INTELLIGENT DRIVESYSTEMS, WORLDWIDE SERVICES

**BU 0200 – en**

# NORDAC® *FLEX* (SK 200E ... SK 235E)

**Users Manual for Frequency Inverters**

NORD® DRIVESYSTEMS

# Documentation

| | | |
|---|---|---|
| **Title:** | BU 0200 | |
| **Order – No.:** | 6072002 | |
| **Series:** | SK 200E | |
| **Device series:** | SK 200E, SK 210E, SK 220E, SK 230E,<br>SK 205E, SK 215E, SK 225E, SK 235E | |
| **Device types:** | *SK 2xxE-250-112-O ... SK 2xxE-750-112-O* | 0.25 – 0.75 kW, 1~100-120 V, Out: 230 V |
| | *SK 2xxE-250-123-A ... SK 2xxE-111-123-A* | 0.25 – 1.1 kW, 1~200-240 V |
| | *SK 2xxE-250-323-A ... SK 2xxE-112-323-A* | 0.25 – 11.0 kW, 3~200-240 V [1)] |
| | *SK 2xxE-550-340-A ... SK 2xxE-222-340-A* | 0.55 – 22.0 kW, 3~380-500 V [2)] |

1) Size 4 (5.5 – 11.0 kW) only in version SK 2x0E
2) Size 4 (11.0 – 22.0 kW) only in version SK 2x0E

# Version list

| Title, Date | Order number | Device software version | Remarks |
|---|---|---|---|
| BU 0200, March 2009 | 6072002 / 1009 | V 1.1 R1 | First issue |
| Further revisions:<br>March, December 2010, May 2011, October 2011, June 2014<br>An overview of the changes in the above-mentioned editions can be found in the respective document. | | | |
| BU 0200, May 2015 | 6072002 / 2115 | V 2.0 R1 | Among other things<br>• General corrections<br>• Structural adaptations in the document (Chapter "Options and Accessories" broken down, content reorganised)<br>• New parameters: P240–247, P330–334<br>• Adaptation of parameters: P003, 100, 105, 108, 109, 110, 200, 219, 220, 300, 312, 313, 315, 316, 327, 401, 418, 420, 436, 480, 481, 502, 504, 535, 538, 550, 709, 740, 741, 745<br>• Error messages E006, E007, E022–024, I000.6, I000.7<br>• Operation of PM synchronous motors possible<br>• PLC available<br>• New display of scope of delivery / accessory overview<br>• Revision of UL/cUL, plus inclusion of "Group protection"<br>• HTL rotary encoder, evaluation of zero track possible |

| Title, Date | Order number | Device software version | Remarks |
|---|---|---|---|
| BU 0200, March 2016 | 6072002 / 1216 | V 2.1 R0 | Among other things<br>• General corrections<br>• Structural adjustments to document<br>• Removal of various descriptions for accessories (reference to additional documents →Technical Information)<br>• Adaptation of parameters: P513, 504, 520, 550, 560, 703<br>• Error messages I000.8, I000.9 added<br>• Revision of section "UL/cUL", including for CSA: Voltage limitation filter (SK CIF) no longer required → Module removed from document<br>• Installation description of ring core (ferrite) for improving EMC with size 4 added<br>• AS Interface, addition of device versions …-AXB and …-AUX.<br>• Updating of EC/EU conformity declarations |
| BU 0200, December 2017 | 6072002 / 5117 | V 2.1 R3 | Among other things<br>• General corrections<br>• Adaptation of safety information<br>• Revision of warnings and hazard notes<br>• Adaptation for ATEX, outdoor installation and brake resistors<br>• Adapter kits for motor mounting and wall mounting kits now divided into versions for IP55 and IP66<br>• Adaptation of parameters: P106, 107, 206, 208, 211, 212, 220, 330, 331, 400, 434, 546, 558, 709 |
| BU 0200, July 2018 | 6072002 / 3118 | V 2.1 R4 | Among other things<br>• General corrections<br>• Adaptation of safety information<br>• Adaptations for wall-mounting kits<br>• Adaptation for ATEX, outdoor installation and brake resistors<br>• Addition of EAC EX<br>• Adaptations for AS interface<br>• Adaptation of parameters: P331, 332, 333, 555, 556, 557<br>• Correction of standardisation of setpoint and actual values<br>• Motor data extended with 100 Hz characteristic curve |

**Table 1: Version List BU0200**

# Copyright notice

# Publisher

**Getriebebau NORD GmbH & Co. KG**
Getriebebau-Nord-Straße 1 • 22941 Bargteheide, Germany • http://www.nord.com/
Fon +49 (0) 45 32 / 289-0 • Fax +49 (0) 45 32 / 289-2253

**Member of the NORD DRIVESYSTEMS Group**

# Table of Contents

# List of illustrations

# List of tables

# 1 General

The SK 2xxE series is based on the tried and tested NORD platform. The devices are characterised by their compact design and optimum control characteristics, and have uniform parametrisation.

The devices have sensor-less current vector control with a wide range of settings. In combination with suitable motor models, which always provide an optimised voltage/frequency ratio, all three-phase asynchronous motors that are suitable for inverter operation and permanently excited synchronous motors can be driven. For the drive unit, this means very high starting and overload torques with constant speed.

The performance range extends from 0.25 kW bis 22.0 kW.

The use of modular modules means that the device series can be adapted to individual customer requirements.

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

Additional descriptions for optional functions and bus systems exist (http://www.nord.com/).

**Information** **Accessories**

The accessories mentioned in the manual are also subject to change. Current details of these are summarised in separate data sheets, which are available at www.nord.com under the heading *Documentation → Manuals → Electronic Drive Technology → Techn. Info / Data Sheet*. The data sheets available at the date of publication of this manual are listed by name in the relevant sections (TI ...).

Installation directly on a motor is typical of this device series. Alternatively, optional accessories are also available for mounting the devices close to the motor, e.g. on the wall or on a machine frame.

In order to have access to all parameters, the internal RS232 interface (access via RJ12 connection) can be used. Access to the parameters takes place via an optional SimpleBox or ParameterBox, for example.

The parameter settings modified by the operator are backed up in the integrated, non-volatile memory of the device.

**Up to firmware version 1.4 R1** the data was backed up in pluggable EEPROM. The EEPROM then had to remain plugged in during operation.

In the simplest configuration (SK 2x0E size 4, SK 2x5E), even without the plugged-in EEPROM, all of the most important parameters can be set using two potentiometers and eight DIP switches. LEDs are provided for the diagnostics of the operating status. The use of a control module is therefore not absolutely necessary.

## Information — Adaptation of parameter structure

With the software version change from **V1.1 R1 to V1.2 R0** of the frequency inverter, the structure of individual parameters was changed (📖Section 5 "Parameter"), e. g.: Up to version V 1.1 R2 (P417) was a single parameter, but from version V1.2 R0 it was subdivided into two arrays ((P417) [-01] and [-02]).
When an EEPROM from a frequency inverter with an earlier software version is plugged into a frequency inverter with software version V1.2 or higher, the stored data is automatically converted to the new format. New parameters are stored with the default setting. This therefore provides correct functionality.
**However, it is not permissible to plug in an EEPROM (memory module) with a software version of V1.2 or above into a frequency inverter with a previous software version, since this would lead to loss of all data.**

## Information — DIP switch function change

The functional assignment of DIP switch S1-6 was changed in the software version change from **V1.4 R1 to V1.4 R2** of the frequency inverter (📖 Section 4.3.2.2 "DIP switches (S1)"). The U/F function (changeover between ISD control and the U/F characteristic curve) was replaced with the "COPY" function (triggering of data exchange from external EEPROM (memory module) to the internal EEPROM).

## 1.1 Overview

This manual describes two very similar basic versions of the SK 200E product family (NORDAC *FLEX*).

Wherever the *SK 2xxE* is mentioned in the following, this refers to information that applies to all devices in this family.

If the information exclusively applies to the versions SK 205E / SK 215E / SK 225E / SK 235E, this is apparent from the designation *SK 2x5E*.

If the information only applies to versions SK 200E / SK 210E / SK 220E / SK 230E, this is recognisable from the designation *SK 2x0E*.

**Basic properties**

- High starting torque and precise motor speed control setting by means of sensorless current vector control
- Can be installed directly on, or close to the motor.
- Permissible ambient temperature -25°C to 50°C (please refer to technical data)
- Integrated EMC mains filter for limit curve A Category C2 or C3 (not with 115 V devices)
- Automatic measurement of the stator resistance and determination of the precise motor data possible
- Programmable direct current braking
- Built-in brake chopper for 4-quadrant operation, optional braking resistors (internal/external)
- Separate temperature sensor input (TF+/TF-)
- Evaluation of an incremental encoder via digital inputs possible
- NORD system bus for linking modular additional modules
- Four separate parameter sets that can be changed over online
- 8x DIP switches for minimal configuration
- LEDs for diagnosis (SK 2x5E incl. DI/DO signal statuses)
- RS232/485 interface via RJ12 plug
- Plug-in data memory (EEPROM)
- Integrated "POSICON" positioning control (🕮 BU 0210)
- CANopen absolute value encoder evaluation via the NORD system bus
- Operation of *three-phase current **as**ynchronous **m**otors* (ASM) and ***P**ermanent **M**agnet **S**ynchronous **M**otors* (PMSM)
- Integrated PLC (🕮 BU 0550)

Differences between the individual versions (SK 200E / SK 205E / … SK 235E) are summarised in the following table and will be described in this manual.

### Additional characteristics, sizes 1 ... 3

| Feature | 200E | 205E | 210E | 215E | 220E | 225E | 230E | 235E |
|---|---|---|---|---|---|---|---|---|
| Integrated 24V power supply | x | | x | | x | | x | |
| Optionally available 24V mains unit | | x | | x | | x | | x |
| Number of digital inputs (DIN) | 4 | 4 | 3 | 3 | 4 | 4 | 3 | 3 |
| Number of digital outputs (DO) | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 |
| Number of analogue inputs (AIN) | 2 | | 2 | | 1 | | 1 | |
| Additional 2 potentiometers for minimal configuration | | x | | x | | x | | x |
| Electromechanical brake control | | x | | x | | x | | x |
| Safe pulse block (STO / SS1) (📖BU0230) | | | x | x | | | x | x |
| AS interface (4I / 4O) | | | | | x | x | x | x |

Table 2: Additional characteristics, sizes 1 ... 3

### Additional characteristics, size 4

| Feature | 200E | 210E | 220E | 230E |
|---|---|---|---|---|
| Integrated 24V power supply | x | x | x | x |
| Number of digital inputs (DIN) | 4 | 3 | 4 | 3 |
| Number of digital outputs (DO) | 2 | 2 | 2 | 2 |
| Number of analogue inputs (AIN) | 2 | 2 | 1 | 1 |
| Additional 2 potentiometers for minimal configuration | x | x | x | x |
| Electromechanical brake control | x | x | x | x |
| Safe pulse block (STO / SS1) (📖BU0230) | | x | | x |
| AS interface (4I / 4O) | | | x | x |

Table 3: Additional characteristics, size 4

### Option modules

Option modules are used to extend the functionality of the device.

These options are available as an installation variant, the so-called SK CU4-… customer unit, and also as an attachment variant, the so-called SK TU4-… technology unit. As well as the mechanical differences, the installation and attachment variants also have some functional differences.

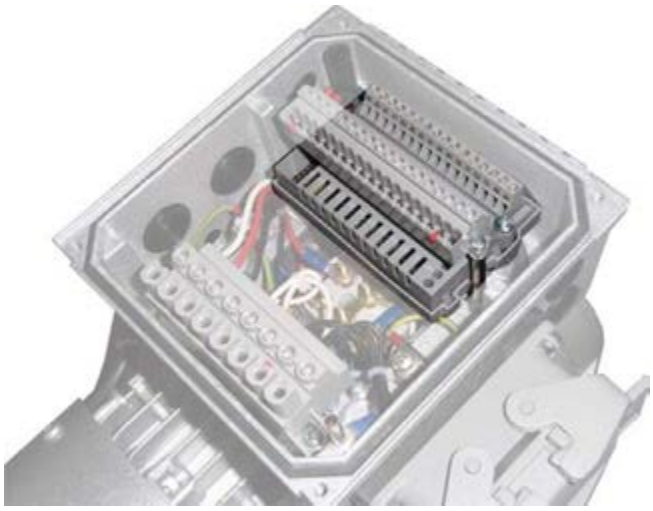


Figure 1: Device with internal SK CU4-...

Figure 2: Device with external SK CU4-...

*Attachment variant*

The **external technology unit (Technology Unit SK TU4-…)** is externally attached to the device and is therefore easy to access.

A technology unit basically requires the use of a suitable SK TI4-TU-… connection unit.

The power supply and signal lines are connected using the screw clamps of the connection unit. Depending on the version, additional connections for connectors (e.g. M12 or RJ45) may be available.

The optional wall mounting kit SK TIE4-WMK-TU also allows the technology units to be mounted away from the starter.

*Built-in variant*

The **internal customer unit (Customer Unit, SK CU4-...)** is integrated in the device. The power supply and signal lines are connected using screw clamps.

The **SK CU4-POT** potentiometer adapter is an exception among the "SK CU4 Modules", since it is not integrated in the device but attached to it.

Communication between "intelligent" option modules and the device takes place via the system bus. Intelligent option modules are modules with their own processor and communication technology, as is the case with field bus modules, for example.

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
1 x CANopen absolute encoder

Up to 4 frequency inverters with their appropriate options can be connected to a system bus.

## 1.2 Delivery

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

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

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

## 1.3 Scope of delivery

**NOTICE** — **Defect in the device**

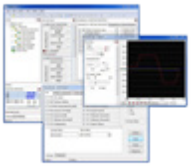
Use of unapproved accessories and options (e.g. options from other device series (SK CSX-0)) may result in defects of the interconnected components.

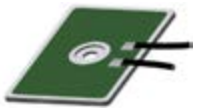
Only use options and accessories which are explicitly intended for use with this device and are stated accordingly in this manual.

*Standard version:*

- IP55 version of device (optionally IP66)
- Operating instructions as PDF file on CD ROM including NORD CON, (PC parametrisation software)

*Available accessories:*

| | Designation | Example | Description |
|---|---|---|---|
| Control and parametrisation options | **Parametrisation units for temporary connection to the device, handheld** |  | For commissioning, parametrisation and control of the device.<br>**Model SK PAR-3H, SK CSX-3H**<br>📖 Section 3.1.1 "Control and Parametrisation Boxes / Software" |
| | **Hand-held control units** |  | For controlling the device,<br>**Model SK POT- …**<br>📖 Section 3.1.1 "Control and Parametrisation Boxes / Software" |
| | **NORD CON**<br>**MS Windows ® - based software** |  | For commissioning, parametrisation and control of the device.<br>Refer to www.nord.com<br>NORD CON<br>(Free download) |
| Bus interface | **Internal bus interfaces** |  | Customer unit for installation device for: CANopen, DeviceNet, EtherCAT, Ethernet/IP, Powerlink, Profibus DP, Profinet IO<br>**Model SK CU4- …**<br>📖 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **External bus interfaces** |  | Technology unit for attaching to the device or alternatively for wall mounting (wall mounting kit required) for: CANopen, DeviceNet, EtherCAT, Ethernet/IP, Powerlink, Profibus DP, Profinet IO,<br>**Model SK TU4- …**<br>📖 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |

| | | | |
|---|---|---|---|
| **Braking resistors** | **Internal braking resistors** |  | Braking resistor for installation in the device for leading away generated heat from the drive system caused by conversion to heat. Energy is generated by the braking processes or downward movement of loads,<br>**Model SK BRI4- …**<br>📖 Section 2.3.1 "Internal brake resistor SK BRI4-…" |
| | **External braking resistors** |  | Refer to:<br>*Internal braking resistors*,<br>but for attaching to the device<br>**Model SK BRE4- …**<br>📖 Section 2.3.2 "External braking resistor SK BRE4-... / SK BRW4-… / SK BREW4-…" |

| | | | |
|---|---|---|---|
| **I/O expansions** | **Internal I/O expansion** |  | Customer unit for installing in the device for extending the analogue and digital inputs and outputs.<br>**Model SK CU4-IOE…**<br>📖 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **Internal signal converter** |  | Customer unit for installation in the device for converting bipolar analogue signals to unipolar analogue signals, e.g. digital signals on relays<br>**Model SK CU4-REL- …**<br>📖 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **External I/O extension** |  | Technology unit for attaching to the device or alternatively for wall mounting (wall mounting kit required) for extending the analogue and digital inputs and outputs.<br>**Model SK TU4-IOE- …**<br>📖 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |

| | | | |
|---|---|---|---|
| **Power supply** | **Internal power supplies** |  | SK 2x5E: Power supply for installation in the device for generating the low control voltage (24 V DC).<br>**Model SK CU4-24V- …**<br>📖 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **External power supplies** |  | SK 2x5E: Technology unit for attaching to the device or alternatively for wall mounting (wall mounting kit required) for generating the low control voltage (24 V DC).<br>**Model SK TU4-24V- …**<br>📖 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |

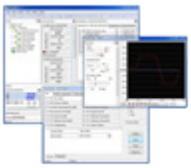
| | | | |
|---|---|---|---|
| **Wall mounting** | **Wall mounting for the device** |  | Set for mounting the device, separate from the motor (e.g. to a wall).<br>**Model SK TIE4-WMK-…**<br>(🕮 Section 2.1.3 "Wall mounting") |
| | **Wall mounting for SK TU4-… modules** |  | Set for mounting a technology unit, SK TU4-..., separate from the device (e.g. to a wall).<br>**Model SK TIE4-WMK-TU**<br>(🕮 Section 3.2.2 "External technology units SK TU4-… (module attachment)") |

| | | | |
|---|---|---|---|
| **Switches and potentiometers** | **Switch / potentiometer unit**<br>(L – OFF – R / 0 – 10 V) |  | Customer unit for attaching to the device for ease of control of the device using switches and potentiometers<br>**Model SK CU4-POT**<br>🕮 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **ATEX potentiometer**<br>(0 – 10 V) |  | Potentiometer with ATEX capability for attaching to the device for ease of control of the device<br>**Model SK ATX-POT**<br>🕮 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **Potentiometer**<br>(0 – 10 V) |  | Potentiometer for attaching to the device for ease of control of the device<br>**Model SK TIE4-POT**<br>🕮 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |
| | **Switch**<br>(L – OFF – R) |  | Switch for attaching to the device for simple control of the device<br>**Model SK TIE4-SWT**<br>🕮 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |
| | **Maintenance switch**<br>(0 – I) |  | Technology unit for attaching to the device or alternatively for wall mounting (wall mounting kit required) for safely insulating the device from the AC power supply.<br>**Model SK TU4-MSW- …**<br>🕮 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |
| | **Setpoint adjuster**<br>(L – 0 – R / 0 – 100 %) |  | Technology unit for attaching to the device or alternatively for wall mounting (wall mounting kit required) for simple control of the device using buttons and potentiometers, including power supply for generating a 24 V DC control voltage.<br>**Model SK TU4-POT- …**<br>🕮 Section 3.2.2 "External technology units SK TU4-… (module attachment)" |

| | | | |
|---|---|---|---|
| **Plug connector** | **Power connection**<br>(for power input, power output, motor output) |  | AC Power connector for attaching to the device for making a detachable connection for supply lines (e.g. mains supply line)<br>**Model SK TIE4-…**<br>📖 Section 3.2.3.1 "Plug connectors for power connections" |
| | **Control line connection** |  | System connector (M12) for attaching to the device, for making a detachable connection for control lines<br>**Model SK TIE4-…**<br>📖 Section 3.2.3.2 "Plug connectors for control connection" |

| | | | |
|---|---|---|---|
| **Adapter** | **Adapter cable** |  | Different adapter cables<br>(Link) |
| | **Mounting Adapter** |  | Different adapter kits for setting up the device on different motor sizes<br>📖 Section 2.1.2.1 "Adapters for different motors" |
| | **Parametrisation adapter**<br>(EEPROM memory module adapter) |  | For data backups and parametrising the *memory module* (external EEPROM) of the frequency inverter, independently of the frequency inverter<br>**Type SK EPG-3H**<br>(Link) |

| | | | |
|---|---|---|---|
| **Miscellaneous** | **Internal electronic brake rectifier** |  | Customer unit for installing in the device for direct actuation of an electro-mechanical brake<br>**Model SK CU4-MBR- …**<br>📖 Section 3.2.1 "Internal customer interfaces SK CU4-… (installation of modules)" |

| | | | |
|---|---|---|---|
| **Software** (Free download) | **NORD CON**<br>**MS Windows ® - based software** |  | For commissioning, parametrisation and control of the device.<br>Refer to www.nord.com<br>NORD CON |
| | **ePlan macros** |  | Macros for producing electrical circuit diagrams<br>Refer to www.nord.com<br>ePlan |
| | **Device master data** |  | Device master data / device description files for NORD field bus options<br>NORD fieldbus files |
| | **S7 standard modules** for PROFIBUS DP and PROFINET IO |  | Standard modules for NORD frequency converters<br>Refer to www.nord.com<br>NORD S7_files |
| | **Standard modules for the TIA portal** for PROFIBUS DP and PROFINET IO | | Standard modules for NORD frequency converters<br>*Available on request.* |

## 1.4 Safety, installation and operating instructions

Before working on or with the device, please read the following safety instructions extremely carefully. Please pay attention to all other information from the device manual.

Non-compliance can result in serious or fatal injuries and damage to the device or its surroundings.

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

**1. General**

Do not use defective devices or devices with defective or damaged housings or missing covers (e.g. blind plugs for cable glands). Otherwise there is a risk of serious or fatal injuries caused by electric shock or bursting electrical components such as powerful electrolytic capacitors.

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

During operation and depending on the protection class of the devices, there may be live, bare, moving or rotating parts or hot surfaces.

The device operates with a dangerous voltage. Dangerous voltage may be present at the supply lines, contact strips and PCBs of all connecting terminals (e.g. mains input, motor connection), even if the device is not working or the motor is not rotating (e.g. caused by electronic disabling, jamming of the drive or a short circuit at the output terminals).

The device is not equipped with a mains switch and is therefore always live when connected to the power supply. Voltages may therefore be connected to a connected motor at standstill.

Even if the drive unit has been disconnected from the mains, a connected motor may rotate and possibly generate a dangerous voltage.

If you come into contact with dangerous voltage such as this, there is a risk of an electric shock, which can lead to serious or fatal injuries.

The device and any power plug connectors must not be disconnected while a voltage is applied to the device. Failure to comply with this may cause arcing, which in addition to the risk of injury, also results in a risk of damage or destruction of the device.

The fact that the status LED or other indicators are not illuminated does not indicate that the device has been disconnected from the mains and is without voltage.

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

Touching these parts can result in local burns to the body parts concerned (cooling times and clearance from neighbouring components must be complied with).

All work on the device, e.g. transportation, installation, commissioning and maintenance work must be carried out by qualified experts (observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national accident prevention regulations). 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.

During all work on the device, take care that no foreign bodies, loose parts, moisture or dust enter or remain in the device (risk of short circuit, fire and corrosion).

Further information can be found in this documentation.

**2. Qualified experts**

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.

Furthermore, the device and the associated accessories may only be installed and started up by qualified electricians. An electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- switching on, switching off, isolating, earthing and marking power circuits and devices,
- proper maintenance and use of protective devices in accordance with defined safety standards.

**3. Correct purpose of use – general**

The frequency inverters are devices for industrial and commercial systems used for the operation of three-phase asynchronous motors with squirrel-cage rotors and Permanent Magnet Synchronous Motors – PMSM. These motors must be suitable for operation with frequency inverters, other loads must not be connected to the devices.

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

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

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

CE-labelled devices fulfil the requirements of the Low Voltage Directive 2014/35/EU. The stated harmonized standards for the devices are used in the declaration of conformity.

**a. Supplement: Correct purpose of use within the European Union**

When installed in machines, the devices must not be commissioned (i.e. commencement of proper use) until it has been ensured that the machine fulfils the provisions of EC Directive 2006/42/EC (Machinery Directive); EN 60204-1 must also be complied with.
Commissioning (i.e. start-up of proper use) is only permitted if the EMC directive (2014/30/EU) has been complied with.

**b. Supplement: Correct purpose of use outside the European Union**

The local conditions of the operator for the installation and commissioning of the device must be complied with at the usage location (see also "a) Supplement: Correct purpose of use within the European Union").

**4. Phases of life**

***Transport, storage***

The information in the manual regarding transport, storage and correct handling must be complied with.

The permissible mechanical and climatic ambient conditions (see technical data in the manual for the device) must be complied with.

If necessary, suitable, adequately dimensioned means of transport (e.g. lifting gear, rope guides) must be used.

***Installation and assembly***

The installation and cooling of the device must be implemented according to the regulations in the corresponding documentation. The permissible mechanical and climatic ambient conditions (see technical data in the manual for the device) must be complied with.

The device must be protected against impermissible loads. In particular, components must not be deformed and/or insulation distances must not be changed. Touching of electronic components and contacts must be avoided.

The device and its optional modules contain electrostatically sensitive components, which can be easily damaged by incorrect handling. Electrical components must not be mechanically damaged or destroyed.

***Electrical Connection***

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

Installation, maintenance and repair work must not be carried out unless the device has been disconnected from the voltage and at least 5 minutes have elapsed since the mains was switched off! (Due to charged capacitors, the equipment may continue to carry hazardous voltages for up to 5 minutes after being switched off at the mains). Before starting work it is essential to check by measurement that all contacts of the power plug connections or the connection are voltage-free.

The electrical installation must be implemented as per the applicable regulations (e.g. cable cross-section, fuses, earth lead connections). Further instructions can be found in the documentation or manual for the device.

Information regarding EMC-compliant installation such as shielding, earthing, location of filters and routing of cables can be found in the documentation for the devices and in the technical information manual TI 80-0011. CE marked devices must also comply with these instructions. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

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

The device may only be operated with effective earth connections which comply with local regulations for large leakage currents (> 3.5 mA). Detailed information regarding connections and operating conditions can be obtained from the technical Information manual TI 80-0019.

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

All phases of all power connections (e.g. power supply) must always be disconnected.

***Set-up, troubleshooting and commissioning***

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

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

The parametrisation and configuration of the devices must be selected so that no hazards can occur.

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

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

***Operation***

Where necessary, systems in which the devices are installed must be equipped with additional monitoring and protective equipment according to the applicable safety requirements (e.g. legislation concerning technical equipment, accident prevention regulations, etc.).

All covers must be kept closed during operation.

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

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

Due to its operation, the device produces noises within the audible frequency range. These noises may cause long-term stress, discomfort and fatigue, with negative effects on concentration. The frequency range or the noise can be shifted to a less disturbing or almost inaudible range by adjustment of the pulse frequency. However, this may possibly result in derating (lower power) of the device.

***Maintenance, repair and decommissioning***

Installation, maintenance and repair work must not be carried out unless the device has been disconnected from the voltage and at least 5 minutes have elapsed since the mains was switched off! (Due to charged capacitors, the equipment may continue to carry hazardous voltages for up to 5 minutes after being switched off at the mains). Before starting work it is essential to check by measurement that all contacts of the power plug connections or the connection are voltage-free.

For further information, please refer to the manual for the device.

***Disposal***

The product and its parts and accessories must not be disposed of as domestic waste. At the end of its life, the product must be properly disposed of according to the local regulations for industrial waste. In particular, this product contains integrated semiconductor circuits (PCBs and various electronic components, including high power capacitors). In case of incorrect disposal there is a risk of formation of toxic gases, which may cause contamination of the environment and direct or indirect injuries (e.g. chemical burns). In the case of high power capacitors, there is also a risk of explosion, with the associated risk of injury.

**5. Potentially explosive environment (ATEX, EAC Ex)**

In order to operate or carry out installation work in potentially explosive environments (ATEX, EAC Ex), the device must be approved and the relevant requirements and notes from the manual of the device must be complied with.

Failure to comply can result in the ignition of an explosive atmosphere and fatal injuries.

- Only persons who are qualified, i.e. trained and authorised for all assembly, service, commissioning and operation work on association with explosion hazard environments may work with the devices described here (including the motors, geared motors, any accessories and all connection technology).
- 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.

- The drive must comply with the specifications of ***"Planning guideline for the operating and installation instructions B1091"*** B1091-1.
- Only original parts which are approved for the device and for operation in an explosion hazard area ATEX Zone 22 3D, EAC Ex must be used.
- **Repairs may only be carried out by Getriebebau NORD GmbH & Co. KG.**

## 1.5 Warning and hazard information

Under certain circumstances, hazardous situations may occur in association with the frequency inverter. In order to give explicit warning of possibly hazardous situations, clear warning and hazard information can be found on the device and in the relevant documentation.

### 1.5.1 Warning and hazard information on the product

The following warning and hazard information is used on the product.

| Symbol | Supplement to symbol [1] | Meaning |
|---|---|---|
|  | DANGER<br>Device is live<br>> 5min after removing mains voltage | **Danger** **Electric shock**<br>The device contains powerful capacitors. Because of this, there may be a hazardous voltage for more than 5 minutes after disconnection from the mains.<br>Before starting work, check that the device is free of voltage at all power contacts by means of suitable measuring equipment. |
|  |  | It is essential to read the manual in order to prevent hazards! |
|  | | **CAUTION** **Hot surfaces**<br>The heat sink and all other metal components as well as the surfaces of plug connectors may heat up to temperatures in excess of 70°C.<br>• Danger of injury due to local burns on contact.<br>• Heat damage to adjacent objects<br>Allow sufficient cooling time before starting work on the device. Check the surface temperatures with suitable measuring equipment. Maintain an adequate distance to adjacent components or provide protection against contact. |
|  | | ***NOTICE*** **EDS**<br>The device contains electrostatically sensitive components, which can be easily damaged by incorrect handling.<br>Avoid all contact (indirect contact by tools or similar, or direct contact) with PCBs and their components. |

1) Texts are written in English.

**Table 4: Warning and hazard information on the product**

### 1.5.2 Warning and hazard information in the document

The warning and hazard information in this document are located at the beginning of the section which describes the action which may result in the corresponding hazards.

The warning and hazard information is classified as follows according to the risk and the severity of the resulting injuries.

| | |
|---|---|
| **DANGER!** | Indicates an immediate danger, which may result in death or serious injury. |
| **WARNING** | Indicates a possibly dangerous situation, which may result in death or serious injury. |
| **CAUTION** | Indicates a possibly dangerous situation, which may result in slight or minor injuries. |
| ***NOTICE*** | Indicates a possibly harmful situation, which may cause damage to the product or the environment. |

## 1.6 Standards and approvals

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

| Approval | Directive | | Applied standards | Certificates | Code |
|---|---|---|---|---|---|
| CE *(European Union)* | Low Voltage Directive | 2014/35/EU | EN 61800-5-1<br>EN 60529<br>EN 61800-3<br>EN 50581 | C310700_2016<br>C310401_2016 | CE |
| | EMC | 2014/30/EU | | | |
| | RoHS | 2011/65/EU | | | |
| UL *(USA)* | | | UL 61800-5-1 | E171342 | c UL us LISTED IND.CONT.EQ. E171342 |
| CSA *(Canada)* | | | C22.2 No.274-13 | E171342 | |
| C-Tick *(Australia)* | | | | N 23134 | |
| EAC *(Eurasia)* | TR CU 004/2011,<br>TR CU 020/2011 | | IEC 61800-5-1,<br>IEC 61800-3 | TC RU C-DE.АЛ32.В.00000 | EAC |

Table 5: Standards and approvals

Devices which are configured and approved for use in explosion hazard environments (📖 Section 2.6 "Operation in potentially explosive environments ") comply with the following directives and standards.

| Approval | Directive | | Applied standards | Certificates | Code |
|---|---|---|---|---|---|
| ATEX *(European Union)* | ATEX | 2014/34/EU | EN 60079-0<br>EN 60079-31<br>EN 61800-5-1<br>EN 60529<br>EN 61800-3<br>EN 50581 | C432710_2016 | CE Ex |
| | EMC | 2014/30/EU | | | |
| | RoHS | 2011/65/EU | | | |
| EAC Ex *(Eurasia)* | TR CU 012/2011 | | IEC 60079-0<br>IEC 60079-31 | TC RU C-DE.AA87.B.01109 | EAC Ex |

**Table 6: Standards and approvals for explosion hazard environments**

## 1.7 UL and CSA approval

**File No. E171342**

Categorisation of protective devices approved by the UL according to United States Standards for the inverters described in this manual is listed below with essentially the original wording. The categorisation of individually relevant fuses or circuit breakers can be found in this manual under the heading “Electrical Data”. All devices include motor overload protection.

(📖 section 7.2 "Electrical data")

**Information** — **Group fuse protection**

The devices can basically be protected as a group via a common fuse (details in the following). The adherence of the total currents and the use of the correct cables and cable cross-sections must be taken into account when doing this. If the device or devices is/are being installed close to the motor, this also applies to the motor cable.

**UL / CSA conditions according to the report**

**Information**

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

“Use 80°C Copper Conductors Only." (size 1 – 3)

“Use 60/75°C copper field wiring conductors.” (size 4)

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

“The device has to be mounted according to the manufacturer instructions.”

“For NFPA79 applications only”

**Information** — **Internal Break Resistors (PTCs)**

Alternate - internal brake resistors, optional for drives marked for USL only (not for Canada), Unlisted Component NMTR3, manufactured by Getriebebau:

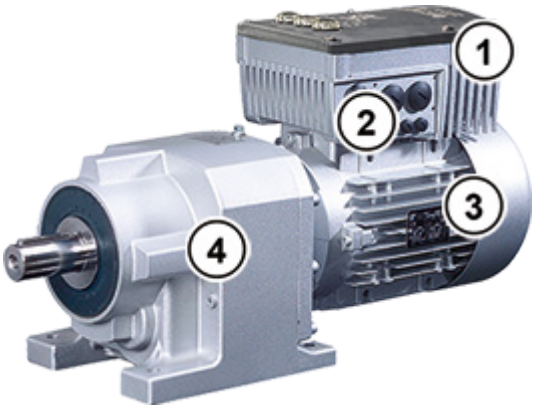
| | Usage | Cat. No. |
|---|---|---|
| 1 | FS1-112,<br>FS2-112,<br>FS1-123,<br>FS2-123 | BRK-100R0-10-L or- M alternate PLR or PLRC100.61.41 100R 100W |
| 2 | FS1-323,<br>FS2-323 | BRK-200R0-10-L or- M alternate PLR or PLRC100.61.41 200R 100W |
| 3 | FS1-340 | BRK-400R0-10-L or- M alternate PLR or PLRC100.61.41 400R 100W |
| 4 | FS3-323 | BRM-100R0-10-L or- M alternate PLR or PLRC200.70.51 100R 200W |
| 5 | FS2-340,<br>FS3-340 | BRM-200R0-10-L or- M alternate PLR or PLRC200.70.51 200R 200W |
| 6 | -551-323 | 1x BRQ-47R0-10-L or- M alternate PLR or PLRC300.70.61 47R 300W |
| 7 | -751-323 | 1x BRQ-47R0-10-L or- M alternate PLR or PLRC300.70.61 47R 300W |
| 8 | -112-323 | 2x BRQ-47R0-10-L or- M alternate PLR or PLRC300.70.61 47R 300W |
| 9 | -112-340 | 1x BRQ-100R-10-L or- M alternate PLR or PLRC300.70.61 100R 300W |
| 10 | -152-340 | 1x BRQ-100R-10-L or- M alternate PLR or PLRC300.70.61 100R 300W |
| 11 | -182-340 | 2x BRQ-100R-10-L or- M alternate PLR or PLRC300.70.61 100R 300W |
| 12 | -222-340 | 2x BRQ-100R-10-L L or- M alternate PLR or PLRC300.70.61 100R 300W |

| Size | valid | description |
|---|---|---|
| 1 - 3 | For 240 V for 1 phase models or 500V for 3 phase models only: | “Suitable For Use On A Circuit Capable Of Delivering Not More Than 65 000 rms Symmetrical Amperes, ____ Volt maximum”,<br>“When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated _____ Amperes, and _____Volts”, as listed in [1]. |
| | For 120 V, 240 V, 400 V, 500 V models only: | “Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, ____ Volts Maximum” and minimum one of the two following alternatives.<br><br>When used together with Accessory SK TU4-MSW:<br>“Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, ____ Volts Maximum” and minimum one of the two following alternatives.<br><br>1. “When Protected by Fuses manufactured by Bussmann, type _____”, as listed in[1].<br>2. “When Protected by class RK5 Fuses or faster or when Protected by High-Interrupting Capacity, Current Limiting Class CC, G, J, L, R, T, etc. Fuses, rated _____ Amperes, and _____ Volts”, as listed in [1]. |
| | **Motor group installation (Group fusing):** | “Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 500 V max” “When Protected by class RK5 Fuses or faster, rated 30_Amperes”<br>“Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 500 V max” “When Protected by High-Interrupting Capacity, Current Limiting Class CC, G, J, L, R, T, etc. Fuses rated 30 Amperes”<br>“Suitable for motor group installation on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 500 V max” “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 30 Amperes and 500 Volts min” |
| | **differing data CSA:** | If device is used for Canadian market and bears the cUL Listing mark: “For Canada SCCR is limited to 5 000 rms Symmetrical Amperes.”.<br>Marking not required for UL only marked devices. |
| 4 | Models<br>-551-323-A;<br>-751-323-A;<br>-112-323-A only: | “Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, 240 Volts Maximum When Protected By High-Interrupting Capacity, Current Limiting Type Fuses such as Class CC, G, J, L, R, T, etc., rated 300V/60A."<br>“Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, 240 Volts Maximum When Protected By A Circuit Breaker Having An Interrupting Rating Not Less Than 10 000 rms Symmetrical Amperes, 300 Volts Maximum." |
| | Models<br>-112-340-A;<br>-152-340-A;<br>-182-340-A;<br>-222-340-A only: | “Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, 500 Volts Maximum When Protected By High-Interrupting Capacity, Current Limiting Type Fuses such as Class CC, G, J, L, R, T, etc., rated 600A/60A."<br>“Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, 500 Volts Maximum When Protected By A Circuit Breaker Having An Interrupting Rating Not Less Than 10 000 rms Symmetrical Amperes, 600 Volts Maximum." |

1) 🕮 7.2

## 1.8 Type code / nomenclature

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



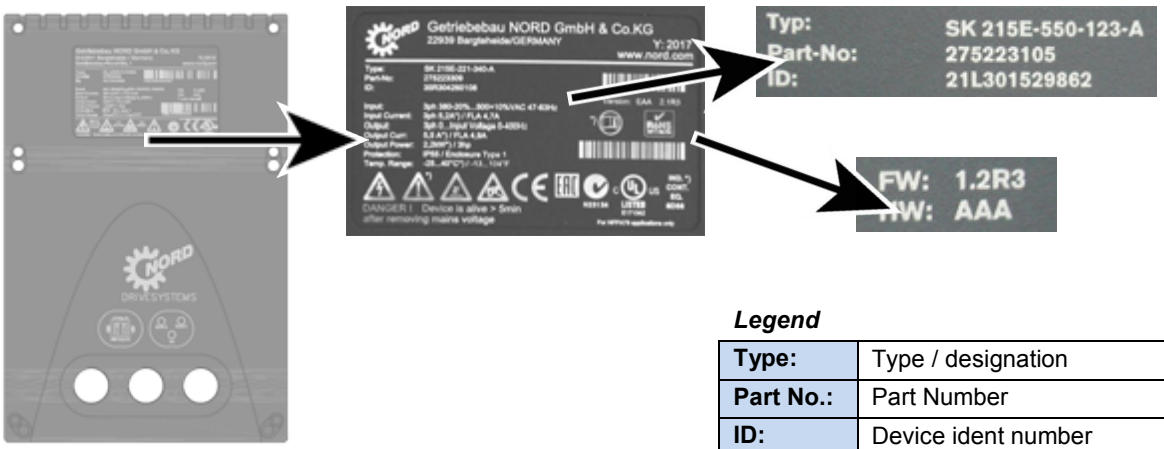


| | |
|---|---|
| **1** | Frequency inverter |
| **2** | Connection unit |
| **3** | Motors |
| **4** | Gear units |

| | |
|---|---|
| **5** | Optional module |
| **6** | Connection unit |
| **7** | Wall-mounting kit |
| | |

### 1.8.1 Name plate

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




***Legend***

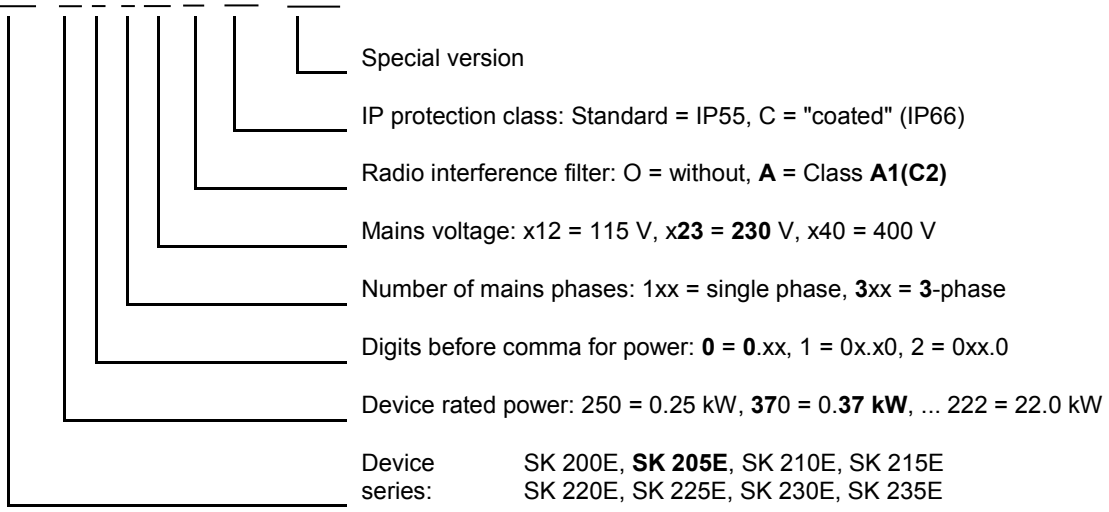
| | |
|---|---|
| **Type:** | Type / designation |
| **Part No.:** | Part Number |
| **ID:** | Device ident number |

| | |
|---|---|
| **FW:** | Firmware version (x.x Rx) |
| **HW:** | Hardware version (xxx) |

**Figure 3: Name plate**

### 1.8.2 Frequency inverter type code - Basic device

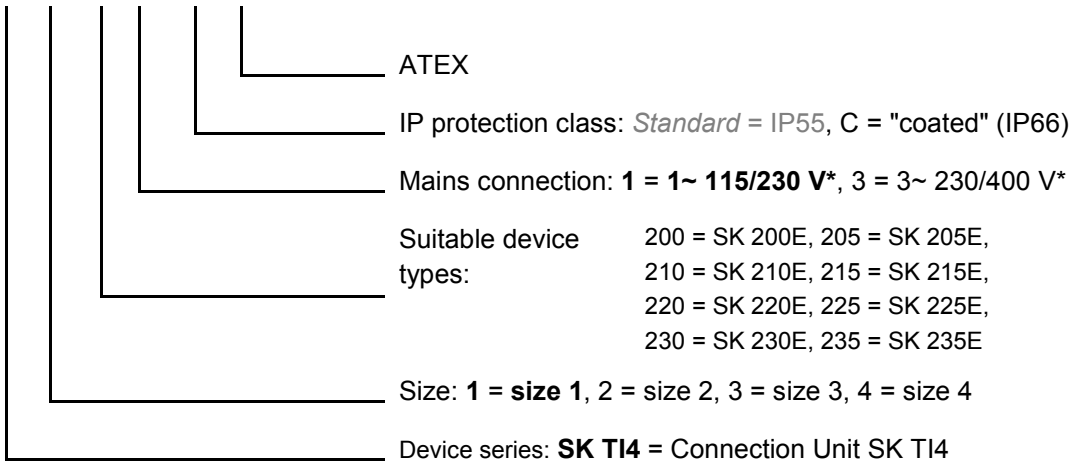
SK 205E-370-323-A (-C) (-xxx)




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

### 1.8.3 Frequency inverter type code - Connection unit

SK TI4-1-205-1 (-C-EX)

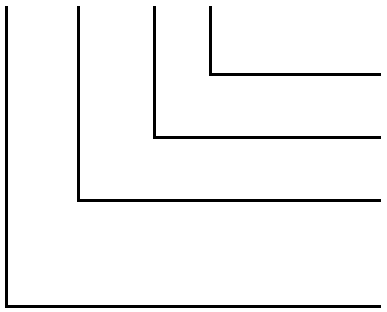



*) The voltage depends on the frequency inverter used; refer to the technical data.
(...) Options, only implemented if required.

### 1.8.4 Type code for option modules

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

SK TU4-CAO (-C-M12)



M12 system connector: only TU4, alternative to terminals

IP protection class: Standard = IP55, **C = "coated" = IP66**

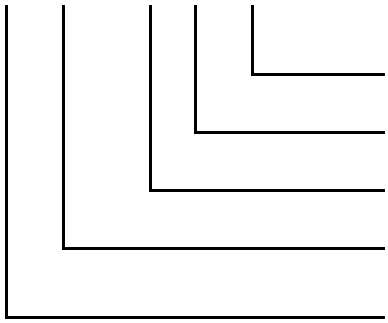
Option type: **CAO = CANopen**, PBR = Profibus, ECT = EtherCAT®, DEV = DeviceNet, IOE = Internal I/O extension

Group: CU = Customer interface, **TU = Technology box**

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

**For "PotiBox" power supply or potentiometer modules**

SK TU4-24V-123-B (-C)



IP protection class: Standard = IP55, **C = "coated" = IP66**

Radio interference filter: **B = Class B (C1)**

Mains connection: **123 = 1~ 230V,** 140 = 1~ 400V

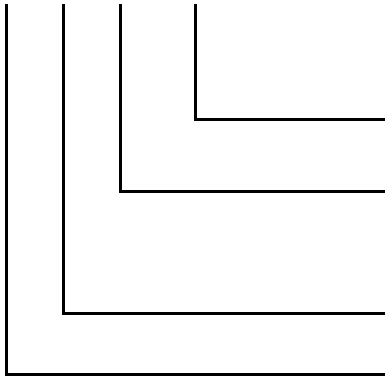
Option type: **24V = 24V power supply**, POT = Potentiometer/switch module

Option series: **TU4 = external technology unit (attachment),** CU4 = internal customer unit (installation)

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

### 1.8.5 Type code, connection unit for technology unit

SK TI4-TU-BUS (-C)



IP protection class: Standard = IP55, **C = "coated" IP66**

Suitable device types: NET = Mains option module (e.g. TU4-24V-…) **BUS** = **Bus option module** (e.g. CANopen: TU4-CAO

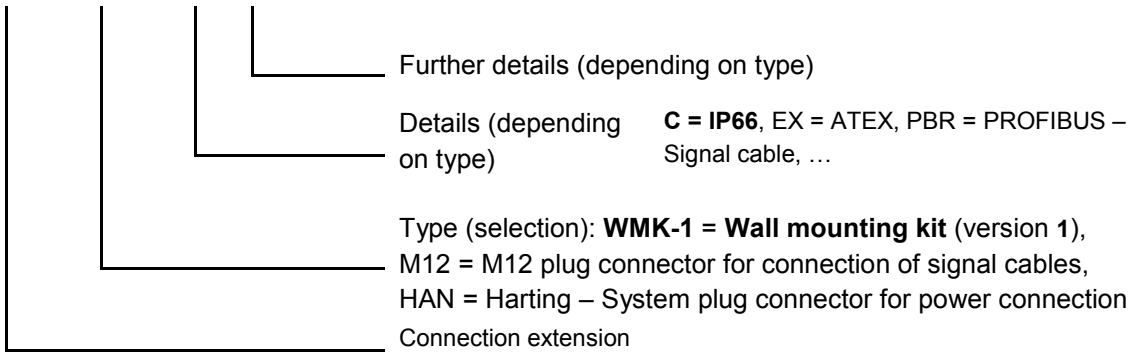
Group: TU = **Technology unit**

Device series: **SK TI4** = **Connection unit SK TI4**

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

### 1.8.6 Adapter Unit type code

SK TIE4-WMK-1 (-C- …)




## 1.9 Power rating / Motor size

| Size | Mains / Power category SK 2xxE | | | |
|---|---|---|---|---|
| | 1~ 110 - 120 V [1] | 1~ 200 – 240 V [2] | 3~ 200 – 240 V | 3~ 380 – 500 V |
| Size 1 | 0.25 ... 0.37 kW | 0.25 ... 0.55 kW | 0.37 ... 1.1 kW | 0.55 ... 2.2 kW |
| Size 2 | 0.55 ... 0.75 kW | 0.75 ... 1.1 kW | 1.5 ... 2.2 kW | 3.0 ... 4.0 kW |
| Size 3 | - | - | 3.0 ... 4.0 kW | 5.5 ... 7.5 kW |
| Size 4 | - | - | 5.5 ... 11.0 kW | 11.0 … 22.0 kW |

1) only available as SK 2x5E model
2) only available as SK 2x0E model in size 1

## 1.10 Version in protection class IP55, IP66

The SK 2xxE is available in IP55 (standard) or IP66 (optional). The additional modules are available in protection classes IP55 (standard) or IP66 (optional).

A protection class that differs from the standard (IP66) must always be specified in the order when ordering!

There are no restrictions or differences to the scope of functionality in the protection classes that have been mentioned. The type designation is extended accordingly in order to distinguish between the protection classes.

e.g. SK 2xxE-221-340-A-**C**

**Information** **Cable laying**

For all versions, care must be taken that the cables and the cable glands at least comply with the protection class of the device and the attachment regulations and are carefully matched. The cables must 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.

**IP55 version:**

The IP55 version is the **standard** version. In this version, the two installation types *motor mounted* (fitted onto the motor) and *close coupled* (fitted to the wall bracket) are available. All adapter units, technology units and customer units are also available for this version.

**IP66 version:**

The IP66 version is a modified **option** of the IP55 version. Both installation types *(motor-integrated*, *close coupled*) are also available for this version. The modules available to the IP66 design (adapter units, technology units and customer units) have the same functionalities as the corresponding IP55 design modules.

### Information — IP66 special measures

The modules for the IP66 version are identified by an additional "-C" in the type key, and are modified with the following special measures:

- impregnated PCBs,
- Powder coating RAL 9006 (white aluminium) for housing,
- modified blank screw caps (UV-resistant),
- Diaphragm valve for pressure compensation in the event of temperature changes,
- Low pressure test.
  - A free M12 screw connection is required for low pressure testing. After successful testing, a diaphragm valve is inserted here. This screw connection is therefore no longer available for a cable gland.

If the frequency inverter is going to be retrofitted, i.e. the entire drive unit (inverter pre-attached to motor) is not being purchased from NORD, the diaphragm valve is supplied in the bag enclosed with the frequency inverter. The valve must be professionally installed on site by the system installer (**Note:** the valve must be installed in a location that is as high as possible in order to avoid contact with accumulated moisture (e.g. standing water due to condensation)).

### Information — "SK 2xxE-…-C" devices, size 4

Up to week of manufacture 38 / 2012 (up to ID no. 38M...), size 4 frequency inverters are also available as "coated" versions "-C", *but they only fulfil IP55 because of the integrated fan*. **From ID no.: 39M…. these devices are also compliant with IP66.**

"SK 2xxE-…-C" devices with output of 5.5 kW and 7.5 kW (230 V), and 11 kW and 15 kW (400 V) **from ID no.: 28M… already compliant with IP66**.

# 2 Assembly and installation

## 2.1 Installation SK 2xxE

The devices 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 |
|---|---|
|  |  |

When a complete drive unit (gear unit + motor + SK 2xxE) is delivered, the device is always fully installed and tested.

**Information** — **Device version IP6x**

IP6x-compliant devices must be installed by NORD, since special measures have to be implemented. IP6x components that are retrofitted on site cannot ensure that this protection class is provided.

The SK 2xxE is connected to the motor or the wall-mounting kit using the size that is suitable for the SK T14-… connection unit . The adapter unit can also be ordered separately for subsequent mounting on an existing motor or to replace a different motor-mounted frequency inverter.

The **"Adapter unit SK T14"** module includes the following components:

- Cast housing, seal (already glued in) and insulation plate
- Power terminal block, in accordance with mains connection
- Control terminal block, in accordance with SK 2xxE version
- Screw kit, for mounting on the motor and the terminal bars
- Pre-fabricated cable for motor and PTC connections
- *Size 4 only:* As of hardware status "EAA" (frequency inverter) or "EA" (connection unit) ring core (ferrite) with fastening material

## Information

### Power derating

The equipment requires **sufficient ventilation** to protect against overheating. If this cannot be guaranteed, this results in power reduction (derating) of the frequency inverter. The ventilation is influenced by the type of installation (motor-mounting, wall-mounting) and/or with motor-mounting: the air flow of the motor fan (continuous slow speed → lack of cooling).

Insufficient cooling can result in power reduction of 1 - 2 power stages during S1 operation, for example, which can only be compensated for by using a nominally bigger device.

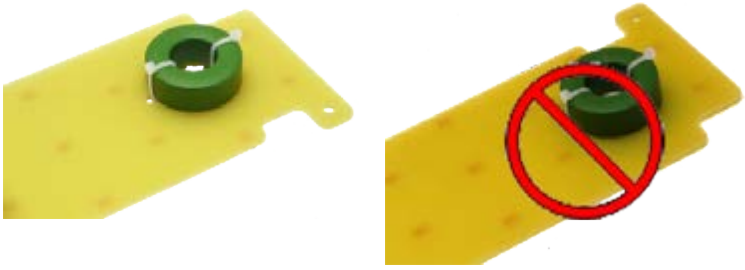
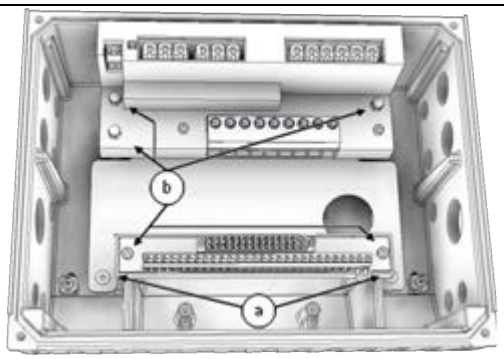
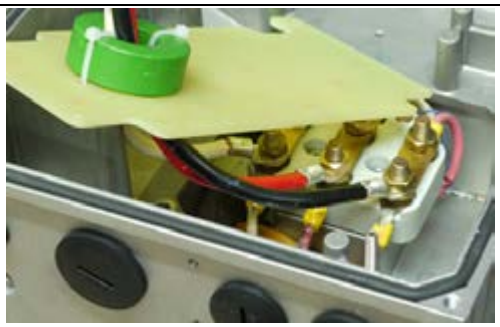
Details concerning output reduction and possible ambient temperatures, and other details (🕮 Section 7.2 "Electrical data").

