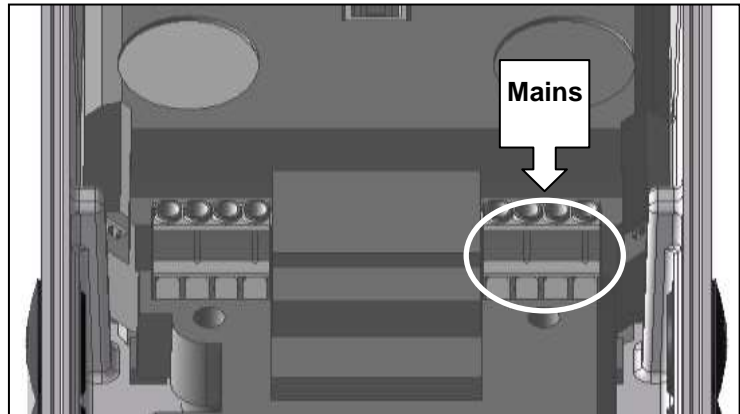
### Connection cross-section:

0.2 ... 4/6 mm<sup>2</sup> rigid/ flexible cable AWG 24-10

For looping of the mains voltage, up to a cable cross-section of 2 x 2.5mm<sup>2</sup> double wire end sleeves must be used.

### Starting torque:

0.5 ... 0.6Nm



### Operation in IT network

The use of this frequency inverter on an **IT network** is possible after modifications by means of jumpers for size 2. Further details in Section 2.7.4. The prerequisite is a connected brake resistor, in order to prevent impermissible charging of the inverter link circuit in case of a mains fault (short-circuit to earth).

## 2.7.2 Motor cable (U, V, W, PE)

The motor cable may have a **total length of up to 50m** if this is a standard cable. If a screened motor cable is used, or if the cable is laid in a well earthed metal conduit, the **total length should not exceed 20m**. In order to comply with interference suppression class C2, a **total length of 5m** must not be exceeded.

### Connection cross-section:

0.2 ... 4/6 mm<sup>2</sup> rigid/ flexible cable AWG 24-10

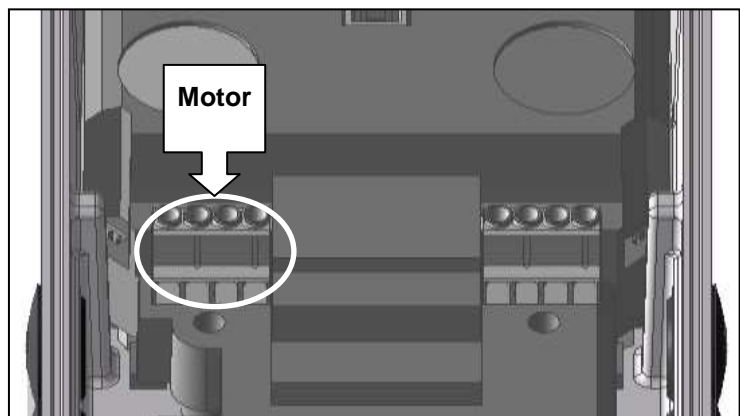
### Starting torque:

0.5 ... 0.6 Nm

**Note:** Please note also Section 9.3.3 (EMC).

**Note:** For multiple motors operation the total motor cable length consists of the sum of the individual cable lengths.

**Note:** The motor cable must not be switched as long as the inverter is providing power to the motor. (The inverter must be on "Standby" or "Starting Disabled")



### 2.7.3 Brake resistor connection (-B, +B) (only size 2)

The terminals +B/ -B are intended for the connection of a suitable braking resistor (only size 2). The connection should be as short as possible.

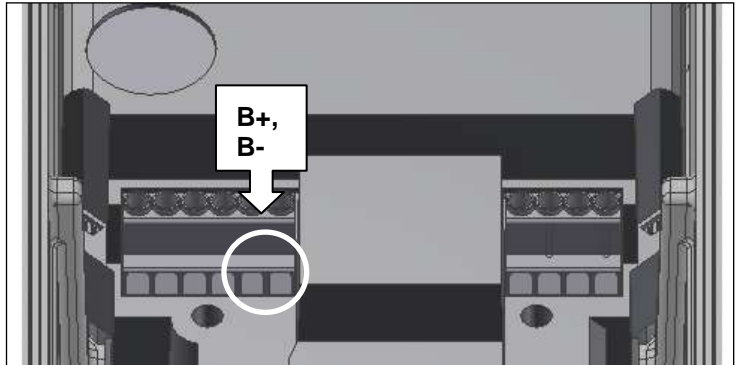
#### Connection cross-section:

0.2 ... 4/6mm<sup>2</sup> rigid/ flexible cable  
AWG 24-10

#### Starting torque:

0.5 ... 0.6 Nm

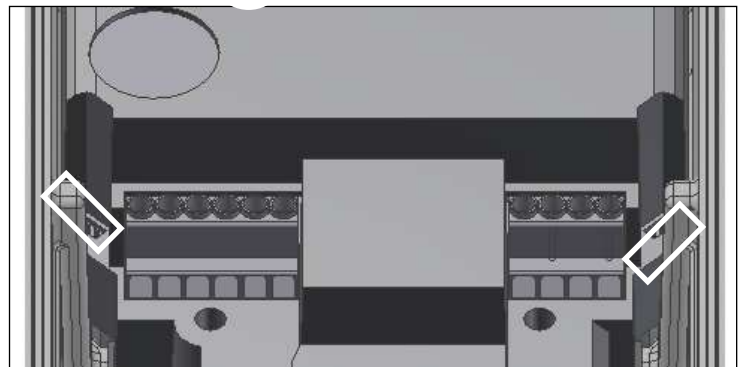
**Note:** The great production of heat in the braking resistor must be taken into account.



### 2.7.4 Mains supply jumpers

These jumpers are used to adapt the frequency inverter to various types of networks (e.g. IT network). As delivered, the jumpers are plugged in the "normal position" ( $C_Y=ON$ ) and are to be used in a network which is earthed at the star point, with a neutral conductor for single phase devices!

To adapt the frequency inverter to an IT network (only size 2 in combination with a brake resistor), the capacitors  $C_Y$  must be disconnected from the PE. This is carried out by changing a jumper position as shown in the diagram.



Here it must be noted that the specified degree of radio interference suppression changes. Further details can be found in Section 9.3 EMC.

Jumper on the left side ( $C_Y$  capacitors, link circuit PE):



Jumper on the right side ( $C_Y$  capacitors, link circuit PE):



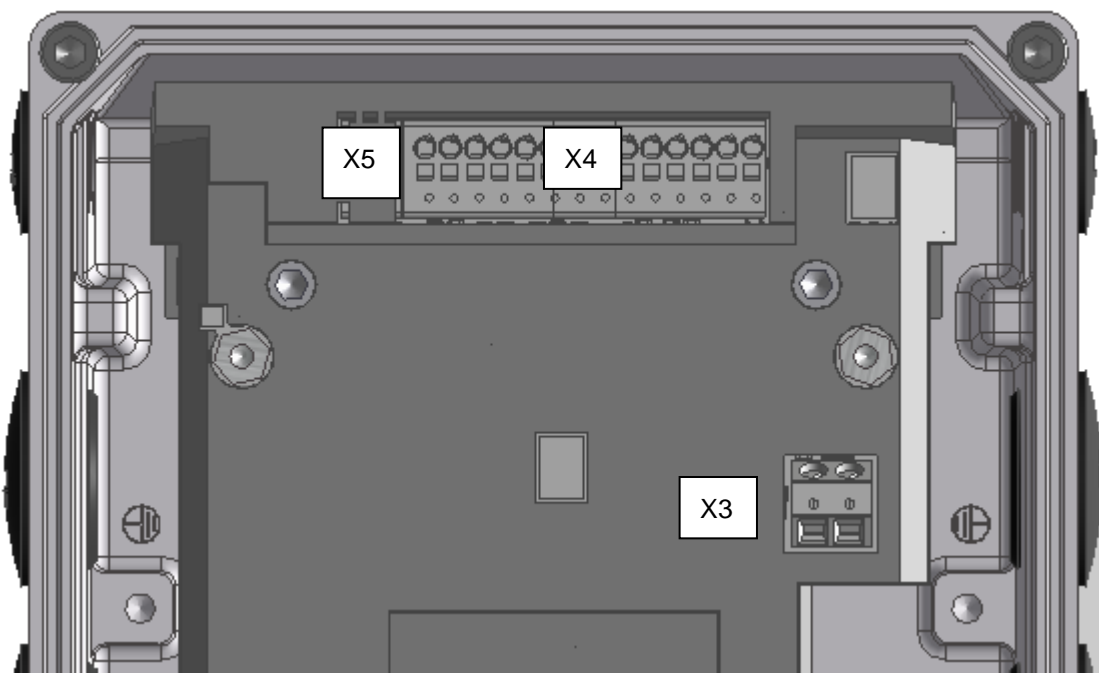
## 2.8 Electrical connection of the control unit

The control connections are located on the inside of the frequency inverter housing. The connections to the terminal bar differ according to the version (SK 180E...190E).

**Connection terminals:** Spring-loaded terminal (X4, X5), slot-head screwdriver, size 2.0 mm  
PCB terminal with screw connection (X3), size 2.0 mm, 0.5...0.6 Nm

**Connection cross-section:** 0.2...1.5 mm<sup>2</sup>, AWG 24-16, rigid or flexible, with wire end sleeves without plastic sleeves

**Control cable:** Lay and shield separately from the mains/motor cables



### NOTE



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

The labelling of the control terminal bar differs according to the inverter version.

## 2.8.1 Control terminals

### Terminal X3:

FI type		SK 180E	SK 190E
<b>Labelling</b>			
Pin			
1	<b>39</b>	TF-, motor thermistor (PTC) connection	
2	<b>38</b>	TF+, motor thermistor (PTC) connection	

### Terminal X4:

FI type		SK 180E	SK 190E (ASI)
<b>Labelling</b>			
Pin			
1	<b>11</b>	10V, reference voltage output	
2	<b>14</b>	AIN1, analog input 1 / DIN4, digital input 4	
3	<b>16</b>	AIN2, analog input 2 / DIN5, digital input 5	
4	<b>12 / 40</b>	AGND / 0 V, reference potential for analog signals* GND / 0 V, reference potential for digital signals	
5	<b>43</b>	24 V, power supply output	
6	<b>21</b>	DIN1 / digital input 1	
7	<b>22</b>	DIN2 / digital input 2	
8	<b>23</b>	DIN3, digital input 3	
9	<b>1</b>	DOUT1, digital output 1	
10	<b>40</b>	GND / 0 V, reference potential for digital signals	
11	<b>3</b>	DOUT2, digital output 2	
12	<b>40</b>	GND / 0 V, reference potential for digital signals	
13	<b>77</b>	SYS H, system bus +	
14	<b>78</b>	SYS H, system bus-	

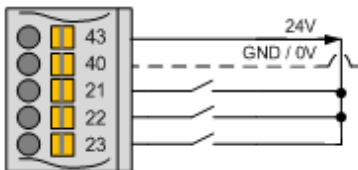
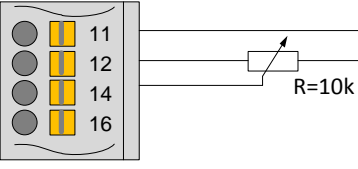
\*) the analog and digital reference voltages are internally bridged and are therefore identical

### Terminal X5 (only SK 190E):

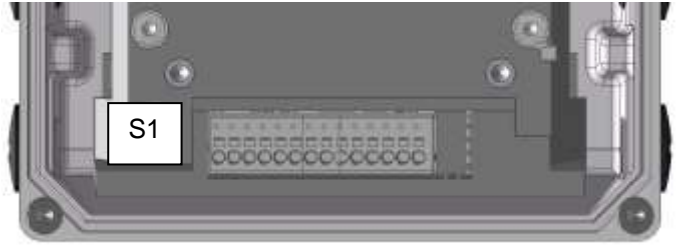
FI type		SK 180E	SK 190E (ASI)
<b>Labelling</b>			
Pin			
1	<b>84</b>	ASI+, AS interface+	
2	<b>85</b>	ASI-, AS interface-	

## 2.8.2 Control connection details

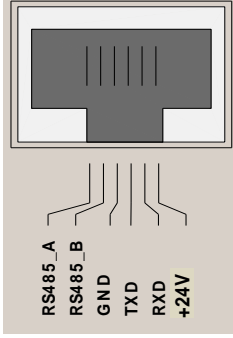
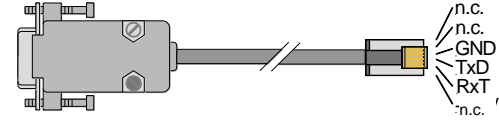
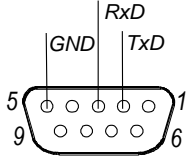
The frequency inverter generates its own control voltage and provides this to Terminal 43.

Terminal/ Designation	Function {Factory setting}	Data	Description / wiring suggestion	Parameter
43 VO/24V	24V supply Output	24V DC $\pm 25\%$ max. 150 mA <sup>1</sup> (output)	Voltage supply provided by the FI for control of the digital inputs	-
40 GND / 0V	Reference potential for digital signals			-
21 DIN1	Digital input 1 {ON right}	Digital input as per EN 61131-2 Type 1 Low: 0 -5 V (~ 9.5 k $\Omega$ ) High: 15-30 V (~ 2.5-3.5 k $\Omega$ )  Input capacitance: Input 1...3 = 10 nF  Scan time: 1 ms Reaction time: $\geq 4$ ms		P420 [01]
22 DIN2	Digital input 2 {ON left}			P420 [02]
23 DIN3	Digital input 3 {fixed frequency 1, (P465[-01])}			P420 [03]
1 DOUT1	Output 1 {Fault}	Digital output 24V DC, max. 20 mA	For evaluation in a control system.	P434 [01]
3 DOUT2	Output 2 {Fault}	For inductive loads: provide protection with a free-wheeling diode.		P434 [02]
14 AIN1 +	Analog input 1 {Setpoint frequency}	U=0...10 V, R <sub>i</sub> =30 k $\Omega$ Resolution 12Bit I=0/4...20 mA, burden resistor (250 $\Omega$ ) via DIP switch S1 can be switched to AIN1/2		P400 [01]
16 AIN2 +	Analog input 2 {No function}			P400 [02]
12 AGND / 0V	Reference potential for analog signals	0 V analog	Matching of the analog signals is performed via P402 and P403.	
11 10V REF	+10 V Reference voltage	+10 V, 5 mA		
38 TF+	PTC resistor input	-	For monitoring motor temperature with PTC	-
39 TF-	PTC resistor input		A shielded cable must be used for separate mounting of the motor and the FI (note the cable length).	

<sup>1</sup> The current which is drawn from the digital outputs must also be covered by this. Any control modules which are connected to the RJ12 socket also place a load on the 24V supply. (150mA = I<sub>DIG1</sub> + I<sub>DIG2</sub> + I<sub>OUT</sub> + I<sub>CONTROL</sub>)

Terminal/ Designation	Function {Factory setting}	Data	Description / wiring suggestion	Parameter
77    SYS H	System bus+	Up to four SK 1x0E or SK 2xxE can be operated on a single system bus. Address = 32 / 34 / 36 / 38	Internal FI system bus for communication with optional modules and other frequency inverters. For further details see Section 9.6.	P509/510 P514/515
78    SYS L	System bus-			
S1	Termination resistor System bus {OFF}			
<b>Additionally for SK 190E</b>				
84    ASI+	Actuator Sensor Interface	26.5 – 31.6 V, max. 25 mA	For control of the SK 190E via the simple field bus level.	P480 ... P483
85    ASI-			In this case, only the yellow AS interface cable can be used. Additional supply via the black cable is not possible.	

## 2.8.3 Control connections, communication

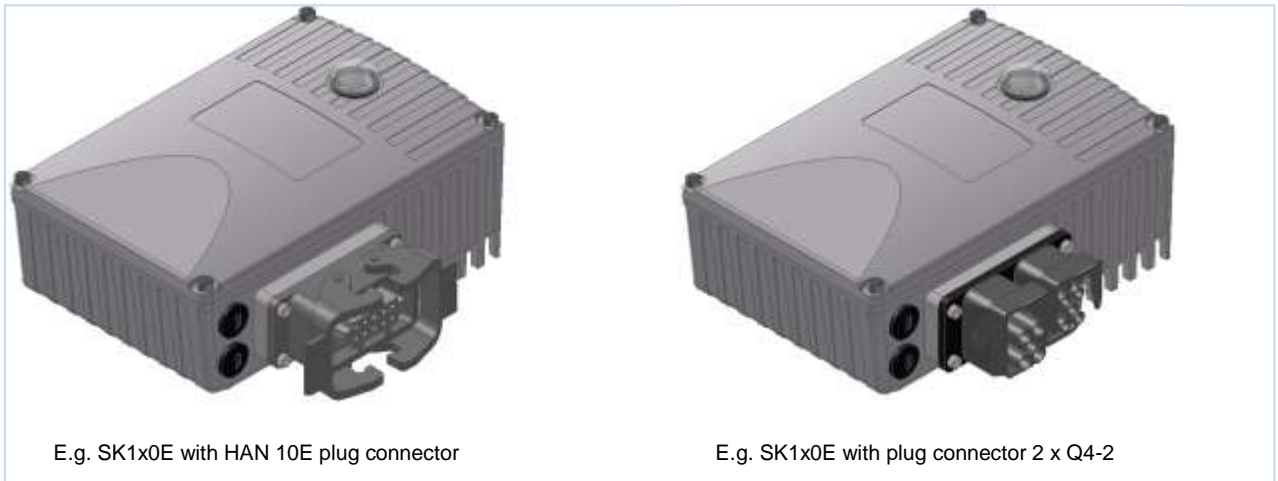
Terminal/ Designation	Function {Factory setting}	Data	Description / wiring suggestion	Parameter
<b>all devices, plug connector block RJ12, RS485/RS232</b>				
1 RS485 A +	Data cable RS485 (for connection to a ParameterBox)	Baud rate 9600...38400 Baud  Termination resistor R=1 kΩ is fixed.	 <p>RJ12: Pin No. 1 ... 6</p> <p>1: RS485_A 2: RS485_B 3: GND 4: RS232_TxD 5: RS232_RxD 6: +24V</p>	P502 ...P513
2 RS485 B -				
3 GND	Reference potential for Bus signals	0 V digital		
4 232 TXD	Data cable RS232 (for connection to a PC for NORDCON)	Baud rate 9600...38400 Baud		
5 232 RXD				
6 +24V	24 V voltage supply from FI	24 V ± 20%		
<b>All devices, cable accessories</b>				
Optional	Adapter cable RJ12 to SUB-D9 ... for direct connection to a PC with NORD CON software  <b>Note:</b> For connection to a USB port on the PC, a normal interface converter (RS232 (SUB-D9) / USB 2.0) is required.	Length 3m Assignment RS 232 (RxD, TxD, GND) Part. No. 278910240	 <p>Pin2: RS232_TxD Pin3: RS232_RxD Pin5: GND</p> 	

## 2.9 Plug connectors

The use of optionally available plug connectors for power and control connections not only makes it possible to replace the drive unit more quickly in case of servicing, but also minimises the danger of installation errors when connecting the device. The most common plug connector versions are summarized below. The possible mounting locations on the housing box are listed in Section 2.1.4.

### 2.9.1 Plug connectors for power connections

Plug connectors for the motor or mains connection to the frequency inverter are available.



Connection of up to two power plug connectors (HAN Q4-2: up to 2 x 2 plug connectors) are made on the housing of the frequency inverter. The following 3 connection versions are available:

Mounting version	Meaning
... - LE	Power input
... - LA	Power output
... - MA	Motor output

With this, the mains connection and the motor output can be implemented with separate plug connectors in the case of wall-mounted frequency inverters.

For motor-mounted inverters it is possible to install a mains output plug connector instead of the motor connection. Via this, the mains voltage can be looped to the next device.

#### ATTENTION



The permissible current load for the connection terminals, plugs and supply cables must be observed when looping the mains voltage.






## Assembly

Mounting of a plug connector on the housing of the frequency inverter is usually only possible with a connection adapter (connection extension SK TIE4-HAN10E).

Plug connector*	Part. No.	Technical data	plus SK TIE4-HAN10E (275274100)
HAN 10E LA 2BUE (Power output)	275135010	Add-on housing with 2-clamp lock, socket insert 10-pin. + PE, spring terminals, PE: Screw connection, electrical data: 16A 500V	X
HAN 10E LE 1BUE (Power input)	275135070	Add-on housing with 1-clamp lock, pin insert 10-pin. + PE, spring terminals, PE: Screw connection, electrical data: 16A 500V	X
HAN 10E LE 2BUE (Power input)	275135000	Add-on housing with 2-clamp lock, pin insert 10-pin. + PE, spring terminals, PE: Screw connection, electrical data: 16A 500V	X
HAN 10E MA 2BUE (Motor output)	275135020	Add-on housing with 2-clamp lock, socket insert 10-pin. + PE, spring terminals, PE: Screw connection, electrical data: 16A 500V	X
HQ8 LA (Power output)	275135040	Add-on housing, socket insert 8-pin. + PE, crimp connection, electrical data: 16A 500V	X
HQ8 LE (Power input)	275135030	Add-on housing, pin insert 8-pin. + PE, crimp connection, electrical data: 16A 500V	X
HQ8 MA (Motor output)	275135050	Add-on housing, socket insert 8-pin. + PE, crimp connection, electrical data: 16A 500V	X
Connection extension HAN Q5 (Power input + motor or power output)	275274110	2 x add-on housing on a connector frame, each with one 5-pin pin insert + PE and a 5-pin socket insert + PE, crimp connection, PE: Screw connection, electrical data: 16A, 230V/400V	Not required!

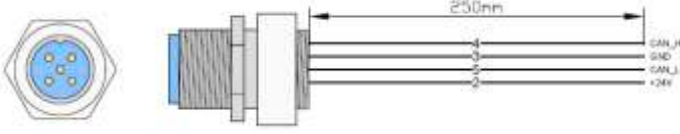
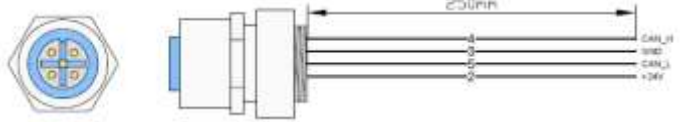
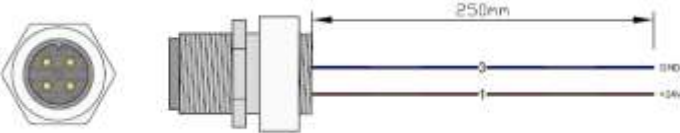
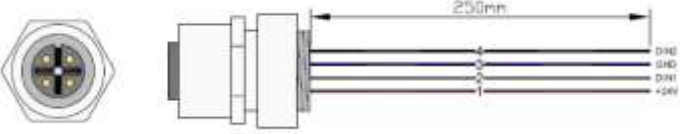
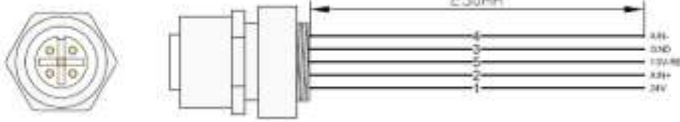
\* Further types available on request

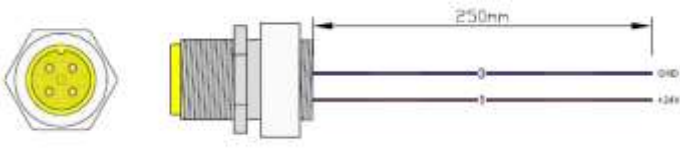
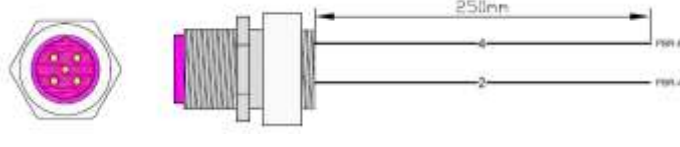
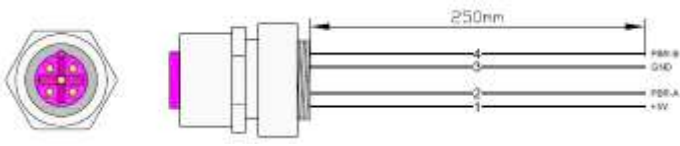
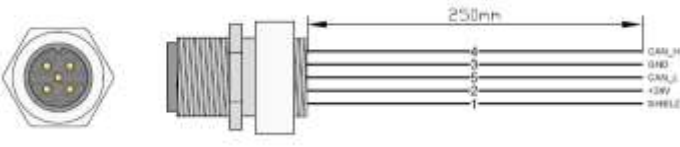
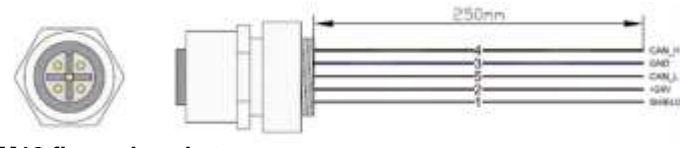
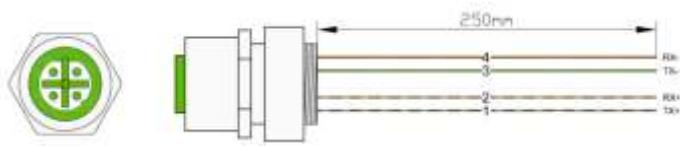
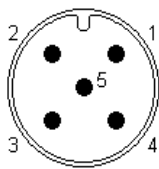
The connection extension SK TIE4-HAN10E contains all the additional elements required for the HAN 10E and HAN Q8 versions listed above. Installation is recommended as follows. Steps 2 and 3 are not required for plug version HAN Q5.

Step 1	Step 2	Step 3	Step 4	Step 5
Disassembly of the 2 x M25 blank plug	Put on seal	Put on adapter plate	Install the add-on plug housing with screws and contact washers	Make the electrical connections
				

## 2.9.2 Plug connectors for control connection

Various M12 round plug connectors are available as flanged plugs or flanged sockets. The plug connectors are intended for installation in the housing box of the frequency inverter and can be oriented as required. The protection class (IP67) of the plug connector only applies in the screwed state. The cover caps correspond to the colour version as does the plastic body of the plug connector.

System components	Description	Data
System bus		
<b>SK TIE4-M12-SYSS</b> Part. No. 275274506	 <p><b>M12 flanged plug</b> to connect the <u>incoming</u> system bus cable</p>	A-coded, 5-pin PIN 1 n. c. PIN 2 +24V (brown) PIN 3 GND (blue) PIN 4 Sys-H (black) PIN 5 Sys-L (green) Plastic body in <b>light blue</b>
<b>SK TIE4-M12-SYSM</b> Part. No. 275274505	 <p><b>M12 flanged plug</b> to connect the <u>outgoing</u> system bus cable</p>	A-coded, 5-pin PIN 1 n. c. PIN 2 +24V (brown) PIN 3 GND (blue) PIN 4 Sys-H (black) PIN 5 Sys-L (green) Plastic body in <b>light blue</b>
External voltage supply		
<b>SK TIE4-M12-POW</b> Part. No. 275274507	 <p><b>M12 flanged plug</b> to connect a <u>24V- supply</u></p>	A-coded, 4-pin PIN 1 +24V (brown) PIN 2 n. c. PIN 3 GND (blue) PIN 4 n. c. PIN 5 n. c. Plastic body in <b>black</b>
Sensors and actuators		
<b>SK TIE4-M12-INI</b> Part. No. 275274503	 <p><b>M12 flanged plug</b> to connect <u>sensors and actuators</u></p>	A-coded, 4-pin PIN 1 +24V (brown) PIN 2 DI or DO (white) PIN 3 GND (blue) PIN 4 DI or DO (black) PIN 5 n. c. Plastic body in <b>black</b>
Analog signal		
<b>SK TIE4-M12-ANA</b> Part. No. 275274508	 <p><b>M12 flanged plug</b> to connect <u>analog signal encoders</u></p>	A-coded, 5-pin PIN 1 +24V (brown) PIN 2 AIN+ (/AUOT) (white) PIN 3 GND (blue) PIN 4 AIN- (black) PIN 5 10V - REF (red) Plastic body in <b>white</b>

System components	Description	Data
<b>AS Interface</b>		
<b>SK TIE4-M12-ASI</b> Part. No. 275274502	 <p><b>M12 flanged plug</b> to connect an <u>AS interface cable</u></p>	A-coded, 5-pin PIN 1 ASi+ (/+24V) (brown) PIN 2 n. c. PIN 3 ASi- (/GND) (blue) PIN 4 n. c. PIN 5 n. c. Plastic body in <b>yellow</b>
<b>PROFIBUS DP</b>		
<b>SK TIE4-M12-PBR</b> Part. No. 275274500	 <p><b>M12 flanged plug</b> to connect the <u>incoming PROFIBUS DP cable</u></p>	B-coded, 5-pin PIN 1 +5V* (brown) PIN 2 PBR-A (green) PIN 3 GND * (blue) PIN 4 PBR-B (red) PIN 5 n. c.
<b>Kit consisting of M12 flanged plug and flanged socket</b>	 <p><b>M12 flanged plug</b> to connect the <u>outgoing PROFIBUS DP cable</u></p>	Plastic body and screw cap in <b>violet</b>  *PIN 1 and PIN 3 are <u>only</u> assigned in the <u>M12-flanged socket</u>
<b>CANopen</b>		
<b>SK TIE4-M12-CAO</b> Part. No. 275274501	 <p><b>M12 flanged plug</b> to connect the <u>CANopen or DeviceNet cable</u></p>	A-coded, 5-pin PIN 1 PE (shield) (white) PIN 2 +24V (brown) PIN 3 GND (blue) PIN 4 CAN-H (black) PIN 5 CAN-L (green) Plastic body in <b>grey</b>
<b>SK TIE4-M12-CAO-OUT</b> Part No. 275274515	 <p><b>M12 flanged socket</b> to connect the <u>CANopen or DeviceNet cable</u></p>	A-coded, 5-pin PIN 1 PE (shield) (white) PIN 2 +24V (bn) PIN 3 GND (bl) PIN 4 CAN-H (black) PIN 5 CAN-L (green) Plastic body in <b>grey</b>
<b>Ethernet</b>		
<b>SK TIE4-M12-ETH</b> Part. No. 275274514	 <p><b>M12 flanged socket</b> for connection of the <u>Ethernet cable</u></p>	D-coded, 4-pin PIN 1 TX+ (orange / white) PIN 2 RX (green / white) PIN 3 TX- (green) PIN 4 RX- (orange) Plastic body in <b>yellow-green</b>
<b>PIN designations for M12 plug connector</b>		
		The pin designations of the M12 socket are the corresponding mirror image.

## 2.10 ATEX Zone 22 for frequency inverters (in preparation)

### General information

With appropriate modification, the frequency inverter can be used in explosion hazard areas. For this it is important that all the safety information in the operating instructions is strictly complied with for the prevention of personal injury and material damage. This is essential to prevent injury and damage.

### Qualified personnel

Qualified personnel must be used to carry out work involving the transport, assembly, installation, commissioning and maintenance. Qualified personnel are persons who due to their training, experience and instruction, and their knowledge of the relevant standards, accident prevention regulations and operating conditions are authorised to carry out the necessary activities for starting up the frequency inverter. This also includes knowledge of first aid measures and the local emergency services.

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#### ATTENTION



All work must only be carried out with the power to the system switched off.

If the frequency inverter is connected to a motor and a gear unit, the EX labelling of the motor and the gear unit must also be observed.

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### Safety information

The increased danger in areas with inflammable dust demands the strict observation of the general safety and commissioning information. The drive unit must comply with the specifications in **Planning Guideline No. 6052101**. Explosive concentrations of dust may cause explosions if ignited by hot or sparking objects. Such explosions may cause serious or fatal injuries to persons or severe material damage.

It is essential that the person responsible for the use of motors and frequency inverters in explosion hazard areas is trained in their correct use.

---

#### ATTENTION



Before opening the frequency inverter for the connection of electric cables or other work, the mains voltage must always be switched off and secured against switching on again!

Temperatures may be present within the frequency inverter and the motor, which are higher than the maximum permissible surface temperature of the housing. The frequency inverter may therefore not be opened or removed from the motor in an atmosphere of explosive dust!

Impermissibly heavy dust deposits must not be permitted, as these impair the cooling of the frequency inverter!

All cable glands which are not used, must be closed with blind screw plugs which are approved for explosion hazard areas.

Only the original seals may be used.

The protective film covering the diagnostic LEDs in TU4 modules must not be damaged.

It must be ensured that the plastic housing cover cannot be electrostatically charged by streams of particles caused by the fan.

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**Repairs may only be carried out by Getriebebau NORD.**

### 2.10.1 Modified frequency inverter for compliance with Category 3D

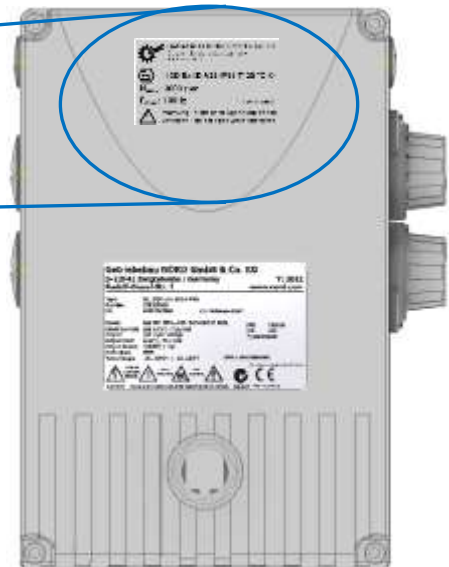
Operation of the frequency inverter in ATEX Zone 22 is only possible with appropriate modifications. This adaptation is only made at the NORD factory. In order to use frequency inverters in ATEX Zone 22, among other things, the diagnostic caps are replaced with aluminium / glass versions.



II 3D Ex tD A22 IP55 T125 °C X

Categorisation:

- Protection with "housing"
- Procedure "A" Zone "22" Category 3D
- Protection class IP55 / IP66 (according to the device)
- Maximum surface temperature 125°C
- Ambient temperature -20°C to +40°C



Series SK 1x0E frequency inverters and the associated options are designed for a degree of mechanical hazard corresponding to a impact energy of 7J.

The necessary adaptations are contained in the ATEX outdoor installation kits.

Device*	Kit designation	Part Number
SK 1x0E	SK 200E-ATEX-TU4	275274206
SK TU4-xxx		

\* One kit must be used for each device

### 2.10.2 Options for ATEX Zone 22 3D

In order to ensure an ATEX-compliant frequency inverter, the approval of optional modules for explosion hazard areas must be observed. The following lists the various options with regard to their approval for use in ATEX Zone 22 3D.

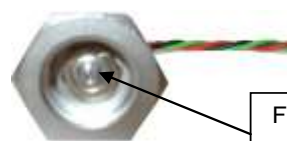
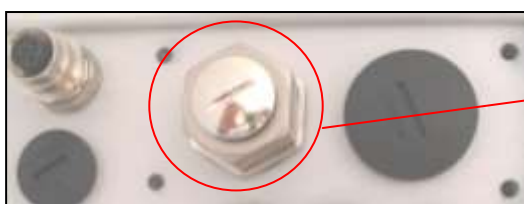
### 2.10.2.1 Technology Units for ATEX Zone 22 3D

Designation	Part Number	Approved for ATEX Zone 22 3D	Not approved for ATEX Zone 22 3D
SK TI4-TU-BUS(-C)	275280000 / (275280500)	x	
SK TI4-TU-NET(-C)*	275280100 / (275280600)	x	
SK TU4-PBR(-C)	275281100 / (275281150)	x	
SK TU4-CAO(-C)	275281101 / (275281151)	x	
SK TU4-DEV(-C)	275281102 / (275281152)	x	
SK TU4-IOE(-C)	275281106 / (275281156)	x	
SK TU4-PBR-M12(-C)	275281200 / (275281250)		x
SK TU4-CAO-M12(-C)	275281201 / (275281251)		x
SK TU4-DEV-M12(-C)	275281202 / (275281252)		x
SK TU4-IOE-M12(-C)	275281206 / (275281206)		x
SK TU4-PNT(-C)	275281115 / (275281165)		x
SK TU4-ECT(-C)	275281117 / (275281167)		x
SK TU4-POL(-C)	275281118 / (275281168)		x
SK TU4-EIP(-C)	275281119 / (275281169)		x

### 2.10.2.2 Customer Units for ATEX Zone 22 3D

Designation	Part Number	Approved for ATEX Zone 22 3D	Not approved for ATEX Zone 22 3D
SK CU4-PBR	275271000	x	
SK CU4-CAO	275271001	x	
SK CU4-DEV	275271002	x	
SK CU4-PNT	275271015	x	
SK CU4-ECT	275271017	x	
SK CU4-POL	275271018	x	
SK CU4-EIP	275271019	x	
SK CU4-IOE	275271006	x	
SK CU4-POT	275271207		x
SK ATX-POT	275142000	x	

The Category 3D frequency inverter can be equipped with an ATEX-compliant potentiometer, which can be used to adjust a setpoint (e.g. speed) on the device. The potentiometer is used with an M20-M25 extension in one of the M25 cable glands. The selected setpoint can be adjusted with a screwdriver. Due to the removable screw closing cap, this component complies with ATEX requirements. Permanent operation may only be carried out with the cap closed.



Frequency setpoint setting with a screwdriver

Resistance of the potentiometer 10 kOhm

Wire colors on the potentiometer	Designation	Terminal SK CU4-24V*	Terminal SK CU4-IOE	Terminal SK 1x0E
red	+10V reference	[11]	[11]	[11]
black	AGND / 0V	[12]	[12]	[12] / [40]
green	Analog input	[14]	[14] / [16]	[14] / [16]

### 2.10.2.3 Hand-held Technology Units for ATEX Zone 22 3D

All hand-held technology units are not approved for continuous use in the ATEX Zone 22 3D. They may therefore only be used during commissioning or for maintenance purposes, if it is ensured that no explosive dust atmosphere exists.

Designation	Part Number	Approved for ATEX Zone 22 3D	Not approved for ATEX Zone 22 3D
SK CSX-3H	275281013		x
SK PAR-3H	275281014		x

#### ATTENTION



The diagnostic opening of the basic unit for the connection of a hand-held technology unit or a PC must not be opened in an atmosphere containing explosive dust.

### 2.10.2.4 Braking resistors

External braking resistors of type SK BRE4-x-xxx-xxx are not permitted for use in ATEX Zone 22 3D.

Designation	Part Number	Approved for ATEX Zone 22 3D	Not approved for ATEX Zone 22 3D
SK BRI4-1-200-100	275272008	x	
SK BRI4-1-400-100	275272012	x	
SK BRE4-1-100-100	275273005		x
SK BRE4-1-200-100	275273008		x

#### ATTENTION



If an internal braking resistor of type SK BRI4-x-xxx-xxx is used, the power limitation for this must be activated under all circumstances. This is achieved via parameters (P555), (P556) and (P557) with the appropriate values. Only the resistors assigned to the relevant inverter type may be used.

### 2.10.2.5 Other options

M12 sockets and plugs for installation in the terminal box of the basic device or in technology units may only be used if they are approved for use in ATEX Zone 22 3D.

Designation	Part Number	Approved for ATEX Zone 22 3D	Not approved for ATEX Zone 22 3D
SK TIE4-WMK-1	275274000	x	
SK TIE4-WMK-TU	275274002	x	
SK TIE4-HAN10E	275274100		x
SK TIE4-HANQ5	275274110		x
SK TIE4-SWITCH	275274610		x
SK TIE4-M12-M16	275274510	x	
SK TIE4-M12-PBR	275274500		x
SK TIE4-M12-ETH	275274514		x
SK TIE4-M12-CAO	275274501		x
SK TIE4-M12-AS1	275274502		x
SK TIE4-M12-INI	275274503		x
SK TIE4-M12-ANA	275274508		x
SK TIE4-M12-SYSM	275274505		x
SK TIE4-M12-SYSS	275274506		x
SK TIE4-M12-POW	275274507		x
SK TIE4-M12-HTL	275274512		x

### 2.10.3 Maximum output voltage and torque reduction

As the maximum output voltage depends on the pulse frequency to be set, in some cases the torque which is stated in Planning Guideline 605 2101 must be reduced for values above the rated pulse frequency of 6 kHz.

$$\text{For } F_{\text{pulse}} > 6 \text{ kHz: } T_{\text{reduction}}[\%] = 1\% * (F_{\text{pulse}} - 6\text{kHz})$$

Therefore the maximum torque must be reduced by 1% for each kHz pulse frequency above 6 kHz. The torque limitation must be taken into account on reaching the break frequency. The same applies for the degree of modulation (P218). With the factory setting of 100%, in the field reduction range a torque reduction of 5% must be taken into account:

$$\text{For } P218 > 100\%: T_{\text{reduction}}[\%] = 1\% * (105 - P218)$$

Above a value of 105%, no reduction needs to be taken into account. However, with values above 105% no increase in torque above that of the Planning Guideline will be achieved. Under certain circumstances, degrees of modulation > 100% may lead to oscillations and motor vibration due to increased harmonics.

#### ATTENTION



At pulse frequencies above 6 kHz (400/480V devices) or 8 kHz (230V) devices, the reduction in power must be taken into account for the design of the drive unit.

If parameter (P218) is set to < 105%, the derating of the degree of modulation must be taken into account in the field reduction range.

## 2.10.4 Commissioning information

For Zone 22 the cable glands must at least comply with protection class IP 55. Unused openings must be closed with blank screw caps suitable for ATEX Zone 22 3D (minimum protection class IP 55).

The motors are protected against overheating by means of the frequency inverter. This is carried out by the evaluation of the motor PTC by the frequency inverter. In order to ensure this function, the PTC must be connected to the intended input (Terminal 38/39 control terminal plug connector). In addition, care must be taken that a NORD motor from the motor list (P200) is set. If a standard 4-pole NORD motor or a motor from a different manufacturer is not used, the data for the motor parameters ((P201) to (P208)) must be adjusted to those on the motor rating plate. In addition, the frequency inverter must be parameterised so that the motor can be operated with a maximum speed of  $3000 \frac{1}{\text{min}}$ . For a four-pole motor, the "maximum frequency" must be set to a value which is smaller or equal to 100Hz ((P105)  $\leq 100$ ). Here the maximum permissible output speed of the gear unit must be observed. In addition, the monitoring "I<sup>2</sup>t-Motor" (Parameter (P535) / (P533)) must be switched on and the pulse frequency set to between 4 kHz and 6 kHz.

### Overview of the necessary parameter settings:

Parameter	Setting value	Factory setting	Description
<b>P105</b> Maximum frequency	$\leq 100$ Hz	[50]	This value relates to a 4-pole motor. On principle, the value must only be so large that a motor speed of 3000 rpm is not exceeded.
<b>P200</b> motor list	Select the appropriate motor power	[0]	If a 4-pole NORD motor is used, the preset motor data can be called up.
<b>P201 – P208</b> Motor data	Data according to rating plate	[xxx]	If a 4-pole NORD motor is not used, the motor data on the rating plate must be entered here.
<b>P218</b> Degree of modulation	$\geq 100\%$	[100]	Determines the maximum possible output voltage
<b>P504</b> Pulse frequency	4kHz ... 6kHz	[6]	For pulse frequencies above 6 kHz a reduction of the maximum torque is necessary.
<b>P533</b> Factor I <sup>2</sup> t-Motor	< 100%	[100]	A reduction in torque can be taken into account with values less than 100 in the I <sup>2</sup> t monitoring.
<b>P535</b> I <sup>2</sup> t motor	According to motor and ventilation	[0]	The I <sup>2</sup> t- monitoring of the motor must be switched on. The values to be set depend on the type of ventilation and the motor which is used, see <b>Planning Guideline No.: 605 2101</b>

## 2.11 Outdoor installation

The frequency inverter and the technology units can be installed outdoors under the following conditions:

- IP66 version (See Special Measures, Section 1.7)
- UV-resistant blank screw caps. and inspection windows.

**It is recommended that the frequency inverter is provided with a sun shield.**

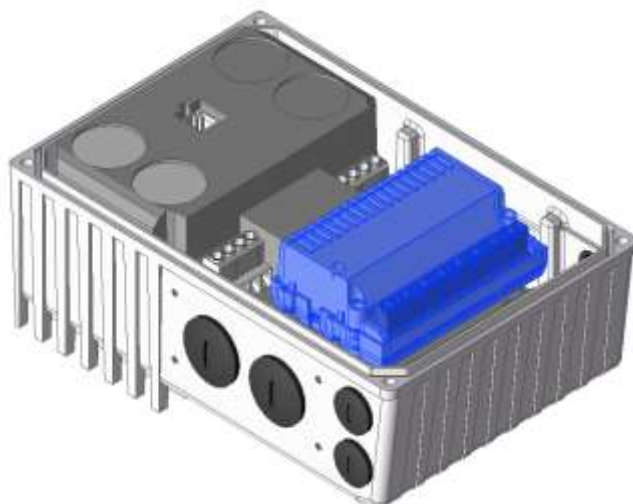
The UV-resistant blind plugs and inspection glasses form part of the ATEX kit for the frequency inverter. I.e. if the ATEX option for IP66 (Section 2.10) is used, all conditions for outdoor installation of the frequency inverter are fulfilled.

### 3 Options

The frequency inverter provides a series of optional expansion modules. These modules are preferably used for the direct control or connection of the frequency inverter to a higher level field bus.