### 2.1.1 Installation of insulating plate – size 4

As of hardware status EAA of the frequency inverter (suitable connecting unit hardware status EA), a ring core must be fitted to the insulating plate (motor terminal cover). The ring core and the required fastening materials are included in the scope of delivery of the connecting unit.

The ring core is required to ensure that the EMC requirements are adhered to.

**Assembly sequence**

| | | |
|---|---|---|
| 1. | Secure ring core with cable ties as shown in left-hand illustration (pay attention to insulating plate alignment). |  |
| 2. | Remove terminal strips (b). |  |
| 3. | Connect wiring harness (motor cable) and lead through the ring core attached to the insulating plate. |  |
| 4. | Wire motor cable to connecting terminals U – V – W of the relevant terminal strip. |  |
| 5. | • Fit insulating plate (see illustration in step 2 – (a)).<br>• Fit terminal strips (see illustration in step 2 – (b)). | |

### 2.1.2 Motor installation work operations

1. If necessary, remove the original terminal box from the NORD motor, so that only the base of the terminal box and the motor terminal block remain.
2. Set the bridges for the correct motor circuit at the motor terminal block and connect the pre-fabricated cables for motor and PTC connections to the respective connection points of the motor.
3. Mount the connecting unit on the terminal box base of the NORD motor using the existing screws and seal as well as the enclosed toothed / contact washers. When doing this, align the housing so that the rounded side is facing in the direction of the A bearing shield of the motor. Carry out mechanical adaptation using the "Adapter kit" (🕮 2.1.2.1 "Adapters for different motors"). It must generally be checked whether motors made by other manufacturers can be connected.

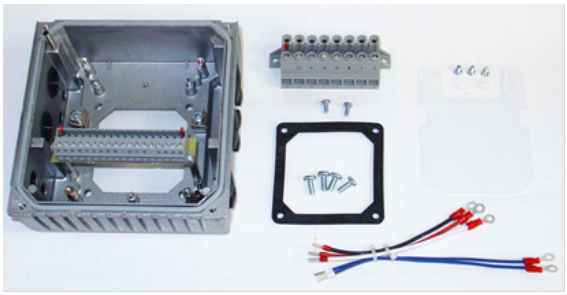


Figure 4: Connecting unit size 1 … 3

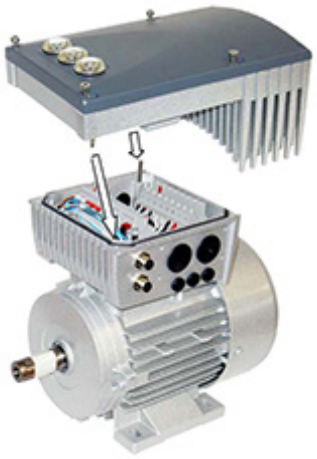
Figure 5: Connecting unit size 4

4. Fix insulating plate above the motor terminal block.
   – Size 4: Attach ring core to insulating plate (🕮 Section 2.1.1 "Installation of insulating plate – size 4").

   Screw on the power terminal block above this using 2x M4x8 screws and the plastic washers. (Size 4: 3x M4 cap nuts).
5. Make the electrical connections. For the cable gland of the connecting cable, appropriate screwed connections for cable cross-section must be used.
6. Fit the frequency inverter to the connection unit With sizes 1 to 3, special attention must be paid to correct contacting of the PE pins. These are located diagonally in 2 corners of the frequency inverter and the connection unit.

   In order to ensure that the protection class for which the device is intended is achieved, it must be ensured that all fastening screws that attach the frequency inverter to the connecting unit are tightened crosswise, step-by-step and with the torques stated in the table below.

   The cable screw connections that are used must at least correspond with the protection class of the device.



| Size SK 2xxE | Screw size | Tightening torque |
|---|---|---|
| Size 1 | M5 x 45 | 2.0 Nm ± 20 % |
| Size 2 | M5 x 45 | 2.0 Nm ± 20 % |
| Size 3 | M5 x 45 | 2.0 Nm ± 20 % |
| Size 4 | M6 x 20 | 2.5 Nm ± 20 % |

### 2.1.2.1 Adapters for different motors

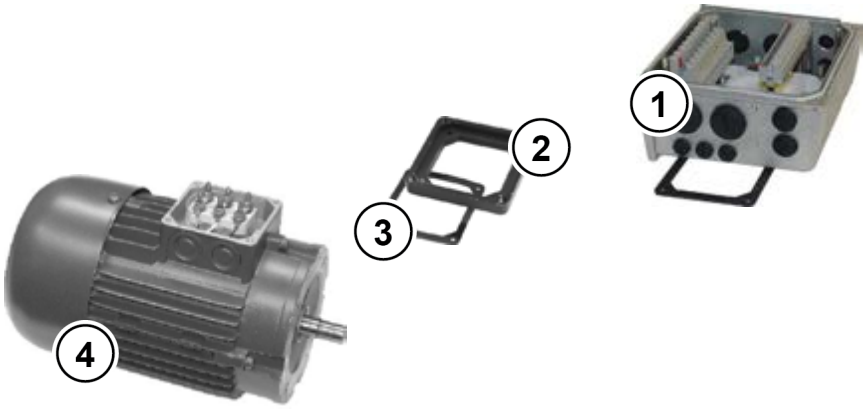
In some cases, the terminal box attachments are different for different motor sizes. Therefore, it may be necessary to use adapters to mount the device.

In order to ensure that the maximum IPxx protection class of the device is provided for the entire unit, all elements of the drive unit (e.g. motor) must correspond to at least the same protection class.

**Information** **External motors**

The adaptability of motors from other manufacturers must be checked individually!

Information about converting a drive to the device can be found in BU0320.




**1** Connection unit SK TI4
**2** Adapter plate
**3** Gasket
**4** Motor, size 71

**Figure 6: Example of motor size adaptation**

| NORD motor sizes | Add-on SK 2xxE Size 1 | Add-on SK 2xxE Size 2 | Add-on SK 2xxE Size 3 | Add-on SK 2xxE Size 4 |
|---|---|---|---|---|
| Size 63 – 71 | **with adapter kit I** | **with adapter kit I** | *Not possible* | *Not possible* |
| Size 80 – 112 | ***Direct mounting*** | ***Direct mounting*** | **with adapter kit II** | *Not possible* |
| Size 132 | *Not possible* | *Not possible* | ***Direct mounting*** | **with adapter kit III** |
| Size 160-180 | *Not possible* | *Not possible* | *Not possible* | ***Direct mounting*** |

**Overview of adapter kits**

| Adapter kit | | Designation | Components | Part No. |
|---|---|---|---|---|
| Adapter kit I | IP55 | SK TI4-12-Adapter kit_63-71 | Adapter plate, terminal box frame seal and screws | 275119050 |
| | IP66 | SK TI4-12-Adapter kit_63-71-C | | 275274324 |
| Adapter kit II | IP55 | SK TI4-3-Adapter kit_80-112 | Adapter plate, terminal box frame seal and screws | 275274321 |
| | IP66 | SK TI4-3-Adapter kit_80-112-C | | 275274325 |
| Adapter kit III | IP55 | SK TI4-4-Adapter kit_132 | Adapter plate, terminal box frame seal and screws | 275274320 |
| | IP66 | SK TI4-4-Adapter kit_132-C | | 275274326 |

### 2.1.2.2 Dimensions, SK 2xxE mounted on motor

| Size | | Housing dimensions SK 2xxE / Motor | | | | | Weight of SK 2xxE without motor Approx. [kg] |
|---|---|---|---|---|---|---|---|
| FI | Motor | ∅ g | g 1 | n | o | p | |
| Size 1 | Size 71 * | 145 | 201 | 236 | 214 | 156 | 3.0 |
| | Size 80 | 165 | 195 | | 236 | | |
| | Size 90 S / L | 183 | 200 | | 251 / 276 | | |
| | Size 100 | 201 | 209 | | 306 | | |
| Size 2 | Size 80 | 165 | 202 | 266 | 236 | 176 | 4.1 |
| | Size 90 S / L | 183 | 207 | | 251 / 276 | | |
| | Size 100 | 201 | 218 | | 306 | | |
| | Size 112 | 228 | 228 | | 326 | | |
| Size 3 | Size 100 | 201 | 251 | 330 | 306 | 218 | 6.9 |
| | Size 112 | 228 | 261 | | 326 | | |
| | Size 132 S / M | 266 | 262 | | 373 / 411 | | |
| Size 4 | Size 132 | 266 | 313 | 480 | 411 | 305 | 17.0 |
| | Size 160 | 320 | 318 | | 492 | | |
| | Size 180 | 358 | 335 | | 614 | | |

All dimensions in [mm]
*) including additional adapter and seal [13097000]

### 2.1.3 Wall mounting

As an alternative to wall mounting, the device can also be installed close to the motor using an optional wall-mounting kit.

#### 2.1.3.1 Wall mounting kit without fan

**Wall mounting kit SK TIE4-WMK-… (…1-K, …2-K, …3)**

Simple wall mounting kits with the following versions are available for size 1 to 4 frequency inverters. The wall mounting kits for the small sizes are made of plastic and are equally suitable for IP55 and IP66. For Size 4, various stainless steel wall mounting kits are available for IP55 and IP66.

| FI size | Frequency inverter type | | Housing dimensions | | | Mounting dimensions | | | | | Total weight approx. [kg] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | g2 | n | p | d1 | d2 | e1 | e2 | ∅ | |
| **Size 1** | SK TIE4-WMK-1-K<br>Part. No. 275 274 004 | | 130.5 | 236 | 156 | 205 | 180 | 95 | 64 | 5.5 | 3.1 |
| **Size 2** | SK TIE4-WMK-1-K<br>Part. No. 275 274 004 | | 137.5 | 266 | 176 | | | | | | 4.2 |
| **Size 3** | SK TIE4-WMK-2-K<br>Part. No. 275 274 015 | | 154.5 | 330 | 218 | 235.5 | 210.5 | 105 | 74 | 5.5 | 7.0 |
| **Size 4** | IP55 | SK TIE4-WMK-3<br>Part. No. 275 274 003 | 168 | 470 | 305 | 295 | 255 | 150 | 100 | 8.5 | 19 |
| | IP66 | SK TIE4-WMK-3-C<br>Part. No. 275 274 009 | | | | | | | | | |
| | | | All dimensions in [mm] | | | | | | | | |

**Information**

**Derating**

Due to the use of the wall mounting kit **SK TIE4-WMK-1-K** and **SK TIE4-WMK-2-K** the frequency inverter no longer has optimum ventilation. Therefore, especially with 3-phase frequency inverters, the maximum continuous power output can be considerably lower than is typical for wall mounting. For details, please refer to the technical data (Section (please see chapter 7.2 "Electrical data" on page 239)).

In size 4 of the SK 2x0E a fan block is integrated as standard, so that no power derating can occur.

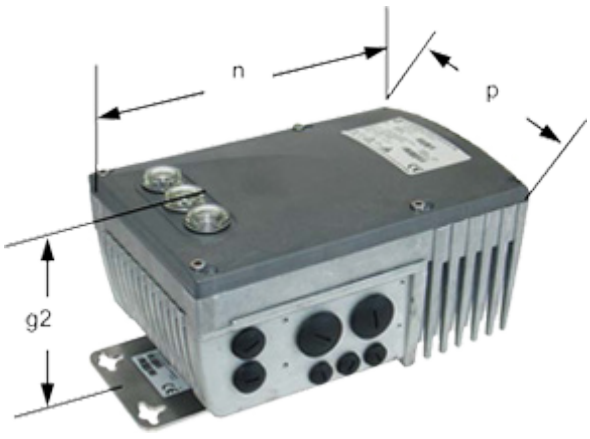



Figure 7: SK 2xxE with wall-mounting kit

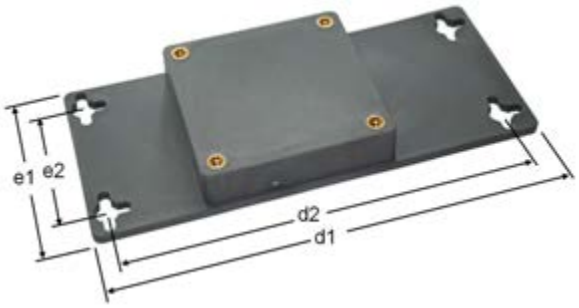



Figure 8: SK TIE4-WMK-1-K (or -2-K)

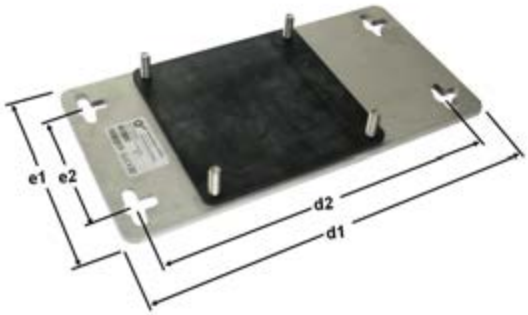



Figure 9: SK TIE4-WMK-3(-C)

### Wall mounting kit SK TIE4-WMK-… (…1-EX, …2-EX)

These wall mounting kits are intended for use in explosion hazard environments (📖 Section 2.6 "Operation in potentially explosive environments "). They are made of stainless steel and are equally suitable for IP55 and IP66 applications.

**Information** — **Derating**

With the use of the wall mounting kit the frequency inverter is no longer optimally ventilated. Therefore, especially with 3-phase frequency inverters, the maximum continuous power output can be considerably lower than is typical for wall mounting. For details, please refer to the technical data (📖 Section 7.2 "Electrical data")

| FI size | Frequency inverter type | Housing dimensions | | | Mounting dimensions | | | | | Total weight approx. [kg] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | g2 | n | p | d1 | d2 | e1 | e2 | ∅ | |
| **Size 1** | SK TIE4-WMK-1-EX<br>Part. No. 275 175 053 | 130.5 | 236 | 156 | 205 | 180 | 95 | 64 | 5.5 | 3.5 |
| **Size 2** | SK TIE4-WMK-1-EX<br>Part. No. 275 175 053 | 137.5 | 266 | 176 | | | | | | 4.6 |
| **Size 3** | SK TIE4-WMK-2-EX<br>Part. No. 275 175 054 | 154.5 | 330 | 218 | 235.5 | 210.5 | 105 | 74 | 5.5 | 7.5 |
| | | All dimensions in [mm] | | | | | | | | |

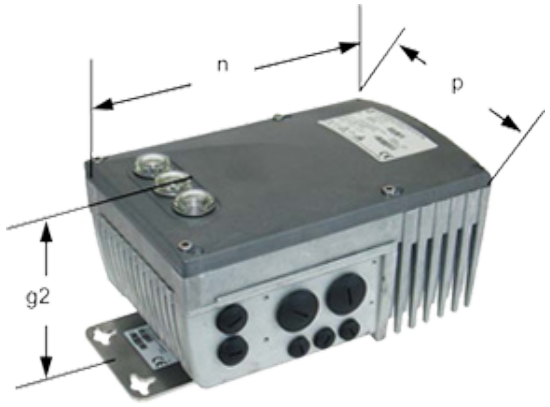
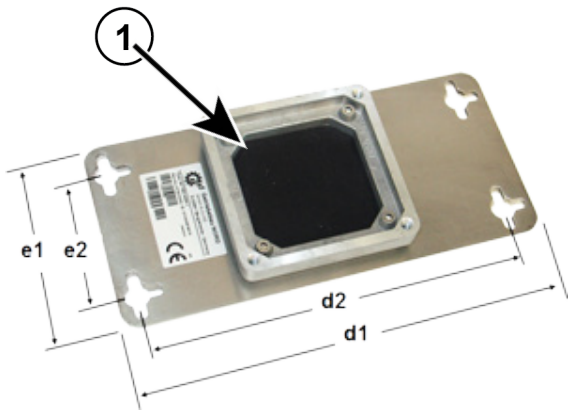



Figure 10: SK 2xxE with wall-mounting kit




**1** Adapter plate

Figure 11: SK TIE4-WMK-... (…1-EX / 2-EX)

### 2.1.3.2 Wall mounting kit with fan

**Wall mounting kit for SK TIE4-WMK-L-…**

The wall-mounting kit SK TIE4-WMK-L-… enables the frequency inverter to be installed close to the motor. With this kit, the frequency inverter can comply with protection class IP55. This kit is only available for inverter sizes 1 to 3

When installing, care must be taken that the fan is located below the cooling ribs of the inverter. The fan connection cable must be inserted through the cable gland in the frequency inverter connection unit (see diagram below) and wired to +24 V DC (red cable) and GND (black cable) on the terminal bar.

Power consumption of fan: **approx. 1.3 W**

**Information** **Derating**

**With the use of the wall-mounting kit SK TIE4-WMK-L-1 (**or -**2)** the frequency inverter has continuous ventilation. Therefore the permissible continuous output of a ***3-phase*** frequency inverter corresponds to that of a motor-mounted inverter. For ***single phase*** frequency inverters the same power data applies for wall mounting. Details can be found in the technical data (please see chapter 7.2 "Electrical data" on page 239).

| FI size | Device type | Housing dimensions | | | Mounting dimensions | | | | | | tot. Weight Approx. [kg] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | g2 | n | p | d1 | d2 | d3 | e1 | e2 | ∅ | |
| **Size 1** | SK TIE4-WMK-L-1<br>Part. No. 275 274 005 | 150.5 | 236 | 156 | 257 | 187 | 61 | 130 | 100 | 5.5 | 3.3 |
| **Size 2** | SK TIE4-WMK-L-1<br>Part No. 275 274 / 005 | 157.5 | 266 | 176 | | | | | | | 4.4 |
| **Size 3** | SK TIE4-WMK-L-2<br>Part No. 275 274 / 006 | 174.5 | 330 | 218 | 303 | 212 | 81 | 150 | 120 | 5.5 | 7.3 |
| | | All dimensions in [mm] | | | | | | | | | |

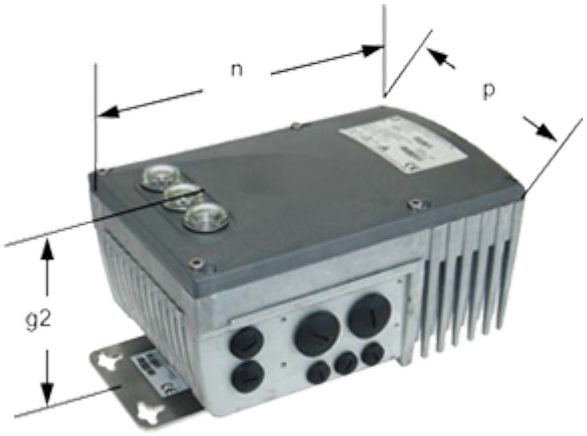
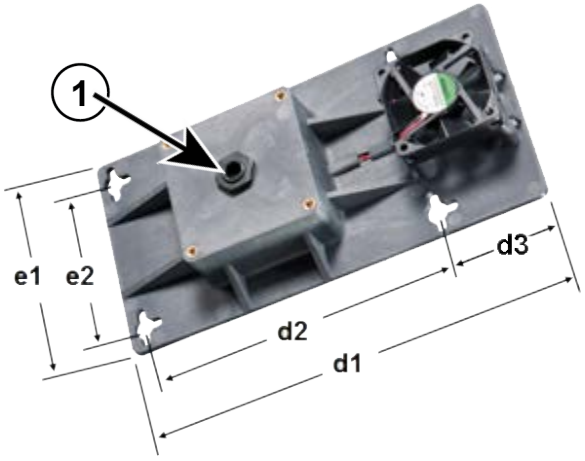



Figure 12: SK 2xxE with wall-mounting kit




**1** Introduction of fan connecting cable

Figure 13: SK TIE4-WMK-L …

### 2.1.3.3 Frequency inverter installation positions with wall-mounting kit

Installation of the frequency inverter close to the motor is permissible in the following installation orientations.

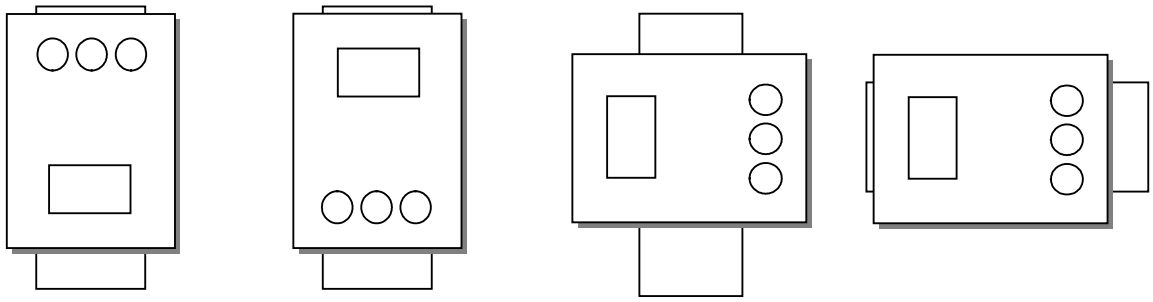



Figure 14: Frequency inverter installation positions with wall-mounting kit

| | | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| **Installation orientation** | **Frequency inverter** | **vertical** | **vertical** | **horizontal** | **horizontal** |
| | **Position of cooling fins ( / fan)** | **bottom** | **top** | **on side** | **on side** |
| | **Wall-mounting kit** | **vertical** | **vertical** | **vertical** | **horizontal** |
| Type Wall-mounting kit | SK TIE4-WMK-1-K<br>SK TIE4-WMK-2-K | - | √ | √ | √ |
| | SK TIE4-WMK-1-EX<br>SK TIE4-WMK-2-EX | - | √ | √ | √ |
| | SK TIE4-WMK-3 | √ | - | √ | √ |
| | SK TIE4-WMK-L-1<br>SK TIE4-WMK-L-2 | - | √ | - | √ |

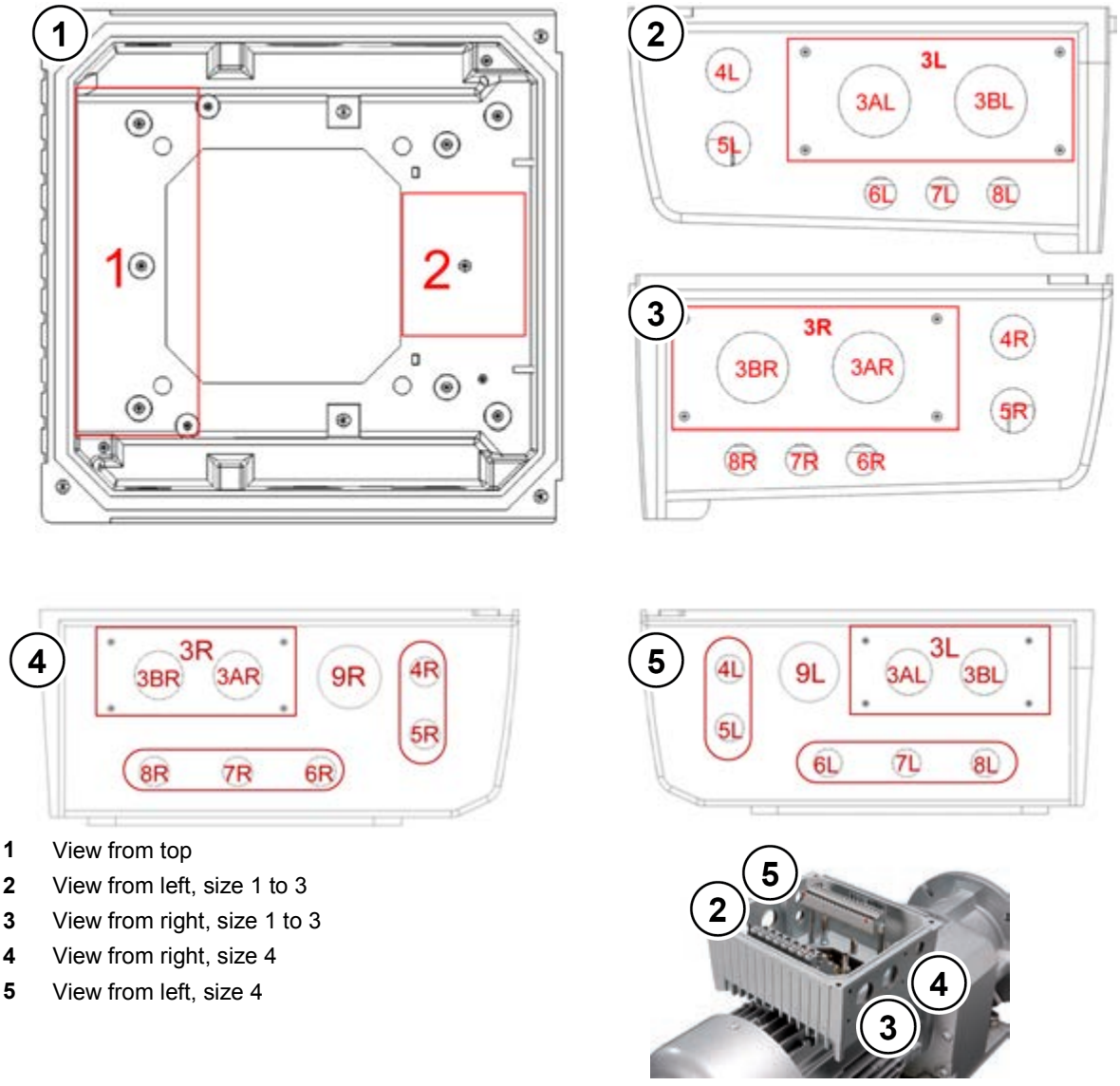
√ = permissible / - = not permissible.

## 2.2 Installation of optional modules

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

### 2.2.1 Option locations on the device

The installation locations for optional modules are not directly on the frequency inverter but on its connecting unit.




**1** View from top
**2** View from left, size 1 to 3
**3** View from right, size 1 to 3
**4** View from right, size 4
**5** View from left, size 4

**Figure 15: Option locations on the connection unit**

The various installation locations for the optional modules are displayed in the above-mentioned drawings. Option location 1 is used for implementation of an internal bus module or an internal power supply (not SK 2x0E). An internal brake resistor can be implemented at option location 2. External bus modules, 24 V DC power supplies (not SK 2x0E) or potentiometer modules can be fitted at option location 3L or 3R. The same applies to external brake resistors. Option locations 4 and 5 are used to install M12 sockets or connectors. Additional extensions from M12 to M16 are required at locations 6, 7 and 8 for sizes 1 to 3 so that M12 sockets and connectors can also be fitted here. Option locations 6 - 8 are also M16 for size 4 devices. Only one option can be attached in an option location, of course.

The preferred installation location for M12 sockets or connectors should be 4L or 4R. An additional M32 hole (option location 9) is provided for the mains connection of size 4.

| Option location | Position | Meaning | Size<br>Size 1 - 3 | Size<br>Size 4 | Comments |
|---|---|---|---|---|---|
| 1 | Internal | Installation location for customer interfaces SK CU4-… | | | |
| 2 | Internal | mounting location for internal braking resistor SK BRI4-… | | | |
| 3* | on side | Mounting location for<br>• External brake resistor SK BRE4-…<br>• external technology units SK TU4-…<br>• Operating options<br>• Power connector | | | |
| 3 A/B* | on side | Cable gland | M25 | M25 | Not available if location 3 is occupied or SK TU4-… is fitted. |
| 4*<br>5* | on side | Cable gland | M16 | M16 | Not available if SK TU4-… is fitted. |
| 6*<br>7*<br>8* | on side | Cable gland | M12 | M16 | Not available if location 3 is occupied by SK BRE4 or SK TU4-… is fitted |
| 9* | on side | Cable gland | -- | M32 | Preferably used for mains cable |
| * R and L (right and left side) | | | | | |

### 2.2.2 Installation of internal customer unit SK CU4-… (installation)

**Information** — **Installation location of customer unit**

Installation of the SK CU4-... customer unit **separately** from the device is not permitted. If must always be installed inside the device in the intended position (option location 1). Only one customer unit can be installed per device!

Prefabricated cables are provided with the customer unit.

Connections are made according to the following table:

Similar to illustration
Bag enclosed with internal customer unit

**Wiring harness assignments (enclosed with the customer interface)**

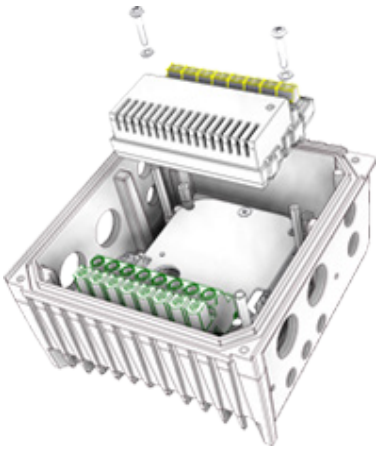
| | Function | Terminal label | | Cable colour |
|---|---|---|---|---|
| Field bus / IOE | Voltage supply (24V DC) (between device and customer interface) | **44** | 24V | brown |
| | | **40** | GND / 0V | blue |
| | System bus | **77** | SYS H (+) | black |
| | | **78** | SYS L (-) | grey |
| Mains unit | Voltage supply (24V DC) (between device and customer interface) | **44** | 24V | brown |
| | | **40** | GND / 0V | blue |
| | Power supply (mains (AC)) (between supply network and customer unit) | **L1** | L1 | brown |
| | | **L2** | L2 | black |
| | Frequency output | **B1** | DOUT BUS (FOUT) | black |

The bus modules require a 24V supply voltage.

The customer interfaces are installed inside connection unit SK T14-…of the SK 2xxE, beneath the control terminal bar.

Fastening is by means of the control terminal bar of the frequency inverter and two screw bolts (bag enclosed with the customer unit).

Only one Customer Unit per device is possible!



### 2.2.3 Installation of external technology units SK TU4-… (attachment)

The technology units SK TU4-…(-C) require a connection unit SK TI4-TU-…(-C). This is the only way to create a closed functional unit. This can be attached to the device or installed separately by means of the optional SK TIE4-WMK-TU wall-mounting kit. In order to provide reliable operation, cable lengths of more than 20 m between the technology unit and the device must be avoided.

**Information** — **Detailed installation information**

A detailed description can be found in the documents for the connection unit concerned.

| Connection unit | Document |
|---|---|
| SK TI4-TU-BUS | TI 275280000 |
| SK TI4-TU-BUS-C | TI 275280500 |
| SK TI4-TU-NET | TI 275280100 |
| SK TI4-TU-NET-C | TI 275280600 |
| SK TI4-TU-MSW | TI 275280200 |
| SK TI4-TU-MSW-C | TI 275280700 |

## 2.3 Braking resistor (BW) - (from size 1)

During dynamic braking (frequency reduction) of a three-phase motor, electrical energy is returned to the inverter if necessary. **From size 1 and above**, an internal or external braking resistor can be used to avoid a shut-down of the device due to overvoltage. With this, the integrated brake chopper (electronic switch) pulses the link circuit voltage (switching threshold approx. 420 V / 720 $V_{DC}$, depending on mains voltage) into the braking resistor. The braking resistor converts excess energy into heat.

**CAUTION** **Hot surfaces**

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

- Danger of injury due to local burns on contact.
- Heat damage to adjacent objects

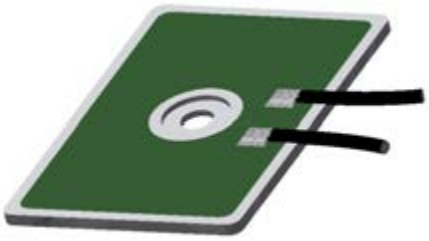
Allow sufficient cooling time before starting work on the product. Check the surface temperatures with suitable measuring equipment. Maintain an adequate distance to adjacent components or provide protection against contact.

**Information** **Parameterisation of braking resistor data**

To protect the braking resistor against overload, the electrical data of the braking resistor which is used must be parameterised in parameters **P555**, **P556** and **P557**. With the use of an *internal braking resistor* (SK BRI4-…) this is done by setting the DIP switch **S1:8** (📖 Section 2.3.1)

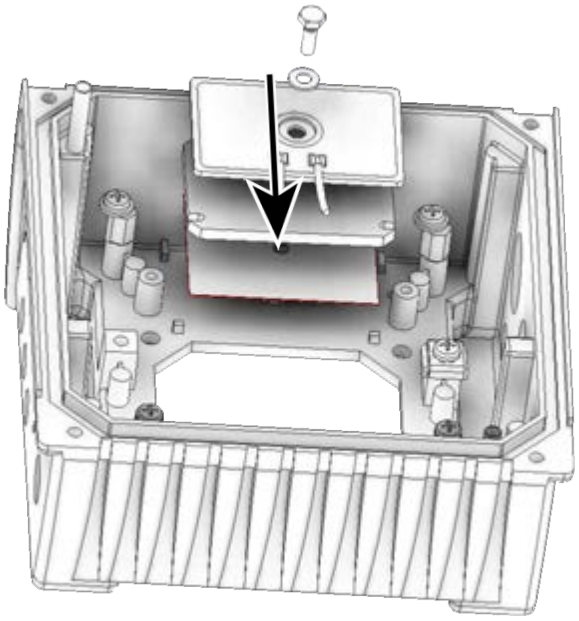
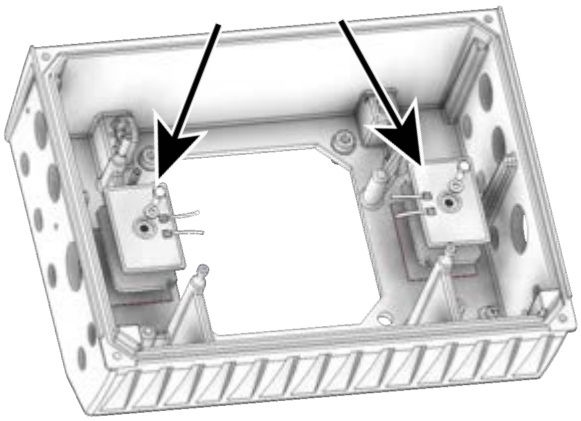
### 2.3.1 Internal brake resistor SK BRI4-…

The internal brake resistor can be used if only slight, short braking phases are to be expected. For the individual power ranges of size 4, the item includes a set of 2 brake resistors. These must be connected in parallel and thereby achieve the electrical data from the description of the material. The installation location for the 2nd brake resistor is opposite the installation location of the 1st brake resistor.



similar to Figure

## Assembly

| Size 1 … 3 | Size 4 |
| --- | --- |
|  |  |

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

$P = P_n * (1 + \sqrt{(30 / t_{brake})^2}$ , however, the following applies P < $P_{max}$

(P=Brake power (W), $P_n$= Continuous brake power of resistor (W), $P_{max}$. peak brake power, $t_{brake}$ = duration of braking process (s))

The permissible continuous brake power $P_n$ must not be exceeded in the long-term average.

**Information** **Peak load limitation - DIP switches (S1)**

When using internal brake resistors, DIP switches (S1), No. 8 (please see chapter 4.3.2.2 "DIP switches (S1)")must be set to "on". This is important for activating a peak output limit for protecting the brake resistor.

**Electrical data**

| Designation (IP54) | Part No. | Resistance | Max. continuous output / limit [2] ($P_n$) | Power consumption [1] ($P_{max}$) | Connecting cable or terminals |
|---|---|---|---|---|---|
| SK BRI4-1-100-100 | 275272005 | 100 Ω | 100 W / 25 % | 1.0 kWs | Silicone conductor 2x AWG 20 approx. 60 mm |
| SK BRI4-1-200-100 | 275272008 | 200 Ω | 100 W / 25 % | 1.0 kWs | |
| SK BRI4-1-400-100 | 275272012 | 400 Ω | 100 W / 25 % | 1.0 kWs | |
| SK BRI4-2-100-200 | 275272105 | 100 Ω | 200 W / 25 % | 2.0 kWs | Silicone conductor 2x AWG 18 approx. 60 mm |
| SK BRI4-2-200-200 | 275272108 | 200 Ω | 200 W / 25 % | 2.0 kWs | |
| SK BRI4-3-047-300 | 275272201 | 47 Ω | 300 W / 25 % | 3.0 kWs | Silicone conductor 2x AWG 16 approx. 170 mm |
| SK BRI4-3-100-300 | 275272205 | 100 Ω | 300 W / 25 % | 3.0 kWs | |
| SK BRI4-3-023-600 | 275272800 [3] | 23 Ω (2 x 47 Ω) | 600 W / 25 % (2 x 300 W) | 6.0 kWs (2 x 3 kWs) | Silicone conductor 2x 2x AWG 16 approx. 170 mm |
| SK BRI4-3-050-600 | 275272801 [3] | 50 Ω (2 x 100 Ω) | 600 W / 25 % (2 x 300 W) | 6.0 kWs (2 x 3 kWs) | |
| **NOTE:** DIP switches (S1), DIP switch No. 8 = on | 1) maximum one-off within 10 s [2]<br>2) In order to prevent non-permissible heating of the connection unit, the continuous power is limited to 1/4 of the rated power of the brake resistor. This also has a limiting effect on the energy consumption.<br>3) Set consisting of 2 resistors to be connected in parallel | | | | |

### 2.3.2 External braking resistor SK BRE4-... / SK BRW4-… / SK BREW4-…

The external braking resistor is provided for energy feedback, e.g. as occurs in pulsed drive units or lifting gear. Here, it may be necessary to plan for the exact braking resistor that is required (see adjacent figure).

Installation of an SK BRE4-… is not possible in combination with the wall-mounting kit **SK TIE4-WMK…**. In this case, braking resistors of type **SK BREW4-…** are available as an alternative, which can also be fitted to the frequency inverter.

In addition **SK BRW4-…** type brake resistors are available for mounting on a wall near to the device.

**Electrical data**

| Designation [1] (IP67) | Resistance | Max. continuous power ($P_n$) | Energy consumption [2] ($P_{max}$) |
|---|---|---|---|
| SK BRx4-1-100-100 | 100 Ω | 100 W | 2.2 kWs |
| SK BRx4-1-200-100 | 200 Ω | 100 W | 2.2 kWs |
| SK BRx4-1-400-100 | 400 Ω | 100 W | 2.2 kWs |
| SK BRx4-2-100-200 | 100 Ω | 200 W | 4.4 kWs |
| SK BRx4-2-200-200 | 200 Ω | 200 W | 4.4 kWs |
| SK BRx4-3-050-450 | 50 Ω | 450 W | 3.0 kWs |
| SK BRx4-3-100-450 | 100 Ω | 450 W | 3.0 kWs |
| | 1) SK BRx4-: versions: SK BRE4-, SK BRW4-, SK BREW4- | | |
| | 2) Maximum once within 120s | | |

**External brake resistors for motor-mounted frequency inverters**

The **SK BRE4-** series is intended for direct mounting on a motor-mounted frequency inverter.

Detailed information about the brake resistors can be obtained from the relevant product-specific documentation.

| Name | Material number | Document |
|---|---|---|
| SK BRE4-1-100-100 | 275273005 | TI 275273005 |
| SK BRE4-1-200-100 | 275273008 | TI 275273008 |
| SK BRE4-1-400-100 | 275273012 | TI 275273012 |
| SK BRE4-2-100-200 | 275273105 | TI 275273105 |
| SK BRE4-2-200-200 | 275273108 | TI 275273108 |
| SK BRE4-3-050-450 | 275273201 | TI 275273201 |
| SK BRE4-3-100-450 | 275273205 | TI 275273205 |

**External brake resistors for wall-mounted frequency inverters**

The **SK BRW4-** series is intended for wall mounting in the vicinity of a wall-mounted frequency inverter.

The **SK BREW4-** series is intended for direct mounting on a wall-mounted frequency inverter.

The electrical data are identical to those for the **SK BRE4-** series. Detailed information can be obtained from the relevant product-specific documentation.

| Name | Material number | Document |
|---|---|---|
| | | |
| SK BRW4-1-100-100 | 275273305 | TI 275273305 |
| SK BRW4-1-200-100 | 275273308 | TI 275273308 |
| SK BRW4-1-400-100 | 275273312 | TI 275273312 |
| SK BRW4-2-100-200 | 275273405 | TI 275273405 |
| SK BRW4-2-200-200 | 275273408 | TI 275273408 |
| SK BRW4-2-400-200 | 275273412 | TI 275273412 |
| SK BRW4-3-100-450 | 275273505 | TI 275273505 |
| | | |
| SK BREW4-1-100-100 | 275273605 | TI 275273605 |
| SK BREW4-1-200-100 | 275273608 | TI 275273608 |
| SK BREW4-1-400-100 | 275273612 | TI 275273612 |
| SK BREW4-2-100-200 | 275273705 | TI 275273705 |
| SK BREW4-2-200-200 | 275273708 | TI 275273708 |
| SK BREW4-2-400-200 | 275273712 | TI 275273712 |

**Information** **Braking resistor**

If required, other versions or installation variants for external braking resistors can be provided.

### 2.3.3 Brake resistor assignments

The brake resistors provided by NORD are directly tailored to the individual devices. However, when external brake resistors are being used, it is usually possible to select between 2 or 3 alternatives.

| Inverter ID | Internal | External braking resistor [1] | | |
|---|---|---|---|---|
| SK 2xxE-… | Braking resistor | Preferred | Alternative | Alternative |
| 250-112-O | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 370-112-O | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 550-112-O | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 750-112-O | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| | | | | |
| 250-123-A | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 370-123-A | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 550-123-A | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 750-123-A | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| 111-123-A | SK BRI4-1-100-100 | SK BRx4-1-100-100 | SK BRx4-2-100-200 | |
| | | | | |
| 250-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 370-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 550-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 750-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 111-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 151-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 221-323-A | SK BRI4-1-200-100 | SK BRx4-1-200-100 | SK BRx4-2-200-200 | SK BRx4-2-100-200 |
| 301-323-A | SK BRI4-2-100-200 | SK BRx4-2-100-200 | | |
| 401-323-A | SK BRI4-2-100-200 | SK BRx4-2-100-200 | | |
| 551-323-A | SK BRI4-3-047-300 | SK BRx4-3-050-450 | | |
| 751-323-A | SK BRI4-3-047-300 | SK BRx4-3-050-450 | | |
| 112-323-A | SK BRI4-3-023-600 | SK BRx4-3-050-450 | | |
| | | | | |
| 550-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 750-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 111-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 151-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 221-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 301-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 401-340-A | SK BRI4-1-400-100 | SK BRx4-1-400-100 | SK BRx4-2-200-200 | |
| 551-340-A | SK BRI4-2-200-200 | SK BRx4-2-200-200 | | |
| 751-340-A | SK BRI4-2-200-200 | SK BRx4-2-200-200 | | |
| 112-340-A | SK BRI4-3-100-300 | SK BRx4-3-100-450 | | |
| 152-340-A | SK BRI4-3-100-300 | SK BRx4-3-100-450 | | |
| 182-340-A | SK BRI4-3-050-600 | SK BRx4-3-100-450 | | |
| 222-340-A | SK BRI4-3-050-600 | SK BRx4-3-100-450 | | |

1) SK BRx4-: versions: SK BRE4-, SK BRW4-, SK BREW4-

**Table 7: Assignment of brake resistors to frequency inverter**

## 2.4 Electrical Connection

**WARNING** — **Electric shock**

Dangerous voltages can be present at the mains input and the motor connection terminals even when the device is not in operation.

- Before starting work, check that all relevant components (voltage source, connection cables, connection terminals of the device) are free of voltage using suitable measuring equipment.
- Use insulated tools (e.g. screwdrivers).
- DEVICES MUST BE EARTHED.

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

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

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

In order to access the electrical connections, the SK 2xxE must be removed from the SK TI4-… connection unit (📖 Section 2.1.2 "Motor installation work operations").

One terminal block is provided for the power connections and one for the control connections.

The PE connections (device-earth) are inside the cast housing of the connecting unit on the base. A contact is available on the power terminal block for size 4.

The terminal strip assignments differ according to the version of the device. The correct assignment can be found on the inscription on the respective terminal or the terminal overview plan printed inside the device.

| | **Connecting terminals for** |
|---|---|
| **(1)** | Power cable<br>Motor cable<br>Brake resistance lines |
| **(2)** | Control lines<br>Electromechanical brake<br>PTC (TF) of motor |
| **(3)** | PE |

### 2.4.1 Wiring guidelines

The soft starters have been developed for use in an industrial environment. In this environment, electromagnetic interference can affect the device. 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 devices are securely earthed to a common earthing point or earthing rail using short earthing cables with a large cross-section. It is especially important that each control unit which is connected to the electronic drive technology (e.g. an automatic device) has a short cable with a large cross-section, which is connected to the same earthing point as the device itself. Flat cables (e.g. metal stirrups) are preferable, as they have a lower impedance at high frequencies.
2. The bonding cable of the motor controlled by the soft starter should be connected directly to the earthing terminal of the associated device. The presence of a central earthing bar in the control cabinet and the grouping together of all bonding conductors to this bar normally ensures safe operation.
3. Where possible, shielded cables should be used for control circuits. The shielding at the cable end should be carefully sealed and it must be ensured that the wires are not laid over longer distances without shielding.

   The shields of analogue setpoint cables should only be earthed on one side on the device.
4. The control cables should be installed as far as possible from power cables, using separate cable ducts, etc. Where cables cross, an angle of 90° should be ensured as far as possible.
5. Ensure that the contactors in the cabinet are interference protected, either by RC circuits in the case of AC contactors or by free-wheeling diodes for DC contactors, for which **the interference traps must be positioned on the contactor coils**. Varistors for over-voltage limitation are also effective.
6. Shielded or armoured cables should be used for the load connections (motor cable if necessary). The shielding or armouring must be earthed at both ends. The earthing should be provided directly to the PE of the device if possible.

In addition, EMC-compliant wiring must be ensured.

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

| ***NOTICE*** | **Damage due to high voltage** |
|---|---|

The device may be damaged by electrical loads which do not correspond to its specification.

- Do not perform any high voltage tests on the device itself.
- Disconnect the cable which is to be tested from the device before performing a high voltage insulation test.

| **Information** | **Looping of the mains voltage** |
|---|---|

The permissible current load for the connection terminals, plugs and supply cables must be observed when looping the mains voltage. Failure to comply with this will result in thermal damage to current-carrying modules and the immediate vicinity thereof.

If the device is installed according to the recommendations in this manual, it meets all EMC directive requirements, as per the EMC product standard EN 61800-3.

### 2.4.2 Electrical connection of power unit

**NOTICE** **EMC Interference to the environment**

This device produces high frequency interference, which may make additional suppression measures necessary in domestic environments (📖 Section 8.3 "Electromagnetic compatibility (EMC)").

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

When the device is being connected, please note the following:

1. Ensure that the mains supply provides the correct voltage and is suitable for the current required (📖 Section 7 "Technical data").
2. Ensure that suitable electrical fuses with the specified nominal current range are installed between the voltage source and the device.
3. Mains cable connection: to terminals **L1**-**L2/N**-**L3** and **PE** (depending on device)
4. Motor connection: to terminals **U**-**V**-**W**

   A 4-core motor cable must be used if the device is being wall-mounted As well as **U**-**V**-**W**, **PE** must also be connected. If present, in this case the cable shielding must be connected to a large area of the metallic screw connector of the cable gland.

The use of wire end rings is recommended for connecting to PE.

**Information** **Connection cables**

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

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

| Device | Cable Ø [mm²] | | AWG | Tightening torque | |
|---|---|---|---|---|---|
| Size | rigid | flexible | | [Nm] | [lb-in] |
| 1 … 3 | 0.5 … 6 | 0.5 … 6 | 20-10 | 1.2 … 1.5 | 10.62 … 13.27 |
| 4 | 0.5 … 16 | 0.5 … 16 | 20-6 | 1.2 … 1.5 | 10.62 … 13.27 |
| **Electromechanical brake** | | | | | |
| 1 … 3 | 0.2 … 2.5 | 0.2 … 2.5 | 24-14 | 0.5 … 0.6 | 4.42 … 5.31 |
| 4 | 0.2 … 4 | 0.2 … 2.5 | 24-12 | 0.5 … 0.6 | 4.42 … 5.31 |

Table 8: Connection data

### 2.4.2.1 Mains supply (L1, L2(/N), L3, PE)

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

| Frequency inverter data | | | Permissible mains data | | | |
|---|---|---|---|---|---|---|
| **Type** | **Voltage** | **Power** | **1 ~ 115 V** | **1 ~ 230 V** | **3 ~ 230 V** | **3 ~ 400 V** |
| SK…112-O | 115 VAC | 0.25 … 0.75 kW | X | | | |
| SK…123-A | 230 VAC | 0.25 … 1.1 kW | | X | | |
| SK…323-A | 230 VAC | ≥ 0,25 kW | | | X | |
| SK…340-A | 400 VAC | ≥ 0,37 kW | | | | X |
| **Connections** | | | **L/N = L1/L2** | **L/N = L1/L2** | **L1/L2/L3** | **L1/L2/L3** |

Disconnection from or connection to the mains must always take place with all poles, and must also be synchronous (L1/L2/L3 or L1/N).

As delivered, the device is configured for operation in TN or TT networks. With this, the mains filter has its normal effect and leakage current. A network that is earthed in the neutral point must be used, and with single-phase devices a zero conductor must be used!

**Adaptation to IT networks** – (from size **1**)

**⚠ WARNING** **Unexpected movement in case of mains faults**

In case of a mains fault (short circuit to earth) a frequency inverter which is switched off may switch on automatically. Depending on the parameterisation, this may cause the drive unit to start automatically.

- Danger of injury due to automatic start

Secure the system against unexpected movement (block, decouple mechanical drive, provide protection against falling, etc.)

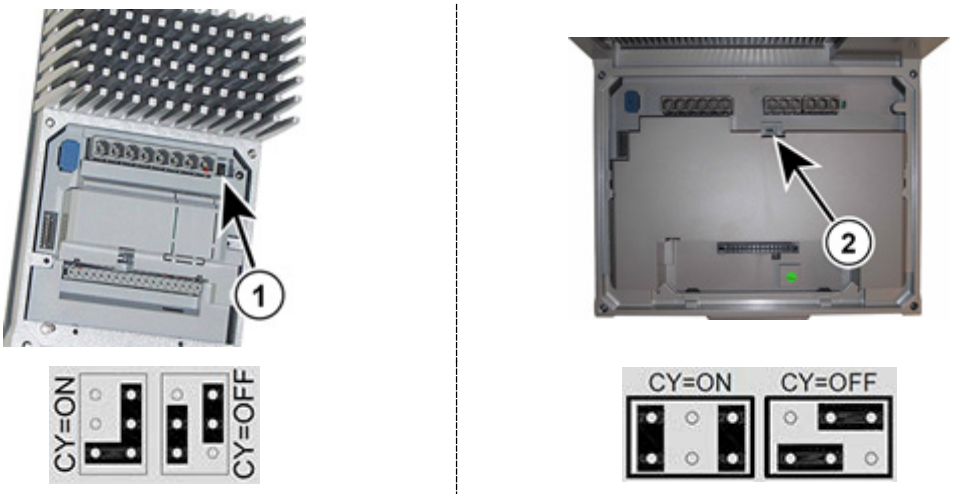
***NOTICE*** **Operation in IT networks**

If a mains fault (short-circuit to earth) occurs in an IT network, the link circuit of a connected frequency inverter may become charged, even if it is switched off. This results in destruction of the link circuit capacitors due to overcharging.

- Connect a brake resistor to dissipate excess energy.
- Ensure that the frequency inverter controller is ready for operation as necessary:
  - If a device with an integrated mains unit (**SK 2x0E**) is used, the internal control unit, and therefore all monitoring functions switch on automatically.
  - If a device without an integrated mains unit (**SK 2x5E**) is used, the 24 V supply of the device must be switched on before the mains voltage is switched on. The 24 V supply to the device must only be switched off after the device has been disconnected from the mains voltage.

For operation on the IT network, simple adaptations must be carried out by relocating the jumpers ($C_Y$=OFF). which may result in impairment of the radio interference suppression.

The insulation resistance of the frequency inverter must be taken into consideration when operating on an insulation monitor (📖 Section 7 "Technical data").




**(1) = Jumper with size 1 - 3**

**(2) = Jumper with size 4**

**Figure 16: Jumpers for mains adaptation**

**Adaptation to HRG networks** – (from size **1**)

The device may also be operated in supply networks with a high resistance earthed star point (**H**igh **R**esistance **G**rounding) (typical for the US American region). For this, the same conditions and modifications must be taken into account as for operation in an IT network (see above).

**Use with differing supply networks or network types**

The frequency inverter may only be connect to and operated in supply networks which are explicitly stated in this section (📖 Section 2.4.2.1 "Mains supply (L1, L2(/N), L3, PE)"). Operation in **deviating network types** may be possible, but must be **explicitly checked and approved by the manufacturer in advance**.

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

The motor cable may have a **total length of 100 m** if it is a standard cable type (take EMC into consideration). 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 **20 m** (connect cable shield to PE, on both sides).

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

**NOTICE** **Output switching**

Switching a motor cable under load causes an impermissibly high load on the device. Components in the power section may be damaged and destroyed either immediately or in the long term.

- Only switch the motor cable when the frequency inverter no longer pulses, i.e. the device must be in the state "ready for switch-on" or "switch-on block".

**Information** **Synchronous motors or multiple motor operation**

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.

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

#### 2.4.2.3 Braking resistor (+B, -B) – (from size 1)

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

**CAUTION** **Hot surfaces**

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

- Danger of injury due to local burns on contact.
- Heat damage to adjacent objects

Allow sufficient cooling time before starting work on the product. Check the surface temperatures with suitable measuring equipment. Maintain an adequate distance to adjacent components or provide protection against contact.

#### 2.4.2.4 Electromechanical brake

Only valid for SK 2x5E size 1 - 3 and SK 2x0E size 4:

The device generates an output voltage at terminals 79 / 80 (MB+ / MB-) for actuating an electromagnetic brake. This is dependent on the supply voltage present at the device. The allocation is as follows:

| Mains voltage / AC voltage | Brake coil voltage (DC) |
|---|---|
| 115 V ~ / 230 V ~ | 105 V = |
| 400 V ~ | 180 V = |
| 460 V ~ / 480 V ~ | 205 V = |
| 500 V ~ | 225 V = |

With the SK 2x5E, the connecting terminals are on the control terminal block, and with the SK 2x0E, size 4 they are separate from this to a certain extent.

The assignment of the correct brake and brake coil voltage must be taken into consideration in the design with regard to the mains voltage of the device.

**Information** **Parameters P107 / P114**

For the connection of an electro-mechanical brake to the terminals of the device, parameters P107 / P114 (brake application time / release time ) must be adjusted. In order to prevent damage to the brake control, parameter (P107) must contain a non-zero value.

### 2.4.3 Electrical connection of the control unit

**Connection data:**

| Terminal block | | Size 1-4 | Size 4 |
|---|---|---|---|
| | | Typically | Terminals 79/80 |
| Cable Ø * | [mm²] | 0.2 … 2.5 | 0.2 … 4 |
| AWG standard | | 24-14 | 24-12 |
| Tightening torque | [Nm] | 0.5 … 0.6 | 0.5 … 0.6 |
| | [lb-in] | 4.42 … 5.31 | 4.42 … 5.31 |
| Slotted screwdriver | [mm] | 3.5 | 3.5 |

* flexible cable with wire-end ferrules (with or without plastic collar) or rigid cable

**SK 2x0E**

The device generates its own 24 V DC control voltage and provides this to terminal 43 (for connecting external sensor systems, for example).

However, size 4 device can also be supplied by an external control voltage source (connection to terminal 44). The switchover between the internal and external power supply takes place automatically.

**SK 2x5E**

The device must be provided with an external 24 V DC supply. Alternatively, an optionally available 24 V DC power supply of type SK CU4-… or SK TU4-… can be used.

The control voltage for devices that use the AS interface (SK 225E and SK 235E) must be supplied via the yellow AS interface line. However, in this case the frequency inverter must not have an additional supply via terminal 44 in order to prevent damage to the mains unit or the AS interface bus.

**Information** — **Control voltage overload**

A control unit overload caused by non-permissible high currents can destroy the unit. Impermissibly high currents occur if the total cuurent which is actually obtained exceeds the permissible total current, or if the 24 V DC control voltage for other devices is passed through the frequency inverter. To avoid conduction through the frequency inverter, e.g. double wire end ferrules must be used.

The control unit can also be overloaded and destroyed if the 24 V DC supply terminals of devices with an integrated power supply (SK 2x0E) are connected to a different voltage source. For this reason, particularly when installing connectors for the control connection it must be ensured that any cores for the 24 V DC power supply are not connected to the device but are insulated accordingly (example of connector for system bus connection SK TIE4-M12-SYSS).

**Information** — **Total currents**

24 V DC can be taken from several terminals if necessary. This also includes e.g. digital outputs or a operating module connected via RJ45

The sum total of the currents that are obtained must not exceed:

| Device type | Size 1 to 3 | Size 4 |
|---|---|---|
| SK 2x0E | 200 mA | 500 mA |
| SK 2x5E | 200 mA | - |
| Devices with AS Interface, when using the AS Interface | 60 mA | 60 mA |

## Information

### Reaction time of the digital inputs

The reaction time of a digital signal is approx. 4-5 ms and consists of the following:

| | |
|---|---|
| Scan time | 1 ms |
| Signal stability check | 3 ms |
| Internal processing | < 1 ms |

A parallel channel exists for digital inputs DIN2 and DIN3, which relays the signal pulses between 250 Hz and 205 kHz directly to the processor, and therefore makes it possible for an encoder to be evaluated.

## Information

### Cable laying

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

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

Alternative: Using a hybrid cable with shielding of the control lines.

### 2.4.3.1 Control terminal details

#### Labelling, function

| | | | |
|---|---|---|---|
| SH: | Function: Safe stop | DOUT: | Digital output |
| AS1+/-: | Integrated AS interface | 24 V SH: | "Safe stop" input |
| 24 V: | 24 V DC control voltage | 0 V SH: | "Safe stop" reference potential |
| 10 V REF: | 10 V DC reference voltage for AIN | AIN +/- | Analogue input |
| AGND: | Reference potential for analogue signals | SYS H/L: | System bus |
| GND: | Reference potential for digital signals | MB+/-: | Control of electro-mechanical brake |
| DIN: | Digital input | TF+/-: | Motor thermistor (PTC) connection |

#### Connections depending on the development stage

Detailed information regarding **functional safety** (Safe Stop) can be found in supplementary manual BU0230. - www.nord.com -

***Sizes 1 ... 3***

| SK 200E | SK 210E SH | SK 220E AS1 | SK 230E SH+AS1 | Device type Labelling | Pin | | SK 205E | SK 215E SH | SK 225E AS1 | SK 235E SH+AS1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 V (output) | | | | **43** | 1 | **44** | 24 V (input)* | | | |
| AIN1+ | | ASI+ | | **14/84** | 2 | **44/84** | 24 V (input)* | | ASI+ | |
| AIN2+ | | | | **16** | 3 | **40** | GND | | | |
| AGND | | ASI- | | **12/85** | 4 | **40/85** | GND | | ASI- | |
| DIN1 | | | | **21** | 5 | **21** | DIN1 | | | |
| DIN2 | | | | **22** | 6 | **22** | DIN2 | | | |
| DIN3 | | | | **23** | 7 | **23** | DIN3 | | | |
| DIN4 | 24 V SH | DIN4 | 24 V SH | **24/89** | 8 | **24/89** | DIN4 | 24 V SH | DIN4 | 24 V SH |
| GND | 0V SH | GND | 0V SH | **40/88** | 9 | **40/88** | GND | 0V SH | GND | 0V SH |
| DOUT1 | | | | **1** | 10 | **1** | DOUT1 | | | |
| GND | | | | **40** | 11 | **40** | GND | | | |
| SYS H | | | | **77** | 12 | **77** | SYS H | | | |
| SYS L | | | | **78** | 13 | **78** | SYS L | | | |
| 10 V REF | | | | **11** | 14 | **-** | --- | | | |
| DOUT2 | | | | **3** | 15 | **79** | MB+ | | | |
| GND | | | | **40** | 16 | **80** | MB- | | | |
| TF+ | | | | **38** | 17 | **38** | TF+ | | | |
| TF- | | | | **39** | 18 | **39** | TF- | | | |

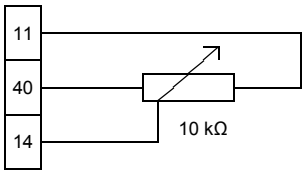
* when using the AS interface, terminal 44 provides an output voltage (26.5 V DC … 31.6 V DC, max. 60 mA). In this case, no voltage sources may be connected to this terminal!

***Size 4***

| Device type | | SK 200E | SK 210E (SH) | SK 220E (ASI) | SK 230E (SH+ASI) |
|---|---|---|---|---|---|
| Pin | **Labelling** | | | | |
| 1 | **43** | 24 V (output) | | | |
| 2 | **43** | 24 V (output) | | | |
| 3 | **40** | GND | | | |
| 4 | **40** | GND | | | |
| 5 | **-/84** | / | | ASI+ | |
| 6 | **-/85** | / | | ASI- | |
| 7 | **11** | 10 V REF | | | |
| 8 | **14** | AIN1+ | | | |
| 9 | **16** | AIN2+ | | | |
| 10 | **12** | AGND | | | |
| 11 | **44** | 24 V (input) | | | |
| 12 | **44** | 24 V (input) | | | |
| 13 | **40** | GND | | | |
| 14 | **40** | GND | | | |
| 15 | **21** | DIN1 | | | |
| 16 | **22** | DIN2 | | | |
| 17 | **23** | DIN3 | | | |
| 18 | **24/89** | DIN4 | 24 V SH | DIN4 | 24 V SH |
| 19 | **40/88** | GND | 0V SH | GND | 0V SH |
| 20 | **40** | GND | | | |
| 21 | **1** | DOUT1 | | | |
| 22 | **40** | GND | | | |
| 23 | **3** | DOUT2 | | | |
| 24 | **40** | GND | | | |
| 25 | **77** | SYS H | | | |
| 26 | **78** | SYS L | | | |
| 27 | **38** | TF+ | | | |
| 28 | **39** | TF- | | | |
| Separate terminal block (2-pole): | | | | | |
| 1 | **79** | MB+ | | | |
| 2 | **80** | MB+ | | | |

| Meaning, Functions | | Description / Technical data | | |
|---|---|---|---|---|
| Terminal | | | Parameter | |
| **No.** | Designation | Meaning | No. | Function of factory setting |
| **Digital outputs** | | Signalling of device operating statuses | | |
| | | 24 V DC<br>With inductive loads: Provide protection via free-wheeling diode! | Maximum load 20 mA | |
| **1** | DOUT1 | Digital output 1 | P434 [-01] | Fault |
| **3** | DOUT2 | Digital output 2 | P434 [-02] | Fault |

**Notes:**
Size 4: Max. load 50 mA
SK 2x5E: Voltage level depending on input voltage level (18 – 30 V DC)

| | | | | |
|---|---|---|---|---|
| **Analogue inputs** | | Actuation of device by external controller, potentiometer or the like. | | |
| | | *Resolution* 12Bit<br>U= 0 …10 V, $R_i$=30 kΩ<br>I= 0/4 … 20 mA<br>*Burden resistance* (250 Ω) via DIP switch AIN1/2<br><br>Maximum permissible voltage at analogue input: 30 V DC | Matching of the analogue signals is performed via P402 and P403.<br>*+ 10 V Reference voltage:* 5 mA not short-circuit resistant<br>  | |
| **11** | 10V REF | + 10 V Reference voltage | - | - |
| **14** | AIN1+ | Analogue input 1 | P400 [-01] | Setpoint frequency |
| **16** | AIN2+ | Analogue input 2 | P400 [-02] | No function |
| **40** | GND | Reference potential GND | - | - |

**NOTICE:** SK 200E and SK 210E: **Terminal 12** must be used instead of terminal 40 (AGND/0V)

| | | | | |
|---|---|---|---|---|
| **Digital inputs** | | Actuation of device via an external controller, switch or the like, connection of HTL transmitter (DIN2 and DIN3 only) | | |
| | | **as per EN 61131-2, type 1**<br>Low: 0-5 V (~ 9.5 kΩ)<br>High: 15-30 V (~ 2.5 - 3.5 kΩ)<br>*Scan time:* 1 ms<br>*Reaction time:* 4 - 5 ms | *Input capacitance*<br>10 nF (DIN1, DIN 4)<br>1.2 nF (DIN 2, DIN 3)<br>DIN 2 and DIN 3 double allocation<br>Min.: 250 Hz, Max.: 205 kHz | |
| **21** | DIN1 | Digital input 1 | P420 [-01] | ON right |
| **22** | DIN2 | Digital input 2 | P420 [-02] | ON left |
| **23** | DIN3 | Digital input 3 | P420 [-03] | Fixed frequency 1 (→ P465[-01]) |
| **24** | DIN4 | Digital input 4 | P420 [-04] | Fixed frequency 2 (→ P465[-02]) |
| **PTC resistor input** | | Monitoring of motor temperature using PTC | | |
| | | If the device is installed near the motor, a shielded cable must be used. | The input is always active. In order to make the device operational, a temperature sensor must be connected or both contacts must be jumpered. | |
| **38** | TF+ | PTC resistor input | - | - |
| **39** | TF- | PTC resistor input | - | - |

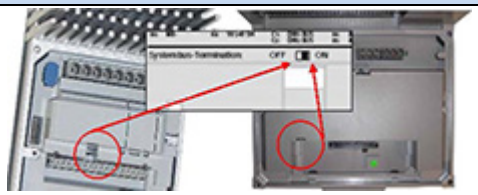
| **Control voltage source** | | Control voltage of device, e.g. for supplying accessories. | | |
|---|---|---|---|---|
| | | 24 V DC ± 25 %, short circuit-proof | Maximum load 200 mA [1)] | |
| **43** | VO / 24V | Voltage output | - | - |
| **40** | GND / 0V | Reference potential GND | - | - |

**1)** See "Total currents" information (🕮 Section 2.4.3 "Electrical connection of the control unit")

**Note:** Size 4: Max. load 500 mA

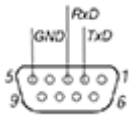
| **Control voltage connection** | | Supply voltage for device | | |
|---|---|---|---|---|
| | | 24 V DC ± 25 % (size 1 – 3)<br>24 V DC + 25 % (size 4)<br>200 mA … 800 mA, depending on load of inputs and outputs and use of options | Size 4: Automatic changeover between terminal 44 and internal power supply if connected control voltage is insufficient.<br>With use of AS interface: 24 V output voltage, ≤ 60 mA. | |
| **44** | 24V | Voltage input | - | - |
| **40** | GND / 0V | Reference potential GND | - | - |

| **System bus** | | NORD-specific bus system for communicating with other devices (e.g. smart option modules or frequency inverter) | | |
|---|---|---|---|---|
| | | Up to four frequency inverters (SK 2xxE, SK 1x0E) can be operated on a single system bus. | → Address = 32 / 34 / 36 / 38 | |
| **77** | SYS H | System bus+ | P509/510 | Control terminals / Auto |
| **78** | SYS L | System bus- | P514/515 | 250kBaud / Address $32_{dec}$ |

| **System bus terminating resistance** | | Termination at the physical end of the bus system | |
|---|---|---|---|
| | | If the device is supplied preassembled (e.g. equipped with customer unit SK CU4 / SK TU4) the terminating resistors on the device and the module are factory-set. If other devices are going to be incorporated in the system bus, the terminating resistors must be reset accordingly. **It must always be checked before commissioning that the terminating resistors have been correctly set (1x at beginning and 1x at end of system bus).** | |
| **S2** | |  | Factory setting "OFF"<br><br>(For deviating factory setting, see explanation above) |

| **Brake actuation** | | Connection and actuation of an electromechanical brake. The device generates an output voltage for this. This depends on the mains voltage. The assignment of the correct brake coil voltage must be taken into account in the selection. | | |
|---|---|---|---|---|
| | | *Connected loads:*<br>🕮 Section 2.4.2.4 "Electromechanical brake"<br>Current: ≤ 500 mA | Permissible switching cycle time:<br>to 150 Nm ≤ 1/s<br>to 250 Nm ≤ 0.5/s | |
| **79** | MB+ | Brake control | P107/114 | 0 / 0 |
| **80** | MB- | Brake control | | |

**INFORMATION**
SK 2x0E, size 4: ≤ 600 mA
This function is identical to P434=1

| | | | | |
|---|---|---|---|---|
| **AS Interface** | | Control of device via the simple field bus level: Actuator/sensor interface | | |
| | | 26.5 – 31.6 V<br>SK 220E and SK 230E: ≤ 25 mA<br>SK 225E and SK 235E: ≤ 290 mA, of which a maximum of 60 mA required to supply external actuators | Only usable for yellow AS interface line, feed via black cable not possible.<br>Configuration via DIP switches S1:4 and 5 | |
| **84** | ASI+ | ASI+ | P480 … | - |
| **85** | ASI- | ASI- | P483 | - |
| **Functional Safety "Safe Stop"** | | Fail-safe input | | |
| | | Details: BU0230, “Technical data” | The input is always active. In order to make the device ready for operation, this input must be provided with the required voltage. | |
| **89** | VI/24V SH | 24 V input | - | - |
| **88** | VI/0V SH | Reference potential | - | - |
| **Communication interface** | | Device connected to different communication tools | | |
| | | *24 VDC ± 20%* | *RS 485 (*For connecting a parametrisation box)<br>9600 … 38400 Baud<br>*Terminating resistance* (1 kΩ) fixed<br>*RS 232 (*For connecting to a PC (NORD CON))<br>9600 … 38400 Baud | |
| **1** | RS485 A+ | Data cable RS485 | P502… P513 [-02] |  <br>1 - 2 - 3 - 4 - 5 - 6 |
| **2** | RS485 B- | Data cable RS485 | | |
| **3** | GND | Reference potential of bus signals | | |
| **4** | RS232 TXD | Data cable RS232 | | |
| **5** | RS232 RXD | Data cable RS232 | | |
| **6** | +24 V | Voltage output | | |
| **Connection cables (accessories / optional)** | | Connection of the device to an MS-Windows® PC with NORDCON software | | |
| | | *Length:* approx. 3.0 m + approx. 0.5 m<br>*Part number:* 275274604<br>Suitable for connection to a USB port in a PC or alternatively to a SUB-D9 connection.<br>Details: 🕮 TI 275274604 |  |  |

### 2.4.4 Power supply SK xU4-24V-… - connection example

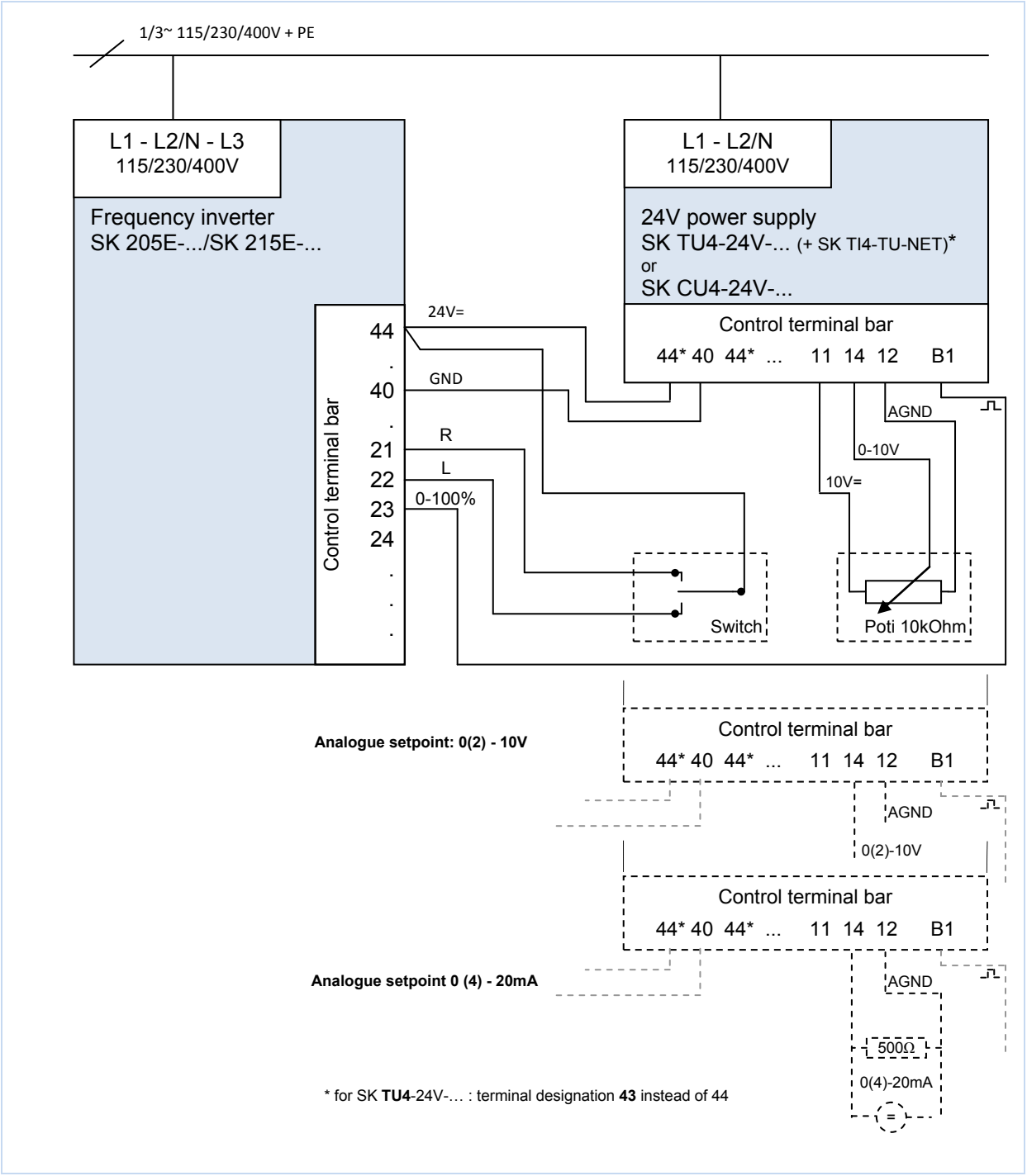



**Figure 17: Connection example for power supply SK xU4-24V-…**

| | | | |
|---|---|---|---|
| Setting (S1): (DIP switches) | DIP3 = off, DIP4 = on, DIP5 = off (chapter 4.3.2.2) | | |
| | (can only be used for 0–10 V or 0–20 mA signals!) | | |
| or | | | |
| recommended parameter setting, S1: DIP1-8 = off | P400 [07] = 1 | P420 [02] = | 2 |
| | P420 [01] = 1 | P420 [03] = | 26 (with 0-10 V / 0-20 mA - signals) |
| | | | 27 (with 2-10 V / 4-20 mA - signals) |

With device variants **SK 2x0E** a mains unit is integrated, meaning that no external 24 V DC is required. For *Sizes 1 – 3,* connection of an external power source (e.g. mains unit SK xU4-24V-…) is not intended. No connection terminals are provided for this. *Size 4* is equipped with the relevant connection terminals and enables connection of an external power source (📖 Section 2.4.3.1 "Control terminal details ").

The SK 2x5E does not have its own analogue input. In order to be able to evaluate an analogue signal with this device variant (e.g. from a potentiometer), the analogue signal can be converted into a pulse signal using the power supply and made usable by an appropriate digital function of the device.

In order to process current setpoints (0(4) – 20 mA) the enclosed bag includes a 500 Ω resistor, which must be connected between terminals 12 and 14. The relevant input at the frequency inverter is adjusted via parameter P420.

| Setpoint | Parameter [Array] | Setting |
|---|---|---|
| 0 … 20 mA | P420 [-02] or [-03] | {26} |
| 4 … 20 mA | P420 [-02] or [-03] | {27} |

## 2.5 Colour and contact assignments for the incremental encoder (HTL)

| Function | Wire colours for incremental encoders [1] | Assignment for SK 2xxE | |
|---|---|---|---|
| 24V supply | brown / green | 43 (/44) | 24V (VO) |
| 0V supply | white / green | 40 | 0V (GND) |
| Track A | brown | 22 | DIN2 |
| Track A inverse (A /) | green | -- | |
| Track B | grey | 23 | DIN3 |
| Track B inverse (B /) | pink | -- | |
| Track 0 | red | 21 | DIN1 |
| Track 0 inverse | black | -- | |
| Cable shield | Large-area connection to frequency inverter housing. | | |

1) The wire colours depend on the type of encoder and may differ. Please **note** the encoder **data sheet**!

Note the current consumption of the encoder (normally up to 150 mA) and the permissible load on the voltage source.

Only digital inputs DIN 2 and DIN 3 are in a position to process the signals of an HTL encoder. For the use of an encoder, parameters (P300) and/or (P600) must be activated according to requirements (speed feedback / servo mode or positioning).

**Information** — **DIN 2 and DIN 3 double allocation**

The digital inputs DIN2 and DIN3 are used for 2 different functions:

1. For digital functions which can be parameterised (e.g. “enable left”),
2. For evaluation of an incremental encoder.

Both functions are coupled by an "OR" link.

Evaluation of an incremental encoder is always activated. This means that if an incremental encoder is connected, it must be ensured that the digital functions are disabled (Parameter (P420 [-02] and [-03]) or via DIP switch (chapter 4.3.2.2)).

**Information** — **Rotation direction**

The "counting direction" of the incremental encoder must correspond to the direction of rotation of the motor. If the two directions are not identical, the connections of the encoder tracks (Track A and Track B) must be switched. Alternatively, the resolution (pulse number) of the encoder in **P301** can be set with a negative prefix.

**Information** — **Encoder signal faults**

Wires that are not required (e.g. Track A inverse / B inverse) must be isolated.

Otherwise, if these wires come into contact with each other or the cable shield, short-circuits can occur that can cause encoder signal problems or destruction of the encoder.

If the rotary encoder has a zero track, this must be connected to digital input 1 of the device. The zero track is read out by the frequency inverter if parameter P420 [-01] has been set to function "43".

## 2.6 Operation in potentially explosive environments

**WARNING** — **Danger of explosion due to electricity**

Electric sparks may ignite an explosive atmosphere.

- Do not open the device in an explosive atmosphere and do not remove any covers (e.g. diagnostic openings).
- All work on the device must only be carried out with the **power to the system switched off**.
- Wait for the required time (≥ 30 min) after switching off.
- Before starting work, check that all relevant components (voltage source, connection cables, connection terminals of the device) are free of voltage using suitable measuring equipment.

**WARNING** — **Explosion hazard due to high temperatures**

High temperatures may cause the ignition of an explosive atmosphere.

Temperatures may occur within the device and the motor, which are higher than the maximum permissible surface temperature of the housing. Dust deposits may restrict the cooling of the device.

- Clean the device at regular intervals to prevent the accumulation of impermissible dust deposits.
- Do not open or remove the device from the motor in an explosive atmosphere.

**WARNING** — **Explosion hazard due to electrostatic charge**

Electrostatic charges may cause sudden discharges with the formation of sparks. Sparks may ignite an explosive atmosphere.

The housing cover is made of plastic. This may become electrostatically charged, e.g. due to a flow of particles caused by the fan.

- Avoid air movement or air flows at the operation location of the device.

With appropriate modification, the device can be used in certain potentially explosive areas.

If the device is connected to a motor and a gear unit, the EX labelling of the motor and the gear unit must also be observed. Otherwise the drive must not be operated.

**Information** — **SK 2xxE, size 4**

Devices of size 4 (SK 2x0E-551-323 … -112-323 and SK 2x0E-112-340 … -222-340) are **not** approved for operation in potentially explosive environments.

### 2.6.1 Operation in potentially explosive environments - ATEX zone 22 3D

All of the conditions which must be observed for operation of the frequency inverter in an explosion hazard environment (ATEX) are listed below.

#### 2.6.1.1 Modification of the device for compliance with Category 3D

Only a specially modified device is permissible for operation in ATEX zone 22. This adaptation is only made at the NORD factory. In order to use the device in ATEX Zone 22, the diagnostic caps are replaced with aluminium / glass versions, among other things.


**( 1 ) Year of manufacture**

**( 2 ) Marking of the device (ATEX)**

| | |
|---|---|
| IP55: | II 3D Ex tc IIIB T125 °C Dc X |
| IP66: | II 3D Ex tc IIIC T125 °C Dc X |

**Categorisation:**

- Protection with "housing"
- Procedure "A" Zone "22" Category 3D
- Protection class IP55 / IP66 (according to the device)

  →IP66 is required for conductive dust
- Maximum surface temperature 125°C
- Ambient temperature -20°C to +40°C

**Information** **Potential damage**

Devices in series SK 2xxE and the permitted options are only designed for a degree of mechanical stress that corresponds to a low impact energy of 4J.

Higher loads will lead to damage to or in the device.

The components which are required for the modification are contained in an appropriately modified frequency inverter connection unit (SK TI4-…-EX).

#### 2.6.1.2 Options for ATEX Zone 22, category 3D

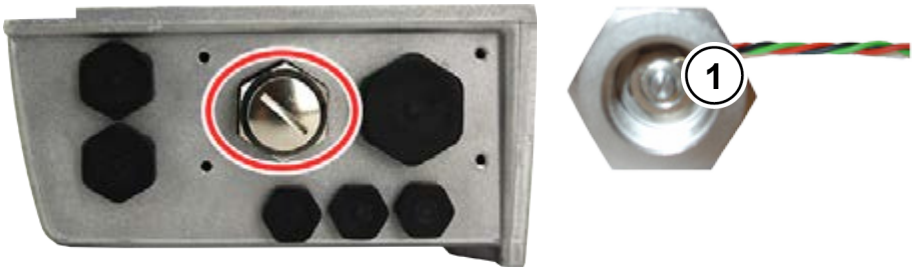
In order to ensure that the device is ATEX-compliant, its optional modules must also be approved for potentially explosive areas. Option modules that are not in the following list may **not** be used in an ATEX zone 22 3D. This also includes connectors and switches that may also not be used in such an environment.

**Control and parametrisation units** are basically **not** approved for **operation in ATEX zone 22 3D**. They may therefore only be used for commissioning or maintenance purposes and if it has been ensured that no explosive dust atmosphere exists.

| Designation | Part Number | Use permissible |
|---|---|---|
| **Braking resistors** | | |
| SK BRI4-1-100-100 | 275272005 | Yes |
| SK BRI4-1-200-100 | 275272008 | Yes |
| SK BRI4-1-400-100 | 275272012 | Yes |
| SK BRI4-2-100-200 | 275272105 | Yes |
| SK BRI4-2-200-200 | 275272108 | Yes |
| **Bus interfaces** | | |
| SK CU4-CAO(-C) | 275271001 / (275271501) | Yes |
| SK CU4-DEV(-C) | 275271002 / (275271502) | Yes |
| SK CU4-ECT(-C) | 275271017 / (275271517) | Yes |
| SK CU4-EIP(-C) | 275271019 / (275271519) | Yes |
| SK CU4-PBR(-C) | 275271000 / (275271500) | Yes |
| SK CU4-PNT(-C) | 275271015 / (275271515) | Yes |
| SK CU4-POL(-C) | 275271018 / (275271518) | Yes |
| **IO Extensions** | | |
| SK CU4-IOE(-C) | 275271006 / (275271506) | Yes |
| SK CU4-IOE2(-C) | 275271007 / (275271507) | Yes |
| SK CU4-REL(-C) | 275271011 / (275271511) | Yes |
| **Power supply** | | |
| SK CU4-24V-123-B(-C) | 275271108 / (275271608) | Yes |
| SK CU4-24V-140-B(-C) | 275271109 / (275271609) | Yes |
| **Potentiometers** | | |
| SK ATX-POT | 275142000 | Yes |
| **Miscellaneous** | | |
| SK CU4-FUSE(-C) | 275271122 / (275271622) | Yes |
| SK CU4-MBR(-C) | 275271010 / (275271510) | Yes |
| **Wall mounting kits** | | |
| SK TIE4-WMK-1-EX | 275175053 | Yes |
| SK TIE4-WMK-2-EX | 275175054 | Yes |
| **Adapter kits** | | |
| SK TI4-12-Adapter kit_63-71-EX | 275175038 | Yes |
| SK TI4-3-Adapter kit_80-112-EX | 275175039 | Yes |

### SK ATX-POT

The Category 3D frequency inverter can be equipped with an ATEX-compliant 10 kΩ potentiometer (SK ATX-POT), which can be used to setpoint (e.g. speed) adjustment 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 detachable screw closing cap, this component complies with ATEX requirements. Permanent operation may only be carried out with the cap closed.




**1** Setting adjustment using a screwdriver

| SK ATX-POT wire colour | Name | Terminal SK CU4-24V… | Terminal SK CU4-IOE | Terminal SK 2x0E |
|---|---|---|---|---|
| red | +10 V reference | [11] | [11] | [11] |
| black | AGND / 0V | [12] | [12] | [12] / [40] |
| green | Analogue input | [14] | [14] / [16] | [14] / [16] |

**Information** — **Internal braking resistor "SK BRI4-…"**

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 (📖 Section 2.3.1 "Internal brake resistor SK BRI4-…"). Only the resistors assigned to the relevant inverter type may be used.

#### 2.6.1.3 Maximum output voltage and torque reduction

As the maximum achievable output voltage depends on the pulse frequency to be set, in some cases the torque which is specified in document B1091-1 must be reduced for values above the rated pulse frequency of 6 kHz.

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

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:

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

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.

**Information** **Power derating**

At pulse frequencies above 6 kHz (400 V devices) or 8 kHz (230 V) 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.

#### 2.6.1.4 Commissioning information

For Zone 22 the cable glands must at least comply with protection class IP55. Unused openings must be closed with blank screw caps that are suitable for ATEX Zone 22 3D (generally IP 55).

The motors are protected from overheating by the device. This takes place by means of evaluation of the motor PTC (TF) at the device side. In order to ensure this function, the PTC must be connected to the intended input (Terminal 38/39).

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. *The stator resistance of the motor (see P208) must be measured by the inverter and at ambient temperature. In order to do this, parameter P220 must be set to "1".* In addition, the frequency inverter must be parameterised so that the motor can be operated with a maximum speed of 3000 rpm. For a four-pole motor, the "maximum frequency" must be set to a value which is smaller or equal to 100 Hz ((P105) ≤ 100). Here the maximum permissible output speed of the gear unit must be observed. In addition, the monitoring "I²t-Motor" (Parameter (P535) / (P533)) must be switched on and the pulse frequency set to between 4 kHz and 6 kHz.

**Overview of required parameter settings:**

| Parameter | Setting value | Factory setting | Description |
|---|---|---|---|
| P105<br>Maximum frequency | ≤ 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. |
| P200<br>Motor list | Select appropriate motor power | [0] | If a 4-pole NORD motor is used, the pre-set motor data can be called up. |
| P201 – P208<br>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. |
| P218<br>Degree of modulation | ≥ 100% | [100] | Determines the maximum possible output voltage |
| P220<br>Parameter identification | 1 | [0] | Measures the stator resistance of the motor. When the measurement is complete, the parameter is automatically reset to "0". The value that is determined is written to P208 |
| P504<br>Pulse frequency | 4 kHz … 6 kHz | [6] | For pulse frequencies above 6 kHz a reduction of the maximum torque is necessary. |
| P533<br>Factor $I^2t$-Motor | < 100% | [100] | A reduction in torque can be taken into account with values less than 100 in the I²t monitoring. |
| P535<br>I²t motor | According to motor and ventilation | [0] | The I²t- monitoring of the motor must be switched on. The set values depend on the type of ventilation and the motor used. See B1091-1 |

### 2.6.1.5 EU conformity declaration - ATEX

# GETRIEBEBAU NORD

Member of the NORD DRIVESYSTEMS Group

DRIVESYSTEMS

**Getriebebau NORD GmbH & Co. KG**

Getriebebau-Nord-Str. 1 . 22941 Bargteheide, Germany . Fon +49(0)4532 289 - 0 . Fax +49(0)4532 289 - 2253 . info@nord.com

C432710_1418

## EU Declaration of Conformity

In the meaning of the EU directives 2014/34/EU Annex X, 2014/30/EU Annex II and 2011/65/EU Annex VI

Getriebebau NORD GmbH & Co. KG as manufacturer in sole responsibility hereby declares, that the variable speed drives of the product series



- **SK 200E-xxx-123-B-.. , SK 200E-xxx-323-.-.. , SK 200E-xxx-340-.-..**
  (xxx= 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751)
  also in these functional variants:
  **SK 205E-... , SK 210E-... , SK 215E-... , SK 220E-... , SK 225E-... , SK 230E-... , SK 235E-...**
  and the further options/accessories:
  **SK BRI4-..., SK ATX-POT, SK TIE4-M12-M16, SK TIE4-WMK-1, SK TIE4-WMK-2, SK CU4-PBR, SK CU4-CAO, SK CU4-DEV, SK CU4-PNT, SK CU4-ECT, SK CU4-POL, SK CU4-EIP, SK CU4-IOE**

**with ATEX labeling** Ⓔx **II 3D Ex tc IIIB T125°C Dc X** (in IP55) or

Ⓔx **II 3D Ex tc IIIC T125°C Dc X** (in IP66)

comply with the following regulations:

| | | |
|---|---|---|
| **ATEX Directive for products** | **2014/34/EU** | OJ. L 96 of 29.3.2014, P. 309–356 |
| **EMC Directive** | **2014/30/EU** | OJ. L 96 of 29.3.2014, P. 79–106 |
| **RoHS Directive** | **2011/65/EU** | OJ. L 174 of 1.7.2011, P. 88–110 |

**Applied standards:**

| | | |
|---|---|---|
| EN 60079-0:2012+A11:2013 | EN 60079-31:2014 | EN 61800-9-1:2017 |
| EN 61800-5-1:2007+A1:2017 | EN 61800-3:2004+A1:2012+AC:2014 | EN 61800-9-2:2017 |
| EN 60529:1991+A1:2000+A2:2013+AC:2016 | EN 50581:2012 | |

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.

First marking was carried out in 2010.

**Bargteheide, 06.04.2018**

U. Küchenmeister
Managing Director

pp F. Wiedemann
Head of Inverter Division

### 2.6.2 Operation in potentially explosive environments - EAC Ex

All of the conditions which must be observed for operation of the frequency inverter in an explosion hazard environment according to EAC Ex are listed below. All of the conditions according to 🕮 Section 2.6.1 "Operation in potentially explosive environments - ATEX zone 22 3D "apply . ations which are relevant for approval according to EAC EX are described below and must be Devi .complied with

#### 2.6.2.1 Modification of the device

🕮 Section 2.6.1.1applies.

The labelling of the device according to EAC Ex differs as follows.



**Labelling of the device:**

The following applies for wall mounted devices;

| | |
|---|---|
| IP55: | Ex tc IIIB T125 °C Dc X |
| IP66: | Ex tc IIIC T125 °C Dc X |



The following applies for motor mounted devices;

| | |
|---|---|
| IP55: | Ex tc IIIB Dc U |
| IP66: | Ex tc IIIC Dc U |

**Categorisation:**

- Protection with "housing"
- Procedure "A" Zone "22" Category 3D
- Protection class IP55 / IP66 (depending on the device)

  →IP66 is required for conductive dust

- Maximum surface temperature 125 °C
- Ambient temperature -20 °C to +40 °C

**Information** **Code "U"**

Code "U" applies for frequency inverters which are intended for motor mounting. Devices which are so labelled are considered to be incomplete and may only be operated in combination with a corresponding motor. If a device which is coded "U" is mounted in a motor, the labels and restrictions which are marked on the motor or the geared motor also apply.

**Information** **Code "X"**

The code "X" indicates that the permissible ambient temperature range is between -20°C and +40°C

### 2.6.2.2 Further Information

Further information regarding explosion protection can be found in the following sections.

| Description | 🕮 Section |
|---|---|
| "Options for ATEX Zone 22, category 3D" | 2.6.1.2 |
| "Maximum output voltage and torque reduction" | 2.6.1.3 |
| "Commissioning information" | 2.6.1.4 |

### 2.6.2.3 EAC Ex certificate

TC RU C-DE.AA87.B.01109

## 2.7 Outdoor installation

The device and the technology units (SK TU-...) can be installed outdoors under the following conditions:

- IP66 version (incl. UV-resistant blank screw caps, see special measures, section 1.10 "Version in protection class IP55, IP66"),
- UV-resistant inspection windows (Part Number: 200852000 (📖 TI 200852000)), number of pieces: 3,
- Cover the device to ensure that it is protected from the direct influence of the weather (rain/sun),
- Used accessories (e.g. connectors), also at least IP66.

**Information** — **Diaphragm valve**

The membrane valve (bag enclosed with the IP66 version of the frequency inverter connection unit) enables the compensation of pressure differences between the inside of the frequency inverter and its environment and also prevents the entry of moisture. If it is fitted in an M12 screw gland of the inverter connecting unit, care must be taken that the diaphragm valve does not come into contact with standing water.

**Information** — **Older devices**

If older device models (year of manufacture 2010 or later) are going to be retrofitted outdoors, it may be necessary to also replace the housing cover with a UV resistant version.

# 3 Display, operation and options

As supplied, without additional options, the diagnostic LEDs are externally visible. These indicate the actual device status. 2 potentiometers (only SK 2x5E) and 8 DIP switches (S1) are provided in order to set the most important parameters. In this minimal configuration no other adapted parameters are stored in the external (plug-in) EEPROM. The only exception are data concerning operating hours, faults and fault circumstances. This data can only be saved in the external EEPROM (memory module) up to firmware version V1.2. As of firmware version 1.3, this data is saved in the internal EEPROM of the frequency inverter.

The memory module (external EEPROM) can be pre-parametrised independently of the frequency inverter using programming adapter SK EPG-3H.


Figure 18: SK 2xxE (size 1), top view


Figure 19: SK 2xxE (size 1), internal view

| No. | Designation | SK 2x0E size 1 … 3 | SK 2x5E and SK 2x0E size 4 |
|---|---|---|---|
| 1 | Diagnostic opening 1 | RJ12 connection | RJ12 connection |
| 2 | Diagnostic opening 2 | DIP - Switch AIN<br>(250 Ω for current setpoint) | Diagnostic LEDs |
| 3 | Diagnostic opening 3 | Diagnostic LEDs | Potentiometers (P1 / P2) |
| 4 | 8x DIP switches | | |
| 5 | Plug-in EEPROM | | |

## 3.1 Control and parametrisation options

Various control options are available that can be fitted directly to the device or in close proximity to it and directly connected.

Parametrisation units also provide a facility for accessing the parametrisation of the device and adapting it.

| Designation | | Part Number | Document |
|---|---|---|---|
| **Switches and potentiometers** (attachment) | | | |
| SK CU4-POT | Switch/Potentiometer | 275271207 | 🕮 Section 3.2.4 "Potentiometer adapter, SK CU4-POT" |
| SK TIE4-POT | Potentiometer 0-10V | 275274700 | TI 275274700 |
| SK TIE4-SWT | Switch "L-OFF-R"" | 275274701 | TI 275274701 |
| **Control and parametrisation boxes** (Handheld) | | | |
| SK CSX-3H | SimpleBox | 275281013 | BU0040 |
| SK PAR-3H | ParameterBox | 275281014 | BU0040 |

### 3.1.1 Control and Parametrisation Boxes / Software

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

Up to 5 complete device data sets can be stored in the ParameterBox and then retrieved.

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

Figure 20: SimpleBox, handheld, SK CSX-3H

Figure 21: ParameterBox, handheld, SK PAR-3H

| Module | Description | Data |
|---|---|---|
| SK CSX-3H<br>(handheld SimpleBox) | Used for commissioning, parameterisation, configuration and control of the device [1]. | 4-digit, 7-segment LED display, membrane keyboard<br>IP20<br>RJ12-RJ12 cable (connection to the device [1]) |
| SK PAR-3H<br>(handheld ParameterBox) | Used for commissioning, parameterisation, configuration and control of the frequency inverter and its options (SK xU4-…). Entire parameter data sets can be stored. | 2-line backlit LCD-display, membrane keyboard<br>Stores up to 5 complete parameter data sets<br>IP20<br>RJ12-RJ12 cable (connection to device)<br>USB cable (connection to PC) |
| **1)** | does not apply to optional modules such as bus interfaces | |

**Connection**

1. Remove diagnostics glass of RJ12 socket.
2. Connect the RJ12-RJ12 cable between the control unit and the frequency inverter.

   *When a diagnostics glass or a blind plug is open, take care that no dirt or moisture enters the device.*
3. After commissioning, the **diagnostics glass or blind plugs must be screwed back in again** and it must be ensured that they are **tightly sealed** before starting regular operation.

### 3.1.2 Connection of multiple devices to one parametrisation tool

In principle it is possible to access several frequency inverters via the **ParameterBox** or the **NORD CON software**. In the following example, communication is made via the parameterisation tool, by tunnelling the protocols of the individual devices (max. 4) via the common system bus (CAN). The following points must be noted:

1. Physical bus structure

   Establish a CAN connection (system bus) between the devices

2. Parameterisation

| **Parameter** | | **Settings on the inverter** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Designation** | **FI 1** | **FI 2** | **FI 3** | **FI 4** | | | | |
| P503 | Leading function output | 2 (system bus active) | | | | | | | |
| P512 | USS address | 0 | 0 | 0 | 0 | | | | |
| P513 | Telegram time-out (s) | 0.6 | 0.6 | 0.6 | 0.6 | | | | |
| P514 | CAN bus baud rate | 5 (250 kBaud) | | | | | | | |
| P515 | CAN bus address | 32 | 34 | 36 | 38 | | | | |

3. Connect the parameterisation tool as usual via RS485 (e.g. via RJ12) to the **first** frequency inverter.

*Conditions / Restrictions:*

Basically, all of the currently available frequency converters from NORD (SK 1x0E, SK 2xxE, SK 5xxE) can communicate via a common system bus. When devices in the SK 5xxE model series are incorporated, the framework conditions described in the manual for the device series concerned must be noted.

## 3.2 Optional modules

The device can be easily adapted to various requirements by using function-extending modules and modules for for display, control and parameterisation.

Alphanumeric display and control modules (🕮 Section 3.1 "Control and parametrisation options ") can be used for simple commissioning by means of adapting parameters. For more complex tasks, connection to a PC system can take place with the aid of the NORD CON parameterisation software.

### 3.2.1 Internal customer interfaces SK CU4-… (installation of modules)

Internal customer units allow the scope of functionality of the devices to be extended without changing the physical size thereof. The device provides an installation location for the installing an appropriate option. If other option modules are required the external technology units must be used for these (🕮 Section 3.2.2 "External technology units SK TU4-… (module attachment)").

**Figure 22: internal customer units SK CU4 … example**

The bus interfaces require an external 24 V power supply, and are therefore also ready for operation if the device is not connected to the mains supply. Parameterisation and diagnosis of the bus interface is therefore possible independently from the frequency inverter.

| Designation *) | | Part Number | Document |
|---|---|---|---|
| **Bus interfaces** | | | |
| SK CU4-CAO(-C) | CANopen | 275271001 / (275271501) | TI 275271001 / (TI 275271501) |
| SK CU4-DEV(-C) | DeviceNet | 275271002 / (275271502) | TI 275271002 / (TI 275271502) |
| SK CU4-ECT(-C) | EtherCAT | 275271017 / (275271517) | TI 275271017 / (TI 275271517) |
| SK CU4-EIP(-C) | Ethernet IP | 275271019 / (275271519) | TI 275271019 / (TI 275274519) |
| SK CU4-PBR(-C) | PROFIBUS DP | 275271000 / (275271500) | TI 275271000 / (TI 275271500) |
| SK CU4-PNT(-C) | PROFINET IO | 275271015 / (275271515) | TI 275271015 / (TI 275271515) |
| SK CU4-POL(-C) | POWERLINK | 275271018 / (275271518) | TI 275271018 / (TI 275271518) |
| **IO -Extensions** | | | |
| SK CU4-IOE(-C) | | 275271006 / (275271506) | TI 275271006 / TI 275271506 |
| SK CU4-IOE2(-C) | | 275271007 / (275271507) | TI 275271007 / TI 275271507 |
| SK CU4-REL(-C) | | 275271011 / (275271511) | TI 275271011 / TI 275271511 |
| **Power supply** | | | |
| SK CU4-24V-123-B(-C) | | 275271108 / (275271608) | TI 275271108 / TI 275271608 |
| SK CU4-24V-140-B(-C) | | 275271109 / (275271609) | TI 275271109 / TI 275271609 |
| **Miscellaneous** | | | |
| SK CU4-FUSE(-C) | Fuse module | 275271122 / (275271622) | TI 275271122 / TI 275271622 |
| SK CU4-MBR(-C) | El. brake rectifier | 275271010 / (275271510) | TI 275271010 / TI 275271510 |

* All modules with the identifier **–C** have lacquered PCBs so that they can be used in IP6x devices.

### 3.2.2 External technology units SK TU4-… (module attachment)

External technology units allow the scope of functionality of the devices to be extended in a modular way.

Depending on the type of module, different versions are available (differentiated according to IP protection class, with/without connector etc.). They can be fitted directly to the device using the relevant connection unit or in the vicinity of the device using an optional wall mounting kit.

**Each SK TU4-… technology unit requires an associated SK T14-TU-… connection unit.**

Figure 23: external technology units SK TU4-… (example)

With the bus modules or the I/O extension, it is possible to access the system bus via the RJ12 socket (behind a transparent screw gland (diagnostics glass)) and therefore access all active devices that are connected to it (frequency inverters, other SK xU4 modules) using ParameterBox SK PAR-3H or a PC (NORD CON software).

The bus modules require a 24 V power supply. If the power is on the bus modules are ready, even if the frequency inverter is not in operation.

| Type | IP55 | IP66 | M12 | Designation | Part Number | Document |
|---|---|---|---|---|---|---|
| CANopen | X | | | SK TU4-CAO | 275 281 101 | TI 275281101 |
| | | X | | SK TU4-CAO-C | 275 281 151 | TI 275281151 |
| | X | | X | SK TU4-CAO-M12 | 275 281 201 | TI 275281201 |
| | | X | X | SK TU4-CAO-M12-C | 275 281 251 | TI 275281251 |
| DeviceNet | X | | | SK TU4-DEV | 275 281 102 | TI 275281102 |
| | | X | | SK TU4-DEV-C | 275 281 152 | TI 275281152 |
| | X | | X | SK TU4-DEV-M12 | 275 281 202 | TI 275281202 |
| | | X | X | SK TU4-DEV-M12-C | 275 281 252 | TI 275281101 |
| EtherCAT | X | | | SK TU4-ECT | 275 281 117 | TI 275281117 |
| | | X | | SK TU4-ECT-C | 275 281 167 | TI 275281167 |
| EtherNet/IP | X | | X | SK TU4-EIP | 275 281 119 | TI 275281119 |
| | | X | 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 | TI 275281100 |
| | | X | | SK TU4-PBR-C | 275 281 150 | TI 275281150 |
| | X | | X | SK TU4-PBR-M12 | 275 281 200 | TI 275281200 |
| | | X | X | SK TU4-PBR-M12-C | 275 281 250 | TI 275281250 |
| 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 |
| **Required accessories (each module must have a matching connection unit)** | | | | | | |
| Connection unit | X | | | SK TI4-TU-BUS | 275 280 000 | TI 275280000 |
| | | X | | SK TI4-TU-BUS-C | 275 280 500 | TI 275280500 |
| **Optional accessories** | | | | | | |
| Wall-mounting kit | X | X | | SK TIE4-WMK-TU | 275 274 002 | TI 275274002 |

**Table 9: external bus modules and IO expansions SK TU4- …**

| Type | IP55 | IP66 | Designation | Part Number | Document |
|---|---|---|---|---|---|
| Power supply 24V / 1~ 230V | X | | SK TU4-24V-123-B | 275 281 108 | TI 275281108 |
| | | X | SK TU4-24V-123-B-C | 275 281 158 | TI 275281158 |
| Power supply 24V / 1~ 400V | X | | SK TU4-24V-140-B | 275 281 109 | TI 275281109 |
| | | X | SK TU4-24V-140-B-C | 275 281 159 | TI 275281159 |
| PotentiometerBox 1~ 230V | X | | SK TU4-POT-123-B | 275 281 110 | TI 275281110 |
| | | X | SK TU4-POT-123-B-C | 275 281 160 | TI 275281160 |
| PotentiometerBox 1~ 400V | X | | SK TU4-POT-140-B | 275 281 111 | TI 275281111 |
| | | X | SK TU4-POT-140-B-C | 275 281 161 | TI 275281161 |
| **Required accessories (each module must have an associated connection unit)** | | | | | |
| Connection unit | X | | SK TI4-TU-NET | 275 280 100 | TI 275280100 |
| | | X | SK TI4-TU-NET-C | 275 280 600 | TI 275280600 |
| **Optional accessories** | | | | | |
| Wall-mounting kit | X | X | SK TIE4-WMK-TU | 275 274 002 | TI 275274002 |

**Table 10: external modules with power supply SK TU4-24V- … / SK TU4-POT- …**

| Type | IP55 | IP66 | Designation | Part Number | Document |
|---|---|---|---|---|---|
| Maintenance switch | X | | SK TU4-MSW | 275 281 123 | TI 275281123 |
| | | X | SK TU4-MSW-C | 275 281 173 | TI 275281173 |
| | X | | SK TU4-MSW-RG | 275 281 125 | TI 275281125 |
| | | X | SK TU4-MSW-RG-C | 275 281 175 | TI 275281175 |
| **Required accessories (each module must have a matching connection unit)** | | | | | |
| Connection unit | X | | SK TI4-TU-MSW | 275 280 200 | TI 275280200 |
| | | X | SK TI4-TU-MSW-C | 275 280 700 | TI 275280700 |
| **Optional accessories** | | | | | |
| Wall-mounting kit | X | X | SK TIE4-WMK-TU | 275 274 002 | TI 275274002 |

**Table 11: external modules – maintenance switch SK TU4-MSW- …**

### 3.2.3 plug connectors

The use of optionally available plug connectors for power and control connections not only makes it possible to replace the drive unit with almost no loss of time in case of servicing, but also minimises the danger of installation errors when connecting the device. The most common plug connector versions are summarised below. The possible installation locations on the device are listed in section 2.2.1 "Option locations on the device".

#### 3.2.3.1 Plug connectors for power connections

Various connectors are available for the motor or mains connection.

Figure 24: Examples of devices with connectors for connecting the power

3 different connections are available, which can also be combined (example "-LE-MA"):

| Mounting version | Meaning |
|---|---|
| … - LE | Power input |
| … - LA | Power output |
| … - MA | Motor output |

### Connector (selection)

| Type | Data | Designation | Material no. | Document |
|---|---|---|---|---|
| Power input | 500 V, 16 A | SK TIE4-HANQ8-K-LE-MX | 275 135 030 | TI 275135030 |
| Power input | 500 V, 16 A | SK TIE4-HAN10E-M1B-LE | 275 135 070 | TI 275135070 |
| Power input | 500 V, 16 A | SK TIE4-HAN10E-M2B-LE | 275 135 000 | TI 275135000 |
| Power input | 690 V, 20 A | SK TIE4-QPD_3PE-K-LE | 275 274 125 | TI 275274125 |
| Power input | 630 V, 16 A | SK TIE4-NQ16-K-LE | 275 274 133 | TI 275274133 |
| Power input + power outlet | 400 V, 16 A | SK TIE4-2HANQ5-K-LE-LA | 275 274 110 | TI 275274110 |
| Power input + motor outlet | 600 V, 16 A | SK TIE4-2HANQ5-M-LE-MA-001 | 275 274 123 | TI 275274123 |
| Power output | 500 V, 16 A | SK TIE4-HAN10E-M2B-LA | 275 135 010 | TI 275135010 |
| Power output | 500 V, 16 A | SK TIE4-HANQ8-K-LA-MX | 275 135 040 | TI 275135040 |
| Motor output | 500 V, 16 A | SK TIE4-HAN10E-M2B-MA | 275 135 020 | TI 275135020 |
| Motor output | 500 V, 16 A | SK TIE4-HANQ8-K-MA-MX | 275 135 050 | TI 275135050 |

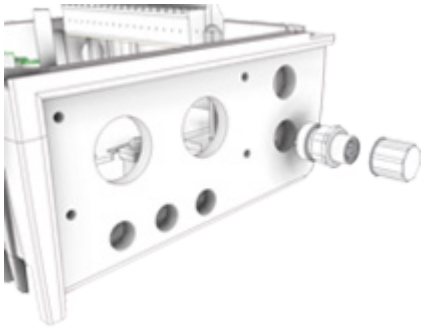
**Information** — **Looping of the mains voltage**

The permissible current load for the connection terminals, plugs and supply cables must be observed when looping the mains voltage. Failure to comply with this will result in thermal damage to current-carrying modules and the immediate vicinity thereof.