The options are available both as an internal version for integration (into the FI), the so-called customer unit SK CU4-... or as an external version, the so-called technology unit SK TU4-... The differences between the internal and external options are merely limited to the number of additional IOs and the permissible current load of the connection terminals.

The **internal customer interface (Customer Unit, SK CU4-...)** is integrated into the frequency inverter. The electrical connection to the frequency inverter is usually made via the internal system bus. This is equipped with screw terminals for connection to external peripherals. As an option, there is also the possibility of using 4/5-pin M12 plug connectors in the FI housing.



SK 1x0E with integrated customer unit



SK 1x0E with attached technology unit

The **external technology unit (Technology Unit, SK TU4-...)** is externally attached to the frequency inverter and is therefore easy to access. The electrical connection to the frequency inverter is made via the internal system bus. External 4/5-pin plug connectors are available for use by the customer. A technology unit requires the use of a suitable SK TI4-TU-... connection unit. The optional wall mounting kit SK TIE4-WMK-TU also allows the technology units to be mounted close to the inverter.

The frequency inverter can manage the following options via its system bus:

- 1 x ParameterBox SK PAR-3H and (via an RJ12 connector)
- 1 x Field bus option (e.g. Profibus DP), internal or external and
- 2 x I/O extension (SK xU4-IOE-...), internal and / or external

Up to 4 frequency inverters with their appropriate options can belong to a field bus.

#### WARNING



Modules must not be inserted or removed unless the device is free of voltage.

## 3.1 Overview of optional modules

### 3.1.1 Overview of internal customer units SK CU4-...

Internal customer interfaces enable the expansion of the range of functions of the frequency inverter without changing its physical size. For example, either a field bus module or an I/O extension can be selected.

The frequency inverter provides one slot for the fitting of an appropriate option. External options (technology units) are available for additionally required optional modules (Section 3.2.2).

The bus modules require an external 24 V supply. Therefore they are also available if the frequency inverter is not supplied from the mains, but the 24 V supply to the module is active.



#### Bus modules

Type	Designation	Part Number	Document
CANopen	SK CU4-CAO	275 271 001	BU0260
DeviceNet	SK CU4-DEV	275 271 002	BU0280
PROFIBUS DP	SK CU4-PBR	275 271 000	BU0220
PROFINET IO	SK CU4-PNT	275 271 015	TI 275271015
EtherCAT	SK CU4-ECT	275 271 017	TI 275271017
POWERLINK	SK CU4-POL	275 271 018	TI 275271018
EtherNet/IP	SK CU4-EIP	275 271 019	TI 275271019
I/O extension	SK CU4-IOE	275 271 006	TI 275271006

#### Other modules

Type	Designation	Part Number	Document
Electronic brake rectifier	SK CU4-MBR	275 271 010	BU0180
Setpoint converter	SK CU4-REL	275 271 011	BU0180
Potentiometer	SK TIE4-POT	275 274 700	BU0180
Switch	SK TIE4-SWT	275 274 701	BU0180
Switch/potentiometer unit	SK CU4-POT	275 271 207	BU0180

#### NOTE



The Ethernet module (PROFINET IO, EtherCat, POWERLINK and EtherNet/IP) causes a derating of the frequency inverter. For detailed information please refer to the data sheet (TI ...) for the relevant module.

### 3.1.2 Overview of external technology units SK TU4-...

External technology units enable the modular extension of the scope of frequency inverter functions.

Users have access to both communication modules and an internal mains unit or an I/O expansion and other modules.



Bus modules with connection terminals or M12 system connectors are available as options.

Modules with protection class IP55 or optionally IP66 can be ordered according to the installation location. They can be mounted directly on the frequency inverter, or separately using a suitable wall mounting kit.

Each SK TU4-... Technology Unit requires an SK T14-TU-... Connection Unit. The SK T14-TU-BUS is available for bus modules or the I/O extension. The SK T14-TU-MSW must be used for the maintenance switch.

For the bus modules or I/O extension with integrated system bus an RJ12 socket (behind a transparent screw-on cover) is also available. This enables communication with other modules or frequency inverters. With this linkage, all devices can be parameterised by means of a ParameterBox SK PAR-3H or with a PC and the NORD CON software.

The bus modules require an external 24V supply. Therefore they are also available if the frequency inverter is not supplied from the mains, but the 24V supply to the module is active.

#### Bus modules

Type	IP55	IP66	M12	Designation	Part Number	Document
CANopen	X			SK TU4-CAO	275 281 101	BU0260
		X		SK TU4-CAO-C	275 281 151	BU0260
	X		X	SK TU4-CAO-M12	275 281 201	BU0260
		X	X	SK TU4-CAO-M12-C	275 281 251	BU0260
DeviceNet	X			SK TU4-DEV	275 281 102	BU0280
		X		SK TU4-DEV-C	275 281 152	BU0280
	X		X	SK TU4-DEV-M12	275 281 202	BU0280
		X	X	SK TU4-DEV-M12-C	275 281 252	BU0280
EtherCAT	X			SK TU4-ECT	275 281 117	TI 275281117
		X		SK TU4-ECT-C	275 281 167	TI 275281167
EtherNet/IP	X			SK TU4-EIP	275 281 119	TI 275281119
		X		SK TU4-EIP-C	275 281 169	TI 275281169
POWERLINK	X			SK TU4-POL	275 281 118	TI 275281118
		X		SK TU4-POL-C	275 281 168	TI 275281168
PROFIBUS DP	X			SK TU4-PBR	275 281 100	BU0220
		X		SK TU4-PBR-C	275 281 150	BU0220
	X		X	SK TU4-PBR-M12	275 281 200	BU0220
		X	X	SK TU4-PBR-M12-C	275 281 250	BU0220

Type	IP55	IP66	M12	Designation	Part Number	Document
PROFINET IO	X			SK TU4-PNT	275 281 115	TI 275281115
		X		SK TU4-PNT-C	275 281 165	TI 275281165
	X		X	SK TU4-PNT-M12	275 281 122	TI 275281122
		X	X	SK TU4-PNT-M12-C	275 281 172	TI 275281172
I/O extension	X			SK TU4-IOE	275 281 106	TI 275281106
		X		SK TU4-IOE-C	275 281 156	TI 275281156
	X		X	SK TU4-IOE-M12	275 281 206	TI 275281206
		X	X	SK TU4-IOE-M12-C	275 281 256	TI 275281256
<b>Required accessories (each module must have a matching connection unit)</b>						
Bus connection unit	X			SK TI4-TU-BUS	275 280 000	TI 275280000
		X		SK TI4-TU-BUS-C	275 280 500	TI 275280500
<b>Optional accessories</b>						
Wall-mounting kit				SK TIE4-WMK-TU	275 274 002	TI 275274002

**Other modules**

Type	IP55	IP66	M12	Designation	Part Number	Document
Maintenance switch	X			SK TU4-MSW	275 281 123	BU0180
		X		SK TU4-MSW-C	275 281 173	BU0180
<b>Required accessories (each module must have a matching connection unit)</b>						
Connection unit	X			SK TI4-TU-MSW	275 280 200	BU0180
		X		SK TI4-TU-MSW-C	275 280 700	BU0180
<b>Optional accessories</b>						
Wall-mounting kit				SK TIE4-WMK-TU	275 274 002	TI 275274002

## 3.2 Mounting of optional module

### 3.2.1 Installation of internal customer units SK CU4-...

#### WARNING



Installation must be carried out by qualified personnel only, paying particular attention to safety and warning instructions.

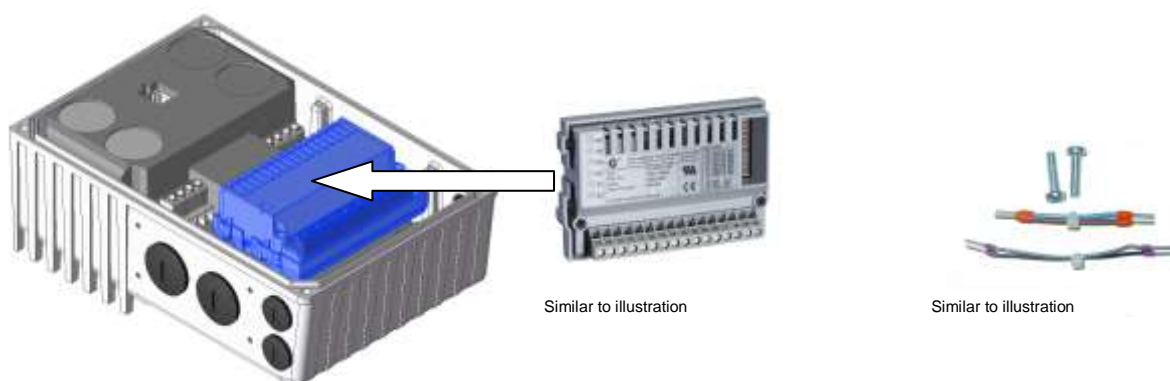
Modules must not be inserted or removed unless the device is free of voltage. The slots may only be used for the intended modules.

Installation of the SK CU4-... customer **unit remote** from the frequency inverter is not permitted. This must be mounted directly in the housing box of the SK 1x0E.

The customer interfaces are installed directly within the housing box of the frequency inverter, behind the control terminal bar. The customer interface is fastened with the two screws which are included in the delivery. Only one Customer Unit per device is possible!

The pre-assembled cables for connection to the frequency inverter are also included in the bag enclosed with the customer unit. Connections are made according to the following table:

The bus modules require a 24 V supply voltage.



SK 1x0E with integrated technology unit SK CU4-...

Customer unit SK CU4-...

Bag enclosed with internal customer unit

Allocation of the cable sets (bag enclosed with the customer unit)

	Function	Terminal label		Cable colour
Field bus / IOE	Power supply (24V DC) (between the frequency inverter and the customer unit)	44	24V	brown
		40	GND / 0V	blue
	System bus	77	SYS H (+)	black
		78	SYS L (-)	grey

### 3.2.2 Installation of external technology units SK TU4-...

A detailed description can be found in the *technical information or data sheet* (TI ...) for the relevant connection unit.

Connection unit	Document
SK TI4-TU-BUS	TI 275280000
SK TI4-TU-BUS-C	TI 275280500

### 3.3 Details of internal Customer Units SK CU4-...

#### 3.3.1 Potentiometer adapter, SK CU4-POT

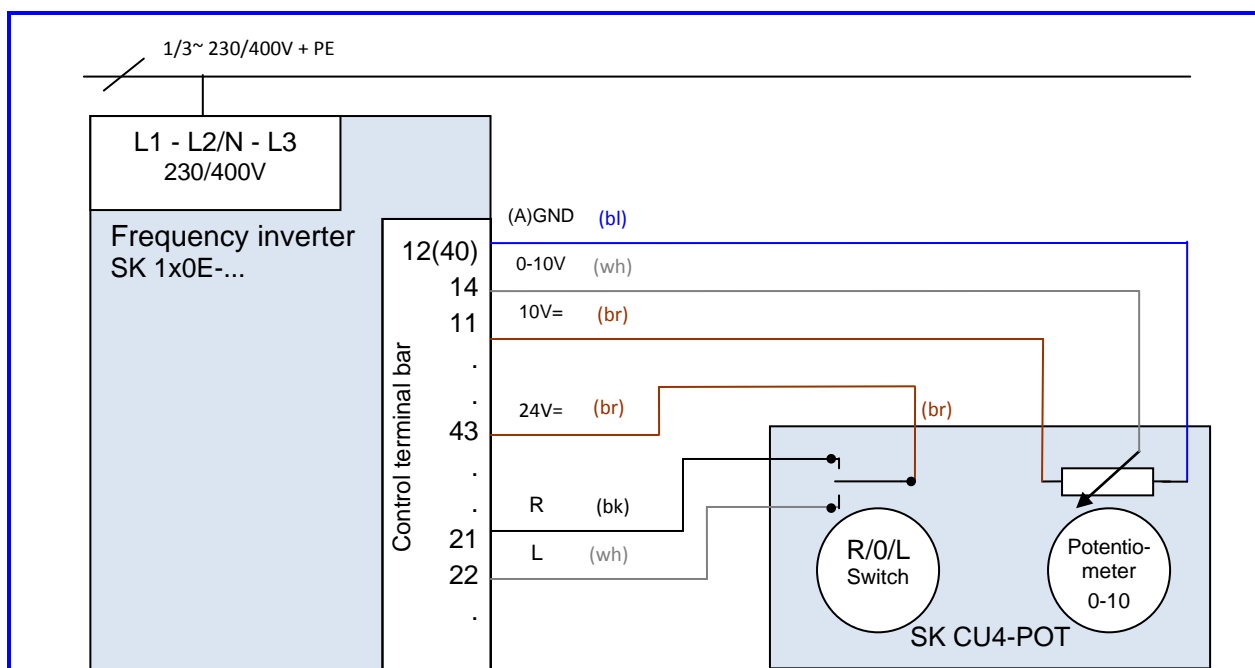
The digital signals R and L can be directly applied to the corresponding digital inputs 1 and 2 or 3 of the frequency inverter.

The potentiometer (0-10V) can be evaluated via the analog inputs of the frequency inverter, or via an optional I/O extension.



Module		SK CU4-POT	Function	
Pin	Color		SK 1x0E	
			FI	
1	brown	24V-supply voltage	43	Rotary switch L - OFF - R
2	black	Enable R (e.g. DIN1)	21	
3	white	Enable L (e.g. DIN2)	22	
4	white	Access to AIN +	14	Potentiometer 10kΩ
5	brown	Reference voltage 10V	11	
6	blue	Analog ground AGND	12	

#### SK CU4-POT connections



### 3.3.2 Electronic brake rectifier, SK CU4-MBR

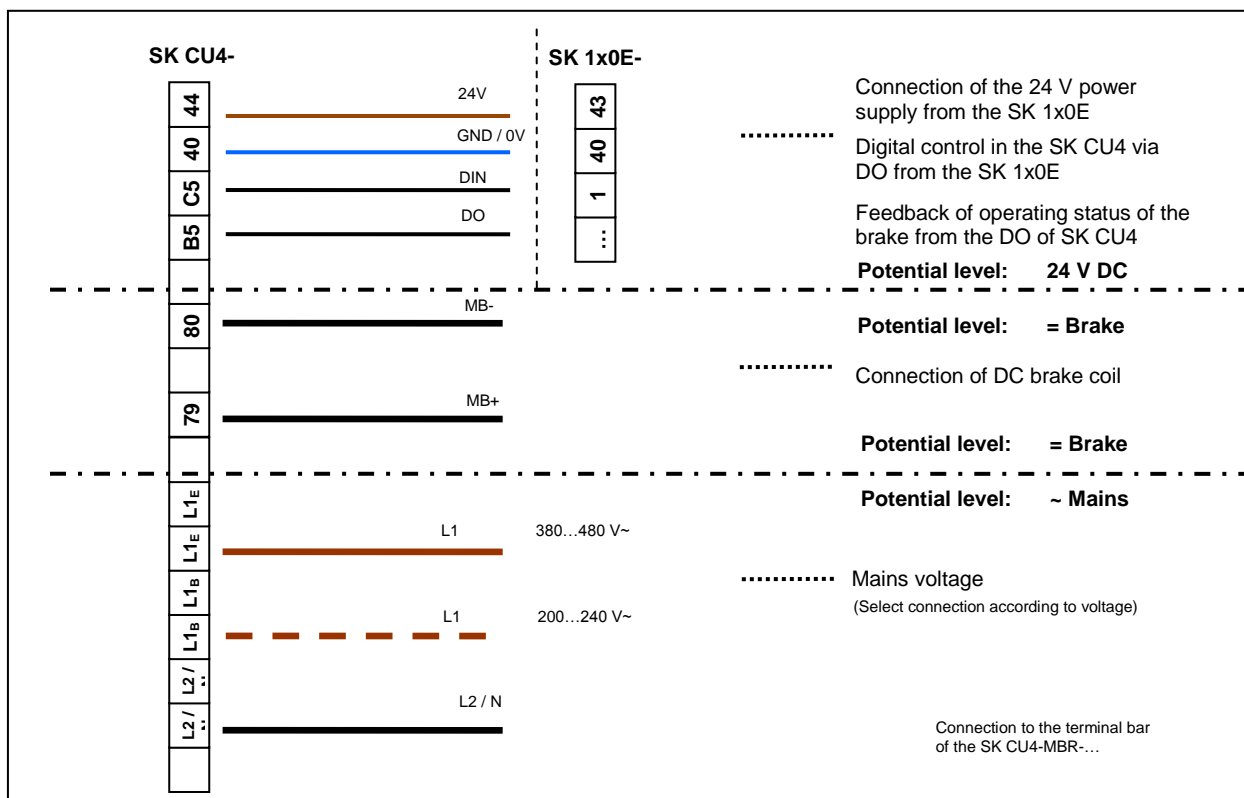
The electronic brake rectifier SK CU4-MBR is used to control electromechanical brakes with a coil voltage of 180V DC and 205V DC (for sizes 5Nm to 40Nm via the frequency inverter or its accessories (SK xU4-IOE). Monitoring of the current in the brake coil is integrated into the SK CU4-MBR module.

- Mains voltage 230 V~ and 400 V~
- +24 V control voltage
- 1x Digital input (control)
- 1x Digital output (feedback)
- Brake connection (DC)
- Max. permissible permanent relay current 0.5 A
- Interference suppression class C2
- Permissible cycle time (1 switching cycle =1xON/1xOFF):  
Brake 5...100 Nm:  $\geq 0.5$  s



Similar to illustration

The terminal bar of the customer unit SK CU4-MBR-... is divided into three potential levels.



According to the mains voltage, the mains cable must be connected to L1<sub>E</sub> (380 V~ ... 480 V~) or L1<sub>B</sub> (200 V~ ... 275 V~) and L2/N. The brake connection is made to Terminals 79/80. Assignment of the brakes is made according to the following table. The module must be supplied with 24 V DC. Control is via Terminal C5 by means of a digital output of the frequency inverter which is parameterised to the function {1} "External brake". Feedback of the operating status of the brake (current/no current supplied to the brake) is via Terminal B5 of the module.

Brake coil voltage	Mains voltage	Contact No.
205 V DC	230 V AC	L1 <sub>B</sub> + N/L2
180 V DC	400 V AC	L1 <sub>E</sub> + N/L2
205 V DC	460 V AC or 480V AC	L1 <sub>E</sub> + N/L2

## Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
44 24V	24V supply	24 V DC $\pm$ 25% 50 ... 500mA (according to load on the digital output)	Supply voltage connection for the module	-
40 GND /0V	GND Reference potential			-
C5 DIN	Digital input	Current consumption with 30 V DC: 13 mA 24 V DC: 10 mA 15 V DC: 5.5 mA Switching thresholds ON: > approx. 8.5 V OFF: < approx. 7.5 V	Digital input for DC brake switching	-
B5 DOUT	Digital output	15 ... 30 V, 200 mA, SPS-compatible according to EN61131-2 Low: 0 V / <30 mA No current through brake High: 24V / >70mA Current through brake	Reporting of current status of the mechanical brake	-
<b>Potential isolation</b>				
79 MB+	Brake control	<i>Voltage:</i> Mains brake 230 V~ 205 V= 400 V~ 180 V= 460/480 V~ 205 V=  <i>Current:</i> max. 0.5 A	The module SK CU4-MBR generates an output voltage on Terminals MB+/MB- for control of an electromechanical brake. This depends on the supply voltage and the connection of the supply cable to the one-way (L1 <sub>E</sub> ) or bridge rectification (L1 <sub>B</sub> ) of the module. The assignment of the correct brake coil voltage must be taken into account in the selection. (NOTE: this function is identical to P434=1)	P107*, P114*, P505
80 MB-	Brake control			
<b>Potential isolation</b>				
L1 <sub>E</sub>	Mains connection 1st phase	Supply voltage L1: 380V ... 480 V $\pm$ 10% AC, max. 10 A	Mains connection for one-way rectification.	-
L1 <sub>E</sub>				-
L1 <sub>B</sub>	Mains connection 1. Phase	Supply voltage L1: 200V ... 240 V $\pm$ 10% AC, max. 10 A	Mains connection for bridge rectification.	-
L1 <sub>B</sub>				-
L2 / N	Mains connection 2. Phase		Connection of 2nd phase for mains connection L1 <sub>E</sub> or L1 <sub>B</sub> .	-
L2 / N				-
* Recommended setting (P107/P114) for NORD brakes: BRE5, 10, 40: 0.02s / BRE 20, 60 : 0.03s				

### 3.3.3 Setpoint converter, SK CU4-REL

The analog inputs of SK 1x0 E series frequency inverters and the optional mains units SK xU4-24V can only process unipolar setpoint values referenced to GND (0/2 ... 10 V; 0/4 ... 20 mA). If a bipolar setpoint (10V ... + 10 V) is available, this must be converted to a 0 ... 10 V signal by means of an SK CU4-REL setpoint converter.

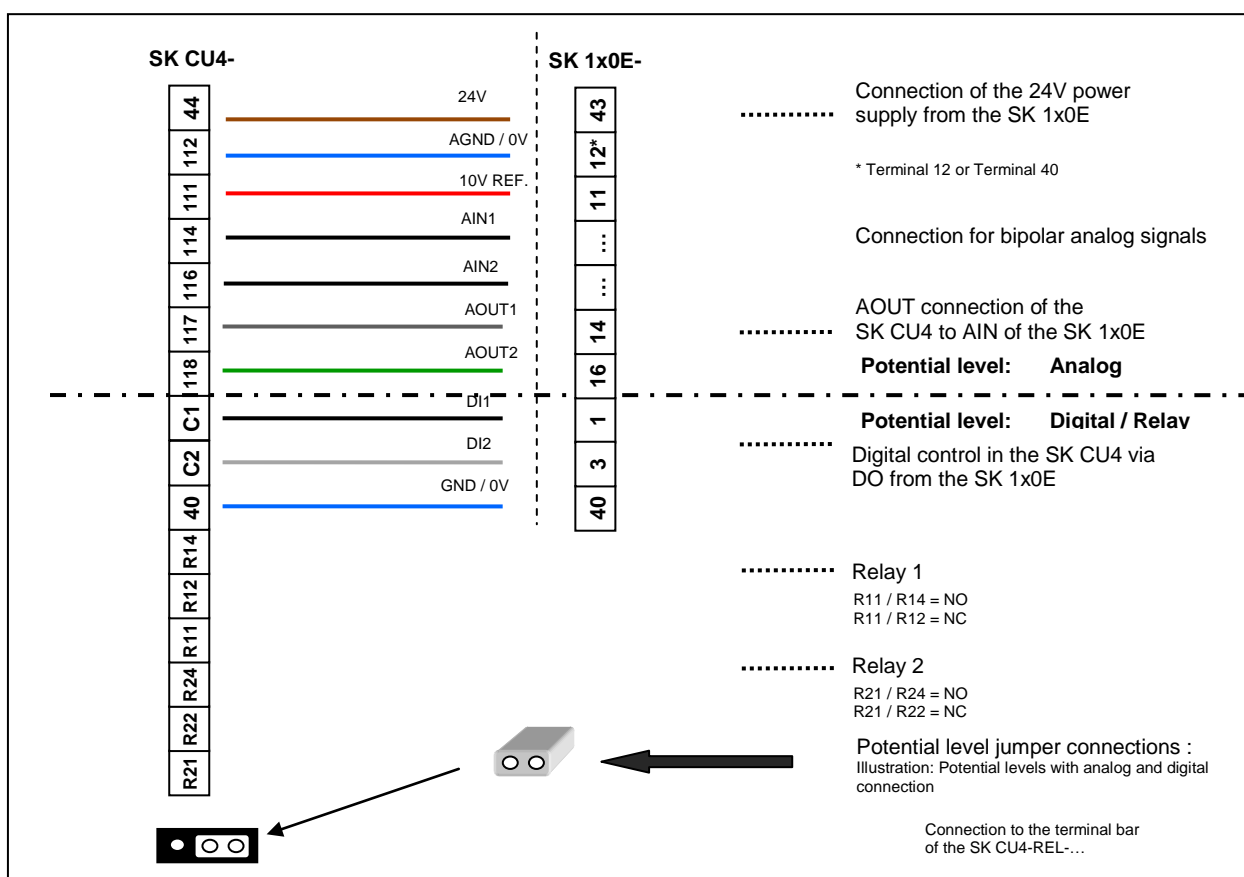
Two coupling relays are integrated into the module. These are controlled via the digital outputs of the frequency inverter and can be used as openers or closers according to their connection.

- +24V control voltage
- 2x Analog inputs (-10 ... +10 V)
- 2x digital inputs
- 2x Analog outputs (0 ... 10 V) → *only for transfer to the frequency inverter*
- 2x Relay outputs (each configured as changeovers)
- Max. permissible continuous relay current: 1000 mA ( $\leq 30$  V DC)
- incl. cable set



Similar to illustration

The terminal bar of the customer unit SK CU4-REL-... is divided into two potential levels (potential separation max. 50 V DC). On delivery, these are connected together with a plug-in jumper.



The bipolar analog signals must be connected to input terminals 114 or 116. Via the analog outputs (Terminal 117 or 118) the signals which are transformed to 0...10V can be accessed and transferred to the frequency inverter for further processing. In order to ensure the function of the analog signal converter, the 10V DC reference voltage of the frequency inverter must be wired to the reference potential of the setpoint source(s) of the SK CU4-REL.

Up to 2 digital signals can be transferred to the coupling relays from the frequency inverter. Regardless of the wiring, both relays each provide the possibility of accessing an opening (NC) or a closing (NO) signal.

The module must be supplied with 24V DC.

To separate the two potential levels, the jumper (at the start of the series terminal) must be plugged in differently or pulled out entirely.

### Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
44 24V	24V supply	24V DC $\pm 25\%$	Connection of the supply voltage for the module and the reference potential of the analog signals	
112 AGND / 0V	Reference potential for analog signals	20 mA		
111 10V REF	+10V Reference voltage	+10V, 5 mA	Connection of reference voltage from frequency inverter	
114 AIN1	Analog input 1	U= -10 ... +10 V, R <sub>i</sub> =2 M $\Omega$ Resolution 10Bit	The conversion of the analog signals is inverted.	
116 AIN2	Analog input 2			
117 AOUT1	Analog output 1			Resolution: 10Bit Precision: 0.25 V
118 AOUT2	Analog output 2	Load capacity with signal: 0...10 V: $\leq 10$ mA	Assignment of the functions of the analog input signals is made via parameter P400[...] of the frequency inverter.	
<b>Potential isolation</b>				
C1 DIN1	Digital input 1	Relay input: Low: 0-5V (2.8kOhm) High: 18-30V (1.6kOhm)  Reaction time max. 7ms	Assignment of the functions of the analog output signals is made via parameter P434[...] of the frequency inverter.	
C2 DIN2	Digital input 2			
40 GND / 0V	Reference potential for digital signals			
R14 R1 NO	Relay 1.1 Normally closed contact	Relay input: Low: 0-5 V (2.8 kOhm) High: 18-30 V (1.6 kOhm)  Reaction time max. 7 ms	Relay (changeover) with function: Closer: R11 / R14 Opener: R11 / R12	
R12 R1 NC	Relay 1.2 Normally opened contact			
R11	Relay 1.3 Common contact			
R24 R2 NO	Relay 2.1 Normally closed contact	Mechanical lifetime: 1x10 <sup>8</sup> (1 billion) OPS (Operations)	Relay (changeover) with function: Closer: R21 / R24 Opener: R21 / R22	
R22 R2 NC	Relay 2.2 Normally opened contact	Electrical: 3x10 <sup>5</sup> (3 million) OPS (Operations)		
R21	Relay 2.3 Common contact			

### 3.3.4 Direction selection switch and potentiometer SK TIE4-SWT and SK TIE4-POT

The digital signals R and L of the direction selector switch **SK TIE4-SWT** (Part No.: 275274701) can be applied directly to the corresponding digital inputs 1 and 2 of the frequency inverter.

The potentiometer (0-10 V) **SK TIE4-POT** (Part No.: 275274700) can be evaluated via the analog inputs of the frequency inverter or the I/O extension. Each of the modules (control element) is supplied with a pre-assembled cable. This must be plugged into the connection plug of the relevant module. The open ends of the cable set must be wired to the terminal bar of the frequency inverter according to the table.

Both modules have protection class IP66.

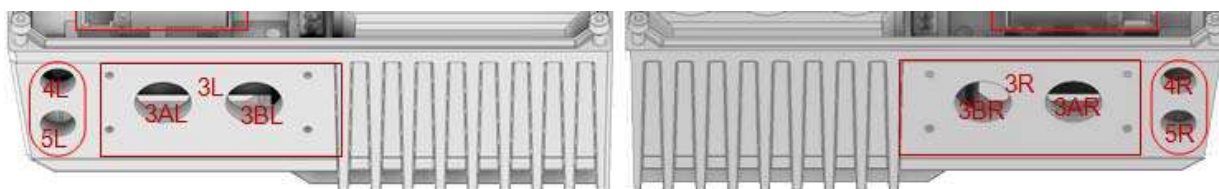


Module	SK TIE4-SWT	Function	
		SK 1x0E	
<b>Color</b>		FI	
<b>brown</b>	24 V-supply voltage	43	Rotary switch L - OFF - R
<b>black</b>	Enable R (e.g. DIN1)	21	
<b>white</b>	Enable L (e.g. DIN2)	22	
Module	<b>SK TIE4-POT</b>		
<b>white</b>	Access to AIN +	14	Potentiometer 10kΩ
<b>brown</b>	Reference voltage 10 V	11	
<b>blue</b>	Analog ground AGND	12	

For examples of connections to the frequency inverter, please refer to Section 3.3.1.

#### Installation

Installation of the potentiometer (SK TIE4-POT) is possible on a 4 M25 versions of the device. In contrast, installation of the switch (SK TIE4-SWT) is only possible on the M25 holes 3BL and 3BR; for Size 2 also on 3AL:



### 3.4 Details of external Technology Units SK TU4-...

The technology units are divided into two different groups. The BUS group contains all the bus modules and the I/O extension. These are connected to the SK 1x0E via the system bus.

The second group includes other technology units, e.g. the maintenance switch SK TU4-MSW.

Due to the very different functions, the device groups require different connection units.

#### 3.4.1 Connection unit SK TI4-TU-BUS / -MSW



SK TI4-TU-BUS



SK TI4-TU-MSW

Feature	Bus modules	Maintenance switch
Designation of connection unit	SK TI4-TU-BUS	SK TI4-TU-MSW
Designation of Technology Units	SK TU4-PBR-... ...CAO... / ...DEV... / ...EIP... / ...ECT... / ...PNT... / ...POL... / ...IOE...	SK TU4-MSW-...
24V - supply required!	Yes	No
24V supply integrated	No	No
System bus connection	Yes	No
Motor mounting possible	Yes	Yes
Mounting near to motor possible	Yes, with wall-mounting kit <i>SK TIE4-WMK-TU</i>	Yes, with wall-mounting kit <i>SK TIE4-WMK-TU</i>

All connections are made via the connection unit. This includes customer control of the module and connection of the module to the frequency inverter. In parallel with this, the analog and digital inputs and outputs of the frequency inverter also remain available.

The relevant Technology Unit is attached to the appropriate Adapter Unit with screws. Installation information can be found in Section 3.2.2.



#### NOTE



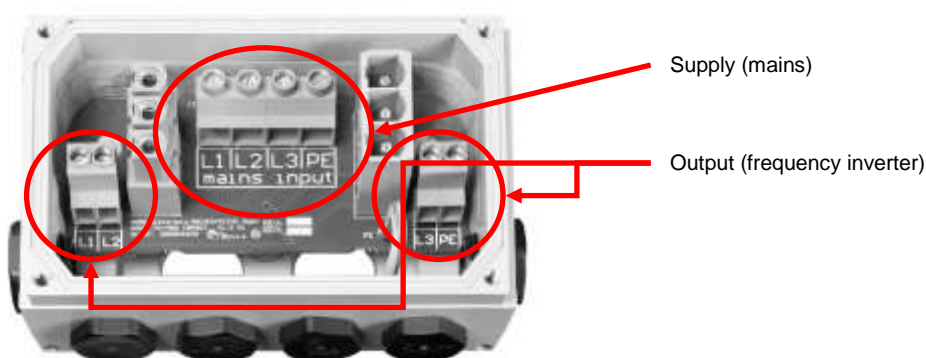
Connection terminals with identical designations are first connected internally, if the technology unit has been mounted on the corresponding connection unit. Because of this, when removing a BUS module from the connection unit, the relevant BUS system (e.g. Profibus) is disconnected.

### 3.4.1.1 Connections of the SK TI4-TU-BUS

The precise connections of the 36 spring-loaded terminals depend on the Technology Unit used. Details can be found in the relevant documents for the bus system.

### 3.4.1.2 Connections of the SK TI4-TU-MSW

Connection of the incoming and outgoing mains cable (incl. PE) is made on the relevant terminal blocks as shown in the illustration. With single phase mains cables the conducting phase must be connected to L1 and the neutral conductor to L2.



Connection to the terminal bar of the SK TI4-TU-MSW

#### Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
<b>Supply (Mains input)</b>				
L1	Mains connection 1st phase	$I_{nom} = 16A$	Mains connection, according to network 1~100 – 240 V to L1 and L2 or 3~ 200 – 480 V to L1, L2 and L3	-
L2	Mains connection 2nd phase or "N"			-
L3	Mains connection 3rd phase			-
PE	PE, Earth			-
<b>Output</b>				
L1	Mains connection 1st phase	$I_{nom} = 16A$	Frequency inverter connection, according to network 1~100 – 240 V to L1 and L2 or 3~ 200 – 480 V to L1, L2 and L3	-
L2	Mains connection 2nd phase or "N"			-
L3	Mains connection 3rd phase			-
PE	PE, Earth			-

### 3.4.2 Maintenance switch, SK TU4-MSW-...

The maintenance switch can be looped into the mains supply cable of the frequency inverter in order to interrupt the voltage supply to a connected frequency inverter. The maintenance switch has a 3-pole design and can therefore be used for 1 - 3 phase AC supply networks up to 480 V  $U_{Nom}$ .

- Maintenance switch for AC supply networks  
1~100-240 V or 3~ 200-480 V,  $I_{nom}$  16A<sub>rms</sub>
- Status LEDs = L1, L2, L3

The **SK TU4-MSW-...** maintenance switch is operated in combination with an **SK TI4-TU-MSW** connection unit.

Details of the control connections can be found in the connection unit section (Section 3.4.1.2).

The front-mounted LEDs L1 ... L3 indicate the presence of a voltage at the output side of the switch.

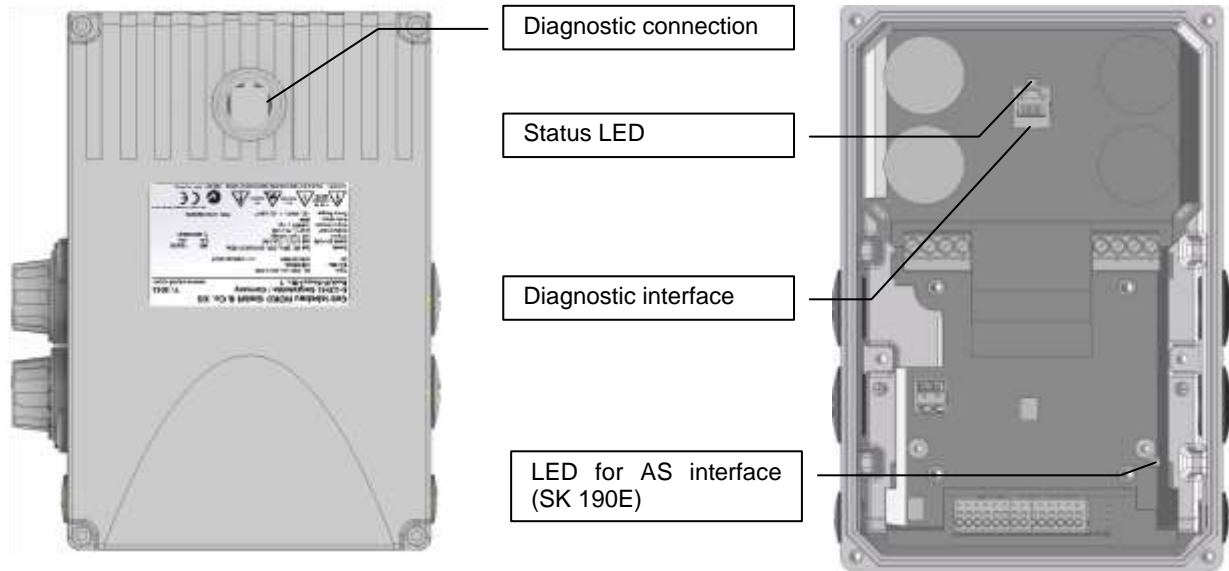


## 4 Displays and control

By the use of various modules for display, control and parameterisation, the frequency inverter can be easily adapted to various requirements.

Alphanumeric display and control modules (Section 4.2) can be used for simple commissioning. For more complex tasks, connection to a PC system and the use of NORD CON parameterisation software is available.

As supplied, without additional options, the diagnostic LED is externally visible. This indicates the actual status of the device. In contrast, the AS-i LED (SK 190E) is only visible if the device is open.



### 4.1 Diagnostic LEDs on the Frequency Inverter

The frequency inverter generates operating status messages. These messages (warnings, faults, switching statuses, measurement data) can be displayed with parameterisation tools (e.g. ParameterBox - see Section 4.2) (Parameter group P7xx). To a limited extent, the messages are also indicated via the diagnostic and status LEDs.

LED		Description	Signal status		Meaning	
Name	Colour					
DS	dual red/green	Device status	off		Frequency inverter not ready for operation, ⇒ no control voltage	
			green on		Frequency inverter ready for operation	
			green flashing		0.5 Hz	Frequency inverter ready for switch-on
					4 Hz	Frequency inverter is in switch-on block
			red/green Alternating		4 Hz	Warning
					1...25 Hz	Degree of overload of switched-on FI
			green on + red flashing		Frequency inverter not ready for operation,	
red flashing		Error, flashing frequency → Error number				
AS-I	dual red/green	AS-i status	off		No voltage to the AS-i module (PWR)	
			green		Normal operation	
			red		No exchange of data ⇒ Slave Address = 0 / Slave not in LPS / Slave with incorrect IO/ID / Master in STOP mode / Reset active	
			alternately flashing red / green		Peripheral error	

## 4.2 Overview of external control devices

All parameters can be easily accessed for reading or editing by means of an optional SimpleBox or ParameterBox. The changed parameter data are stored in the non-volatile EEPROM memory.

In addition, up to 5 complete frequency inverter data sets can be saved in the ParameterBox and then recalled.

The connection between the SimpleBox or ParameterBox and the SK 1x0E is made with an RJ12-RJ12 cable.

**NOTE:** For use on the SK 1x0E the ParameterBox SK PAR-3H must have at least the software version 4.4 R2.



Module	Description	Data
SimpleBox Handheld <b>SK CSX-3H</b>	Used (exclusively) for commissioning, parameterisation, configuration and control of the frequency inverter. Storage of the parameters is <u>not</u> possible.  <b>Manual BU 0040 (<a href="http://www.nord.com">www.nord.com</a>)</b>	4-digit, 7-segment LED display IP20 RJ12-RJ12 cable ((for connection to FI)  Part. No. 275281013
ParameterBox Handheld <b>SK PAR-3H</b>	Used for commissioning, parameterisation, configuration and control of the frequency inverter and its options (SK xU4-...). Saving of parameters is possible.  <b>Manual BU 0040 (<a href="http://www.nord.com">www.nord.com</a>)</b>	4 digit back-lit LCD display, keyboard Stores up to 5 complete FI data sets IP20 RJ12-RJ12 cable (for connection to FI / Option) USB-Cable (For connection to PC)  Part. No. 275281014

Mounting of the control unit on the frequency inverter:

**Installation** of the control unit is performed as follows:

1. Remove the blind plug from the cable gland.
2. Connect the RJ12-RJ12 cable between the control unit and the frequency inverter.
3. After commissioning the blind plug must be replaced and care must be taken that there is a tight seal before regular operation is started.
4. As long as the cable gland is open, take care that no dirt or moisture enters the device.

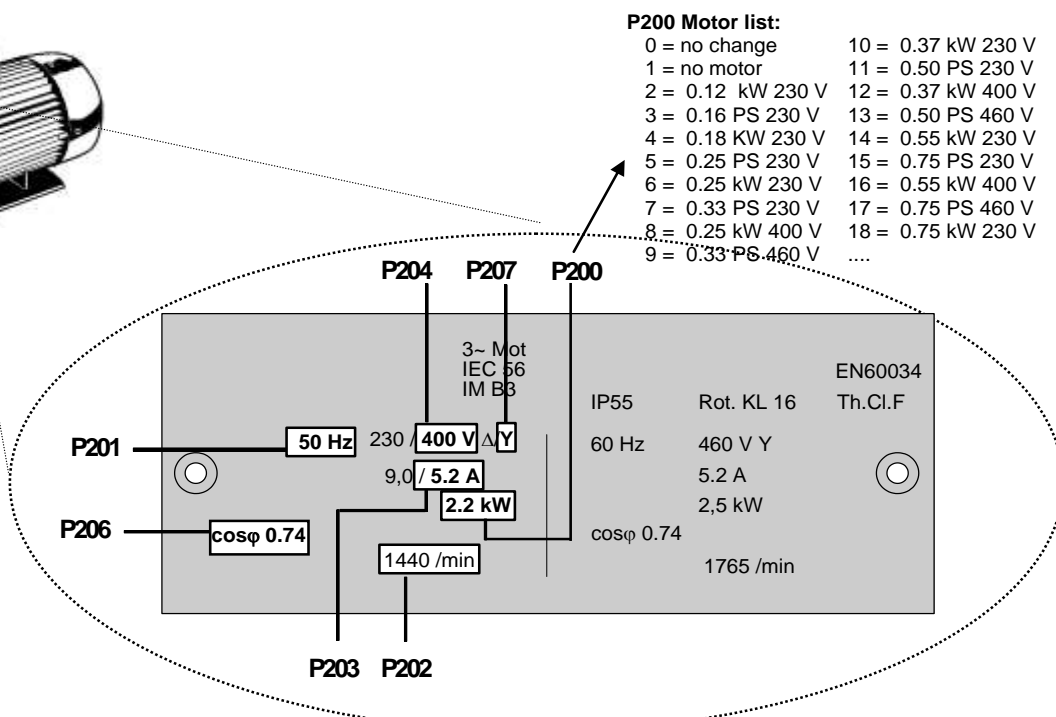
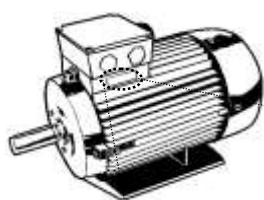


## 5 Commissioning

### 5.1 Factory settings

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

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



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

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

### 5.2 Commissioning of frequency inverters

The frequency inverter can be commissioned by adjustments to the parameters with software, using ParameterBox (SK CSX-3H or SK PAR-3H) or the PC-based software NORD CON. Here, the parameterised data is stored in the internal EEPROM.

#### ATTENTION



**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.

**NOTE**

For commissioning standard applications, a limited number of the frequency inverter inputs and outputs (physical and I/O bits) have predefined functions. These settings may need to be changed (Parameters (P420), (P434), (P480), (P481)).

**5.2.1 Connection**

After mounting the frequency inverter on the motor or the wall mounting kit, the mains and motor cables must be connected to the relevant terminals (PE, L1, N (/L2, L3) and U, V, W) (See sections 2.7 and 2.8).

In principle, the frequency inverter can be operated in this configuration. (See Section 5.2.3)

**5.2.2 Configuration**

Changes to individual parameters are usually necessary for operation.

**5.2.2.1 Parameterisation**

The use of a ParameterBox (SK CSX-3H / SK PAR) or NORD CON software is necessary to change the parameters.

Parameter group	Parameter numbers	Functions	Comments
Motor data	P201 ... P207, (P208)	Data on motor rating plate	
	P220, Function 1	Measure stator resistance	Value is written to P208
	alternatively P200	Motor data list	Selection of a 4-pole standard motor from a list
	alternatively P220, Function 2	Motor identification	Complete measurement of a connected motor Prerequisite: motor no more than 3 power levels less than the frequency inverter
Basic parameters	P102 ... P105	Ramp times and frequency limits	
Control terminals	P400, P420	Analog and digital inputs	

**NOTE**

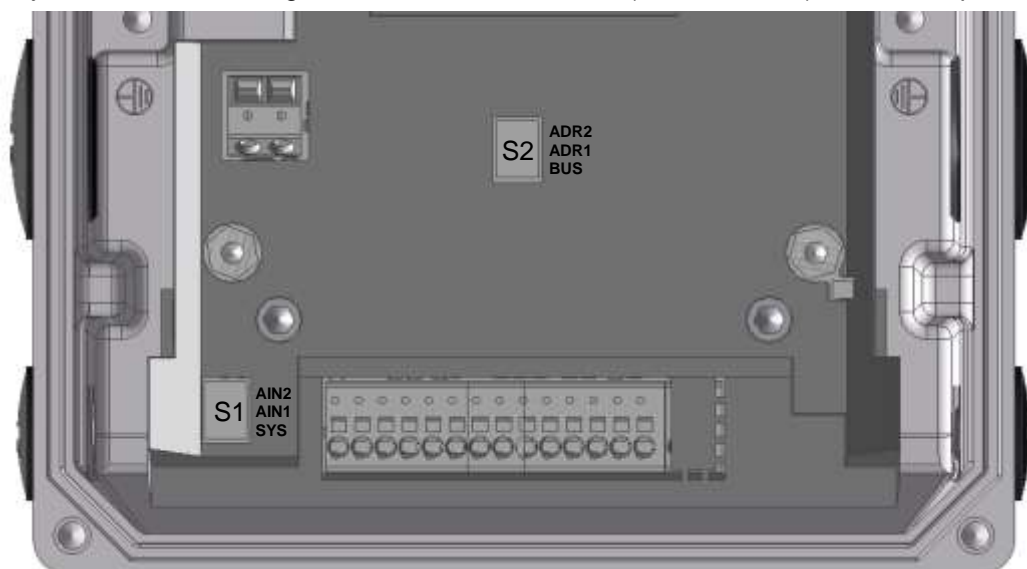
Prior to commissioning, it should be ensured that the frequency inverter is in its default setting (P523). DIP switches S2 should remain in the "off" setting. DIP switches S2 have priority over the parameters P509, P514 and P515.