### 3.2.3.2 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 an M16 cable gland of the device, or in an external technology unit. The protection class (IP67) of the plug connector only applies in the screwed state. Similarly to the use of coding pins / grooves, the colour coding of the connectors (plastic unit inside and cover caps) is based on functional requirements and is intended to avoid erroneous operation.

Suitable expansion and reducer adapters are available for installation in M12 and M20 cable glands.



**Information** — **Control unit overload SK 2x0E**

The control unit of the device can be overloaded and destroyed if the 24 V DC supply terminals of the device are connected to another voltage source

For this reason, particularly when installing connectors for the control connection it must be ensured that any cores for the 24 V DC power supply are not connected to the device but are insulated accordingly (example of connector for system bus connection SK TIE4-M12-SYSS).

**Connector (selection)**

| Type | Version | Designation | Part Number | Document |
|---|---|---|---|---|
| Power supply | Connector | SK TIE4-M12-POW | 275 274 507 | TI 275274507 |
| Sensors / actuators | Socket | SK TIE4-M12-INI | 275 274 503 | TI 275274503 |
| Initiators and 24 V | Connector | SK TIE4-M12-CAO | 275 274 516 | TI 275274516 |
| AS Interface | Connector | SK TIE4-M12-ASI | 275 274 502 | TI 275274502 |
| AS Interface – Aux | Connector | SK TIE4-M12-ASI-AUX | 275 274 513 | TI 275274513 |
| PROFIBUS (*IN* + *OUT*) | Plug connector + socket | SK TIE4-M12-PBR | 275 274 500 | TI 275274500 |
| Analogue signal | Socket | SK TIE4-M12-ANA | 275 274 508 | TI 275274508 |
| CANopen or DeviceNet *IN* | Connector | SK TIE4-M12-CAO | 275 274 501 | TI 275274501 |
| CANopen or DeviceNet *OUT* | Socket | SK TIE4-M12-CAO-OUT | 275 274 515 | TI 275274515 |
| Ethernet | Socket | SK TIE4-M12-ETH | 275 274 514 | TI 275274514 |
| System bus *IN* | Connector | SK TIE4-M12-SYSS | 275 274 506 | TI 275274506 |
| System bus *OUT* | Socket | SK TIE4-M12-SYSM | 275 274 505 | TI 275274505 |
| HTL transmitter | Socket | SK TIE4-M12-HTL | 275 274 512 | TI 275274512 |
| Safe stop | Socket | SK TIE4-M12-SH | 275 274 509 | TI 275274509 |

### 3.2.4 Potentiometer adapter, SK CU4-POT

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

The potentiometer (010 V) can be evaluated via an analogue input of the frequency inverter (if present) or via an I/O extension. An optional 24V module (SK xU4-24V-...) also provides the possibility of converting analogue setpoint values into proportional pulses (frequencies). These pulses can in turn be evaluated via one of the digital inputs 2 or 3 (P420 [02]/[03] = 26/27) of the frequency inverter in the form of a setpoint (P400 [-06]/[-07]).

| Module | | SK CU4-POT | Connection: Terminal No. | | | Function |
|---|---|---|---|---|---|---|
| | | | SK 2x0E | SK 2x5E | | |
| Pin | Colour | | FI | FI | Mains unit | |
| 1 | brown | 24V- supply voltage | 43 | | 44 | Rotary switch L - OFF - R |
| 2 | black | Enable R (e.g. DIN1) | 21 | 21 | | |
| 3 | white | Enable L (e.g. DIN2) | 22 | 22 | | |
| 4 | white | Access to AIN + | 14 | | 14 | Potentiometer 10 kΩ |
| 5 | brown | Reference voltage 10V | 11 | | 11 | |
| 6 | blue | Analogue ground AGND | 12 | | 12 | |

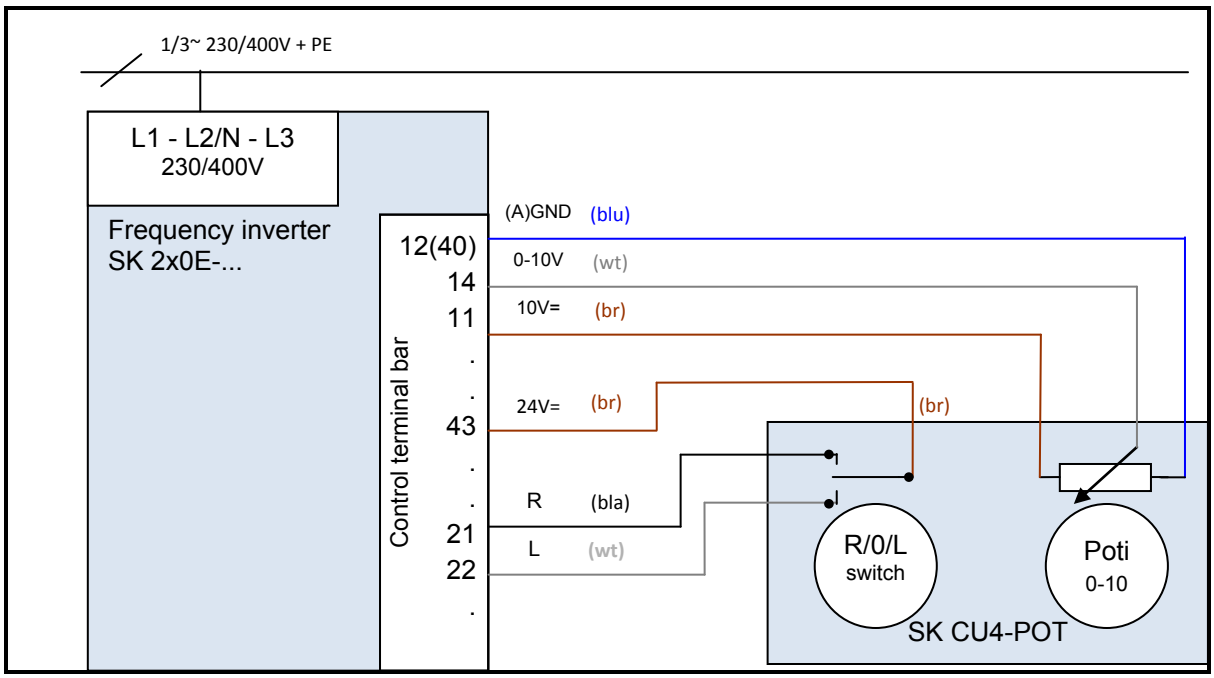



Figure 25: Connection diagram SK CU4-POT, example SK 2x0E

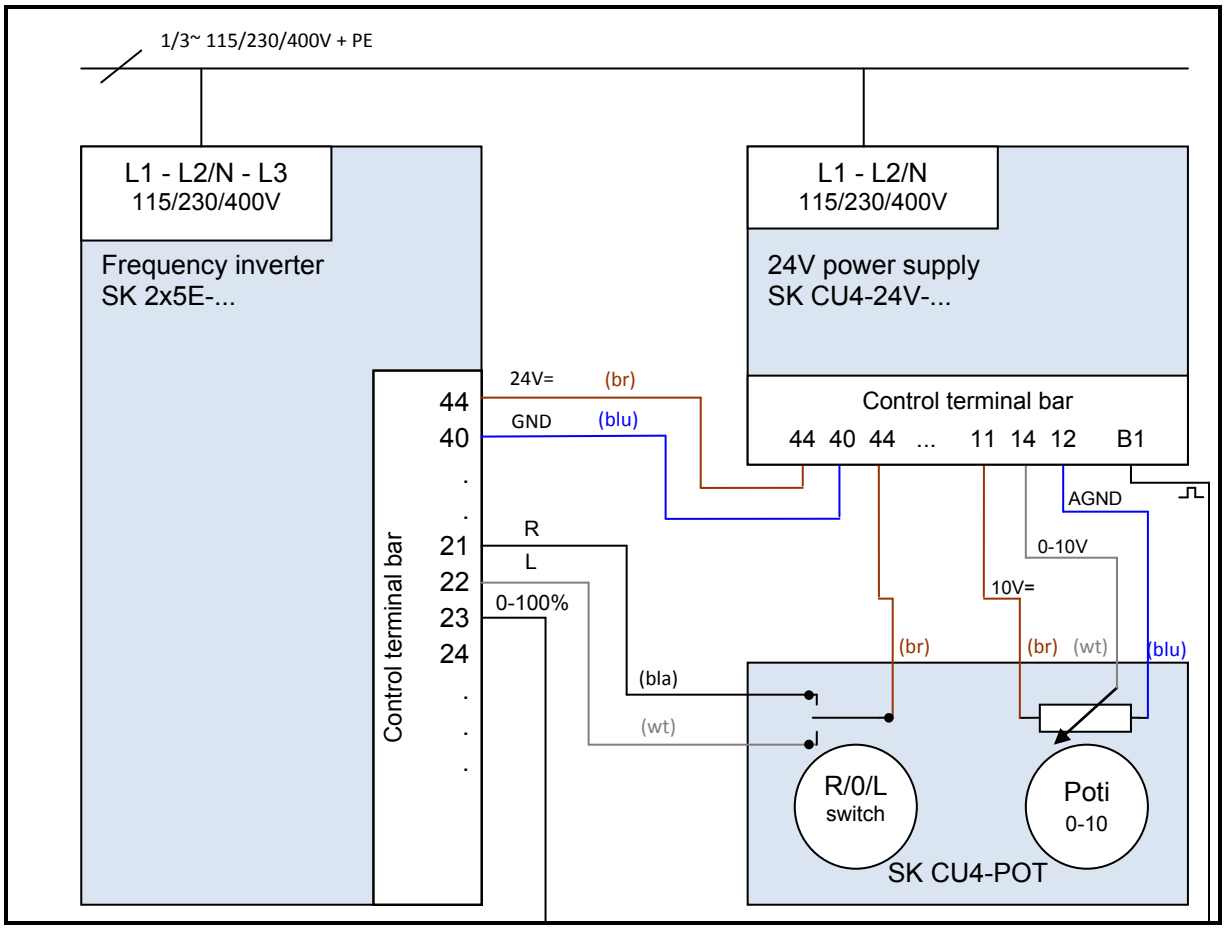



**Figure 26: Connection diagram and parametrisation of SK CU4-POT, example SK 2x5E**

| | | |
|---|---|---|
| DIP switch settings (S1:): | DIP3 = off, DIP4 = on, DIP5 = off (please see chapter 4.3.2.2 "DIP switches (S1)" on page 106) | |
| ***or*** | | |
| recommended parameter setting, S1: DIP1-8 = off | P400 [07] = 1 | P420 [02] = 2 |
| | P420 [01] = 1 | P420 [03]= 26 |

# 4 Commissioning

**WARNING** **Unexpected movement**

Connection of the supply voltage may directly or indirectly set the drive unit into motion. This may cause an unexpected movement of the drive unit and the machine which is connected to it. This unexpected movement may cause severe or fatal injuries and/or material damage.

Unexpected movements may be due to several causes, e.g.

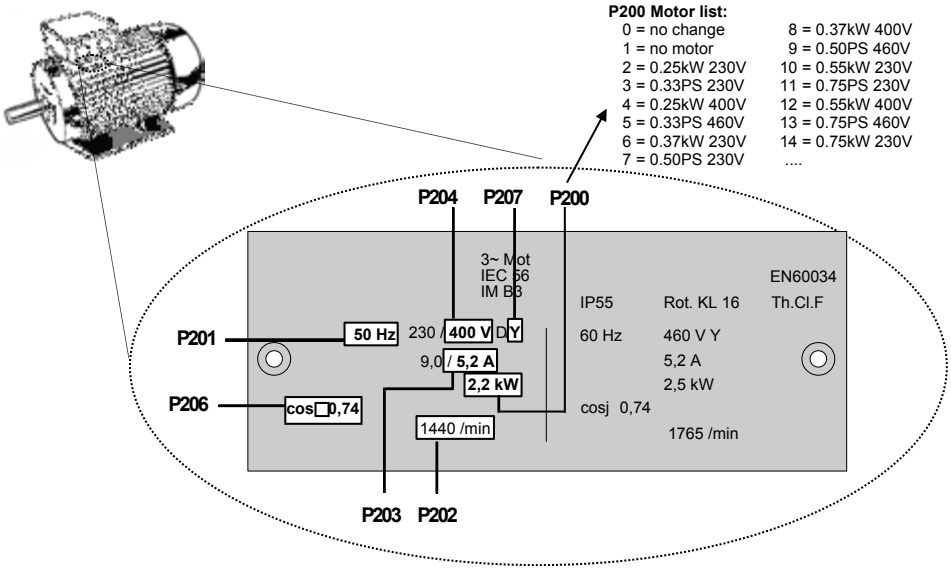
- Parameterisation of an "automatic start",
- Incorrect parameterisation,
- Control of the device with an enabling signal from a higher level control unit (via IO or bus signals),
- Incorrect motor data,
- Incorrect encoder connection,
- Release of a mechanical holding brake,
- External influences such as gravity or other kinetic energy which acts on the drive unit,
- In IT networks: Earth fault (short circuit to earth)

To avoid any resulting hazard the drive or drive chain must be secured against unexpected movements (mechanical blocking and/or decoupling, provision of protection against falling, etc.) In addition, it must be ensured that there are no persons within the area of action and the danger area of the system.

## 4.1 Factory settings

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

All motor data (IE1, IE4) 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.




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.

Motor data for IE2 and IE3 motors are provided via the **NORD CON** software. With the aid of the "Import motor parameter" function (also refer to the manual for the **NORD CON** software BU 0000), the required data record can be selected and imported into the frequency inverter.

**Information** — **DIN 2 and DIN 3 double allocation**

The digital inputs DIN2 and DIN3 are used for 2 different functions:

1. For digital functions which can be parameterised (e.g. “enable left”),
2. For evaluation of an incremental encoder.

Both functions are coupled by an "OR" link.

Evaluation of an incremental encoder is always activated. This means that if an incremental encoder is connected, it must be ensured that the digital functions are disabled (Parameter (P420 [-02] and [-03]) or via DIP switch (please see chapter 4.3.2.2 "DIP switches (S1)" on page 106)).

**Information** — **DIP switch priority**

It must be noted that DIP switch settings at the frequency inverter (**S1**) have priority over the parameter settings.

The settings of the integrated potentiometers **P1** and **P2** must also be taken into consideration.

## 4.2 Selecting the operating mode for motor control

The frequency inverter is able to control motors with all efficiency classes (IE1 to IE4). Motors which we manufacture are produced as asynchronous motors in efficiency classes IE1 to IE3, whereas IE4 motors are produced as synchronous motors.

Operation of IE4 motors has many special features with regard to the control technology. In order to enable the optimum results, the frequency inverter was specially designed for the control of NORD IE4 motors, whose construction corresponds to an IPMSM type (Interior Permanent Magnet Synchronous Motor). In these motors, the permanent magnets are embedded in the rotor. The operation of other brands must be checked by NORD as necessary. Also refer to the technical information TI 80-0010 "Planning and commissioning guidelines for NORD IE4 motors with NORD frequency inverters“.

### 4.2.1 Explanation of the operating modes (P300)

The frequency inverter provides different operating modes for the control of a motor. All operating modes can be used with either an ASM (asynchronous motor) or a PMSM (Permanent Magnet Synchronous Motor), however various constraints must be complied with. In principle, all these methods are "flux oriented control methods.

1. VFC open-loop mode (P300, setting "0")

   This operating mode is based on a voltage-governed flux oriented control method (Voltage Flux Control Mode (*VFC*)). This is used for both ASMs as well as PMSMs. In association with the operation of asynchronous motors this is often referred to as "ISD control".
   Control is carried out without the use of encoders and exclusively on the basis of fixed parameters and the measurement results of actual electrical values. No specific control parameter settings are necessary for the use of this mode. However, parameterisation of the precise motor data is an essential prerequisite for efficient operation.
   As a special feature for the operation of an ASM there is also the possibility of control according to a simple V/f characteristic curve. This mode of operation is important if several motors which are not mechanically coupled are to be operated with a single frequency inverter, or if it is only possible to determine the motor data in a comparatively imprecise manner.
   Operation according to a V/f characteristic curve is only suitable for drive applications with relatively low demands on the quality of speed control and dynamics (ramp times ≥ 1 s). For machines which tend to have relatively large mechanical vibrations due to their construction, control according to a V/f characteristic curve can also be advisable. Typically, V/f characteristic curves are used to

control fans, certain types of pump drives or agitators. Operation according to a V/f characteristic curve is activated via parameters (P211) and (P212) (each set to "0").

2. CFC closed-loop mode (P300, setting "1")

   In contrast to the "0" setting "VFC open-loop mode" this is a form of control with current controlled flux orientation (Current Flux Control). For this operating mode, which for ASMs is functionally identical to the previously used designation "servo control", use of an encoder is essential. The precise speed behaviour of the motor is detected and included in the calculation for control of the motor. Determination of the position of the rotor is also possible through the use of the encoder, whereby the initial value of the rotor position must also be determined for the operation of a PMSM. This enables even more precise and rapid control of the drive unit.
   This operating mode provides the best possible results for the control behaviour of both ASMs and PMSMs and is especially suitable for lifting equipment applications or applications with requirements for the highest possible dynamic behaviour (ramp times ≥ 0,05 sec). The greatest advantage of this operating mode is gained in combination with an IE4 motor (energy efficiency, dynamics, precision).

3. CFC open-loop –mode (P300, setting "2")

   CFC mode is also possible with the open-loop method, i.e. in operation without an encoder. Here, the speed and position detection are determined by "observation" of measurements and setting values. Precise setting of the current and speed controller is also essential for this operating mode. This mode is especially suitable for applications with higher demands for dynamics in comparison with VFC control (ramp times ≥ 0.25 s) and e.g. also for pump applications with high starting torques).

### 4.2.2 Overview of control parameter settings

The following provides an overview of all parameters which are of importance, depending on the selected operating mode. Among other things, a distinction is made between "relevant" and "important", which provides an indication of the required precision of the particular parameter setting. However, in principle, the more precisely the setting is made, the more exact the control, so that higher values for dynamics and precision are possible for the operation of the drive unit. A detailed description of these parameters can be found in Section 5 "Parameter".

| | | | |
|---|---|---|---|
| "Ø" = | Parameter has no significance | "-" = | Leave the parameter in the factory setting |
| "√" = | Setting of the parameter is relevant | "!" = | Setting of the parameter is important |

| Group | Parameter | Operating mode | | | | | |
|---|---|---|---|---|---|---|---|
| | | VFC open-loop | | CFC open-loop | | CFC closed-loop | |
| | | ASMs | PMSMs | ASMs | PMSMs | ASMs | PMSMs |
| Motor data | P201 … P209 | √ | √ | √ | √ | √ | √ |
| | P208 | ! | ! | ! | ! | ! | ! |
| | P210 | √ [1)] | √ | √ | √ | Ø | Ø |
| | P211, P212 | - [2)] | - | - | - | - | - |
| | P215, P216 | - [1)] | - | - | - | - | - |
| | P217 | √ | √ | √ | √ | Ø | Ø |
| | P220 | √ | √ | √ | √ | √ | √ |
| | P240 | - | √ | - | √ | - | √ |
| | P241 | - | √ | - | √ | - | √ |
| | P243 | - | √ | - | √ | - | √ |
| | P244 | - | √ | - | √ | - | √ |
| | P246 | - | √ | - | √ | - | √ |
| | P245, 247 | - | √ | Ø | Ø | Ø | Ø |
| Controller data | P300 | √ | √ | √ | √ | √ | √ |
| | P301 | Ø | Ø | Ø | Ø | ! | ! |
| | P310 … P320 | Ø | Ø | √ | √ | √ | √ |
| | P312, P313, P315, P316 | Ø | Ø | - | √ | - | √ |
| | P330 … P333 | - | √ | - | √ | - | √ |
| | P334 | Ø | Ø | Ø | Ø | - | √ |

[1)] = For V/f characteristic curve: precise matching of the parameter is important.

[2)] = For V/f characteristic curves: typical setting "0"

### 4.2.3 Motor control commissioning steps

The most important commissioning steps are mentioned below in their ideal order. Correct assignment of the inverter / motor and the mains voltage is assumed. Detailed information, especially for optimisation of the current, speed and position control of asynchronous motors is described in the guide "Control optimisation" (AG 0100). Detailed commissioning and optimisation information for PMSM in CFC closed loop operation can be found in the "Drive optimisation" guideline (AG 0101). Please contact our Technical Support.

1. Carry out the motor connection as usual (note Δ / Y!). Connect the encoder, if present
2. Connect the mains supply.
3. Carry out the factory setting (P523)
4. Select the basic motor from the motor list (P200) (ASM types are at the beginning of the list, PMSM types are at the end, designated by their type (e.g. **…80T…**))
5. Check the motor data (P201 … P209) and compare with the type plate / motor data sheet
6. Measure the stator resistance (P220) → P208, P241[-01] are measured, P241[-02] is calculated. (Note: is an SPMSM is used, P241[-02] must be overwritten with the value from P241[-01])
7. Rotary encoder: Check the settings (P301, P735)
8. with PMSM only:
   a. EMF voltage (P240) → motor type plate / motor data sheet
   b. Determine / set reluctance angle (P243) (not required with NORD motors)
   c. Peak current (P244) → motor data sheet
   d. Only for PMSMs in VFC mode:
      determine (P245), (P247)
   e. Determine (P246)
9. Select the operating mode (P300)
10. Determine / adjust the current control (P312 – P316)
11. Determine / adjust the speed control P310, P311)
12. PMSM only:
    a. Select the control method (P330)
    b. Make the settings for the starting behaviour (P331 … P333)
    c. Make the settings for the 0 pulse of the encoder P334 … P335)
    d. Activation of slip error monitoring (P327 ≠ 0)

**Information** **NORD IE4 Motors**

Further information for commissioning NORD IE4 motors with NORD frequency inverters can be found in the technical information TI80_0010.

## 4.3 Starting up the device

The frequency inverter can be commissioned in various ways:

a) For simple applications (e.g conveyor applications) by means of the DIP switches (S1) integrated in the frequency inverter (internal) and the externally accessible potentiometers (SK 2x5E only).

   In this configuration the plug-in EEPROM is not required.

b) By means of parameter adaptations using the control and parametrisation box (SK CSX-3H or SK PAR-3H) or the NORD CON PC - supported software.

   The changes to the parameters in the plug-in EEPROM ("memory module") are stored when doing this. As of firmware **V1.3**, the data is automatically saved in the internal EEPROM if no EEPROM is plugged in.

   As of firmware **V1.4 R2**, the data will generally be stored in the internal EEPROM. The data is stored in parallel on the external EEPROM.

   For older firmware versions an external EEPROM must always be plugged in during operation in order to permanently save changed parameter values.

**Information** — **Presetting of physical I/O and I/O bits**

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)).

### 4.3.1 Connection

In order to provide basic operational capability, after the device has been attached to the motor or the wall mounting kit, the power and motor lines must be connected to the relevant terminals (📖 Section 2.4.2 "Electrical connection of power unit").

**SK 2x5E:** It is also essential for the device to be provided with a 24 V DC control voltage.

**Information** — **Control voltage SK 2x5E:**

The 24 V control voltage that is required can be implemented by means of an integrated (SK CU4-24V-…) or external (SK TU4-24V-…) optional mains module or a comparable 24 V DC power source (📖 Section 2.4.3 "Electrical connection of the control unit").

### 4.3.2 Configuration

Changes to individual parameters are usually necessary for operation.

However, configuration can be carried out to a limited extent with the by means of the integrated 8-pole DIP switch (S1).

**Information** — **Configuration via DIP switch**

Mixing of DIP switch configuration and (software) parameterisation should be avoided.

#### 4.3.2.1 Parameterisation

The use of a ParameterBox (SK CSX-3H / SK PAR) or the NORD CON software is required in order to adapt the parameters.

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

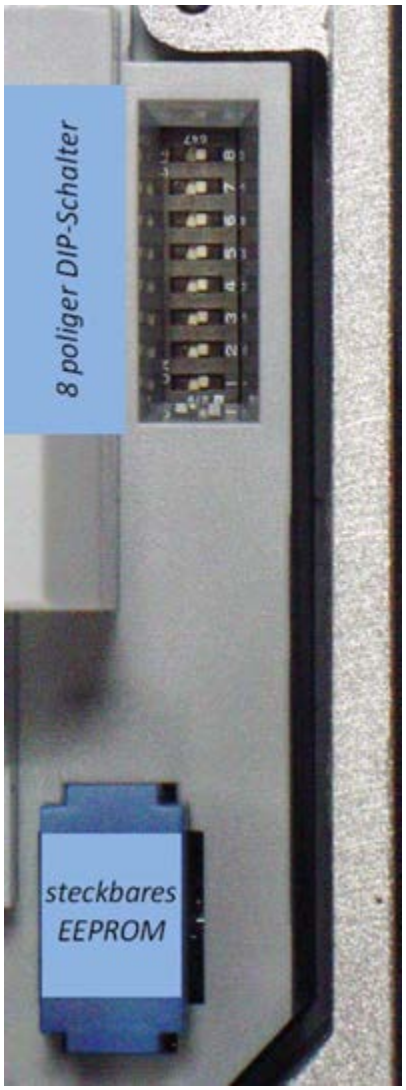
**Information** — **Factory settings**

Prior to commissioning, it should be ensured that the frequency inverter is in its factory settings (P523).

If configuration is carried out at parameter level, the DIP switches (S1) must also be set to the "0" ("OFF") position.

#### 4.3.2.2 DIP switches (S1)

The DIP switches make it possible to carrying out commissioning without additional control units. Further settings are made using the potentiometer on the top of the frequency inverter (P1 / P2, SK 2x5E only).




| No. Bit | DIP switch (S1) | | |
|---|---|---|---|
| 8<br>$2^7$ | **Int $R_{Brake}$**<br>Internal brake resistor | 0 | Internal brake resistor not existing |
| | | I | Internal brake resistor existing<br>(📖 Section2.3.1) |
| 7<br>$2^6$ | **60Hz** [1]<br>50/60Hz operation | 0 | Motor data corresponding to the rated power of the<br>FI in kW relative to 50 Hz, fmax = 50 Hz |
| | | I | Motor data corresponding to the rated power of the<br>FI in hp relative to 60 Hz, fmax = 60 Hz |
| 6<br>$2^5$ | **COPY** [2]<br>EEPROM copy function | 0 | No function |
| | | I | EEPROM copy function active, once |
| 5/4<br>$2^{4/3}$ | **I/O**<br>Potentiometer function, digital inputs and AS interface | *DIP-No 5* | *DIP-No 4* |
| | | 0 | 0 | Corresponding to P420 [1-4] and P400 [1-2]<br>or P480 [1-4] and P481 [1-4] |
| | | 0 | I | Further details in the next table. (depends on the DIP3 "BUS") |
| | | I | 0 | |
| | | I | I | |
| 3<br>$2^2$ | **BUS**<br>Source control word and setpoint value | 0 | Corresponding to P509 and P510 [1] [2] |
| | | I | System bus (⇒ P509=3 and P510=3) |
| 2/1<br>$2^{1/0}$ | **ADR**<br>System bus address/ baud rate | *DIP-No 2* | *DIP-No 1* |
| | | 0 | 0 | Corresponding to P515 and P514 [32, 250kBaud] |
| | | 0 | I | Address 34, 250 kBaud |
| | | I | 0 | Address 36, 250 kBaud |
| | | I | I | Address 38, 250 kBaud |

1) A changed setting is applied the next time the mains is switched on. Existing settings in parameters P201-P209 and P105 are overwritten!

2) up to firmware version 1.4 R1 the DIP switch designation was **U/F**. A changeover between the control procedures (U/F / ISD control) has been made possible via the DIP switch.

**Information** — **Factory setting, as delivered!**

As delivered, all DIP switches are in the "0" ("off") position. Actuation takes place using the digital control signals (P420 [01]-[04]) and the potentiometers P1 and P2 integrated in the FI (P400 [01]-[02]) (P1 / P2 with SK 2x5E only).

**Information** — **IO bit factory settings:**

For controlling the frequency inverter via In/Out bits (e.g.: AS-i, DIG In 1 - 4) typical values are pre-set in the relevant parameters (P480) and (P481) (Details: 📖 Section 5 "Parameter").

**These settings apply to both control via AS-i bits and BUS I/O bits.**

### Details of DIP switch S1: 5/4 and 3

## Applies to devices SK 20xE, SK 21xE (without on board AS interface)

| DIP | | | Functions as per the list of digital functions (P420) | | | | Functions as per the list of analogue functions (P400) | |
|---|---|---|---|---|---|---|---|---|
| 5 | 4 | 3 | Dig 1 | Dig 2 | Dig 3 | Dig 4** | Poti 1*** | Poti 2*** |
| off | off | off | P420 [01]* {01} "enable R" | P420 [02]* {02} "enable L" | P420 [03]* {04} "Fixed freq1" =5Hz (P465[01]) | P420 [04]* {05} "Fixed freq2" =10Hz (P465[02]) | P400 [01]* {01} "F setpoint" | P400 [02]* {15} "Ramp" |
| off | on | off | {01} "Enable R" | {02} "Enable L" | {26} "F setpoint"*** | {12} "Quit" | {05} "F max" | {04} "F min" |
| on | off | off | {45} "3-on" | {49} "3-off" | {47} "Freq. +" | {48} "Freq. -" | {05} "F max" | {15} "Ramp" |
| on | on | off | {50} "F Arr Bit0 =5Hz (P465[01]) | {51} "F Arr Bit1" =10Hz (P465[02]) | {52} "F Arr Bit2" =20Hz (P465[03]) | {53} "F Arr Bit3" =35Hz (P465[04]) | {05} "F max" | {15} "Ramp" |
| off | off | on | The functions of the digital inputs are inactive (control via system bus), however, the settings made in parameters (P420 [01 … 04]) result in the activation of the correspondingly parametrised input, for the functions designated with ..² in the function list (e.g.: {11}²= "Quick stop). | | | | P400 [01] {01} "F setpoint" | P400 [02] {15} "Ramp" |
| | | | P420 [01] no function | P420 [02] no function | P420 [03] {04} "Fixed freq1" =5Hz (P465[01]) | P420 [04] {05} "Fixed freq2" =10Hz (P465[02]) | | |
| off | on | on | {14} "Remote control" | "Encoder track A" | "Encoder track B" | {01} "Enable R" | {01} "F setpoint" | {05} "F max" |
| on | off | on | {14} "Remote control" | {01} "Enable R" | {10} "Block" | {66} "Release brake" | {01} "F setpoint" | {05} "F max" |
| on | on | on | {14} "Remote control" | {51} "F Arr Bit1" =10Hz (P465[02]) | {52} "F Arr Bit2" =20Hz (P465[03]) | {53} "F Arr Bit3" =35Hz (P465[04]) | {05} "F max" | {15} "Ramp" |

Explanation: (values underlined in brackets) = (relevant parameter / source of function), **e.g.: Parameter (P420[01])**
{curly brackets} = {Function} **e.g..: {01} "Enable right"**
* Default setting | ** only if present (devices without "Safe stop" function) | *** only with SK 2x5E

## Applies to devices SK 22xE, SK 23xE (without AS interface on board)

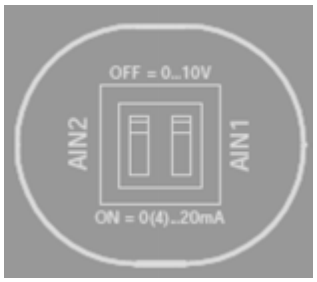
| DIP | | | Functions as per the list of digital functions (P420) | | | | Functions as per the list of digital outputs (P434) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 4 | 3 | ASi In1 | ASi In2 | ASi In3 | ASi In4 | ASi Out1 | ASi Out2 | ASi Out3 | ASi Out4 |
| off | off | off | P480 [01]* {01} "Enable R“ | P480 [02]* {02} "Enable L“ | P480 [03]* {04} "Fixed freq. 1" =5Hz (P465[01]) | P480 [04]* {12} "Quit" | P481 [01]* {07} "Error" | P481 [02]* {18} "Standby" | "DigIn1" | "DigIn2" |
| off | on | off | {04} "Fixed freq. 1" =5Hz (P465[01]) | {05} "Fixed freq. 2" =10Hz (P465[02]) | {06} "Fixed freq. 3" =20Hz (P465[03]) | {07} "Fixed freq. 4" =35Hz (P465[04]) | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |
| on | off | off | {01} "Enable R" | {02} "Enable L" | {47} "Freq. +" | {48} "Freq. -" | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |
| on | on | off | {51} "F Arr B1" =10Hz (P465[02]) | {52} "F Arr B2" =20Hz (P465[03]) | {53} "F Arr B3" =35Hz (P465[04]) | {14} "Remote control" | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |
| off | off | on | The functions of the digital inputs are inactive (control via system bus), however, the settings made in parameters (P480 [01 … 04]) result in the activation of the correspondingly parametrised bits, for the functions designated with ..² in the function list (e.g.: {11}²= "Quick stop). | | | | P481 [01] {07} "Error" | P481 [02] {18} "Standby" | "DigIn1" | "DigIn2" |
| | | | P480 [01] no function | P480 [02] no function | P480 [03] {04} "Fixed freq. 1" =5Hz (P465[01]) | P480 [04] {12} "Quit" | | | | |
| off | on | on | {14} "Remote control" | {04} "Fixed freq. 1" =5Hz (P465[01]) | {05} "Fixed freq. 2" =10Hz (P465[02]) | {06} "Fixed freq. 3" =20Hz (P465[03]) | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |
| on | off | on | {14} "Remote control" | {01} "Enable R" | {47} "Freq. +" | {48} "Freq. -" | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |
| on | on | on | {14} "Remote control" | {50} "F Arr B0" =5Hz (P465[01]) | {51} "F Arr B1" =10Hz (P465[02]) | {52} "F Arr B2" =20Hz (P465[03]) | {07} "Error" | {18} "Standby" | "DigIn1" | "DigIn2" |

Explanation: See table above
Note: The functions of potentiometers*** P1 and P2 correspond to those of devices without an AS interface (see table above).
With DIP switches 5 and 4 in the OFF position (default setting), the digital inputs are also active. The functions then correspond to those of devices without an AS interface (table above). In all other DIP switch combinations the functions of the digital inputs are deactivated.
ASi OUT1 and ASi OUT2 loop the signal level (High / Low) of digital inputs 1 and 2.

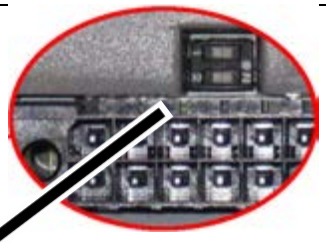
#### 4.3.2.3 DIP switches, analogue input (only SK 2x0E)

The analogue inputs in the SK 2x0E are suitable for current and voltage setpoints. For correct processing of current setpoints (0-20 mA / 4-20 mA) the relevant DIP switch must be set for current signals ("ON").

Adjustment (to fail-safe signals in case of cable breaks (2-10 V / 4-20 mA) is made via parameters (P402) and (P403).

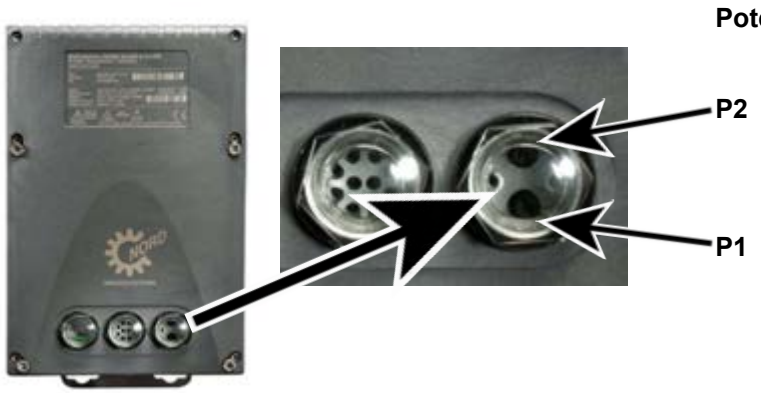



**Access to DIP switches**

| SK 2x0E | Access | Detail |
|---|---|---|
| Size 1 … 3 | … from outside, middle diagnostic opening |  |
| Size 4 | ... from inside |   |

#### 4.3.2.4 Potentiometers P1 and P2 (SK 2x0E size 4 and SK 2x5E)

The setpoint can be set to a fixed value with the integrated potentiometer P1. Adjustment of the start-up and braking ramps can be made via potentiometer P2.




**Potentiometers**

| **P1** (continuous) | | | **P2** (stepped) | | |
|---|---|---|---|---|---|
| 0 % | P102/103 | P105 | - | - | - |
| 10 % | 0.2 s | 10 Hz | 1 | P102/103 | P104 |
| 20 % | 0.3 s | 20 Hz | 2 | 0.2 s | 2 Hz |
| 30 % | 0.5 s | 30 Hz | 3 | 0.3 s | 5 Hz |
| 40 % | 0.7 s | 40 Hz | 4 | 0.5 s | 10 Hz |
| 50 % | 1.0 s | 50 Hz | 5 | 0.7 s | 15 Hz |
| 60 % | 2.0 s | 60 Hz | 6 | 1.0 s | 20 Hz |
| 70 % | 3.0 s | 70 Hz | 7 | 2.0 s | 25 Hz |
| 80 % | 5.0 s | 80 Hz | 8 | 3.0 s | 30 Hz |
| 90 % | 7.0 s | 90 Hz | 9 | 5.0 s | 35 Hz |
| 100 % | 10.0 s | 100 Hz | 10 | 7.0 s | 40 Hz |

The function of P1 and P2 depends on DIP 4/5. The meaning changes according to the setting.
As standard, P1 sets the setpoint value of 0-100 % and P2 sets the ramp from 0.2-7 sec.

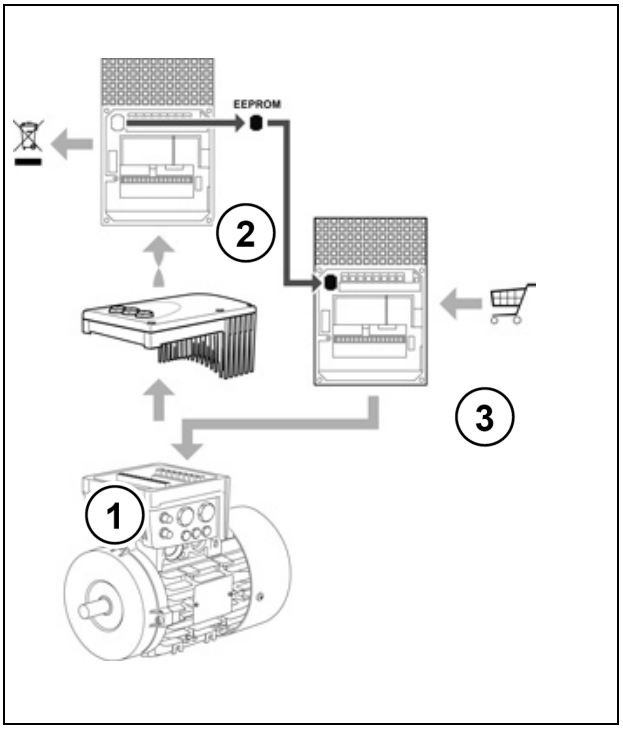
### 4.3.3 Plug-in EEPROM ("Memory Module")

The frequency inverter is equipped with an internal EEPROM and a plug-in EEPROM ("Memory Module") which operates in parallel to this for the storage and management of parameter data. The data from the device are managed in parallel on both devices, so that a safe and rapid exchange of parameter settings in the device is possible for commissioning or in case of service.

#### 4.3.3.1 Replacing the plug-in EEPROM ("Memory Module")

A decisive advantage in case if servicing of the SK 2xxE is necessary is the simple transfer of data from the failed frequency inverter to the replacement device. However, the following must be noted for the exchange of data via the plug-in EEPROM:

- The data transfer must be deliberately activated (📖 section 4.3.3.2 "Copy function").
- Any restrictions which exist due to the change between devices from different generations must be noted.




The plug-in EEPROM is located on the underside of the device.

Access to the EEPROM is enabled by removing the defective frequency inverter (2) from the connection unit (1). The EEPROM is unlocked by lightly pressing the short sides together and then pulling it out.

The EEPROM must be inserted into the new device. The EEPROM is correctly seated when the lock audibly engages. It is not possible to insert the EEPROM so that it is laterally reversed.

| | |
|---|---|
| (1) | Connection unit |
| (2) | Frequency inverter defective |
| (3) | Frequency inverter, replacement device |

**Figure 27: Replacing the plug-in EEPROM**

Devices with hardware version "**EAA**" and above have a more powerful processor than devices from the 1st. Generation (hardware version "AAA"). This includes a larger range of functions, e.g. integrated PLC functionality (SPS function) and operation of PMSMs.

In order to manage the larger amount of data, the capacity of the plug-in EEPROM ("Memory Module") has been extended. EEPROMs with the larger memory capacity can be identified from an additional raised marking ("**II**") on the housing. Alternatively, an adhesive label with "**V2**" may be applied.

**Downward compatibility:**

In principle it is permissible to operate older generation frequency inverters with an EEPROM from a newer generation and vice versa.

**NB:**

Before the exchange of data, in addition to the firmware status (software versions) of the two frequency inverters it is also necessary to compare the hardware versions of the frequency inverters and the EEPROMS, because:

- Frequency inverters with the hardware status "EAA" can **only read** the data from a first generation EEPROM (EEPROM without label). The EEPROM cannot be written by the frequency inverter, so that parameter changes are only saved in the device itself and are no longer saved in the EEPROM
- Frequency inverters with the hardware status "AAA" can read and write the data from a second generation EEPROM (EEPROM with label). However, only the data which is saved on the EEPROM which can be processed by the frequency inverter due to its older construction status are used (incompatibility).

**Information** **Incompatibility**

During the transfer of data records between devices with different firmware statuses (software versions) in which the replacement device has an older status than the defective device, incompatibilities between individual functions may occur. Because of this, we recommend an update of the firmware to the currently available software status for the generation of the device.

After the data transfer we recommend that the EEPROM which is included in the scope of delivery of the device is re-inserted in the replacement device and the data from the device are copied into the EEPROM

#### 4.3.3.2 Copy function

The copy function is located in Parameter P550 and is described in detail in the manual. In addition, a copy function is available, which is triggered independently from Parameter P550, simply by setting a DIP switch.

#### 4.3.3.3 Copy function DIP switches S1 – 6 "COPY"

Through the new function of the DIP switch element S1-6 ("COPY") transfer of data from the external to the internal EEPROM has been made even simpler.

If a 0 → 1 flank is detected on the DIP switch element S1-6 when the frequency inverter is restarted, copying of data from the plug-in EEPROM to the internal EEPROM is triggered.

The copying process takes several seconds. During the copying process, the status LED rapidly flashes red-green alternately.

- If an error is detected during copying of the data, the process is interrupted and an error message (E008.2 "External copying error") is generated.
- If no plug-in EEPROM is detected (not available or defective), the process is interrupted and an error message (E008.2 "External copying error") is generated.
- Interruption of the data transfer, e.g. due to premature switch-off of the mains voltage or the control voltage of the inverter, interrupts the copying process. ***No error message is generated***! The interruption can only be identified by checking the parameter settings of the frequency inverter.

If necessary, the copying process must be repeated.

**Starting the copy function**

To start the copy function, the DIP – switch S1-6 "COPY" must be set from position { 0 } (factory setting) to position { 1 }. On the next start of the frequency inverter („POWER ON“ (24 V)) a 0 → 1 flank is detected here and the copying process is started.

1. Set DIP switch S1-6 "COPY" to { 1 },
2. Switch on the frequency inverter ("POWER ON" (24 V)).
3. → The copying process starts.

*A renewed start of the copying process is not performed without a previous change to the DIP switch.*

Carry out the following steps to trigger the process again:

1. Set DIP switch S1-6 "COPY" to { 0 },
2. Switch on the frequency inverter ("POWER ON" (24 V)),
3. Switch off the frequency inverter ("POWER OFF" (24 V)),
4. Set DIP switch S1-6 "COPY" to { 1 },
5. Switch on the frequency inverter ("POWER ON" (24 V)).
6. → The copying process starts.

**Information** **Parameter P550**

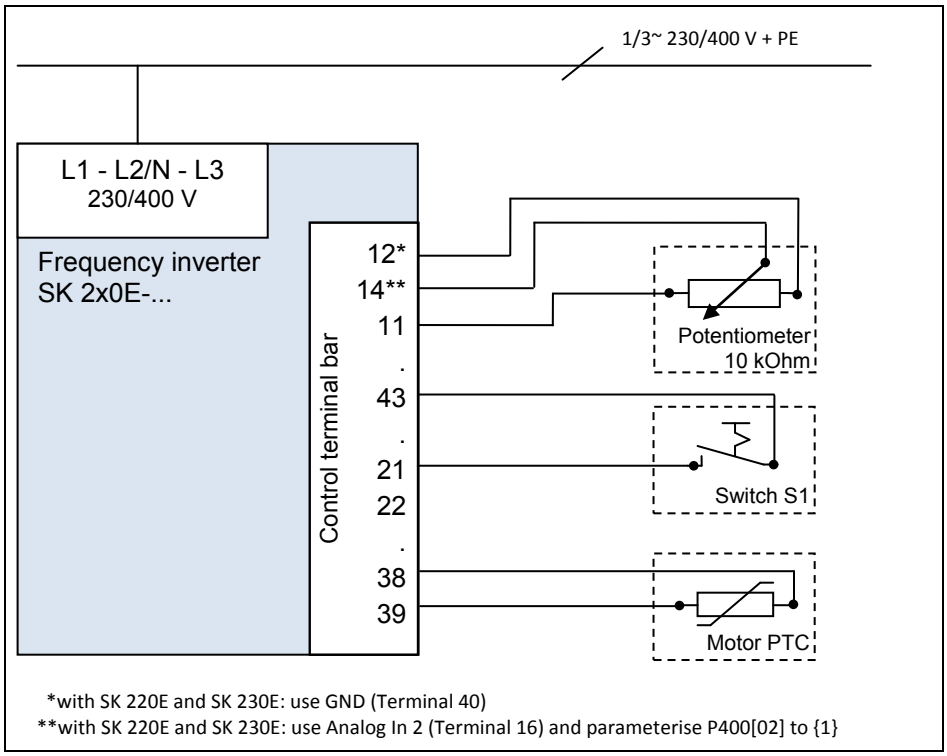
The COPY function of the DIP switch S1-6 is comparable with the parameter function P550 ("EEPROM copy order" setting { 1 } "Ext. → Int. EEPROM“). This function is still available.

### 4.3.4 Commissioning examples

All SK 2xxE models can be operated as delivered. Standard motor data for a 4-pole standard asynchronous motor of the same power is parameterised. The PTC input must be bypassed, if a motor with PTC is not available. Parameter (P428) must be changed if an automatic startup with "Mains On" is required.

#### 4.3.4.1 SK 2x0E - Minimal Configuration

The frequency inverter provides all the necessary low voltages (24 $V_{DC}$ / 10 $V_{DC}$).

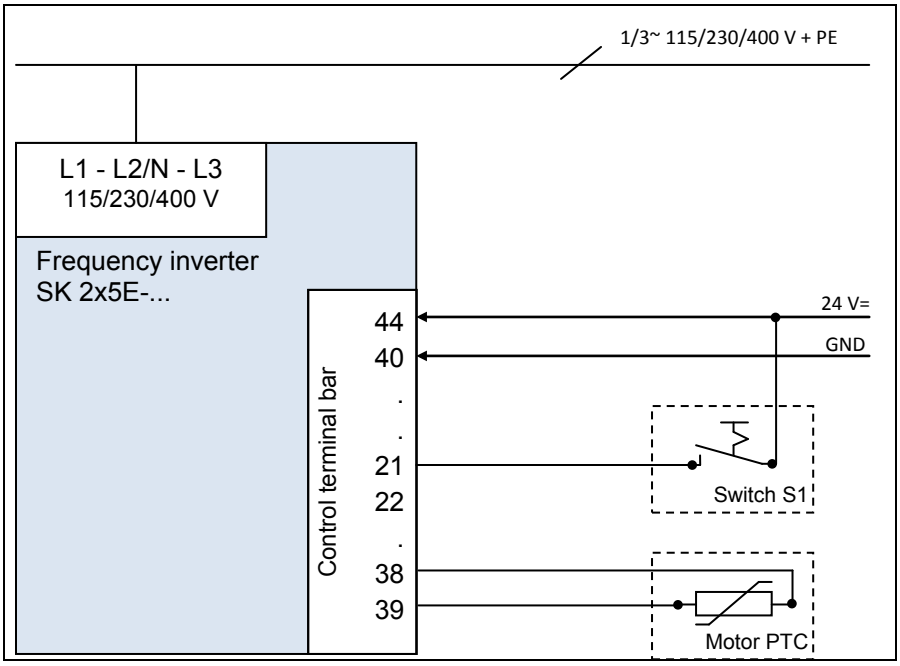



| Function | Setting |
|---|---|
| Setpoint | External 10 kΩ potentiometer |
| Controller enable | External switch S1 |

#### 4.3.4.2 SK 2x5E - Minimal Configuration

**Minimal configuration without options**

The frequency inverter must be provided with a 24V control voltage.




| Function | Setting |
|---|---|
| Setpoint | Integrated potentiometer P1 |
| Frequency ramp | Integrated potentiometer P2 |
| Controller enable | External switch S1 |

**Minimal configuration with options**

In order to implement completely autonomous operation (independent of control lines etc.) a switch and a potentiometer such as potentiometer adapter SK CU4-POT are required. In combination with an integrated power supply (SK CU4-…-24V), a solution that only has the power supply line can be set up with an SK 2x5E in this way, and requirement-oriented speed and rotation direction of rotation control provided (📖 Section 3.2.4 "Potentiometer adapter, SK CU4-POT").

**Information** — **Convert analogue signal**

An 8-bit A/D converter is integrated in the SK TU4-…-24V and SK CU4-…-24V power supplies. This makes it possible to connect a potentiometer or another analogue setpoint source to the power supply. The power supply can convert the analogue setpoint into an appropriate pulse signal. This signal can be connected to a digital input of the frequency converter and processed by it as a setpoint.

**Test operation**

The frequency inverter versions SK 2x0E in size 4 and SK 2x5E may be commissioned without any auxiliary equipment for testing purposes.

In order to do this, after making the electrical connection (please see chapter 2.4 "Electrical Connection"), set DIP switches S1: 1 to 5 of the frequency inverter to position "0" ("OFF") (please see chapter 4.3.2.2 "DIP switches (S1)")and hard-wire digital input DIN1 (terminal 21) to a 24 V control voltage.

Enabling is carried out as soon as the inverters own setpoint potentiometer (Potentiometer P1, Section) is moved from the 0 % position.

The setpoint can be adjusted to the requirements by further continuous adjustment of the potentiometer.

Resetting the setpoint to 0 % sets the frequency inverter into "Standby" status.

Stepwise adjustment of the ramp times within defined limits is also possible with the aid of potentiometer P2.

**Information** **Test operation**

This setting method is not suitable for the implementation of a so-called "automatic start with mains".

In order to use this function, it is essential that parameter (P428) "Automatic Start" is set to the function "ON". Adjustment of parameters is possible with the aid of a ParameterBox (SK xxx-3H) or with the NORD CON software (Windows PC and adapter cable required).

## 4.4 KTY84-130 connection

The current vector control of the frequency inverter can be further optimised by the use of a *KTY84-130 temperature sensor* ($R_{th(0°C)}$=500Ω, $R_{th(100°C)}$=1000Ω). 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.

**Information**

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.

**Information** **Pay attention to polarity**

KTY sensors are wired semiconductors that must be operated in the conducting direction. In order to do this, the anode must be connected to the "+" contact of the analogue input. The cathode must be connected to the "-" ground or ground contact of the analogue input.

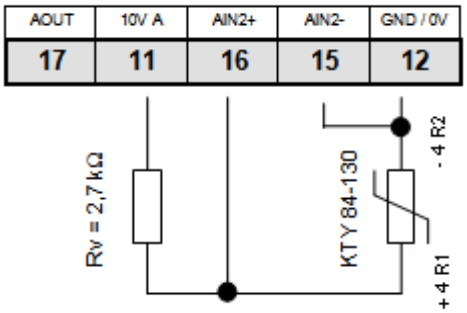
Failure to observe this can lead to erroneous measurements. Motor winding protection will no longer be guaranteed.

### Connection examples

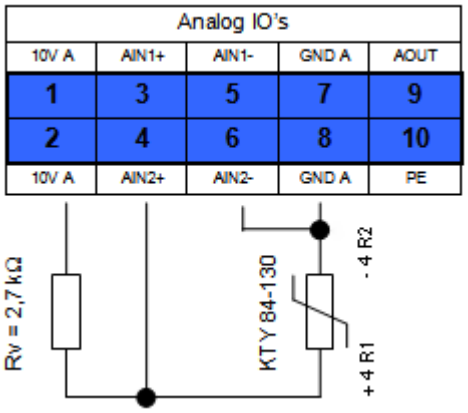
#### *SK CU4-IOE / SK TU4-IOE-…*

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

**SK CU4-IOE**




**SK TU4-IOE**




(Illustration shows a section of the terminal strips)

**Parameter settings** (Analogue input 2)

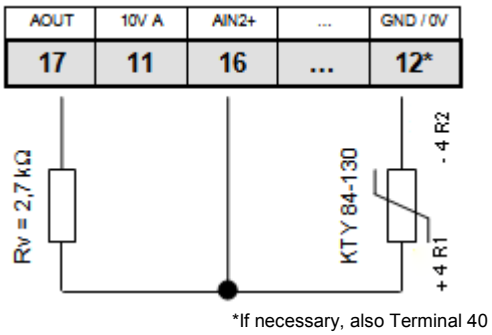
The following parameters must be set for the function of the KTY84-130.

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. Analogue input 2 function, **P400 [-04] = 30**
   (motor temperature)
4. The mode analogue input 2 **P401 [-02] = 1**
   (negative temperatures are also measured)
   (As of firmware version: V1.2)
5. Adjustment of analogue input 2: **P402 [-02]** = **1.54 V** and **P403 [-02] = 2.64 V**
   (with $R_V$= 2.7 kΩ)
6. Adjust time constants: **P161 [-02] = 400ms** (Filter time constant is at a maximum)
   Parameter (P161) is a module parameter. It cannot be set at the frequency inverter, but must be set directly at the I/O module. Communication takes place by directly connecting a ParameterBox to the RS232 interface of the module, for example, or by means of connecting to the frequency converter via the system bus. (Parameter (P1101) object selection → … )
7. Motor temperature control (display): **P739 [-03]**

### *SK 2x0E*

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

**SK 2x0E**




*If necessary, also Terminal 40

**Parameter settings** (Analogue 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 analogue input 2, **P400 [-02] = 30**
   (Motor temperature)
4. The mode analogue input 2 **P401 [-06] = 1**
   (negative temperatures are also measured)
5. Adjustment of analogue input 2: **P402 [-06] = 1.54 V** and **P403 [-06] = 2.64 V**
   (with RV= 2.7 kΩ)
6. Adjust time constants: **P404 [-02] = 400 ms** (Filter time constant is maximum)
7. Motor temperature control (display): **P739 [-03]**

### *SK 2x5E*

Direct connection of a KTY-84 to the **SK 2x5E** is not possible.

In order to use this function on the SK 2x5E the use of an I/O - extension module (**SK xU4-IOE**) is necessary.

## 4.5 AS Interface (AS-i)

This section is only relevant for device of type SK 22xE / SK 23xE.

### 4.5.1 The bus system

**General information**

The **A**ctuator-**S**ensor-**I**nterface (AS interface) is a bus system for the lower field bus level. It is fully defined in the AS interface *Complete Specification* and standardised as per EN 50295, IEC62026.

The transmission principle is a single master system with cyclical polling. Since *Complete Specification V2.1*, a maximum of **31 standard slaves** which use device profile **S-7.0.** or **62 A/B slaves** that use device profile **S-7.A.** can be operated on a non-shielded two-wire cable up to 100 m in length with any network structure.

The number of possible slave subscribers can be doubled by means of double assignment of addresses 1-31 and designation "A Slave" or "B Slave". A/B Slaves are designated by the ID code A, and therefore can be uniquely identified by the Master.

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

| **Permissible** |
|---|
| Standard slave 1 (Address 6) |
| ***A/B slave 1 (Address 7A)*** |
| ***A/B slave 2 (Address 7B)*** |
| Standard slave 2 (Address 8) |

| **Not permissible** |
|---|
| Standard slave 1 (Address 6) |
| ***Standard slave 2 (Address 7)*** |
| ***A/B slave 1 (Address 7B)*** |
| Standard slave 3 (Address 8) |

Addressing is implemented via the master, which can also provide other management functions, or via a separate addressing device.

**Device-specific information**

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 5 ms. Due to the correspondingly higher number of participants, for A/B slaves the cycle time (*max. 10 ms*) 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. 21 ms*.

The yellow AS interface cable supplies data and energy.

With special devices **SK 2x5E-…-AUX** and **…-AXB**, the connection of **another two-wire lead (black)** is required for connecting an auxiliary voltage (24 V DC). When doing this it is not strictly necessary to provide the supply via a protective extra-low voltage (**PELV** - **P**rotective **E**xtra **L**ow **V**oltage), but this is recommended.

### 4.5.2 Features and technical data

The device can be directly integrated in an AS interface network is parametrised in its factory settings so that the most frequently used AS-i functionality is available immediately. Only adaptations for application-specific functions of the device or the bus system, the addressing and proper connection of the supply, BUS, sensor and actuator cables need to be carried out.

**Features**

- Electrically isolated bus interface
- Status display (1 LED) (SK 225E and SK 235E only)
- Configuration optionally via
  - Integrated potentiometer and DIP switch
  - Or by means of parametrisation
- 24 V DC supply of integrated AS-i module or AS-i line
- 24 V DC supply of frequency inverter
  - Via yellow AS-i line (SK 225E and SK 235E only, but not special versions SK 2x5E-…-AUX and -AXB)
  - Via black line or another 24 V DC source – e.g. SK xU4-24V-… power supply (special versions SK 2x5E-…-AUX and -AXB only)
- Connection to device
  - Via terminal block
  - Or via M12 flanged connector

**Technical data for AS interface**

| Designation | Value | | |
|---|---|---|---|
| | **SK 220E / SK 230E<br>SK 225E-…-AXB<br>SK 235E-…-AXB** | **SK 225E / SK 235E** | **SK 225E-…-AUX<br>SK 235E-…-AUX** |
| AS-i supply, PWR connection | 24 V DC, max. 25 mA | 26.5 – 3.,6 V DC, max. 290 mA[1)] | 24 V DC, max. 25 mA |
| Slave profile | S-7.A | S-7.0 | |
| I/O-Code | 7 | 7 | |
| ID Code | A | 0 | |
| External ID Code 1 / 2 | 7 | F | |
| Address | 1A – 31A and 1B - 31B (Delivery condition 0A) | 1 – 31 (Delivery condition: 0) | |
| Cycle time | Slave → Master ≤ 10 ms<br>Master → Slave ≤ 21 ms | ≤ 5 ms | |
| Quantity of BUS I/O | 4I / 4O | 4I / 4O | |

1) Of which 60 mA available for peripherals (initiators, connected parametrisation tool, actuators)

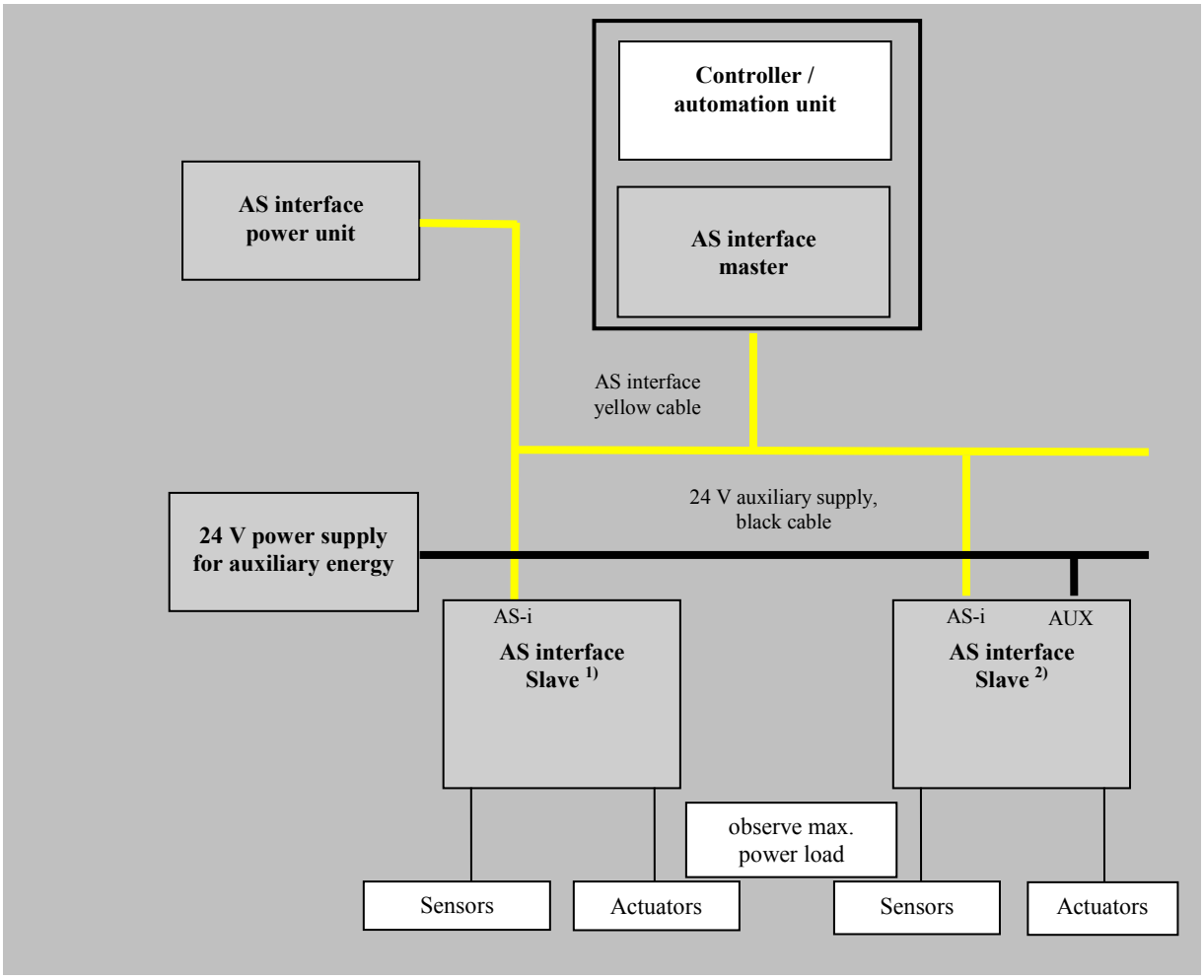
### 4.5.3 Bus structure and topology

The AS Interface network must be set up in any form (line, star, ring and tree structure) and is managed by an AS interface master as the interface between the PLC and slaves. Additional slaves can be added to an existing network at any time, up to a limit of 31 standard slaves or 62 A/B slaves. The slaves are addressed by the master or an appropriate addressing device.

An AS-i master communicates independently and exchanges data with the connected AS-i slaves. Normal power units may not be used in the AS interface network. Only a special AS interface power unit may be used for the power supply for each AS interface connector. This AS interface power supply is directly connected to the yellow standard cable (AS-i(+) and AS-i(-) cable) and should be positioned as close as possible to the AS-i master in order to keep the voltage drop small.

In order to avoid problems, the **PE connection of the AS interface power supply** (if present) **must be earthed**.

The brown **AS-i(+)** and the blue **AS-i(-)** wire of the yellow AS interface cable **must not be earthed**.




| | | |
|---|---|---|
| 1) | SK 22xE / SK 23xE | |
| 2) | SK 225E-… / SK 235E-…-AUX and -AXB | 24 V DC auxiliary energy at terminals 44/40 |

## 4.5.4 Commissioning

### 4.5.4.1 Connection

Connection of the AS interface cable (yellow) is made via terminals 85/85 of the terminal strip and can optionally be made to an appropriately labelled M12 flange plug connector (yellow)

Details of control terminals (🕮 Section 2.4.3.1 "Control terminal details ")

Details of connector (🕮 Section 3.2.3 "plug connectors")

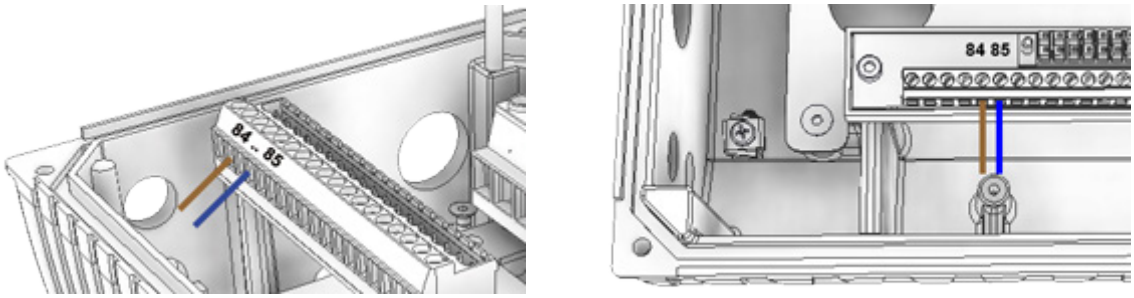



Figure 28: Connecting terminals AS-i, left size 1 – 3, right size 4

| Type | Special version | Size | AS Interface connection | | Control voltage connection e.g. AUX line of a PELV | |
|---|---|---|---|---|---|---|
| | | | AS-i(+) | AS-i(-) | 24 V DC | GND |
| SK 220E, SK 230E | | Size 1 – 3 | 84 | 85 | - [1] | - [1] |
| | | Size 4 | 84 | 85 | 44 [1), 2)] | 40 [1), 2)] |
| SK 225E, SK 235E | | Size 1 – 3 | 84 | 85 | **Connection not permitted!** | |
| | - AUX / -AXB | Size 1 – 3 | 84 | 85 | 44 | 40 |

1) The control section of the frequency inverter is not supplied from the AS interface line. The required auxiliary voltage for this is generated by the device itself.

2) Connection possible, but not required.

Table 12: AS Interface, connection of signal and supply lines

If the AS interface ("yellow cable") is not used, the normal connection requirements for the device apply (🕮 Section 2.4.3.1 "Control terminal details ").

**Information** **24 V DC / AS-Interface** (SK 225E/ SK 235E, except -AUX, -AXB)

With the use of the yellow AS interface line:

- the supply voltage (26.5 - 31.6 V DC) for the use of the digital inputs or other external peripherals (e.g. activators) **can be obtained from terminals 44/40**. The permissible total current for this is limited to **60 mA**!
  The terminal "44" is protected against short circuit. In case of an overload it will switch off by a thermal fuse element. After a cooling time that depends on the ambient conditions, the fuse will reset.
- **no voltage source may be connected to terminals 44/40**,
- the frequency inverter is supplied via the yellow AS-i line.

### Variants of a 24 V supply for the peripherals (e.g. actuators)

(Valid for SK 225E/ SK 235E, except –AUX, -AXB)

**Information** — **Use of wall mounting kit with fan**

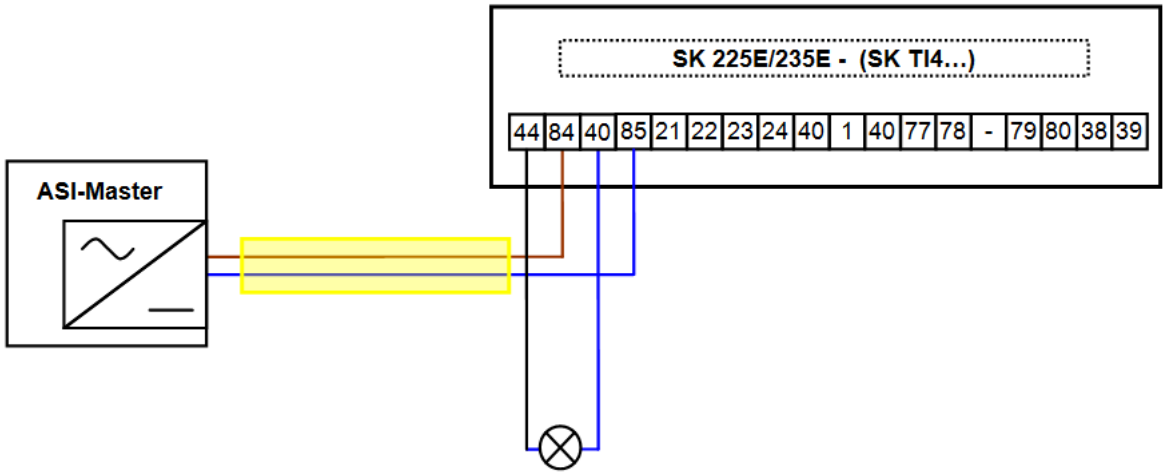
If the frequency inverter is operated with a **SK TIE4-WMK-L-…** (📖 Section 2.1.3.2 "Wall mounting kit with fan") wall mounting kit, the following must be noted:

- Power supply to the fan via the frequency inverter is not permitted
- Only provide the power supply to the fan via a separate 24 V DC power supply (see following example: "***Variant 2 – Use of an optional SK xU4-24V-… mains unit***").

***Variant 1 – connection to 24 V (Terminal 44)***

- The limit of 60 mA for the maximum load (total current) must be complied with.

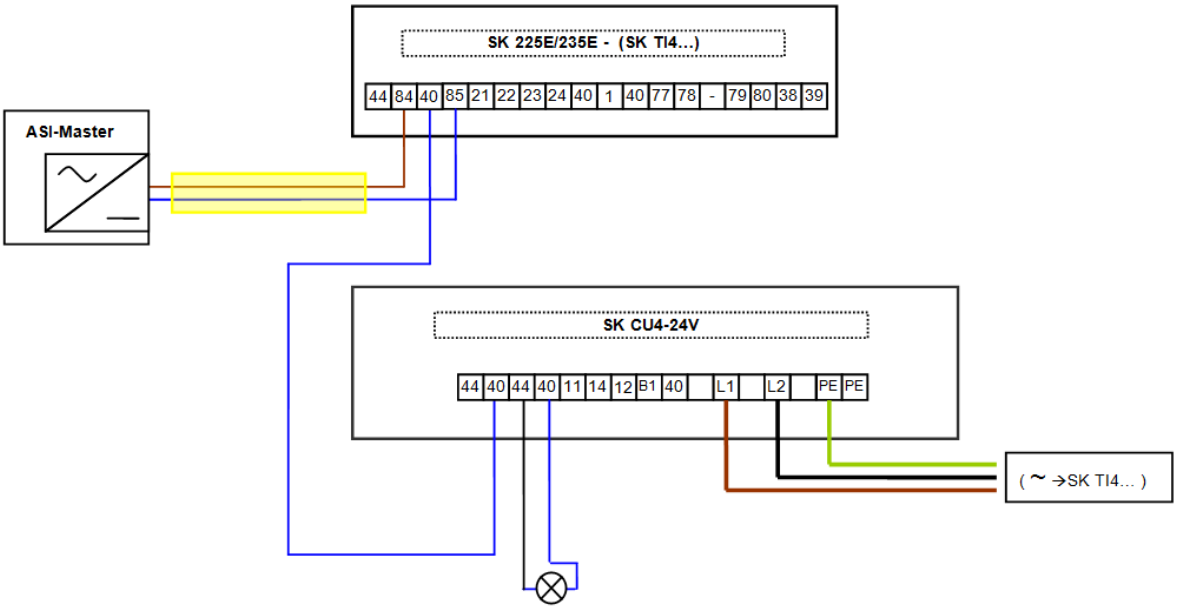
*Connection example:*



***Variant 2 – use of an optional power supply SK xU4-24V-…***

Since the permissible load of terminal 44 is limited to 60 mA when using the AS interface, if there is an increased power requirement it is possible to incorporate a power supply (e.g. SK CU4-24V-…) for supplying the additional peripherals. **However, under no circumstances must the 24 V voltage of the power supply be connected to the frequency inverter** (see also following connection example).

*Connection example:*



### 4.5.4.2 Displays

The status of the AS interface is signalled by a multi-colour **AS-i** LED.

| AS-i LED | Meaning |
|---|---|
| OFF | • No AS interface voltage to the module<br>• Connections not connected or exchanged |
| green ON | • Normal operation (AS interface active) |
| red ON | • No exchange of data<br>– Slave address = 0 (slave still in factory setting)<br>– Slave not in LPS (list of planned slaves)<br>– Slave with incorrect IO/ID<br>– Master in STOP mode<br>– Reset active |
| Alternately flashing red / green Flashing (2 Hz) [1)] | • Peripheral error<br>– Control unit in device not starting<br>(AS-i voltage too low or control unit defective) |

1) Switch-on frequency per second, example: 2 Hz = LED 2 x second "On"

**The AS-i LED is only available for devices of type SK 2x0E size 4 and SK 2x5E.**

#### 4.5.4.3 Configuration

The most important functions (functions of sensor / actuator signals via the AS Interface and the "on board potentiometers" *P1* and *P2* (only SK 2x0E size 4 and SK 2x5E)) can be set at the frequency inverter via DIP4 and DIP 5 of DIP switch block S1 (🕮 Section 4.3.2.2 "DIP switches (S1)").

Alternatively, the functions can also be assigned via the arrays [-01] … [-04] of parameters (P480) and (P481) (🕮 Section 5 "Parameter"). Settings that are made in these parameters only become effective if DIP switch S1: (DIP4 and DIP5) are in **Position "0" ("OFF")**.

The functions of the integrated potentiometers P1 and P2 (SK 2x0E size 4 and SK 2x5E only) can be adapted in parameter (P400).

**Information** — **DIP switch**

With the DIP switch default settings (S1: DIP4/5 = "0" ("off")) the digital inputs of the frequency inverter are active.

However, as soon as one of the two DIP switches is moved to position "I" ("ON"), the digital inputs are deactivated. However, the gateway function of digital inputs 1 and 2 on AS-i-Out bits 2 and 3 is retained.

**Information** — **Overloading of the 24V supply**

*When using the AS-Interface, this affects devices of type SK 2x5E (not special version SK 225E-…-AUX and …-AXB)*

Because of the low load reserves of the low voltage when using the AS interface, it is advisable to parametrise the frequency inverter with the aid of the NORDCON software. The use of a parametrisation box (SK PAR-3H / SK CSX-3H) can cause damage to the frequency inverter, particularly during long periods of operation.

### Bus I/O bits

**⚠ WARNING** **Unexpected movement due to automatic starting**

In the event of a fault (communication interrupted or bus cable disconnection, the device automatically switches off, since the device enable is no longer present.

Restoration of communication may result in an automatic start and therefore, unexpected movement of the drive unit. To prevent any hazard, a possible automatic start must be prevented as follows:

- If a communication error occurs, the bus master must actively set the control bits to "zero".

Initiators can be directly connected to the digital inputs of the frequency inverter. Actuators can be connected via the available digital outputs of the device. The following connections are each provided for four reference data bits:

| BUS IN | Function (P480[-01…-04]) |
|---|---|
| Bit 0 | Enable right |
| Bit 1 | Enable left |
| Bit 2 | Fixed frequency 2 (→ P465[-02]) |
| Bit 3 | Acknowledge fault [1] |

| Status | | Status |
|---|---|---|
| Bit 1 | Bit 0 | |
| 0 | 0 | Motor is switched off |
| 0 | 1 | Right rotation field is present at the motor |
| 1 | 0 | Left rotation field is present at the motor |
| 1 | 1 | Motor is switched off |

1) Acknowledge with flank 0 → 1.

For control via the bus, acknowledgement is not automatically performed by a flank at one of the enable inputs

| BUS OUT | Function (P481 [-01 … -04]) |
|---|---|
| Bit 0 | Inverter ready |
| Bit 1 | Warning |
| Bit 2 [1] | Digital-In 1 status |
| Bit 3 [1] | Digital-In 2 status |

| Status | | Status |
|---|---|---|
| Bit 1 | Bit 0 | |
| 0 | 0 | Error active |
| 0 | 1 | Warning |
| 1 | 0 | Start disabled |
| 1 | 1 | Standby / Run |

1) Bits 2 and 3 are directly coupled to digital inputs 1 and 2

The configuration of the I/O bits can also take place within a limited scope via DIP-switch S1: 3, 4 and 5 (📖 Section 4.3.2.2 "DIP switches (S1)").

Parallel actuation via the BUS and the digital inputs is possible. The relevant inputs are dealt with more or less as normal digital inputs. If a changeover between manual and automatic is going to take place, it must be ensured that no enable via the normal digital inputs takes place in automatic mode. This could be implemented e.g. with a three-position key switch. Position 1: "Manual left" Position 2: "Automatic" Position 3: "Manual right".

If an enable is present via one of the two "normal" digital inputs, the control bits from the bus system are ignored. An exception is the control bit "Acknowledge fault". This function is always possible in parallel, regardless of the control hierarchy. The bus master can therefore only take over control if no actuation via a digital input takes place. If "Enable left" and "Enable right" are set simultaneously, the enable is removed and the motor stops without a deceleration ramp (block voltage).

#### 4.5.4.4 Addressing

In order to use the device in an AS-i network, it must have a unique address. The address is set to 0 in the factory. This means that the device can be recognised as a "new device" by an AS-i master (prerequisite for automatic address assignment by the master).

***Course of action***

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

In many other cases, addressing is carried out using a normal addressing device for AS interface slaves (example follows).

- Pepperl+Fuchs, VBP-HH1-V3.0-V1 (separate M12 connection for external power supply)
- IFM, AC1154 (battery operated addressing device)

**Information** **Special conditions for SK 2x5E**

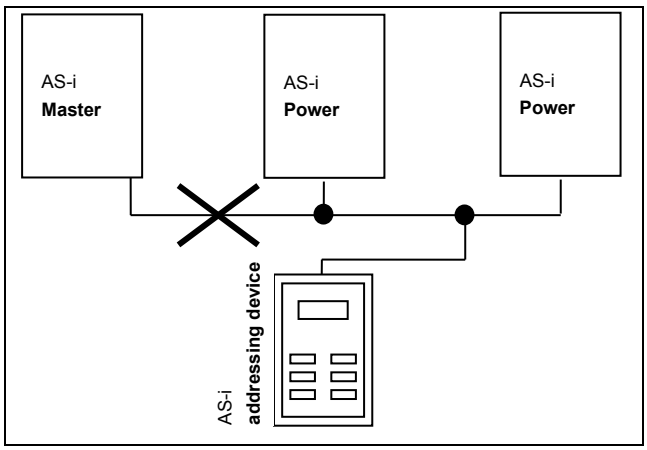
*Does not apply to special versions …-AUX and –AXB*

- Also provide voltage supply of frequency inverter via the yellow AS interface line (pay attention to power consumption of control level of frequency inverter (290 mA))
- When using an addressing device
  - Do not use the internal voltage source of the addressing device
  - Battery-operated addressing devices do not supply the current that is needed and are therefore unsuitable
  - Use addressing unit with a separate 24 V DC connection for an external power supply (example: Pepperl+Fuchs, VBP-HH1-V3.0-V1)

The options for addressing the AS-i slave with an addressing unit in practice are listed in the following.

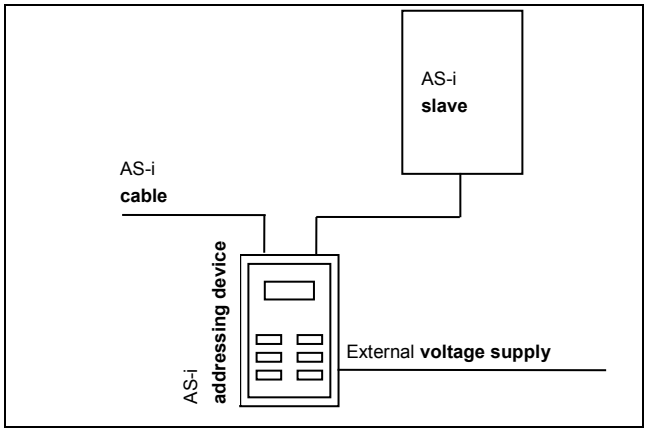
***Version 1***

Using an addressing device which is equipped with an **M12 connector** for connecting to the **AS**-i bus, you can incorporate yourself into a the AS interface network via an appropriate access. The prerequisite for this is that the AS interface master can be switched off.




***Version 2***

With an addressing device that is equipped with an **M12 connector** for connecting to the **AS**-i bus **and** an additional **M12 connector** for connecting an external **voltage supply**, the addressing device can be directly incorporated in the AS-i cable.




### 4.5.5 Certificate

Currently available certificates can be found on the Internet at Link "www.nord.com"

# 5 Parameter

**WARNING** **Unexpected movement**

Connection of the supply voltage may directly or indirectly set the drive unit into motion. This may cause an unexpected movement of the drive unit and the machine which is connected to it. This unexpected movement may cause severe or fatal injuries and/or material damage.

Unexpected movements may be due to several causes, e.g.

- Parameterisation of an "automatic start",
- Incorrect parameterisation,
- Control of the device with an enabling signal from a higher level control unit (via IO or bus signals),
- Incorrect motor data,
- Incorrect encoder connection,
- Release of a mechanical holding brake,
- External influences such as gravity or other kinetic energy which acts on the drive unit,
- In IT networks: Earth fault (short circuit to earth)

To avoid any resulting hazard the drive or drive chain must be secured against unexpected movements (mechanical blocking and/or decoupling, provision of protection against falling, etc.) In addition, it must be ensured that there are no persons within the area of action and the danger area of the system.

**WARNING** **Unexpected movement due to parameter changes**

**Parameter changes become effective immediately**. Dangerous situations can occur under certain conditions, even when the drive is stationary. Functions such as **P428** "Automatic Start" or **P420** "Digital inputs" or the "Release Brake" setting can put the drive in motion and put persons at risk due to moving parts.

Therefore:

- Changes to parameter settings must only be made when the frequency inverter is not enabled.
- During parametrisation work precautions must be taken to prevent unwanted drive movements (e.g. lifting gear plunging down). The danger area of the system must not be entered.

**WARNING** **Unexpected movement due to overload**

In case of overload of the drive there is a risk that the motor will "break down" (= sudden loss of torque). An overload may be caused e.g. by underdimensioning of the drive unit or by the occurrence of sudden peak loads. Sudden peak loads may be of a mechanical origin (e.g. blockage) or may be due to extremely steep acceleration ramps (Parameter **P102**, **P103**, **P426**).

Depending on the type of application, "breakdown" of the motor may cause unexpected movement (e.g. dropping of loads by lifting gear).

To prevent any risk, the following must be observed:

- For lifting gear applications or applications with frequent, large load changes, the parameter (**P219**) must remain in the factory (**100 %**).
- Do not underdimension the drive unit, provide adequate overload reserves.
- If necessary, provide fall protection (e.g. for lifting gear) or equivalent protective measures.

The relevant parameters for the device are described in the following. The parameters are accessed using a parametrisation tool (e.g. NORD CON software or control and parametrisation unit, see also (🕮 Section 3.1.1 "Control and Parametrisation Boxes / Software") and therefore makes it possible to adapt the device to the drive task in the best possible way. Different device configurations can result in dependencies for the relevant parameters.

The parameters can only be accessed if the control unit of the device is active.

Device of type SK 2x5E must be provided with a 24 V DC control voltage to do this (🕮 Section 2.4.3 "Electrical connection of the control unit").

Devices of type SK 2x0E must be equipped with a power supply that generates the 24 V DC control voltage that is required for this purpose by applying the mains voltage (🕮 Section 2.4.2.1 "Mains supply (L1, L2(/N), L3, PE)").

Limited adaptations of individual functions of the relevant devices can be implemented via DIP switches. Access to the parameters of the device is essential for all other adaptations. **It should be noted that the hardware configuration (DIP - switches) has priority over configuration via software (parametrisation).**

Every frequency inverter is factory-set for a motor of the same power. All parameters can be adjusted "online". Four switchable parameter sets are available during operation. The scope of the parameters to be displayed can be influenced using the supervisor parameter **P003**.

## Information — Incompatibility

In the software change of version **V1.2 R0** of the frequency inverter, the structure of individual parameters was modified for technical reasons.

(E.g.: Up to version V 1.1 R2 (P417) was a single parameter, but from version V1.2 R0 is was subdivided into two arrays((P417) [-01] and [-02]).

When plugging an EEPROM (memory - module) from a frequency inverter with an earlier software version into a frequency inverter with software version V1.2 or higher, the stored data is automatically converted to the new format. New parameters are stored with the default setting. This therefore provides correct functionality.

**However, it is not permissible to plug in an EEPROM (memory module) with a software version of V1.2 or above into a frequency inverter with a previous software version, since this would lead to loss of all data.**

As delivered, an external EEPROM ("memory module") is plugged into the frequency inverter.

***The following applies up to firmware version V1.4 R1:***

All parameter changes are made in the plug-in (external) EEPROM. As of firmware version 1.3, an internal EEPROM is automatically activated for data management if the plug-in EEPROM is removed. Parameter changes therefore affect the internal EEPROM.

The frequency inverter treats the external EEPROM with a higher priority. This means that as son as an external EEPROM ("memory module") is plugged in, the dataset of the internal EEPROM is concealed.

The datasets can be copied between the internal and the external EEPROM (P550).

***The following applies as of firmware version V1.4 R2:***

All parameter changes are made in the internal EEPROM. If an external EEPROM has been connected, all changes are automatically stored on this as well. The external EEPROM therefore acts as an additional data backup. Parameter P550 can be used to transfer data from the external EEPROM to the internal EEPROM (e.g. during the data transfer between different devices of the same type). It is also possible to trigger the copying procedure using DIP switches (📖 Section 4.3.2.2 "DIP switches (S1)").

The relevant parameters for the device are described in the following. Explanations for parameters which concern the field bus options or the special functionality of the POSICON, for example, can be obtained from the respective supplementary manuals.

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

| Menu group | No. | Master function |
|---|---|---|
| **Operating displays** | (P0--) | Display of parameters and operational values |
| **Basic parameters** | (P1--) | Basic device settings, e.g. on/off switching behaviour |
| **Motor data** | (P2--) | Electrical settings for the motor (motor current or start voltage (start-off voltage)) |
| **Speed control** | (P3--) | Setting of current and speed controllers and settings for rotary encoders (incremental encoders) and settings for the integrated PC. |
| **Control terminals** | (P4--) | Assignment of functions for the inputs and outputs |
| **Additional parameters** | (P5--) | Mainly monitoring functions and other parameters |
| **Positioning** | (P6--) | Setting of the positioning function (details 📖 BU0210) |
| **Information** | (P7--) | Display of operating values and status messages |

## Information

### Factory settings P523

The factory setting of the entire parameter set can be loaded at any time using parameter **P523**. For example, this can be useful during commissioning if it is not known which device parameters were changed earlier and could therefore influence the operating behaviour of the drive in an undesirable way.

The restoration of the factory settings (**P523**) normally affects all parameters. This means that all motor data must subsequently be checked or reconfigured. However, parameter **P523** also provides a facility for excluding the motor data or the parameters relating to bus communication when the factory settings are restored.

To save the current device settings, these can be transferred to a ParameterBox memory beforehand (see 📖 BU0040).

## 5.1 Parameter overview

***Operating displays***

| | | |
|---|---|---|
| **P000** Operating display | **P001** Selection of display value | **P002** Display factor |
| **P003** Display factor | | |

***Basic parameters***

| | | |
|---|---|---|
| **P100** Parameter set | **P101** Copy parameter set | **P102** Acceleration time |
| **P103** Deceleration time | **P104** Minimum frequency | **P105** Maximum frequency |
| **P106** Ramp smoothing | **P107** Brake reaction time | **P108** Disconnection mode |
| **P109** DC brake current | **P110** Time DC-brake on | **P111** P factor torque limit |
| **P112** Torque current limit | **P113** Jog frequency | **P114** Brake delay off |
| **P120** Option monitoring | | |

***Motor data***

| | | |
|---|---|---|
| **P200** Motor list | **P201** Nominal frequency of motor | **P202** Nominal speed |
| **P203** Nominal current | **P204** Nominal voltage of motor | **P205** Nominal power of motor |
| **P206** Cos phi | **P207** Motor circuit | **P208** Stator resistance |
| **P209** No load current | **P210** Static boost | **P211** Dynamic boost |
| **P212** Slip compensation | **P213** Amplification Isd control | **P214** Torque precontrol |
| **P215** Boost precontrol | **P216** Time boost prectrl. | **P217** Oscillation damping |
| **P218** Modulation depth | **P219** Auto. Magn. adaptation | **P220** Par.-identification |
| **P240** EMK voltage PMSM | **P241** Inductivity PMSM | **P243** Reluct. angle IPMSM |
| **P244** Peak current PMSM | **P245** Osc damping PMSM VFC | **P246** Mass Inertia PMSM |
| **P247** Switch freq VFC PMSM | | |

***Speed control***

| | | |
|---|---|---|
| **P300** Servo mode | **P301** Incremental encoder res. | **P310** Speed controller P |
| **P311** Speed controller I | **P312** Torque current controller P | **P313** Torque current controller I |
| **P314** Torque current controller limit | **P315** Field curr. ctrl. P | **P316** Field curr. ctrl. I |
| **P317** Field curr. ctrl. lim. | **P318** Field weakening controller P | **P319** Field weakening controller I |
| **P320** Weak border | **P321** Speedctr. I brake off | **P325** Function encoder |
| **P326** Ratio encoder | **P327** Speed slip error | **P328** Speed slip delay |
| **P330** Rotor starting position detection | **P331** Switch over freq. CFC ol | **P332** Hyst. Switchover CFC ol |
| **P333** Flux feedback CFC ol | **P334** Encoder offset PMSM | **P350** PLC functionality |
| **P351** PLC setpoint selection | **P353** Bus status via PLC | **P555** PLC integer setpoint |
| **P356** PLC long setpoint | **P360** PLC display value | **P370** PLC status |

***Control terminals***

| | | | | | |
|---|---|---|---|---|---|
| **P400** | Function Setpoint inputs | **P401** | Analogue input mode | **P402** | Adjustment: 0% |
| **P403** | Adjustment: 100% | **P404** | Analogue input filter | **P410** | Min. freq. Auxiliary setpoint |
| **P411** | Max. Freq. Auxiliary setpoint | **P412** | Nom. val. process ctrl. | **P413** | PI control P comp. |
| **P414** | PI control I comp. | **P415** | Limit process ctrl. | **P416** | Ramp time PI setpoint |
| **P417** | Offset analogue output | **P418** | Funct. analogue output | **P419** | Standard analogue output |
| **P420** | Digital inputs | **P426** | Quick stop time | **P427** | Emerg. stop Fault |
| **P428** | Automatic starting | **P434** | Digital output function | **P435** | Dig. out scaling |
| **P436** | Dig. out. hysteresis | **P460** | Watchdog time | **P464** | Fixed frequency mode |
| **P465** | Fixed freq. Array | **P466** | Minimum freq. process control | **P475** | delay on/off switch |
| **P480** | Function BusIO In Bits | **P481** | Function BusIO Out Bits | **P482** | Standard BusIO Out Bits |
| **P483** | Hyst. BusIO Out Bits | | | | |

***Extra parameters***

| | | | | | |
|---|---|---|---|---|---|
| **P501** | Inverter name | **P502** | Master function value | **P503** | Leading function output |
| **P504** | Pulse frequency | **P505** | Absolute minimum freq. | **P506** | Auto. Fault acknowledgement |
| **P509** | Control word source | **P510** | Setpoint source | **P511** | USS baud rate |
| **P512** | USS address | **P513** | Telegram timeout | **P514** | CAN bus baud rate |
| **P515** | CAN bus address | **P516** | Skip frequency 1 | **P517** | Skip freq. area 1 |
| **P518** | Skip frequency 2 | **P519** | Skip freq. area 2 | **P520** | Flying start |
| **P521** | Flying start Resolution | **P522** | Flying start Offset | **P523** | Factory setting |
| **P525** | Load control max | **P526** | Load control min | **P527** | Load monitoring Freq. |
| **P528** | Load monitoring delay | **P529** | Mode Load control | **P533** | Factor $I^2t$ |
| **P534** | Torque shutoff lim. | **P535** | $I^2t$ motor | **P536** | Current limit |
| **P537** | Pulse disconnection | **P539** | Output monitoring | **P540** | Mode phase sequence |
| **P541** | Set relays | **P542** | Set analogue out | **P543** | Bus - Actual value |
| **P546** | Function Setpoint Bus value | **P549** | Pot Box function | **P550** | EEPROM Copy Order |
| **P552** | CAN master cycle | **P553** | PLC setpoint | **P555** | P - limit chopper |
| **P556** | Braking resistor | **P557** | Braking resistor type | **P558** | Flux delay |
| **P559** | DC Run-on time | **P560** | Parameter, saving mode | | |

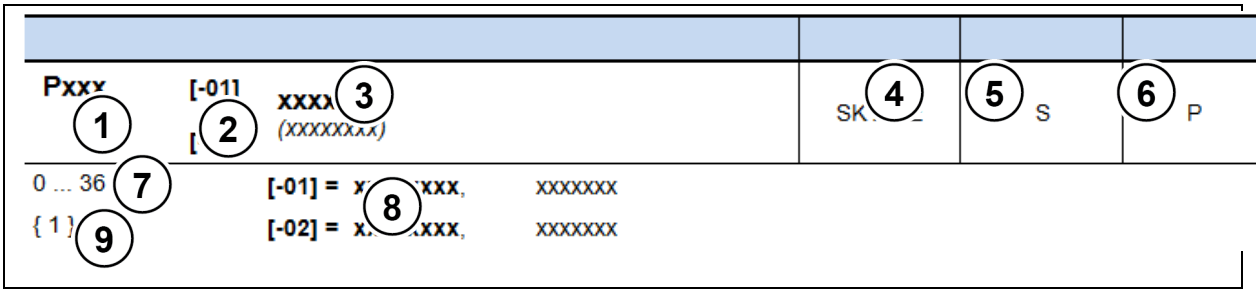
***Positioning***

| | | | | | |
|---|---|---|---|---|---|
| **P600** | Position control | **P601** | Actual position | **P602** | Actual setpoint position |
| **P603** | Actual Pos. diff. | **P604** | Encoder type | **P605** | Absolute encoder |
| **P607** | Ratio | **P608** | Reduction ratio | **P609** | Offset Position |
| **P610** | Setpoint Mode | **P611** | Position controller P | **P612** | Pos. window |
| **P613** | Position | **P615** | Maximum Position | **P616** | Minimum Position |
| **P625** | Output Hysteresis | **P626** | Comparative position output | **P630** | Position slip error |
| **P631** | Slip error. Abs./inc. | **P640** | Unit of pos. value | | |

***Information***

| | | | | | |
|---|---|---|---|---|---|
| **P700** | Present Operating status | **P701** | Last fault | **P702** | Freq. last error |
| **P703** | Current. last error | **P704** | Volt. last error | **P705** | Dc.lnk volt. last er. |
| **P706** | P set last error | **P707** | Software version | **P708** | Status of digital in. |
| **P709** | Analogue input voltage | **P710** | Analogue output volt. | **P711** | State of relays |
| **P714** | Operating time | **P715** | Running time | **P716** | Current frequency |
| **P717** | Current speed | **P718** | Present Setpoint frequency | **P719** | Actual current |
| **P720** | Present Torque current | **P721** | Actual field current | **P722** | Current voltage |
| **P723** | Voltage -d | **P724** | Voltage -q | **P725** | Current cos phi |
| **P726** | Apparent power | **P727** | Mechanical power | **P728** | Input voltage |
| **P729** | Torque | **P730** | Field | **P731** | Parameter set |
| **P732** | Phase U current | **P733** | Phase V current | **P734** | Phase W current |
| **P735** | Speed encoder | **P736** | DC link current | **P737** | Usage rate brake res. |
| **P738** | Usage rate motor | **P739** | Heatsink temperature | **P740** | Process data Bus In |
| **P741** | Process data Bus Out | **P742** | Data base version | **P743** | Inverter ID |
| **P744** | Configuration | | | | |
| **P747** | Inverter Volt. Range | | | | |
| **P748** | CANopen status | **P749** | Status of DIP switches | **P750** | Stat. Overcurrent |
| **P751** | Stat. Overvoltage | **P752** | Stat. Mains fault | **P753** | Stat. Overtemp. |
| **P754** | Stat. Param. loss | **P755** | Stat. System error | **P756** | Stat. Timeout |
| **P757** | Stat. Customer error | **P760** | Current mains current | **P799** | Op.-time last error |

## 5.2 Description of parameters




**1** Parameter number
**2** Array values
**3** Parameter text; top: Display in ParameterBox, bottom: Meaning
**4** Special features (e.g. only available in device model SK xxx)
**5** (S) Parameter of type Supervisor, → depending on setting in **P003**
**6** (P) Parameter, to which different values can be assigned depending on the selected parameter set (selection in **P100**)
**7** Parameter value range
**8** Description of parameters
**9** Factory settings (default value) of parameter

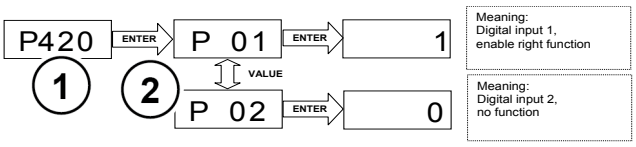
**Array parameter display**

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

If the SimpleBox SK CSX-3H is used, the array level is shown by **_ - 0 1**. With the ParameterBox SK PAR-3H (picture on right) the selection options for the array level appear at the top right of the display (Example: **[01]**).

**Array display:**

**SimpleBox SK CSX-3H**




**1** Parameter number
**2** Array

**ParameterBox SK PAR-3H**


**1** Parameter number
**2** Array

### 5.2.1 Operating displays

Abbreviations used:

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

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

| | | |
|---|---|---|
| 0 = | **Actual frequency [Hz]** | Currently supplied output frequency |
| 1 = | **Speed [rpm]** | Calculated speed |
| 2 = | **Target frequency [Hz]** | Output frequency that corresponds to the pending setpoint. This need not correspond with the current output frequency. |
| 3 = | **Current [A]** | Current measured output current |
| 4 = | **Actual torque current [A]:** | Torque-forming output current |
| 5 = | **Voltage [V AC]** | Current alternating voltage present at the device output |
| 6 = | **Link voltage [V DC]** | The *Link voltage [Vdc]* is the FI-internal DC voltage. Amongst other things, this depends on the level of the mains voltage. |
| 7 = | **cos Phi** | Current calculated value of the power factor |
| 8 = | **Apparent power [kVA]** | Calculated current apparent power |
| 9 = | **Effective power [kW]** | Calculated current effective power |
| 10 = | **Torque [%]** | Calculated current torque |
| 11 = | **Field [%]** | Calculated current field in motor |
| 12 = | **Hours of operation [h]** | Time for which main voltage present at device |
| 13 = | **Operating time Enable [h]** | *"Enabled operating hours"* is the time for which the device was enabled. |
| 14 = | **Analogue input 1 [%]** | Current value that is present at analogue input 1 of the device |
| 15 = | **Analogue input 2 [%]** | Current value that is present at analogue input 2 of the device |
| 16 = | **… 18** | *Reserved*, POSICON |
| 19 = | **Heat sink temperature [°C]** | Current temperature of the heat sink |
| 20 = | **Actual utilisation of motor [%]** | Average motor utilisation, based on the known motor data (P201...P209). |
| 21 = | **Brake resistor utilisation [%]** | *"Braking resistor utilisation"* is the average braking resistor load, based on the known resistance data (P556...P557). |
| 22 = | **Interior temperature [°C]** | Current interior temperature of device *(SK 54xE / SK 2xxE)* |
| 23 = | **Motor temperature** | Measured via KTY-84 |
| 24 = | **… 29** | *Reserved* |
| 30 = | **Present Target MP-S [Hz]** | *"Current motor potentiometer function setpoint with storage"*. (P420…=71/72). The nominal value can be read out with this function or pre-set (without the drive running). |
| 31 = | **… 39** | *Reserved* |
| 40 = | **PLC control box value** | Visualisation mode for PLC communication |

| | | |
|---|---|---|
| 41 = | **… 59** | *Reserved*, POSICON |
| 60 = | **R stator ident** | Stator resistance determined by means of measurement (P220) |
| 61 = | **R rotor ident** | the rotor resistance determined by measurement ((P220) Function 2) |
| 62 = | **L stray stator ident** | the stray inductance determined by measurement ((P220) Function 2) |
| 63 = | **L stator ident** | the inductance determined by measurement ((P220) Function 2) |
| 65 = | | *Reserved* |

## P002 — Display factor

*(Display factor)*

**S**

0.01 ... 999.99
{ 1.00 }

The selected operating value in parameter P001 >Select of display< is multiplied with the scaling factor in P000 and displayed in >Operating parameter display<.

It is therefore possible to display system-specific operating such as e.g. the throughput quantity

## P003 — Supervisor code

*(Supervisor code)*

0 ... 9999
{ 1 }

**0 =** The supervisor parameters and groups P3xx/P6xx are not visible, otherwise all.

**1 =** All parameters are visible, except groups P3xx and P6xx.

**2 =** All parameters are visible, except group P6xx.

**3 =** All parameters are visible.

**4 =** ... 9999, only parameters P001 and P003 are visible.

**Information** — **Display via NORDCON**

If parameterisation is carried out with the NORDCON software, the settings 4 ... 9999 the settings are as for the 0 setting. Settings 1 and 2 behave like setting 3.

### 5.2.2 Basic parameters

| Parameter {factory setting} | Setting value / Description / Note | | Supervisor | Parameter set |
|---|---|---|---|---|
| **P100** | **Parameter set** *(Parameter set)* | | **S** | |
| 0 ... 3 { 0 } | Selection of the parameters sets to be parameterised. 4 parameter sets are available. The parameters to which different values can also be assigned in the 4 parameter sets are known as "parameter set-dependent" and are marked with a **"P"** in the header in the following descriptions.<br>The operating parameter set is selected using appropriately parametrised digital inputs or by means of BUS actuation.<br>If enabled via the keyboard (SimpleBox, ControlBox, PotentiometerBox or ParameterBox), the operating parameter set will match the settings in P100. | | | |
| **P101** | **Copy parameter set** *(Copy parameter set)* | | **S** | |
| 0 ... 4 { 0 } | After confirmation with the OK / ENTER key, a copy of the parameter set selected in P100 >Parameter set< is written to the parameter set dependent on the value selected here<br>**0 = Do not copy**<br>**1 = Copy actual to P1**: Copies the active parameter set to parameter set 1<br>**2 = Copy actual to P2**: Copies the active parameter set to parameter set 2<br>**3 = Copy actual to P3**: Copies the active parameter set to parameter set 3<br>**4 = Copy actual to P4**: Copies the active parameter set to parameter set 4 | | | |
| **P102** | **Acceleration time** *(Acceleration time)* | | | **P** |
| 0 ... 320.00 sec { 2.00 } | The start-up time is the time corresponding to the linear frequency rise from 0 Hz to the set maximum frequency (P105). If an actual setpoint of <100 % is being used, the acceleration time is reduced linearly according to the setpoint which is set.<br>The acceleration time can be extended by certain circumstances, e.g. FI overload, setpoint lag, smoothing, or if the current limit is reached.<br>**NOTE:**<br>Care must be taken that the parameter values are realistic. A setting of P102 = 0 is not permissible for drive units!<br>**Notes on ramp gradient:**<br>Amongst other things, the ramp gradient is governed by the inertia of the rotor.<br>A ramp with a gradient which is too steep may result in the "inversion" of the motor.<br>In general, extremely steep ramps (e.g.: 0 - 50 Hz in < 0.1 s) should be avoided, as may cause damage to the frequency inverter. | | | |

| P103 | **Braking time**<br>*(Braking time)* | | | P |
|---|---|---|---|---|

0 ... 320.00 sec
{ 2.00 }

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

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

**NOTE:**

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

**Notes concerning ramp steepness:** see parameter (P102)

| P104 | **Minimum frequency**<br>*(Minimum frequency)* | | | P |
|---|---|---|---|---|

0.0 ... 400.0 Hz
{ 0.0 }

The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set.

In combination with other setpoints (e.g. analog setpoint of fixed frequencies) these are added to the set minimum frequency.

This frequency is undershot when

a. the drive is accelerated from standstill.
b. The FI is blocked. The frequency then reduces to the absolute minimum (P505) before it is blocked.
c. The FI reverses. The reverse in the rotation field takes place at the absolute minimum frequency (P505).

This frequency can be continuously undershot if, during acceleration or braking, the function "Maintain frequency" (Function Digital input = 9) is executed.

| P105 | **Maximum frequency**<br>*(Maximum frequency)* | | | P |
|---|---|---|---|---|

0.1 ... 400.0 Hz

The frequency supplied by the FI after being enabled and once the maximum setpoint is present, e.g. analogue setpoint corresponding to P403, a correspondingly fixed frequency or maximum via the SimpleBox / ParameterBox.

This frequency can only be overshot by the slip compensation (P212), the function "Maintain frequency" (function digital input = 9) or a change to another parameter set with lower maximum frequency.

Maximum frequencies are subject to certain restrictions, e.g.

- Restrictions in weak field operation,
- Compliance with mechanically permissible speeds,
- PMSM: Maximum frequency restricted to a value that is slightly above the nominal frequency. This value is calculated from the motor data and the input voltage.

{ 50.0 } DIP7 = off
{ 60.0 } DIP7 = on

(chapter 4.3.2.2)

| P106 | Ramp smoothing<br>*(Ramp smoothing)* | | | P |
|---|---|---|---|---|

0 ... 100 %
{ 0 }

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

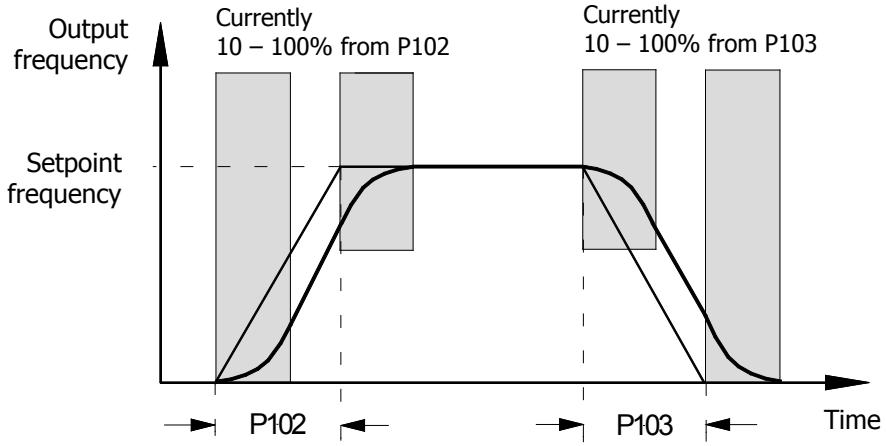
Ramp smoothing is carried out for every setpoint change.

The value to be set is based on the set acceleration and deceleration time, however values <10% have no effect.

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

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

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




**Note:** Under the following conditions ramp rounding is switched off or replaced with a linear ramp with extended times:

- Acceleration values (+/-) less than 1 Hz/s
- Acceleration values (+/-) greater than 1 Hz/ms
- Rounding values less than 10 %

| P107 | **Brake reaction time**<br>*(Brake reaction time)* | | | P |
|---|---|---|---|---|

0 ... 2.50 s
{ 0.00 }

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

The reaction time must be taken into consideration by setting parameter P107.

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.

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

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

See also the parameter >Release time< P114

**Information** — **Brake control**

The relevant connection on the frequency inverter must be used to actuate the electromechanical brake (particularly with lifting mechanisms), if present (please see chapter 2.4.2.4 "Electromechanical brake"). The minimum absolute frequency (P505) should never be less than 2.0 Hz.