### 5.2.2.2 DIP switch configuration of the inverter

The analog inputs in the frequency inverter are suitable for current and voltage setpoints. For correct processing of current setpoints (0-20mA / 4-20mA) the relevant DIP switch (**S1**) must be set for current signals ("ON").

No.			
Bit	DIP switch (S1)		
3 2 <sup>2</sup>	<b>U / I AIN2</b> Voltage/current	0	Analog input 2 in voltage mode 0...10 V
		1	Analog input 2 in current mode 0/4...20 mA
2 2 <sup>1</sup>	<b>U / I AIN1</b> Voltage/current	0	Analog input 1 in voltage mode 0...10 V
		1	Analog input 1 in current mode 0/4...20 mA
1 2 <sup>0</sup>	<b>SYS</b> Burden resistor	0	Burden resistor switched off
		1	Burden resistor activated

Adjustment to fail-safe signals in case of cable breaks (2-10V/4-20mA) is made via parameters 402 and 403.



A second DIP switch (**S2**) is also available, via which the system bus address can be specified or the system bus can be activated. This has priority over the parameters P509, P514 and P515.

No.				
Bit	DIP switch (S2)			
2/1 2 <sup>1/0</sup>	<b>ADR</b> System bus address/ baud rate	<i>DIP-No</i>		
		3	2	
		0	0	Corresponding to P515 and P514 [32, 250kBaud]
		0	1	Address 34, 250kBaud
		1	0	Address 36, 250kBaud
3 2 <sup>2</sup>	<b>BUS</b> Source control word and setpoint value	0		Corresponding to P509 and P510 [1] [2]
		1		System bus (⇒ P509=3 and P510=3)

#### NOTE



FACTORY SETTING, AS DELIVERED!

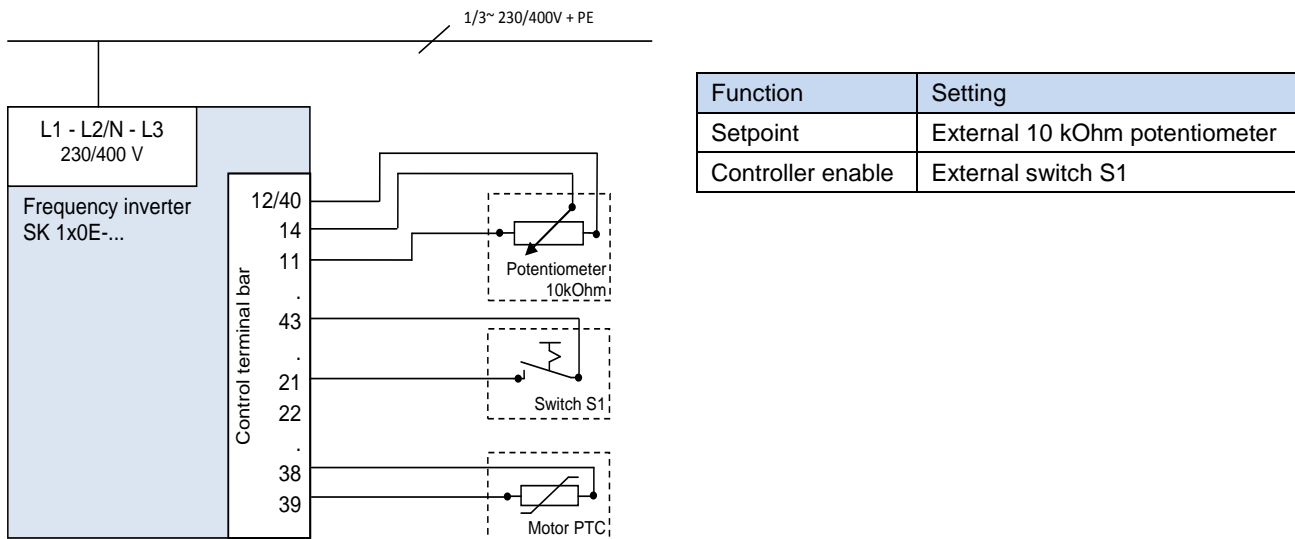
As delivered, all DIP switches are in the "0" ("off") position.

## 5.2.3 Commissioning examples

All devices can be operated in the condition in which they are delivered. The standard motor data of a 4-pole IE1 standard asynchronous motor of the same power are parameterised. The PTC input must be bypassed, if a motor with PTC is not available. Parameter (P428) must be changed if an automatic start-up with "Mains On" is required.

### 5.2.3.1 Minimal configuration

The frequency inverter provides all the necessary low voltages (24V DC / 10V DC).



### Minimal configuration with options

In order to implement completely autonomous operation (i.e. independent of control cables etc.) a potentiometer unit (SK CU4-POT) is required. In this way, the required speed and direction control can be achieved with only a single mains cable (single phase or three-phase, according to the version) (see connection example in Section 3.3.1).

## 5.3 KTY84-130 connection

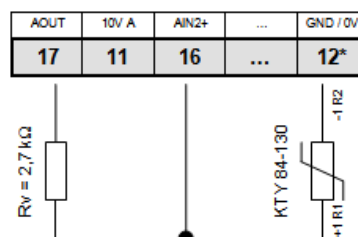
The current vector control of the SK 1x0E series can be further optimised by the use of a KTY84-130 temperature sensor ( $R_{th(0^{\circ}C)}=500\Omega$ ,  $R_{th(100^{\circ}C)}=1000\Omega$ ). By continuous measurement of the motor temperature, the highest precision of regulation by the frequency inverter and the associated optimum speed precision of the motor is achieved at all times. As the temperature measurement starts immediately after the (mains) switch-on of the frequency inverter, the frequency inverter provides immediate optimum control, even if the motor has a considerably increased temperature after an intermediate "Mains off / Mains on" of the frequency inverter.

### Connection examples:

#### SK 1x0E

Connection of a KTY-84 to either of the two analog inputs of the SK 1x0E is possible. In the following examples, analog input 2 of the frequency inverter is used.

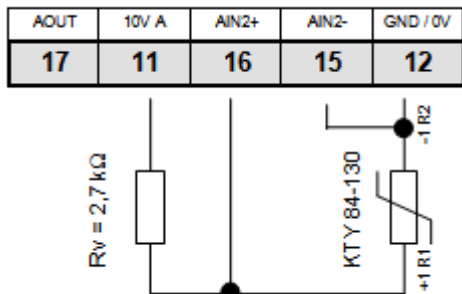
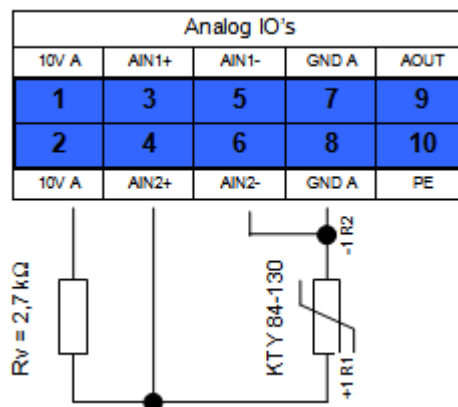
1. The motor data **P201-P207** must be set according to the rating plate.
2. The motor stator resistance P208 is determined at 20°C with **P220 = 1**.
3. Function analog input 2, **P400 [-02] = 30** (Motor temperature)
4. The mode analog input 2 **P401 [-06] = 1** (negative temperatures are also measured)  
Adjustment of analog input 2: **P402 [-06] = 1.54V** and **P403 [-06] = 2.64V** (with  $R_V = 2.7$  kOhm)
5. Adjust time constants: **P404 [-02] = 400ms**  
(Filter time constant is maximum)
6. Motor temperature control (display): **P739 [-03]**



\* If necessary, also Terminal 40

**SK CU4-IOE / SK TU4-IOE-...**

Connection of a KTY-84 to either of the two analog inputs of the relevant option is possible. In the following examples, analog input 2 of the particular optional module is used.

**SK CU4-IOE****SK TU4-IOE**

(Illustration shows a section of the terminal blocks)

**Parameter settings (Analog input 2)**

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

1. The motor data **P201-P207** must be set according to the rating plate.
2. The motor stator resistance P208 is determined at 20°C with **P220 = 1**.
3. Function analog input 2, **P400 [-04] = 30** (Motor temperature)
4. The mode for analog input 2, **P401 [-02] = 1** (negative temperatures are also measured)
5. Adjustment of analog input 2: **P402 [-02] = 1.54V** and **P403 [-02] = 2.64V** (with  $R_V = 2.7 \text{ kOhm}$ )
6. Adjust time constants: **P161 [-02] = 400ms** (Filter time constant is at a maximum)  
Parameter (P161) is a module parameter. This cannot be set on the frequency inverter, but rather directly on the I/O-module. Communication is carried out e.g. via the direct connection of a ParameterBox to the RS232 interface of the module or by the connection of the frequency inverter via the system bus. (Parameter (P1101) object selection → ...)
7. Motor temperature control (display): **P739 [-03]**

**NOTE**

To determine the stator resistance of the motor, the temperature range 15 ... 25°C should not be exceeded.

Excess temperature of the motor is also monitored and at 155°C (switching threshold for the thermistor) causes the drive unit to shut down with error message E002.

## 5.4 AS interface (only SK 190E)

### 5.4.1 The bus system

The **ActuatorSensor Interface** (AS-Interface) is a bus system for the lower field bus level. The transmission principle is a single master system with cyclical polling. A maximum of 31 slaves (or 62 A/B slaves in the extended address region) can be operated on an up to 100m long unshielded two-wire cable in any network structure (tree/line/star). For the AS-interface, since the *Complete Specification V2.1*, a differentiation has been made between Standard Slaves and A/B Slaves. This version includes the doubling of the number of slaves to 62. This is done by the double-assignment of addresses 1-31 and their designation as "A Slave" and "B Slave". A/B Slaves are designated by the ID code A, and therefore can be uniquely identified by the Master.

The **SK 190E** frequency inverter is an A/B slave, which corresponds to slave profile **S-7.A**. They can be administered by masters whose profile at least corresponds to class **M4**.

In contrast to devices with the profile S-7.0 devices with the profile S-7.A use the extended address range.

Devices with slave profiles S-7.0 and S-7.A can be jointly operated within an ASi network as of version 2.1 (Master profile M4) with observance of the allocation of addresses (see example).

<u>Permissible</u>	<u>Not permissible</u>
Standard slave 1 (Address 6)	Standard slave 1 (Address 6)
<b>A/B-Slave 1: (Address 7A)</b>	<b>Standard slave 2: (Address 7)</b>
<b>A/B-Slave 2: (Address 7B)</b>	<b>A/B-Slave 1: (Address 7B)</b>
Standard slave 2 (Address 8)	Standard slave 3 (Address 8)

The yellow AS interface cable supplies data and energy. Addressing is implemented via the master, which can also provide other management functions, or via a separate addressing device. The transfer of the 4 Bit reference data (in each direction) is performed with effective error protection for standard slaves with a maximum cycle time of 5ms. Due to the correspondingly higher number of participants, for A/B slaves the cycle time (max. 10ms) is doubled for data which is sent from the slave to the master. Extended addressing procedures for the transmission of data to the slave also cause an additional doubling of the cycle time to max. 21ms.

The bus system is completely defined in the *AS-Interface Complete Specification* and is standardised as per EN 50295, IEC62026.

### 5.4.2 Features

The SK 190E frequency inverter versions provide an integrated AS interface as standard. Therefore, these devices can be directly integrated into an AS interface network. Only the adaptation of various frequency inverter functions, addressing and the correct connection of the power supply, BUS, sensor and actuator cables needs to be carried out.

#### Features

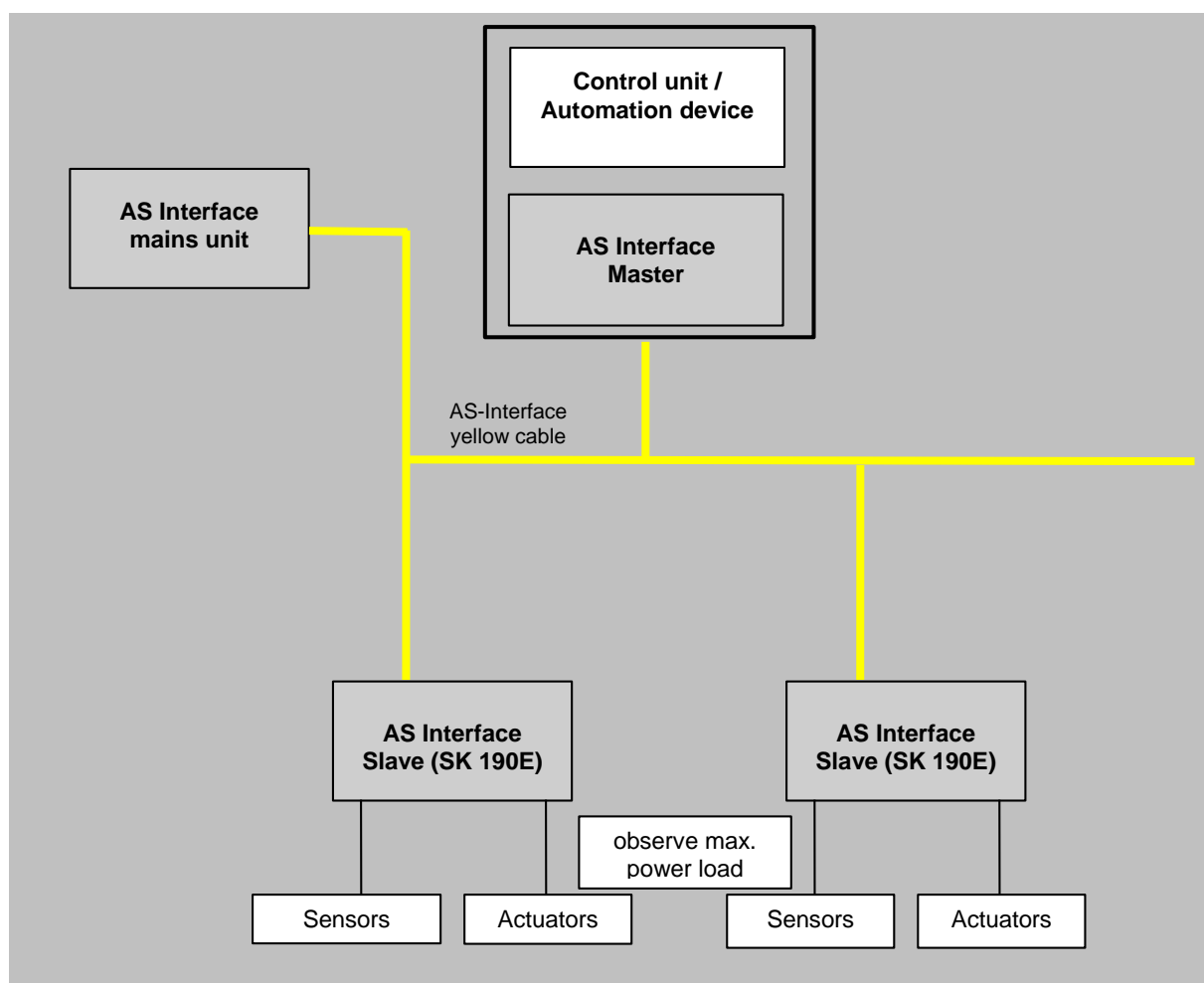
- Electrically isolated bus interface
- Status display (1 LED) inside the device (can be viewed with the cover open)
- Configuration by parameterisation
- Slave profile S-7.A (4I / 4O), (A/B Slave)
- Connection of the frequency inverter via the terminal bar, optionally via M12 flanged plug connector
- Up to 31 standard slave (or 62 A/B slaves in the extended address region) on one bus conductor
- Cycle time ≤ 5 ms / 10 ms (A/B)
- Address as delivered = 0
- Max. current consumption: 25 mA

The factory setting of the frequency inverter enables the immediate availability of common AS-i basic functions. These functions can be adapted by parameterisation.

### 5.4.3 Bus structure and topology

The AS interface network can be set up in any desired form. Linear, star, ring and tree structures are possible. An existing network can be expanded by further slaves at any time. Up to 31 standard slaves (i.e. a maximum of 124 binary sensors and 124 binary actuators) or 62 A/B slaves (i.e. a maximum of 248 binary sensors and 248 binary actuators) can be connected to an AS interface network or an AS interface master. Each AS interface slave has its own address (1 to 31 (or 1A ... 31A, 1B ... 31B)), which is assigned to the slave with the aid of an addressing device, or is transferred to the slave by means of a command from the AS interface master. Each slave address may only be assigned once.

Normally the AS interface master is a component or module of the control unit and forms the interface between the control unit and the connected slave. An AS-i master communicates independently and exchanges data with the connected AS-i slave options. Normal power units must not be used in the AS interface network. For each AS interface connector, only a special AS interface power units may be used for the power supply. This AS interface power supply is directly connected to the yellow standard cable (ASi+ and ASi- cable) and should be positioned as close as possible to the AS-i master in order to keep the voltage drop small.



#### NOTE

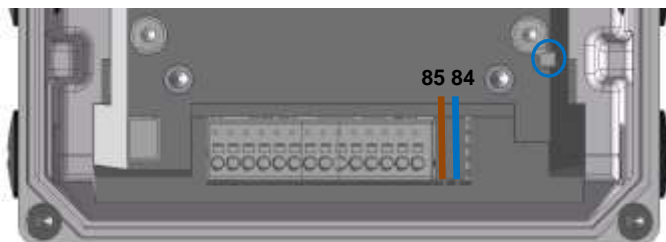


It is essential that the PE connection of the AS interface mains unit (if present) is earthed.  
The brown ASi+ and the blue ASi- wire from of the AS interface cable must not be earthed.

## 5.4.4 Commissioning of the AS Interface

### Connection

Connection of the AS interface cable is made via terminals 85/85 of the terminal block and can optionally be made to an appropriately labelled M12 flange plug contact (yellow) Details of the connection terminals are explained in Section 2.8.2.



### Signal status LED / ASi-specific display

With these devices, the status of the ASi interface is indicated by the dual colour LEDAS-i.

LED (dual)	Meaning
OFF	No AS interface voltage to the module (PWR) Connections to terminals 84 and 85 exchanged.
green ON	Normal operation (AS interface active)
red ON	no exchange of data → Slave address = 0 → Slave not in LPS → Slave with incorrect IO/ID → Master in STOP mode → Reset active
alternately flashing red / green	Peripheral error → FI control unit does not start (AS-i voltage too low, control unit faulty)

### Control voltage - frequency inverter supply

The yellow ASi cable supplies the AS interface with the necessary control voltage. The control section of the frequency inverter is not supplied from the AS interface voltage.

### Configuration

The most important functions are assigned via the arrays [-01] ... [-04] of parameter (P480) and (P481).

### Addressing

In order to use a frequency inverter in an ASi network, this must be assigned with a unique address (1-31). The FI is set to address 1 as the factory setting, and can therefore be identified as a "new device" by the AS-i master (prerequisite for the automatic address assignment by the master).

In many other cases, addressing is carried out by means of a normal addressing device for AS-i slaves. The following should be noted:

Procedure for SK 190E:

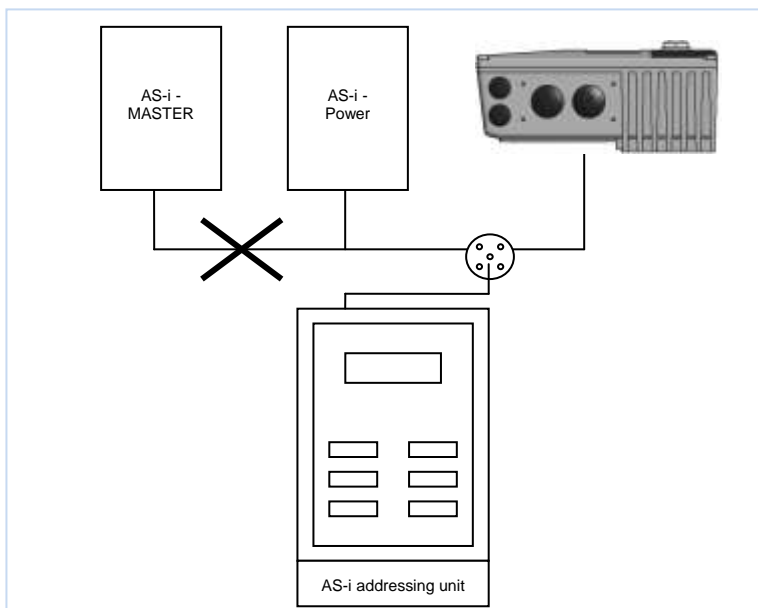
- Ensure power supply of the ASi interface via the yellow ASi cable.
- Disconnect the AS-i master during addressing
- Set the address  $\neq 0$
- Do not doubly assign addresses

Normal hand-held units can be used for the addressing of the frequency inverter. Typical manufacturers are Pepperl+Fuchs (e.g.: VBP-HH1-V3.0-V1) and IFM (E.g.: AC1154).

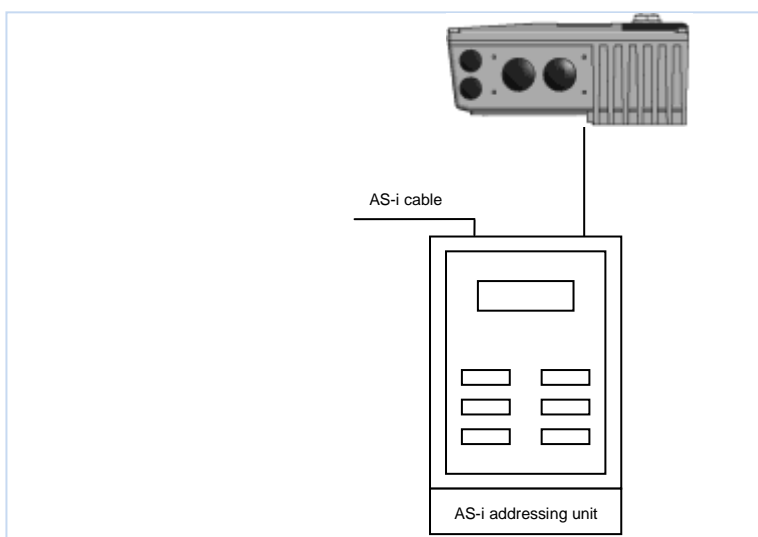
The following lists the possibilities for the practical implementation of addressing an SK 190E with an addressing box.

**Version 1**

With a normal addressing device (equipped with an M12 plug for connection to the AS-i bus) the AS-i can be integrated into the AS-i network via a suitable access point. The prerequisite for this is that the AS-i master can be switched off.

**Version 2**

With an addressing unit (equipped with an M12 plug for connection to the AS-i bus and an additional M12 plug for an external power supply), the addressing unit can be directly connected into the AS-i cable.

**NOTE**

With the SK 190E a battery-operated addressing device is sufficient.

### 5.4.5 Technical data for AS interface

Designation	Value
Supply via AS interface connection PWR connection (yellow cable)	24 V, max. 25 mA
Slave profile	S-7.A
I/O-Code	7
ID Code	A
External ID Code 1 / 2	7
Address	1A – 31A and 1B - 31B (condition as delivered: 0A)

## 6 Parameterisation

The frequency inverter, field bus and I/O -extension modules each have their own logic systems. These can be adapted to customers' requirements by means of changeable parameters. The basic functions of the particular modules are factory-set, so that the units have basic functionalities on delivery. Limited adaptations of individual functions of the relevant devices can be implemented via DIP switches. For all further adjustments, access to the parameters of the relevant device with the aid of a ParameterBox (SK PAR-3H, SK CSX-3H) or NORD CON software is essential. It should be noted that the **hardware configuration (DIP - switches) has priority over configuration via software (parameterisation)**.

**NOTE:** For use on the SK 1x0E the ParameterBox SK PAR-3H must have at least the software version 4.4 R2.

The following describes the relevant parameters for the frequency inverter (Section 6.1) and the I/O extension modules (Section 6.2). Explanation for parameters which relate to the field bus options can be obtained from the relevant supplementary manuals.

### Availability of the parameters

Due to certain configurations, the parameters are subject to certain conditions. The following tables (from Section 6.1 onwards) list all parameters together with the particular information.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P402</b>	<b>Adjustment: 0%</b> (Analog input adjustment: 0%)		S	
-50.00 ... 50.00 V { all 0.00 }	[01] = Analog input 1, Function of analog input 1 integrated into the FI [02] = Analog input 2, Function of analog input 2 integrated into the FI			

*Example illustration*

Description

Parameter text  
Top: P-Box display  
Bottom: Meaning

Array value

Parameter number

Parameter value range

Factory settings of parameter

e.g. only available for size 2 is relevant

Supervisor parameters (S)  
Depend on the setting in P003

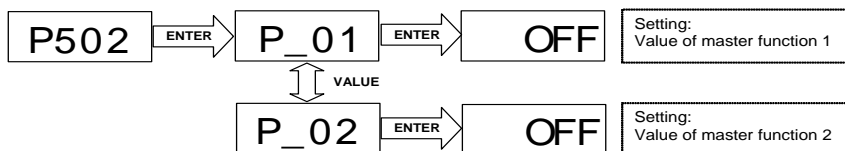
Parameter set dependent (P) parameter selections in P100

### Array parameter display

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

If the SimpleBox SK CSX-3H is used, the array level is shown by  $\boxed{\_ - 01}$ . With the ParameterBox SK PAR-3H (picture on right) the selection options for the array level appear at the top right of the display.

SimpleBox SK CSX-3H



## 6.1 Frequency inverter parameterisation

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

### NOTE



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

The individual parameters are combined in various groups. The first digit of the parameter number indicates the assignment to a **menu group**:

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

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

### ATTENTION



All current parameter settings will be overwritten, if P523= 1 is set and confirmed with "OK". To save the actual parameter settings, these can be transferred to the ParameterBox memory.

## Parameter list - inverter functions (selection)

Parameter	Description	Factory setting	Settings / functions (selection)
<b>P102</b> Start-up time	Start-up time (acceleration ramp) is the time corresponding to the linear frequency rise from 0 Hz to the set maximum frequency (P105).	[2.00]	Note: Values < 0.1 must be avoided
<b>P103</b> Deceleration time	The braking time (braking ramp) is the time corresponding to the linear frequency reduction from the set maximum frequency (P105) to 0Hz.	[2.00]	Note: Values < 0.1 must be avoided
<b>P104</b> Minimum frequency	The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set.	[0]	
<b>P105</b> Maximum frequency	Is the frequency provided by the FI after it has been enabled and the maximum setpoint value is available.	[50]	
<b>P200</b> motor list	If a 4-pole NORD motor is used, the preset motor data can be called up.	[0]	Select appropriate motor power
<b>P201 – P208</b> Motor data	If a 4-pole NORD motor is not used, the motor data on the rating plate must be entered here.	[xxx]	Data according to rating plate
<b>P220</b> Parameter identification	The motor data is automatically determined by the FI with this parameter.	[0]	01= only stator resistance 02= motor identification
<b>P400</b> Setpoint input function	Definition of the functions of the various setpoint inputs <u>Input selection:</u> AIN1 (P400, [-01]) AIN2 (P400, [-02])	[xxx]	00= no function 01= setpoint frequency
<b>P420</b> Digital input functions	Definition of the functions of the various digital inputs <u>Input selection:</u> DIN 1 (P420, [-01]) DIN 2 (P420, [-02]) DIN 3 (P420, [-03])	[xxx]	00= no function 01= enable right 02= enable left 04= fixed frequency 1
<b>P428</b> Automatic starting	Inverter enable with "Mains On"	[0]	0= Off (enable with flank) 1= On (enable with level) <b>Note:</b> one digital input must be programmed and set to enable.
<b>P465</b> Fixed frequency / Fixed frequency array	Definition of fixed frequency values <u>Selection:</u> Fixed frequency 1 (P465, [-01]) Fixed frequency 2 (P465, [-02])	[xxx]	
<b>P509</b> Source Control Word	Selection of the interface via which the FI is controlled.	[0]	00= Control terminals or keyboard 01= Only control terminals 03= System bus
<b>P523</b> Factory setting	Frequency inverter is restored to the factory setting	[0]	00= No change 01= Load factory setting

## Parameter list - inverter information (selection)

Parameter	Description	Settings / functions (selection)
<b>P700</b> Actual operating status	Display of current messages for the actual operating status of the frequency inverter such as faults, warnings or the cause of a switch-on block. <u>Selection:</u> Actual fault (P700, [-01]) Actual warning (P700, [-02]) Reason for switch-on block (P700, [-03])	<u>Error group:</u> 1 / 2 = Overtemperature of inverter / motor 3 / 4 = Overcurrent error 5 = Overvoltage error 16 = Motor phase monitoring 19... = Parameter identification error
<b>P701</b> Last fault	Displays the last 5 frequency inverter faults. <u>Selection:</u> Last fault (P701, [-01]) Second to last fault (P701, [-02])	See P700
<b>P707</b> Software version	Displays the firmware version / Inverter revision <u>Selection:</u> Software version (P707, [-01]) Revision (P707, [-02])	
<b>P708</b> Digital input status	Shows the switching status of the digital inputs.	Bit 0 = DIN 1 Bit 1 = DIN 2 ...
<b>P709</b> Analog input voltage	Displays the measured analog input value. <u>Input selection:</u> AIN1 (P400, [-01]) AIN2 (P400, [-02])	
<b>P719</b> Actual current	Displays the actual output current.	
<b>P740</b> Process data Bus In	Displays the actual control word and the setpoints.	[-01] = STW (Source P509) [-02...-04] SW 1...3 (Source P510[-01]) [-11...-13] SW 1...3 (Source P510[-02])
<b>P749</b> DIP switch status	Displays the actual DIP switch setting (S1).	Bit 0 = DIP switch 1 Bit 1 = DIP switch 2 ...

























## 6.1.1 Operating displays

The abbreviations used are described in Section 9.12 "Abbreviations in this Manual".

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P000</b>	<b>Operating para. disp.</b> ( <i>Operating parameter display</i> )			
0.01 ... 9999	In the SimpleBox (SK CSX-3H) display, the parameter value <i>online</i> selected in P100 is displayed.			
<b>P001</b>	<b>Selection display</b> ( <i>Selection display</i> )			
0 ... 65 { 0 }	<p><b>0 = Actual frequency [Hz]</b>, is the actual output frequency being supplied by the FI.</p> <p><b>1 = Speed [rpm]</b>, the actual speed calculated by the FI.</p> <p><b>2 = Setpoint frequency [Hz]</b>, the output frequency equivalent to the actual setpoint. This need not match the actual output frequency.</p> <p><b>3 = Current [A]</b>, the actual output current measured by the FI.</p> <p><b>4 = Torque current [A]</b>, the torque developing output current of the FI.</p> <p><b>5 = Voltage [V AC]</b>, the actual alternating voltage being output by the FI.</p> <p><b>6 = Link voltage [V DC]</b>, "<i>link voltage</i>" is the internal DC voltage of the FI. Amongst other things, this depends on the level of the mains voltage.</p> <p><b>7 = cos Phi</b>, the currently calculated value of the power factor.</p> <p><b>8 = Apparent power [kVA]</b>, the actual apparent power calculated by the FI.</p> <p><b>9 = Effective power [kW]</b>, the actual effective power calculated by the FI.</p> <p><b>10 = Torque [%]</b>, the actual torque calculated by the FI.</p> <p><b>11 = Field [%]</b>, the actual field in the motor calculated by the FI.</p> <p><b>12 = Operating hours [h]</b>: time that voltage is applied to the FI network.</p> <p><b>13 = Operating time Enable [h]</b>, "<i>Enable operating hours</i>" is the time for which the FI is enabled.</p> <p><b>14 = Analog input 1 [%]</b>, actual value AIN1 of the <u>first</u> I/O extension SK xU4-IOE.</p> <p><b>15 = Analog input 2 [%]</b>, actual value AIN2 of the <u>second</u> I/O extension SK xU4-IOE.</p> <p><b>16 = ... 18 reserved</b></p> <p><b>19 = Heat sink temperature [°C]</b>: current temperature of the FI heat sink.</p> <p><b>20 = Motor load [%]</b>: average motor load, based on the known motor data (P201...P209).</p> <p><b>21 = Brake resistor load - R [%]</b>, "<i>Brake resistor load</i>" average brake resistor load, based on the known resistance data (P556...P557).</p> <p><b>22 = Internal temperature [°C]</b>, current temperature in FI housing.</p> <p><b>23 = Motor temperature [°C]</b>, only in combination with the analog input and appropriate wiring (KTY84).</p> <p><b>30 = Actual motor potentiometer setpoint [Hz]</b>, advance display of the setpoint (without the drive unit running) can be set via the motor potentiometer function 71 / 72 (see parameter P420).</p> <p><b>50 = ... 54 reserved</b></p> <p><b>60 = R Stator Ident</b>: stator resistance, automatic determination of motor data, P220</p> <p><b>61 = R Rotor Ident</b>: rotor resistance, automatic determination of motor data, P220</p> <p><b>62 = L Leakage Stator Ident</b>, stator leakage inductance, from automatic determination of motor data, P220</p> <p><b>63 = L Stator Ident</b>: stator inductance, from automatic determination of motor data, P220</p> <p><b>64 = Reserved</b></p> <p><b>65 = Reserved</b></p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P002</b>	<b>Display factor</b> ( <i>Display factor</i> )		S	
0.01 ... 999.99 { 1.00 }	<p>The selected operating value in parameter P001 &gt;Select of display&lt; is multiplied with the scaling factor in P000 and displayed in &gt;Operating parameter display&lt;.</p> <p>It is therefore possible to display system-specific operating such as e.g. the throughput quantity</p>			
<b>P003</b>	<b>Supervisor code</b> ( <i>Supervisor code</i> )			
0 ... 9999 { 1 }	<p><b>0</b> = The Supervisor parameters are not visible. Otherwise, all parameters are visible.</p> <p><b>1</b> = All parameters are visible.</p> <p><b>2</b> = ... 9999, (except 65) only parameters P001 and P003 are visible.</p>			

### 6.1.2 Basic parameter (frequency inverter)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set																				
<b>P100</b>	<b>Parameter set</b> ( <i>Parameter set</i> )		S																					
0 ... 3 { 0 }	<p>Selection of the parameters sets to be parameterised. 4 parameter sets are available. All parameter set-dependent parameters are identified by <b>P</b>.</p> <p>The selection of the operating parameter set is performed via a digital input or the Bus control. Switching can take place during operation (online).</p> <table border="1"> <thead> <tr> <th>Setting</th> <th>Digital input function [8]</th> <th>Digital input function [17]</th> <th>LEDs SimpleBox</th> </tr> </thead> <tbody> <tr> <td><b>0</b> = Parameter set 1</td> <td>Low</td> <td>Low</td> <td> 1  2</td> </tr> <tr> <td><b>1</b> = Parameter set 2</td> <td>High</td> <td>Low</td> <td> 1  2</td> </tr> <tr> <td><b>2</b> = Parameter set 3</td> <td>Low</td> <td>High</td> <td> 1  2</td> </tr> <tr> <td><b>3</b> = Parameter set 4</td> <td>High</td> <td>High</td> <td> 1  2</td> </tr> </tbody> </table>				Setting	Digital input function [8]	Digital input function [17]	LEDs SimpleBox	<b>0</b> = Parameter set 1	Low	Low	 1  2	<b>1</b> = Parameter set 2	High	Low	 1  2	<b>2</b> = Parameter set 3	Low	High	 1  2	<b>3</b> = Parameter set 4	High	High	 1  2
Setting	Digital input function [8]	Digital input function [17]	LEDs SimpleBox																					
<b>0</b> = Parameter set 1	Low	Low	 1  2																					
<b>1</b> = Parameter set 2	High	Low	 1  2																					
<b>2</b> = Parameter set 3	Low	High	 1  2																					
<b>3</b> = Parameter set 4	High	High	 1  2																					

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P101</b>	<b>Copy</b> (Copy parameter set)		S	
0 ... 4 { 0 }	<p>After confirmation with the OK key, a copy of the parameter set selected in P100 &gt;Parameter set&lt; is written to the parameter set dependent on the value selected here</p> <p><b>0 = Do not copy</b>  <b>1 = Copy actual to P1:</b> copies the active parameter set to parameter set 1  <b>2 = Copy actual to P2:</b> copies the active parameter set to parameter set 2  <b>3 = Copy actual to P3:</b> copies the active parameter set to parameter set 3  <b>4 = Copy actual to P4:</b> copies the active parameter set to parameter set 4</p>			
<b>P102</b>	<b>Acceleration time</b> (Acceleration time)			P
0.05 ... 320.00 sec { 2.00 }	<p>Start-up time (acceleration ramp) is the time corresponding to the linear frequency rise from 0Hz to the set maximum frequency (P105). If an actual setpoint of &lt;100% is being used, the acceleration time is reduced linearly according to the setpoint which is set.</p> <p>The acceleration time can be extended by certain circumstances, e.g. FI overload, setpoint lag, smoothing, or if the current limit is reached.</p> <p><b>Notes on ramp gradient:</b>  Amongst other things, the ramp gradient is governed by the inertia of the rotor.  A ramp with a gradient which is too steep may result in the "inversion" of the motor.  In general, extremely steep ramps (e.g.: 0 - 50Hz in &lt; 0.1 s) should be avoided, as may cause damage to the frequency inverter.</p>			
<b>P103</b>	<b>Deceleration time</b> (Deceleration time)			P
0.05 ... 320.00 sec { 2.00 }	<p>Deceleration time (braking ramp) is the time corresponding to the linear frequency reduction from the set maximum frequency (P105) to 0Hz. If an actual setpoint &lt;100% is being used, the deceleration time reduces accordingly.</p> <p>The braking time can be extended by certain circumstances, e.g. by the selected &gt;Switch-off mode&lt; (P108) or &gt;Ramp smoothing&lt; (P106).</p> <p><b>Notes on ramp gradient:</b> see parameter (P102)</p>			
<b>P104</b>	<b>Minimum frequency</b> (Minimum frequency)			P
0.0 ... 400.0 Hz { 0.0 }	<p>The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set.</p> <p>In combination with other setpoints (e.g. analog setpoint of fixed frequencies) these are added to the set minimum frequency.</p> <p>This frequency is undershot when</p> <ol style="list-style-type: none"> <li>the drive is accelerated from standstill.</li> <li>The FI is blocked. The frequency then reduces to the absolute minimum (P505) before it is blocked.</li> <li>The FI is reversing. The reverse in the rotation field takes place at the absolute minimum frequency (P505).</li> </ol> <p>This frequency can be continuously undershot if, during acceleration or braking, the function "Maintain frequency" (Function Digital input = 9) is executed.</p>			
<b>P105</b>	<b>Maximum frequency</b> (Maximum frequency)			P
0.1 ... 400.0 Hz { 50.0 }	<p>The frequency supplied by the FI after being enabled and once the maximum setpoint is present, e.g. analog setpoint corresponding to P403, a correspondingly fixed frequency or maximum via the SimpleBox / ParameterBox.</p> <p>This frequency can only be overshoot by the slip compensation (P212), the function "Maintain frequency" (function digital input = 9) or a change to another parameter set with lower maximum frequency.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P106</b>	<b>Ramp smoothing</b> (Ramp smoothing)		S	P

0 ... 100 %  
{ 0 }

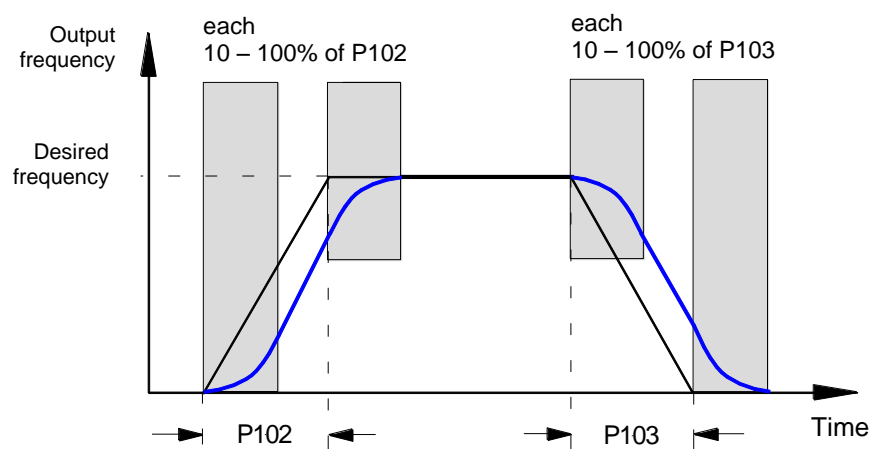
This parameter enables a smoothing of the acceleration and deceleration ramps. This is necessary for applications where gentle, but dynamic speed change is important.

Ramp smoothing is carried out for every setpoint change. The value to be set is based on the set acceleration and deceleration time, however values <10% have no effect.

The following then applies for the entire acceleration or deceleration time, including rounding:

$$t_{\text{tot ACCELERATIONTIME}} = t_{P102} + t_{P102} \cdot \frac{P106[\%]}{100\%}$$

$$t_{\text{tot DECELERATIONTIME}} = t_{P103} + t_{P103} \cdot \frac{P106[\%]}{100\%}$$



Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P107</b>	<b>Brake reaction time</b> ( <i>Brake reaction time</i> )			P
0 ... 2.50 s { 0.00 }	<p>Electromagnetic brakes have a physically-dependent delayed reaction time when actuated. This can cause a dropping of the load for lifting applications, as the brake only takes over the load after a delay.</p> <p>This reaction time can be taken into account under parameter (P107).</p> <p>Within the adjustable application time, the FI supplies the set absolute minimum frequency (P505) and so prevents movement against the brake and load drop when stopping.</p> <p>See also the parameter &gt;Release time&lt; (P114)</p> <p><b>NOTE:</b> The optional module SK CU4-MBR must be used for the control of electromagnetic brakes (especially for lifting gear). The minimum absolute frequency (P505) should never be less than 2.0Hz.</p> <p><b>NOTE:</b> If a time &gt; 0 is set in (P107) or (P114), at the moment the FI is switched on, the level of the excitation current (field current) is checked. If no magnetising current is present, the FI remains in magnetising mode and the motor brake is not released.</p> <p><b>NOTE:</b> If brake control is used, care must be taken that parameter (P107) is not set to 0</p>			

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

P114 = 0.2...0.3 sec. \*

P107 = 0.2...0.3 sec. \*

P201...P208 = Motor data

P505 = 2...4 Hz

for safe start-up

P112 = 401 (off)

P536 = 2.1 (off)

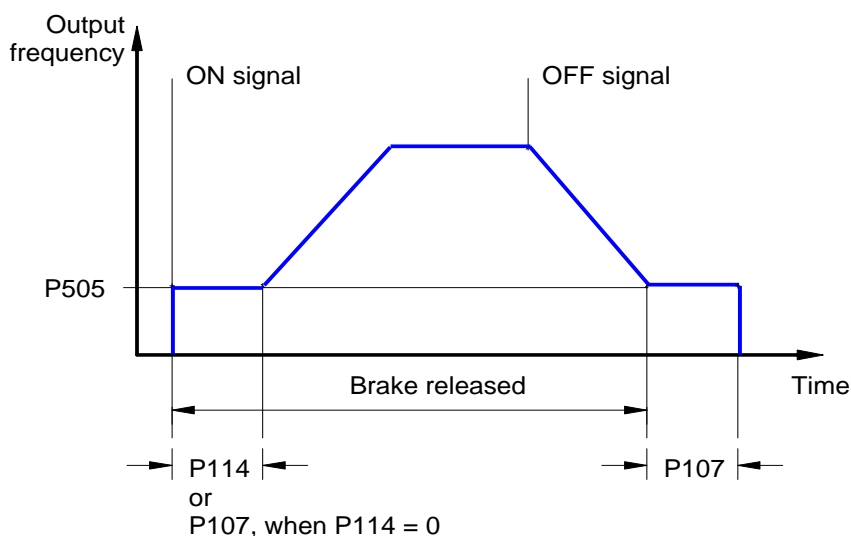
P537 = 150%

P539 = 2/3 (I<sub>SD</sub> monitoring)

to prevent load drops

P214 = 50...100% (precontrol)

\* Setting values (P107/P114) depend on the brake type and motor size. For smaller powers smaller values than those stated may be required.



Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P108</b>	<b>Disconnection mode</b> ( <i>Disconnection mode</i> )		S	P

0 ... 13  
{ 1 }

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

- 0 = Voltage block:** The output signal is switched off immediately. The FI no longer supplies an output frequency. In this case, the motor is braked only by mechanical friction. Immediately switching the FI on again can lead to an error message.
- 1 = Ramp:** The current output frequency is reduced in proportion to the remaining deceleration time, from P103/P105.
- 2 = Ramp with delay:** as with ramp, however for generational operation the brake ramp is extended, or for static operation the output frequency is increased. Under certain conditions, this function can prevent overload switch off or reduce brake resistance power dissipation.  
**NOTE:** This function must not be programmed if defined deceleration is required, e.g. with lifting mechanisms.
- 3 = Immediate DC braking:** The FI switches immediately to the preselected DC current (P109). This DC current is supplied for the remaining proportion of the >DC brake time< (P110). Depending on the relationship, actual output frequency to max. frequency (P105), the >DC braking time< is shortened. The time taken for the motor to stop depends on the application. This deceleration time depends of the moment of inertial of the load and the DC current which is set (P109).  
With this type of braking, no energy is fed back to the FI. Heat losses occur, mainly in the rotor of the motor.
- 4 = Const. brake distance, „Constant brake distance“:** The brake ramp is delayed in starting if the equipment is not being driven at the maximum output frequency (P105). This results in an approximately similar braking distance for different frequencies.  
**NOTE:** This function cannot be used as a positioning function. This function should not be combined with ramp smoothing (P106).
- 5 = Combined braking, „Combined braking“:** Dependent on the actual link voltage, a high frequency voltage is switched to the basic frequency (linear characteristic curves only, P211 = 0 and P212 = 0). The deceleration time is retained where possible (P103). → additional motor warming!
- 6 = Quadratic ramp:** The brake ramp does not follow a linear path, but rather a decreasing quadratic one.
- 7 = Quad. ramp with delay, "Quadratic ramp with delay":** Combination of functions 2 and 6
- 8 = Quad. combined braking "Quadratic combined braking":** Combination of functions 5 and 6
- 9 = Const.acc.pwr., „Constant acceleration power“:** Only applies in field weakening range!  
The drive is accelerated or braked using constant electrical power.
- 10 = Distance calculator:** Constant distance between actual frequency / speed and the set minimum output frequency (P104).
- 11 = Con. acc. pwr. w. delay, "Constant acceleration power with delay":** Combination of functions 2 and 9.
- 12 = Const. Accln. Power Mode3:** as 11 with additional brake chopper relief
- 13 =** As for 1- ramp, however, before the brake is applied, the drive unit remains at the absolute minimum frequency set in parameter (P505) for the time specified in parameter (P110).

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P109</b>	<b>DC brake current</b> (DC brake current)		S	P
0 ... 250 % { 100 }	<p>Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5). The correct setting value depends on the mechanical load and the required deceleration time. A higher setting brings large loads to a standstill more quickly. The 100% setting relates to a current value as stored in the &gt;Nominal current&lt; parameter P203.</p> <p><b>NOTE:</b> The amount of DC current (0 Hz) which the FI can supply is limited. For this value, please refer to the table in Section 9.4.3, column: 0 Hz. In the basic setting this limiting value is about 110%.</p>			
<b>P110</b>	<b>DC braking time on</b> (DC braking time on)		S	P
0.00 ... 60.00 sec { 2.00 }	<p>The time during which the motor has the current selected in parameter &gt;DC brake current&lt; applied to it during the DC braking functions (P108 = 3). Depending on the relationship, actual output frequency to max. frequency (P105), the &gt;Time DC brake on&lt; is shortened. The time starts running with the removal of the enable and can be interrupted by fresh enabling.</p>			
<b>P111</b>	<b>P factor torque limit</b> (P factor torque limit)		S	P
25 ... 400 % { 100 }	<p>Directly affects the behaviour of the drive at torque limit. The basic setting of 100% is sufficient for most drive tasks. If the value is too large, the drive unit will tend to oscillate when the torque limit is reached. If the value is too small, the programmed torque limit may be undershot.</p>			
<b>P112</b>	<b>Torque current limit</b> (Torque current limit)		S	P
25 ... 400 % / 401 { 401 }	<p>With this parameter, a limit value for the torque-generating current can be set. This can prevent mechanical overloading of the drive. It cannot provide any protection against mechanical blockages (movement to stops). A slipping clutch which acts as a safety device must be provided. The torque current limit can also be set over an infinite range of settings using an analog input. The maximum setpoint (compare adjustment 100%, P403[-01] . [-06]) then corresponds to the value set in P112. The limit value 20% of current torque cannot be undershot by a smaller analog setpoint (P400[-01] ... [-09] = 11 or 12). <b>401 = OFF</b> means the switch-off of the torque current limit! This is also the basic setting for the FI.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P113</b>	<b>Jog frequency</b> ( <i>Jog frequency</i> )		S	P
-400.0 ... 400.0 Hz { 0.0 }	<p>When using the <b>SimpleBox</b> or <b>ParameterBox</b> to control the FI, the jog frequency is the initial value following successful enabling.</p> <p>Alternatively, when control is via the control terminals, the jog frequency can be activated via one of the digital inputs.</p> <p>The setting of the jog frequency can be done directly via this parameter or, if the FI is enabled via the keyboard, by pressing the OK key. In this case, the actual output frequency is set in parameter P113 and is then available for the next start.</p> <p><b>NOTE:</b> Specified setpoints via the control terminals, e.g. jog frequency, fixed frequencies or analog setpoints, are generally added with the correct sign. The set maximum frequency (P105) cannot be exceeded and the minimum frequency (P104) cannot be undershot.</p>			
<b>P114</b>	<b>Brake release time</b> ( <i>Brake release time</i> )		S	P
0 ... 2.50 s { 0.00 }	<p>Electromagnetic brakes have a delayed reaction time during ventilation, which depends on physical factors. This can lead to the motor running while the brake is still applied, which will cause the inverter to switch off with an overcurrent report.</p> <p>This release time can be taken into account in parameter P114 (Brake control).</p> <p>During the adjustable ventilation time, the FI supplies the set absolute minimum frequency (P505) thus preventing movement against the brake.</p> <p>See also the parameter &gt;Brake reaction time&lt; P107 (setting example).</p> <p><b>NOTE:</b> If the brake release time is set to "0", then P107 is the brake release and reaction time.</p>			
<b>P120</b>	<b>Options monitoring</b> ( <i>Options monitoring</i> )		S	
0 ... 2 { 1 }	<p>Monitoring of communication at system bus level (in case of fault: error message 10.9)</p> <p><b>Array levels:</b></p> <p><b>Setting value for each array:</b></p> <p><b>14 =</b> Monitoring OFF</p> <p><b>15 = Auto</b>, communication is only monitored if an existing communication is interrupted. If a module which was previously present is not found when the network is switched on, this does <u>not</u> result in an error. Monitoring only becomes active when the extension begins communication with the FI.</p> <p><b>16 = Monitoring active immediately</b> "<i>Monitoring active immediately</i>", the FI starts monitoring the corresponding module immediately after it is switched on. If the module is not detected on switch-on, the FI remains in the status "not ready for switch-on" for 5 seconds and then triggers an error message..</p> <p><b>[-01]</b> = Extension 1 (BUS TB)  <b>[-02]</b> = Extension 2 (<i>second I/O TB</i>)  <b>[-03]</b> = Extension 3 (<i>first I/O TB</i>)  <b>[-04]</b> = Extension 4 (<i>reserved</i>)</p>			
	<p><b>Note:</b> If fault messages which are detected by the optional module (e.g. faults at field bus level) are not to result in a shut-down of the frequency inverter, parameter (P513) must also be set to the value {-0,1}.</p>			

### 6.1.3 Motor data / characteristic curve parameters

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set																																																				
<b>P200</b>	<b>Motor list</b> (Motor list)			P																																																				
0 ... 51 { 0 }	<p>Adjustment of the motor data from a list for 4-pole IE1 DS standard motors.</p> <p>By selecting one of the possible digits and pressing the OK key, all motor parameters (P201...P209) are adjusted to the selected standard power. The basis for the motor data is a 4-pole IE1 DS standard motor</p> <hr/> <p><b>0 = no change</b> "No change to data"</p> <p><b>1 = No motor:</b> In this setting, the FI operates without current control, slip compensation and pre-magnetising time, and is therefore not recommended for motor applications. Possible applications are induction furnaces or other applications with coils and transformers. The following motor data is set here: 50.0 Hz / 1500 rpm / 15.0 A / 400 V / 0.00 kW / <math>\cos \varphi=0.90</math> / Star / <math>R_S</math> 0,01 <math>\Omega</math> / <math>I_{EMPTY}</math> 6.5 A</p> <table border="0"> <tr> <td><b>2</b> = 0.12 kW 230 V</td> <td><b>15</b> = 0.75 Hp 230 V</td> <td><b>28</b> = 1.5 kW 400 V</td> <td><b>41</b> = 5.0 PS 460 V</td> </tr> <tr> <td><b>3</b> = 0.16 PS 230 V</td> <td><b>16</b> = 0.55 kW 400 V</td> <td><b>29</b> = 2.0 PS 460 V</td> <td><b>42</b> = 5.5 kW 230 V</td> </tr> <tr> <td><b>4</b> = 0.18 kW 230 V</td> <td><b>17</b> = 0.75 Hp 460 V</td> <td><b>30</b> = 2.2 kW 230 V</td> <td><b>43</b> = 7.5 PS 230 V</td> </tr> <tr> <td><b>5</b> = 0.25 PS 230 V</td> <td><b>18</b> = 0.75 kW 230 V</td> <td><b>31</b> = 3.0 PS 230 V</td> <td><b>44</b> = 5.5 kW 400 V</td> </tr> <tr> <td><b>6</b> = 0.25 kW 230 V</td> <td><b>19</b> = 1.0 Hp 230 V</td> <td><b>32</b> = 2.2 kW 400 V</td> <td><b>45</b> = 7.5 PS 460 V</td> </tr> <tr> <td><b>7</b> = 0.33 Hp 230 V</td> <td><b>20</b> = 0.75 kW 400 V</td> <td><b>33</b> = 3.0 PS 460 V</td> <td><b>46</b> = 7.5 kW 230 V</td> </tr> <tr> <td><b>8</b> = 0.25 kW 400 V</td> <td><b>21</b> = 1.0 Hp 460 V</td> <td><b>34</b> = 3.0 kW 230 V</td> <td><b>47</b> = 10 PS 230 V</td> </tr> <tr> <td><b>9</b> = 0.33 Hp 460 V</td> <td><b>22</b> = 1.1 kW 230 V</td> <td><b>35</b> = 4.0 PS 230 V</td> <td><b>48</b> = 7.5 kW 400 V</td> </tr> <tr> <td><b>10</b> = 0.37 kW 230 V</td> <td><b>23</b> = 1.5 Hp 230 V</td> <td><b>36</b> = 3.0 kW 400 V</td> <td><b>49</b> = 10.0 PS 460 V</td> </tr> <tr> <td><b>11</b> = 0.50 Hp 230 V</td> <td><b>24</b> = 1.1 kW 400 V</td> <td><b>37</b> = 4.0 PS 460 V</td> <td><b>50</b> = 11.0 kW 400 V</td> </tr> <tr> <td><b>12</b> = 0.37 kW 400 V</td> <td><b>25</b> = 1.5 Hp 460 V</td> <td><b>38</b> = 4.0 kW 230 V</td> <td><b>51</b> = 15.0 PS 460 V</td> </tr> <tr> <td><b>13</b> = 0.50 Hp 460 V</td> <td><b>26</b> = 1.5 kW 230 V</td> <td><b>39</b> = 5.0 PS 230 V</td> <td></td> </tr> <tr> <td><b>14</b> = 0.55 kW 230 V</td> <td><b>27</b> = 2.0 PS 230 V</td> <td><b>40</b> = 4.0 kW 400 V</td> <td></td> </tr> </table> <p><b>NOTE:</b> As P200 returns to = 0 after the input confirmation, the control of the set motor can be implemented via parameter P205.</p>	<b>2</b> = 0.12 kW 230 V	<b>15</b> = 0.75 Hp 230 V	<b>28</b> = 1.5 kW 400 V	<b>41</b> = 5.0 PS 460 V	<b>3</b> = 0.16 PS 230 V	<b>16</b> = 0.55 kW 400 V	<b>29</b> = 2.0 PS 460 V	<b>42</b> = 5.5 kW 230 V	<b>4</b> = 0.18 kW 230 V	<b>17</b> = 0.75 Hp 460 V	<b>30</b> = 2.2 kW 230 V	<b>43</b> = 7.5 PS 230 V	<b>5</b> = 0.25 PS 230 V	<b>18</b> = 0.75 kW 230 V	<b>31</b> = 3.0 PS 230 V	<b>44</b> = 5.5 kW 400 V	<b>6</b> = 0.25 kW 230 V	<b>19</b> = 1.0 Hp 230 V	<b>32</b> = 2.2 kW 400 V	<b>45</b> = 7.5 PS 460 V	<b>7</b> = 0.33 Hp 230 V	<b>20</b> = 0.75 kW 400 V	<b>33</b> = 3.0 PS 460 V	<b>46</b> = 7.5 kW 230 V	<b>8</b> = 0.25 kW 400 V	<b>21</b> = 1.0 Hp 460 V	<b>34</b> = 3.0 kW 230 V	<b>47</b> = 10 PS 230 V	<b>9</b> = 0.33 Hp 460 V	<b>22</b> = 1.1 kW 230 V	<b>35</b> = 4.0 PS 230 V	<b>48</b> = 7.5 kW 400 V	<b>10</b> = 0.37 kW 230 V	<b>23</b> = 1.5 Hp 230 V	<b>36</b> = 3.0 kW 400 V	<b>49</b> = 10.0 PS 460 V	<b>11</b> = 0.50 Hp 230 V	<b>24</b> = 1.1 kW 400 V	<b>37</b> = 4.0 PS 460 V	<b>50</b> = 11.0 kW 400 V	<b>12</b> = 0.37 kW 400 V	<b>25</b> = 1.5 Hp 460 V	<b>38</b> = 4.0 kW 230 V	<b>51</b> = 15.0 PS 460 V	<b>13</b> = 0.50 Hp 460 V	<b>26</b> = 1.5 kW 230 V	<b>39</b> = 5.0 PS 230 V		<b>14</b> = 0.55 kW 230 V	<b>27</b> = 2.0 PS 230 V	<b>40</b> = 4.0 kW 400 V				
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<b>P201</b>	<b>Nominal motor frequency</b> (Nominal motor frequency)		S	P																																																				
10.0 ... 399.9 Hz {***}	The motor nominal frequency determines the V/f break point at which the FI supplies the nominal voltage (P204) at the output.																																																							
<b>P202</b>	<b>Nominal motor speed</b> (Nominal motor speed)		S	P																																																				
150 ... 24000 rpm {***}	The nominal motor speed is important for the correct calculation and control of the motor slip and the speed display (P001 = 1).																																																							
<b>P203</b>	<b>Nominal motor current</b> (Nominal motor current)		S	P																																																				
0.1 ... 300.0 A {***}	The nominal motor current is a decisive parameter for the current vector control.																																																							

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P204</b>	<b>Nominal motor voltage</b> (Nominal motor voltage)		S	P
100 ... 800 V {*}	The >Nominal voltage< matches the mains voltage to the motor voltage. In combination with the nominal frequency, the voltage/frequency characteristic curve is produced.			
<b>P205</b>	<b>Nominal motor power</b> (Nominal motor power output)			P
0.00 ... 150.00 kW {***}	The motor nominal power controls the motor set via P200.			
<b>P206</b>	<b>Motor cos phi</b> (Motor cos $\varphi$ )		S	P
0.50 ... 0.90 {**}	The motor cos $\varphi$ is a decisive parameter for the current vector control.			
<b>P207</b>	<b>Motor circuit</b> (Motor circuit)		S	P
0 ... 1 {***}	<b>0</b> = Star <b>1</b> = Delta The motor circuit is decisive for stator resistance measurement (P220) and therefore for current vector control.			
<b>P208</b>	<b>Stator resistance</b> (Stator resistance)		S	P
0.00 ... 300.00 $\square$ {***}	Motor stator resistance $\Rightarrow$ resistance of a <u>phase winding</u> with a DC motor. Has a direct influence on the current control of the FI. Too high a value will result in a possible overcurrent, on the other hand a value which is too low will result in a motor torque which is too low. The parameter P220 can be used for simple measurement. Parameter P208 can be used for manual setting or as information about the result of an automatic measurement. <b>NOTE:</b> For optimum functioning of the current vector control, the stator resistance must be automatically measured by the FI.			
<b>P209</b>	<b>No load current</b> (No load current)		S	P
0.1 ... 300.0 A {**}	This value is always calculated automatically from the motor data if there is a change in the parameter >cos $\varphi$ < P206 and the parameter >Nominal current< P203. <b>NOTE:</b> If the value is to be entered directly, then it must be set as the last motor data. This is the only way to ensure that the value will not be overwritten.			
<b>P210</b>	<b>Static boost</b> (Static boost)		S	P
0 ... 400 % { 100 }	The static boost affects the current that generates the magnetic field. This is equivalent to the no load current of the respective motor and is therefore <u>load-independent</u> . The no load current is calculated using the motor data. The factory setting of 100% is sufficient for normal applications.			
<b>P211</b>	<b>Dynamic boost</b> (Dynamic boost)		S	P
0 ... 150 % { 100 }	The dynamic boost affects the torque generating current and is therefore a load-dependent parameter. The factory 100% setting is also sufficient for typical applications. Too high a value can lead to overcurrent in the FI. Under load therefore, the output voltage will be raised too sharply. Too low a value will lead to insufficient torque.			

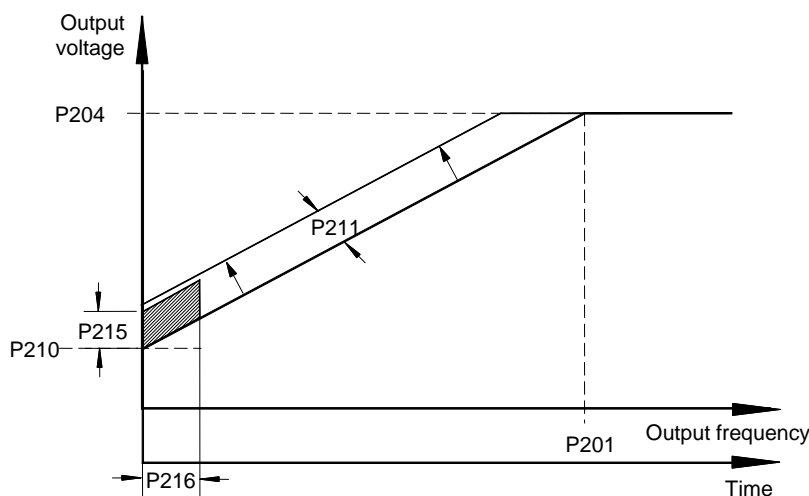
\*\*\* These settings are dependent on the nominal power of the FI or the selection in parameter P200.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P212</b>	<b>Slip compensation</b> ( <i>Slip compensation</i> )		S	P
0 ... 150 % { 100 }	<p>The slip compensation increases the output frequency, dependent on load, to keep the asynchronous motor speed approximately constant.</p> <p>The factory setting of 100% is optimal when using DC asynchronous motors and correct motor data has been set.</p> <p>If several motors (different loads or outputs) are operated with one FI, the slip compensation P212 must be set to 0%. This rules out a negative influence. This is equally valid for synchronous motors that do not have slip due to their design.</p>			
<b>P213</b>	<b>Amplification ISD control</b> ( <i>amplification of ISD control</i> )		S	P
25 ... 400 % { 100 }	<p>This parameter influences the control dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower.</p> <p>Dependent on application type, this parameter can be altered, e.g. to avoid unstable operation</p>			
<b>P214</b>	<b>Torque precontrol</b> ( <i>Torque precontrol</i> )		S	P
-200 ... 200 % { 0 }	<p>This function allows a value for the expected torque requirement to be set in the controller. This function can be used in lifting applications for a better load transfer during start-up.</p> <p><b>NOTE:</b> Motor torques (with rotation field right) are entered with a positive sign, generator torques are entered with a negative sign. The reverse applies for the counter clockwise rotation.</p>			
<b>P215</b>	<b>Boost precontrol</b> ( <i>Boost precontrol</i> )		S	P
0 ... 200 % { 0 }	<p>Only advisable with linear characteristic curve (P211 = 0% and P212 = 0%).</p> <p>For drives that require a high starting torque, this parameter provides an option for switching in an additional current during the start phase. The application time is limited and can be selected at parameter &gt;Time boost precontrol&lt; P216.</p> <p>All current and torque current limits that may have been set (P112 and P536, P537) are deactivated during the boost lead time.</p> <p><b>Note:</b> With active ISD control (P211 and / or P212 ≠ 0) parameterisation of P216 ≠ 0 results in incorrect control.</p>			
<b>P216</b>	<b>Time boost precontrol</b> ( <i>Time boost precontrol</i> )		S	P
0.0 ... 10.0 sec { 0.0 }	<p>This parameter is used for 3 functionalities</p> <p><b>Time limit</b> for the <b>boost lead</b>: Effective time for the increased starting current. Only with linear characteristic curve (P211 = 0% and P212 = 0%).</p> <p><b>Time limit</b> for <b>suppression of pulse switch-off</b> (P537): enables start-up under heavy load.</p> <p><b>Time limit</b> for <b>suppression of switch-off on error</b> in parameter (P401), setting { 05 } „0 – 10 V with switch-off on error 2“</p>			

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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## P2xx Control/characteristic curve parameters



**NOTE:** "typical"

Settings for the...

**Current vector control** (factory setting)

P201 to P209 = Motor data

P210 = 100%

P211 = 100%

P212 = 100%

P213 = 100%

P214 = 0%

P215 = no significance

P216 = no significance

**Linear V/f characteristic curve**

P201 to P209 = Motor data

P210 = 100% (static boost)

P211 = 0%

P212 = 0%

P213 = no significance

P214 = no significance

P215 = 0% (dynamic boost)

P216 = 0s (time dyn. boost)

P220	Para. identification (Parameter identification)			P
0... 2 { 0 }	The motor data is automatically determined by the FI with this parameter. In most cases this leads to considerably better drive characteristics, as DC asynchronous motors are subject to manufacturing tolerances which are not documented on the rating plate.			
Duration up to 240 s	If unfavorable operating characteristics result, select a suitable motor in P200 or set the parameters P201 ... P208 manually.			
	<p><b>0 = No identification</b></p> <p><b>1 = Identification RS:</b> only the stator resistance (display in P208) is determined.</p> <p><b>2 = Motor identification:</b> all motor parameters (P202, P203, P206, P208, P209) are determined.</p>			
Procedure:	<ol style="list-style-type: none"> <li>The identification should be made with the motor cold. Warming up of the motor during operation is automatically taken into account.</li> <li>The FI must be in an "operative condition". For Bus operation, the Bus must be operating without error. The FI must not be in a state of switch-on block.</li> <li>The motor power may only be one power level greater or 3 power levels lower than the nominal power of the FI.</li> <li>The motor data should be set according to the rating plate or P200. However, at least the nominal frequency (P201), the nominal speed (P202), the voltage (P204), the power (P205) and the motor circuit (P207) should be known.</li> <li>If the identification cannot be concluded successfully, the error message E019 is generated. See also Section 6, Error messages.</li> <li>Reliable identification can be made with motor cables up 20m in length.</li> </ol>			
	<p><b>NOTE:</b> After identification of parameters, P220 is again = 0.</p> <p>Care must be taken that the connection to the motor is not interrupted during the entire measuring process.</p>			

## 6.1.4 Control terminals

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P400</b>	<b>Funct. setpoint inputs</b> (Function of setpoint inputs)			P

0 ... 36

{ [-01] = 1 }

{ [-02] = 0 }

{ [-03] = 0 }

{ [-04] = 0 }

{ [-05] = 0 }

{ [-06] = 0 }

{ [-07] = 0 }

[-01] = **Analog input 1**, Function of analog input 1 integrated into the FI[-02] = **Analog input 2**, Function of analog input 2 integrated into the FI[-03] = **Ext. Analog input 1**, AIN1 of the first I/O extension (SK xU4-IOE)[-04] = **Ext. Analog input 2**, AIN2 of the first I/O extension (SK xU4-IOE)[-05] = **Ext. A.in 1 2nd IOE**, AIN1 of the second I/O extension (SK xU4-IOE)[-06] = **Ext. A.in 2 2nd IOE**, AIN2 of the second I/O extension (SK xU4-IOE)[-07] = **Setpoint module**, in preparation ... *setting values below.*

For standardisation of actual values: See also (Section 9.9 ).

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

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

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

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

**4 = Minimum frequency**, setting of the minimum frequency of the inverter (= 0 – 100% from P104)

**5 = Maximum frequency**, setting of the maximum frequency of the inverter (= 0 – 100% from P105)

**6 = Actual value process controller \***, activates the process controller, analog input is connected to the actual value encoder (compensator, air can, flow volume meter, etc.). The mode is set via the DIP switches of the I/O extension or in (P401).

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

**8 = Actual PI frequency \***, is required to set up a control loop. The analog input (actual value) is compared with the setpoint (e.g. fixed frequency). The output frequency is adjusted as far as possible until the actual value equals the setpoint. (see control variables P413...P414)

**9 = Actual freq. PI limited \***, "Actual frequency PI limited", as for function 8 "Actual frequency PI", however the output frequency cannot fall below the programmed minimum frequency value in Parameter P104. (no change to rotation direction)

**10 = Actual freq. PID monitored \***, "Actual frequency PID monitored", as for function 8 "Actual frequency PI", however the FI switches the output frequency off when the minimum frequency P104 is reached

**11 = Torque current limit**, "Torque current limited" depends on parameter (P112). This value corresponds to 100% of the setpoint value. When the set limit value is reached, there is a reduction of the output frequency at the torque current limit.

**12 = Torque current limit switch-off**, "Torque current limit switch-off" depends on parameter (P112). This value corresponds to 100% of the setpoint value. When the set limit value is reached, the device switches off with error code E12.3.

**13 = Current limit**, "Current limited" depends on parameter (P536). This value corresponds to 100% of the setpoint value. When the set limit value is reached, the output voltage is reduced in order to limit the output current.

**14 = Current switch-off**, "Current limit switch-off", depends on parameter (P536), this value corresponds to 100% of the setpoint value. When the set limit value is reached, the device switches off with error code E12.4.

**15 = Ramp time**, "Ramp time" is normally only used in combination with a potentiometer. Standardisation: T\_Ramp time= 10s \* U[V] / 10V (U=Potentiometer voltage).

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
	<p><b>16 = Torque precontrol</b>, a function that enables a value for the anticipated torque requirement to be entered in the controller (interference factor switching). This function can be used to improve the load take-up of lifting equipment with separate load detection.</p> <p><b>17 = Multiplication</b>, the setpoint is multiplied with the analog value supplied. The analog value adjusted to 100% then corresponds to a multiplication factor of 1.</p> <p><b>18 = Curve travel calculator</b>, via the external analog input (P400 [-03] or P400 [-04]) or via the BUS (P546 [-01 .. -03]) the master receives the actual speed from the slave. From its own speed, the slave speed and the guide speed, the master calculates the actual setpoint speed, so that neither of the two drives travels faster than the guide speed in the curve.</p> <p><b>19 = Reserved</b></p> <p><b>25 = Transfer Factor Gearing</b>, "<i>Gearing Transfer Factor</i>", is a multiplier to compensate for the variable transfer of a setpoint value. E.g.: Setting of the transformation between the master and the slave by means of a potentiometer. Reserved</p> <p><b>30 = Motor temperature</b>: enables measurement of the motor temperature with a KTY-84 - temperature sensor (Details in Section 5.3)</p> <p><b>33 = Setpoint torque proc. cntrl.</b>, "<i>Setpoint torque process controller</i>", For even distribution of the torques to coupled drive units (e.g.: synchronised roller drive). This function is also possible with the use of ISD control.</p> <p><b>34 = d-correction. F process</b> - (Diameter correction, PI process controller frequency).</p> <p><b>35 = d-correction. Torque</b> - (Diameter correction, torque).</p> <p><b>36 = d-correction. F+Torque-</b> (Diameter correction, PI process controller frequency and torque).</p>			

\*) For further details of the PI and process controller, please refer to Section 9.2.

\*\*) The limits of these values are formed by the parameters >minimum frequency auxiliary setpoint values< (P410) and the parameter >maximum frequency auxiliary setpoint values< (P411), whereby the limits defined by (P104) and (P105) cannot be undershot or overshoot.

P401	[-01] ... [-06]	Analog On mode (Mode analog input)			
0 ... 5 { all 0 }		<p><b>[-01] = Analog input 1</b>, Function of analog input 1 integrated into the FI</p> <p><b>[-02] = Analog input 2</b>, Function of analog input 2 integrated into the FI</p> <p><b>[-03] = Ext. Analog input 1</b>, AIN1 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-04] = Ext. Analog input 2</b>, AIN2 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-05] = Ext. A.in 1 2nd IOE</b>, AIN1 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p><b>[-06] = Ext. A.in 2 2nd IOE</b>, AIN2 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p><b>0 = 0 – 10 V limited</b>: An analog setpoint smaller than the programmed adjustment 0% (P402) does not lead to undershooting of the programmed minimum frequency (P104).</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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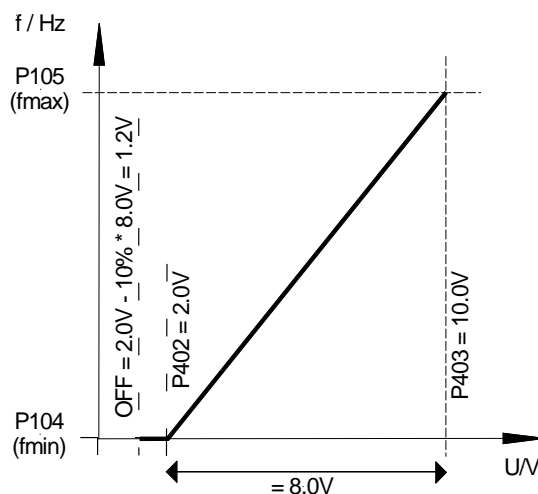
**1 = 0 – 10 V:** If a setpoint smaller than the programmed adjustment 0% (P402) is present, this may cause a change in the direction of rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

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

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

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

**2 = 0 – 10V monitored:** If the minimum adjusted setpoint (P402) is undershot by 10% of the difference value from (P403) and (P402), the FI output switches off. As soon as the setpoint is greater than  $[P402 - (10\% * (P403 - P402))]$  it delivers an output signal again.



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

**NOTE:**

The SK xU4-IOE provides the frequency inverter with a value standardised to 0...100%. In addition, the frequency inverter also receives a bit, which confirms that the analog input signal is within the defined limits.

Example: Setpoint: 4 ... 20 mA

0...4 mA = 0% (0000<sub>hex</sub>)  
 20 mA = 100% (4000<sub>hex</sub>)  
 ≥ 2 mA = Bit "Setpoint value valid"

If the "0-10 V monitored" mode is selected, the bit "Setpoint value valid" is evaluated and if the setpoint value is undershot by a value of 2mA, the inverter output is switched off.

**NOTE:**

Settings of parameters (P402) and (P403) are treated in an additive manner, i.e. they can be used for additional adjustment of the limiting values.

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

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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At the moment of reversal (hysteresis =  $\pm$  P505), the drive stands still when the minimum frequency (P104) is smaller than the absolute minimum frequency (P505). A brake which is controlled by the FI has not been applied in the hysteresis range.

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

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

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

The monitoring function only becomes active if there is an enable signal and the analog value has reached the valid range ( $\geq$ (P402) or  $\leq$ (P403)) for the first time (E.g. Build-up of pressure after switching on a pump).

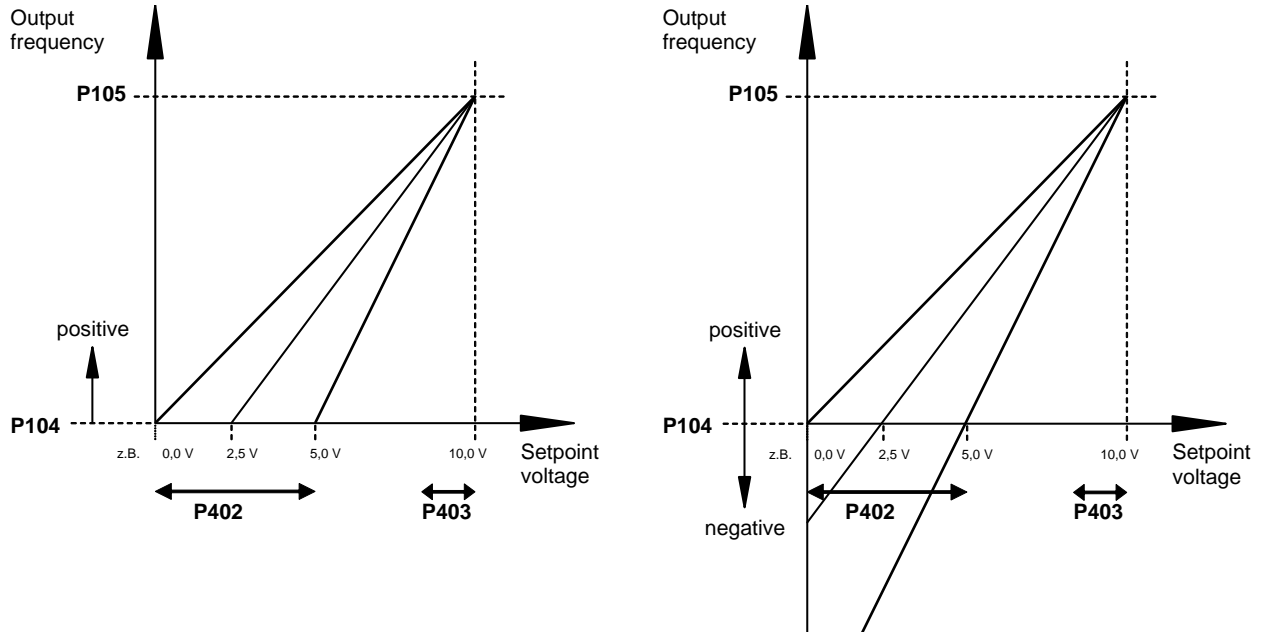
- 
- 5 = 0 – 10V with error 2, "0 – 10 V with switch-off on error 2":**  
See setting 4 ("0 – 10 V with error switch off 1"), however:

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

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Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P402</b>	<b>[-01]</b> <b>Adjustment: 0%</b> ... <b>[-06]</b> (Analog input adjustment: 0%)		S	
-50.00 ... 50.00 V { all 0.00 }	<p><b>[-01] = Analog input 1</b>, Function of analog input 1 integrated into the FI</p> <p><b>[-02] = Analog input 2</b>, Function of analog input 2 integrated into the FI</p> <p><b>[-03] = Ext. Analog input 1</b>, AIN1 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-04] = Ext. Analog input 2</b>, AIN2 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-05] = Ext. A.in 1 2nd IOE</b>, AIN1 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p><b>[-06] = Ext. A.in 2 2nd IOE</b>, AIN2 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p>This parameter sets the voltage which should correspond with the minimum value of the selected function for the analog input 1 or 2. In the factory setting (setpoint) this value is equivalent to the setpoint set via P104 &gt;Minimum frequency&lt;.</p> <p><b>Note</b> <u>SK 1x0E</u> For the adjustment of the integrated analog inputs of the <u>SK1x0E</u> to the type of analog signals, the following values must be set:</p> <p>0 – 10 V → 0.00 V 2 – 10 V → 2.00 V 0 – 20 mA → 0.00 V (switch in internal resistance via DIP switch S1 (Section.: 5.2.2.2)) 4 – 20 mA → 1.00 V (switch in internal resistance via DIP switch S1 (Section.: 5.2.2.2))</p> <p><u>SK xU4-IOE</u> Standardisation to typical signals, such as 0(2)-10V or 0(4)-20mA is carried out via the DIP switch on the I/O-extension module. In this case, additional adjustment of parameters (P402) and (P403) must <u>not</u> be carried out.</p>			
<b>P403</b>	<b>[- 01]</b> <b>Adjustment: 100%</b> ... <b>[- 06]</b> (Analog input adjustment: 100%)		S	
-50.00 ... 50.00 V { all 0.00 }	<p><b>[-01] = Analog input 1</b>, Function of analog input 1 integrated into the FI</p> <p><b>[-02] = Analog input 2</b>, Function of analog input 2 integrated into the FI</p> <p><b>[-03] = Ext. Analog input 1</b>, AIN1 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-04] = Ext. Analog input 2</b>, AIN2 of the <u>first</u> I/O extension (SK xU4-IOE)</p> <p><b>[-05] = Ext. A.in 1 2nd IOE</b>, AIN1 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p><b>[-06] = Ext. A.in 2 2nd IOE</b>, AIN2 of the <u>second</u> I/O extension (SK xU4-IOE)</p> <p>This parameter sets the voltage which should correspond with the maximum value of the selected function for the analog input 1 or 2. In the factory setting (setpoint) this value is corresponds with the setpoint set via P105 &gt;Maximum frequency&lt;.</p> <p><b>Note</b> <u>SK 1x0E</u> For the adjustment of the integrated analog inputs of the <u>SK1x0E</u> to the type of analog signals, the following values must be set:</p> <p>0 – 10 V → 10.00 V 2 – 10 V → 10.00 V 0 – 20 mA → 5.00 V (switch in internal resistance via DIP switch S1 (Section.: 5.2.2.2)) 4 – 20 mA → 5.00 V (switch in internal resistance via DIP switch S1 (Section.: 5.2.2.2))</p> <p><u>SK xU4-IOE</u> Standardisation to typical signals, such as 0(2)-10V or 0(4)-20mA is carried out via the DIP switch on the I/O-extension module. In this case, additional adjustment of parameters (P402) and (P403) must <u>not</u> be carried out.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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**P400 ... P403**

<b>P404</b>	[ -01 ] [ -02 ]	<b>Analog input filter</b> ( <i>analog input filter</i> )		S	
10 ... 400 ms { all 100 }		Adjustable digital low-pass filter for the analog signal. Interference peaks are hidden, the reaction time is extended. [ -01 ] = <b>Analog input 1</b> [ -02 ] = <b>Analog input 2</b>			
<b>P410</b>		<b>Min.freq. aux. setpt.</b> ( <i>Minimum frequency of auxiliary setpoints</i> )			P
-400.0 ... 400.0 Hz { 0.0 }		The minimum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: Frequency addition Auxiliary setpoints via BUS PI controller			
			Frequency subtraction PI process controller Multiplication		
<b>P411</b>		<b>Max.freq. aux. setpt.</b> ( <i>Maximum frequency of auxiliary setpoints</i> )			P
-400.0 ... 400.0 Hz { 50.0 }		The minimum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: Frequency addition Auxiliary setpoints via BUS PI controller			
			Frequency subtraction PI process controller Multiplication		

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P412</b>	<b>Setpoint process controller</b> (Setpoint value for process controller)		S	P
-10.0 ... 10.0 V { 5.0 }	Fixed specification of a setpoint for the process controller that will only occasionally be altered. Only with P400 = 6 or 7 (PID process controller). Further details can be found in Section 9.2 .			
<b>P413</b>	<b>P-component PI-controller</b> (P-component of PI-controller)		S	P
0.0 ... 400.0 % { 10.0 }	This parameter is only effective when the function PI controller actual frequency is selected. The P-component of the PI controller determines the frequency jump if there is a control deviation based on the control difference. E.g.: At a setting of P413 = 10% and a rule difference of 50%, 5% is added to the actual setpoint.			
<b>P414</b>	<b>I-component PI-controller</b> (I-component of PI-controller)		S	P
0.0 ... 3,000.0 %/s { 10.0 }	This parameter is only effective when the function PI controller actual frequency is selected. The I-component of the PI controller determines the frequency change, dependent on time. <b>Note:</b> In contrast to other NORD series, parameter P414 is smaller by a factor of 100 (Reason: better setting ability with small I-components).			
<b>P415</b>	<b>Process controller limit</b> (Control limit of process controller)		S	P
0 ... 400.0 % { 10.0 }	This parameter is only effective when the function <b>PI process controller</b> is selected. This determines the control limit (%) after the PI controller. For further details, see Section 9.2.			
<b>P416</b>	<b>Ramp time PI setpoint.</b> (Ramp time PI setpoint value)		S	P
0.00 ... 99.99 sec { 2.00 }	This parameter is only effective when the function PI process controller is selected. Ramp for PI setpoint			
<b>P417</b>	<b>Offset analog output</b> (Offset analog output)		S	P
-10.0 ... 10.0 V { all 0.0 }	<b>[-01] = First IOE, AOUT of the <u>first</u> I/O extension (SK xU4-IOE)</b> <b>[-02] = Second IOE, AOUT of the <u>second</u> I/O extension (SK xU4-IOE)</b>			
... only with SK CU4-IOE or SK TU4-IOE	In the analog output function an offset can be entered to simplify the processing of the analog signal in other equipment. If the analog output has been programmed with a digital function, then the difference between the switch-on point and the switch-off point can be set in this parameter (hysteresis).			
<b>P418</b>	<b>Analog output function</b> (Analog output function)		S	P
0 ... 33 { all 0 }	<b>[-01] = First IOE, AOUT of the <u>first</u> I/O extension (SK xU4-IOE)</b> <b>[-02] = Second IOE, AOUT of the <u>second</u> I/O extension (SK xU4-IOE)</b>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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... only with  
SK CU4-IOE or  
SK TU4-IOE

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

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

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

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

$$\Rightarrow 10\text{Volt} = \frac{\text{Motor nominalvalue} \cdot \text{P419}}{100\%}$$

For standardisation of actual values: See also (Section 9.9 ).

- 0 = No function**, no output signal at the terminals.
- 1 = Actual frequency \***, the analog voltage is proportional to the FI output frequency. (100%=(P201))
- 2 = Actual speed \***, this is the synchronous speed calculated by the FI based on the existing setpoint. Load-dependent speed fluctuations are not taken into account.
- 3 = Current \***, the effective value of the output current supplied by the FI. (100%=(P203))
- 4 = Torque current \***, displays the motor load torque calculated by the FI. (100% = (P112))
- 5 = Voltage \***, the output voltage supplied by the FI. (100%=(P204))
- 6 = Link voltage, "Link circuit voltage"**, is the DC voltage in the FI. This is not based on the motor rated data. 10V Volt, standardised at 100%, is equivalent to 450V DC (230V mains) or 850 Volt DC (480V mains)!
- 7 = Value from P542**, the analog output can be set using parameter P542 independently of the actual operating status of the FI. For example, with Bus switching (parameter command) this function can supply an analog value from the FI, which is triggered by the control unit.
- 8 = Apparent power \***, the actual apparent power of the motor as calculated by the FI. (100%=(P203)\*(P204) or = (P203)\*(P204)\*√3)
- 9 = Effective power \***, the actual effective power calculated by the FI. (100%=(P203)\*(P204)\*(P206) bzw = (P203)\*(P204)\*(P206)\*√3)
- 10 = Torque [%]**: the actual torque calculated by the FI (100%=Nominal motor torque).
- 11 = Field [%] \***, the actual field in the motor calculated by the FI.
- 12 = Actual frequency ±\***, the analog voltage is proportional to the output frequency of the FI, whereby the zero point is shifted to 5V. For rotation to the right, values between 5V and 10V are output, and for rotation to the left values between 5V and 0V.
- 13 = Actual speed ± \***, is the synchronic rotation speed calculated by the FI, based on the current setpoint, where the null point has been shifted to 5V. For rotation to the right, values from 5V to 10V are output and for rotation to the left, values from 5V to 0V. The measured speed is output via this function if servo mode is used.
- 14 = Torque [%] ± \***, is the actual torque calculated by the FI, whereby the zero point is shifted to 5 V. For drive torques, values between 5V and 10V are output, and for generator torque, values between 5V and 0V.
- 29 = Reserved**
- 30 = Set freq befor ramp**, "Setpoint frequency before frequency ramp", displays the frequency produced by any upstream controllers (ISD, PID, etc.). This is then the setpoint frequency for the power stage after it has been adjusted by the start-up or braking ramp (P102, P103).
- 31 = Output via BUS PZD**, the analog output is controlled via a bus system. The process data is directly transferred (P546, P547, P548).
- 33 = Setpoint freq. Motor pot**, "Setpoint frequency of motor potentiometer"

\*) Values based on the motor data (P201...), or which are calculated from this.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P419</b>	<b>[ -01 ] Analog output scaling</b> <b>[ -02 ]</b> (Standardisation of analog output)		S	P
-500 ... 500 % { all 100 }	<b>[ -01 ] = First IOE, AOUT of the <u>first</u> I/O extension (SK xU4-IOE)</b> <b>[ -02 ] = Second IOE, AOUT of the <u>second</u> I/O extension (SK xU4-IOE)</b>			
... only with SK CU4-IOE or SK TU4-IOE	Using this parameter an adjustment can be made to the analog output for the selected operating zone. The maximum analog output (10 V) corresponds to the standardisation value of the appropriate selection.  If therefore, at a constant working point, this parameter is raised from 100% to 200%, the analog output voltage is halved. 10 Volt output signal then corresponds to twice the nominal value.  For negative values the logic is reversed. An actual value of 0% will then produce 10 V at the output and -100% will produce 0 V.			
<b>P420</b>	<b>[ -01 ] Digital inputs</b> <b>[ -05 ]</b> (Digital inputs)			
0 ... 77 { [-01] = 1 } { [-02] = 2 } { [-03] = 4 } { [-04] = 0 } { [-05] = 0 }	Up to 3 freely programmable digital inputs are available in the SK 1x0E. In addition, the analog inputs can also be used as digital inputs, however, their electrical characteristics are <b>not compatible</b> with the SPS standard.  <b>[ -01 ] = Digital input 1 (DIN1), Enable right</b> as factory setting, control terminal 21  <b>[ -02 ] = Digital input 2 (DIN2), Enable left</b> as factory setting, control terminal 22  <b>[ -03 ] = Digital input 3 (DIN3), fixed frequency 1 (P465 [-01])</b> as factory setting, control terminal 23  <b>[ -04 ] = Analog input 1 (AIN1/DIN4), no function</b> with factory setting, control terminal 14  <b>[ -05 ] = Analog input 2 (AIN2/DIN5), no function</b> with factory setting, control terminal 16			
	Various functions can be programmed. These can be seen in the following table.  The additional digital inputs of the I/O- extensions (SK xU4-IOE) are administered via the parameter "Bus I/O In Bit (4...7)" - (P480 [-05] ... [-08]) for the <u>first</u> I/O extension, and via the parameter "Bus I/O In Bit (0...3)" - (P480 [-01] ... [-04]) for the <u>second</u> I/O extension.			