**Information** — **Torque limitation during active setpoint delay (P107 / P114)**

During an active setpoint delay, the torque is limited to a maximum of 160% of the rated torque. This prevents the occurrence of excessive currents in the inverter or breakdown of the motor if

- For application of the brake, the *brake reaction time* (P107) is set too long.
- For release of the brake, the value for the *absolute minimum frequency* (P505) is set too high.

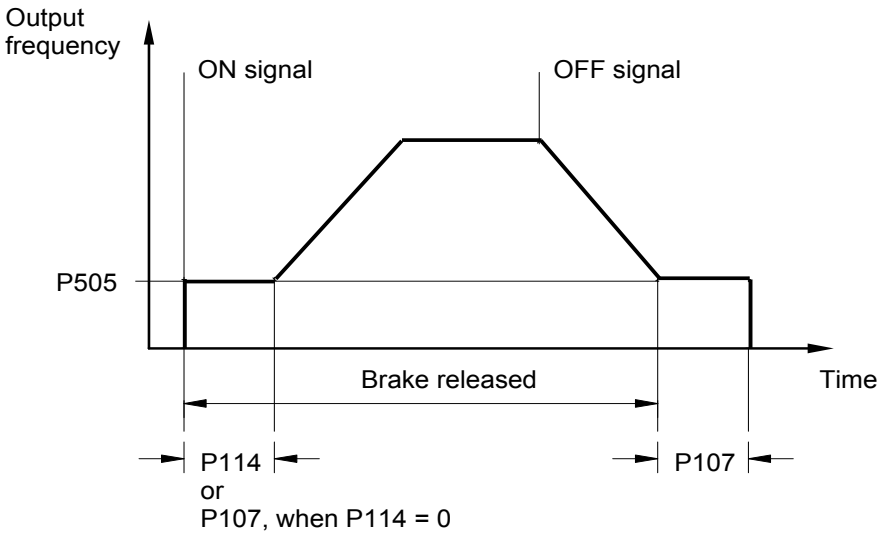
**Recommendation for applications:**
Lifting equipment with brake, without speed feedback Lifting equipment with brake

P114 = 0.02...0.4 s *
P107 = 0.02...0.4 s *
P201…P208 = Motor data
P434 = 1 (ext. brake)
P505 = 2...4 Hz

for safe start-up
P112 = 401 (off)
P536 = 2.1 (off)
P537 = 150 %
P539 = 2/3 ($I_{SD}$ monitoring)

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

* Settings (P107/114) depending on brake type and motor size. At low power levels (< 1.5 kW) lower values apply for higher power ratings (> 4.0 kW) are larger values.



| P108 | Disconnection mode<br>*(Disconnection mode)* | | S | P |
|---|---|---|---|---|

0 ... 13
{ 1 }

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

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

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

**2 = Ramp** with delay: as for 1 **"Ramp“**, however for generational operation the brake ramp is extended, or for static operation the output frequency is increased. Under certain conditions, this function can prevent overload switch off or reduce brake resistance power dissipation.

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

**3 = 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 >Time DC brake on< is shortened. The time taken for the motor to stop depends on the application. The time taken to stop depends on the mass inertia of the load and the DC current set (P109).
With this type of braking, no energy is returned to the FI; heat loss occurs mainly in the motor rotor.

**Not for PMSM motors!**

**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 (UZW), a high frequency voltage is switched to the basic frequency (only for linear characteristic curves, P211 = 0 and P212 = 0). The braking time (P103) is complied with if possible. → Additional heating in the motor!

**Not for PMSM motors!**

**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. comb. braking,** *"Quadratic combined braking"*: Combination of functions 5 and 6

**Not for PMSM motors!**

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

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

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

**12 = Const. acceln. power mode 3,** *"Constant acceleration power mode 3"* as for 11, however with additional relief of the brake chopper

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

| P109 | DC brake current<br>*(DC brake current)* | | S | P |
|---|---|---|---|---|
| 0 ... 250 %<br>{ 100 } | Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5).<br>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.<br>The 100% setting relates to a current value as stored in the >Nominal current< parameter P203.<br>**NOTE:** The amount of DC current (0 Hz) which the FI can supply is limited. For this value, please refer to the table in Section 8.4.3 "Reduced overcurrent due to output frequency", column: 0 Hz. In the basic setting this limiting value is about 110 %.<br>**DC braking Not for PMSM motors!** | | | |

| P110 | Time DC-brake on<br>*(DC braking time on)* | | S | P |
|---|---|---|---|---|
| 0.00 ... 60.00 sec<br>{ 2.00 } | The time during which current selected in parameter P109 is applied to the motor for the function "DC braking" selected in parameter P108 (P108 = 3).<br>Depending on the relationship of the actual output frequency to the max. frequency (P105), the >DC brake time< is shortened.<br>The time starts running with the removal of the enable and can be interrupted by fresh enabling.<br>**DC braking Not for PMSM motors!** | | | |

| P111 | P factor torque limit<br>*(P factor torque limit)* | | S | P |
|---|---|---|---|---|
| 25 ... 400 %<br>{ 100 } | Directly affects the behaviour of the drive at torque limit. The basic setting of 100% is sufficient for most drive tasks.<br>If values are too high the drive tends to vibrate as it reaches the torque limit. If values are too low, the programmed torque limit can be exceeded. | | | |

| P112 | Torque current limit<br>*(torque current limit)* | | S | P |
|---|---|---|---|---|
| 25 ... 400 % / 401<br>{ 401 } | With this parameter, a limit value for the torque-generating current can be set. This can prevent mechanical overloading of the drive. It cannot provide any protection against mechanical blockages (movement to stops). A slipping clutch which acts as a safety device must be provided.<br>The torque current limit can also be set over an infinite range of settings using an analogue input. The maximum setpoint (see 100% calibration, P403[-01] . .[-06]) the corresponds to the setting in P112.<br>The limit value 20% of current torque cannot be undershot by a smaller analogue setpoint (P400[-01] … [-09] = 11 or 12). In contrast, in servo mode ((P300) = "1") as of firmware version V 1.3 a limiting value of 0% is possible (older firmware versions: min. 10%)!<br>**401 = OFF** means the switch-off of the torque current limit! This is also the basic setting for the FI. | | | |

| P113 | Jog frequency *(Jog frequency)* | | S | P |
|---|---|---|---|---|

-400.0 ... 400.0 Hz
{ 0.0 }

When using the **SimpleBox or ParameterBox** to control the FI, the jog frequency is the initial value following successful enabling.

Alternatively, when control is via the control terminals, the jog frequency can be activated via one of the digital inputs.

The setting of the jog frequency can be done directly via this parameter or, if the FI is enabled via the keyboard, by pressing the OK key. In this case, the actual output frequency is set in parameter P113 and is then available for the next start.

**NOTE:** Specified setpoints via the control terminals, e.g. jog frequency, fixed frequencies or analogue setpoints, are generally added with the correct sign. The set maximum frequency (P105) cannot be exceeded and the minimum frequency (P104) cannot be undershot.

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

0 ... 2.50 s
{ 0.00 }

Electromagnetic brakes have a delayed reaction time during ventilation, which depends on physical factors. This can lead to the motor running while the brake is still applied, which will cause the inverter to switch off with an overcurrent report.

This release time can be taken into account in parameter P114 (Brake control).

During the adjustable ventilation time, the FI supplies the set absolute minimum frequency (P505) thus preventing movement against the brake.

See also the parameter >Brake reaction time< P107 (setting example).

**NOTE:**

If the brake ventilation time is set to "0", then P107 is the brake ventilation and reaction time.

| P120 | [-01] ... [-04] | Option monitoring *(Option monitoring)* | | S | |
|---|---|---|---|---|---|

0 ... 2
{ 1 }

Monitoring of communication at system bus level (in case of error: error message 10.9)

**Array levels:**

**[-01] =** Extension 1 (BUS unit)
**[-02] =** Extension 2 *(second I/O unit)*
**[-03] =** Extension 3 *(first I/O unit)*
**[-04] =** Extension 4 (reserved)

**Setting values**

**0 =** **Monitoring OFF**

**1 =** **Auto**, communication is only monitored if an existing communication is interrupted. If a module which was previously present is not found after switching on the mains, this does not result in an error
Monitoring only becomes active when an extension starts communication with the FI.

**2 =** **Monitoring active immediately** *"Monitoring active immediately"* , the FI starts monitoring the corresponding module immediately after the mains are 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.

**Note:** If error messages which are detected by the optional module (e.g. errors at field bus level) are not to result in a shut-down of the drive electronics, parameter (P513) must also be set to the value {-0,1}.

### 5.2.3 Motor data / Characteristic curve parameters

| Parameter {factory setting} | Setting value / Description / Note | | Supervisor | Parameter set |
|---|---|---|---|---|
| **P200** | **Motor list** *(Motor list)* | | | **P** |
| 0 ... 73 { 0 } | The factory settings for the motor data can be changed with this parameter. The factory setting in parameters P201...P209 is a 4-pole IE1 - DS standard motor with the nominal FI power setting.<br>By selecting one of the possible digits and pressing the ENTER key, all motor parameters (P201…P209) are adjusted to the selected standard power. The basis for the motor data is a 4-pole DS standard motor. The motor data for NORD IE4 motors can be found in the final section of the list.<br>**NOTE:**<br>As P200 returns to = 0 after the input confirmation, the control of the set motor can be implemented via parameter P205.<br>**Information** **IE2/IE3 Motors**<br>If IE2/IE3 motors are used, after selecting an IE1 motor (P200) the motor data in P201 to P209 must be adapted to the data on the motor type plate.<br>**NOTE:** If DIP switches S1:7 (50/60Hz operation (chapter 4.3.2.2)) are changed over, the relevant nominal motor data is reloaded in accordance with the FI nominal power from list P200. | | | |

**0 =** **No change**

**1 =** **No motor:** In this setting, the FI operates without current control, slip compensation and pre-magnetising time, and is therefore not recommended for motor applications. Possible applications are induction furnaces or other applications with coils and transformers. The following motor data is set here: 50.0 Hz / 1500 rpm / 15.0 A / 400 V / 0.00 kW / cos φ=0.90 / Stern / $R_S$ 0.01 Ω / $I_{LEER}$ 6.5 A

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2 =** | 0.25kW 230V | **32 =** | 4.0 kW 230V | **62 =** | 90.0 kW 400V | **92 =** | 1.00kW 115V |
| **3 =** | 0.33PS 230V | **33 =** | 5.0 PS 230V | **63 =** | 120.0 PS 460V | **93 =** | 4.0 PS 230V |
| **4 =** | 0.25kW 400V | **34 =** | 4.0 kW 400V | **64 =** | 110.0 kW 400V | **94 =** | 4.0 PS 460V |
| **5 =** | 0.33PS 460V | **35 =** | 5.0 PS 460V | **65 =** | 150.0 PS 460V | **95 =** | 0.75kW 230V 80T1/4 |
| **6 =** | 0.37kW 230V | **36 =** | 5.5 kW 230V | **66 =** | 132.0 kW 400V | **96 =** | 1.10kW 230V 90T1/4 |
| **7 =** | 0.50PS 230V | **37 =** | 7.5 PS 230V | **67 =** | 180.0 PS 460V | **97 =** | 1.10kW 230V 80T1/4 |
| **8 =** | 0.37kW 400V | **38 =** | 5.5 kW 400V | **68 =** | 160.0 kW 400V | **98 =** | 1.10kW 400V 80T1/4 |
| **9 =** | 0.50PS 460V | **39 =** | 7.5 PS 460V | **69 =** | 220.0 PS 460V | **99 =** | 1.50kW 230V 90T3/4 |
| **10 =** | 0.55kW 230V | **40 =** | 7.5 kW 230V | **70 =** | 200.0 kW 400V | **100 =** | 1.50kW 230V 90T1/4 |
| **11 =** | 0.75PS 230V | **41 =** | 10.0 PS 230V | **71 =** | 270.0 PS 460V | **101 =** | 1.50kW 400V 90T1/4 |
| **12 =** | 0.55kW 400V | **42 =** | 7.5 kW 400V | **72 =** | 250.0 kW 400V | **102 =** | 1.50kW 400V 80T1/4 |
| **13 =** | 0.75PS 460V | **43 =** | 10.0 PS 460V | **73 =** | 340.0 PS 460V | **103 =** | 2.20kW 230V 100T2/4 |
| **14 =** | 0.75kW 230V | **44 =** | 11.0 kW 400V | **74 =** | 11.0 kW 230V | **104 =** | 2.20kW 230V 90T3/4 |
| **15 =** | 1.0 PS 230V | **45 =** | 15.0 PS 460V | **75 =** | 15.0 PS 230V | **105 =** | 2.20kW 400V 90T3/4 |
| **16 =** | 0.75kW 400V | **46 =** | 15.0 kW 400V | **76 =** | 15.0 kW 230V | **106 =** | 2.20kW 400V 90T1/4 |
| **17 =** | 1.0 PS 460V | **47 =** | 20.0 PS 460V | **77 =** | 20.0 PS 230V | **107 =** | 3.00kW 230V 100T5/4 |
| **18 =** | 1.1 kW 230V | **48 =** | 18.5 kW 400V | **78 =** | 18.5 kW 230V | **108 =** | 3.00kW 230V 100T2/4 |
| **19 =** | 1.5 PS 230V | **49 =** | 25.0 PS 460V | **79 =** | 25.0 PS 230V | **109 =** | 3.00kW 400V 100T2/4 |
| **20 =** | 1.1 kW 400V | **50 =** | 22.0 kW 400V | **80 =** | 22.0 kW 230V | **110 =** | 3.00kW 400V 90T3/4 |
| **21 =** | 1.5 PS 460V | **51 =** | 30.0 PS 460V | **81 =** | 30.0 PS 230V | **111 =** | 4.00kW 230V 100T5/4 |
| **22 =** | 1.5 kW 230V | **52 =** | 30.0 kW 400V | **82 =** | 30.0 kW 230V | **112 =** | 4.00kW 400V 100T5/4 |
| **23 =** | 2.0 PS 230V | **53 =** | 40.0 PS 460V | **83 =** | 40.0 PS 230V | **113 =** | 4.00kW 400V 100T2/4 |
| **24 =** | 1.5 kW 400V | **54 =** | 37.0 kW 400V | **84 =** | 37.0 kW 230V | **114 =** | 5.50kW 400V 100T5/4 |
| **25 =** | 2.0 PS 460V | **55 =** | 50.0 PS 460V | **85 =** | 50.0 PS 230V | **115 =** | |
| **26 =** | 2.2 kW 230V | **56 =** | 45.0 kW 400V | **86 =** | 0.12kW 115V | **116 =** | |
| **27 =** | 3.0 PS 230V | **57 =** | 60.0 PS 460V | **87 =** | 0.18kW 115V | **117 =** | |
| **28 =** | 2.2 kW 400V | **58 =** | 55.0 kW 400V | **88 =** | 0.25kW 115V | **118 =** | |
| **29 =** | 3.0 PS 460V | **59 =** | 75.0 PS 460V | **89 =** | 0.37kW 115V | **119 =** | |
| **30 =** | 3.0 kW 230V | **60 =** | 75.0 kW 400V | **90 =** | 0.55kW 115V | **120 =** | |
| **31 =** | 3.0 kW 400V | **61 =** | 100.0 PS 460V | **91 =** | 0.75kW 115V | **121 =** | |

## P201 Nominal motor frequency

*(Nominal motor frequency)*

S P

10.0 ... 399.9 Hz
{ see information }

The motor nominal frequency determines the V/f break point at which the FI supplies the nominal voltage (P204) at the output.

**Information** **Default setting**

The default setting is dependent upon the FI nominal power and the setting in P200.

## P202 Nominal motor speed

*(Nominal motor speed)*

S P

150 ... 24000 rpm
{ see information }

The nominal motor speed is important for the correct calculation and control of the motor slip and the speed display (P001 = 1).

**Information** **Default setting**

The default setting is dependent upon the FI nominal power and the setting in P200.

| P203 | Nominal motor current<br>*(Nominal motor current)* | | S | P |
|---|---|---|---|---|
| 0.1 ... 1000.0 A<br>{ see information } | The nominal motor current is a decisive parameter for the current vector control.<br>**Information** **Default setting**<br>The default setting is dependent upon the FI nominal power and the setting in P200. | | | |

| P204 | Nominal motor voltage<br>*(Nominal motor voltage)* | | S | P |
|---|---|---|---|---|
| 100 ... 800 V<br>{ see information } | The >Nominal voltage< matches the mains voltage to the motor voltage. In combination with the nominal frequency, the voltage/frequency characteristic curve is produced.<br>**Information** **Default setting**<br>The default setting is dependent upon the FI nominal power and the setting in P200. | | | |

| P205 | Nominal motor power<br>*(Nominal motor power)* | | | P |
|---|---|---|---|---|
| 0.00 ... 250.00 kW<br>{ see information } | The motor nominal power controls the motor set via P200.<br>**Information** **Default setting**<br>The default setting is dependent upon the FI nominal power and the setting in P200. | | | |

| P206 | Motor cos phi<br>*(Motor cos φ)* | | S | P |
|---|---|---|---|---|
| 0.50 ... 0.95<br>{ see information } | The motor cos φ is a decisive parameter for the current vector control.<br>**Information** **Default setting**<br>The default setting is dependent upon the FI nominal power and the setting in P200.<br>**Information** **PMSM**<br>This parameter is not relevant if a PMSM is used. | | | |

| P207 | Motor circuit<br>*(Motor circuit)* | | S | P |
|---|---|---|---|---|
| 0 ... 1<br>{ see information } | **0 = star** **1 = delta**<br>The motor circuit is decisive for stator resistance measurement (P220) and therefore critical for current vector control.<br>**Information** **Default setting**<br>The default setting is dependent upon the FI nominal power and the setting in P200. | | | |

| P208 | Stator resistance<br>*(Stator resistance)* | | S | P |
|---|---|---|---|---|

0.00 ... 300.00 W
{ see information }

Motor stator resistance ⇒ resistance of a phase winding with a DC motor.

Has a direct influence on the current control of the FI. Too high a value will lead to a possible overcurrent; too low a value to a motor torque that is too low.

The parameter P220 can be used for simple measurement. Parameter P208 can be used for manual setting or as information about the result of an automatic measurement.

**NOTE:**

For optimum functioning of the current vector control, the stator resistance must be automatically measured by the FI.

**Information** **Default setting**

The default setting is dependent upon the FI nominal power and the setting in P200.

| P209 | No load current<br>*(No load current)* | | S | P |
|---|---|---|---|---|

0.0 ... 1000.0 A
{ see information }

This value is always calculated automatically from the motor data if there is a change in the parameter >cos φ< P206 and the parameter >Nominal current< P203.

**NOTE:** If the value is to be entered directly, then it must be set as the last motor data. This is the only way to ensure that the value will not be overwritten.

**Information** **Default setting**

The default setting is dependent upon the FI nominal power and the setting in P200.

| P210 | Static boost<br>*(Static boost)* | | S | P |
|---|---|---|---|---|

0 ... 400 %
{ 100 }

The static boost affects the current that generates the magnetic field. This is equivalent to the no load current of the respective motor and is therefore load-independent. The no load current is calculated using the motor data. The factory setting of 100% is sufficient for normal applications.

| P211 | Dynamic boost<br>*(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.

**Information** **V/f characteristic curve**

With certain applications, particularly those with high centrifugal mass (e.g. fan drives), it may be necessary to control the motor with the aid of a U/f characteristic. In order to do this, parameters **P211** and **P212** must each be set to 0%.

| P212 | Slip compensation<br>*(Slip compensation)* | | S | P |
|---|---|---|---|---|

0 ... 150%
{ 100 }

The slip compensation increases the output frequency, dependent on load, to keep the asynchronous motor speed approximately constant.

The factory setting of 100% is optimal when using DC asynchronous motors and correct motor data has been set.

If several motors (different loads or outputs) are operated with one FI, the slip compensation P212 must be set to 0%. This excludes any negative influences. With PMSM motors, the parameter must be left at the factory setting.

**Information** — **V/f characteristic curve**

With certain applications, particularly those with high centrifugal mass (e.g. fan drives), it may be necessary to control the motor with the aid of a U/f characteristic. In order to do this, parameters **P211** and **P212** must each be set to 0%.

| P213 | ISD ctrl. loop gain<br>*(Amplification of ISD control)* | | S | P |
|---|---|---|---|---|

25 ... 400 %
{ 100 }

This parameter influences the control dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower.

Dependent on application type, this parameter can be altered, e.g. to avoid unstable operation.

| P214 | Torque precontrol<br>*(Torque precontrol)* | | S | P |
|---|---|---|---|---|

-200 ... 200 %
{ 0 }

This function allows a value for the expected torque requirement to be set in the controller. This function can be used in lifting applications for a better load transfer during start-up.

**NOTE:** Motor torques (with rotation field right) are entered with a positive sign, generator torques are entered with a negative sign. The reverse applies for the counter clockwise rotation.

| P215 | Boost precontrol<br>*(Boost precontrol)* | | S | P |
|---|---|---|---|---|

0 ... 200 %
{ 0 }

Only advisable with linear characteristic curve (P211 = 0% and P212 = 0%).

For drives that require a high starting torque, this parameter provides an option for switching in an additional current during the start phase. The application time is limited and can be selected at parameter >Time boost precontrol< P216.

All current and torque current limits that may have been set (P112 and P536, P537) are deactivated during the boost lead time.

**NOTE:**

With active ISD control (P211 and / or P212 ≠ 0%), parameterisation of P215 ≠ 0 results in incorrect control.

| P216 | Time boost precontrol<br>*(Time boost precontrol)* | | S | P |
|---|---|---|---|---|
| 0.0 ... 10.0 sec<br>{ 0.0 } | This parameter is used for 3 functionalities<br>**Time limit** for the **boost lead**: Application time for increased starting current. Only with linear characteristic curve (P211 = 0% and P212 = 0%).<br>**Time limit** for **suppression of** pulse **switch-off** (P537): enables start-up under heavy load.<br>**Time limit** for **suppression** of **switch-off on error** in parameter (P401), setting { 05 } "0 - 10V with switch-off on error 2" | | | |

| P217 | Oscillation damping<br>*(Oscillation damping)* | | S | P |
|---|---|---|---|---|
| 0 ... 400 %<br>{ 10 } | With the oscillation damping, idling current harmonics can be damped. Parameter 217 is a measure of the damping power.<br>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.<br>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.<br>With a set value of 10 % for P217, a maximum of ± 0.045 Hz are switched in. At 400 % in P217, this corresponds to ± 1.8 Hz<br>The function is not active in “Servo mode, P300”. | | | |

| P218 | Modulation depth<br>*(Modulation depth)* | | S | |
|---|---|---|---|---|
| 50 ... 110 %<br>{ 100 }*e* | This setting influences the maximum possible output voltage of the FI in relation to the mains voltage. Values <100% reduce the voltage to values below that of the mains voltage if this is required for motors. Values >100% increase the output voltage to the motor increased the harmonics in the current, which may cause swinging in some motors.<br>Normally, 100% should be set. | | | |

| P219 | **Automatic flux optimisation**<br>*(Automatic flux optimisation)* | | S | |
|---|---|---|---|---|

25 ... 100 % / 101
{ 100 }

With this parameter, the magnetic flux of the motor can be automatically matched to the motor load, so that the energy consumption is reduced to the amount which is actually required. P219 is a limiting value, to which the field in the motor can be reduced.

As standard, the value is set to 100 %, and therefore no reduction is possible. As minimum, 25 % can be set.

The reduction of the field is performed with a time constant of approx. 7.5 s. On increase of load the field is built up again with a time constant of approx. 300 ms. The reduction of the field is carried out so that the magnetisation current and the torque current are approximately equal, so that the motor is operated with “optimum efficiency”. An increase of the field above the setpoint value is not intended.

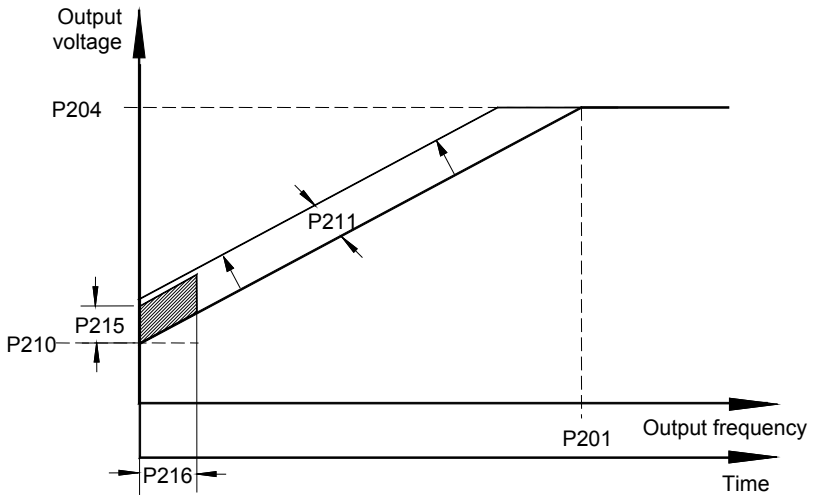
This function is intended for applications in which the required torque only changes slowly (e.g. pumps and fans). Its effect therefore replaces a quadratic curve, as it adapts the voltage to the load.

**This parameter does not function for the operation of synchronous motors (IE4 motors).**

**NOTE**: This must not be used for lifting or applications where a more rapid build-up of the torque is required, as otherwise there would be overcurrent switch-offs or inversion of the motor on sudden changes of load, because the missing field would have be compensated by a disproportionate torque current.

**101 = automatic,** with the setting P219 = 101 an automatic magnetisation current controller is activated. The ISD controller then operates with a subordinate magnetizing controller, which improves the slippage calculation, especially at higher loads. The control times are considerably faster compared to the Normal ISD control (P219 = 100)

## P2xx Control/characteristic curve parameters




**NOTE:**
"typical"

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

| P220 | Para. identification<br>*(Parameter identification)* | | | P |
|---|---|---|---|---|

0 … 2
{ 0 }

With devices with output of 22 KW, the motor data is determined automatically by the device via these parameters. In many cases, better drive behaviour is achieved with the measured motor data.

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

**0 = No identification**

**1 = Identification $R_S$**:

The stator resistance (display in P208) is determined by multiple measurements.

**2 = Motor identification**:

This function can only be used with devices up to 22 KW.

**ASM**: all motor parameters (P202, P203, P206, P208, P209) are determined.

**PMSM**: the stator resistance (P208) and the inductance (P241) are determined.

NB: Motor identification should only be carried out on a cold motor (15 … 25°C) Warming up of the motor during operation is taken into account.

The FI must be in “Ready for operation” condition. For BUS operation, the BUS must be operating without error.

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

A maximum motor cable length of 20m must be adhered to for reliable identification.

Before starting motor identification, the motor data must be preset in accordance with the rating plate or P200. At least the nominal frequency (P201), the nominal speed (P202), the voltage (P204), the power (P205) and the motor circuit (P207) must be known.

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

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

After identification of parameters, P220 is again = 0.

| P240 | EMF voltage PMSM<br>*(EMF voltage PMSM)* | | S | P |
|---|---|---|---|---|

0 … 800 V
{ 0 }

The EMF constant describes the self induction voltage of the motor. The value to be set can be found on the data sheet for the motor or on the type plate and is scaled to 1000 rpm. As the rated speed of the motor is not usually 1000 rpm, these details must be converted accordingly:

***Example:***

| | |
|---|---|
| E (EMF - constant, type plate): | 89 V |
| Nn (rated speed of motor): | 2100 rpm |
| Value in P240 | P240 = E * Nn/1000<br>P240 = 89 V * 2100 rpm / 1000 rpm<br>**P240 = 187 V** |

**0 = ASM is used,** *"Asynchronous machine is used"*: No compensation

| P241 [-01] [-02] | Inductivity PMSM *(Inductivity PMSM)* | | S | P |
|---|---|---|---|---|
| 0.1 ... 200.0 mH<br>{ all 20.0 } | The typical asymmetric reluctances of the PMSM are compensated with this parameter. The stator inductances can be measured by the frequency inverter (P220)<br>**[-01] = d axis ($L_d$)** **[-02] = q axis ($L_q$)** | | | |

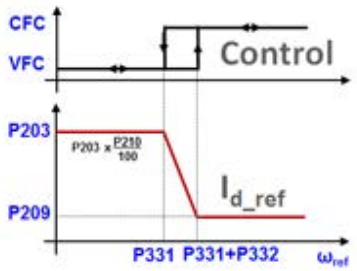
| P243 | Reluct. angle IPMSM *(Reluctance angle IPMSM)* | | S | P |
|---|---|---|---|---|
| 0 … 30 °<br>{ 0 } | In addition to the synchronous torque, synchronous motors with embedded magnets also have a reluctance torque. The reason for this is due to the anisotropy (inequality) between the inductivity in the d and the q direction. Due to the superimposition of these two torque components, the optimum efficiency is not at a load angle of 90°, as with SPMSMs, but rather with larger values. This additional angle, which can be assumed as 10° for NORD motors, can be taken into account with this parameter. The smaller the angle, the smaller the reluctance component.<br>The specific reluctance angle for the motor can be determined as follows:<br>• Allow drives with constant load ( > 0.5 $M_N$) to run in CFC mode (P300 ≥ 1)<br>• Gradually increase the reluctance angle (P243) until the current (P719) reaches a minimum | | | |

| P244 | Peak current PMSM *(Peak current PMSM)* | | S | P |
|---|---|---|---|---|
| 0.1 … 1000.0 A<br>{ 5.0 } | This parameter contains the peak current of a synchronous motor. The value must be obtained from the motor data sheet. | | | |

| P245 | Osc damping .PMSM VFC *(Oscillation damping PMSM VFC)* | | S | P |
|---|---|---|---|---|
| 5 … 100 %<br>{ 25 } | In VFC open-loop mode, PMSM motors tend to oscillate due to insufficient intrinsic damping. With the aid of "oscillation damping" this tendency to oscillate is counteracted by electrical damping. | | | |

| P246 | Mass inertia PMSM *(Mass inertia PMSM)* | | S | P |
|---|---|---|---|---|
| 0.0 … 1000.0 kg*cm²<br>{ 5.0 } | The mass inertia of the drive system can be entered in this parameter. For most applications the default setting is sufficient. However, for highly dynamic systems the actual value should ideally be entered. The values for the motors can be obtained from the technical data. The portion of the external centrifugal mass (gear unit, machine) must be calculated or determined experimentally. | | | |

| P247 | Switch freq.VFC PMSM *(Switchover frequency VFC PMSM)* | | S | P |
|---|---|---|---|---|
| 1 ... 100 %<br>{ 25 } | In order to provide a minimum amount of torque immediately in case of spontaneous load changes, in VFC mode the setpoint of $I_d$ (magnetisation current) is controlled depending on the frequency (field increase mode) The amount of this additional field current is determined by parameter (P210). This reduces linearly to the value "zero", which is reached at the frequency which is governed by (P247). In this case, 100 % corresponds to the rated motor frequency from (P201). | | | |



### 5.2.4 Speed control

In combination with an HTL incremental encoder, a closed speed control loop can be set up using digital inputs 2 and 3 of the FI.

Alternatively, the incremental encoder can also be used in another way. In order to do this, the required function must be selected in parameter L325.

In order to make this parameter visible, the supervisor parameter P003 must be set to 2 or 3.

| Parameter {factory setting} | Setting value / Description / Note | Device | Supervisor | Parameter set |
|---|---|---|---|---|
| **P300** | **Servo Mode** *(Servo Mode)* | | | **P** |
| 0 ... 2 { 0 } | The control method for the motor is defined with this parameter. The following constraints must be observed: In comparison with the setting "0", the setting "2" enables somewhat higher dynamics and control precision, however it requires greater effort for parameterisation. In contrast, the setting "1" operates with speed feedback from an encoder and therefore enables the highest possible quality of speed control and dynamics.<br>**0 = Off (VFC open -loop) 1)** Speed control without encoder feedback<br>**1 = On (CFC closed-loop) 2)** Speed control with encoder feedback<br>**2 = Obs (CFC open-loop)** Speed control without encoder feedback<br>**NOTE:**<br>Commissioning information (🕮 Abschnitt 4.2 "Selecting the operating mode for motor control").<br>1) Corresponds to the previous setting "OFF"<br>2) Corresponds to the previous setting "ON" | | | |

**Information**

**IE4 motor operation**

**with (P330), Setting 1 = On** (CFC closed-loop)

If an IE4 motor is operated in CFC closed-loop mode, the **slip error monitoring** must be **activated** (**P327 ≠ 0**)

| P301 | **Rotary encoder res.**<br>*(Rotary encoder resolution)* | | | |
|---|---|---|---|---|
| 0 ... 17<br>{ 6 } | Input of the pulse-count per rotation of the connected encoder.<br>If the encoder rotation direction is not the same as the FI, (depending on installation and wiring), this can be compensated for by selecting the corresponding negative pulse numbers 8...16.<br>**0 =** 500 pulses<br>**1 =** 512 pulses<br>**2 =** 1000 pulses<br>**3 =** 1024 pulses<br>**4 =** 2000 pulses<br>**5 =** 2048 pulses<br>**6 =** 4096 pulses<br>**7 =** 5000 pulses<br>**17 =** 8192 pulses<br>**8 =** -500 pulses<br>**9 =** -512 pulses<br>**10 =** -1000 pulses<br>**11 =** -1024 pulses<br>**12 =** -2000 pulses<br>**13 =** -2048 pulses<br>**14 =** -4096 pulses<br>**15 =** -5000 pulses<br>**16 =** -8192 pulses<br>**NOTE:**<br>(P301) is also significant for position control via incremental encoders. If an incremental encoder is used for positioning (P604=1), the setting of the pulse number is made here. (Please refer to POSICON Supplementary Manual) | | | |

| P310 | Speed controller P<br>*(Speed controller P)* | | | P |
|---|---|---|---|---|
| 0 ... 3200 %<br>{ 100 } | P-component of the speed encoder (proportional amplification).<br>Amplification factor, by which the speed difference between the setpoint and actual frequency is multiplied. A value of 100% means that a speed difference of 10% produces a setpoint of 10%. Values that are too high can cause the output speed to oscillate. | | | |

| P311 | Speed controller I<br>*(Speed controller I)* | | | P |
|---|---|---|---|---|
| 0 ... 800 % / ms<br>{ 20 } | I-component of the encoder (Integration component).<br>The integration component of the controller enables the complete elimination of any control deviation. The value indicates how large the setpoint change is per ms. Values that are too small cause the controller to slow down (reset time is too long). | | | |

| P312 | Torque current controller P<br>*(Torque current controller P)* | | S | P |
|---|---|---|---|---|
| 0 ... 1000 %<br>{ 400 } | Current controller for the torque current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. Excessively high values in P312 generally lead to high-frequency oscillations at low speeds; on the other hand, excessively high values in P313 generally produce low frequency oscillations across the whole speed range.<br>If the value "Zero" is entered in P312 and P313, then the torque current control is switched off. In this case, only the motor model pre-control is used. | | | |

| P313 | Torque current controller I<br>*(Torque current controller I)* | | S | P |
|---|---|---|---|---|
| 0 ... 800 % / ms<br>{ 50 } | I-proportion of the torque current controller. (See also P312 >Torque current controller P<) | | | |

| P314 | Torque current controller limit<br>*(Torque current controller limit)* | | S | P |
|---|---|---|---|---|
| 0 ... 400 V<br>{ 400 } | Determines the maximum voltage increase of the torque current controller. The higher the value, the greater the maximum effect that can be exercised by the torque current controller. Excessive values in P314 can specifically lead to instability during transition to the field weakening zone (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced. | | | |

| P315 | Field current controller P<br>*(Field current controller P)* | | S | P |
|---|---|---|---|---|
| 0 ... 1000 %<br>{ 400 } | Current controller for the field current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. Excessively high values for P315 generally lead to high frequency vibrations at low speeds. On the other hand, excessively high values in P316 generally produce low frequency vibrations across the whole speed range If the value "Zero" is entered in P315 and P316, then the field current controller is switched off. In this case, only the motor model pre-control is used. | | | |

| P316 | Field current controller I<br>*(Field current controller I)* | | S | P |
|---|---|---|---|---|
| 0 ... 800 % / ms<br>{ 50 } | I-proportion of the field current controller. See also P315 >Field current controller P< | | | |

| P317 | Field current controller limit<br>*(Field current controller limit)* | | S | P |
|---|---|---|---|---|
| 0 ... 400 V<br>{ 400 } | Determines the maximum voltage increase of the field current controller. The higher the value, the greater is the maximum effect that can be exercised by the field current controller. Excessive values in P317 can specifically lead to instability during transition to the field reduction range (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced. | | | |

| P318 | Field weakening controller P<br>*(Field weakening controller P)* | | S | P |
|---|---|---|---|---|
| 0 ... 800 %<br>{ 150 } | The field weakening controller reduces the field setpoint when the synchronous speed is exceeded. Generally, the field weakening controller has no function; for this reason, the field weakening controller only needs to be set if speeds are set above the nominal motor speed. Excessive values for P318 / P319 will lead to controller oscillations. The field is not weakened sufficiently if the values are too small or during dynamic acceleration and/or delay times. The downstream current controller can no longer read the current setpoint. | | | |

| P319 | Field weakening controller I<br>*(Field weakening controller I)* | | S | P |
|---|---|---|---|---|
| 0 ... 800 % / ms<br>{ 20 } | Only affects the field weakening range, see P318 >Field weakening controller P< | | | |

| P320 | Field weakening limit<br>*(Field weakening limit)* | | S | P |
|---|---|---|---|---|
| 0 ... 110 %<br>{ 100 } | The field weakening limit determines at which speed / current the controller will begin to weaken the field. At a set value of 100% the controller will begin to weaken the field at approximately the synchronous speed.<br>If values much larger than the standard values have been set in P314 and/or P317, then the field weakening limit should be correspondingly reduced, so that the control range is actually available to the current controller. | | | |

| P321 | Speedctr. I brake off<br>*(Speed control I brake release time)* | | S | P |
|---|---|---|---|---|
| 0 ... 4<br>{ 0 } | During the brake release time (P107/P114), the I component of the speed control is increased. This leads to better load take-up, especially with vertical movements.<br>**0 =** P311 speed control I x 1<br>**1 =** P311 speed control I x 2<br>**2 =** P311 speed control I x 4<br>**3 =** P311 speed control I x 8<br>**4 =** P311 speed control I x 16 | | | |

| P325 | Rotary encoder function<br>*(Rotary encoder function)* | | S | |
|---|---|---|---|---|

0 ... 4
{ 0 }

The actual speed list value supplied by an incremental encoder to the FI can be used for various functions in the FI.

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

**1 = PID actual frequency value**: The actual speed of a system is used for speed control. This function can also be used for controlling a motor with a linear characteristic curve. It is also possible to use an incremental encoder for speed control which is not mounted directly onto the motor. P413 – P416 determine the control.

**2 = Frequency addition**: The determined speed is added to the actual setpoint value.

**3 = Frequency subtraction**: The determined speed is subtracted from the actual setpoint.

**4 = Maximum frequency**: The maximum possible output frequency / speed is limited by the speed of the encoder.

| P326 | Ratio encoder<br>*(Encoder transformation ratio)* | | S | |
|---|---|---|---|---|

0.01 ... 100.0
{ 1.00 }

If the incremental encoder is not mounted directly onto the motor shaft, then the respectively correct transformation ratio of motor speed to encoder speed must be set.

$$P326 = \frac{\text{Motor speed}}{\text{Encoder speed}}$$

Only when P325 = 1, 2, 3 or 4, therefore not in Servo mode (motor speed control)

| P327 | Speed slip error<br>*(Speed slip error, speed control)* | | S | P |
|---|---|---|---|---|

0 ... 3000 rpm
{ 0 }

The limit value for a permitted maximum slip error can be set. If this value is reached, the FI switches off and indicates error **E013.1**. The slip error monitoring functions both with active and inactive servo mode (**P300**).

**0 = OFF**

Only when **P325** = 0, therefore in Servo mode (motor speed control).

(see also 🕮 **P328**)

| P328 | Speed slip delay<br>*(Speed slip error delay)* | | S | P |
|---|---|---|---|---|

0.0 ... 10.0 sec
{ 0.0 }

If the permissible speed slip error defined in (P327) is exceeded the error message E013.1 is suppressed within the time limits which are set here.

**0.0 = OFF**

| P330 | **Rotor starting position detection**<br>*(Rotor starting position detection)*<br>(Former designation: "**PMSM Regulation** ") | | S | |
|---|---|---|---|---|

0 ... 3
{ 0 }

Selection of the method for determination of the starting position of the rotor (initial value of the rotor position) of a PMSM (Permanent Magnet Synchronous Motor).

The parameter is only relevant for the control method "CFC closed-loop" (P300, setting "1").

**0 =** **Voltage controlled**: With the first start of the machine, a voltage indicator is memorised which ensures that the rotor of the machine is set to the rotor position "zero". This type of starting position of the rotor can only be used if there is no counter-torque from the machine (e.g. flywheel drive) at frequency "zero". If this condition is fulfilled, this method of determining the position of the rotor is very precise (<1° electrical). In principle, this method is not suitable for lifting equipment, as there is always a counter-torque.

*For operation without encoders, the following applies:* Up to the switch over frequency P331 the motor (with the nominal current memorised) is driven under voltage control. Once the switch over frequency has been reached, the method of determining the rotor position is switched over to the EMF method. If, taking hysteresis (P332) into account, the frequency falls below the value in (P331), the frequency inverter switches back from the EMF method to voltage controlled operation.

**1 =** **Test signal method**: The starting position of the rotor is determined with a test signal. This method also functions at a standstill with the brake applied, however it requires a PMSM with sufficient anisotropy between the inductivity of the d and q axes. The higher this anisotropy is, the greater the precision of the method. By means of parameter (P212) the voltage level of the test signal can be adjusted and with parameter (P213) the position of the motor position control can be adjusted. For motors which are suitable for use with the test signal method, a rotor position accuracy of 5°…10° electrical can be achieved (depending on the motor and the anisotropy).

**2 =** **reserved**

**3 =** **Value from CANopen encoder,** *"Value from CANopen encoder"*: With this method the starting position of the rotor is determined from the absolute position of a CANopen absolute encoder. The CANopen absolute encoder type is set in parameter (P604).

For this position information to be unique it must be known (or determined) how this rotor position relates to the absolute position of the CANopen absolute encoder. This is performed via the offset parameter (P334). Motors should be delivered either with a starting rotor position "zero" or the starting rotor position must be marked on the motor. If this value is not available, the offset value can also be determined with the settings "0" and"1" of parameter (P330). For this the drive unit is started with the setting "0" or "1". After the first start the offset value which has been determined is saved in parameter (P334). However, this value is volatile, i.e. it is only saved in the RAM. In order to save it in the EEPROM, it must be briefly changed and then set back to the determined value.

After this, fine tuning can be carried out with the motor idling. For this, the drive is operated in closed loop mode (P300=1) at as high a speed as possible below the field weakening point. From the starting point, the offset is gradually adjusted so that the value of the voltage component $U_d$ (P723) is as close to zero as possible. For this, a balance between the positive and negative direction of rotation must be sought.

Usually the value "zero" will not be completely achieved, as at higher speeds the drive is subjected to a slight load due to the motor fan. The CANopen absolute encoder should be located on the motor shaft.

| P331 | Switch over freq. CFC ol<br>*(Switch over frequency CFC open-loop)*<br>(Former designation: "**Switch over freq. PMSM**") | | S | P |
|---|---|---|---|---|
| 5.0 ... 100.0 %<br>{ 15.0 } | Definition of the frequency from which, in operation without encoder, the control method of a PMSM (Permanent Magnet Synchronous Motor) is activated according to (P300). In this case, 100 % corresponds to the nominal motor frequency from (P201).<br>The parameter is only relevant for the control method "CFC open-loop" (P300, setting "2"). | | | |

| P332 | Hyst. Switchover CFC ol<br>*(Switchover frequency hysteresis CFC open-loop)*<br>(Former designation: "**Hyst. Switchover PMSM**") | | S | P |
|---|---|---|---|---|
| 0.1 ... 25.0 %<br>{ 5.0 } | Difference between the switch-on and switch-off point in order to prevent oscillation on the transition of operation without encoder into the control method specified in (P330) (and vice versa). | | | |

| P333 | Flux feedback CFC ol<br>*(Flux feedback CFC open-loop)*<br>(Former designation: "**Flux feedb. fact. PMSM**") | | S | P |
|---|---|---|---|---|
| 5 ... 400 %<br>{ 25 } | This parameter is necessary for the position monitor in CFC open-loop mode. The higher the value which is selected, the lower the slip error from the rotor position monitor. However, higher values also limit the lower limit frequency of the position monitor. The larger the feedback amplification which is selected, the higher the limit frequency and the higher the values which must be set in (P331) and (P332). This conflict of objectives can therefore not be resolved simultaneously for both optimisation objectives.<br>The default value is selected so that it typically does not need to be adjusted for NORD IE4 motors. | | | |

| P334 | Encoder offset PMSM<br>*(Encoder offset PMSM)* | | S | |
|---|---|---|---|---|
| -0,500 ... 0,500 rev<br>{ 0,000 } | Evaluation of the zero track is necessary for the operation of PMSM (Permanent Magnet Synchronous Motors). The zero impulse is then used for synchronisation of the rotor position. Parameter (P330) must be set to "0" or "1".<br>The value to be set for parameter (P334) (offset between zero pulse and actual rotor position "Zero") must be determined experimentally or included with the motor.<br>A sticker is typically affixed to motors supplied by NORD on which the setting is specified.<br>Provided that the details on the motor are specified in **°**, these must be converted into **rev** (e.g. 90 ° = 0.250 rev).<br>**Note**<br>– The zero track is connected via **digital input 1**.<br>– Parameter P420 [-01] must be set to function *43* "0-track HTL encoder DI1" in order to evaluate the pulses of the zero track. | | | |

| P350 | PLC functionality<br>*(PLC functionality)* | | S | |
|---|---|---|---|---|

0 ... 1
{ 0 }

Activate the integrated PLC

**0 =** **Off**: the PLC is not active, the frequency inverter is actuated in accordance with parameters (P509) and (P510).

**1 =** **To:** the PLC is active, frequency inverter is actuated via the PLC, depending on (P351). The definition of the main setpoints must be carried out accordingly in parameter (P553). Auxiliary setpoints (P510[-02]) can still be defined via (P546).

| P351 | PLC Setpoint selection<br>*(PLC Setpoint selection)* | | S | |
|---|---|---|---|---|

0 ... 3
{ 0 }

Selection of the source for the control word (STW) and the main setpoint (HSW) with active PLC functionality (P350 = 1). With the settings "0" and "1", the main setpoints are defined via (P553), but the definition of the auxiliary setpoints remains unchanged via (P546). This parameter is only taken over if the frequency inverter is in "Ready to start" status.

**0 =** **STW & HSW = PLC:** The PLC supplies the control word (STW) and the main setpoint (HSW), and parameters (P509) and (P510[-01]) have no effect.

**1 =** **STW = P509:** The PLC supplies the main setpoint (HSW), the control word (STW) corresponds to the setting in parameter (P509)

**2 =** **HSW = P510[1]:** The PLC supplies the control word (STW), the source for the main setpoint (HSW) corresponds to the setting in parameter (P510[-01])

**3 =** **STW & HSW = P509/510:** The source for the control word (STW) and the main setpoint (HSW) corresponds to the setting in parameter (P509)/(P510[-01])

| P353 | Bus status via PLC<br>*(Bus status via PLC)* | | S | |
|---|---|---|---|---|

0 ... 3
{ 0 }

This parameter can be used to determine how the control word (STW) for the master function and the status word (ZSW) of the frequency inverter undergo further processing by the PLC.

**0 =** **Off:** The control word (STW) of the master function (P503≠0) and the status word (ZSW) undergo further processing by the PLC without change.

**1 =** **STW for broadcast:** The control word (STW) for the master value function (P503≠ 0) is set by the PLC. In order to do this, the control word must be redefined in the PLC using process value "34_PLC_Busmaster_Control_word".

**2 =** **ZSW for bus:** The status word (ZSW) of the frequency inverter is set by the PLC. In order to do this, the status word must be redefined in the PLC using process value "28_PLC_status_word".

**3 =** **STW Broadcast&ZSWBus:** *See setting 1 and 2*

| P355 [-01] ... [-10] | PLC Integer Setpoint<br>*(PLC Integer Setpoint)* | | S | |
|---|---|---|---|---|
| 0x0000 … 0xFFFF<br>all = { 0 } | Data can be exchanged with the PLC via this INT array. This data can be used by the appropriate process variables in the PLC. | | | |

| P356 [-01] ... [-05] | PLC Long Setpoint<br>*(PLC Long Setpoint)* | | S | |
|---|---|---|---|---|
| 0x0000 0000 … 0xFFFF FFFF<br>all = { 0 } | Data can be exchanged with the PLC via this DINT array. This data can be used by the appropriate process variables in the PLC. | | | |

| P360 [-01] ... [-05] | PLC display value<br>*(PLC display value)* | | S | |
|---|---|---|---|---|
| -2 000 000,000 … 2 000 000.000<br>all = { 0.000 } | The parameter is only used to display the PLC Date. Via the corresponding process variables, this parameter can be written by the PLC. The values are not saved! | | | |

| P370 | PLC Status<br>*(PLC Status)* | | S | |
|---|---|---|---|---|
| 0 … $63_{dec}$<br>*ParameterBox:*<br>0x00 … 0x3F<br>*SimpleBox / ControlBox:*<br>0x00 … 0x3F<br>all = { 0 } | Displays the actual status of the PLC.<br>**Bit 0 = P350=1:** Parameter P350 was set in the "Activate internal PLC" function<br>**Bit 1 = PLC active:** The internal PLC is active.<br>**Bit 2 = Stop active:** The PLC program is in "Stop" status.<br>**Bit 3 = Debug active:** The error checking of the PLC program runs.<br>**Bit 4 = PLC error:** The PLC has an error, but PLC user errors 23.xx are not displayed here.<br>**Bit 5 = PLC halted:** The PLC program has been halted (*Single Step* or *Breakpoint*). | | | |

### 5.2.5 Control terminals

| Parameter {factory setting} | Setting value / Description / Note | | Supervisor | Parameter set |
|---|---|---|---|---|
| **P400** **[-01] ... [-09]** | **Function Setpoint inputs** *(Function of setpoint inputs)* | **SK 2x0E** | | **P** |

0 ... 36

{ [-01] = 1 }
{ [-02] = 0 }
{ [-03] = 0 }
{ [-04] = 0 }
{ [-05] = 1 }
{ [-06] = 0 }
{ [-07] = 1 }
{ [-08] = 0 }
{ [-09] = 0 }

| **SK 2x0E size 1 … 3** | **SK2x0E size 4** |
|---|---|
| **[-01]** **Analogue input 1**, Function of analogue input 1 integrated into the FI | |
| **[-02]** **Analogue input 2**, Function of analogue input 2 integrated into the FI | |
| **[-03]** **External Analogue input 1**, AIN1 of the first I/O extension (SK xU4-IOE) | |
| **[-04]** **External Analogue input 2**, AIN2 of the first I/O extension (SK xU4-IOE) | |
| **[-05]** **Setpoint module** | |
| **[-06]** **Digital input 2**, can be set to pulse signal evaluation via P420 [-02] =26 or 27. The pulses are then evaluated in the FI as an analogue signal according to the function which is set here. | **[-06]** **Potentiometer 1**, Function of the potentiometer P1 integrated into the FI. DIP switches 4/5 must be "Off" so that the function can be influenced by this parameter setting (chapter 4.3.2.2) |
| **[-07]** **Digital input 3**, can be set to pulse signal evaluation via P420 [-03] =26 or 27. The pulses are then evaluated in the FI as an analogue signal according to the function which is set here. | **[-07]** **Potentiometer 2**, as for potentiometer 1 |
| **[-08]** **External A.in. 1 2nd IOE**, *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analogue input 3) | |
| **[-09]** **External A.in. 2 2nd IOE**, *"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analogue input 4) | |

*... Setting values below.*

| P400 [-01] ... [-09] | Function Setpoint inputs<br>*(Function of setpoint inputs)* | SK 2x5E | | P |
|---|---|---|---|---|

0 ... 36
{ [-01] = 1 }
{ [-02] = 15 }
{ [-03] = 0 }
{ [-04] = 0 }
{ [-05] = 1 }
{ [-06] = 0 }
{ [-07] = 1 }
{ [-08] = 0 }
{ [-09] = 0 }

**[-01]** **Potentiometer 1**, Function of the potentiometer P1 integrated into the FI. DIP switches 4/5 must be "Off" so that the function can be influenced by this parameter setting (chapter 4.3.2.2)

**[-02]** **Potentiometer 2**, as for potentiometer 1

**[-03]** **External Analogue input 1**, AIN1 of the first I/O extension (SK xU4-IOE)

**[-04]** **External Analogue input 2**, AIN2 of the first I/O extension (SK xU4-IOE)

**[-05]** **Setpoint module**

**[-06]** **Digital input 2**, can be set to pulse signal evaluation via parameter P420 [-02] =26 or 27. The pulses are then evaluated in the FI as an analogue signal according to the function which is set here.

**[-07]** **Digital input 3**, can be set to pulse signal evaluation via parameter P420 [-03] =26 or 27. The pulses are then evaluated in the FI as an analogue signal according to the function which is set here.

**[-08]** **External A.in. 1 2nd IOE**, *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analogue input 3)

**[-09]** **External A.in. 2 2nd IOE**, *"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analogue input 4)

The basic versions of the SK 2x5E devices do not have an analogue input. An analogue function can only be used by using options (array [-01]...[-05] and [-08]…[-09]) or using digital input 2 or 3 (array [-06]...[-07]).

*... Setting values below.*

For standardisation of actual values: (📖 Section 8.9 "Standardisation of setpoint / target values").

**0 =** **Off**, the analogue 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 analogue 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**, is a typical setting for the functionality of the *potentiometer* (P1 or P2) at the SK 2x5E or the *analogue input* (AIN1 or AIN2) at the SK 2x0E.

SK 2x0E: lower limit: 1 Hz

Standardisation: T_Min. frequency= 50Hz*U[V]/10V (U=voltage potentiometer (P1 or P2)) or U = voltage at analogue input (AIN1 or AIN2)

**5 =** **Maximum frequency** is a typical setting for the functionality of the *potentiometer* (P1 or P2) at the SK 2x5E or the *analogue input* (AIN1 or AIN2) at the SK 2x0E.