## List of the possible functions of the digital inputs P420 [01]... [-04]

Value	Function	Description	Signal
00	No function	Input switched off.	---
01	Enable right	The FI delivers an output signal with the rotation field right if a positive setpoint is present: 0 → 1 Flank (P428 = 0)	High
02	Enable left	The FI delivers an output signal with the rotation field left if a positive setpoint is present: 0 → 1 Flank (P428 = 0)	High
<p>If the drive is to start up automatically when the mains is switched on (P428 = 1) a permanent High level for enabling must be provided (supply terminal 21 with 24V).</p> <p>If the functions "Enable right" and "Enable left" are actuated simultaneously, the FI is blocked.</p> <p>If the frequency inverter is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a <b>1 → 0 flank</b>.</p>			
03	Change of rotation direction	Causes the rotation field to change direction in combination with Enable right or left.	High
04 <sup>1</sup>	Fixed frequency 1	The frequency from P465 [01] is added to the actual setpoint value.	High
05 <sup>1</sup>	Fixed frequency 2	The frequency from P465 [02] is added to the actual setpoint value.	High
06 <sup>1</sup>	Fixed frequency 3	The frequency from P465 [03] is added to the actual setpoint value.	High
07 <sup>1</sup>	Fixed frequency 4	The frequency from P465 [04] is added to the actual setpoint value.	High
<p>If several fixed frequencies are actuated at the same time, then they are added with the correct sign. In addition, the analog setpoint (P400) and possibly the minimum frequency (P104) are added.</p>			
08	Param set switching "Parameter set switchover 1"	Selection of the active parameter set 1...4 (P100)	High
09	Hold frequency	During the acceleration or deceleration phase, a Low level will cause the actual output frequency to be "held". A High level allows the ramp to proceed.	Low
10 <sup>2</sup>	Disable voltage	The FI output voltage is switched off; the motor runs down freely.	Low
11 <sup>2</sup>	Emergency stop	The FI reduces the frequency according to the programmed fast stop time P426.	Low
12 <sup>2</sup>	Fault acknowledgement	Fault acknowledgement with an external signal. If this function is not programmed, a fault can also be acknowledged by a low enable setting (P506).	0→1 Flank
13 <sup>2</sup>	PTC resistor input	Only with the use of a temperature monitor (bimetal switching contact). Switch-off delay = 2 sec, warning after 1 sec.	High
14 <sup>2,3</sup>	Remote control	With bus system control, Low level switches the control unit to control via the control terminals.	High
15	Jog frequency <sup>1</sup>	The fixed frequency value can be adjusted using the HIGHER/LOWER and OK keys (P113), if control is via the SimpleBox or ParameterBox.	High
16	Motor potentiometer	As in setting 09, however, the frequency is not maintained below the minimum frequency P104 and above the maximum frequency P105.	Low
17	ParaSetSwitching 2 "Parameter set switchover 2"	Selection of the active parameter set 1...4 (P100)	High
18 <sup>2</sup>	Watchdog	Input must see a High flank cyclically (P460), otherwise error E012 will cause a shutdown. Function starts with the 1st high flank.	0→1 Flank
19	Setpoint 1 on/off	Analog input switch-on and switch-off 1/2 (high = ON) of the first I/O extension. The Low signal sets the analog input to 0% which does not lead to shutdown when the minimum frequency (P104) > than the absolute minimum frequency (P505).	High
20	Setpoint 2 on/off		High
21	... 28 reserved		
29	Enable SetpointBox		-

Value	Function	Description	Signal
30	Disable PID	Switching the PID controller / process controller function on and off (high = ON)	High
31 <sup>2</sup>	Disable right rotation	Blocks the >Enable right/left< via a digital input or Bus control. Does not depend on the actual direction of rotation of the motor	Low
32 <sup>2</sup>	Disable left rotation	(e.g. following negated setpoint).	Low
33	... 44 reserved		
45	3-W-Ctrl. Start-Right "3-Wire-Control Start-Right" (Closing button)	This control function provides an alternative to enable R/L (01/02), in which a permanently applied level is required. Here, only a control impulse is required to trigger the function. The control of the FI can therefore be performed entirely with buttons.	0→1 Flank
46	3-W-Ctrl Start-Left "3-Wire-Control Start-Left" (Closing button)		0→1 Flank
49	3-Wire-Ctrl. Stop "3-Wire-Control Stop" (Opening button)		1→0 Flank
47	Motorpot. Freq. + "Motor potentiometer frequency +"	In combination with enable R/L the output frequency can be continuously varied. To save a current value in P113, both inputs must be at a High voltage for 0.5s. This value then applies as the next starting value for the same direction of rotation (Enable R/L)	High
48	Motorpot. Freq. - "Motor potentiometer frequency -"	otherwise start at $f_{MIN}$ .	High
50	Bit 0 fixed frequency array	Binary coded digital inputs to generate up to 32 fixed frequencies. (P465: [-01] ... [-15])	High
51	Bit 1 fixed frequency array		High
52	Bit 2 fixed frequency array		High
53	Bit 3 fixed frequency array		High
55	... 64 Reserved		
65 <sup>2</sup>	Man/auto release brake "Release brake manually/ automatically"	The brake is automatically released by the frequency inverter (automatic brake control) if this digital input has been set.	High
66 <sup>2</sup>	Man. release brake "Release brake manually"	The brake is only released if the digital input is set.	High
67	Dig.out. man/auto set "Set digital output manually / automatically"	Set digital output 1 manually, or via the function set in (P434)	High
68	Dig.out. man. set "Set digital output manually"	Set digital output 1 manually	High
69	Speed meas. with ini. "Speed measurement with initiator"	Simple speed measurement (impulse measurement) with initiator	Impulse
70	Evacuation run "Activate evacuation run"	Setting without function	-
71	Motorpot.F+ and Save "Motor potentiometer function Frequency + with automatic saving"	With this "motor potentiometer function" a setpoint value (sum) is set via the digital inputs, and simultaneously stored. With control enabling R/L this is then started up in the correspondingly enabled direction. On change of direction the frequency is retained. Simultaneous activation of the +/- function causes the frequency setpoint value to be set to zero.	High
72	Motorpot.F- and Save "Motor potentiometer function Frequency - with automatic saving"	The frequency setpoint value can also be displayed or set in the operating value display (P001=30, current setpoint MP-S') or in P718. Any minimum frequency set (P104) is still effective. Other setpoint values, e.g. analog or fixed frequencies can be added or subtracted. The adjustment of the frequency setpoint value is performed with the ramps from P102/103.	High
73 <sup>2</sup>	Right block+ Fast "Block right rotation + emergency stop"	As for setting 31, however coupled to the function "Fast Stop".	Low

Value	Function	Description	Signal
<b>74</b> <sup>2</sup>	Left block+ Fast "Block left rotation + emergency stop"	As for setting 32, however coupled to the function "Fast Stop".	Low
<b>75</b>	Dig.out. 2 man/auto set "Set digital output 2 manually / automatically"	As for function 67, however for digital output 2	High
<b>76</b>	Dig.out. 2 man. set "Set digital output 2 manually"	As for function 68, however for digital output 2	High
<b>77</b>	Reserved		
<sup>1</sup>	If neither of the digital inputs is programmed for left or right enable, then the actuation of a fixed frequency or jog frequency will enable the frequency inverter. The rotation field direction depends on the sign of the setpoint.		
<sup>2</sup>	Also effective for bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)		
<sup>3</sup>	Function cannot be selected via BUS IO In Bits		

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P426</b>	<b>Quick stop time</b> (Quick stop time)		S	P
0 ... 320.00 sec { 0.10 }	Setting of the stop time for the fast stop function which can be triggered either via a digital input, the bus control, the keyboard or automatically in case of a fault.  Emergency stop time is the time for the linear frequency decrease from the set maximum frequency (P105) to 0Hz. If an actual setpoint <100% is being used, the emergency stop time is reduced correspondingly.			
<b>P427</b>	<b>Emerg. stop on error</b> (Emergency stop on fault)		S	
0 ... 3 { 0 }	Activation of automatic emergency stop following error  <b>0 = Disabled:</b> Automatic emergency stop following fault is deactivated <b>1 = Mains supply failure:</b> Automatic emergency stop following mains supply failure <b>2 = In case of faults:</b> Automatic emergency stop following error <b>3 = Fault or mains failure:</b> Automatic emergency stop in case of fault or mains failure			
<b>P428</b>	<b>Automatic start</b> (Automatic start)		S	
0 ... 1 { 0 }	In the standard setting (P428 = <b>0</b> → <b>Off</b> ) the inverter requires a flank to enable (signal change from "low → high") at the relevant digital input.  In the setting <b>On</b> → <b>1</b> the FI reacts to a High level. This function is only possible if the FI is controlled using the digital inputs. (see P509=0/1)  In certain cases, the FI must start up directly when the mains are switched on. For this P428 = <b>1</b> → <b>On</b> can be set. If the enable signal is permanently switched on, or equipped with a cable jumper, the FI starts up immediately.  <b>NOTE:</b> (P428) not "ON" if (P506) = 6, <b>Danger!</b> (See note on (P506))  <b>NOTE:</b> The "Automatic Start" function can only be used if a digital input of the <u>frequency inverter</u> (DIN 1 ... DIN 4) is parameterised to the function "Enable Right" or "Enable Left" and this input is permanently set to "High". The digital inputs of the technology units (e.g.:SK CU4 - IOE) do not support this "Automatic Start" function.  <b>NOTE:</b> The "Automatic Start" function can only be activated if the frequency inverter has been parameterised to local control ((P509) setting { 0 } or { 1 } ).			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P434</b>	<b>[-01] Digital output function</b> <b>[-02] (Digital output function)</b>			

0 ... 39

[-01] = **Digital output 1**, Digital output 1 of the frequency inverter

{ [-01] = 7 }

[-02] = **Digital output 2**, Digital output 2 of the frequency inverter

{ [-02] = 1 }

**Control terminals 1/40 (Section 2.8.2):** The settings 3 to 5 and 11 work with 10% hysteresis, i.e. the relay contact closes (function 11 does not deliver) on reaching the limiting value 24 V and switches this off again if a 10% lower value is undershot (function 11 on again).

This behaviour can be inverted with a negative value in P435.

Setting / Function	Output ... with limiting value or function (see also P435)
<b>0 = No function</b>	Low
<b>1 = External brake</b> , to control an external 24V brake relay (max. 20 mA). The output switches at a programmed absolute minimum frequency (P505). For typical brakes a setpoint delay of 0.2-0.3 s should be programmed (see also P107/P114).	High
<b>2 = Inverter operating</b> , the output indicates voltage at the FI output (U - V - W).	High
<b>3 = Current limit</b> , based on the setting of the motor rated current (P203). This value can be adjusted with the scaling (P435).	High
<b>4 = Torque current limit</b> , based on motor data settings in P203 and P206. Signals a corresponding torque load on the motor. This value can be adjusted with the standardisation (P435).	High
<b>5 = Frequency limit</b> , based on motor nominal frequency setting in P201. This value can be adjusted with the scaling (P435).	High
<b>6 = Setpoint reached</b> , indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz → <i>Setpoint value not achieved – signal Low</i> .	High
<b>7 = Fault</b> , general fault message, fault is active or not yet acknowledged. → <i>Fault - Low (Ready - High)</i>	Low
<b>8 = Warning</b> , general warning, a limit value was reached which could lead to a later shutdown of the FI.	Low
<b>9 = Overcurrent warning</b> : At least 130% of the nominal FI current was supplied for 30 seconds.	Low
<b>10 = Overtemp. Warn. Motor</b> , " <i>Motor overtemperature warning</i> ": The motor temperature is evaluated. → Motor is too hot. The warning is given immediately, overheating switch-off after 2 seconds.	Low
<b>11 = Torque curr. lim. active</b> , " <i>Torque current limit / Current limit active warning</i> ": The limiting value in P112 or P536 has been reached. A negative value in P435 inverts the reaction. Hysteresis = 10%.	Low
<b>12 = Value of P541</b> , " <i>Value of P541 - external control</i> ", the output can be controlled with parameter P541 (Bit 0) independent of the actual operating status of the FI.	High
<b>13 = Gen. Torque limit</b> , " <i>Generator torque limit active</i> ": Limit value in P112 has been reached in the generator range. Hysteresis = 10%.	High
<b>16 = Reference value Ain1</b> , Setpoint AIN1 of the FI is compared with the value in (P435[-01 or -02]).	High
<b>17 = Reference value Ain2</b> , Setpoint AIN2 of the FI is compared with the value in (P435[-01 or -02]).	High

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
	<b>18 = FI ready:</b> The FI is ready for operation. After being enabled it delivers an output signal.			High
	<b>19 = ... 29 reserved</b>			
	<b>30 = Digital-In 1 status*</b>		High	Details for the use of the relevant bus systems can be found in the applicable supplementary bus manual.
	<b>31 = Digital-In 2 status*</b>		High	
	<b>32 = Digital-In 3 status*</b>		High	
	<b>33 = Status Digital-In 4 / A-In1 *</b>		High	
	<b>34 = Status Digital-In 5 / A-In2 *</b>			

\*) (P546[-01]...[-03]) = 20

<b>P435</b>	<b>[-01] [-02]</b>	<b>Dig. out scaling</b> (Scaling of digital output)			
-------------	------------------------	--	--	--	--

-400 ... 400 %  
{ 100 }

**[-01] = Digital output 1**, Digital output 1 of the frequency inverter  
**[-02] = Digital output 2**, Digital output 2 of the frequency inverter

Adjustment of the limiting values of the output function. For a negative value, the output function will be output negative.

Reference to the following values:

Current limit (3) = x [%] · P203 >Rated motor current<

Torque current limit (4) = x [%] · P203 · P206 (calculated rated motor torque)

Frequency limit (5) = x [%] · P201 >Rated motor frequency<

<b>P436</b>	<b>[-01] [-02]</b>	<b>Dig. out. hysteresis</b> (Hysteresis of digital outputs)		S	
-------------	------------------------	--	--	---	--

1 ... 100 %  
{ 10 }

**[-01] = Digital output 1**, Digital output 1 of the frequency inverter  
**[-02] = Digital output 2**, Digital output 2 of the frequency inverter

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

<b>P460</b>		<b>Time watchdog</b> (Time watchdog)		S	
-------------	--	---	--	---	--

0.0 / 0.1 ... 250.0 s  
-0.1 ... -250.0 sec  
{ 10.0 }

**0.1 ... 250.0 = The time interval** between the expected Watchdog signals (programmable function of the digital inputs P420 – P425). If this time interval passes without a pulse being registered, a switch off occurs with an E012 error message.

**0.0 = Customer error:** As soon as a high-low flank or a low signal is detected at a digital input (function 18) the FI switches off with error message E012.

**-0.1 ... -250.0 =** In this case the rotor rotation watchdog is active The time is defined by the amount of the set value. There is no watchdog message when switched off. After each enable, a puls must first come before the watchdog is activated.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P464</b>	<b>Fixed frequency mode</b> (Fixed frequency mode)		S	
0 ... 1 { 0 }	This parameter determines the form in which fixed frequencies are to be processed.  <b>0 = Addition to main setpoint:</b> (Addition of the fixed frequency to the main setpoint) Fixed frequencies and the fixed frequency array are added to each other. I.e. they are added together, or added to an analog setpoint to which limits are assigned according to P104 and P105.  <b>1 = As main setpoint:</b> (No addition / Fixed frequency is the main setpoint value) Fixed frequencies are not added - neither together, nor to analog setpoints. If for example, a fixed frequency is switched to an existing analog setpoint, the analog setpoint will no longer be considered. A programmed frequency addition or subtraction to one of the analog inputs or bus setpoints is still possible and valid. If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (E.g.: $20 > 10$ or $20 > -30$ )			
<b>P465</b>	<b>Fixed frequency field</b> (Fixed frequency / Frequency array)			
-400.0 ... 400.0 Hz { [-01] = 5.0 } { [-02] = 10.0 } { [-03] = 20.0 } { [-04] = 35.0 } { [-05] = 50.0 } { [-06] = 70.0 } { [-07] = 100.0 } { [-08] = 0.0 } { [-09] = -5.0 } { [-10] = -10.0 } { [-11] = -20.0 } { [-12] = -35.0 } { [-13] = -50.0 } { [-14] = -70.0 } { [-15] = -100.0 }	In the array levels, up to 15 different fixed frequencies can be set, which in turn can be encoded for the functions 50...54 in binary code for the digital inputs.  <b>[-01] = Fixed frequency 1 / Array 1</b> <b>[-02] = Fixed frequency 2 / Array 2</b> <b>[-03] = Fixed frequency 3 / Array 3</b> <b>[-04] = Fixed frequency 4 / Array 4</b> <b>[-05] = Fixed frequency / Array 5</b> <b>[-06] = Fixed frequency / Array 6</b> <b>[-07] = Fixed frequency / Array 7</b> <b>[-08] = Fixed frequency / Array 8</b>	<b>[-09] = Fixed frequency / Array 9</b> <b>[-10] = Fixed frequency / Array 10</b> <b>[-11] = Fixed frequency / Array 11</b> <b>[-12] = Fixed frequency / Array 12</b> <b>[-13] = Fixed frequency / Array 13</b> <b>[-14] = Fixed frequency / Array 14</b> <b>[-15] = Fixed frequency / Array 15</b>		
<b>P466</b>	<b>Min. process controller freq.</b> (Minimum process controller frequency)		S	P
0.0 ... 400.0 Hz { 0.0 }	With the aid of the minimum frequency process controller the control ratio can also be kept to a minimum ratio, even with a master value of "zero", in order to enable adjustment of the compensator. Further details in P400 and Section 9.2 .			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P475</b>	<b>[ -01 ]</b> ... <b>[ -05 ]</b> <b>delay on/off switch</b> (Switch on/off delay)		S	
-30.000... 30,000 sec { 0.000 }	Adjustable on/off delay for the digital inputs. Use as a switch-on filter or simple process control is possible. <b>[ -01 ]</b> = Digital input 1 <b>[ -02 ]</b> = Digital input 2 <b>[ -03 ]</b> = Digital input 3 <b>[ -04 ]</b> = Digital input 4 / AIN1 <b>[ -05 ]</b> = Digital input 5 / AIN2 <b>Positive values</b> = switch-on delayed <b>Negative values</b> = switch-off delayed			
<b>P480</b>	<b>[ -01 ]</b> ... <b>[ -12 ]</b> <b>Funct. BusIO In Bits</b> (Function Bus I/O In Bits)			
0 ... 77 { [ -01 ] = 01 } { [ -02 ] = 02 } { [ -03 ] = 05 } { [ -04 ] = 12 } { [ -05...-12 ] = 00 }	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420). These I/O bits can also be used in combination with the AS interface (SK 190) (Bit 0 ... 3) or the I/O extensions (SK xU4-IOE) (Bit 4 ... 7 and Bit 0 ... 3). <b>[ -01 ] = Bus / AS-i Dig In1</b> (Bus IO In Bit 0 + AS-i 1 or DI 1 of the <b>second</b> SK xU4-IOE (DigIn 09)) <b>[ -02 ] = Bus / AS-i Dig In2</b> (Bus IO In Bit 1 + AS-i 2 or DI 2 of the <b>second</b> SK xU4-IOE (DigIn 10)) <b>[ -03 ] = Bus / AS-i Dig In3</b> (Bus IO In Bit 2 + AS-i 3 or DI 3 of the <b>second</b> SK xU4-IOE (DigIn 11)) <b>[ -04 ] = Bus / AS-i Dig In4</b> (Bus IO In Bit 3 + AS-i 4 or DI 4 of the <b>second</b> SK xU4-IOE (DigIn 12)) <b>[ -05 ] = Bus / IOE Dig In1</b> (Bus IO In Bit 4 + DI 1 of the <b>first</b> SK xU4-IOE (DigIn 05)) <b>[ -06 ] = Bus / IOE Dig In2</b> (Bus IO In Bit 5 + DI 2 of the <b>first</b> SK xU4-IOE (DigIn 06)) <b>[ -07 ] = Bus / IOE Dig In3</b> (Bus IO In Bit 6 + DI 3 of the <b>first</b> SK xU4-IOE (DigIn 07)) <b>[ -08 ] = Bus / IOE Dig In4</b> (Bus IO In Bit 7 + DI 4 of the <b>first</b> SK xU4-IOE (DigIn 08)) <b>[ -09 ]</b> = Flag 1 <b>[ -10 ]</b> = Flag 2 <b>[ -11 ]</b> = Bit 8 BUS control word <b>[ -12 ]</b> = Bit 9 BUS control word The possible functions for the bus In bits can be found in the table of functions for the digital inputs in parameter (P420). Functions {14} "Remote control" and {29} "Enable SetpointBox" are not possible. <b>NOTE: For AS-i devices (SK 190E), evaluation of a second IO extension is not possible.</b>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P481</b>	<b>[ -01 ]</b> ... <b>[ -10 ]</b> <b>)Funct. BusIO Out Bits</b> (Function Bus I/O Out Bits)			
0 ... 39 { [-01] = 18 } { [-02] = 08 } { [-03] = 30 } { [-04] = 31 } { [-05...-10] = 00 }	<p>The bus I/O Out bits are perceived as multi-function relay outputs. They can be set to the same functions (P434).</p> <p>These I/O bits can also be used in combination with the AS interface (SK 190E) (Bit 0 ... 3) or the I/O extensions (SK xU4-IOE) (Bit 4 ... 5 and flags 1 ... 2).</p> <p><b>[ -01 ] = Bus / AS-i Dig Out1</b> (Bus IO Out Bit 0 + AS-i 1)  <b>[ -02 ] = Bus / AS-i Dig Out2</b> (Bus IO Out Bit 1 + AS-i 2)  <b>[ -03 ] = Bus / AS-i Dig Out3</b> (Bus IO Out Bit 2 + AS-i 3)  <b>[ -04 ] = Bus / AS-i Dig Out4</b> (Bus IO Out Bit 3 + AS-i 4)  <b>[ -05 ] = Bus / IOE Dig Out1</b> (Bus IO Out Bit 4 + DO 1 of the <b>first</b> SK xU4-IOE (DigOut 02))  <b>[ -06 ] = Bus / IOE Dig Out2</b> (Bus IO Out Bit 5 + DO 2 of the <b>first</b> SK xU4-IOE (DigOut 03))  <b>[ -07 ] = Bus / 2nd IOE Dig Out1</b> (Flag1 + DO 1 of the <b>second</b> SK xU4-IOE (DigOut 04))  <b>[ -08 ] = Bus / 2nd IOE Dig Out2</b> (Flag2 + DO 2 of the <b>second</b> SK xU4-IOE (DigOut 05))  <b>[ -09 ] = Bit 10 BUS status word</b>  <b>[ -10 ] = Bit 13 BUS status word</b></p> <p>The possible functions for the Bus Out Bits can be found in the table of functions for the digital outputs (P434).</p>			
<b>P482</b>	<b>[ -01 ]</b> ... <b>[ -10 ]</b> <b>Stand. BusIO Out Bits</b> (Standardisation of Bus I/O Out Bits)			
-400 ... 400 % { all 100 }	<p>Adjustment of the limit values of the bus Out bits. For a negative value, the output function will be output negative.</p> <p>Once the limit value is reached and positive values are delivered, the output produces a High signal, for negative setting values a Low signal.</p> <p><b>[ -01 ] = Bus / AS-i Dig Out1</b> (Bus IO Out Bit 0 + AS-i 1)  <b>[ -02 ] = Bus / AS-i Dig Out2</b> (Bus IO Out Bit 1 + AS-i 2)  <b>[ -03 ] = Bus / AS-i Dig Out3</b> (Bus IO Out Bit 2 + AS-i 3)  <b>[ -04 ] = Bus / AS-i Dig Out4</b> (Bus IO Out Bit 3 + AS-i 4)  <b>[ -05 ] = Bus / IOE Dig Out1</b> (Bus IO Out Bit 4 + DO 1 of the <b>first</b> SK xU4-IOE (DigOut 02))  <b>[ -06 ] = Bus / IOE Dig Out2</b> (Bus IO Out Bit 5 + DO 2 of the <b>first</b> SK xU4-IOE (DigOut 03))  <b>[ -07 ] = Bus / 2nd IOE Dig Out1</b> (Flag1 + DO 1 of the <b>second</b> SK xU4-IOE (DigOut 04))  <b>[ -08 ] = Bus / 2nd IOE Dig Out2</b> (Flag2 + DO 2 of the <b>second</b> SK xU4-IOE (DigOut 05))  <b>[ -09 ] = Bit 10 BUS status word</b>  <b>[ -10 ] = Bit 13 BUS status word</b></p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P483</b>	<b>[ -01 ]</b> ... <b>[ -10 ]</b> <b>Hyst. BusIO Out Bits</b> (Hysteresis of bus I/O Out bits)		S	

1 ... 100 %      Difference between switch-on and switch-off point to prevent oscillation of the output signal.

{ all 10 }

<b>[ -01 ] = Bus / AS-i Dig Out1</b>	(Bus IO Out Bit 0 + AS-i 1)
<b>[ -02 ] = Bus / AS-i Dig Out2</b>	(Bus IO Out Bit 1 + AS-i 2)
<b>[ -03 ] = Bus / AS-i Dig Out3</b>	(Bus IO Out Bit 2 + AS-i 3)
<b>[ -04 ] = Bus / AS-i Dig Out4</b>	(Bus IO Out Bit 3 + AS-i 4)
<b>[ -05 ] = Bus / IOE Dig Out1</b>	(Bus IO Out Bit 4 + DO 1 of the <b>first</b> SK xU4-IOE (DigOut 02))
<b>[ -06 ] = Bus / IOE Dig Out2</b>	(Bus IO Out Bit 5 + DO 2 of the <b>first</b> SK xU4-IOE (DigOut 03))
<b>[ -07 ] = Bus / 2nd IOE Dig Out1</b>	(Flag1 + DO 1 of the <b>second</b> SK xU4-IOE (DigOut 04))
<b>[ -08 ] = Bus / 2nd IOE Dig Out2</b>	(Flag2 + DO 2 of the <b>second</b> SK xU4-IOE (DigOut 05))
<b>[ -09 ] = Bit 10 BUS status word</b>	
<b>[ -10 ] = Bit 13 BUS status word</b>	

**NOTE:** Details for the use of the relevant bus systems can be found in the applicable supplementary bus manual.

## 6.1.5 Extra functions

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P501</b>	<b>Inverter name</b> ( <i>Inverter name</i> )			
A...Z (char) { 0 }	Free input of a designation (name) for the device (max. 20 characters). With this, the frequency inverter can be uniquely identified for setting with NORD CON - software or within a network.			
<b>P502</b>	<b>Master function value</b> ( <i>Master function value</i> )		S	P
0 ... 24 { all 0 }	Selection of up to 3 master values of a Master for output to a bus system (see P503). The assignment of these master values to the slave is carried out via (P546). (for definition of frequencies see Section 9.10):  <b>[-01] = Master value 1</b> <b>[-02] = Master value 2</b> <b>[-03] = Master value 3</b>			

Selection of possible setting values for master values:

- |                                 |   |
|---------------------------------|---|
| <b>0</b> = Off                  | <b>17</b> = Value analog input 1 P400[-01])   |
| <b>1</b> = Actual frequency     | <b>18</b> = Value analog input 2 (P400[-02])  |
| <b>2</b> = Actual speed         | <b>19</b> = Setpoint freq. master value,<br>"Setpoint frequency master value"                       |
| <b>3</b> = Current              | <b>20</b> = Set freq. after ramp master value,<br>"Setpoint frequency from ramp master value"       |
| <b>4</b> = Torque current       | <b>21</b> = Actual freq.wo. slip master<br>"Actual frequency without slip master value"             |
| <b>5</b> = Digital IO status    | <b>22</b> = Speed encoder   |
| <b>6</b> = ... 7 reserved       | <b>23</b> = Actual frequency with slip<br>"Actual frequency with slip"                              |
| <b>8</b> = Setpoint frequency   | <b>24</b> = Master value actual freq. with slip<br>"Master value, actual freq. with slip"<br>delete |
| <b>9</b> = Error number         |   |
| <b>10</b> = ... 11 reserved     |   |
| <b>12</b> = Bus IO Out Bits 0-7 |   |
| <b>13</b> = ... 16 reserved     |   |

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P503</b>	<b>Leading func. output</b> (Master function output)		S	
0 ... 3 { 0 }	<p>For master-slave applications this parameter specifies on which bus system the master transmits the control word and the master values (P502) for the slave. On the slave, parameters (P509), (P510), (P546 ) define the source from which the slave obtains the control word and the master values from the master and how these are to be processed by the slave.</p> <p>Specification of the communication mode on the system bus for ParameterBox and NORD CON.</p> <p><b>0 = Off</b>  <b>No</b> control word and master value output.  <b>If no BUS option</b> (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox or NORD CON is visible.</p> <p><b>1 = CANopen (system bus)</b>  <b>Control word</b> and master values are transferred to the system bus.  <b>If no bus option</b> (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox or NORD CON is visible.</p> <p><b>2 = System bus active</b>  <b>No</b> control word and master value output.  <b>All</b> FIs connected to the system bus are visible in the ParameterBox or NORD CON, even if no bus option is connected. Prerequisite: all FIs must be set to this mode.</p> <p><b>3 = System bus active control word</b> and master value output.  <b>All</b> FIs connected to the system bus are visible in the ParameterBox or NORD CON, even if no bus option is connected. Prerequisite: all other FIs must be set to mode { 2 } "System bus active"</p>			
<b>P504</b>	<b>Pulse frequency</b> (Pulse frequency)		S	
3.0 ... 16.0 kHz { 6.0 }	<p>The internal pulse frequency for actuating the power component can be changed with this parameter. A higher setting reduces motor noise, but leads to increased EMC emissions and reduction of the possible motor nominal torque.</p> <p><b>NOTE:</b> The radio interference suppression limiting curve C1 according to EN55011 is complied with at a setting of 6.0kHz on condition that the wiring guidelines are complied with. For further details, see Section 9.3.3 (EMC).</p> <p><b>NOTE:</b> Raising the pulse frequency leads to a reduction of the possible output current, depending on the time (<math>I^2t</math> curve). For further details, see Section 9.4 Reduced output power.</p>			
<b>P505</b>	<b>Abs. Minimum frequency</b> (Absolute minimum frequency)		S	P
0.0 ... 10.0 Hz { 2.0 }	<p>Gives the frequency value that cannot be undershot by the FI. If the setpoint becomes smaller than the absolute minimum frequency, the FI switches off or changes to 0.0 Hz.</p> <p>At the absolute minimum frequency, braking control (P434) and the setpoint delay (P107) are actuated. If a setting value of "Zero" is selected, the brake relay does not switch during reversing.</p> <p>When controlling lift equipment without speed feedback, this value should be set to a minimum of 2 Hz. From 2 Hz, the current control of the FI operates and a connected motor can supply sufficient torque.</p> <p><b>NOTE:</b> Output frequencies &lt; 4.5 Hz result in a reduced current overload capacity. For further details, see Section 9.4 power derating.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P506</b>	<b>Automatic error acknowledgement</b> (Automatic fault acknowledgement)		S	

0 ... 7  
{ 0 }

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

**0 = No automatic** fault acknowledgement.

**1 = ... 5 = Number** of permissible automatic malfunction acknowledgments within one mains-on cycle. After mains off and switch on again, the full amount is again available.

**6 = Always**, an fault message will always be acknowledged automatically if the cause of the error is no longer present.

**7 = via enable deactivation**, acknowledgement is only possible using the ENTER key or by mains switch-off. No acknowledgement is implemented by removing the enable!

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

<b>P509</b>	<b>Control word source</b> (Control word source)		S	
-------------	---	--	---	--

0 ... 4  
{ 0 }

Selection of the interface via which the FI is controlled.

**0 = Control terminals or keyboard**, "Control terminal or keyboard control" \*\* with the SimpleBox (if (P510)=0), the ParameterBox or via BUS I/O Bits.

**1 = Only control terminals \***, the FI can only be controlled via the digital and analog input signals or via the bus I/O bits.

**2 = USS \***, the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies.

**3 = System bus\***

**4 = System bus broadcast \***

\*) Keyboard control (SimpleBox, ParameterBox, PotentiometerBox) is disabled, parameterisation is still possible.

\*\*) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will disable without an error message.

**NOTE:** For details of the optional bus systems, please refer to the relevant supplementary bus manuals (BU02x0).

- [www.nord.com](http://www.nord.com) -

<b>P510</b>	<b>[-01]</b> <b>[-02]</b> <b>Setpoint source</b> (Setpoint source)		S	
-------------	--	--	---	--

0 ... 4  
{ [-01] = 0 }  
{ [-02] = 0 }

Selection of the setpoint source to be parameterised.

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

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

- |   |                                 |
|---|---------------------------------|
| <b>0 = Auto:</b> The setpoint source is automatically derived from the setting in the parameter P509 >Control word source<. | <b>2 = USS</b>                  |
| <b>1 = Only control terminals</b> , digital and analog inputs control the frequency, including fixed frequencies            | <b>3 = System bus</b>           |
|   | <b>4 = System bus broadcast</b> |

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P511</b>	<b>USS baud rate</b> (USS baud rate)		S	
0 ... 3 { 3 }	Setting of the transfer rate (transfer speed) via the RS485 interface. All bus participants must have the same baud rate setting.  <b>0</b> = 4800 Baud <b>1</b> = 9600 Baud <b>2</b> = 19200 Baud <b>3</b> = 38400 Baud			
<b>P512</b>	<b>USS Address</b> (USS Address)			
0 ... 30 { 0 }	Setting of the FI Bus address.			
<b>P513</b>	<b>Telegram downtime</b> (Telegram downtime)		S	
-0.1 / 0.0 / 0.1 ... 100.0 s { 0.0 }	If the frequency inverter is directly controlled via the CAN protocol or via RS485, this communication path can be monitored via parameter (P513). Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the FI reports an fault and switches off with the error message E010 >Bus Time Out<.  The inverter monitors the system bus communication via parameter (P120). Therefore parameter (P513) must usually be left in the factory setting {0.0}. Parameter (P513) must only be set to {-,0,1} if faults detected by the optional module (e.g. communication errors on the field bus level) are not to result in the drive unit being switched off.  <b>0.0</b> = <b>Off:</b> Monitoring is <b>switched off</b> . <b>-0.1</b> = <b>No error:</b> Even if the bus module detects an error, this does not cause the frequency inverter to be switched off. <b>0.1...</b> = <b>On:</b> Monitoring is activated.			
<b>P514</b>	<b>CAN baud rate</b> (CAN baud rate (system bus))		S	
0 ... 7 { 5 }	Setting of the transfer rate (transfer speed) via the system bus interface. All bus participants must have the same baud rate setting.  <b>Note:</b> Optional modules (SK xU4-...) only operate with a transfer rate of 250kBaud. Therefore the frequency inverter must remain at the factory setting (250kBaud).  <b>0</b> = 10kBaud <b>3</b> = 100kBaud <b>6</b> = 500kBaud <b>1</b> = 20kBaud <b>4</b> = 125kBaud <b>7</b> = 1Mbaud * <b>2</b> = 50kBaud <b>5</b> = <b>250kBaud</b>			

\*) Reliable operation cannot be guaranteed

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P515</b>	<b>CAN address</b> (CAN address (system bus))		S	
[ -01 ] ... ... [ -03 ]				
0 ... 255 <sub>dec</sub> { all 32 <sub>dec</sub> } or { all 20 <sub>hex</sub> }	Setting of the system bus address. [ -01 ] = <b>Slave address</b> , Receive address for system bus [ -02 ] = <b>Broadcast slave address</b> , system bus reception address (slave) [ -03 ] = <b>Master address</b> , "Broadcast master address", transmission address for system bus (master)			
<b>NOTE:</b> If up to four frequency inverters are to be linked via the system bus, the addresses must be set as follows → FI 1 = 32, FI 2 = 34, FI 3 = 36, FI 4 = 38. The system bus addresses should be set via the DIP switches S1:1/2 (Section 5.2.2.2).				
<b>P516</b>	<b>Skip frequency 1</b> (Skip frequency 1)		S	P
0.0 ... 400.0 Hz { 0.0 }	The output frequency around the frequency value (P517) set here is masked. This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set. <b>0.0 = Off:</b> Skip frequency inactive			
<b>P517</b>	<b>Skip frequency range 1</b> (Skip frequency range 1)		S	P
0.0 ... 50.0 Hz { 2.0 }	Masking range for the >Skip frequency 1< P516. This frequency value is added and subtracted from the skip frequency. Skip frequency range 1: P516 - P517 to P516 + P517			
<b>P518</b>	<b>Skip frequency 2</b> (Skip frequency 2)		S	P
0.0 ... 400.0 Hz { 0.0 }	The output frequency around the frequency value (P519) set here is masked. This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set. <b>0.0 = Off:</b> Skip frequency inactive			
<b>P519</b>	<b>Skip frequency range 2</b> (Skip frequency range 2)		S	P
0.0 ... 50.0 Hz { 2.0 }	Masking range for the >Skip frequency 2< P518. This frequency value is added and subtracted from the skip frequency. Skip frequency range 2: P518 - P519 to P518 + P519			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set															
<b>P520</b>	<b>Flying start circuit</b> (Flying start circuit)		S	P															
0 ... 4 { 0 }	<p>This function is required to connect the FI to already rotating motors, e.g. in fan drives. Motor frequencies &gt;100Hz cannot be captured.</p> <p><b>0 = Switched off</b>, no flying start.</p> <p><b>1 = Both directions</b>, the FI looks for a speed in both directions.</p> <p><b>2 = In setpoint value direction</b>, searches only in the direction of the setpoint value which is present.</p> <p><b>3 = Both directions after failure</b> "Both directions after failure", only after mains failure and fault</p> <p><b>4 = Setpoint dir. after fault</b>, "In setpoint direction after fault", only after mains failure and fault</p> <p><b>NOTE:</b> For physical reasons, the flying start circuit only operates above 1/10 of the nominal motor frequency (P201), however, not below <u>10 Hz</u>.</p> <table border="1"> <thead> <tr> <th></th> <th>Example 1</th> <th>Example 2</th> </tr> </thead> <tbody> <tr> <td>(P201)</td> <td>50 Hz</td> <td>200 Hz</td> </tr> <tr> <td><math>f=1/10*(P201)</math></td> <td><b>f=5 Hz</b></td> <td><b>f=20 Hz</b></td> </tr> <tr> <td><b>Comparison of f with <math>f_{min}</math></b> with: <math>f_{min}=10\text{Hz}</math></td> <td><b>5 Hz &lt; 10 Hz</b></td> <td><b>20 Hz &gt; 10 Hz</b></td> </tr> <tr> <td><u>Ergebnis <math>f_{Fly}</math>=</u></td> <td><b><u>The flying start circuit functions above</u></b> <math>f_{Fang}=10\text{ Hz.}</math></td> <td><b><u>The flying start circuit functions above</u></b> <math>f_{Fang}=20\text{ Hz.}</math></td> </tr> </tbody> </table>		Example 1	Example 2	(P201)	50 Hz	200 Hz	$f=1/10*(P201)$	<b>f=5 Hz</b>	<b>f=20 Hz</b>	<b>Comparison of f with <math>f_{min}</math></b> with: $f_{min}=10\text{Hz}$	<b>5 Hz &lt; 10 Hz</b>	<b>20 Hz &gt; 10 Hz</b>	<u>Ergebnis <math>f_{Fly}</math>=</u>	<b><u>The flying start circuit functions above</u></b> $f_{Fang}=10\text{ Hz.}$	<b><u>The flying start circuit functions above</u></b> $f_{Fang}=20\text{ Hz.}$			
	Example 1	Example 2																	
(P201)	50 Hz	200 Hz																	
$f=1/10*(P201)$	<b>f=5 Hz</b>	<b>f=20 Hz</b>																	
<b>Comparison of f with <math>f_{min}</math></b> with: $f_{min}=10\text{Hz}$	<b>5 Hz &lt; 10 Hz</b>	<b>20 Hz &gt; 10 Hz</b>																	
<u>Ergebnis <math>f_{Fly}</math>=</u>	<b><u>The flying start circuit functions above</u></b> $f_{Fang}=10\text{ Hz.}$	<b><u>The flying start circuit functions above</u></b> $f_{Fang}=20\text{ Hz.}$																	
<b>P521</b>	<b>Flying start circuit offset</b> (Flying start circuit offset)		S	P															
0.02... 2.50 Hz { 0.05 }	Using this parameter, the flying start search increment size can be adjusted. Values that are too large affect accuracy and causes the FI to cut out with an overcurrent report. If the values are too small, the search time is greatly extended.																		
<b>P522</b>	<b>Flying start circuit offset</b> (Flying start circuit resolution)		S	P															
-10.0 ... 10.0 Hz { 0.0 }	A frequency value which is added to the frequency value found, e.g. to remain in the motor range and so avoid the generator range and therefore the chopper range.																		
<b>P523</b>	<b>Factory setting</b> (Factory setting)																		
0 ... 3 { 0 }	<p>By selecting the appropriate value and confirming it with the OK key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0.</p> <p><b>0 = No change:</b> Does not change the parameterisation.</p> <p><b>1 = Load factory setting:</b> The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost.</p> <p><b>2 = Factory settings without bus:</b> All parameters of the frequency inverter <u>with the exception of</u> the bus parameter, are reset to the factory setting.</p> <p><b>3 = Fact. wo. motor data</b>, "Factory setting without motor data: All parameters of the frequency inverter, but <u>not</u> the motor data, are reset to the factory setting.</p>																		

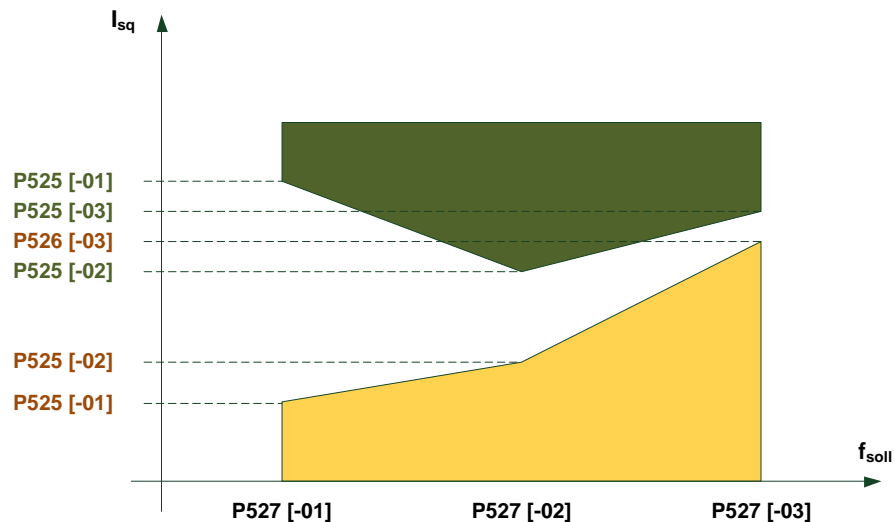
Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P525</b> [ -01 ] ... [ -03 ]	<b>Load monitoring max.</b> (Load monitoring maximum value)		S	P
1 ... 400 % / 401 { all 401 }	Selection of up to 3 auxiliary values: [ -01 ] = Auxiliary value 1      [ -02 ] = Auxiliary value 2      [ -03 ] = Auxiliary value 3			
	Maximum load torque value.  Setting of the upper limit of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) ... (P527), or the entries which are made there always belong together.  <b>401 = OFF</b> Means that the function is switched off. No monitoring is performed. This is also the basic setting for the FI.			
<b>P526</b> [ -01 ] ... [ -03 ]	<b>Load monitoring min.</b> (Load monitoring min.)		S	P
0 ... 400 % { all 0 }	Selection of up to 3 auxiliary values: [ -01 ] = Auxiliary value 1      [ -02 ] = Auxiliary value 2      [ -03 ] = Auxiliary value 3			
	Minimum load torque.  Setting of the lower limit value of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) ... (P527), or the entries which are made there always belong together.  <b>0 = OFF</b> Means that the function is switched off. No monitoring is performed. This is also the basic setting for the FI.			
<b>P527</b> [ -01 ] ... [ -03 ]	<b>Load monitoring freq.</b> (Load monitoring frequency)		S	P
0.0 ... 400.0 Hz { all 25.0 }	Selection of up to 3 auxiliary values: [ -01 ] = Auxiliary value 1      [ -02 ] = Auxiliary value 2      [ -03 ] = Auxiliary value 3  Auxiliary frequency values			
	Definition of up to 3 frequency points, which define the monitoring range for load monitoring. The auxiliary frequency values do not need to be entered in order of size. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters (P525) ... (P527), or the entries which are made there always belong together.			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P528</b>	<b>Load monitoring Delay</b> ( <i>Load monitoring Delay</i> )		S	P
0.10 ... 320.00 sec { 2.00 }	<p>Parameter (P528) defines the delay time for which an error message ("E12.5") is suppressed on infringement of the defined monitoring range ((P525) ... (P527)). A warning ("C12.5") is triggered after half of this time has elapsed.</p> <p>According to the selected monitoring mode (P529) an error message can also be generally suppressed.</p>			
<b>P529</b>	<b>Load monitoring mode</b> ( <i>Load monitoring mode</i> )		S	P
0 ... 3 { 0 }	<p>The reaction of the frequency inverter to an infringement of the defined monitoring range ((P525) ... (P527)) after the elapse of the delay time (P528) is specified by parameter (P529).</p> <p><b>0 = Fault and warning</b>, After the elapse of the time defined in (P528), an infringement of the monitoring range produces a fault ("E12.5"). A warning ("C12.5") is given after the elapse of half of this time.</p> <p><b>1 = Warning</b>, After the elapse of half of the time defined in (P528) and infringement of the monitoring range produces a warning ("C12.5").</p> <p><b>2 = Err. and warn. in const.</b> "<i>Fault and warning in constant travel</i>", as for setting "0", however monitoring is inactive during acceleration phases.</p> <p><b>3 = Only warning in const.</b>, "<i>Warning only during constant travel</i>", as for setting "1", however, monitoring is inactive during acceleration phases.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
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## P525 ... P529 Load monitoring

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



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

A warning **C12.5** is always given after the elapse of half of the set error triggering time (P528). This also applies if a mode is selected for which no fault message is generated. If only a maximum or minimum value is to be monitored, the other limit must be deactivated or must remain deactivated. The torque current and not the calculated torque is used as the reference value. This has the advantage that monitoring in the "non field weakened range" is usually more accurate. Naturally however, it cannot display more than the physical torque in the weakened field range.

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

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P533</b>	<b>Factor I<sup>2</sup>t-Motor</b> (Factor I <sup>2</sup> t-Motor)		S	

50 ... 150 %

{ 100 }

The motor current for the I<sup>2</sup>t motor monitoring P535 can be weighted with the parameter P533. Larger factors permit larger currents.

<b>P534</b>	<b>Torque disconn. limit</b> (Torque switch-off limit)		S	P
-------------	---	--	---	---

25 ... 400 % / 401

{ all 401 }

Via this parameter both the **drive** [-01] and the **generator** [-02] switch-off value can be adjusted.

If 80% of the set value is reached, a warning status is set. At 100% switch-off is performed with an error message.

Error E12.1 is given on exceeding the drive switch-off limit and E12.1 on exceeding the generator switch-off limit.

**[-01] = motor switch-off limit**

**[-02] = generator switch-off limit**

**401 = OFF**, means that this function has been disabled.

<b>P535</b>	<b>I<sup>2</sup>t-Motor</b> (I <sup>2</sup> t-Motor)			
-------------	---	--	--	--

0 ... 24

{ 0 }

The I<sup>2</sup>t motor function can now be set in a differentiated manner. Up to four curves with three different triggering times can be set. The trigger times are based on classes 5, 10 and 20 for semiconductor switching devices.

All curves run from 0Hz to half of the nominal motor frequency (P201). The full nominal current is available from half of the nominal frequency upwards.

**4 = I<sup>2</sup>t Motor Off**: Monitoring is inactive

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

**NOTE:** For switch-off classes 10 and 20, care must be taken that the FI has a sufficiently high overload capacity.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P536</b>	<b>Current limit</b> ( <i>Current limit</i> )		S	
0.1 ... 2.0 / 2.1 (x nominal FI current) { 1.5 }	<p>The inverter output current is limited to the set value. If this limit value is reached, the inverter reduces the actual output frequency.</p> <p>With the analog input function in P400 = 13/14, this limit value can also be varied and cause an error message (E12.4).</p> <p><b>0.1 ... 2.0 = Multiplier</b> with the inverter nominal current, gives the limit value.</p> <p><b>2.1 = OFF</b> means that this limit value is disabled. The FI supplies the maximum possible current.</p>			
<b>P537</b>	<b>Pulse disconnection</b> ( <i>Pulse disconnection</i> )		S	
10 ... 200 % / 201 { 150 }	<p>This function prevents rapid shutdown of the FI according to the load. With the pulse switch-off enabled, the output current is limited to the set value. This limitation is implemented by brief switching off of individual output stage transistors, the actual output frequency remains unchanged.</p> <p><b>10...200%</b> = Limit value related to the nominal FI current</p> <p><b>201</b> = The function is so to speak switched off and the FI delivers the maximum possible current. However, at the current limit the pulse switch off can still be active.</p> <p><b>NOTE:</b> The value set here can be undershot by a smaller value in P536.</p> <p>For smaller output frequencies (&lt;4.5Hz) or higher pulse frequencies (&gt;6 kHz or 8 kHz, P504) the pulse switch-off by the power reduction (see Section 8.3) can be undershot.</p> <p><b>NOTE:</b> If the pulse switch-off is disabled (P537=201) and a high pulse frequency is selected in parameter P504, the FI automatically reduces the pulse frequency when the power limit is reached. If the load on the FI is again reduced, the pulse frequency increases to the original value again.</p>			
<b>P539</b>	<b>Check output voltage</b> ( <i>Check output voltage</i> )		S	P
0 ... 3 { 0 }	<p>This protective function monitors the output current at the U-V-W terminals and checks for plausibility. In cases of error, the error message E016 is output.</p> <p><b>0 = Disabled:</b> Monitoring is not active.</p> <p><b>1 = Only motor phase, "Only motor phase error":</b> The output current is measured and checked for symmetry. If an imbalance is present, the FI switches off and outputs the error message E016.</p> <p><b>2 = Only magnetisation, "Only magnetisation monitoring":</b> At the moment the FI is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the FI switches off with the error message E016. A motor brake is not released in this phase.</p> <p><b>3 = Motor phase + Magnet., "Monitoring of motor phases + magnetisation":</b> as 1 and 2 combined.</p> <p><b>NOTE:</b> This function can also be used as an additional protective function for lifting applications, but is not permissible on its own as protection for persons.</p>			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P540</b>	<b>Mode phase sequence</b> ( <i>Mode phase sequence</i> )		S	P


0 ... 7

{ 0 }

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

This function does not operate with active position control (P600 ≠ 0).

**0 = None**, "No restriction of direction of rotation"

**1 = Dir key locked**, rotation direction change key  of the SimpleBox is locked

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

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

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

**5 = CW only monitored**, "*Only CW rotation monitored*" \*, only CW field direction possible. The selection of the "incorrect" rotation direction leads to a switch-off (control lock) of the FI. If necessary, care should be taken that the setpoint ( $>f_{\min}$ ) is sufficiently high.

**6 = CCW only monitored**, "*Only CCW rotation monitored*" \*, only CCW field direction possible. The selection of the "incorrect" rotation direction leads to a switch-off (control lock) of the FI. If necessary, care should be taken that the setpoint ( $>f_{\min}$ ) is sufficiently high.

**7 = Only enable monitored**, "*Only enabled direction monitored*", Rotation direction is only possible according to the enable signal, otherwise the FI is switched off.

\*) Applies for control via keyboard and control terminals.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P541</b>	<b>Set relay</b> (set digital output)		S	

000 ... FFF<sub>(hex)</sub>  
{ 000 }

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

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

**Bit 0** = Digital output 1  
**Bit 1** = Digital output 2  
**Bit 2** = Bus/AS-i Out Bit 0  
**Bit 3** = Bus/AS-i Out Bit 1  
**Bit 4** = Bus/AS-i Out Bit 2  
**Bit 5** = Bus/AS-i Out Bit 3  
**Bit 6** = Bus Out Bit 4 / Out1 1. IOE  
**Bit 7** = Bus Out Bit 5 / Out2 1. IOE  
**Bit 8** = Bus Out Bit 6 / Out1 2. IOE  
**Bit 9** = Bus Out Bit 7 / Out2 2. IOE  
**Bit 10** = PZD - Bit 10  
**Bit 11** = PZD - Bit 13

	Bits 8-11	Bits 7-4	Bits 3-0	
Min. value	0000 <b>0</b>	0000 <b>0</b>	0000 <b>0</b>	Binary <b>hex</b>
Max. value	1111 <b>F</b>	1111 <b>F</b>	1111 <b>F</b>	Binary <b>hex</b>

Changes which are made to the settings are not saved in the EEPROM. After "Power ON" of the frequency inverter, the parameter is therefore in the default setting.

Setting of the value via ...

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

**SimpleBox:** The hexadecimal code is entered directly when the SimpleBox is used.

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

<b>P542</b>	<b>[-01]</b> <b>[-02]</b>	<b>Set analog output</b> (Set analog output)		S	
-------------	------------------------------	---	--	---	--

0.0 ... 10.0 V  
{ all 0.0 }

**[-01]** = **First IOE**, AOUT of the first I/O extension (SK xU4-IOE)  
**[-02]** = **Second IOE**, AOUT of the second I/O extension (SK xU4-IOE)

... only with  
SK CU4-IOE or  
SK TU4-IOE

The analog output of the FI can be set with this function, independently of the actual operating state. To do this, the relevant analog output must be set to the function "External control" (P418 = 7).

This function can either be used manually or in combination with a bus control. The value set here will, once confirmed, be produced at the analog output.

Changes which are made to the settings are not saved in the EEPROM. After "Power ON" of the frequency inverter, the parameter is therefore in the default setting.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P543</b>	<b>[-01]</b> ... <b>[-03]</b> <b>Actual bus value 1 3</b> (Actual bus value 1 ... 3)		S	P

0 ... 24

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

{ [-01] = 1 }

**NOTE:** For further details, please refer to the relevant bus manual or the description for (P418).  
(Values from 0% ... 100% correspond to 0000<sub>hex</sub> ... 4000<sub>hex</sub>)  
For standardisation of the actual values: See also (Section 9.9).

{ [-02] = 4 }

{ [-03] = 9 }

**[-01] = Actual bus value 1****[-02] = Actual bus value 2** (only for PPO Type 2 or 4)**[-03] = Actual bus value 3** (only for PPO Type 2 or 4)

(Definition of frequencies, see Section 9.10)

**Possible values which can be set:****0 = Off****1 = Actual frequency**  
( $x=4000_{hex} * f[Hz]/(P105)$ )**2 = Actual speed**  
( $x=4000_{hex} * n(rpm)/(P202)$ )**3 = Current**  
( $x=4000_{hex} * I[A]/(P203)$ )**4 = Torque current (100% = P112)**  
( $x=4000_{hex} * Iq[A]/(P112) * 100 / \sqrt{(P203)^2 + (P209)^2}$ )**5 = Digital IO status**<sup>2</sup>**6 = ... 7 Reserved****8 = Setpoint frequency**  
( $x=4000_{hex} * fs[Hz]/(P105)$ )**9 = Error number****10 = ... 11 Reserved****12 = BusIO Out Bits 0-7****13 = ... 16 Reserved****17 = Value analog input 1,**  
Analog input 1 (P400[-01]),**18 = Value analog input 2,**  
Analog input 2 (P400[-02]),**19 = Setpoint frequency Master value (P503)**  
( $x=4000_{hex} * fs[Hz]/(P105)$ )**20 = Setpoint freq. from ramp master,**  
"Setpoint frequency from ramp master value"  
( $x=4000_{hex} * fsnr[Hz]/(P105)$ )**21 = Act. freq. wo. slip master,**  
"Actual frequency without slip master value"  
( $x=4000_{hex} * f-f2[Hz]/(P105)$ )**22 = Reserved****23 = Actual frequency with slip**  
"Actual frequency with slip"  
( $x=4000_{hex} * f[Hz]/(P105)$ )**24 = Actual frequency master value with slip**  
"Actual frequency master value with slip" ( $x=4000_{hex} * f[Hz]/(P105)$ )<sup>2</sup> The assignment of the digital inputs for P543 = 5

Bit 0 = DigIn 1 (FI)

Bit 1 = DigIn 2 (FI)

Bit 2 = DigIn 3 (FI)

Bit 3 = DigIn 4 (FI)

Bit 4 = PTC input (FI)

Bit 5 = reserved

Bit 6 = DigOut 3 (DO1, 1. SK...IOE)

Bit 7 = DigOut 4 (DO2, 1. SK...IOE)

Bit 8 = DigIn 5 (DI1, 1. SK...IOE)

Bit 9 = DigIn 6 (DI2, 1. SK...IOE)

Bit 10 = DigIn 7 (DI3, 1. SK...IOE)

Bit 11 = DigIn 8 (DI4, 1. SK...IOE)

Bit 12 = DigOut 1 (FI)

Bit 13 = DigOut 2 (FI)

Bit 14 = reserved

Bit 15 = reserved

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set																								
<b>P546</b>	<b>Func. bus-set point 1... 3</b> (Function of bus setpoint 1 ... 3)		S	P																								
0 ... 32 { [-01] = 1 } { [-02] = 0 } { [-03] = 0 }	<p>In this parameter, a function is allocated to the output setpoint during bus actuation.</p> <p><b>NOTE:</b> For further details, please refer to the relevant bus manual or the description for (P400). (Values from 0% ... 100% correspond to 0000<sub>hex</sub> ... 4000<sub>hex</sub>.) For standardisation of the setpoint values: see also Section 9.10.</p> <hr/> <p><b>[-01] = Bus setpoint value 1</b>  <b>[-02] = Bus setpoint value 2</b> (only for PPO type 2 or 4)  <b>[-03] = Bus setpoint value 3</b> (only for PPO type 2 or 4)</p> <hr/> <p><b>Possible values which can be set:</b></p> <table> <tr> <td><b>0</b> = Off</td> <td><b>12</b> = Torque current switch-off, "Switch off at torque current limit"</td> </tr> <tr> <td><b>1</b> = Setpoint frequency, (16 bit)</td> <td><b>13</b> = Current limit, "Current limited"</td> </tr> <tr> <td><b>2</b> = Frequency addition</td> <td><b>14</b> = Current switch-off "Switch-off current limited"</td> </tr> <tr> <td><b>3</b> = Frequency subtraction</td> <td><b>15</b> = Ramp time, (P102/103)</td> </tr> <tr> <td><b>4</b> = Minimum frequency</td> <td><b>16</b> = Lead torque, ((P214) multiplication)</td> </tr> <tr> <td><b>5</b> = Maximum frequency</td> <td><b>17</b> = Multiplication</td> </tr> <tr> <td><b>6</b> = Process controller actual value</td> <td><b>18</b> = Curve travel calculator</td> </tr> <tr> <td><b>7</b> = Process controller setpoint</td> <td><b>19</b> = Reserved</td> </tr> <tr> <td><b>8</b> = Actual frequency PI</td> <td><b>20</b> = BusIO InBits 0-7</td> </tr> <tr> <td><b>9</b> = Actual PI freq. limited</td> <td><b>21</b> = ...24 reserved</td> </tr> <tr> <td><b>10</b> = Actual PI freq. monitored</td> <td><b>31</b> = Digital output IOE, sets the state of DOUT of the first IOE</td> </tr> <tr> <td><b>11</b> = Torque current limit, "Torque current limited"</td> <td><b>32</b> = Analog output IOE, sets the value AOUT of the first IOE), condition: P418 = Function "31"</td> </tr> </table>	<b>0</b> = Off	<b>12</b> = Torque current switch-off, "Switch off at torque current limit"	<b>1</b> = Setpoint frequency, (16 bit)	<b>13</b> = Current limit, "Current limited"	<b>2</b> = Frequency addition	<b>14</b> = Current switch-off "Switch-off current limited"	<b>3</b> = Frequency subtraction	<b>15</b> = Ramp time, (P102/103)	<b>4</b> = Minimum frequency	<b>16</b> = Lead torque, ((P214) multiplication)	<b>5</b> = Maximum frequency	<b>17</b> = Multiplication	<b>6</b> = Process controller actual value	<b>18</b> = Curve travel calculator	<b>7</b> = Process controller setpoint	<b>19</b> = Reserved	<b>8</b> = Actual frequency PI	<b>20</b> = BusIO InBits 0-7	<b>9</b> = Actual PI freq. limited	<b>21</b> = ...24 reserved	<b>10</b> = Actual PI freq. monitored	<b>31</b> = Digital output IOE, sets the state of DOUT of the first IOE	<b>11</b> = Torque current limit, "Torque current limited"	<b>32</b> = Analog output IOE, sets the value AOUT of the first IOE), condition: P418 = Function "31"			
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<b>5</b> = Maximum frequency	<b>17</b> = Multiplication																											
<b>6</b> = Process controller actual value	<b>18</b> = Curve travel calculator																											
<b>7</b> = Process controller setpoint	<b>19</b> = Reserved																											
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<b>9</b> = Actual PI freq. limited	<b>21</b> = ...24 reserved																											
<b>10</b> = Actual PI freq. monitored	<b>31</b> = Digital output IOE, sets the state of DOUT of the first IOE																											
<b>11</b> = Torque current limit, "Torque current limited"	<b>32</b> = Analog output IOE, sets the value AOUT of the first IOE), condition: P418 = Function "31"																											
<b>P549</b>	<b>PotentiometerBox function</b> (PotentiometerBox function)		S																									
0 ... 3 { 1 }	<p>This parameter provides the possibility of adding a correction value (fixed frequency, analog, bus) to the current setpoint value by means of the SimpleBox/ParameterBox keyboard.</p> <p>The adjustment range is determined by the auxiliary setpoint value P410/411.</p> <table> <tr> <td><b>0</b> = Off</td> <td><b>2</b> = Frequency addition</td> </tr> <tr> <td><b>1</b> = <b>Setpoint frequency</b>, with(P509)≠ 1 control via USS is possible</td> <td><b>3</b> = Frequency subtraction</td> </tr> </table>	<b>0</b> = Off	<b>2</b> = Frequency addition	<b>1</b> = <b>Setpoint frequency</b> , with(P509)≠ 1 control via USS is possible	<b>3</b> = Frequency subtraction																							
<b>0</b> = Off	<b>2</b> = Frequency addition																											
<b>1</b> = <b>Setpoint frequency</b> , with(P509)≠ 1 control via USS is possible	<b>3</b> = Frequency subtraction																											

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P552</b>	<b>[-01] CAN Master cycle</b> <b>[-02] (CAN Master cycle time)</b>		S	

0 ... 100 ms  
{ all 2 }

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

**[01] = CAN Master function**, Cycle time for system bus master functions

**[02] = CANopen Abs. encoder**, "CANopen absolute encoder", system bus cycle time of absolute encoder

With the setting **0 = "Auto"** the default value (see table) is used.

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

Baud rate	Minimum value t <sub>z</sub>	Default system bus master	Default system bus abs.
10 kBaud	10 ms	50 ms	20 ms
20 kBaud	10 ms	25 ms	20 ms
50 kBaud	5 ms	10 ms	10 ms
100 kBaud	2 ms	5 ms	5 ms
125 kBaud	2 ms	5 ms	5 ms
250 kBaud	1 ms	5 ms	2 ms
500 kBaud	1 ms	5 ms	2 ms
1000 kBaud:	1 ms	5 ms	2 ms

<b>P555</b>	<b>P - limit chopper</b> <i>(P - limit chopper)</i>	Only relevant for size 2	S	
-------------	--	--------------------------	---	--

5 ... 100 %  
[ 100 ]

A power limit for the brake resistor can be programmed with this parameter. The switch-on time (modulation level) for the brake chopper can only increase to the maximum specified limit.

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

The correct percentage value is calculated as follows:  $k[\%] = \frac{R \times P_{\max BR}}{U_{\max}^2} \times 100\%$

R = Brake resistor resistance

P<sub>maxBR</sub> = short-term peak power of the brake resistor

U<sub>max</sub> = chopper switching wave from the FI

1~ 115/230V ⇒ 440V=

3~ 230V~ ⇒ 440V=

3~ 400V~ ⇒ 840V=

**NOTE:** If the internal brake resistor SK BRI4-... is used, a suitable limit must be set.

<b>P556</b>	<b>Brake resistor</b> <i>(Brake resistor)</i>	Only relevant for size 2	S	
-------------	--	--------------------------	---	--

20 ... 400 Ω  
{ 120 }

Value of the brake resistance for the calculation of the maximum brake power to protect the resistor.

Once the maximum continuous output (P557) including overload (200% for 60s) is reached, an I<sup>2</sup>t limit error (E003.1) is triggered. Further details in P737.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P557</b>	<b>Brake resistor power</b> ( <i>Brake resistor power</i> )	Only relevant for size 2	S	
0.00 ... 20.00 kW { 0.00 }	Continuous power (nominal power) of the resistor, to display the actual utilisation in P737. For a correctly calculated value, the correct value must be entered into P556 and P557.  <b>0.00 = Off</b> , monitoring disabled			
<b>P558</b>	<b>Magnetisation time</b> ( <i>Magnetisation time</i> )		S	P
0 / 1 / 2 ... 500 ms { 1 }	The ISD control can only function correctly if there is a magnetic field in the motor. For this reason, a DC current is applied before starting the motor. The duration depends on the size of the motor and is automatically set in the factory setting of the FI.  For time-critical applications, the magnetizing time can be set or deactivated.  <b>0 =</b> Switched off <b>1 =</b> Automatic calculation <b>2 ... 500 =</b> Time set in [ms]  <b>NOTE:</b> Setting values that are too low can reduce the dynamics and starting torque.			
<b>P559</b>	<b>DC run-on time</b> ( <i>DC run-on time</i> )		S	P
0.00 ... 30.00 sec { 0.50 }	Following a stop signal and the braking ramp, a direct current is briefly applied to the motor to fully bring the drive to a stop. Depending on the inertia, the time for which the current is applied can be set in this parameter.  The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic).			
<b>P560</b>	<b>Param. saving mode</b> ( <i>Parameter saving mode</i> )		S	
0 ... 2 { 1 }	<b>0 = Only in RAM</b> , changes to the parameter settings are no longer saved on the EEPROM. All previously saved settings are retained, even if the FI is disconnected from the mains.  <b>1 = RAM and EEPROM</b> , all parameter changes are automatically written to the EEPROM and remain stored there even if the FI is disconnected from the mains supply.  <b>2 = Off</b> , no saving in RAM <u>and</u> EEPROM possible <u>no</u> parameter changes are accepted  <b>NOTE:</b> If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles to the (memory module) EEPROM (100,000 x) is not exceeded.			

## 6.1.6 Information (Frequency inverter)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P700</b>	<b>[-01]</b> ... <b>[-03]</b> <b>Actual operating status</b> ( <i>Actual operating status</i> )			
0.0 ... 21.4	<p>Display of current messages for the present operating status of the frequency inverter such as faults, warnings or the reason why switch-on is disabled. For details of the messages, see Section 7</p> <hr/> <p><b>[-01] = Present fault</b>, shows the currently active (unacknowledged) fault (Section 7.2.1).  <b>[-02] = Present warning</b>, indicates a current warning message (Section 7.3)  <b>[-03] = Reason for disabled starting</b>, indicates the reason for an active start disable (Section 7.4)</p> <hr/> <p><b>Note</b></p> <p><i>SimpleBox</i>: with the Simplebox only warning messages and faults can be displayed. Display of the messages is in encoded form. For the description of the codes (warning/error numbers), please refer to the tables in Sections 7.2.1 and 7.3.</p> <p><i>ParameterBox</i>: with the ParameterBox the messages are displayed in plain text. In addition, the reason for a possible disabling of starting can also be displayed.</p> <p><i>Bus</i>: The display of bus-level error messages is made in decimal integer format. If this value is divided by 10, the display corresponds to that which is listed in Section 7.2.</p> <p>Example: Display: 20 → Error number 2.0</p>			
<b>P701</b>	<b>[-01]</b> ... <b>[-05]</b> <b>Last error 1...5</b> ( <i>Last fault 1...5</i> )			
0.0 ... 21.4	<p>This parameter stores the last 5 faults. (Details in Section 7 )</p> <p>With the SimpleBox the corresponding memory location 1...5 (Array parameter), must be selected and confirmed with the ENTER key in order to read the stored error code.</p>			
<b>P702</b>	<b>[-01]</b> ... <b>[-05]</b> <b>Freq. prev. error 1...5</b> ( <i>Frequency previous error 1...5</i> )		S	
-400.0 ... 400.0 Hz	<p>This parameter stores the output frequency that was being delivered at the time the fault occurred. The values of the last 5 errors are stored.</p> <p>With the SimpleBox, the corresponding memory location 1...5- (Array parameter) must be selected and confirmed using the OK key to read the stored error code.</p>			
<b>P703</b>	<b>[-01]</b> ... <b>[-05]</b> <b>Current previous fault 1...5</b> ( <i>Current previous fault 1...5</i> )		S	
0.0 ... 999.9 A	<p>This parameter stores the output current that was being delivered at the time the fault occurred. The values of the last 5 errors are stored.</p> <p>With the SimpleBox, the corresponding memory location 1...5- (Array parameter) must be selected and confirmed using the OK key to read the stored error code.</p>			
<b>P704</b>	<b>[-01]</b> ... <b>[-05]</b> <b>Vltg. previous error 1...5</b> ( <i>Voltage previous error 1...5</i> )		S	
0 ... 600 V AC	<p>This parameter stores the output voltage that was being delivered at the time the fault occurred. The values of the last 5 errors are stored.</p> <p>With the SimpleBox, the corresponding memory location 1...5- (Array parameter) must be selected and confirmed using the OK key to read the stored error code.</p>			



Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P709</b>	<b>Voltage analog input</b> (Voltage of analog input)			
-100.0 ... 100.0 %	Displays the measured analog input value.  [-01] = <b>Analog input 1</b> , Function of analog input 1 integrated into the FI [-02] = <b>Analog input 2</b> , Function of analog input 2 integrated into the FI [-03] = <b>Ext. Analog input 1</b> , AIN1 of the <u>first</u> I/O extension (SK xU4-IOE) [-04] = <b>Ext. Analog input 2</b> , AIN2 of the <u>first</u> I/O extension (SK xU4-IOE) [-05] = <b>Ext. A.in 1 2nd IOE</b> , AIN1 of the <u>second</u> I/O extension (SK xU4-IOE) [-06] = <b>Ext. A.in 2 2nd IOE</b> , AIN2 of the <u>second</u> I/O extension (SK xU4-IOE) [-07] = <b>Setpoint module</b>			
<b>P710</b>	<b>Analog output voltage</b> (Analog output voltage)			
0.0 ... 10.0 V	Displays the delivered value of analog output.  [-01] = <b>First IOE</b> , AOUT of the <u>first</u> I/O extension (SK xU4-IOE) [-02] = <b>Second IOE</b> , AOUT of the <u>second</u> I/O extension (SK xU4-IOE)			
<b>P711</b>	<b>State of relays</b> (State of digital output)			
00000 ... 11111 (bin) or 00 ... FF (hex)	Indicates the actual status of the digital outputs of the frequency inverter.  <b>Bit 0</b> = Digital output 1 <b>Bit 1</b> = Digital output 2 <b>Bit 2</b> = reserved <b>Bit 3</b> = reserved <b>Bit 4</b> = Digital output 1, IO extension 1 <b>Bit 5</b> = Digital output 2, IO extension 1 <b>Bit 6</b> = Digital output 1, IO extension 2 <b>Bit 7</b> = Digital output 2, IO extension 2			
		Bits 7-4	Bits 3-0	
	Minimum value	0000	0000	Binary
		0	0	hex
	Maximum value	1111	0011	Binary
		F	3	hex
	<b>SimpleBox:</b> The binary bits are converted to a hexadecimal value and displayed. <b>ParameterBox:</b> The bits are displayed with increasing values from right to left (binary).			
<b>P714</b>	<b>Operating time</b> (Operating time)			
0.00 ... ____ h	This parameter shows the time for which the FI was connected to the mains and was ready for operation.			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P715</b>	<b>Running time</b> ( <i>Enablement time</i> )			
0.00 ... ____ h	This parameter shows the time for which the FI was enabled and supplied current to the output.			
<b>P716</b>	<b>Actual frequency</b> ( <i>Actual frequency</i> )			
-400.0 ... 400.0 Hz	Displays the actual output frequency.			
<b>P717</b>	<b>Actual speed</b> ( <i>Actual rotation speed</i> )			
-9999 ... 9999 rpm	Displays the actual motor speed calculated by the FI.			
<b>P718</b>	<b>Current set freq.</b> ( <i>Actual setpoint frequency</i> )			
-400.0 ... 400.0 Hz	Displays the frequency specified by the setpoint. [-01] = Actual setpoint frequency from the setpoint source [-02] = Actual setpoint frequency after processing in the FI status machine [-03] = Actual setpoint frequency after frequency ramp			
<b>P719</b>	<b>Actual current</b> ( <i>Actual current</i> )			
0.0 ... 999.9 A	Displays the actual output current.			
<b>P720</b>	<b>Act. torque current</b> ( <i>Actual torque current</i> )			
-999.9 ... 999.9 A	Displays the actual calculated torque-developing output current (active current). Basis for calculation are the motor data P201...P209. → negative values = generator, → positive values = drive			
<b>P721</b>	<b>Actual field current</b> ( <i>Actual field current</i> )			
-999.9 ... 999.9 A	Displays the actual calculated field current (reactive current). Basis for calculation are the motor data P201...P209.			
<b>P722</b>	<b>Actual voltage</b> ( <i>Actual voltage</i> )			
0 ... 500 V	Displays the actual AC voltage supplied by the FI output.			
<b>P723</b>	<b>Voltage -d</b> ( <i>Actual voltage component Ud</i> )		S	
-500 ... 500 V	Displays the actual field voltage component.			
<b>P724</b>	<b>Voltage -d</b> ( <i>Actual voltage component Ud</i> )		S	
-500 ... 500 V	Displays the actual torque voltage component.			
<b>P725</b>	<b>Actual cos phi</b> ( <i>Actual cos φ</i> )			
0.00 ... 1.00	Displays the actual calculated cos φ of the drive.			
<b>P726</b>	<b>Apparent power</b> ( <i>Apparent power</i> )			
0.00 ... 99.99 kVA	Displays the actual calculated apparent power. Basis for calculation are the motor data P201...P209.			



Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P737</b>	<b>Usage rate brake res.</b> (Actual brake resistor usage rate)			
0 ... 1000 %	<p>This parameter provides information about the actual degree of modulation of the brake chopper or the current utilisation of the braking resistor in generator mode.</p> <p>If parameters P556 and P557 are correctly set, the utilisation related to P557, the resistor power, is displayed.</p> <p>If only P556 is correctly set (P557=0), the degree of modulation of the brake chopper is displayed. Here, 100 means that the brake resistor is fully switched. On the other hand, 0 means that the brake chopper is not active at present.</p> <p>If P556=0 and P557=0, this parameter also provides information about the degree of modulation of the brake chopper in the FI.</p>			
<b>P738</b>	<b>Usage rate motor</b> (Actual utilisation of motor)			
0 ... 1000 %	<p>Shows the actual motor load. Basis for calculation is the motor data P203. The actually recorded current is related to the nominal motor current.</p> <p><b>[-01] = related to <math>I_N</math> (P203) of the motor</b></p> <p><b>[-02] = related to <math>I^2t</math> monit., „related to <math>I^2t</math> monitoring“ (P535)</b></p>			
<b>P739</b>	<b>Heat sink temperature</b> (Heat sink temperature )			
-40 ... 150 °C	<p><b>[-01] = FI heat sink temperature</b></p> <p><b>[-02] = Internal temperature of the FI</b></p> <p><b>[-03] = Temp. Motor KTY</b>, motor temperature via KTY, recording exclusively via <u>IO extension</u>, setting in (P400) to function {30} "Motor temperature"</p>			
<b>P740</b>	<b>Process data Bus In</b> (Process data Bus In)		S	
0000 ... FFFF (hex)	<p>This parameter provides information about the actual control word (STW) and the setpoints (SW1-3) that are transferred via the bus systems.</p> <p>For values to be displayed, a bus system must be selected in P509.</p> <p>For standardisation of actual values: See also (Section 9.9).</p> <p><b>[-01] = Control word (P509)</b> Control word, source from (P509).</p> <p><b>[-02] = Setpoint 1 (P510-01) / (P546 [-01])</b></p> <p><b>[-03] = Setpoint 2 (P510-01) / (P546 [-02])</b> Setpoint data from main setpoint (P510 [-01]).</p> <p><b>[-04] = Setpoint 3 (P510-01) / (P546 [-03])</b></p> <p><b>[-05] = res. stat. In Bit P480</b> "Resulting status of In Bit P480" The displayed value depicts all Bus In bit sources linked with OR.</p> <p><b>[-06 ] = Parameter data In 1</b></p> <p><b>[-07 ] = Parameter data In 2</b> Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)</p> <p><b>[-08] = Parameter data In 3</b></p> <p><b>[-09] = Parameter data In 4</b></p> <p><b>[-10] = Parameter data In 5</b></p> <p><b>[-11] = Setpoint 1 (P510-01)</b></p> <p><b>[-12] = Setpoint 2 (P510-02)</b> Setpoint data from master function value (Broadcast), if P509/510 = 4 (P502/P503)</p> <p><b>[-13] = Setpoint 3 (P510-03)</b></p>			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set																				
<b>P741</b>	<b>[-01]</b> ... <b>[-10]</b> <b>Process data Bus Out</b> (Process data Bus Out)		S																					
0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems. For standardisation of actual values: See also (Section 9.9). <b>[-01] = Status word</b> Status word <b>[-02] = Actual value 1 (P543 [-01])</b> <b>[-03] = Actual value 2 (P543 [-02])</b> <b>[-04] = Actual value 3 (P543 [-03])</b> <b>[-05] = res. stat. In Bit P481</b> "Resulting status of In Bit P481" <b>[-06] = Parameter data 1</b> <b>[-07] = Parameter data Out 2</b> <b>[-08] = Parameter data Out 3</b> Data during parameter transfer. <b>[-09] = Parameter data Out 4</b> <b>[-10] = Parameter data Out 5</b>																							
<b>P742</b>	<b>Database version</b> (Database version)		S																					
0 ... 9999	Displays the internal database version of the FI.																							
<b>P743</b>	<b>Inverter type</b> (Inverter type)																							
0.25 ... 11.00kW	Displays the inverter power in kW, e.g. "1.50" ⇒ FI with 1.5 kW nominal power.																							
<b>P744</b>	<b>Configuration level</b> (Configuration level)																							
0000 ... FFFF (hex)	This parameter displays the special devices integrated in the FI. Display is in hexadecimal code (SimpleBox, ControlBox, Bus System). The display is in plain text when the ParameterBox is used.																							
	<table border="1"> <thead> <tr> <th colspan="2">High byte:</th> <th colspan="2">Low byte:</th> </tr> </thead> <tbody> <tr> <td>00<sub>hex</sub></td> <td>No extension</td> <td>00<sub>hex</sub></td> <td>Standard I/O (SK 180E)</td> </tr> <tr> <td>01<sub>hex</sub></td> <td>---</td> <td>01<sub>hex</sub></td> <td>ASI (SK 190E)</td> </tr> <tr> <td>02<sub>hex</sub></td> <td>---</td> <td></td> <td></td> </tr> <tr> <td>03<sub>hex</sub></td> <td>---</td> <td></td> <td></td> </tr> </tbody> </table>	High byte:		Low byte:		00 <sub>hex</sub>	No extension	00 <sub>hex</sub>	Standard I/O (SK 180E)	01 <sub>hex</sub>	---	01 <sub>hex</sub>	ASI (SK 190E)	02 <sub>hex</sub>	---			03 <sub>hex</sub>	---					
High byte:		Low byte:																						
00 <sub>hex</sub>	No extension	00 <sub>hex</sub>	Standard I/O (SK 180E)																					
01 <sub>hex</sub>	---	01 <sub>hex</sub>	ASI (SK 190E)																					
02 <sub>hex</sub>	---																							
03 <sub>hex</sub>	---																							
<b>P747</b>	<b>Inverter Volt. Range</b> (Inverter voltage range)																							
0 ... 2	Indicates the mains voltage range for which this device is specified. <b>0 = 100...120 V</b> <b>1 = 200...240 V</b> <b>2 = 380...480 V</b>																							

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P748</b>	<b>CANopen status</b> (CANopen status (system bus status))			

0000 ... FFFF (hex)

Shows the status of the system bus.

or

0 ... 65535 (dec)

Bit 0:	24V Bus supply voltage
Bit 1:	CANbus in "Bus Warning" status
Bit 2:	CANbus in "Bus Off" status
Bit 3:	System bus → Bus module online (field bus module, e.g.: SK xU4-PBR)
Bit 4:	System bus → Additional module 1 online (I/O - module, e.g.: SK xU4-IOE)
Bit 5:	System bus → Additional module 2 online (I/O - module, e.g.: SK xU4-IOE)
Bit 6:	The protocol of the CAN module is    0 = CAN / 1 = CANopen
Bit 7:	Vacant
Bit 8:	"Bootup Message" sent
Bit 9:	CANopen NMT State
Bit 10:	CANopen NMT State

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

<b>P749</b>	<b>Status of DIP switches</b> (Status of DIP switches)			
-------------	---	--	--	--

0000 ... 0007 (hex)

This parameter shows the actual setting of the FI DIP switch "S1" (See Section 5.2.2.2)

or

0 ... 007 (dec)

Bit 0:	DIP switch 1
Bit 1:	DIP switch 2
Bit 2:	DIP switch 3

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P750</b>	<b>Overcurrent statistic</b> ( <i>Overcurrent statistic</i> )		S	
0 ... 9999	Number of overcurrent messages during the operating period P714.			
<b>P751</b>	<b>Stat. Overvoltage</b> ( <i>Overvoltage statistic</i> )		S	
0 ... 9999	Number of overvoltage messages during the operating period P714.			
<b>P752</b>	<b>Stat. mains failure</b> ( <i>Mains failure statistics</i> )		S	
0 ... 9999	Number of mains faults during the operating period P714.			
<b>P753</b>	<b>Stat. overtemperature</b> ( <i>Overheating statistics</i> )		S	
0 ... 9999	Number of overtemperature faults during the operating period P714.			
<b>P754</b>	<b>Stat. parameter lost</b> ( <i>Parameter loss statistic</i> )		S	
0 ... 9999	Number of parameters lost during the operating period P714.			
<b>P755</b>	<b>Stat. system error</b> ( <i>System faults statistics</i> )		S	
0 ... 9999	Number of system faults during the operating period P714.			
<b>P756</b>	<b>Stat. Timeout</b> ( <i>Time out statistics</i> )		S	
0 ... 9999	Number of Time out errors during the operating period P714.			
<b>P757</b>	<b>Stat. Customer error</b> ( <i>Customer faults statistic</i> )		S	
0 ... 9999	Number of Customer Watchdog faults during the operating period P714.			
<b>P760</b>	<b>Actual mains current</b> ( <i>Actual mains current</i> )		S	
0.0 ... 999.9 A	Displays the actual input current.			
<b>P799</b>	<b>Op.-time last error</b> ( <i>Operating time, last fault</i> )			
0.00 ... ___ h	[-01] ... [-05]	This parameter shows the operating hours counter status (P714) at the moment of the previous fault. Array [-01] ... [-05] corresponds to the last fault 1 ... 5.		

## 6.2 Parameterisation of I/O - extension SK xU4-IOE-...

In order to access the parameters of the I/O extension, the parameterisation tool (ParameterBox, NORD CON) must be connected directly to the device.

If the I/O extension is on an active system bus, it can be accessed with the ParameterBox SK PAR-3H or the NORD CON software as well as via another device (e.g. frequency inverter SK 1x0E). After the bus scan, it is only necessary to select the I/O extension (menu item SK PAR-3H: "Object selection").

### 6.2.1 Basic parameter (I/O - extension)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P150</b>	<b>Set relay</b> (Set relays)	SK TU4-IOE		
0 ... 4 { 0 }	The switching statuses of the digital outputs (only SK TU4 IOE) can be changed.  <b>0 = Via bus:</b> all digital outputs are controlled via the system bus, the functions are defined in the frequency inverter (P480) <b>1 = Outputs OFF:</b> all digital outputs are off (Low = 0V) <b>2 = Output 1 ON (DO1):</b> digital output DO1 is set to "High" (active), digital output DO2 remains switched off <b>3 = Output 2 ON (DO2):</b> digital output DO2 is set to "High" (active), digital output DO1 remains switched off <b>4 = Outputs 1 and 2 ON:</b> all digital outputs are set to "High" (active)			
<b>P152</b>	<b>Factory setting</b> (Factory setting)			
0 ... 2 { 0 }	By selecting the appropriate value and confirming it with the OK key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0.  <b>0 = No change:</b> Does not change the parameterisation. <b>1 = Load factory setting:</b> The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost. <b>2 = Calibration AOUT:</b> The accuracy of the analog output can be improved with a correction line, however, this is not activated as standard. If factory settings (P152={ 1 }) are loaded, the correction values are retained. A calibration is carried out if (P152) is set to { 2 }, i.e. the line is re-recorded and stored in the EEPROM.			
<b>P153</b>	<b>Min. system bus cycle time</b> (Minimum system bus cycle time)			
0 ... 250.00 ms { [-01] = 10 } { [-02] = 5 }	To reduce the load on the system bus, the transmission cycle time of the <b>Service Data Objects</b> and <b>Process Data Objects</b> may be increased.  <b>[-01] = SDO Inhibit Time</b> <b>[-02] = PDO Inhibit Time</b>			
<b>P160</b>	<b>Set analog output</b> (Set analog output)			
-0.1 ... 10.0 V { -0.1 }	The analog output can output a defined value, which is independent of the system bus.  <b>-0.1</b> = Control voltage via system bus <b>0.0 .... 10.0</b> = Voltage value in V			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P161</b>	<b>Filter time</b> (Filter time)			
0 ... 400.00 ms { [-01] = 100 } { [-02] = 100 } { [-03] = 0 } { [-04] = 2 } { [-05] = 2 } { [-06] = 2 } { [-07] = 2 } { [-08] = 0 } { [-09] = 0 }	<p>The analog and digital inputs are read cyclically every 250µs, this results in an input uncertainty of 0.25ms. In order to eliminate bounce and smooth the input signals, the information which is read in is passed through a filter routine. The filter time can be parameterised</p> <p>If, for example, a filter time of 1 ms is parameterised for a digital input, the input signal is delayed by approx. 1...1.25ms.</p> <p>The parameterisation of the filter time for the analog outputs is used to round off signal jumps.</p> <p><b>[-01] = AIN1</b> <b>[-02] = AIN2</b> <b>[-03] = AOUT</b> <b>[-04] = DIN1</b> <b>[-05] = DIN2</b></p>			
		<b>[-06] = DIN3</b> (SK TU4-IOE only)	<b>[-07] = DIN4</b> (SK TU4-IOE only)	<b>[-08] = DOUT1</b> (SK TU4-IOE only) <b>[-09] = DOUT2</b> (SK TU4-IOE only)
<b>P162</b>	<b>Send broadcast</b> (Send broadcast)			
0 ... 1 { 0 }	<p>Activation of this parameter (setting <b>On</b> → <b>1</b>) switches the I/O extension module into broadcast mode and thus enables simultaneous access by up to four frequency inverters. Each frequency inverter evaluates the information from the I/O extension individually.</p> <p>The addressing of the module (DIP switches) is no longer taken into account.</p> <p><b>0</b> = Off <b>1</b> = To:</p> <p><b>NOTE:</b> The received data are linked in the I/O module using OR logic. If several frequency inverters are linked to the digital outputs of the module, the relevant output is set to "High" as soon as an inverter accesses it. The analog outputs behave in a similar manner. Here, the highest value has priority.</p>			
<b>P163</b>	<b>AOut Inverse</b> (Invert analog output)			
0 ... 1 { 0 }	<p>The function of the analog output can be inverted</p> <p><b>0</b> = No inversion <b>1</b> = Analog output signal is inverted</p>			

## 6.2.2 Information (I/O - extension)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
<b>P170</b>	... [-01] ... [-02]			
0 ... 9999	<p><b>Present error</b> (<i>Present error</i>)</p> <p>Actual error present. Further details in Section 7 "Operating status messages".</p> <p>... [-01 ] = Current module error            ... [-02 ] = Last module error</p> <p><b>Possible displayed values:</b></p> <p><b>1000</b> = EEPROM error  <b>1030</b> = System bus OFF  <b>2000</b> = DIP changed  <b>2001</b> = DIP configuration error / not permissible  <b>2010</b> = Analog output error  <b>2020</b> = Inverter does not support SK xU4-IOE (Error not associated with SK 1x0E possible)</p>			
<b>P171</b>	... [-01] ... ... [-03]			
0.0 ... 9999.9	<p><b>Software version</b> (<i>Software version/ revision</i>)</p> <p>This parameter shows the software and revision numbers in the module. Array [-03] provides information about any special versions of the hardware or software A zero stands for the standard version.</p> <p>... [-01] = <b>Software Version 1</b>, "<i>Version number</i>": (e.g.: <b>V1.0</b>)            ... [-02] = <b>Software Version 2</b>, "<i>Version number</i>": (e.g.: <b>R1</b>)            ... [-03] = <b>Software Version 3</b>, "<i>Version number</i>": (e.g.: <b>0</b>)</p>			
<b>P172</b>	<b>Configuration level</b> ( <i>Configuration level</i> )			
0 ... 2	<p>This parameter displays the functions or variants integrated into the module.</p> <p><b>0</b> = <b>Internal bus module</b> (SK CU4-...)  <b>1</b> = <b>External bus module</b> (SK CU4-...)  <b>2</b> = <b>BUS Technology Unit via SPI</b></p>			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set															
<b>P173</b>	<b>Module status</b> ( <i>Status of the module</i> )																		
0 ... FFFF (hex)	<p><b>Possible displayed values:</b></p> <ul style="list-style-type: none"> <li>Bit 0 = not used</li> <li>Bit 1 = not used</li> <li>Bit 2 = not used</li> <li>Bit 3 = not used</li> <li>Bit 4 = not used</li> <li>Bit 5 = not used</li> <li>Bit 6 = System bus "BUS WARNING"</li> <li>Bit 7 = System bus "BUS OFF"</li> <li>Bit 8 = Status FI1 (Low - Bit)</li> <li>Bit 9 = Status FI1 (High - Bit)</li> <li>Bit 10= Status FI2 (Low - Bit)</li> <li>Bit 11= Status FI2 (High - Bit)</li> <li>Bit 12= Status FI3 (Low - Bit)</li> <li>Bit 13= Status FI3 (High - Bit)</li> <li>Bit 14= Status FI4 (Low - Bit)</li> <li>Bit 15= Status FI4 (High - Bit)</li> </ul> <p><b>Status for FI x:</b></p> <table border="1"> <thead> <tr> <th>BIT High</th> <th>BIT Low</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>FI is offline</td> </tr> <tr> <td>0</td> <td>1</td> <td>Unknown FI</td> </tr> <tr> <td>1</td> <td>0</td> <td>FI is online</td> </tr> <tr> <td>1</td> <td>1</td> <td>FI lost (switched off)</td> </tr> </tbody> </table>	BIT High	BIT Low	Meaning	0	0	FI is offline	0	1	Unknown FI	1	0	FI is online	1	1	FI lost (switched off)			
BIT High	BIT Low	Meaning																	
0	0	FI is offline																	
0	1	Unknown FI																	
1	0	FI is online																	
1	1	FI lost (switched off)																	
<b>P174</b>	<b>State of digital in.</b> ( <i>Status of digital inputs</i> )																		
0 ... 15	<p>Instantaneous image of input level logic of the digital inputs.</p> <p><b>Possible displayed values:</b></p> <ul style="list-style-type: none"> <li>Bit 0= Input 1 ((DIN1) (of the BUS module))</li> <li>Bit 1= Input 2 ((DIN2) (of the BUS module))</li> <li>Bit 2= Input 3 ((DIN3) (of the BUS module))</li> <li>Bit 3= Input 4 ((DIN4) (of the BUS module))</li> </ul>																		
<b>P175</b>	<b>Relay status</b> ( <i>State of relays</i> )	SK TU4-IOE																	
0 ... 3	<p>Instantaneous image of output level logic of the digital output.</p> <p><b>Possible displayed values:</b></p> <ul style="list-style-type: none"> <li>Bit 1= Output 1 ((DO1) (of the BUS module))</li> <li>Bit 2= Output 2 ((DO2) (of the BUS module))</li> </ul>																		
<b>P176</b>	<b>Actual voltage</b> ( <i>Actual voltage</i> )																		
0.0 ... 10.0 V	<p>Displays the voltage level of the signals at the analog inputs/outputs of the I/O extension module.</p> <ul style="list-style-type: none"> <li>... [-01] = Current voltage (AIN1)</li> <li>... [-02] = Current voltage (AIN2)</li> <li>... [-03] = Current voltage (AOUT)</li> </ul>																		

## 7 Operating status messages

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

Display of the Technology Unit messages is carried out via parameter (P170). The messages generated for the frequency inverter are displayed in the corresponding array of parameter (P700).