SK 2x0E: lower limit: 2 Hz

Standardisation: T_Max. frequency= 100Hz*U[V]/(U=voltage potentiometer (P1 or P2)) or U = voltage at analogue input (AIN1 or AIN2)

**6 =** **Actual value process controller ***, activates the process controller, analogue 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 6, 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 build up a control loop. The analogue 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**, (only SK 2x0E size 4 and SK 2x5E) is a typical setting value for the function of potentiometer P1 or P2 (P400 [01] or [02]), which are integrated in the cover of the FI (📖Section 4.3.2 "Configuration").

SK 2x0E: lower limit: 50 ms

Standardisation: T_Ramp time= 10s*U[V]/10V (U=Voltage of potentiometer (P1 or P2))

**16 =** **Torque precontrol**, 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.

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

**18 =** **Curve travel calculator**, via the external analogue 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.

**19 =** **Servo mode torque,** in servo mode ((P300)= "1") the motor torque can be set / limited using this function. As of firmware version V1.3 this function is also without speed feedback, however it can be used at a lower quality.

**25 =** **Transfer Factor Gearing**, *"Gearing Transfer Factor"*, 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.

**26 =** *…reserved*, for Posicon, see BU0210

**30 =** **Motor temperature**: enables measurement of the motor temperature with a KTY-84 temperature sensor (📖 Section 4.4 "KTY84-130 connection")

**33 =** **Setpoint Torque Proc. cntrl.**, *"Setpoint torque process controller",* for even distribution of the torques to coupled drive units (e.g.: S-roller drive). This function is also possible with the use of ISD control.

**34 =** **d-correction F process** - (diameter correction, frequency PI / process controller).

**35 =** **d-correction Torque** - (diameter correction, torque).

**36 =** **d-correction F + Torque** - (diameter correction, frequency for PI / process controller and torque)

*) For further details of the PI and process controller, please refer to Section 8.2 "Process controller".

**) 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 overshot.

| P401 [-01] ... [-06] | **Mode analogue in** *(Mode analogue input)* | | **S** | |
|---|---|---|---|---|

0 ... 5
{ all 0 }

This parameter determines how the frequency inverter reacts to an analogue signal which is less than the 0% adjustment (P402).

| | |
|---|---|
| **[-01]** | **External Analogue input 1,** AIN1 of the first I/O extension |
| **[-02]** | **External Analogue input 2,** AIN2 of the first I/O extension |
| **[-03]** | **External A.in. 1 2nd IOE,** *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension |
| **[-04]** | **External A.in. 2 2nd IOE** *"External analogue input 2 2nd IOE*, AIN2 of the second I/O extension |
| **[-05]** | **Analogue input 1,** Analogue input1 (only SK 200E, SK 210E) |
| **[-06]** | **Analogue input 2,** Analogue input 2 (only SK 2x0E) |

**0 = 0 – 10V limited:** An analogue setpoint smaller than the programmed adjustment 0% (P402) does not lead to undershooting of the programmed minimum frequency (P104), i.e. it does not result in a change of the direction of rotation.

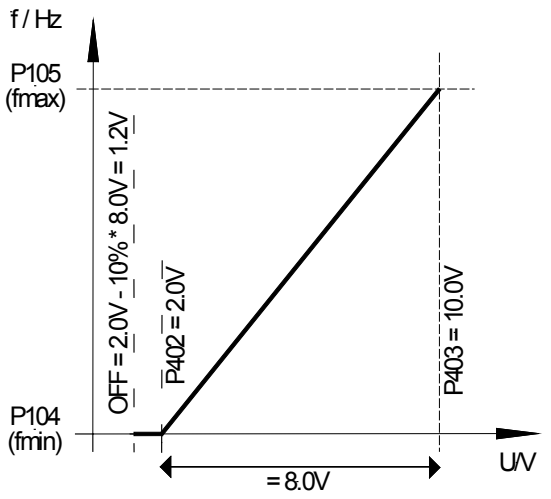
**1 = 0 – 10V:** If a setpoint smaller than the programmed adjustment 0% (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

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

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

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

**2 = 0 – 10V monitored:** If the minimum adjusted setpoint (P402) is undershot by 10% of the difference value from P403 and P402, the FI output switches off. Once the setpoint is greater than [P402 - (10% * (P403 - P402))], it will deliver an output signal again. With the change to firmware version V 2.0 R0 the behaviour of the FI changes in that the function is only active if a function for the relevant input has been selected in P400




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

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

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

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

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

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

**4 = 0 – 10V with Error 1,** *"0 – 10V with shut-down on Error 1"*:
If the value of the 0% adjustment in (P402) is undershot, the error message 12.8 "Undershoot of Analogue In Min." is activated.
If the value of the 100% adjustment in (P402) is undershot, the error message 12.9 "Undershoot of Analogue In Max." is activated.
Even if the analogue value is outside the limits defined in (P402) and (P403), the setpoint value is limited to 0 - 100%.

The monitoring function only becomes active if an enable signal is present and the analogue value has reached the valid range (≥(P402) or ≤(P403)) for the first time (e.g. pressure build-up after switching on a pump).
*Once the function has been activated, it also operates if the actuation takes place via a field bus, for example, and the analogue input is not actuated at all.*

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

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

| P402 [-01] ... [-06] | **Adjustment: 0%**<br>*(Analogue input adjustment: 0%)* | | **S** | |
|---|---|---|---|---|

-50.00 ... 50.00 V
{ all 0.00 }

**[-01]** **External Analogue input 1,** AIN1 of the first I/O extension (SK xU4-IOE)

**[-02]** **External Analogue input 2,** AIN2 of the first I/O extension (SK xU4-IOE)

**[-03]** **External A.in. 1 2nd IOE,** *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analogue input 3)

**[-04]** **External A.in. 2 2nd IOE,** *"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analogue input 4)

**[-05]** **Analogue input 1,** Analogue input1 (only SK 200E, SK 210E)

**[-06]** **Analogue input 2,** Analogue input 2 (only SK 2x0E)

This parameter sets the voltage which should correspond with the minimum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint) this value is equivalent to the setpoint set via P104 >Minimum frequency<.

**Note**

SK 2x0E

For the adjustment of the integrated analogue inputs of the SK2x0E to the type of analogue signals, the following values must be set:

0 - 10V → 0.00 V
2 - 10V → 2.00 V
0 - 20mA → 0.00 V (enable internal resistance via DIP switch!)
4 - 20mA → 1.00 V (enable internal resistance via DIP switch!)

DIP switches: (please see chapter 4.3.2.3 "DIP switches, analogue input (only SK 2x0E)")

SK xU4-IOE

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 not be carried out.

| P403 [-01] ... [-06] | Adjustment: 100% *(Analogue input adjustment: 100%)* | | S | |
|---|---|---|---|---|

-50.00 ... 50.00 V
{ all 0.00 }

**[-01]** **External Analogue input 1,** AIN1 of the first I/O extension (SK xU4-IOE)

**[-02]** **External Analogue input 2,** AIN2 of the first I/O extension (SK xU4-IOE)

**[-03]** **External A.in. 1 2nd IOE,** *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analogue input 3)

**[-04]** **External A.in. 2 2nd IOE,** *"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analogue input 4)

**[-05]** **Analogue input 1,** Analogue input1 (only SK 200E, SK 210E)

**[-06]** **Analogue input 2,** Analogue input 2 (only SK 2x0E)

This parameter sets the voltage which should correspond with the maximum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint) this value is corresponds with the setpoint set via P105 >Maximum frequency<.

**Note**
SK 2x0E
For the adjustment of the integrated analogue inputs of the SK2x0E to the type of analogue signals, the following values must be set:

0 - 10V → 10.00 V
2 - 10V → 10.00 V
0 - 20mA → 5.00 V (enable internal resistance via DIP switch!)
4 - 20mA → 5.00 V (enable internal resistance via DIP switch!)

DIP switches: (please see chapter 4.3.2.3 "DIP switches, analogue input (only SK 2x0E)")

SK xU4-IOE
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 not be carried out.

| P404 [-01] [-02] | Analogue input filter *(analogue input filter)* | SK 2x0E | S | |
|---|---|---|---|---|

10 ... 400 ms
{ all 100 }

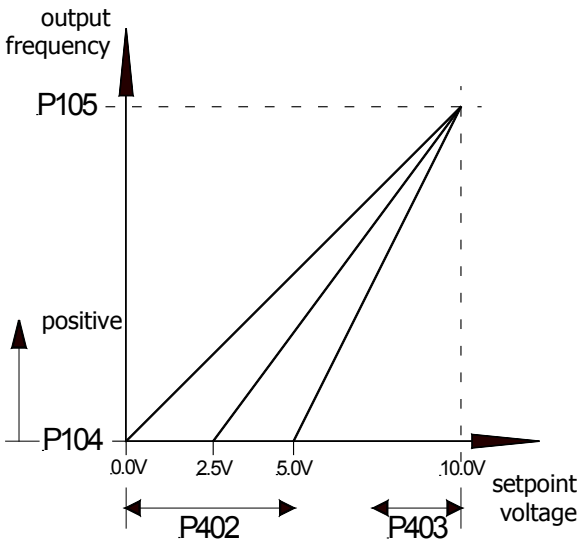
Adjustable digital low-pass filter for the analogue signal. Interference peaks are hidden, the reaction time is extended.

**[-01] = Analogue input 1**: analogue input 1 integrated in the device
**[-02] = Analogue input 2**: analogue input 2 integrated in the device

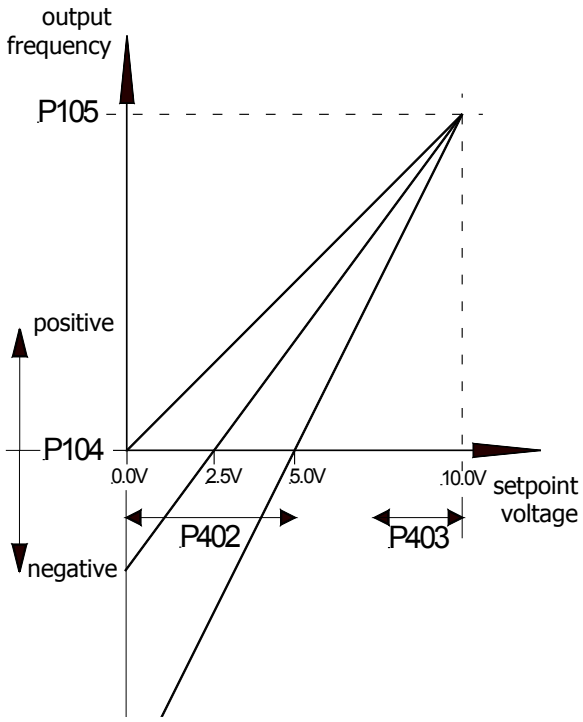
The filter time for the analogue inputs of the optional external IO extension modules is set in the parameter set for the relevant module (P161).

## P400 ... P403

P401 = 0 → 0 - 10V limited




P401 = 1 → 0 - 10V not limited




| P410 | **Min. freq. a-in 1/2**<br>*(Minimum frequency a-in 1/2 (auxiliary setpoint value))* | | | **P** |
|---|---|---|---|---|
| -400.0 ... 400.0 Hz<br>{ 0.0 } | The minimum frequency that can act on the setpoint via the auxiliary setpoints.<br>Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI:<br>Actual frequency PID Frequency addition Frequency subtraction<br>Auxiliary setpoints via BUS Process controller<br>Min. frequency above analog setpoint (potentiometer) | | | |

| P411 | **Max. freq. a-in 1/2**<br>*(Maximum frequency a-in 1/2 (auxiliary setpoint value))* | | | **P** |
|---|---|---|---|---|
| -400.0 ... 400.0 Hz<br>{ 50.0 } | The maximum frequency that can act on the setpoint via the auxiliary setpoints.<br>Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI:<br>Actual frequency PID Frequency addition Frequency subtraction<br>Auxiliary setpoints via BUS Process controller<br>Min. frequency above analog setpoint (potentiometer) | | | |

| P412 | Nom. val. process ctrl.<br>*(Nominal value process controller)* | | S | P |
|---|---|---|---|---|
| -10.0 ... 10.0 V<br>{ 5.0 } | Fixed specification of a setpoint for the process controller that will only occasionally be altered.<br>Only with P400 = 14 ... 16 (process controller) 8.2 "Process controller". | | | |

| P413 | P-component of PI-controller<br>*(P-component PI-controller)* | | S | P |
|---|---|---|---|---|
| 0.0 ... 400.0 %<br>{ 10.0 } | This parameter is only effective when the function PI controller actual frequency is selected.<br>The P-component of the PI controller determines the frequency jump if there is a control deviation based on the control difference.<br>E.g.: At a setting of P413 = 10% and a rule difference of 50%, 5% is added to the actual setpoint. | | | |

| P414 | I-component PI-controller<br>*(I-component of PI-controller)* | | S | P |
|---|---|---|---|---|
| 0.0 ... 3,000.0 %/s<br>{ 10.0 } | This parameter is only effective when the function PI controller actual frequency is selected.<br>The I-component of the PI controller determines the frequency change, dependent on time.<br>**Note:** In contrast to other NORD series, parameter P414 is smaller by a factor of 100 (Reason: better setting ability with small I-proportions). | | | |

| P415 | Process controller limit<br>*(Control limit of process controller)* | | S | P |
|---|---|---|---|---|
| 0 ... 400.0 %<br>{ 10.0 } | This parameter is only effective when the function **PI process controller** is selected. This determines the control limit (%) after the PI controller (please see chapter 8.2 "Process controller"). | | | |

| P416 | Ramp time PI setpoint<br>*(Ramp time PI setpoint value)* | | S | P |
|---|---|---|---|---|
| 0.00 ... 99.99 sec<br>{ 2.00 } | This parameter is only effective when the function PI process controller is selected.<br>Ramp for PI setpoint | | | |

| P417 [-01]<br>...<br>[-02] | Offset analogue output<br>*(Offset analogue output)* | | S | P |
|---|---|---|---|---|
| -10.0 ... 10.0 V<br>{ all 0.0 }<br>only with<br>SK CU4-IOE or<br>SK TU4-IOE | **[-01] = First IOE,** AOUT of the first I/O extension (SK xU4-IOE)<br>**[-02] = Second IOE,** AOUT of the second I/O extension (SK xU4-IOE)<br>In the analogue output function an offset can be entered to simplify the processing of the analogue signal in other equipment.<br>If the analogue output has been programmed with a digital function, then the difference between the switch-on point and the switch-off point can be set in this parameter (hysteresis). | | | |

| P418 [-01] ... [-02] | Function Analogue output *(Analogue output function)* | | S | P |
|---|---|---|---|---|

0 ... 60
{ all 0 }
only with SK CU4-IOE or SK TU4-IOE

**[-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)

**Analogue functions** (max. load: 5mA analogue)**:**

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

0 Volt analogue 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.:

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

For standardisation of actual values: (📖 Section 8.9 "Standardisation of setpoint / target values").

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

**1 =** **Actual frequency ***, the analogue 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.
If Servo mode is used, the measured speed will be output via this function. (100%=(P202))

**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. 10 V with 100% standardisation, corresponds to 450 V DC (230 V mains) or 850 Volt DC (480 V mains)!

**7 =** **Value from P542**, the analogue 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 analogue 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) or = (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 analogue voltage is proportional to the output frequency of the FI, whereby the zero point is shifted to 5 V. For rotation to the right, values between 5 V and 10 V are output, and for rotation to the left values between 5 V and 0 V.

**13 =** **Actual speed ± ***, is the synchronous rotation speed calculated by the FI, based on the current setpoint, where the null point has been shifted to 5 V. Values of 5 V to 10 V are output with right-hand rotation, and values of 5 V to 0 V with left-hand rotation.
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 5 V and 10 V are output, and for generator torque, values between 5 V and 0 V.

**29 =** *reserved* for Posicon, see BU0210

**30 =** **Set freq before ramp,** *"Setpoint frequency before frequency ramp"*, displays the frequency produced by any upstream controllers (ISD, PID, etc.). This is then the target frequency for the power stage after it has been adjusted via the start-up or braking ramp (P102, P103).

**31 =** **Output via BUS PZD**, the analogue output is controlled via a bus system. The process data is transferred directly (P546 = "32").

**33 =** **Setpoint freq. Motor potentiometer,** *"Setpoint frequency of motor potentiometer"*

**60 =** **Value of PLC,** the analogue output is set by the integrated PLC, independently of the current operating status of the FI.

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

| **P419** [-01] [-02] | **Standard Analogue output** *(Standardisation of analogue output)* | | **S** | **P** |
|---|---|---|---|---|

-500 ... 500 %
{ all 100 }

**[-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

Using this parameter an adjustment can be made to the analogue output for the selected operating zone. The maximum analogue 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 analogue 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.

| **P420** [-01] ... [-04] | **Digital inputs** *(Digital inputs)* | | | |
|---|---|---|---|---|

0 ... 80
{ [-01]= 1 }
{ [-02] = 2 }
{ [-03] = 4 }
{ [-04] = 5 }

Up to 4 freely programmable digital inputs are available depending on the version. The functions can be seen in the following table.

**[-01]** **Digital input 1** (DIN1), **Enable right** (default), control terminal 21

**[-02]** **Digital input 2** (DIN2), **Enable left** (default), control terminal 22

**[-03]** **Digital input 3** (DIN3), **Fixed frequency 1** (default), control terminal 23

**[-04]** **Digital input 4** (DIN4), **Fixed frequency 2** (default), control terminal 24

(DIN4 not with SK 21xE and SK 23xE: Recommended for these devices if "Safe stop" is used: Parameterise DIN4 to function "10" "Disable voltage" → Error message E18.0 suppressed when "Safe stop" triggered)

When an encoder is being used, digital inputs DIN 2 and DIN 3 must be deactivated using an OR operation of the parameterised functionality and the encoder evaluation that are always active in the inverter (parameter P420 [-02, -03]).

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 first I/O extension, and via the parameter "Bus I/O In Bit (0…3)" - (P480 [-01] … [-04]) for the second I/O extension.

## List of possible functions of digital inputs P420

| 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 |

| Value | Function | Description | Signal |
|---|---|---|---|
| | 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).<br>If the functions "Enable right" and "Enable left" are actuated simultaneously, the FI is blocked.<br>If the frequency inverter is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a **1 → 0 flank**. | | |
| **03** | Change of rotation direction | Causes the rotation field to change direction in combination with Enable right or left. | High |
| **04** [1] | Fixed frequency 1 | The frequency from P465 [01] is added to the actual setpoint value. | High |
| **05** [1] | Fixed frequency 2 | The frequency from P465 [02] is added to the actual setpoint value. | High |
| **06** [1] | Fixed frequency 3 | The frequency from P465 [03] is added to the actual setpoint value. | High |
| **07** [1] | Fixed frequency 4 | The frequency from P465 [04] is added to the actual setpoint value. | High |
| | If several fixed frequencies are actuated at the same time, then they are added with the correct sign. In addition, the analogue setpoint (P400) and if necessary the minimum frequency (P104) are added. | | |
| **08** [5] | Par. set changeover<br>*"Parameter set changeover 1"* | Selection of active parameter set 1…4 - first bit. | 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** [2] | Disable voltage **(coast to stop)** | The FI output voltage is switched off; the motor runs down freely. | Low |
| **11** [2] | Emergency stop | The FI reduces the frequency according to the programmed fast stop time P426. | Low |
| **12** [2] | 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** [2] | PTC resistor input | Only with the use of a temperature monitor (bimetallic switching contact). Switch-off delay = 2sec, warning after 1 sec. | High |
| **14** [2, 4] | Remote control | With bus system control, Low level switches the control to control via control terminals. | High |
| **15** | Jog frequency [1] | The frequency value from (P113) can also be set directly using the HIGHER/LOWER buttons with a controller, SimpleBox or ParameterBox and stored in (P113) using the OK button.<br>If the device is operating with inching frequency, any bus actuation that may be active is deactivated. | 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** [5] | ParaSet Switching 2<br>*"Parameter set changeover 2"* | Selection of active parameter set 1…4 - second bit. | High |
| **18** [2] | 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 | **SK 2x0E:** Analogue input switch-on and switch-off 1/2 (high = ON) of the frequency inverter<br>**SK 2x5E:** Analogue input switch-on and switch-off 1/2 (high = ON) of the first I/O extension. The Low signal sets the analogue 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** | ... 25 reserved for Posicon | → BU0210 | |

| Value | Function | Description | Signal |
|---|---|---|---|
| **26** | Analogue function Dig2+3 *("0-10V")* | Pulses that are proportional to an analogue signal can be evaluated with this setting via **DIN 2** and **DIN 3**. The function of this signal is determined in parameter P400 [-06] or [-07].<br>The conversion of 0-10 V to pulses can be carried out via customer unit SK CU/TU4-24V-.... An analogue input and a pulse output (ADC) are available with this module, among other things.<br>A rotating direction reversal takes place in setting { 28 } with an analogue value of <5V.<br>(please see chapter 3.2.4 "Potentiometer adapter, SK CU4-POT") | Impulse ≈ 1.6-16 kHz |
| **27** | Analogue function 2-10V Dig2+3 | | |
| **28** | Analogue function 5-10V Dig2+3 | | |
| | These functions can only be used for the digital inputs 2 (P420 [-02]) and 3 (P420 [-03]) and not with IV Size SK 2x0E. | | |
| **29** | Enable SetpointBox | The release signal is provided by the *Simple SetpointBox* (setpoint box) SK SSX-3A, whereby the Box must be operated in **IO-S** mode. → BU0040 | High |
| **30** | Disable PID | Switching the PID controller / process controller function on and off (high = ON) | High |
| **31** [2] | Disable right rotation | Blocks the >Enable right/left< via a digital Input or bus actuation. Does not depend on the actual direction of rotation of the motor (e.g. following negated setpoint). | Low |
| **32** [2] | Disable left rotation | | Low |
| **33** | ... 41 reserved | | |
| **42** | 0-track HTL sync2 DI1 | Activates the evaluation of the zero track of a rotary encoder. Synchronization to zero pulse after each enable. | High |
| **43** | 0-track HTL encoder DI1 | Activates the evaluation of the zero track of a rotary encoder. Synchronization to zero pulse after the first enable after "Power ON". | High |
| **44** | 3-wire direction *"3-wire control direction change"* (normally open button) | This control function provides an alternative to enable R/L (01/02), in which a permanently applied level (maintained signal) is required.<br>Here, only a control impulse is required to trigger the function. The control of the FI can therefore be performed entirely with pushbuttons. | 0→1 Flank |
| **45** | 3-W-Ctrl. Start-Right 3-Wire-Control Start-Right (normally open button) | | 0→1 Flank |
| **46** | 3-W-Ctrl Start-Left *"3-Wire-Control Start-Left"* (normally open button) | | 0→1 Flank |
| **49** | 3-Wire-Ctrl. Stop *"3-Wire-Control Stop"* (normally closed 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) otherwise start at $f_{MIN}$. | High |
| **48** | Motorpot. Freq. - *"Motor potentiometer frequency -"* | | High |
| **50** | Bit 0 fixed frequency array | Binary coded digital inputs to generate up to 15 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 for Posicon → BU0210 | | |
| **65** [2] | Man/auto brake release *"Release brake manually / automatically"* | The brake is automatically released by the frequency inverter (automatic brake control) if this digital input has been set. | High |

| Value | Function | Description | Signal |
|---|---|---|---|
| **66** [2] | Release brake manually<br>*"Release brake manually"* | The brake is only released of the digital input is set. | High |
| **67** | Man/auto set dig. out.<br>"Set digital output manually/automatically" | Set digital output 1 manually, or via the function set in (P434) | High |
| **68** | Digit. out. man. Set<br>"Set digital output manually" | Set digital output 1 manually | High |
| **69** | Speed meas. with ini.<br>*"Speed measurement with initiator"* | Simple speed measurement (impulse measurement) with initiator | Impulse |
| **70** | Evacuation runs<br>*"Activate evacuation run"* | This also provides the possibility of operation with a very low link circuit voltage (e.g. using batteries). With this function the charging relay is activated and existing monitoring functions are deactivated.<br>**NOTICE!** There is no overload monitoring! (e.g. lifting gear) | High |
| **71** [3] | Motorpot.F+ and Save<br>*"Motor potentiometer function frequency + with automatic saving"* | This "motor potentiometer function" is used to set a setpoint (amount) via the dig. inputs that is saved at the same time. With control enabling R/L this is then started up in the correspondingly enabled direction. On change of direction the frequency is retained.<br>Simultaneous activation of the +/- function causes the frequency setpoint value to be set to zero. | High |
| **72** [3] | Motorpot.F- and Save<br>*"Motor potentiometer function Frequency - with automatic saving"* | The frequency setpoint can also be set in the operating value display (P001=30, 'Actual. setpoint MP-S') or displayed or set in P718.<br>Any minimum frequency set (P104) is still effective. Other setpoint values, e.g. analogue or fixed frequencies can be added or subtracted.<br>The adjustment of the frequency setpoint value is performed with the ramps from P102/103. | High |
| **73** [2] | Clockw. disable + fast<br>*"Disable clockwise rotation + Fast Stop"* | As for setting 31, however coupled to the function "Fast Stop". | Low |
| **74** [2] | Anticlockw. disable + fast<br>*"Disable anticlockwise rotation + Fast Stop"* | As for setting 32, however coupled to the function "Fast Stop". | Low |
| **75** | D. out. 2 man/ auto set<br>*"Set digital output 2 manually/automatically"* | As for function 67, however for digital output 2 (only SK 2x0E) | High |
| **76** | D. out. 2 man. set<br>*"Set digital output 2 manually"* | As for function 68, however for digital output 2 (only SK 2x0E) | High |
| **77** | ...79 reserved for Posicon | → BU0210 | |
| **80** | PLC stop | The program execution of the integrated PLC is stopped for as long as the signal is present. | High |

1 If no digital output has been parametrised to "Right enable" or "Left enable" and with devices from SK 22xE, all AS-i related BUS-In bits (P480) are deactivated and DIP switches S1 "3-5" are in the factory setting, the actuation of a fixed frequency or the jog frequency leads to the enabling of the frequency inverter. The rotation field direction depends on the sign of the setpoint.

2 Also effective for BUS control (e.g. RS232, RS485, CANopen, AS-Interface, …)

3 With SK 2x5 devices the frequency inverter control unit must be supplied with power for a further 5 minutes after the last change to the motor potentiometer in order to permanently save the data.

4 Function cannot be selected via BUS IO In Bits

5 The operating parameter set is selected via appropriately parametrised digital inputs or BUS actuation. Switching can take place during operation (online). Coding takes place binary in accordance with the adjacent sample.

In the event of enabling via the keyboard (SimpleBox, ControlBox, PotentiometerBox or ParameterBox), the operating parameter set will match the settings in P100.

| Setting | Digital input function [8] | Digital input function [17] |
|---|---|---|
| 0 = Parameter set 1 | LOW | LOW |
| 1 = Parameter set 2 | HIGH | LOW |
| 2 = Parameter set 3 | LOW | HIGH |
| 3 = Parameter set 4 | HIGH | HIGH |

| P426 | Quick stop time<br>*(Quick stop time)* | | S | P |
|---|---|---|---|---|
| 0 ... 320.00 sec<br>{ 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.<br>Emergency stop time is the time for the linear frequency decrease from the set maximum frequency (P105) to 0Hz. If an actual setpoint <100% is being used, the emergency stop time is reduced correspondingly. | | | |

| P427 | Emergency stop on error<br>*(Emergency stop on error)* | | S | |
|---|---|---|---|---|
| 0 ... 2<br>{ 0 } | Activation of automatic emergency stop following error<br>**0 =** **Disabled:** Automatic emergency stop following error is deactivated<br>**1 =** Reserved<br>**2 =** **Activated:** Automatic emergency stop following fault<br>A quick stop can be triggered by error **E2.x, E7.0, E10.x, E12.8, E12.9** and **E19.0**. | | | |

| P428 | Automatic start<br>(*Automatic start)* | | S | P |
|---|---|---|---|---|
| 0 ... 1<br>{ 0 } | In the standard setting (P428 =**0 → Off**) the inverter requires a flank to enable (signal change from "low →high") at the relevant digital input.<br>In the setting **On → 1** the FI reacts to a High level. This function is only possible if the FI is controlled using the digital inputs. (see P509=0/1)<br>In certain cases, the FI must start up directly when the mains are switched on. For this P428 = **1 → On** can be set. If the enable signal is permanently switched on, or equipped with a cable jumper, the FI starts up immediately.<br>**NOTE:** (P428) not "ON" if (P506) = 6, **Danger!** (See note on (P506))<br>**NOTE:** The "Automatic Start" function can only be used if a digital input of the frequency inverter (DIN 1 …) is parameterised to the function "Enable Right" or "Enable Left" and this input is permanently set to "High". The digital inputs of the technology modules (e.g.: SK CU4 - IOE) do not support this "Automatic Start" function!<br>**NOTE:** The "Automatic Start" function can only be activated if the frequency inverter has been parameterised to local control ((P509) setting { 0 } or { 1} ). | | | |

## P434 [-01] [-02] Digital output function

*(Digital output function)*

0 ... 40

{ 7 }

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

**[-02] = Digital output 2,** Digital output 2 of the frequency inverter (only SK 2x0E)

Settings 3 to 5 and 11 work with a 10% hysteresis, i.e. the output delivers (function 11 does not deliver) when the 24V limit value is reached and switches off again when the value drops to a value that is 10 % less again (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) |
|---|---|
| **0 = No function** | Low |
| **1 = External brake**, to control an external 24V brake relay (max. 20 mA). The output switches at a programmed absolute minimum frequency (P505).<br>For typical brakes a setpoint delay of 0.2-0.3s should be programmed (see also P107/P114).<br>SK 2x0E (Size 4) and SK 2x5E: A typical motor brake (105-180-205V) can be connected directly via control terminals 79 MB+/80 MB- (chapter 2.4.2.4). | Low |
| **2 = Inverter operating**, the output indicates voltage at the FI output (U - V - W). | High |
| **3 = Current limit**, based on the setting of the motor rated current (P203). This value can be adjusted via the standardisation (P435). | High |
| **4 = Torque current limit**, based on motor data settings in P203 and P206. Signals a corresponding torque load on the motor. This value can be adjusted via the standardisation (P435). | High |
| **5 = Frequency limit**, based on motor nominal frequency setting in P201. This value can be adjusted via the standardisation (P435). | High |
| **6 = Setpoint reached**, indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz → *Setpoint value not achieved – signal Low.* | High |
| **7 = Error,** general error message, error is active or not yet acknowledged. → *Fault - Low (Ready - High)* | Low |
| **8 = Warning:** general warning, a limit value was reached that could lead to a later shutdown of the FI. | Low |
| **9 = Overcurrent warning**: At least 130 % of the nominal FI current was supplied for 30 s. | Low |
| **10 = Overtemp. Warn. Motor**, *"Motor overtemperature warning"*: The motor temperature is evaluated. →Motor is too hot. The warning is given immediately, overheating switch-off after 2 seconds. | Low |
| **11 = Torque curr. lim. active,** *"Torque current limit / Current limit active warning"***:** The limiting value in P112 or P536 has been reached. A negative value in P435 inverts the reaction. Hysteresis = 10 %. | Low |
| **12 = Value of P541,** *"Value of P541 - external control*, the output can be controlled with parameter P541 (Bit 0) independent of the actual operating status of the FI. | High |
| **13 = Gen. torque current limit,** *"Drive torque current limit active"***:** Limit value in P112 has been reached in the generator range. Hysteresis = 10 %. | High |
| **16 = Reference value Ain1,**<br>**SK 2x0E:**<br>Setpoint AIN1 of the FI is compared with the value in (P435[-01 or -02]).<br>**SK 2x5E:** Setpoint AIN1 of 1st IO extension is compared with value in (P435[-01]) | High |

| | | |
|---|---|---|
| **17 =** | **Reference value Ain2,**<br>**SK 2x0E:**<br>Setpoint AIN2 of the FI is compared with the value in (P435[-01 or -02]).<br>**SK 2x5E:** Setpoint AIN2 of 1st IO extension is compared with value in (P435[-01]) | High |
| **18 =** | **FI ready**: The FI is ready for operation. After being enabled it delivers an output signal. | High |
| **19 =** | ... 29 Reserved POSICON functions see BU 0210) | |
| **30 =** | **Digital-In 1 status** | High |
| **31 =** | **Digital-In 2 status** | High |
| **32 =** | **Digital-In 3 status** | High |
| **33 =** | **Digital-In 4 status** | High |
| **38 =** | **Value from bus setpoint** | High |
| **39 =** | **STO inactive** | High |
| **40 =** | **Output via PLC:** The output is set by the integrated PLC | High |

**Information** **"low" active settings / functions**

If the frequency inverter is not in operation, i.e. no mains or control voltage is connected, all output functions are without function ("low"). This means that for the use of settings or functions which are "low" active (e.g setting **7 → Fault**) the following must be taken into account:

Evaluation of the output signal of the device, e.g. by a PLC must be compared with the basic readiness for operation of the frequency inverter.

## P435 [-01] [-02] Dig. out scaling

*(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 SK 2x0E

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<

| P436 | [-01] [-02] | Dig. out. hysteresis *(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 SK 2x0E

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

| P460 | Time Watchdog *(Time Watchdog)* | | S | |
|---|---|---|---|---|

-250.0 ... 250.0 sec
{ 10.0 }

**0.1 ... 250.0** = The time interval between the expected Watchdog signals (programmable function of the digital inputs P420…). If this time interval elapses without a pulse being registered, switch off and error message E012 are actuated.

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

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

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

0 ... 1
{ 0 }

This parameter determines the form in which fixed frequencies are to be processed.

**0 = Addition to main setpoint:** Fixed frequencies and the fixed frequency array are added to each other. I.e. they are added together, or added to an analog setpoint to which limits are assigned according to P104 and P105.

**1 = Main setpoint:** Fixed frequencies are not added - neither together, nor to analog setpoints. If for example, a fixed frequency is switched to an existing analog setpoint, the analog setpoint will no longer be considered.
Programmed frequency addition or subtraction with an analog input value or a bus setpoint is still possible and valid, as is the addition to the setpoint of a motor potentiometer function (function of digital inputs: 71/72)
If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (E.g.: 20>10 or 20>-30).
**Note:**
The highest active fixed frequency is added to the setpoint value of the motor potentiometer if the functions 71 or 72 are selected for 2 digital inputs.

| P465 | [-01] ... [-15] | Fixed frequency field<br>*(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.

**[-01] =** Fixed frequency 1 / Array 1
**[-02] =** Fixed frequency 2 / Array 2
**[-03] =** Fixed frequency 3 / Array 3
**[-04] =** Fixed frequency 4 / Array 4
**[-05] =** Fixed frequency / Array 5
**[-06] =** Fixed frequency / Array 6
**[-07] =** Fixed frequency / Array 7
**[-08] =** Fixed frequency / Array 8
**[-09] =** Fixed frequency / Array 9
**[-10] =** Fixed frequency / Array 10
**[-11] =** Fixed frequency / Array 11
**[-12] =** Fixed frequency / Array 12
**[-13] =** Fixed frequency / Array 13
**[-14] =** Fixed frequency / Array 14
**[-15] =** Fixed frequency / Array 15

| P466 | Min.freq. process cont.<br>*(Minimum frequency process controller)* | | S | P |
|---|---|---|---|---|

0.0 ... 400.0 Hz
{ 0.0 }

With the aid of the minimum frequency process controller the control ratio can also be kept to a minimum ratio, even with a master value of “zero”, in order to enable adjustment of the compensator. More details can be found in P400 and (chapter 8.2).

| P475 | [-01] ... [-04] | delay on/off switch<br>*(Digital function switch on/off delay)* | | S | |
|---|---|---|---|---|---|

-30,000 ... 30,000 sec
{ 0,000 }

Adjustable switch-on/off delay for the digital inputs and the digital functions of the analogue inputs. Use as a switch-on filter or simple process control is possible.

**[-01] =** Digital input 1
**[-02] =** Digital input 2
**[-03] =** Digital input 3
**[-04] =** Digital input 4

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

## P480 [-01] ... [-12] Function BusIO In Bits

*(Bus I/O In Bits function)*

0 ... 80
{ [-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).

With devices with an integrated AS interface, the I/O bits can be used by the interface itself (bit 0 ... 3) or in combination with I/O extensions (SK xU4-IOE) (bits 4 … 7 and bits 0 … 3). *With AS-i devices, the priority is AS-i. In this case BUS IO BITs 1 … 4 cannot be used by the 2nd. IO extension.*

**[-01] = Bus / AS-i Dig In1** (Bus IO In Bit 0 + AS-i 1 or DI 1 of the **second** SK xU4-IOE (DigIn 09))
**[-02] = Bus / AS-i Dig In2** (Bus IO In Bit 1 + AS-i 2 or DI 2 of the **second** SK xU4-IOE (DigIn 10))
**[-03] = Bus / AS-i Dig In3** (Bus IO In Bit 2 + AS-i 3 or DI 3 of the **second** SK xU4-IOE (DigIn 11))
**[-04] = Bus / AS-i Dig In4** (Bus IO In Bit 3 + AS-i 4 or. DI 4 of the **second** SK xU4-IOE (DigIn 12))
**[-05] = Bus / IOE Dig In1** (Bus IO In Bit 4 + DI 1 of the **first** SK xU4-IOE (DigIn 05))
**[-06] = Bus / IOE Dig In2** (Bus IO In Bit 5 + DI 2 of the **first** SK xU4-IOE (DigIn 06))
**[-07] = Bus / IOE Dig In3** (Bus IO In Bit 6 + DI 3 of the **first** SK xU4-IOE (DigIn 07))
**[-08] = Bus / IOE Dig In4** (Bus IO In Bit 7 + DI 4 of the **first** SK xU4-IOE (DigIN 08))
**[-09] =** Flag 1 [1)]
**[-10] =** Flag 2 [1)]
**[-11] =** Bit 8 BUS control word
**[-12] =** Bit 9 BUS control word

The possible functions for the bus In bits can be found in the table of functions for the digital inputs in parameter (P420). Functions {14} "Remote control" and {29} "Enable SetpointBox" are not possible.

1) The flag function is only possible with control via control terminals.

## P481 [-01] ... [-10] Function BusIO Out Bits

*(Function of Bus I/O Out Bits)*

0 ... 40
{ [-01] = 18 }
{ [-02] = 08 }
{ [-03] = 30 }
{ [-04] = 31 }
{ [-05...-10] = 00 }

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

With devices with in integrated AS interface, the I/O bits can be used by the interface itself (bit 0 ... 3) or in combination with I/O extensions (SK xU4-IOE) (bits 4 … 5 and flags 1 … 2).

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

The possible functions for the Bus Out Bits can be found in the table of functions for the digital outputs (P434).

1) The flag function is only possible with control via control terminals.

## P480 … P481 Using flags

With the aid of the two flags it is possible to define simple, logical sequences of functions.

To do this, the "triggers" for a function (e.g. a motor PTC overtemperature warning) are defined in parameter (P481) in arrays [-07] - "Flag 1" or [-08] - "Flag 2"

As well as this, the function which the frequency inverter is to execute when the "trigger" is active - i.e. the response by the frequency inverter is defined in parameter (P480) in arrays [-09] or [-10].

*Example:*

In an application, if the temperature of the motor reaches the overtemperature range ("Overtemperature motor PTC") the frequency inverter is to immediately reduce the speed to a specific speed (e.g. by means of an active fixed frequency). This is to be implemented by "Deactivation of analog input 1" via which in this example, the actual setpoint is normally set.

This is used to reduce the load on the motor, so that the temperature can stabilise or the drive unit reduces speed to a defined value before a shut-down due to error is made.

| Step | Description | Function |
|---|---|---|
| 1 | Determine the trigger<br>Set Flag 1 to the "Motor overtemperature" function | P481 [-07] → Function "12" |
| 2 | Specify the reaction,<br>Set Flag 1 to the function "Setpoint 1 On/Off | P480 [-09] → Function "19" |

It should be noted that depending on the function which is selected in (P481) the function may need to be inverted by modification of the standardisation (P482).

| P482 | [-01] ... [-10] | **Standard BusIO Out Bits** *(Standardisation of Bus I/O Out Bits)* | | S | |
|---|---|---|---|---|---|

-400 … 400 %
{ all 100 }

Adjustment of the limit values of the bus Out bits. For a negative value, the output function will be output negative.

Once the limit value is reached and positive values are delivered, the output produces a High signal, for negative setting values a Low signal.

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

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

1 … 100 %
{ all 10 }

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

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

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

### 5.2.6 Additional parameters

| Parameter {factory setting} | Setting value / Description / Note | | Supervisor | Parameter set |
|---|---|---|---|---|
| **P501** **[-01] ... [-20]** | **Inverter name** *(Inverter name)* | | | |
| A…Z (char) { 0 } | Free input of a designation (name) for the device (max. 20 characters). With this, the frequency inverter can be uniquely identified for setting with NORD CON software or within a network. | | | |
| **P502** **[-01] ... [-03]** | **Value master function** *(Master function value)* | | **S** | **P** |
| 0 ... 57 { 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). Definition of frequencies: (📖 Section 8.10 "Definition of setpoint and actual value processing (frequencies)") | | | |

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

Selection of possible setting values for master values:

| | | | |
|---|---|---|---|
| **0 =** | Off | **17 =** | Value analogue input 1<br>**SK2x0E:** Analogue input 1 (P400[-01]),<br>**SK2x5E:** AIN1 of the first I/O extension (SK xU4-IOE (P400 [-03])) |
| **1 =** | Actual frequency | **18 =** | Value analogue input 2<br>**SK2x0E:** Analogue input 2 (P400[-02]),<br>**SK2x5E:** AIN2 of the first I/O extension (SK xU4-IOE (P400 [-04])) |
| **2 =** | Actual speed | **19 =** | Setpoint freq. Master value, *"Setpoint frequency master value"* |
| **3 =** | Current | **20 =** | Setpoint freq. after ramp master value, *"Setpoint frequency from ramp master value“* |
| **4 =** | Torque current | **21 =** | Actual freq. without slip Master value *"Actual frequency without master value slip"* |
| **5 =** | Digital IO status | **22 =** | Speed encoder |
| **6 =** | ... 7 reserved, Posicon BU0210 | **23 =** | Master actual with slip *(SW V1.3 and above)* *"Actual frequency with slip"* |
| **8 =** | Setpoint frequency | **24 =** | Master value Actual freq. w. slip (SW V1.3 and above) *"Actual frequency master value with slip"* |
| **9 =** | Error number | **53 =** | Actual value 1 PLC |
| **10 =** | ... 11 reserved, Posicon BU0210 | **54 =** | Actual value 2 PLC |
| **12 =** | Bus IO Out Bits 0-7 | **55 =** | Actual value 3 PLC |
| **13 =** | ... 16 reserved, Posicon BU0210 | **56 =** | Actual value 4 PLC |
| | | **57 =** | Actual value 5 PLC |

**NOTE:** Details with regard to target and actual value processing: (📖 Section 8.9 "Standardisation of target values").

| P503 | Master function output<br>*(Master function output)* | | S | |
|---|---|---|---|---|

0 ... 3
{ 0 }

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

Specification of communication mode on the system bus for ParameterBox and NORDCON.

**0 =** **Off**
***No*** control word and master value output,
***If*** no individual BUS option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox or NORDCON is visible.

**1 =** **CANopen (system bus)**
***Control word*** and master values are transferred to the system bus.
***If*** no individual bus option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox or NORDCON is visible.

**2 =** **System bus active**
***No*** control word and master value output,
***All*** FIs connected to the system bus are visible in the ParameterBox or NORDCON, even if no bus option is connected. Prerequisite: all FIs must be set to this mode.

**3 =** **CANopen + system bus active**
**Control word** and master values are transferred to the system bus
***All*** FIs connected to the system bus are visible in the ParameterBox or NORDCON, even if no bus option is connected. Prerequisite: all other FIs must be set to mode { 2 } "System bus active"

| P504 | Pulse frequency<br>*(Pulse frequency)* | | S | |
|---|---|---|---|---|

3.0 ... 16.1 kHz
{ 6.0 }

The internal pulse frequency for controlling the power unit can be changed with this parameter. A higher setting reduces motor noise, but leads to increased EMC emissions and reduction of the possible motor nominal torque.

**NOTE:** The best possible degree of interference suppression for the device is adhered to by using the default value and taking the wiring directives into consideration.

**NOTE:** Raising the pulse frequency leads to a reduction of the possible output current, depending on the time ($I^2t$ curve). When the temperature warning limit (C001) is reached, the pulse frequency is gradually lowered to the default value. If the inverter temperature drops by a sufficient amount, the pulse frequency is increased to the original value.

**NOTE:** *Setting **16.1***: The automatic adaptation of the pulse frequency is activated with this setting. When doing this, the frequency inverter permanently determines the maximum possible pulse frequency taking different influential factors into consideration such as the heat sink temperature or an overcurrent warning

| P505 | Abs. minimum frequency<br>*(Absolute minimum frequency)* | | S | P |
|---|---|---|---|---|

0.0 ... 10.0 Hz
{ 2.0 }

Specifies the frequency value that cannot be undershot by the FI. If the setpoint is less than the abs. minimum frequency, the FI switches off or switches to 0.0Hz.

At the absolute minimum frequency, braking control (P434) and the setpoint delay (P107) are actuated. If a setting value of "Zero" is selected, the brake relay does not switch during reversing.

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

**NOTE:**
Output frequencies of < 4.5 Hz lead to current limitation (chapter 8.4.3).

| P506 | Automatic error acknowledgement<br>*(Automatic error acknowledgement)* | | S | |
|---|---|---|---|---|

0 ... 7
{ 0 }

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

**0 =** **No automatic** error acknowledgement.

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

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

**7 =** **Via Deactivate enable:** acknowledgement is only possible using the OK / ENTER key or by mains switch-off. No acknowledgement is implemented by removing the enable!

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

| P509 | Control word source<br>*(Control word source)* | | S | |
|---|---|---|---|---|

0 ... 4
{ 0 }

Selection of the interface via which the FI is controlled.

**0 =** **Control terminals or keyb. cont.**, *"Control terminals 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 analogue inputs or via the bus I/O Bits.

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

**3 =** **System bus** *, setting for actuation by master via a bus interface

**4 =** **System bus broadcast** *, setting for actuation by a master drive in Master / Slave mode (e.g. with synchronous applications)

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

**) If communication is interrupted during keyboard control (timeout 0.5 sec), the FI will block without an error message.

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

- www.nord.com –

As an alternative to setting the parameter, **System Bus** can also be selected with DIP switch S1:3.

| P510 | [-01]<br>[-02] | Setpoints source<br>*(Setpoints 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.

**0 =** **Auto:** The source of the setpoint is automatically derived from the setting of parameter P509.

**1 =** **Only control terminals**, digital and analogue inputs control the frequency, including fixed frequencies

**2 =** **USS**, see P509

**3 =** **System bus**, see P509

**4 =** **System bus broadcast**, see P509

| P511 | USS baud rate<br>*(USS baud rate)* | | S | |
|---|---|---|---|---|

0 ... 3
{ 3 }

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

**0 =** 4800 Baud

**1 =** 9600 Baud

**2 =** 19200 Baud

**3 =** 38400 Baud

| P512 | USS address<br>*(USS address)* | | | |
|---|---|---|---|---|
| 0 ... 30<br>{ 0 } | Setting of the FI bus address for USS communication. | | | |

| P513 | Telegram downtime<br>*(Telegram downtime)* | | S | |
|---|---|---|---|---|
| -0.1 / 0.0 /<br>0.1 ... 100.0 sec<br>{ 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<.<br>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.<br>**0.0 =** **off**: Monitoring is **switched off**.<br>**-0.1 =** **No error**: Even if the bus module detects an error, this does not cause the frequency inverter to be switched off.<br>**0.1 … =** **On**: Monitoring is activated.<br>**NOTE:** The process data channels for USS, CAN/CANopen and CANopen Broadcast are monitoring independently of each other. The decision concerning which channel to monitor is made by means of the setting in parameters P509 and P510.<br>For example, in this way it is possible to register the interruption of a CAN Broadcast communication, although the FI is still communicating with a Master via CAN. | | | |

| P514 | CAN baud rate<br>*(CAN baud rate)* | | S | |
|---|---|---|---|---|
| 0 ... 7<br>{ 5 } | Setting of the transfer rate (transfer speed) via the system bus interface. All bus participants must have the same baud rate setting.<br>**Note:**<br>Optional modules (SK xU4-…) only operate with a transfer rate of 250kBaud. Therefore the frequency inverter must remain at the factory setting (250kBaud).<br>**0 =** 10 kBaud **3 =** 100 kBaud **6 =** 500 kBaud<br>**1 =** 20 kBaud **4 =** 125 kBaud **7 =** 1 MBaud * (test purposes only)<br>**2 =** 50 kBaud **5 =** **250 kBaud**<br>*) Reliable operation cannot be guaranteed | | | |

| P515 | [-01] ... [-03] | **CAN address** *(CAN address (system bus))* | | S | |
|---|---|---|---|---|---|

0 ... $255_{dec}$
{ all $32_{dec}$ }
or { all $20_{hex}$}

Setting of the system bus address.

**[-01] = Slave address**, Receive address for system bus

**[-02] = Broadcast slave address**, system bus reception address (slave)

**[-03] = Master address,** *"Broadcast master address"***,** transmission address for system bus (master)

**NOTE:** If up to four FI 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 DIP switches (chapter 4.3.2.2).

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

0.0 ... 400.0 Hz
{ 0.0 }

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

This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set.

**0 =** Skip frequency inactive

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

0.0 ... 50.0 Hz
{ 2.0 }

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

Skip frequency range 1: P516 - P517 ... P516 + P517

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

0.0 ... 400.0 Hz
{ 0.0 }

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

This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set.

**0 =** Skip frequency inactive

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

0.0 ... 50.0 Hz
{ 2.0 }

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

Skip frequency range 2: P518 - P519 ... P518 + P519

| P520 | Flying start<br>*(Flying start)* | | S | P |
|---|---|---|---|---|

0 ... 4
{ 0 }

This function is required to connect the FI to already rotating motors, e.g. in fan drives. Motor frequencies >100Hz are only picked up in speed controlled mode (Servo mode P300 = ON).

**0 = Switched off**, no flying start.

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

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

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

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

**NOTE:** For physical reasons, the flying start circuit only operates above 1/10 of the nominal motor frequency (P201), however, not below 10Hz.

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

**NOTE:** *PMSM*: The catch function automatically determines the direction of rotation. The device therefore behaves in an identical way to function 1 with the setting for function 2. The device behaves in an identical way to function 3 with the setting for function 4.

In CFC closed loop operation, the catch circuit can only be executed if the rotor position is known in relation to the incremental encoder. For this purpose, the motor can initially not rotate when it is switched on for the first time after a "mains on" of the device.

| P521 | Fly. start resol.<br>*(Flying start resolution)* | | S | P |
|---|---|---|---|---|

0.02... 2.50 Hz
{ 0.05 }

Using this parameter, the flying start circuit search increment size can be adjusted. Values that are too large affect accuracy and causes the FI to cut out with an overcurrent message. If the values are too small, the search time is greatly extended.

| P522 | Fly. start offset<br>*(Flying start offset)* | | S | P |
|---|---|---|---|---|

-10.0 ... 10.0 Hz
{ 0.0 }

A frequency value that can be added to the frequency value found, e.g. to remain in the motor range and so avoid the generator range and therefore the chopper range.

| P523 | Factory setting<br>*(Factory setting)* | | | |
|---|---|---|---|---|

0 ... 3
{ 0 }

By selecting the appropriate value and confirming it with the Enter key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0.

- **0 =** **No change:** Does not change the parameterisation.
- **1 =** **Load factory settings:** The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost.
- **2 =** **Factory settings without bus:** All parameters of the frequency inverter, with the exception of the bus parameter, are reset to the factory setting.
- **3 =** **Factory settings without motor data:** All parameters of the frequency inverter, but not the motor data parameters (P2xx), are reset to the factory setting.

**Note:** If an external EEPROM ("memory module"“) is plugged in, then a value of ("Factory setting …") only affect this. If no "memory module" is present, the set command ("Factory setting …") is applied to the internal EEPROM

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

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

Selection of up to 3 auxiliary values:

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

Maximum load torque value.

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

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

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

0 ... 400 %
{ all 0 }

Selection of up to 3 auxiliary values:

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

Minimum load torque.

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

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

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

0.0 ... 400.0 Hz
{ all 25.0 }

Selection of up to 3 auxiliary values:

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

Auxiliary frequency values

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

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

0.10 ... 320.00 s
{ 2.00 }

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

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

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

0 ... 3
{ 0 }

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

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

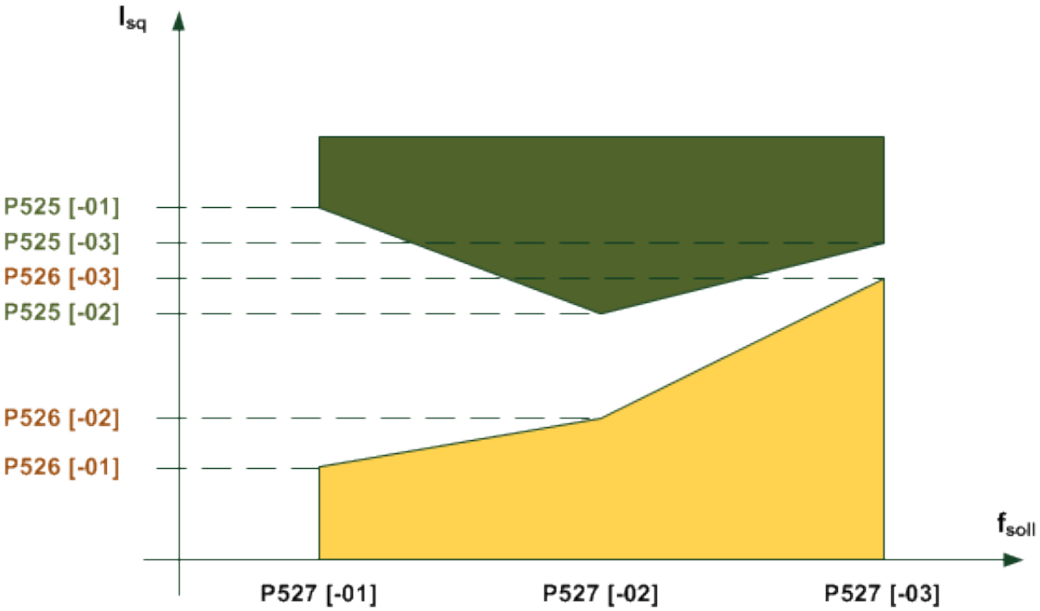
1 = **Warning**, After the elapse of half of the time defined in (P528) and infringement of the monitoring range produces a warning ("C12.5").