### Frequency inverter start disabled

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

Display is only possible with the NORD CON software or the ParameterBox (SK PAR-3H).

### 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 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 frequency inverters to switch off, in order to prevent a device fault.

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

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

An error message can only be acknowledged if its direct cause is no longer present.

<b>FI / DS LED:</b>	<p>This LED (Section 4.1) is dual-colour and can therefore indicate both a ready or an error status of the FI.</p> <p><b>Green</b> indicates the standby status and the presence of mains voltage. During operation an increasingly rapid flashing code indicates the degree of overload of the FI output.</p> <p><b>Red</b> indicates the presence of an error by flashing with a frequency which corresponds to the number code of the fault (Section 7.2).</p>
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## 7.1 SimpleBox display

The **SimpleBox** 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 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 current 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.

## 7.2 Table of possible error messages

### 7.2.1 Table of possible error messages in the frequency inverter

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P700[-01] / P701		
E001	<b>1.0</b>	<b>Overtemp. inverter</b> "Inverter overtemperature" (inverter heat sink)	Error signal from output stage module (static) Reduce ambient temperature <50°C or <40°C (see also Section 8 Technical data)
	<b>1.1</b>	<b>Overtemp. FI internal</b> "Internal overtemperature of FI" (interior of inverter)	Check control cabinet ventilation Increase ambient temperature, > - 25°C
E002	<b>2.0</b>	<b>Overtemp. Motor PTC</b> "Overtemperature of motor PTC" (from thermistor)	Motor temperature sensor has triggered Reduce motor load Increase motor speed Use external motor fan
	<b>2.1</b>	<b>Overtemperature motor I<sup>2</sup>t</b> "I <sup>2</sup> t motor overtemperature"  Only if I <sup>2</sup> t motor (P535) is programmed.	I <sup>2</sup> t motor has triggered Reduce motor load Increase motor speed
	<b>2.2</b>	<b>Overtemp. Brake R.ext.</b> "Overtemperature of external brake resistor"  Overtemperature via digital input (P420 [...])={13}	Temperature monitor has triggered (only size 2) Digital input is Low

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy	
Group	Details in P700[-01] / P701			
E003	<b>3.0</b>	<b>I<sup>2</sup>t overcurrent limit</b>	Rectifier I <sup>2</sup> t limit has triggered, e.g. > 1,5 x I <sub>n</sub> for 60s (Please also note P504) Continuous overload at inverter output	
	<b>3.1</b>	<b>Chopper overtemperature I<sup>2</sup>t</b>	I <sup>2</sup> t limit for brake chopper triggered (Only Size II) (1.5 times the value has been reached for a period of 60s) (please also note P555, P556, P557) Avoid overcurrent in brake resistance	
	<b>3.2</b>	<b>Overcurrent IGBT monitoring 125%</b>	De-rating (power reduction) 125% overcurrent for 50ms Brake chopper current too high for fan drives: enable flying start circuit (P520)	See also Section 9.4
	<b>3.3</b>	<b>Overcurrent IGBT monitoring 150%</b>	De-rating (power reduction) 150% overcurrent Brake chopper current too high	
E004	<b>4.0</b>	<b>Overcurrent module</b>	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 (Section 8) <b>The occurrence of this fault can cause a considerable reduction of the service life, including the destruction of the device.</b>	
	<b>4.1</b>	<b>Overcurrent current measurement</b> <i>"Overcurrent from overcurrent measurement"</i>	P537 (pulse current switch-off) was reached 3x within 50ms (only possible if P112 and P536 are disabled) FI is overloaded (Drive unit sluggish, too small, Ramps (P102/P103) to steep → Increase ramp time) Check motor data (P201 ... P209)	
E005	<b>5.0</b>	<b>Overvoltage DC link voltage</b>	DC link voltage is too high Reduce energy return by means of a braking resistance (only size 2) Extend deceleration time (P103) If necessary, set switch-off mode (P108) with delay (not for lifting equipment) Extend emergency stop time (P426)	
	<b>5.1</b>	<b>Mains overvoltage</b>	Mains voltage is too high Please check 380 V -20% ... 480 V +10% or 200 ... 240 V ± 10%	
E006	---	<b>Reserved</b>		
E007	---	<b>Reserved</b>		

Display in the SimpleBox		Fault	Cause
Group	Details in P700[-01] / P701	Text in the ParameterBox	Remedy
E008	<b>8.0</b>	<b>Parameter loss</b> (maximum EEPROM value exceeded)	Error in EEPROM data  Software version of the stored data set not compatible with the software version of the FI.  <b>NOTE:</b> <u>Faulty parameters</u> are automatically reloaded (default data).  EMC interferences (see also E020)
	<b>8.1</b>	<b>Inverter type incorrect</b>	EEPROM faulty
	<b>8.2</b>	<b>External copying error</b>	--
	<b>8.3</b>	<b>EEPROM KSE error</b>  (Customer interface incorrectly identified (customer's interface equipment))	The upgrade level of the frequency inverter was not correctly identified.
	<b>8.4</b>	<b>Internal EEPROM error</b>  (Database version incorrect)	Switch mains voltage off and on again.
	<b>8.7</b>	<b>EEPR copy not the same</b>	
E009	---	<b>Reserved</b>	

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P700[-01] / P701		
E010	<b>10.0</b>	<b>Bus Timeout</b> (Telegram time-out / Bus off 24V int. CANbus)	Data transfer is faulty. Check P513. Check physical bus connections. Check bus protocol program process. Check Bus Master. Check 24V supply of internal CAN/CANopen Bus. <i>Nodeguarding</i> error (internal CANopen) <i>Bus Off</i> error (internal CANbus)
	<b>10.2</b>	<b>Bus Timeout Option</b> (Telegram timeout)	Telegram transfer is faulty. Check physical connections. Check bus protocol program process. Check Bus Master.
	<b>10.4</b>	<b>Init error Option</b> (Initialisation error in bus module)	Check Bus module current supply. DIP switch setting of a connected I/O extension module is incorrect
	<b>10.1</b>	<b>System error option</b> (Bus module)	Further details can be found in the respective additional BUS operating instructions. <u>I/O extension:</u> Incorrect measurement of the input voltage or undefined provision of the output voltage due to error in reference voltage generation. Short circuit at analog output
	<b>10.3</b>		
	<b>10.5</b>		
	<b>10.6</b>		
<b>10.7</b>			
<b>10.9</b>	<b>Module missing / P120</b>	The module entered in parameter (P120) is not available.	
E011	<b>11.0</b>	<b>Customer interface</b> (AnalogDigital converter error)	Internal customer unit (internal databus) faulty or damaged by radio radiation (EMC) Check control terminals connection for short-circuit. Minimize EMC interference by laying control and power cables separately. Device and shielding must be well earthed.

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P700[-01] / P701		
E012	<b>12.0</b>	<b>External watchdog</b>	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<.
	<b>12.1</b>	<b>Motor limit</b> <i>"Motor switch-off limit"</i>	The drive switch-off limit (P534 [-01]) has triggered. Reduce load on motor Set higher value in (P534 [-01]).
	<b>12.2</b>	<b>Generator limit</b> <i>"Generator switch-off limit"</i>	The generator switch-off limit (P534 [-02]) has triggered. Reduce load on motor Set higher value in (P534 [-02]).
	<b>12.3</b>	<b>Torque limit</b>	Limit from potentiometer or setpoint source has switched off. P400 = 12
	<b>12.4</b>	<b>Current limit</b>	Limit from potentiometer or setpoint source has switched off. P400 = 14
	<b>12.5</b>	<b>Load limit</b>	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).
	<b>12.8</b>	<b>Analog In minimum</b>	Switch-off due to undershooting of the 0% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "...2"
	<b>12.9</b>	<b>Analog In maximum</b>	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	<b>13.2</b>	<b>Shut-down monitoring</b>
E014		Reserved	

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P700[-01] / P701		
E015	<b>15.0</b>	<b>Reserved</b>	
E016	<b>16.0</b>	<b>Motor phase error</b>	A motor phase is not connected. Check P539 Check motor connection
	<b>16.1</b>	<b>Magn. current monitoring</b> <i>"Magnetisation current monitoring"</i>	Required exciting current not achieved at moment of switch-on. Check P539 Check motor connection
E018		<b>Reserved</b>	
E019	<b>19.0</b>	<b>Parameter ident.</b> <i>"Parameter identification"</i>	Automatic identification of the connected motor was unsuccessful
	<b>19.1</b>	<b>Star delta incorr.</b> <i>"Motor star/delta switching incorrect"</i>	Check motor connection Check preset motor data (P201 ... P209)
E020	<b>20.0</b>	<b>Reserved</b>	
E021	<b>20.1</b>	<b>Watchdog</b>	
	<b>20.2</b>	<b>Stack overflow</b>	
	<b>20.3</b>	<b>Stack underflow</b>	
	<b>20.4</b>	<b>Undefined opcode</b>	
	<b>20.5</b>	<b>Protected Instruct.</b> <i>"Protected Instruction"</i>	
	<b>20.6</b>	<b>Illegal word access</b>	System error in program execution, triggered by EMC interference.
	<b>20.7</b>	<b>Illegal Inst. Access</b> <i>"Illegal Instruction Access"</i>	Please comply with wiring guidelines in Section 2.5.
	<b>20.8</b>	<b>Prog.mem. error</b> <i>"Program memory error"</i> (EEPROM error)	Use additional external mains filter. (Section 9.3 / 9.3.3 (EMC)) FI must be very well earthed.
	<b>20.9</b>	<b>Reserved</b>	
	<b>21.0</b>	<b>NMI error</b> (not used by hardware)	
	<b>21.1</b>	<b>PLL error</b>	
	<b>21.2</b>	<b>ADU error</b>	
	<b>21.3</b>	<b>PMI error</b>	
	<b>21.4</b>	<b>Userstack Overflow</b>	

## 7.2.2 Table of possible error messages in the I/O extension module

Error number		Fault	Cause
Group	Details in P170	Text in the ParameterBox	Remedy
<b>E1000</b>	<b>1000</b>	<b>EEPROM error</b>	EMC interference on the SPI bus Module faulty
	<b>1030</b>	<b>System bus OFF</b>	Check connections and supply cables Ensure 24 V voltage supply Check bus master.
<b>E2000</b>	<b>2000</b>	<b>DIP changed</b>	DIP switch configuration changed during operation
	<b>2001</b>	<b>DIP configuration incorrect</b>	Illegal DIP switch setting Check DIP switch setting. Note coding of analog inputs and outputs!
	<b>2010</b>	<b>Analog output error</b>	Check switching of 10V reference voltage Short circuit of analog output Analog output overload (max. 10 mA) Calibration error (P152) A range error has occurred during measurement of the correction values The measured values could not be saved in the EEPROM
	<b>2020</b>	<b>Inverter does not support SK xU4-IOE</b>	The connected frequency inverter does not support the IO extension. (Fault not associated with SK 1x0E possible)

### 7.3 Table of possible warning messages

Display		Warning Text in the ParameterBox	Cause Remedy
Group	Details in P700 [-02]		
C001	1.0	<b>Overtemp. inverter</b> "Inverter overtemperature" (inverter heat sink)	Warning from output stage module (static) Reduce ambient temperature <50°C or <40°C (see also Section 8 Technical data) Check ventilation
C002	2.0	<b>Overtemp. Motor PTC</b> "Overtemperature of motor PTC" (from thermistor)	Warning from motor temperature sensor (triggering threshold reached) Reduce motor load Increase motor speed Use external motor fan
	2.1	<b>Overtemperature motor I<sup>2</sup>t</b> "I <sup>2</sup> t" motor overtemperature  Only if I <sup>2</sup> t motor (P535) is programmed.	Warning: I <sup>2</sup> t- motor monitoring (1.3 times the rated current reached for the time period specified in (P535)) Reduce motor load Increase motor speed
	2.2	<b>Overtemp. Brake R.ext.</b> "Overtemperature of external brake resistor"  Overtemperature via digital input (P420 [...])={13}	Warning: Temperature monitor has triggered (only Size 2) Digital input is Low
C003	3.0	<b>I<sup>2</sup>t overcurrent limit</b>	Warning: Converter I <sup>2</sup> t limit, (e.g. output current > rated current for FI) (1.3 times the rated inverter current reached for a period of 60s)  Continuous overload at inverter output (Please also note P504)
	3.1	<b>Chopper overtemperature I<sup>2</sup>t</b>	Warning: I <sup>2</sup> t limit for brake chopper triggered (only Size II) (1.3 times the value has been reached for a period of 60s) (please also note P555, P556, P557) Avoid overcurrent in brake resistance
	3.5	<b>Torque current limit</b>	Warning: Torque current limit reached (P112)
	3.6	<b>Current limit</b>	Warning: Current limit reached (P536)
C004	4.1	<b>Overcurrent current measurement</b> "Overcurrent from 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 Check motor data (P201 ... P209)

Display		Warning	Cause
Group	Details in P700 [-02]	Text in the ParameterBox	Remedy
C008	8.0	<b>Parameter loss</b>	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	<b>Motor limit</b> <i>"Motor switch-off limit"</i>	Warning: 80% of the drive torque switch-off limit (P534 [-01]) has been exceeded.  Reduce load on motor Set higher value in (P534 [-01]).
	12.2	<b>Generator limit</b> <i>"Generator switch-off limit"</i>	Warning: 80% of the generator torque switch-off limit (P534 [-02]) has been exceeded.  Reduce load on motor Set higher value in (P534 [-02]).
	12.3	<b>Torque limit</b>	Warning: 80% of the limit from the potentiometer or the setpoint source has been reached. P400 = 12
	12.4	<b>Current limit</b>	Warning: 80% of the limit from the potentiometer or the setpoint source has been reached. P400 = 14
	12.5	<b>Load limit</b>	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).

## 7.4 Table of possible reasons for the operating status "switch-on disabled"

The following table summarises the messages which are generated if the frequency inverter cannot be enabled, although no **fault** is present.

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

## 8 Technical data

### 8.1 General data for frequency inverter series SK 1x0E

Function	Specification	
Output frequency	0.0 ... 400.0 Hz	
Pulse frequency	3.0 ... 16.0 kHz, standard setting = 6 kHz Power reduction > 8 kHz for 115/230V device, >6 kHz for 400 V device.	
Typical overload capacity	150% for 60 s, 200% for 3.5 s	
Protection measures against	Overtemperature of the frequency inverter, Short-circuit, earthing fault, overvoltage and undervoltage overload, idling	
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic curve, automatic flux adaptation (energy-saving function)	
Motor temperature monitoring	I <sup>2</sup> t motor, PTC / Bimetal switch	
Digital input	3x low 0-5 V, high 14-30 V, R <sub>i</sub> = 9.5 kΩ, C <sub>i</sub> = 10 nF, cycle time = 4 ms	
Electrical isolation	Control terminals	
Control outputs	digital output: 24V±25% DC, max. 20mA, max. 1.2kΩ Load	
Interfaces	Standard: RS 485 (USS) – only for Parameter boxes RS 232 (Single Slave) System bus	Option: Profibus, CANopen, DeviceNet, AS-Interface, EtherCAT, PROFINET, POWERLINK, Ethernet/IP
Efficiency of frequency inverter	> 95% according to size	
Storage and transport temperature	-25°C ... +60/70°C	
Operating / ambient temperature	-25°C ... +50°C, according to operating mode (Details: Section 8.2) ATEX: -20...+40°C (Details: Section 2.10)	
Long-term storage	See Section 9.11.1	
Protection class	IP55, optional IP66	
Max. installation altitude above sea level	Up to 1000 m: No power reduction 1000...4000 m: 1%/ 100 m power reduction (up to 2000m overvoltage cat. 3) 2000...4000 m: Only overvoltage category 2 is maintained, external overvoltage protection at the mains input is necessary	
Ambient conditions	Transport (IEC 60721-3-2): Operation (IEC 60721-3-3):	Vibration: 2M2 Vibration: 3M7; Climate: 3K3 (IP55) / 3K4 (IP66)
Waiting time between two mains switching cycles	60 sec for all devices in normal operating cycle	
Mains/motor/brake resistance	4mm <sup>2</sup> flexible cable with wire end sleeves, 6mm <sup>2</sup> with rigid cable	Terminal screw tightening torque 0.5...0.6 Nm
Control unit /System bus	1.5mm <sup>2</sup> , rigid and flexible cable with wire end sleeves, 0.75mm <sup>2</sup> flexible cable with wire end sleeves with plastic sleeves	
RS485 / RS232	1x RJ12 (6-pin)	
24V - Output (Terminal 43)	24 V DC ± 25%, max. 150 mA <sup>3</sup>	
Digital outputs	24 V DC ± 25%, max. 20 mA	

<sup>3</sup> The current which is drawn from the digital outputs must also be covered by this. Any control modules which are connected to the RJ12 socket also place a load on the 24V supply. (150mA = I<sub>DIG1</sub> + I<sub>DIG2</sub> + I<sub>OUT</sub> + I<sub>CONTROL</sub>)

## 8.2 Electrical data for frequency inverter

The following table lists the electrical data for SK1x0E series frequency inverters. The details based on measurement series for the operating modes are for orientation purposes and may deviate in practice. The measurement series were made at the rated speed with 4-pole NORD standard motors

The following factors have a particular influence on the determined limiting values:

### Wall-mounting

- Installation location
- Influence from adjacent devices
- Additional air currents

and also with

### Motor Assembly

- type of motor used,
- size of motor used
- speed of self-ventilated motors
- use of external fans

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#### NOTE



The powers stated for the operating modes are only a rough categorization.

The current values are more reliable details for the selection of the correct frequency inverter/motor combination!

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The following tables include the data relevant for UL.

Details of the UL /cUL approval conditions can be found in Section 1.5.2

More detailed information can be obtained from Getriebebau NORD.

## 8.2.1 Electrical data 1~115V

		Size 1				
Device type:	SK 1x0E...	-250-112-O	-370-112-O	-550-112-O	-750-112-O	
Nominal motor power	230 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	
(4-pole standard motor)	240 V	1/3 hp	1/2 hp	3/4 hp	1 hp	
Input	Mains voltage	1~ 115 V				
	Typical input current at 115V	1 AC 110 ... 120 V, ± 10%, 47 ... 63 Hz				
		1~ rms	9.1 A	11 A	14.3 A	18 A
	1~ FLA	9.1 A	11 A	14.3 A	18 A	
	Rec. mains fuse	1 AC slow-acting [A]	16 A	16 A	16 A	25 A
	Permissible mains fuses (UL)	RK5 or faster fuses, min. 115V	30 A	30 A	30 A	30 A
Bussmann		FRS-R-30	FRS-R-30	FRS-R-30	FRS-R-30	
Circuit breaker* min. 115 V		25 A	25 A	25 A	25 A	
Output	Output voltage	3~ 230 V				
	Nominal output current at 230V	rms	3 AC 0 – 2x mains voltage			
		Motor Assembly**	1.7 A	2.1 A	3.0 A	3.7 A
		Wall-mounted**	1.7 A	2.1 A	3.0 A	3.4 A
Motor mounting (ventilation with motor fan)						
Max. continuous power / max. continuous current:						
	S1-50°C	0.25 kW / 1.7 A	0.37 kW / 2.1 A	0.55 kW / 2.6 A	0.55 kW / 2.9 A	
	S1-40°C	0.25 kW / 1.7 A	0.37 kW / 2.1 A	0.55 kW / 3.0 A	0.75 kW / 3.7 A	
Max. permissible ambient temp. with nominal output current						
	S1	50°C	50°C	40°C	40°C	
	S3 70%ED 10min	50°C	50°C	50°C	50°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	50°C	50°C	
Wall mounting (unventilated)						
Max. continuous power / max. continuous current:						
	S1-50°C	0.25 kW / 1.7 A	0.37 kW / 2.1 A	0.55 kW / 3.0 A	0.55 kW / 2.7 A	
	S1-40°C	0.25 kW / 1.7 A	0.37 kW / 2.1 A	0.55 kW / 3.0 A	0.75 kW / 3.4 A	
Max. permissible ambient temp. with nominal output current						
	S1	50°C	50°C	40°C	35°C	
	S3 70%ED 10min	50°C	50°C	50°C	45°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	50°C	45°C	

\* Circuit Breaker (inverse time trip type) as per UL489

\*\* FLA (S1-40 °C)

## 8.2.2 Electrical data 1/3~230V

		Size 1			
Device type:	SK 1x0E...	-250-323-B	-370-323-B	-550-323-B	
Nominal motor power	230 V	0.25 kW	0.37 kW	0.55 kW	
(4-pole standard motor)	240 V	1/3 hp	1/2 hp	3/4 hp	
Input	Mains voltage	1~ /3~ 230 V 1/3 AC 200 ... 240V, ± 10%, 47 ... 63 Hz			
	Typical input current at 230V	1~ / 3~ rms	4.5 A / 3.2 A	5.7 A / 3.8 A	7.2 A / 4.8 A
		1~ / 3~ FLA	4.5 A / 3.2 A	5.7 A / 3.8 A	7.2 A / 4.8 A
	Rec. mains fuse	1 AC slow-acting [A]	10 A	10 A	16 A
	Permissible mains fuses (UL)	RK5 or faster fuses, min 230 V	10 A	10 A	10 A
		Bussmann	FRS-R-10	FRS-R-10	FRS-R-10
Circuit breaker* min. 230 V		10 A	10 A	10 A	
Output	Output voltage	3~ 230V 3 AC 0 - Mains voltage			
	Nominal output current at 230V	rms	1.7 A	2.2 A	3.0 A
		Motor Assembly**	1.7 A	2.2 A	2.9 A
		Wall-mounted**	1.7 A	2.2 A	1~2.5 A / 3~2.9 A
Min. braking resistor		-	-	-	
Recommended braking resistor	Section 2.3	-	-	-	
Motor mounting (ventilation with motor fan)					
Max. continuous power / max. continuous current:					
	S1-50°C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.37 kW / 2.2 A	
	S1-40°C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 3.0 A	
Max. permissible ambient temp. with nominal output current					
	S1	50°C	50°C	40°C	
	S3 70%ED 10min	50°C	50°C	50°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	50°C	
Wall mounting (unventilated)					
Max. continuous power / max. continuous current:					
(for single phase operation, the deviating value is shown in brackets)	S1-50°C	0.25 kW / 1.7 A	0.37 kW / 2.2 A (1.9 A)	0.55 kW / 3.0 A (2.2 A)	
	S1-40°C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 3.0 A (2.5 A)	
Max. permissible ambient temp. with nominal output current					
	S1	50°C	1~ 40°C / 3~ 50°C	1~ 25°C / 3~ 40°C	
	S3 70%ED 10min	50°C	50°C	1~ 35°C / 3~ 50°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	1~ 35°C / 3~ 50°C	

\* Circuit Breaker (inverse time trip type) as per UL489

\*\* FLA (S1-40 °C)

		Size 2			
Device type:	SK 1x0E...	-750-323-B	-111-323-B	-151-323-B	
Nominal motor power	230 V	0.75 kW	1.1 kW	1.5 kW	
(4-pole standard motor)	240 V	1 hp	1½ hp	2 hp	
Input	Mains voltage	<b>1~ /3~ 230 V</b>	<b>1/3 AC</b>		
			200 ... 240V, ± 10%, 47 ... 63 Hz		
	Typical input current at 230V	1~ / 3~ rms	10.6 A / 7 A	14 A / 9.2 A	- / 11.2 A
		1~ / 3~ FLA	10.6 A / 7 A	14 A / 9.2 A	- / 11.2 A
	Rec. mains fuse	1 AC slow-acting [A]	16 A	16 A	16 A
	Permissible mains fuses (UL)	RK5 or faster fuses, min 230 V	30 A / 10A	30 A	30 A
Bussmann		FRS-R-30	FRS-R-30	FRS-R-30	
Circuit breaker* min. 230 V		25 A / 10A	25 A	25 A	
Output	Output voltage	<b>3~ 230 V</b>	<b>3 AC 0 - Mains voltage</b>		
	Nominal output current at 230V	rms	4.0 A	5.5 A	7.0 A
		Motor Assembly**	3.9 A	5.4 A	6.9 A
		Wall-mounted**	3.9 A	1~4.4 A / 3~5.4 A	6.9 A
Min. braking resistor		-	100 Ω	75 Ω	
Recommended braking resistor	Section 2.3	-	100 Ω	100 Ω	
Motor mounting (ventilation with motor fan)					
Max. continuous power / max. continuous current:					
(for single phase operation, the deviating value is shown in brackets)	S1-50°C	0.75 kW / 4.0 A (3.4 A)	0.75 kW / 4.0 A	1.1 kW / 5.5 A	
	S1-40°C	0.75 kW / 4.0 A	1.1 kW / 5.5 A	1.5 kW / 7.0 A	
Max. permissible ambient temp. with nominal output current					
S1		1~ 40°C / 3~ 50°C	40°C	40°C	
S3 70%ED 10min		50°C	50°C	50°C	
S6 70%ED 10min (100% / 20%Mn)		50°C	50°C	50°C	
Wall mounting (unventilated)					
Max. continuous power / max. continuous current:					
(for single phase operation, the deviating value is shown in brackets)	S1-50°C	0.75 kW / 4.0 A (3.4 A)	0.75 kW / 4.0 A (3.6 A)	1.1 kW / 5.5 A	
	S1-40°C	0.75 kW / 4.0 A	0.75 kW / 4.5 A (4.4 A)	1.5 kW / 6.5 A	
Max. permissible ambient temp. with nominal output current					
S1		1~ 40°C / 3~ 45°C	1~ 30°C / 3~ 40°C	30°C	
S3 70%ED 10min		50°C	1~ 40°C / 3~ 50°C	40°C	
S6 70%ED 10min (100% / 20%Mn)		50°C	1~ 40°C / 3~ 50°C	40°C	

\* Circuit Breaker (inverse time trip type) as per UL489

\*\* FLA (S1-40 °C)

## 8.2.3 Electrical data 3~400 V

		Size 1					
Device type:	SK 1x0E...	-250-340-B	-370-340-B	-550-340-B	-750-340-B	-111-340-B	
Nominal motor power	400 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	1.1 kW	
(4-pole standard motor)	480 V	1/3 hp	1/2 hp	3/4 hp	1 hp	1 1/2 hp	
Input	Mains voltage	<b>3~ 400 V</b>					
	Typical input current at 400V	<b>3 AC 380 ... 480V, -20% / +10%, 47 ... 63 Hz</b>					
		<b>3~ rms</b>	2.0 A	2.3 A	2.6 A	3.2 A	4.1 A
		<b>3~ FLA</b>	1.7 A	1.9 A	2.2 A	2.7 A	3.5 A
	Rec. mains fuse	1 AC slow-acting [A]	10 A	10 A	10 A	10 A	10 A
	Permissible mains fuses (UL)	RK5 or faster fuses, min 230V/400 V	5.0 A	5.0 A	5.0 A	5.0 A	10 A
Bussmann		FRS-R-5	FRS-R-5	FRS-R-5	FRS-R-5	FRS-R-10	
Circuit breaker* min. 230V/400 V		5.0 A	5.0 A	5.0 A	5.0 A	10 A	
Output	Output voltage	<b>3~ 400 V</b>					
	Nominal output current at 400V	<b>3 AC 0 - Mains voltage</b>					
		rms	1.2 A	1.5 A	1.7 A	2.3 A	3.1 A
		Motor Assembly**	1.1 A	1.3 A	1.5 A	2.1 A	2.8 A
	Wall-mounted**	1.1 A	1.3 A	1.5 A	2.1 A	2.8 A	
Motor mounting (ventilation with motor fan)							
Max. continuous power / max. continuous current:							
	S1-50°C	0.25 kW / 1.2 A	0.37 kW / 1.5 A	0.55 kW / 1.7 A	0.75 kW / 2.3 A	0.75 kW / 2.3 A	
	S1-40°C	0.25 kW / 1.2 A	0.37 kW / 1.5 A	0.55 kW / 1.7 A	0.75 kW / 2.3 A	1.10 kW / 3.1 A	
Max. permissible ambient temp. with nominal output current							
	S1	50°C	50°C	50°C	50°C	40°C	
	S3 70%ED 10min	50°C	50°C	50°C	50°C	50°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	50°C	50°C	50°C	
Wall mounting (unventilated)							
Max. continuous power / max. continuous current:							
	S1-50°C	0.25 kW / 1.2 A	0.37 kW / 1.5 A	0.55 kW / 1.7 A	0.75 kW / 2.0 A	0.75 kW / 2.0 A	
	S1-40°C	0.25 kW / 1.2 A	0.37 kW / 1.5 A	0.55 kW / 1.7 A	0.75 kW / 2.3 A	1.10 kW / 2.6 A	
Max. permissible ambient temp. with nominal output current							
	S1	50°C	50°C	50°C	40°C	30°C	
	S3 70%ED 10min	50°C	50°C	50°C	50°C	40°C	
	S6 70%ED 10min (100% / 20%Mn)	50°C	50°C	50°C	50°C	40°C	

\* Circuit Breaker (inverse time trip type) as per UL489

\*\* FLA (S1-40 °C)

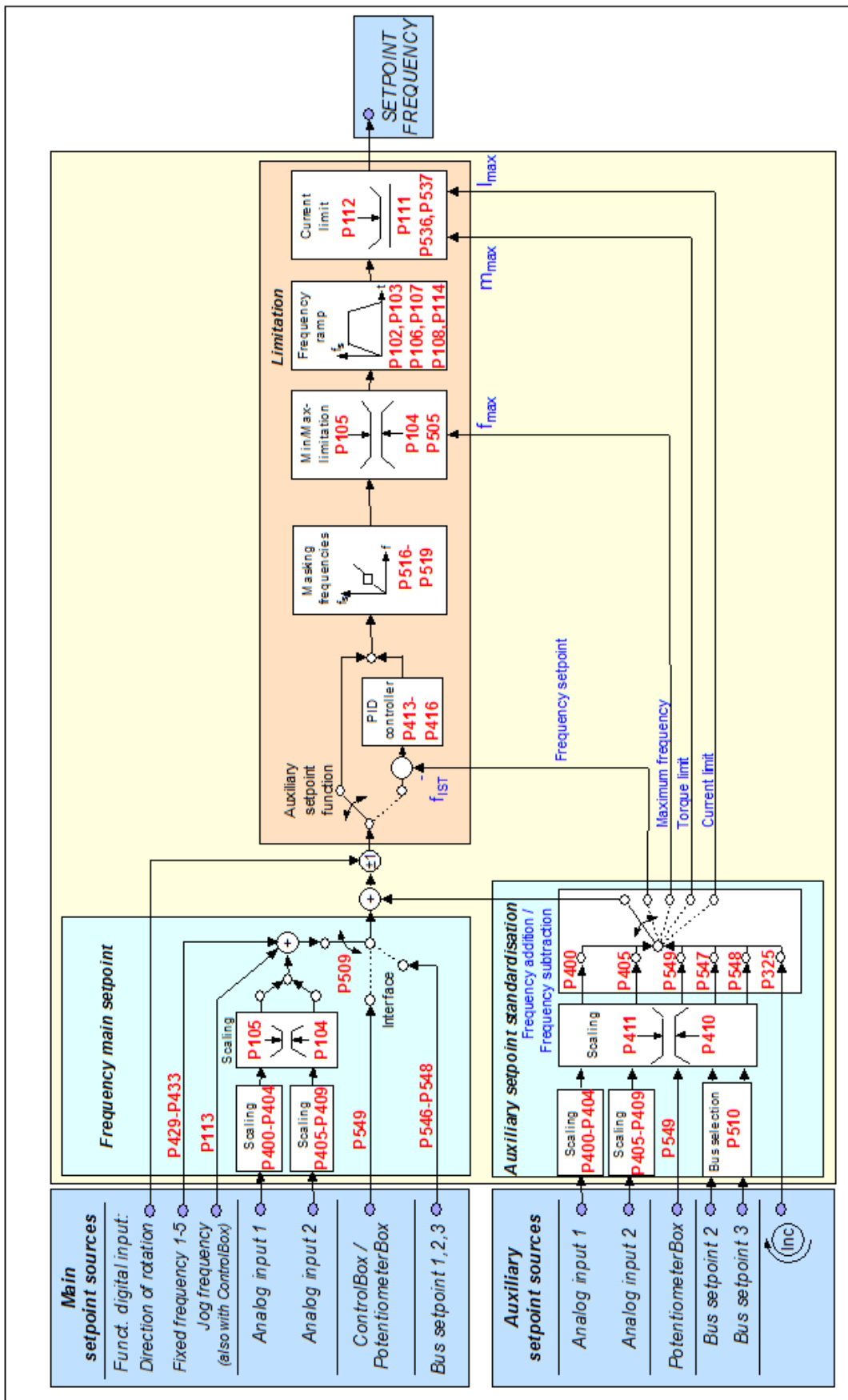
		Size 2	
Device type:	SK 1x0E...	-151-340-B	-221-340-B
Nominal motor power	400 V	1.5 kW	2.2 kW
(4-pole standard motor)	480 V	2 hp	3 hp
Input	Mains voltage	<b>3~ 400 V</b>	<b>3 AC 380 ... 480V, -20% / +10%, 47 ... 63 Hz</b>
	Typical input current at 400V	<b>3~ rms</b>	6 A
		<b>3~ FLA</b>	5 A
	Rec. mains fuse	1 AC slow-acting [A]	10 A
	Permissible mains fuses (UL)	RK5 or faster fuses, min 230V/400 V	10 A
		Bussmann	FRS-R-10
	Circuit breaker* min. 230V/400 V	10 A	
Output	Output voltage	<b>3~ 400V</b>	<b>3 AC 0 - Mains voltage</b>
	Nominal output current at 400V	rms	4.0 A
		Motor Assembly**	3.6 A
		Wall-mounted**	3.6 A
Min. braking resistor		180 Ω	
Recommended braking resistor	Section 2.3	200 Ω	
Motor mounting (ventilation with motor fan)			
Max. continuous power / max. continuous current:			
	S1-50°C	1.50 kW / 4.0 A	1.50 kW / 4.0 A
	S1-40°C	1.50 kW / 4.0 A	2.20 kW / 5.5 A
Max. permissible ambient temp. with nominal output current			
S1		50°C	40°C
S3 70%ED 10min		50°C	50°C
S6 70%ED 10min (100% / 20%Mn)		50°C	50°C
Wall mounting (unventilated)			
Max. continuous power / max. continuous current:			
	S1-50°C	1.10 kW / 2.5 A	1.10 kW / 2.5 A
	S1-40°C	1.50 kW / 3.5 A	1.50 kW / 3.5 A
Max. permissible ambient temp. with nominal output current			
S1		30°C	20°C
S3 70%ED 10min		40°C	30°C
S6 70%ED 10min (100% / 20%Mn)		40°C	30°C

\* Circuit Breaker (inverse time trip type) as per UL489

\*\* FLA (S1-40 °C)

## 9 Additional information

### 9.1 Setpoint processing in the SK 1x0E



## 9.2 Process controller

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

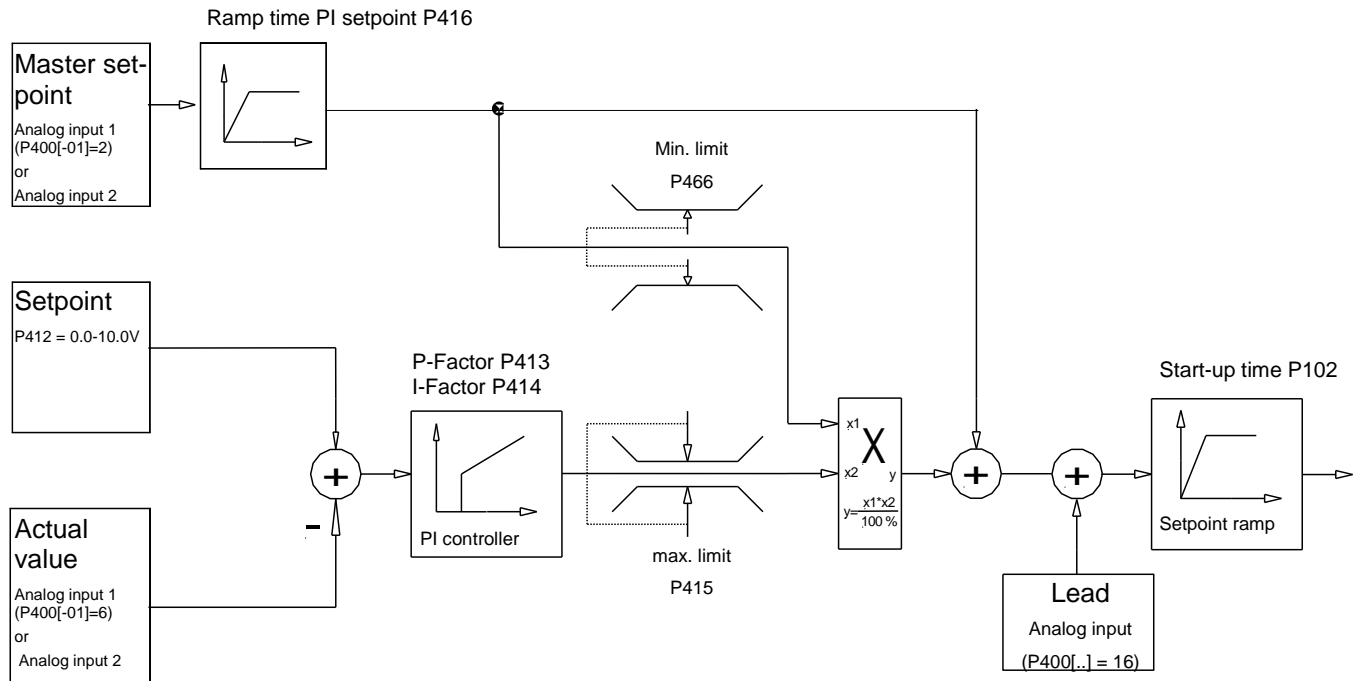
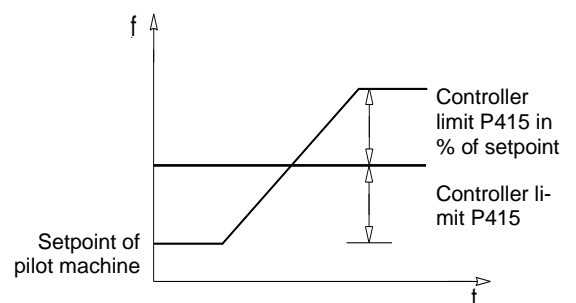
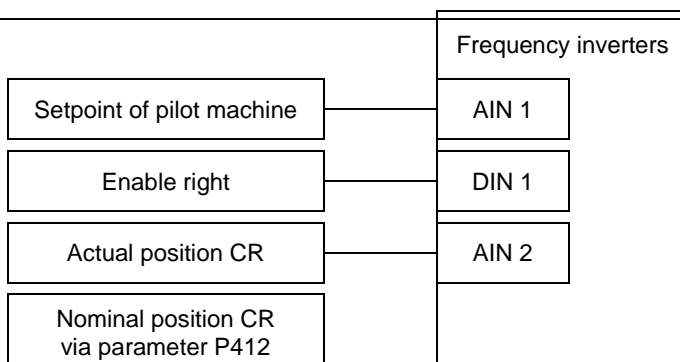
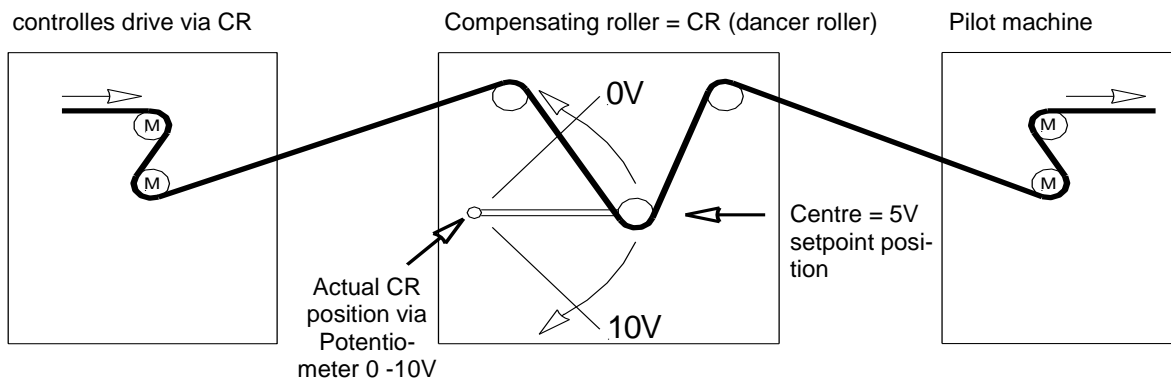


Fig.: Flow diagram process controller of the SK 1x0E

### 9.2.1 Process controller application example



## 9.2.2 Process controller parameter settings

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

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

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

P400 [-01] (Funct. Analog input1) : "2" (frequency addition)

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

Example: **50 Hz**

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

P413 (P controller) [%] : Factory setting **10%** (adjust if necessary)

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

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

**Note:** Parameter P415 is used as a control limit after the PI controller.

Example: **25%** of setpoint

P416 (Ramp time PI setpoint) [s] : Factory setting **2s** (if necessary, adjust to match controller behaviour)

P420 [-01] (Funct. digital input 1) : "1" Enable right

P400 [-02] (Funct. Analog input 2) : "6" PI process controller actual value

## 9.3 Electromagnetic compatibility (EMC)

### 9.3.1 General Provisions

As of July 2007, all electrical equipment which has an intrinsic, independent function and which is sold as an individual unit for end users, must comply with Directive 2004/108/EEC (formerly Directive EEC/89/336). There are three different ways for manufacturers to display compliance with this directive:

1. *EC declaration of conformity*

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

2. *Technical documentation*

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

3. *EC Type test certificate*

This method only applies to radio transmitter equipment.

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

The manufacturer can certify that his equipment meets the requirements of the EMC directive for industrial environments with respect to their EMC behaviour in the relevant environment. The relevant limit values correspond to the basic standards EN 61000-6-2 and EN 61000-6-4 for interference immunity and interference emissions.

### 9.3.2 Assessment of EMC

Two standards must be observed for the assessment of electromagnetic compatibility.

**1. EN 55011 (environmental standard)**

In this standard the limiting values are defined depending on the specified environment in which the product is to be operated. A differentiation is made between 2 environments, whereby the **1st environment** describes the non-industrial **domestic and commercial area** without its own high or medium voltage distribution transformers. The **2nd environment** describes **industrial areas**, which are not connected to the public low voltage mains, but rather have their own high or medium voltage distribution transformers. A subdivision of the limiting values is made according to **Classes A1, A2 and B**.

**2. EN 61800-3 (Product standard)**

This standard defines the limiting values depending of the field of use of the product. The subdivision of the limiting values is made according to **Categories C1, C2, C3 and C4**, whereby Class C4 only applies for drive systems with high voltages (> 1000 V AC, > 400 A).

The same limiting values apply for both standards. However, the standards differ by an extended application in the product standard. The manufacturer decides which of the two standards are used, whereby in the case of suppression of interference, the environmental standard is typically used.

The essential correlation between the two standards is illustrated as follows:

Category according to product standard EN 61800-3	C1	C2	C3
Limit value class according to EN 55011	B	A1	A2
Operation permissible in 1st environment (domestic environment)	X	X	-
2nd environment (industrial environment)	X	X	X
Information required according to EN 61800-3	-	1)	2)
Distribution method	Generally available	Limited availability	
EMC knowledge	No requirements	Installation and commissioning by persons with knowledge of EMC	
1) "In a domestic environment, the drive system may cause high frequency interference, which may make interference suppression measures necessary." 2) "The drive system is not intended for use in a public low voltage mains network which supplies the domestic area."			

### 9.3.3 EMC of the frequency inverter

#### ATTENTION



The frequency inverters are **exclusively intended for commercial use**. They are therefore not subject to the requirements of the standard EN 61000-3-2 for radiation of harmonics.

This device produces high frequency interference, which may make additional suppression measures necessary in **domestic environments**.

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

In addition, it is essential to use wiring suitable for EMC. For wall mounting, the screening of the motor cable must be connected to both the motor terminal box and the housing of the inverter.

Device type max. cable length, shielded	Jumper position see Section 2.7.4	Conducted emissions 150kHz - 30 MHz	
		Class C2	Class C1
Motor-mounted frequency inverter	Jumper set	+	+
Wall-mounted frequency inverter	Jumper set	5m	-

Overview of the standards, which according to product standard EN 61800-3 are applicable as testing and measuring methods for electric drives whose speed can be altered:

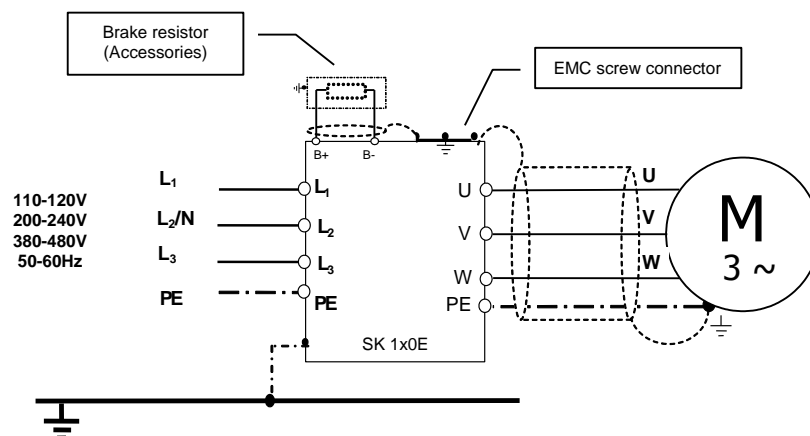
### **Emission of interference**

Emission from cables (interference voltage)	EN 55011	C1 (only if mounted on motor) otherwise C2
Radiated emissions (Interference field strength)	EN 55011	C1 (only if mounted on motor) otherwise C2


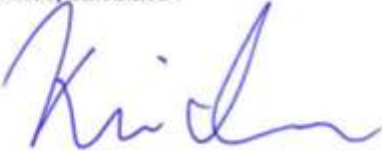

### **Interference immunity** EN 61000-6-1, EN 61000-6-2

ESD, discharge of static electricity	EN 61000-4-2	6 kV (CD), 8 kV (AD)
EMF, high frequency electro-magnetic fields	EN 61000-4-3	10 V/m; 80 – 1000 MHz
Burst on control cables	EN 61000-4-4	1 kV
Burst on mains and motor cables	EN 61000-4-4	2 kV
Surge (phase-phase / phase-ground)	EN 61000-4-5	1 kV / 2kV
Cable-led interference due to high frequency fields	EN 61000-4-6	10 V, 0.15 – 80 MHz
Voltage fluctuations and drops	EN 61000-2-1	+10%, -15%; 90%
Voltage asymmetries and frequency changes	EN 61000-2-4	3%; 2%

### **Wiring recommendations for mounting near to motor**



### 9.3.4 EC Declaration of Conformity

<p><b>GETRIEBEBAU NORD</b> Member of the NORD DRIVESYSTEMS Group</p>																
<p><b>Getriebebau NORD GmbH &amp; Co. KG</b> Getriebebau-Nord-Str. 1 · 22941 Bargteheide, Germany · Fon +49(0)4532 289 - 0 · Fax +49(0)4532 289 - 2253 · info@nord.com</p>																
<h2>EC Declaration of Conformity</h2> <p style="font-size: small;">in the meaning of the regulation 2006/95/EC Annex III, 2004/108/EC Annex IV, 2011/65/EU Annex VI</p>																
<p>Getriebebau NORD GmbH &amp; Co. KG hereby declares that the frequency inverters from the product series</p> <ul style="list-style-type: none"> <li>• SK 180E-xxx-123-B-.. , SK 180E-xxx-323-B-.. , SK 180E-xxx-340-B-.. (xxx= 0,25...2,2 kW)</li> <li>• SK 190E-xxx-123-B-.. , SK 190E-xxx-323-B-.. , SK 190E-xxx-340-B-..</li> </ul> <p style="padding-left: 40px;">with the options SK CU4-... , SK TU4-... , SK PAR-3. , SK CSX-3. , SK SSX-3A</p> <p>comply with the following regulations:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">Low Voltage Directive</td> <td style="width: 35%;">2006/95/EC</td> <td style="width: 35%;"></td> </tr> <tr> <td>EMC Directive</td> <td>2004/108/EC</td> <td></td> </tr> <tr> <td>RoHS Directive</td> <td>2011/65/EU</td> <td></td> </tr> </table> <p><b>Applied standards:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">EN 61800-5-1:2008</td> <td style="width: 33%;">EN 61800-3:2012</td> <td style="width: 33%;">EN 60529:2000</td> </tr> <tr> <td>EN 50581:2013</td> <td></td> <td></td> </tr> </table> <p>It is necessary to notice the data in the operating manual to meet the regulations of the EMC-Directive. Specially take care about correct EMC installation and cabling, differences in the field of applications and if necessary original accessories.</p> <p>Initial labelling was carried out in 2014.</p> <p><b>Bargteheide, 12.02.2014</b></p> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>U. Küchenmeister Managing Director</p> </div> <div style="text-align: center;">  <p>pp F. Wiedemann Head of Inverter Division</p> </div> </div>	Low Voltage Directive	2006/95/EC		EMC Directive	2004/108/EC		RoHS Directive	2011/65/EU		EN 61800-5-1:2008	EN 61800-3:2012	EN 60529:2000	EN 50581:2013			<p>Page 1 of 1</p>
Low Voltage Directive	2006/95/EC															
EMC Directive	2004/108/EC															
RoHS Directive	2011/65/EU															
EN 61800-5-1:2008	EN 61800-3:2012	EN 60529:2000														
EN 50581:2013																

## 9.4 Reduced output power

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

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

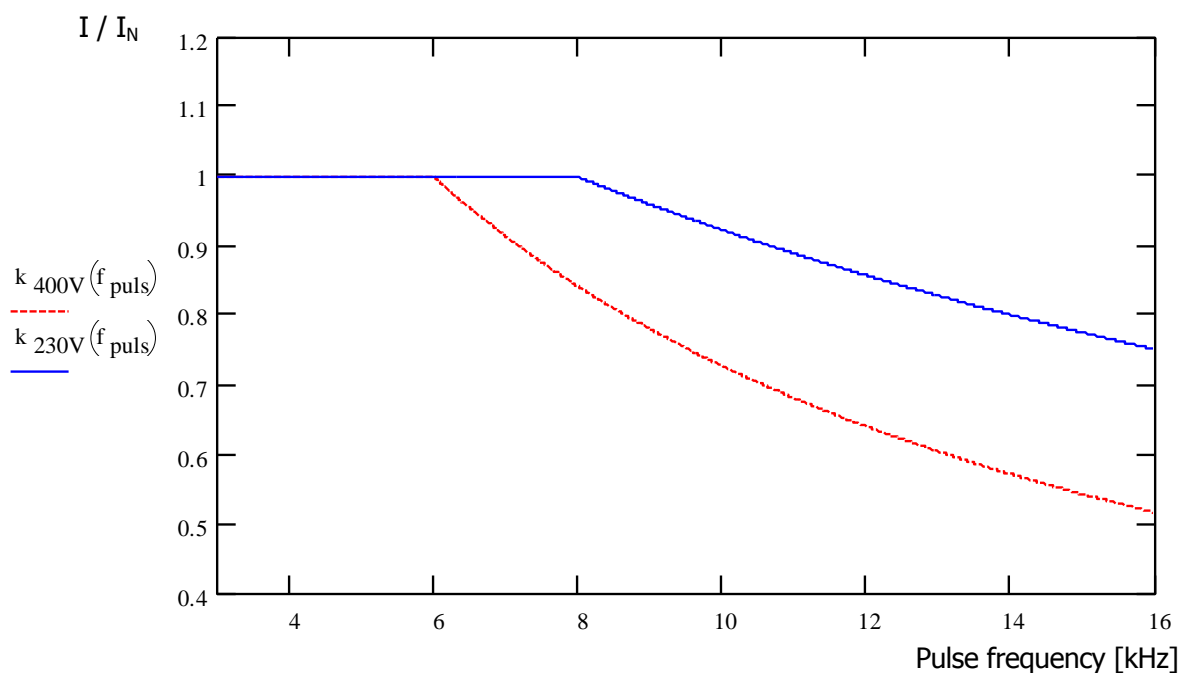
On the basis of the following characteristic curves, the particular current / power limitation can be read off.

### 9.4.1 Increased heat dissipation due to pulse frequency

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

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

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



## 9.4.2 Reduced overcurrent due to time

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

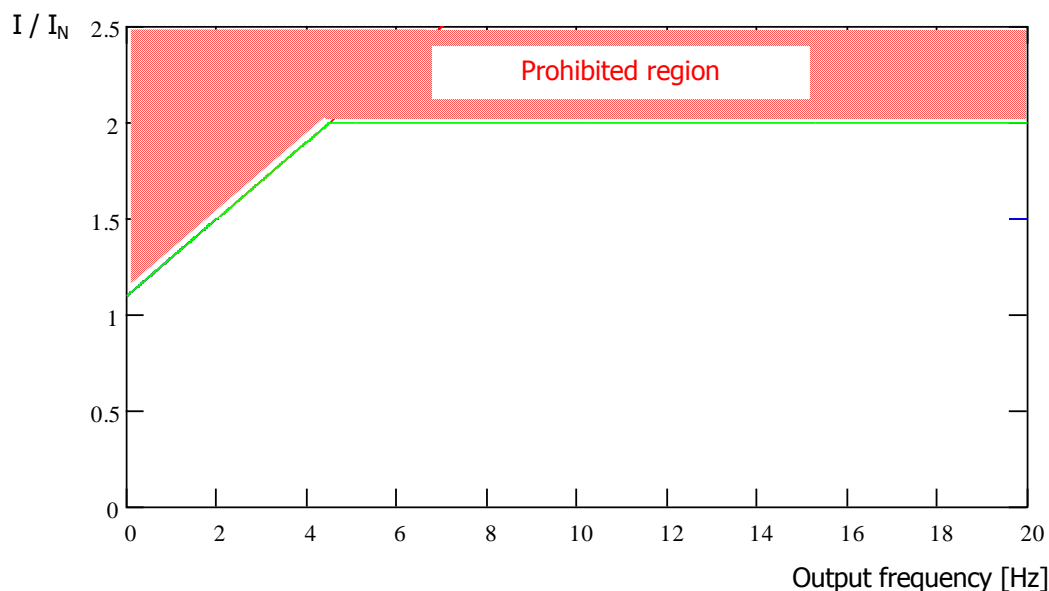
If operated repeatedly in the overload region at short intervals, the limiting values stated in the tables are reduced.

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

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

### 9.4.3 Reduced overcurrent due to output frequency

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



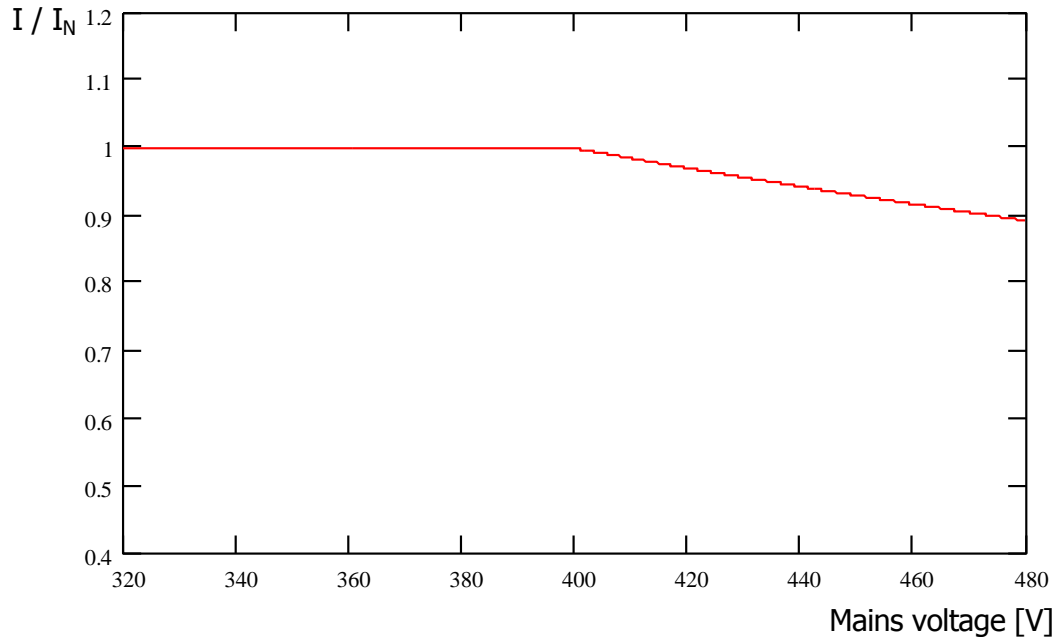
The upper limiting values for the various pulse frequencies can be obtained from the following tables. In all cases, the value (0.1...1.9) which can be set in parameter P537, is limited to the value stated in the tables according to the pulse frequency. Values below the limit can be set as required.

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

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

#### 9.4.4 Reduced output current due to mains voltage

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



#### 9.4.5 Reduced output current due to the heat sink temperature

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

## 9.5 Operation with FI circuit breakers

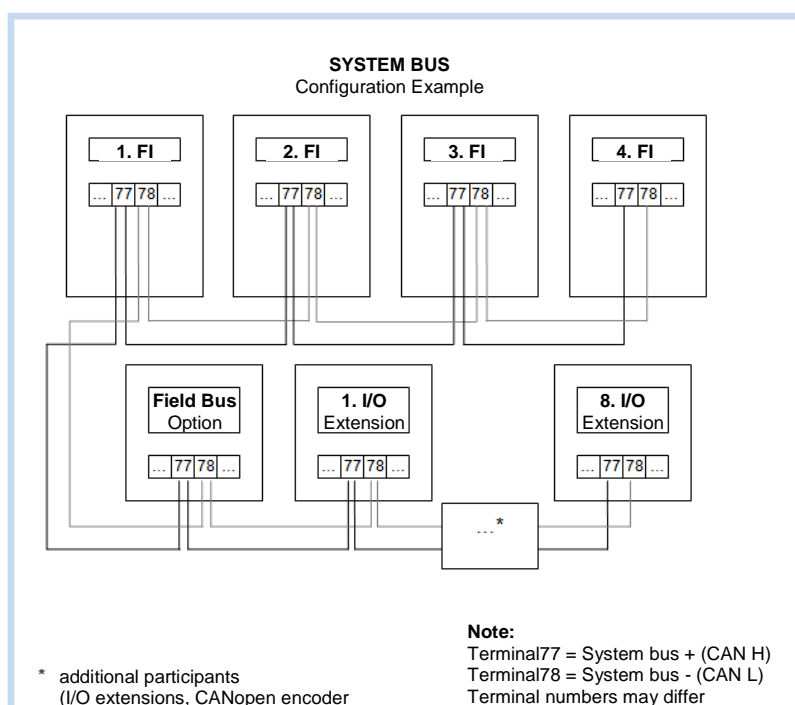
With frequency inverters (except 115V devices), leakage currents of up to 16mA are to be expected if the mains filter is active. These are designed for operation with leakage current circuit breakers for the protection of persons.

For further details, please refer to Section 2.7.4.

## 9.6 System bus

Frequency inverters and components communicate with each other via the system bus. This bus system is a CAN bus with CANopen protocol. Up to four frequency inverters and their associated components (field bus module, absolute encoder, I/O modules etc.) can be connected to the system bus. Integration of the components into the system bus does not require any specific knowledge of the bus on the part of the user.

Only the proper physical configuration of the bus system and if necessary the correct addressing of the participants need to be taken into account by the user.



The connection of the individual NORD components is described in this manual (See section 2.8, 3.3 and 3.4).

**NOTE:** Communication on the system bus only starts if an extension module is connected to the bus or if in a Master / Slave system, the Master is parameterised to P503=3 and the Slave is parameterised to P503=2. This is especially important if several frequency inverters which are connected via the system bus are to be read out in parallel with the NORDCON parameterisation software. In this case, identification of the devices with NORDCON is not possible.

### Physical structure

Standard	CAN
Bus length	20m with a wire cross section of 0.25mm <sup>2</sup> (AWG23)
Structure	preferably linear
Spur cables	possible, (max. 6m)
Termination resistors	120Ω, 250mW at both ends of a system bus (with SK 1x0E-... or SK xU4-... via DIP switches)
Baud rate	250kBaud - preset

## Addressing

If several frequency inverters are connected to a system bus, these devices must be assigned with unique addresses. This is preferably implemented via DIP switch S2 of the frequency inverter (Section 5.2.2.2).

Frequency inverters	Addressing via DIP switch S2		Resulting Node ID Frequency inverters
	DIP2	DIP1	
FI 1	ON	ON	32
FI 2	ON	OFF	34
FI 3	OFF	ON	36
FI 4	OFF	OFF	38

For field bus modules, no assignment of addresses is necessary. The module identifies all the frequency inverters automatically. Access to the individual frequency inverter is made via the field bus master (SPS). Details of how this is carried out are explained in the relevant bus instructions.

I/O extensions must be assigned to the relevant frequency inverter. This is carried out by means of a DIP switch on the I/O module. A special case for the I/O extensions is the "Broadcast" mode. In this mode, the data of the I/O extension (analog values, inputs etc.) are sent to all inverters simultaneously. Via the parameterisation in each individual frequency inverter, a decision is made as to which of the received values are to be used.

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### NOTE



Care must be taken that each address is only assigned once. In a CAN-based network double assignment of addresses may lead to misinterpretation of the data and therefore undefined activities in the system.

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### Integration of devices from other manufacturers

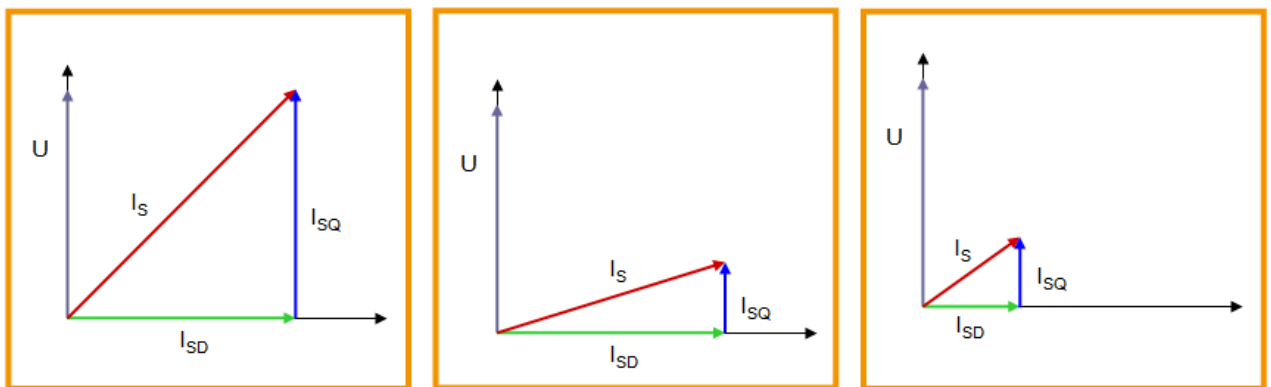
In principle, the integration of other devices into this bus system is possible. These must support the CANopen protocol and a 250kBaud baud rate. The address range (Node ID) 1 to 4 is reserved for additional CANopen masters. All other participants must be assigned addresses between 50 and 79.

## 9.7 Energy Efficiency

NORD frequency inverters have a low power consumption and are therefore highly efficient. In addition, with the aid of "Automatic flux optimisation" (Parameter (P219)) the inverter provides a possibility for increasing the overall efficiency of the drive in certain applications (in particular applications with partial load).

According to the torque required, the magnetisation current through the frequency inverter or the motor torque is reduced to the level which is required for the present drive power. The resulting reduction in power consumption, as well as the optimisation of the  $\cos \varphi$  factor of the motor rating even in the partial load range, contributes to creating optimum conditions both with regard to energy consumption and mains characteristics.

A parameterisation which is different from the factory setting (Factory setting = 100%) is only permissible for applications which do not require rapid torque changes. (For details, see Section 6.1.3 Parameter (P219))



$I_S$  = Motor current vector (line current)  $I_{SD}$  = Magnetizing current vector (magn. current)  $I_{SQ}$  = Load current vector (load current)

	No flux optimisation	With flux optimisation
Motor under full load	Motor under partial load	

### WARNING!



This function is not suitable for lifting applications or applications with frequent, large changes in load and parameter (P219) MUST be left in the factory setting (100%).

## 9.8 Motor data - characteristic curves

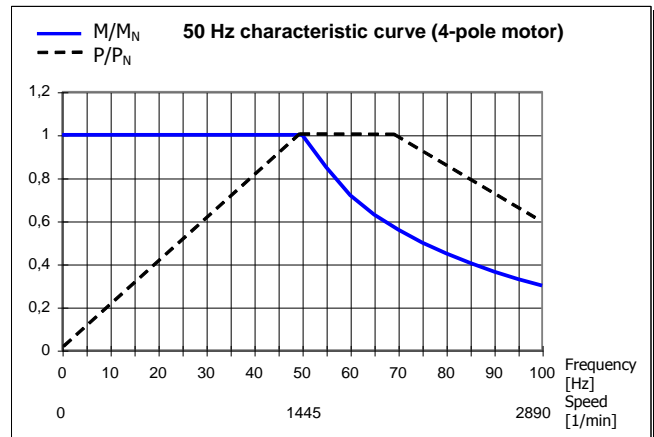
### 9.8.1 50Hz characteristic curve

(→ Variation 1:10)

#### a) 115V / 230 V frequency inverter

The motor used for 50 Hz operation can be operated up to its rated point 50 Hz/230 V with the nominal torque. In spite of this, operation above 50Hz is possible, however the output torque reduces in a non-linear manner (see following diagram). Above the rated point, the motor enters its field weakening range, as the voltage cannot be raised over 230 V when the frequency is increased above 50 Hz. Because of the mains voltage, maximum 230 V are available.

The following data is based on an output of 4 kW using a 230/400 V motor winding. They apply for IE1 or IE2 motors. It should be noted that these details may deviate slightly, as motors are subject to certain manufacturing tolerances. It is recommended that the resistance of the connected motor is measured by the frequency inverter (P208 / P220).



Frequency inverter type	Parameterisation data of frequency inverter							
	F <sub>N</sub> [Hz]	n <sub>N</sub> [min <sup>-1</sup> ]	I <sub>N</sub> [A]	U <sub>N</sub> [V]	P <sub>N</sub> [kW]	cos φ	Circuit	R <sub>St</sub> [Ω]
<b>IE1 Motors</b>								
SK...71S/4 TI 4 - SK 1x0E-250-323-B*	50	1365	1.3	230	0.25	0.79	Delta	39.90
SK...71L/4 TI 4 - SK 1x0E-370-323-B*	50	1380	1.89	230	0.37	0.71	Delta	22.85
SK...80S/4 TI 4 - SK 1x0E-550-323-B*	50	1385	2.62	230	0.55	0.75	Delta	15.79
SK...80L/4 TI 4 - SK 1x0E-750-323-B*	50	1395	3.52	230	0.75	0.75	Delta	10.49
SK...90S/4 TI 4 - SK 1x0E-111-323-B	50	1410	4.78	230	1.1	0.76	Delta	6.41
<b>IE2 Motor</b>								
SK...80SH/4 TI 4 - SK 1x0E-550-323-B*	50	1415	2.39	230	0.55	0.70	Delta	9.34
SK...80LH/4 TI 4 - SK 1x0E-750-323-B*	50	1410	3.12	230	0.75	0.75	Delta	6.30
SK...90SH/4 TI 4 - SK 1x0E-111-323-B	50	1430	4.26	230	1.1	0.80	Delta	4.96

\* the same data apply for the use of the 115V version of the SK1x0E

Frequency inverter type	Performance data at rated point**		
	P <sub>B</sub> [kW]	n <sub>B</sub> [minP <sup>-1P</sup> ]	M <sub>B</sub> [Nm]
SK...71S/4 TI 4 - SK 1x0E-250-323-B*	0.25	1380	1.73
SK...71L/4 TI 4 - SK 1x0E-370-323-B*	0.37	1380	2.56
SK...80S(H)/4 TI 4 - SK 1x0E-550-323-B*	0.55	1375 (1420)	3.82 (3.73)
SK...80L(H)/4 TI 4 - SK 1x0E-750-323-B*	0.75	1375 (1415)	5.21 (5.06)
SK...90S(H)/4 TI 4 - SK 1x0E-111-323-B	1.1	1395 (1435)	7.53 (7.32)

\* the same data apply for the use of the 115V version of the SK1x0E

\*\* Values in brackets apply for IE2 motors

### b) 400 V frequency inverter

The motor used for 50 Hz operation can be operated up to its rated point 50 Hz/400 V with the nominal torque. In spite of this, operation above 50 Hz is possible, however the output torque reduces in a non-linear manner (see following diagram). Above the rated point, the motor enters its field weakening range, as the voltage cannot be raised over 400 V when the frequency is increased above 50 Hz. Because of the mains voltage, maximum 400 V are available.

The following data refer to a 230/400 V motor winding. They apply for IE1 or IE2 motors. It should be noted that these details may deviate slightly, as motors are subject to certain manufacturing tolerances. It is recommended that the resistance of the connected motor is measured by the frequency inverter (P208 / P220).

Frequency inverter type	Parameterisation data of frequency inverter							
	$F_N$ [Hz]	$n_N$ [ $\text{min}^{-1}$ ]	$I_N$ [A]	$U_N$ [V]	$P_N$ [kW]	$\cos \varphi$	Circuit	$R_{St}$ [ $\Omega$ ]
<b>IE1 Motors</b>								
SK...71S/4 SK 1x0E-250-340-B	50	1365	0.75	400	0.25	0.79	Star	39.90
SK...71L/4 SK 1x0E-370-340-B	50	1380	1.09	400	0.37	0.71	Star	22.85
SK...80S/4 SK 1x0E-550-340-B	50	1385	1.51	400	0.55	0.75	Star	15.79
SK...80L/4 SK 1x0E-750-340-B	50	1395	2.03	400	0.75	0.75	Star	10.49
SK...90S/4 SK 1x0E-111-340-B	50	1410	2.76	400	1.1	0.76	Star	6.41
SK...90L/4 SK 1x0E-151-340-B	50	1390	3.53	400	1.5	0.78	Star	3.99
SK...100L/4 SK 1x0E-221-340-B	50	1415	5.00	400	2.2	0.78	Star	2.78
<b>IE2 Motor</b>								
SK...80SH/4 SK 1x0E-550-340-B	50	1415	1.38	400	0.55	0.70	Star	9.34
SK...80LH/4 SK 1x0E-750-340-B	50	1410	1.80	400	0.75	0.75	Star	6.30
SK...90SH/4 SK 1x0E-111-340-B	50	1430	2.46	400	1.1	0.80	Star	4.96
SK...90LH/4 SK 1x0E-151-340-B	50	1420	3.38	400	1.5	0.79	Star	3.27
SK...100LH/4 SK 1x0E-221-340-B	50	1445	4.76	400	2.2	0.79	Star	1.73

Frequency inverter type	Performance data at rated point*		
	$P_B$ [kW]	$n_B$ [ $\text{minP}^{-1P}$ ]	$M_B$ [Nm]
SK...71S/4 SK 1x0E-250-340-B	0.25	1380	1.73
SK...71L/4 SK 1x0E-370-340-B	0.37	1380	2.56
SK...80S(H)/4 SK 1x0E-550-340-B	0.55	1375 (1420)	3.82 (3.73)
SK...80L(H)/4 SK 1x0E-750-340-B	0.75	1375 (1415)	5.21 (5.06)
SK...90S(H)/4 SK 1x0E-111-340-B	1.1	1395 (1435)	7.53 (7.32)
SK...90L(H)/4 SK 1x0E-151-340-B	1.5	1395 (1415)	10.30 (10.10)
SK...100L(H)/4 SK 1x0E-221-340-B	2.2	1440 (1445)	14.60 (14.50)

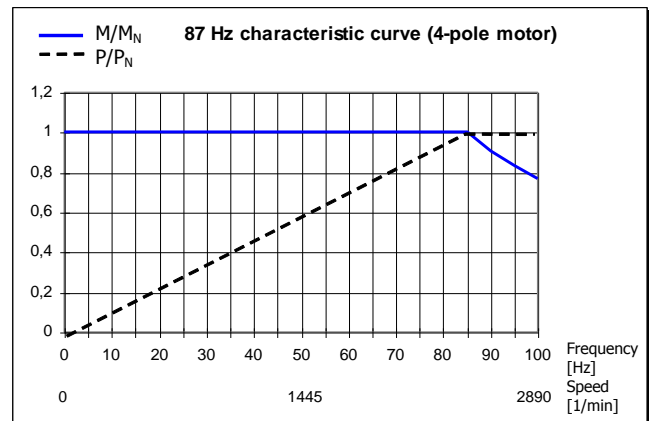
\* Values in brackets apply for IE2 motors

## 9.8.2 87Hz characteristic curve (only 400 V devices)

(→ Variation 01:17:00)

The 87 Hz characteristic represents an extension of the speed adjustment range with a constant motor nominal torque. The following points must be met for realisation:

- Motor delta connection with a motor winding for 230/400 V
- Frequency inverter with an operating voltage **3~400 V**
- Output current of frequency inverter must be greater than the delta current of the motor used (ref. value → frequency inverter power  $\geq \sqrt{3}$  x motor power)



In this configuration, the motor used has a rated operating point at 230 V/50 Hz and an extended operating point at 400 V/ 87 Hz. This increases the power of the drive by the factor  $\sqrt{3}$ . The nominal torque of the motor remains constant up to a frequency of 87 Hz. Operation of a 230 V winding with 400 V is totally uncritical as the insulation is designed for test voltages of > 1000 V.

The following data refer to a 230/400 V motor winding. They apply for IE1 or IE2 motors. It should be noted that these details may deviate slightly, as motors are subject to certain manufacturing tolerances. It is recommended that the resistance of the connected motor is measured by the frequency inverter (P208 / P220).

Frequency inverter type	Parameterisation data of frequency inverter							
	F <sub>N</sub> [Hz]	n <sub>N</sub> [min <sup>-1</sup> ]	I <sub>N</sub> [A]	U <sub>N</sub> [V]	P <sub>N</sub> [kW]	cos φ	Circuit	R <sub>St</sub> [Ω]
<b>IE1 Motors</b>								
SK...63S/4 SK 1x0E-250-340-B	50	1335	0.95	230	0.12	0.64	Delta	68.00
SK...63L/4 SK 1x0E-370-340-B	50	1360	1.18	230	0.18	0.64	Delta	47.37
SK...71S/4 SK 1x0E-550-340-B	50	1365	1.30	230	0.25	0.79	Delta	39.90
SK...71L/4 SK 1x0E-750-340-B	50	1380	1.89	230	0.37	0.71	Delta	22.85
SK...80S/4 SK 1x0E-111-340-B	50	1385	2.62	230	0.55	0.75	Delta	15.79
SK...80L/4 SK 1x0E-151-340-B	50	1395	3.52	230	0.75	0.75	Delta	10.49
SK...90S/4 SK 1x0E-221-340-B	50	1410	4.78	230	1.1	0.76	Delta	6.41
<b>IE2 Motor</b>								
SK...80SH/4 TI 4 - SK 1x0E-110-340-B	50	1415	2.39	230	0.55	0.70	Delta	9.34
SK...80LH/4 TI 4 - SK 1x0E-151-340-B	50	1410	3.12	230	0.75	0.75	Delta	6.30
SK...90SH/4 TI 4 - SK 1x0E-221-340-B	50	1430	4.26	230	1.1	0.80	Delta	4.96

Frequency inverter type	Performance data at rated point*		
	P <sub>B</sub> [kW]	n <sub>B</sub> [min <sup>-1</sup> ]	M <sub>B</sub> [Nm]
SK...63S/4 SK 1x0E-250-340-B	0.21	2430	0.80
SK...63L/4 SK 1x0E-370-340-B	0.31	2455	1.20
SK...71S/4 SK 1x0E-550-340-B	0.43	2460	1.65
SK...71L/4 SK 1x0E-750-340-B	0.64	2475	2.49
SK...80S(H)/4 SK 1x0E-111-340-B	0.95	2480 (2510)	3.67 (3.6)
SK...80L(H)/4 SK 1x0E-151-340-B	1.3	2490 (2505)	5.01 (4.9)
SK...90S(H)/4 SK 1x0E-221-340-B	1.9	2505 (2525)	7.32 (7.2)

\* Values in brackets apply for IE2 motors

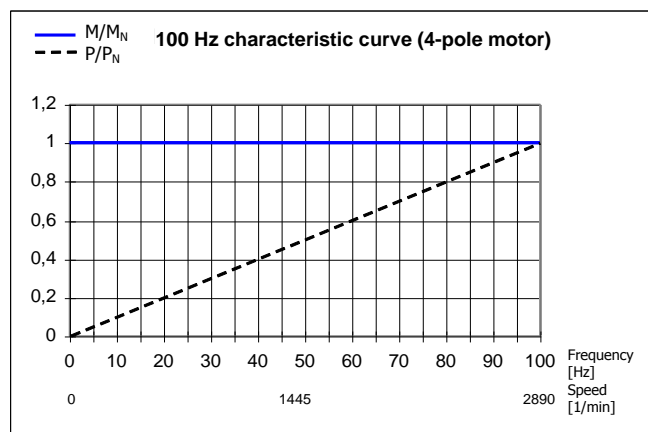
### 9.8.3 100Hz characteristic curve (only 400 V devices)

(→ Variation 01:20:00)

An operating point 100 Hz/400 V can be selected for a greater speed adjustment range with up to a ratio of 1:20. Special motor data are required (see below) that differ from the normal 50 Hz data. It must be ensured in this case that a constant torque is generated across the entire adjustment range but that it is smaller than the nominal torque for 50 Hz operation.

The advantage, in addition to the greater speed adjustment range, is the improved motor temperature behaviour. An external fan is not absolutely essential for smaller output speed ranges.

The following data refer to a 230/400 V motor winding. They apply for IE1 or IE2 motors. It should be noted that these details may deviate slightly, as motors are subject to certain manufacturing tolerances. It is recommended that the resistance of the connected motor is measured by the frequency inverter (P208 / P220).



Frequency inverter type	Parameterisation data of frequency inverter							
	F <sub>N</sub> [Hz]	n <sub>N</sub> [min <sup>-1</sup> ]	I <sub>N</sub> [A]	U <sub>N</sub> [V]	P <sub>N</sub> [kW]	cos φ	Circuit	R <sub>St</sub> [Ω]
<b>IE1 Motors</b>								
SK...63S/4 SK 1x0E-250-340-B	100	2880	0.95	400	0.25	0.63	Delta	47.37
SK...71S/4 SK 1x0E-370-340-B	100	2895	1.07	400	0.37	0.71	Delta	39.90
SK...71L/4 SK 1x0E-550-340-B	100	2900	1.59	400	0.55	0.72	Delta	22.85
SK...80S/4 SK 1x0E-750-340-B	100	2910	2.0	400	0.75	0.72	Delta	15.79
SK...80L/4 SK 1x0E-111-340-B	100	2910	2.8	400	1.1	0.74	Delta	10.49
SK...90S/4 SK 1x0E-151-340-B	100	2925	3.75	400	1.5	0.76	Delta	6.41
SK...90L/4 SK 1x0E-221-340-B	100	2920	4.96	400	2.2	0.82	Delta	3.99
<b>IE2 Motor</b>								
SK...80SH/4SK 1x0E-750-340-B	100	2930	1.9	400	0.75	0.70	Delta	9.34
SK...80LH/4SK 1x0E-111-340-B	100	2920	2.56	400	1.1	0.73	Delta	6.30
SK...90SH/4SK 1x0E-151-340-B	100	2930	3.53	400	1.5	0.79	Delta	4.96
SK...90LH/4SK 1x0E-221-340-B	100	2925	4.98	400	2.2	0.79	Delta	3.27

Frequency inverter type	Performance data at rated point*		
	P <sub>B</sub> [kW]	n <sub>B</sub> [min <sup>-1</sup> ]	M <sub>B</sub> [Nm]
SK...63S/4 SK 1x0E-250-340-B	0.25	2840	0.90
SK...71S/4 SK 1x0E-370-340-B	0.37	2855	1.23
SK...71L/4 SK 1x0E-550-340-B	0.55	2860	1.83
SK...80S(H)/4 SK 1x0E-750-340-B	0.75	2885 (2905)	2.48 (2.4)
SK...80L(H)/4 SK 1x0E-111-340-B	1.1	2900 (2905)	3.62 (3.6)
SK...90S(H)/4 SK 1x0E-151-340-B	1.5	2925 (2925)	4.90 (4.8)
SK...90L(H)/4 SK 1x0E-221-340-B	2.2	2920 (2925)	7.20 (7.1)

\* Values in brackets apply for IE2 motors

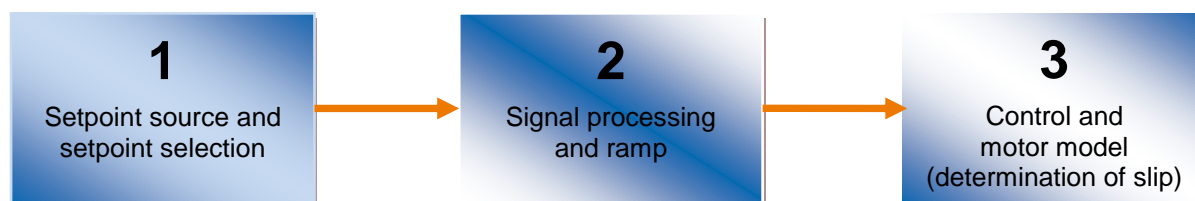
## 9.9 Standardisation of setpoint / target values

The following table contains details for the standardisation of typical setpoint and actual values. These details relate to parameters (P400), (P418), (P543), (P546), (P740) or (P741).

Designation	Analog signal		Bus signal						Limitation absolute
	Value range	Standardisation	Value range	max. value	Type	100% =	-100% =	Standardisation	
Setpoint frequency {01}	0-10V (10V=100%)	P104 ... P105 (min - max)	±100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f <sub>setpoint</sub> [Hz]/P105	P105
Frequency addition {02}	0-10V (10V=100%)	P410 ... P411 (min - max)	±200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f <sub>setpoint</sub> [Hz]/P411	P105
Frequency subtraction {03}	0-10V (10V=100%)	P410 ... P411 (min - max)	±200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f <sub>setpoint</sub> [Hz]/P411	P105
Minimum frequency {04}	0-10V (10V=100%)	50Hz* U <sub>AIn</sub> (V)/10V	0...200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	/	50Hz* Bus setpoint/4000 <sub>hex</sub>	P105
Maximum frequency {05}	0-10V (10V=100%)	100Hz* U <sub>AIn</sub> (V)/10V	0...200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	/	100Hz* Bus setpoint/4000 <sub>hex</sub>	P105
Actual value Process controller {06}	0-10V (10V=100%)	P105* U <sub>AIn</sub> (V)/10V	±100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f <sub>setpoint</sub> [Hz]/P105	P105
Setpoint value Process controller {07}	0-10V (10V=100%)	P105* U <sub>AIn</sub> (V)/10V	±100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f <sub>setpoint</sub> [Hz]/P105	P105
Torque current limit {11}, {12}	0-10V (10V=100%)	P112* U <sub>AIn</sub> (V)/10V	0...100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	/	4000 <sub>hex</sub> * I[A]/P112	P112
Current limit {13}, {14}	0-10V (10V=100%)	P536* U <sub>AIn</sub> (V)/10V	0...100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	/	4000 <sub>hex</sub> * I[A]/P536	P536
Ramp time {15}	0-10V (10V=100%)	10s* U <sub>AIn</sub> (V)/10V	0...200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	/	10s * Bus setpoint/4000 <sub>hex</sub>	20s
<b>Actual values</b> {Function}									
Actual frequency {01}	0-10V (10V=100%)	P201* U <sub>AOut</sub> (V)/10V	±100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f[Hz]/P201	
Speed {02}	0-10V (10V=100%)	P202* U <sub>AOut</sub> (V)/10V	±200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * n[rpm]/P202	
Current {03}	0-10V (10V=100%)	P203* U <sub>AOut</sub> (V)/10V	±200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f[Hz]/P105	
Torque current {04}	0-10V (10V=100%)	P112* 100/ √((P203) <sup>2</sup> -(P209) <sup>2</sup> )* U <sub>AOut</sub> (V)/10V	±200%	32767	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * I <sub>q</sub> [A]/(P112)*100/ √((P203) <sup>2</sup> -(P209) <sup>2</sup> )	
Master value Setpoint frequency {19} ... {24}	0-10V (10V=100%)	P105* U <sub>AOut</sub> (V)/10V	±100%	16384	INT	4000 <sub>hex</sub> 16384 <sub>dec</sub>	C000 <sub>hex</sub> 16385 <sub>dec</sub>	4000 <sub>hex</sub> * f[Hz]/P105	

## 9.10 Definition of setpoint and actual value processing (frequencies)

The frequencies used in parameters (P502) and (P543) are processed in various ways according the following table.



Function	Name	Meaning	Output to ...			without Right/ Left	with slip
			1	2	3		
8	Setpoint frequency	Setpoint frequency from setpoint source	X				
1	Actual frequency	Setpoint frequency for motor model		X			
23	Actual frequency with slip	Actual frequency at motor			X		X
19	Setpoint frequency master value	Setpoint frequency from setpoint source Master value (free from enable correction)	X			X	
20	Setpoint frequency n R master value	Setpoint frequency from motor model Master value (free from enable correction)		X		X	
24	Master value of actual frequency with slip	Actual frequency from motor model Master value (free from enable correction)			X	X	X
21	Actual frequency without slip master value	Actual frequency without slip Master value			X		

## 9.11 Maintenance and servicing information

### 9.11.1 Maintenance Instructions

In normal use, frequency inverters are maintenance-free. Please note the "General data" in Section 8.1.

#### **Dusty environments**

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

#### **Long-term storage**

The frequency inverter and the electronic brake rectifier SK CU4-MBR must be connected to the supply network for at least 60 minutes at regular intervals.

If this is not carried out, there is a danger that the devices 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).

## 9.11.2 Repair information

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

### Repairs

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

#### **NORD Electronic DRIVESYSTEMS GmbH**

Tjüchkampstraße 37  
26605 Aurich, Germany

For queries about repairs, please contact:

#### **Getriebebau NORD GmbH & Co. KG**

Tel.: 04532 / 289-2515  
Fax: 04532 / 289-2389

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

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

---

#### **NOTE**



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

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

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

Unless otherwise agreed, the device is reset to the factory settings after inspection or repair.

---

### Internet information

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

[www.nord.com](http://www.nord.com)

## 9.12 Abbreviations in this manual

<b>AS</b> (AS1)	AS interface	<b>FI</b> .....	Frequency inverter
<b>AIN</b> .....	Analog input	<b>ISD</b> .....	Field current (Current vector control)
<b>AOUT</b> ...	Analog output	<b>LED</b> .....	Light-emitting diode
<b>BW</b> .....	Brake resistor	<b>S</b> .....	Supervisor Parameter, P003
<b>DI</b> (DIN)	Digital input	<b>S1</b> .....	DIP switch FI A-IN (3-pole)
<b>DO</b> (DOUT)	Digital output	<b>S2</b> .....	DIP switch FI (3-pole)
<b>I/O</b> .....	Input / Output	<b>SW</b> .....	Software version, P707
<b>EEPROM</b>	Non-volatile memory	<b>TI</b> .....	Technical information / Data sheet ..... (Data sheet for NORD accessories)
<b>EMC</b> .....	Electromagnetic compatibility		
<b>I/O</b> .....	In-/ Out (Input / Output)		
<b>FI</b> -(Switch)	Leakage current circuit breaker		

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