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

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

## P525 … P529 Load monitoring

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




The time after which a fault is triggered can be set with parameter (P528). If the permissible range is exceeded *(Example diagram: 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 no the calculated torque is used as the reference value. This has the advantage that monitoring in the "non field weakened range" without servo mode is usually more accurate. Naturally however, it cannot display more than the physical torque in the weakened field range.

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

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

| P533 | Factor $I^2t$-Motor<br>*(Factor $I^2t$-Motor)* | | S | |
|---|---|---|---|---|
| 50 ... 150 %<br>{ 100 } | The motor current for the $I^2t$ motor monitoring P535 can be weighted with the parameter P533. Larger factors permit larger currents. | | | |

| P534 [-01] [-02] | Torque disconn. limit<br>*(Torque disconnection limit)* | | S | P |
|---|---|---|---|---|
| 0 ... 400 % / 401<br>{ all 401 } | Via this parameter both the **drive** [-01] and the **generator** [-02] switch-off value can be adjusted.<br>If 80% of the set value is reached, a warning status is set. At 100% switch-off is performed with an error message.<br>Error 12.1 is given on exceeding the drive switch-off limit and 12.2on exceeding the generator switch-off limit.<br>**[01] =** drive switch-off limit **[02] =** generator switch-off limit<br>**401 = OFF** means that this function has been disabled. | | | |

| P535 | $I^2t$ Motor<br>*($I^2t$ Motor)* | | | |
|---|---|---|---|---|
| 0 … 24<br>{ 0 } | The motor temperature is calculated depending on the output current, the time and the output frequency (cooling). If the temperature limit value is reached then switch off occurs and error message E002 (motor overheating) is output. Possible positive or negative acting ambient conditions cannot be taken into account here.<br>The $I^2t$ motor function can be set in a differentiated manner. 8 characteristic curves with three different triggering times (<5 s, <10 s and <20 s) can be set. The trigger times are based on classes 5, 10 and 20 for semiconductor switching devices. The recommended setting for standard applications is **P535=5**.<br>All curves run from 0 Hz to half of the nominal motor frequency (P201). The full nominal current is available from half of the nominal frequency upwards.<br>With multi-motor operation the monitoring must be disabled.<br>**0 = $I^2t$ Motor off**: Monitoring is inactive | | | |

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

**NOTE:** Shut-off classes 10 and 20 are provided for applications with heavy starting. When using these shut-off classes, it must be ensured that the FI has a sufficiently high overload capacity.

| P536 | Current limit<br>*(Current limit)* | | S | |
|---|---|---|---|---|

0.1 ... 2.0 / 2.1 (x nominal FI current)

{ 1.5 }

The inverter output current is limited to the set value. If this limit value is reached, the inverter reduces the actual output frequency.

With the analogue input function in P400 = 13/14, this limit value can also be varied and cause an error message (E12.4).

**0.1 ... 2.0 = Multiplier** with the inverter nominal current, gives the limit value.

**2.1 = OFF** means that this limit value is disabled. The FI supplies the maximum possible current.

| P537 | Pulse disconnection<br>*(Pulse disconnection)* | | S | |
|---|---|---|---|---|

10 ... 200 % / 201

{ 150 }

This function prevents rapid shutdown of the FI according to the load. With the pulse switch-off enabled, the output current is limited to the set value. This limitation is implemented by brief switching off of individual output stage transistors, the actual output frequency remains unchanged.

| | |
|---|---|
| **10...200 % =** | **Limit value in relation to nominal FI current** |
| **201 =** | **The function is** so to speak **disabled,** the FI supplies the maximum possible current. However, at the current limit the pulse switch-off can still be active. |

**NOTE:** The value set here can be undershot by a smaller value in P536.

With smaller output frequencies (<4.5 Hz) or higher pulse frequencies (>6 kHz or 8 kHz, P504) the pulse switch-off can be undershot by the power reduction (please see chapter 8.4 "Reduced output power").

**NOTE:** If the pulse switch-off is disabled (P537=201) and a high pulse frequency is selected in parameter P504, the FI automatically reduces the pulse frequency when the power limit is reached. If the load on the FI is reduced again, the pulse frequency increases back to the original value.

| P539 | Output monitoring<br>*(Output monitoring)* | | S | P |
|---|---|---|---|---|

0 ... 3
{ 0 }

This protective function monitors the output current at the U-V-W terminals and checks for plausibility. In cases of error, the error message E016 is output.

**0 =** **Disabled:** Monitoring is not active.

**1 =** **Only motor phases:** The output current is measured and checked for symmetry. If an imbalance is present, the FI switches off and outputs the error message E016.

**2 =** **Only magnetisation:** At the moment the FI is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the FI switches off with the error message E016. A motor brake is not released in this phase.

**3 =** **Motor phase + Magnet:** Monitoring of the motor phases and magnetisation as in 1 and 2 are combined.

**NOTE:** This function can be used as an additional protective function for lifting applications, but is not permissible on its own as protection for persons.

| P540 | Mode phase sequence<br>*(Mode phase sequence)* | | 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 =** **Clockwise 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 =** **Anticlockwise only***, only counter-clockwise direction is possible. The selection of the "incorrect" rotation direction leads to the output of the minimum frequency P104 with the field of rotation L.

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

**5 =** **Clockwise only monitored**, "O*nly clockwise monitored*,* only clockwise rotation is possible. The selection of the "incorrect" rotation direction leads to the FI switching off (control block). If necessary, a sufficiently large setpoint value (>$f_{min}$) must be observed.

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

**7 =** **Only 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.

## P541 Set relay

*(set digital output)*

S

0000 ... FFF (hex)

{ 0000 }

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

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

**Bit 0 =** Digital output 1

**Bit 1 =** Bus/AS-i Out Bit 0

**Bit 2 =** Bus/AS-i Out Bit 1

**Bit 3 =** Bus/AS-i Out Bit 2

**Bit 4 =** Bus/AS-i Out Bit 3

**Bit 5 =** Bus/An/Dig Out Bit 4, *"Bus/Analogue /Digital Out Bit 4"*

**Bit 6 =** Bus/An/Dig Out Bit 5, *"Bus/Analogue /Digital Out Bit 5"*

**Bit 7 =** Bus digital output 7

**Bit 8 =** Bus digital output 8

**Bit 9 =** Bus statusword Bit10

**Bit 10 =** Bus statusword Bit13

**Bit 11 =** Digital output 2

| | Bits 8-11 | Bits 7-4 | Bits 3-0 | |
|---|---|---|---|---|
| Min. value | 0000<br>**0** | 0000<br>**0** | 0000<br>**0** | Binary<br>**hex** |
| Max. value | 1111<br>**F** | 1111<br>**F** | 1111<br>**F** | Binary<br>**hex** |

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 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.

## P542 [-01] [-02] Set analogue output

*(Set analogue output)*

S

0.0 ... 10.0 V

{ all 0.0 }

only with SK CU4-IOE or SK TU4-IOE

**[-01] =** First IOE, AOUT of the **first** I/O extension (SK xU4IOE)

**[-02] =** Second IOE, AOUT of the **second** I/O extension (SK xU4IOE)

The analogue output of the FI can be set with this function, independently of the actual operating state. To do this, the relevant analogue 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 analogue 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.

| P543 [-01] ... [-03] | Actual bus value 1 … 3<br>*(Actual bus value 1 ... 3)* | | S | P |
|---|---|---|---|---|

0 ... 57
{ [-01] = 1 }
{ [-02] = 4 }
{ [-03] = 9 }

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

**NOTE:** For further details, please refer to the relevant bus manual or the description for (P418). (Values from 0% … 100% correspond to $0000_{hex}$ … $4000_{hex}$) For standardisation of the actual values: (please see chapter 8.9 "Standardisation of setpoint / target values").

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

(Definition of frequencies (chapter 8.10))

**0 =** Off
**1 =** Actual frequency
**2 =** Actual speed
**3 =** Current
**4 =** Torque current (100% = P112)
**5 =** Digital IO* status
**6 =** … 7 reserved, Posicon BU0210
**8 =** Setpoint frequency
**9 =** Error number
**10 =** … 11 reserved, Posicon BU0210
**12 =** BusIO Out Bits 0-7
**13 =** … 16 reserved, Posicon BU0210
**17 =** Value analogue input 1,
**SK2x0E:** Analogue input 1 (P400[-01]),
**SK2x5E:** AIN1 of the first I/O extension SK xU4-IOE (P400 [-03]))
**18 =** Value of analogue input 2,
**SK2x0E:** Analogue input 2 (P400[-02]),
**SK2x5E:** AIN2 of first I/O extension SK xU4-IOE (P400 [-04]))
**19 =** Setpoint frequency master value (P503)
**20 =** Target frequency aft. mast. val. ramp,
*"Setpoint frequency after master value ramp"*
**21 =** Actual freq. without slip Master value
*"Actual frequency without master value slip"*
**22 =** Speed encoder,
*"Speed from encoder"*
**23 =** Actual frequency with slip *(from software version V1.3)*
*"Actual frequency with slip"*
**24 =** Master value Actual freq. w. slip *(SW 1.3 and above)*
*"Master value, actual freq. with slip"*
**53 =** Actual value 1 PLC
**54 =** Actual value 2 PLC
**55 =** Actual value 3 PLC
**56 =** Actual value 4 PLC
**57 =** Actual value 5 PLC

* 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 = mech. Brake (FI) | Bit 14 = DigOut 2 (FI) (SK 2x0E) | Bit 15 = reserved |

| P546 | [-01] ... [-03] | Function Bus setpoint *(Function of bus setpoint)* | | S | P |
|---|---|---|---|---|---|

0 ... 36
{ [-01] = 1 }
{ [-02] = 0 }
{ [-03] = 0 }

In this parameter, a function is allocated to the output setpoint during bus actuation.

**NOTE:** For further details, please refer to the relevant bus manual or the description for (P400). (Values from 0 % … 100 % correspond to $0000_{hex}$ … $4000_{hex}$,) For standardisation of the setpoint values: (please see chapter 8.9 "Standardisation of setpoint / target values").

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

**Possible values which can be set:**

- **0 =** Off
- **1 =** Setpoint frequency (16 bit)
- **2 =** Frequency addition
- **3 =** Frequency subtraction
- **4 =** Minimum frequency
- **5 =** Maximum frequency
- **6 =** Process controller actual value
- **7 =** Process controller setpoint
- **8 =** Actual frequency PI
- **9 =** Actual freq. PI limited
- **10 =** Actual freq. PI monitored
- **11 =** Torque current limit, *"Torque current limited"*
- **12 =** Torque current switch-off, *"Torque current switch-off limit"*
- **13 =** Current limit, *"Current limited"*
- **14 =** Current Switch-off *"Current switch-off limit"*
- **15 =** Ramp time, (P102/103)
- **16 =** Lead torque, ((P214) multiplication)
- **17 =** Multiplication
- **18 =** Curve travel calculator
- **19 =** Servo mode torque
- **20 =** BusIO InBits 0-7
- **21 =** ...25 reserved, POSICON
- **31 =** Digital output IOE, sets the state of DOUT of the first IOE
- **32 =** Analogue output IOE, sets the value AOUT of the first IOE), condition: P418 = Function "31" Value must be between 0 and 100 ($0_{hex}$ and $64_{hex}$). Otherwise the minimum value is output at the analogue output.
- **33 =** Setpoint Torque processreg., *"Setpoint torque process controller"*
- **34 =** d-correction F process
- **35 =** d-correction Torque
- **36 =** d-correction F+torque

| P549 | PotentiometerBox function *(PotentiometerBox function)* | | S | |
|---|---|---|---|---|

0 ... 16
{ 0 }

This parameter provides the possibility of adding a correction value (fixed frequency, analogue, bus) to the current setpoint value by means of the SimpleBox/ParameterBox keyboard.

The adjustment range is determined by the auxiliary setpoint value P410/411.

- **0 = Off**
- **1 = Setpoint frequency**, with(P509)≠ 1 control via USS is possible
- **2 = Frequency addition**
- **3 = Frequency subtraction**

| P550 | EEPROM copy order<br>*(EEPROM copy order)* | | | |
|---|---|---|---|---|

0 ... 3
{ 0 }

The frequency inverter is equipped with an internal EEPROM and a plug-in EEPROM ("Memory Module") which operates in parallel to this for the storage and management of parameter data. The data from the device are managed in parallel on both devices, so that a safe and rapid exchange of parameter settings in the device is possible for commissioning or in case of service.

The data sets saved in the internal EEPROM and in the Memory Module can be copied between the devices. This includes a PLC program that is present on the device.

**0 =** **No change**

**1 =** **External** → **Internal**, the data set is copied from the memory module (external EEPROM) to the internal EEPROM

**2 =** **Internal** → **Externa**l, the data set is copied from the internal EEPROM to the memory module (external EEPROM)

**3 =** **External < - > Internal**, the data sets are exchanged between the two EEPROMs

**Note:** Since software version 1.4 R2, the frequency converter always uses the data record that is stored on the internal EEPROM.

With older versions the data record for the external EEPROM (memory module) is used. The parametrisation of the internal EEPROM was only used if no Memory Module was plugged in.

| P552 [-01] [-02] | CAN Master cycle<br>*(CAN Master cycle time)* | | S | |
|---|---|---|---|---|

0.0 / 0.1 … 100.0 ms
{ all 0.0 }

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 $t_Z$ | Default CAN Master | Default CANopen Abs. |
|---|---|---|---|
| 10kBaud | 10ms | 50ms | 20ms |
| 20kBaud | 10ms | 25ms | 20ms |
| 50kBaud | 5ms | 10ms | 10ms |
| 100kBaud | 2ms | 5ms | 5ms |
| 125kBaud | 2ms | 5ms | 5ms |
| 250kBaud | 1ms | 5ms | 2ms |
| 500kBaud | 1ms | 5ms | 2ms |
| 1000kBaud: | 1ms | 5ms | 2ms |

| P553 | [-01] ... [-05] | **PLC setpoints** *(PLC setpoints)* | | S | P |
|---|---|---|---|---|---|

0 ... 57
all = { 0 }

The PLC setpoints are assigned with a function in this parameter. The settings only apply for main setpoints and with active PLC actuation ((P350) = "On") and ((P351) = "0" or "1").

**[-01] = Bus setpoint value 1** … **[-05] = Bus setpoint 5**

**Possible values which can be set:**

| | | | |
|---|---|---|---|
| **0 =** | Off | **17 =** | BusIO In Bits 0-7 |
| **1 =** | Setpoint frequency | **18 =** | Curve travel calculator |
| **2 =** | Torque current limit | **19 =** | Set relays |
| **3 =** | Actual frequency PID | **20 =** | Set analogue out |
| **4 =** | Frequency addition | **21 =** | Setpoint position Low word |
| **5 =** | Frequency subtraction | **22 =** | Setpoint pos. HighWord |
| **6 =** | Current limit | **23 =** | Setpoint pos. Inc.LowWord |
| **7 =** | Maximum frequency | **24 =** | Target pos.Inc.HighWord |
| **8 =** | Actual PID frequency limited | **46 =** | Torque process controller setpoint |
| **9 =** | Actual PID frequency monitored | **47 =** | Gearing ratio |
| **10 =** | Servo mode torque | **48 =** | Motor temperature |
| **11 =** | Torque precontrol | **49 =** | Ramp time |
| **12 =** | Reserved | **53 =** | d-correction F process |
| **13 =** | Multiplication | **54 =** | d-correction Torque |
| **14 =** | Process controller actual value | **55 =** | d-correction F+Torque |
| **15 =** | Process controller setpoint | **56 =** | Acceleration time |
| **16 =** | Process controller lead | **57 =** | Deceleration time |

| P555 | Chopper P limitation<br>*(Chopper power limitation)* | | S | |
|---|---|---|---|---|

5 ... 100 %
{ 100 }

With this parameter it is possible to program a manual (peak) power limit for the brake resistor. The switch-on delay (modulation level) for the chopper can only rise to a certain maximum specified limit. Once this value has been reached, irrespective of the level of the link voltage, the inverter switches off the current to the resistor.

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

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

R = Resistance of the brake resistor

$P_{maxBW}$ = Momentary peak power of the brake resistor

$U_{max}$ = FI chopper switching threshold

1~ 115/230 V ⇒ 440 V=

3~ 230 V ⇒ 500 V=

3~ 400 V ⇒ 1000 V=

**Information**

- Use of an *external braking resistor*: DIP switch **S1:8**: Setting „**0**“ (**Off**). Set the parameter according to the braking resistor which is used.
- Use of an *internal braking resistor*: DIP switch **S1:8**: Setting „**I**“ (**On**). Settings in the parameter do not have any effect.

(chapter 2.3.2) (chapter 2.3.1) (chapter 4.3.2.2)

| P556 | Braking resistor<br>*(Brake resistor)* | | S | |
|---|---|---|---|---|

20 ... 400 Ω
{ 120 }

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

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

**Information**

- Use of an *external braking resistor*: DIP switch **S1:8**: Setting „**0**“ (**Off**). Set the parameter according to the braking resistor which is used.
- Use of an *internal braking resistor*: DIP switch **S1:8**: Setting „**I**“ (**On**). Settings in the parameter do not have any effect.

(chapter 2.3.2) (chapter 2.3.1) (chapter 4.3.2.2)

| P557 | Brake resistor type<br>*(Brake resistor power)* | | S | |
|---|---|---|---|---|

0.00 ... 20.00 kW
{ 0.00 }

Continuous power (nominal power) of the resistor, to display the actual utilisation in (**P737**). For a correctly calculated value, the correct value must be entered into (**P556**) and (**P557**).

**0.00 =** Monitoring disabled

**Information**

- Use of an *external braking resistor*: DIP switch **S1:8**: Setting „**0**“ (**Off**). Set the parameter according to the braking resistor which is used.
- Use of an *internal braking resistor*: DIP switch **S1:8**: Setting „**I**“ (**On**). Settings in the parameter do not have any effect.

(chapter 2.3.2) (chapter 2.3.1) (chapter 4.3.2.2)

| P558 | Flux delay<br>*(Flux delay)* | | 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 to provide the excitation of the stator winding. The duration depends on the size of the motor and is automatically set in the factory setting of the FI.

For time-critical applications, the magnetizing time can be set or deactivated.

**0 =** Disabled

**1 =** Automatic calculation

**2 ... 500 =** Time set in [ms]

**NOTE:** Setting values that are too low can reduce the dynamics and starting torque.

| P559 | DC Run-on time<br>*(DC Run-on time)* | | S | P |
|---|---|---|---|---|

0.00 ... 30.00 s
{ 0.50 }

Following a stop signal and the braking ramp, a direct current is briefly applied to the motor to fully bring the drive to a stop. Depending on the inertia, the time for which the current is applied can be set in this parameter.

The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic).

| P560 | Parameter, Saving mode<br>*(Saving mode parameter)* | | S | |
|---|---|---|---|---|

0 ... 2
{ 1 }

**0 =** **Only in RAM**, changes to the parameter settings are no longer saved on the EEPROM. All previously saved settings are retained, even if the FI is disconnected from the mains.

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

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

**NOTE:** If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles (100,000 x) in the EEPROM is not exceeded.

*PLC:* A stored PLC program is also protected by the settings "**0"** or "**2"**. However, with the setting "**0"** the PLC program can also not be loaded or executed.

### 5.2.7 Positioning

Parameter group P600 is used to adjust the positioning control or the position control. In order to make this parameter visible, the supervisor parameter P003 must be set to 3.

A detailed description of these parameters can be found in manual BU0210.

### 5.2.8 Information

| Parameter | | Setting value / Description / Note | | Supervisor | Parameter set |
|---|---|---|---|---|---|
| **P700** | **[-01] ... [-03]** | **Actual operating status**<br>*(Actual operating status)* | | | |
| 0.0 ... 25.4 | | 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 (please see chapter 6 "Operating status messages").<br>**[-01] = Present fault,** shows the currently active (unacknowledged) fault (please see section "Error messages").<br>**[-02] = Present warning,** indicates a current warning message (please see section "Warning messages").<br>**[-03] = Reason for disabled starting,** indicates the reason for an active start disable (please see section "Switch-on block messages").<br>**NOTE**<br>*SimpleBox / ControlBox:* the error numbers of the warning messages and faults can be displayed using SimpleBox and ControlBox.<br>*ParameterBox:* with the ParameterBox the messages are displayed in plain text.. In addition, the reason for a possible disabling of starting can also be displayed.<br>*Bus:* The display of bus-level error messages is displayed in decimal integer format. The displayed value must be divided by 10 in order to correspond with the correct format.<br>Example: Display: 20 → Error number: 2.0 | | | |
| **P701** | **[-01] ... [-05]** | **Last fault 1 ... 5**<br>*(Last fault 1...5)* | | | |
| 0.0 ... 25.4 | | This parameter stores the last 5 faults (please see chapter 0 "Error messages").<br>The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code. | | | |
| **P702** | **[-01] ... [-05]** | **Last frequency error**<br>*(Last frequency error 1...5)* | | **S** | |
| -400.0 ... 400.0 Hz | | This parameter stores the output frequency that was being delivered at the time the fault occurred. The values of the last 5 errors are stored.<br>The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK- / ENTER key to read the stored error code. | | | |

| P703 | [-01] ... [-05] | Current last error *(Last current error 1...5)* | | S | |
|---|---|---|---|---|---|

0.0 ... 999.9 A

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

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

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

0 ... 600 V AC

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

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

| P705 | [-01] ... [-05] | Last link circuit error *(Last link circuit error 1...5)* | | S | |
|---|---|---|---|---|---|

0 ... 1000 V DC

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

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

| P706 | [-01] ... [-05] | P set last error *(Parameter set, last error 1… 5)* | | S | |
|---|---|---|---|---|---|

0 ... 3

This parameter stores the parameter set code that was active when the error occurred. Data for the previous 5 faults are stored.

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

| P707 | [-01] ... [-03] | Software-Version *(Software version/ revision)* | | | |
|---|---|---|---|---|---|

0.0 ... 9999.9

This parameter shows the software and revision numbers in the FI. This can be significant when different FIs are assigned the same settings.

Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version.

**... [-01] =** Version number (Vx.x)
**... [-02] =** Revision number (Rx)
**... [-03] =** Special version of hardware/software (0.0)

| P708 | **Status of digital input**<br>*(Status of digital input)* | | | |
|---|---|---|---|---|

00000 ... 11111 (bin)
or
0000 ... FFFF (hex)

Displays the status of the digital inputs in binary/hexadecimal code. This display can be used to check the input signals.

**Bit 0 =** Digital input 1
**Bit 1 =** Digital input 2
**Bit 2 =** Digital input 3
**Bit 3 =** Digital input 4
**Bit 4 =** Thermistor input
**Bits 5 - 7** reserved

First SK xU4-IOE (optional)
**Bit 8 =** 1: IO extension: Digital input 1
**Bit 9 =** 1: IO extension: Digital input 2
**Bit 10 =** 1: IO extension: Digital input 3
**Bit 11 =** 1: IO extension: Digital input 4

Second SK xU4-IOE (optional)
**Bit 12 =** 2: IO extension: Digital input 1
**Bit 13 =** 2: IO extension: Digital input 2
**Bit 14 =** 2: IO extension: Digital input 3
**Bit 15 =** 2: IO extension: Digital input 4

| | Bits 15-12 | Bits 11-8 | Bits 7-4 | Bits 3-0 | |
|---|---|---|---|---|---|
| **Minimum value** | 0000<br>0 | 0000<br>0 | 0000<br>0 | 0000<br>0 | Binary<br>**hex** |
| **Maximum value** | 1111<br>F | 1111<br>F | 1111<br>F | 1111<br>F | Binary<br>**hex** |

**SimpleBox**: The binary bits are converted to a hexadecimal value and displayed.
**ParameterBox:** The Bits are displayed increasing from right to left (binary).

| P709 | [-01] ... [-09] | **Analog input voltage** *(Voltage analogue input)* | | | |
|---|---|---|---|---|---|

-100 ... 100 %

Displays the measured analogue input value.

| SK 2x0E | | SK 2x5E | |
|---|---|---|---|
| **[-01] =** | **Analogue input 1**, function of analogue input 1 integrated into the FI | **[-01] =** | **Potentiometer 1**, Internal potentiometer P1 in the FI (chapter 4.3.2), for setting the maximum frequency, minimum frequency and ramp time |
| **[-02] =** | **Analogue input 2**, function of analogue input 2 integrated into the FI | **[-02] =** | **Potentiometer 2**, as for potentiometer 1. |

| SK 2xxE | |
|---|---|
| **[-03] =** | **Ext. analogue input 1,** AIN 1 of the first I/O extension SK xU4-IOE |
| **[-04] =** | **Ext. analogue input 2,** AIN2 of the first I/O extension SK xU4-IOE |
| **[-05] =** | **Setpoint module**, SK SSX-3A, see BU0040 |

| SK 2xxE, size 1 – 3 | | SK 2x0E, size 4 | |
|---|---|---|---|
| **[-06] =** | **Analogue function Dig. 2**, analogue function of FI digital input 2 | **[-06] =** | **Potentiometer 1**, Internal potentiometer P1 in the FI (chapter 4.3.2), for setting the maximum frequency, minimum frequency and ramp time |
| **[-07] =** | **Analogue function Dig. 3**, analogue function of FI digital input 3 | **[-07] =** | **Potentiometer 2**, as for potentiometer 1. |

| SK 2xxE | |
|---|---|
| **[-08] =** | **Ext. A.in. 1 2nd IOE,** *"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analogue input 3) |
| **[-09] =** | **Ext. A.in. 2 2nd IOE,** *"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analogue input 4) |

| P710 | [-01] [-02] | **Analogue output volt.** *(Analogue output voltage)* | | | |
|---|---|---|---|---|---|

0.0 ... 10.0 V

Displays the delivered value of analogue output.

**[-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)

## P711 State of relays
*(state of digital outputs)*

00000 ... 11111 (bin)
or
00 ... FF (hex)

Indicates the actual status of the digital outputs of the frequency inverter.

| | |
|---|---|
| **Bit 0 =** Digital output 1 | **Bit 4 =** Digital output 1, IO extension 1 |
| **Bit 1 =** Mechanical brake | **Bit 5 =** Digital output 2, IO extension 1 |
| **Bit 2 =** Digital output 2 | **Bit 6 =** Digital output 1, IO extension 2 |
| **Bit 3 =** reserved | **Bit 7 =** Digital output 2, IO extension 2 |

| | Bits 7-4 | Bits 3-0 | |
|---|---|---|---|
| Minimum value | 0000 | 0000 | Binary |
| | 0 | 0 | hex |
| Maximum value | 1111 | 1111 | Binary |
| | F | F | hex |

**SimpleBox:** The binary bits are converted to a hexadecimal value and displayed.
**ParameterBox:** The bits are displayed increasing from right to left (binary).

## P714 Operating time
*(Operating time)*

0.10 ... ___ h

This parameter shows the time for which the FI was connected to the mains and was ready for operation.

## P715 Running time
*(Enablement time)*

0.00 ... ___ h

This parameter shows the time for which the FI was enabled and supplied current to the output.

## P716 Current frequency
*(Actual frequency)*

-400.0 ... 400.0 Hz

Displays the actual output frequency.

## P717 Current speed
*(Actual rotation speed)*

-9999 ... 9999 rpm

Displays the actual motor speed calculated by the FI.

## P718 [-01] ... [-03] Present Actual setpoint frequency
*(Actual setpoint frequency)*

-400.0 ... 400.0 Hz

Displays the frequency specified by the setpoint
(please see chapter 8.1 "Setpoint processing").

**[-01] =** Actual setpoint frequency from the setpoint source
**[-02] =** Actual setpoint frequency after processing in the FI status machine
**[-03] =** Actual setpoint frequency after frequency ramp

| | | | | |
|---|---|---|---|---|
| **P719** | **Actual current**<br>*(Actual current)* | | | |
| 0.0 ... 999.9 A | Displays the actual output current. | | | |
| **P720** | **Act. torque current**<br>*(Actual torque current)* | | | |
| -999.9 ... 999.9 A | Displays the actual calculated torque-developing output current (active current). Basis for calculation are the motor data P201...P209.<br>→ negative values = generator, → positive values = drive | | | |
| **P721** | **Actual field current**<br>*(Actual field current)* | | | |
| -999.9 ... 999.9 A | Displays the actual calculated field current (reactive current). Basis for calculation are the motor data P201...P209. | | | |
| **P722** | **Current voltage**<br>*(Actual voltage)* | | | |
| 0 ... 500 V | Displays the actual AC voltage supplied by the FI output. | | | |
| **P723** | **Voltage -d**<br>*(Actual voltage component Ud)* | | **S** | |
| -500 ... 500 V | Displays the actual field voltage component. | | | |
| **P724** | **Voltage -q**<br>*(Actual voltage component Uq)* | | **S** | |
| -500 ... 500 V | Displays the actual torque voltage component. | | | |
| **P725** | **Current Cos phi**<br>*(Actual cosj)* | | | |
| 0.00 ... 1.00 | Displays the actual calculated cos φ of the drive. | | | |
| **P726** | **Apparent power**<br>*(Apparent power)* | | | |
| 0.00 ... 300.00 kVA | Displays the actual calculated apparent power. The basis for calculation are the motor data P201...P209. | | | |
| **P727** | **Mechanical power**<br>*(Mechanical power)* | | | |
| -99.99 ... 99.99 kW | Displays the actual calculated effective power of the motor. Basis for calculation are the motor data P201...P209. | | | |

| P728 | **Input voltage**<br>*(mains voltage)* | | | |
|---|---|---|---|---|
| 0 ... 1000 V | Displays the actual mains voltage at the FI input. This is directly determined from the amount of the intermediate circuit voltage | | | |

**Information** — **Display of static value**

In devices with a separate 24 V supply, a static value is displayed if *no mains voltage* is present (e.g.: with 1~ 230 V devices: P728 = 230 V). This value is used for internal initialisation purposes.

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

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

| P731 | **Parameter set**<br>*(Actual parameter set)* | | | |
|---|---|---|---|---|
| 0 ... 3 | Shows the actual operating parameter set.<br>0 = Parameter set 1<br>1 = Parameter set 2<br>2 = Parameter set 3<br>3 = Parameter set 4 | | | |

| P732 | **Phase U current**<br>*(U phase current)* | | **S** | |
|---|---|---|---|---|
| 0.0 ... 999.9 A | Displays the actual U phase current.<br>**NOTE:**<br>This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents. | | | |

| P733 | **Phase V current**<br>*(V phase current)* | | **S** | |
|---|---|---|---|---|
| 0.0 ... 999.9 A | Displays the actual V phase current.<br>**NOTE:**<br>This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents. | | | |

| P734 | Phase W current<br>*(W phase current)* | | S | |
|---|---|---|---|---|
| 0.0 ... 999.9 A | Displays the actual W phase current.<br>**NOTE:**<br>This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents. | | | |

| P735 | Encoder speed<br>*(encoder speed)* | | S | |
|---|---|---|---|---|
| -9999 ... 9999 rpm | Displays the actual rotation speed supplied by the incremental encoder. For this, P301 must be correctly set. | | | |

| P736 | D.c. link voltage<br>*(DC link voltage)* | | | |
|---|---|---|---|---|
| 0 ... 1000 V DC | Displays the actual link voltage.<br>**Information** **Display of untypical value**<br>In devices with a separate 24 V supply, a small, non-typical value is displayed if *no mains voltage* is present (e.g.: with 1~ 230 V devices: P736 ≈ 4 V). This value results from internal measuring and testing routines, and is dependent upon measuring errors, offsets and signal noise, for example. | | | |

| P737 | Usage rate brakeres.<br>*(Actual brake resistor usage rate)* | | | |
|---|---|---|---|---|
| 0 ... 1000 % | This parameter provides information about the actual degree of modulation of the brake chopper or the current utilisation of the braking resistor in generator mode.<br>If parameters P556 and P557 are correctly set, the utilisation related to P557, the resistor power, is displayed.<br>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.<br>If P556 = 0 and P557 = 0, this parameter also provides information about the degree of modulation of the brake chopper in the FI. | | | |

| P738 [-01] [-02] | Motor usage rate<br>*(current motor usage rate)* | | | |
|---|---|---|---|---|
| 0 ... 1000 % | Shows the actual motor load. Basis for calculation is the motor data P203. The actually recorded current is related to the nominal motor current.<br>**[-01] = in relation to $I_N$** (P203) of the motor<br>**[-02] = in relation to $I^2t$ monitoring,** *"in relation to $I^2t$ monitoring"* (P535) | | | |

| P739 | [-01] ... [-03] | **Heat sink temp.** *(Current heat sink temperature)* | | | |
|---|---|---|---|---|---|
| -40 ... 150°C | | **[-01] = FI heat sink temperature**<br>**[-02] = Internal temperature of the FI**<br>**[-03] = Temp. Motor KTY**, motor temperature via KTY, recording exclusively via IO extension, setting in (P400) to function {30} "Motor temperature" | | | |

| P740 | [-01] ... [-19] | **PZD bus In** *(Process data Bus In)* | | **S** | |
|---|---|---|---|---|---|
| 0000 ... FFFF (hex) | This parameter provides information about the actual control word and the setpoints that are transferred via the bus systems.<br>For display, a BUS system must be selected in P509.<br>Standardisation: (📖 section 8.9 "Standardisation of setpoint / target values") | **[-01 ] =** Control word | Control word, source from P509. | | |
| | | **[-02] =** Setpoint 1 (P510/1, P546)<br>**[-03] =** Setpoint 2 (P510/1, …)<br>**[-04] =** Setpoint 3 (P510/1, …) | Setpoint data from main setpoint (P510 [-01]). | | |
| | | **[-05] =** res.status InBit P480 | The displayed value depicts all Bus In Bit sources linked with an "*OR*". | | |
| | | **[-06]** = Parameter data In 1<br>**[-07]** = Parameter data In 2<br>**[-08]** = Parameter data In 3<br>**[-09]** = Parameter data In 4<br>**[-10]** = Parameter data In 5 | Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2) | | |
| | | **[-11] =** Setpoint 1 (P510/2)<br>**[-12] =** Setpoint 2 (P510/2)<br>**[-13] =** Setpoint 3 (P510/2) | Setpoint data from the master function value (Broadcast) - (P502/P503), if P509 = 4 | | |
| | | **[-14] =** Control word PLC<br>**[-15] =** Setpoint 1 PLC<br>**…**<br>**[-19] =** Setpoint 5 PLC | Control word + Setpoint data from PLC | | |

| P741 [-01] ... [-19] | PZD bus Out *(Process data Bus Out)* | | | S | |
|---|---|---|---|---|---|
| 0000 ... FFFF (hex) | This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.<br>Standardisation:<br>(📖 section 8.9 "Standardisation of setpoint / target values") | **[-01] =** Status word | | Status word, source from P509. | |
| | | **[-02]** = Actual value 1 (P543)<br>**[-03]** = Actual value 2 (…)<br>**[-04]** = Actual value 3 (…) | | Actual values | |
| | | **[-05] =** res.status OutBit P481 | | The displayed value depicts all Bus OUT Bit sources linked with an "*OR*". | |
| | | **[-06] =** Parameter data Out 1<br>**[-07] =** Parameter data Out 2<br>**[-08] =** Parameter data Out 3<br>**[-09] =** Parameter data Out 4<br>**[-10] =** Parameter data Out 5 | | Data during parameter transfer. | |
| | | **[-11] =** Actual value 1 master funct.<br>**[-12] =** Actual value 2 master funct.<br>**[-13] =** Actual value 3 master funct. | | Actual value of master function P502 / P503. | |
| | | **[-14] =** Status word PLC<br>**[-15] =** Actual value 1 PLC<br>…<br>**[-19] =** Actual value 5 PLC | | Status word + Actual values to PLC | |

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

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

## P744 Configuration level

*(Configuration level)*

0000 ... FFFF (hex)

This parameter displays the special devices integrated in the FI. Display is in hexadecimal code (SimpleBox, Bus System).

The display is in plain text when the ParameterBox is used.

| **High byte:** | | **Low byte:** | | |
|---|---|---|---|---|
| | | $00_{hex}$ | Standard I/O | (SK 205E) |
| | | $01_{hex}$ | STO | (SK 215E) |
| $00_{hex}$ | No extension | $02_{hex}$ | AS-i | (SK 225E) |
| $01_{hex}$ | Encoder | $03_{hex}$ | STO and AS-i | (SK 235E) |
| $02_{hex}$ | Posicon | $04_{hex}$ | Standard I/O | (SK 200E) |
| $03_{hex}$ | --- | $05_{hex}$ | STO | (SK 210E) |
| | | $06_{hex}$ | AS-i | (SK 220E) |
| | | $07_{hex}$ | STO and AS-i | (SK 230E) |

## P747 Inverter Volt. Range

*(Inverter voltage range)*

0 ... 2

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

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

## P748 CANopen status

*(CANopen status (system bus status))*

0000 ... FFFF (hex)
or
0 ... 65535 (dec)

Shows the status of the system bus.

| | |
|---|---|
| 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 |

| P749 | Status of DIP switches<br>*(Status of DIP switches)* | | | |
|---|---|---|---|---|
| 0000 ... 01FF (hex)<br>or<br>0 ... 511 (dec) | This parameter shows the actual setting of the FI DIP switch "S1" (See BU0200)(please see chapter 4.3.2.2 "DIP switches (S1)"). | | | |
| | Bit 0: | DIP switch 1 | | |
| | Bit 1: | DIP switch 2 | | |
| | Bit 2: | DIP switch 3 | | |
| | Bit 3: | DIP switch 4 | | |
| | Bit 4: | DIP switch 5 | | |
| | Bit 5: | DIP switch 6 | | |
| | Bit 6: | DIP switch 7 | | |
| | Bit 7: | DIP switch 8 | | |
| *Bit 8: from SW 1.3* | Bit 8: | EEPROM (memory module) | Bit 8 = 0: plugged in / Bit 8 = 1: not plugged in | |

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

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

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

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

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

| | | | | |
|---|---|---|---|---|
| **P755** | **Stat. system error**<br>*(System fault statistics)* | | **S** | |
| 0 ... 9999 | Number of system faults during the operating period P714. | | | |
| **P756** | **Stat. Timeout**<br>*(Time out statistics)* | | **S** | |
| 0 ... 9999 | Number of Time out errors during the operating period P714. | | | |
| **P757** | **Stat. Customer error**<br>*(Customer fault statistics)* | | **S** | |
| 0 ... 9999 | Number of Customer Watchdog faults during the operating period P714. | | | |
| **P760** | **Actual mains current**<br>*(Actual mains current)* | | **S** | |
| 0.0 ... 999.9 A | Displays the actual input current. | | | |
| **P799** **[-01]** ... **[-05]** | **Op.-time last error**<br>*(Operating time, last fault 1...5)* | | | |
| 0.1 ... ___ h | This parameter shows the operating hours counter status (P714) at the moment of the previous fault. Array 01…05 corresponds to the lastest fault 1…5. | | | |

# 6 Operating status messages

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

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

**Start disabled, “Not Ready” → (P700 [-03])**

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

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

**Warning messages → (P700 [-02])**

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

**Error messages → (P700 [-01])**

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

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

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

## 6.1 Display of messages

**LED displays**

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

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

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

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

**ParameterBox display**

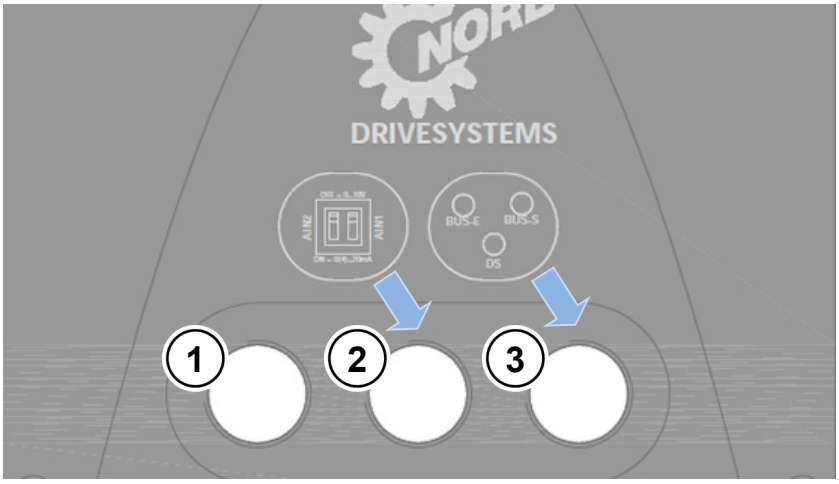
The ParameterBox displays the messages in plain text.

## 6.2 Diagnostic LEDs on device

The device generates operating status messages. These messages (warnings, errors, switching statuses, measurement data) can be displayed with parametrisation tools (📖 Section 3.1.1 "Control and Parametrisation Boxes / Software") (Parameter group **P7xx**).

To a limited extent, the messages are also indicated via the diagnostic and status LEDs.

### 6.2.1 Diagnostic LEDs on the SK 2x0E (size 1 … 3)




**1** RJ12,
RS 232, RS 485

**2** DIP switch AIN1/2

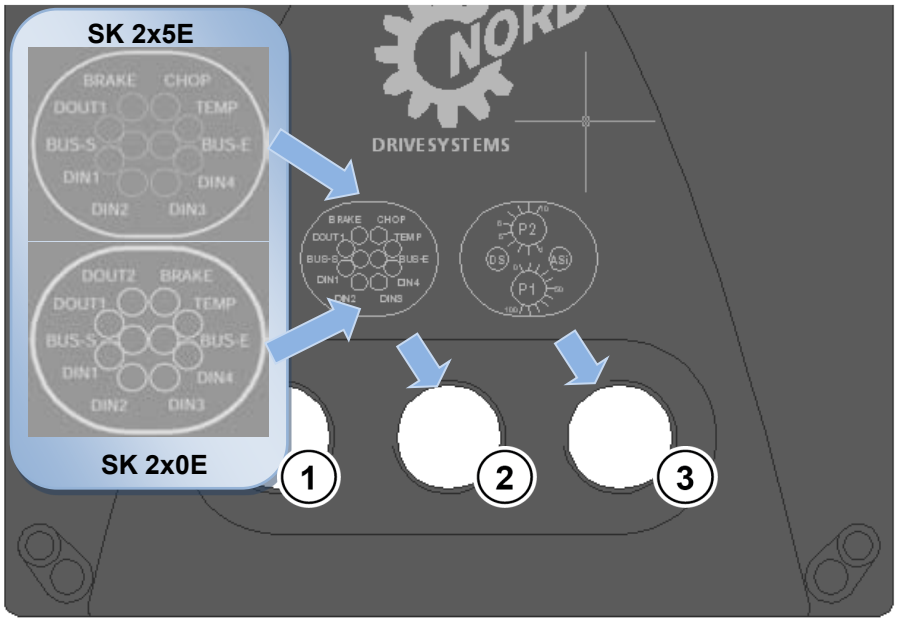
**3** Diagnostic LEDs

Figure 29: Diagnostic opening SK 2x0E (size 1 … 3)

**Diagnostic LEDs**

| LED | | | Signal status | | Meaning |
|---|---|---|---|---|---|
| Name | Colour | Description | | | |
| BUS-S | green | System bus Status | off | | No process data communication |
| | | | Flashing | 4 Hz | "BUS Warning" |
| | | | on | | Process data communication active<br>→ Reception of at least 1 telegram / s<br>→ SDO data transfer is not displayed |
| BUS-E | red | System bus Error | off | | No error |
| | | | Flashing | 4 Hz | Monitoring error P120 or P513<br>→ E10.0 / E10.9 |
| | | | Flashing | 1 Hz | Error in an external system bus module<br>→ Bus module → timeout on external bus (E10.2)<br>→ System bus module has a module error (E10.3) |
| | | | on | | System bus in state “BUS off” |
| DS | dual red/green | FI status | off | | FI not ready for operation,<br>→ no mains or control voltage |
| | | | green on | | FI is enabled (inverter running) |
| | | | green flashing | 0.5 Hz | FI is in standby or not enabled |
| | | | | 4 Hz | FI is in switch-on block |
| | | | red/green alternating | 4 Hz | Warning |
| | | | | 1…25 Hz | Degree of overload of switched-on FI |
| | | | red flashing | | Error, flashing frequency → Error number |

### 6.2.2 Diagnostic LEDs on the SK 2x0E (size 4) and SK 2x5E




**1** RJ12, RS 232, RS 485

**2** Diagnostic LEDs

**3** P1 / P2, LED-FU, LED-ASi

Figure 30: Diagnostic opening SK 2x0E (size 4) and SK 2x5E

**Status LEDs**

| LED | | | Signal | | |
|---|---|---|---|---|---|
| **Name** | **Colour** | **Description** | **Status** | | **Meaning** |
| DS | dual red/green | FI status | off | | FI not on standby,<br>→ no mains and control voltage |
| | | | green on | | FI is enabled (inverter running) |
| | | | green Flashing | 0.5 Hz | FI is in standby or not enabled |
| | | | | 4 Hz | FI 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 | | FI not ready for operation,<br>→ control voltage present, but no mains voltage |
| | | | red flashing | | Error, flashing frequency → Error number |
| AS-I | dual red/green | AS-i status | | | Details (📖 section 4.5 "AS Interface (AS-i)") |

### Diagnostic LEDs

| LED | | | Signal | |
|---|---|---|---|---|
| **Name** | **Colour** | **Description** | **Status** | **Meaning** |
| DOUT 1 | yellow | Digital output 1 | on | High signal applied |
| DIN 1 | yellow | Digital input 1 | on | High signal applied |
| DIN 2 | yellow | Digital input 2 | on | High signal applied |
| DIN 3 | yellow | Digital input 3 | on | High signal applied |
| DIN 4 | yellow | Digital input 4 | on | High signal applied |
| TEMP | yellow | Motor PTC | on | Motor overtemperature |
| CHOP | yellow | Brake chopper | on | Brake chopper active, brightness → degree of load *(only SK 2x5E)* |
| BRAKE | yellow | Mech. brake | on | Mech. Brake released |
| DOUT 2 | yellow | Digital output 2 | on | High signal present *(only SK 2x0E)* |
| BUS-S | green | System bus Status | off | No process data communication |
| | | | Flashing (4 Hz) | "BUS Warning" |
| | | | On | Process data communication active<br>→ Reception of at least 1 telegram / s<br>→ SDO data transfer is not displayed |
| BUS-E | red | System bus Error | off | No error |
| | | | Flashing (4 Hz) | Monitoring error P120 or P513<br>→ E10.0 / E10.9 |
| | | | Flashing (1 Hz) | Error in an external system bus module<br>→ Bus module → timeout on external bus (E10.2)<br>→ System bus module has module error (E10.3) |
| | | | on | System bus in state “BUS off” |

## 6.3 Messages

### Error messages

| Display in the SimpleBox / ControlBox | | Fault<br>Text in the ParameterBox | Cause<br>• Remedy |
|---|---|---|---|
| **Group** | **Details in P700 [-01] / P701** | | |
| E001 | **1.0** | **Overtemp. Inverter**<br>*"Inverter overtemperature"*<br>(inverter heat sink) | Inverter temperature monitoring<br>measurements are outside of the permissible temperature range, i.e. the error is triggered if the permissible lower limit is undershot or the permissible upper temperature limit is exceeded.<br>• Depending on the cause: Reduce or increase the ambient temperature<br>• Check the FI fan / control cabinet ventilation<br>• Check the FI for dirt |
| | **1.1** | **Overtemp. FI internal**<br>*"Internal FI overtemperature"*<br>(interior of FI) | |
| E002 | **2.0** | **Overtemp. Motor PTC**<br>*"Overtemperature motor thermistor "* | Motor temperature sensor (PTC) has triggered<br>• Reduce motor load<br>• Increase motor speed<br>• Use external motor fan |
| | **2.1** | **Overtemp. Motor I²t**<br>*"Motor overtemperature I²t"*<br><br>Only if $I^2t$ motor (P535) is programmed. | $I^2t$ motor has triggered (calculated overtemperature of motor)<br>• Reduce motor load<br>• Increase motor speed |
| | **2.2** | **Overtemp. Brake r.ext**<br>*"Overtemperature of external brake resistor "*<br><br>Overtemperature via digital input (P420 […])={13} | Temperature monitor (e.g. brake resistor) has activated<br>• Digital input is Low<br>• Check connection, temperature sensor |

| | | | |
|---|---|---|---|
| E003 | **3.0** | **$I^2t$ overcurrent limit** | a.c. inverter: $I^2t$ limit has triggered, e.g. > 1.5 x $I_n$ for 60s (also note P504)<br>• Continuous overload at inverter output<br>• Possible encoder fault (resolution, defect, connection) |
| | **3.1** | **Chopper overtemperature $I^2t$** | Brake chopper: $I^2t$ limit has activated, 1.5 times values reached for 60s (please also pay attention to P554, if present, and P555, P556, P557)<br>• Avoid overcurrent in brake resistance |
| | **3.2** | **IGBT overcurrent**<br>125% monitoring | De-rating (power reduction)<br>• 125% overcurrent for 50ms<br>• Brake chopper current too high<br>• for fan drives: enable flying start circuit (P520) |
| | **3.3** | **IGBT overcurrent fast**<br>150% monitoring | De-rating (power reduction)<br>• 150% overcurrent<br>• Brake chopper current too high |
| E004 | **4.0** | **Overcurrent module** | Error signal from module (short duration)<br>• Short-circuit or earthing fault at FI output<br>• Motor cable is too long<br>• Use external output choke<br>• Brake resistor faulty or resistance too low<br>**→ Do not shut off P537!**<br>**The occurrence of a fault can significantly shorten the service life of the device, or even destroy it.** |
| | **4.1** | **Overcurrent measurement**<br>*"Overcurrent measurement"* | P537 (pulse current switch-off) was reached 3x within 50 ms (only possible if P112 and P536 are disabled)<br>• FI is overloaded<br>• Drive sluggish, insufficiently sized<br>• Ramps (P102/P103) too steep -> Increase ramp time<br>• Check motor data (P201 … P209) |

| | | | |
|---|---|---|---|
| E005 | **5.0** | **Overvoltage UZW** | Link circuit voltage too high<br>• Increase deceleration time (P103)<br>• If necessary, set switch-off mode (P108) with delay (not with lifting equipment)<br>• Extend emergency stop time (P426)<br>• Fluctuating speed (e.g. due to high centrifugal masses) → adjust U/f characteristic curve if necessary (P211, P212)<br>Devices with brake chopper:<br>• Reduce energy return using a braking resistor<br>• Check the function of the connected braking resistor (broken cable)<br>• Resistance value of connected braking resistor too high |
| | **5.1** | **Mains overvoltage** | Mains voltage is too high<br>• See technical data (📖 Section 7) |
| E006 | **6.0** | **Charging error** | Link circuit voltage is too low<br>• Mains voltage too low<br>• See technical data (📖 Section 7) |
| | **6.1** | **Mains undervoltage** | Mains voltage too low<br>• See technical data (📖 Section 7) |
| E007 | **7.0** | **Mains phase error** | Error at terminal connection side<br>• a network phase is not connected<br>• network is non-symmetrical |
| E008 | **8.0** | **Parameter loss**<br>(maximum EEPROM value exceeded) | Error in EEPROM data<br>• Software version of the stored data set not compatible with the software version of the FI.<br>**NOTE:** Faulty parameters are automatically reloaded (default data).<br>• EMC interferences (see also E020) |
| | **8.1** | **Inverter type incorrect** | • EEPROM faulty |
| | **8.2** | **Reserved** | |
| | **8.3** | **EEPROM KSE error**<br>(Customer interface incorrectly identified (customer's interface equipment)) | The upgrade level of the frequency inverter was not correctly identified.<br>EEPROM with a firmware status of version 1.2 or above plugged in to an FI with older firmware status → **Loss of parameters!** (see also *Information* in section 5 )<br>• Switch mains voltage off and on again. |
| | **8.4** | **Internal EEPROM error**<br>(Database version incorrect) | |
| | **8.7** | **EEPR copy not the same** | |
| E009 | **---** | **Reserved** | |

| | | | |
|---|---|---|---|
| E010 | **10.0** | **Bus Timeout** | Telegram time-out / Bus off 24V int. CANbus<br>• Data transfer is faulty. Check P513.<br>• Check physical bus connections<br>• Check bus protocol program process.<br>• Check Bus Master.<br>• Check 24V supply of internal CAN/CANopen Bus.<br>• Node guarding error (internal CANopen)<br>• *Bus Off* error (internal CANbus) |
| | **10.2** | **Bus Timeout Option** | Telegram timeout<br>• Telegram transfer is faulty.<br>• Check physical bus connections<br>• Check bus protocol program process.<br>• Check Bus Master.<br>• PLC is in the "STOP" or "ERROR" state. |
| | **10.4** | **Init error Option** | Initialisation error in bus module<br>• Check Bus module current supply.<br>• DIP switch setting of a connected I/O extension module is incorrect |
| | **10.1**<br>**10.3**<br>**10.5**<br>**10.6**<br>**10.7** | **System error option** | System error bus module<br>• Further details can be found in the respective additional bus instructions.<br>I/O extension:<br>• Incorrect measurement of the input voltage or undefined provision of the output voltage due to error in reference voltage generation.<br>• Short circuit at analogue output |
| | **10.9** | **Module missing / P120** | The module entered in parameter (P120) is not available.<br>• Check connections |

| | | | |
|---|---|---|---|
| E011 | **11.0** | **Customer interface** | Error in analog-digital converter<br>• Internal customer unit (internal data bus) faulty or damaged by radio radiation (EMC)<br>• Check control connections for short-circuit.<br>• Minimize EMC interference by laying control and power cables separately.<br>• Earth the devices and shields well. |
| E012 | **12.0** | **External watchdog** | The Watchdog function is selected at a digital input and the impulse at the corresponding digital input is not present for longer than the time set in parameter P460 >Watchdog time<.<br>• Check connections<br>• Check setting P460 |
| | **12.1** | **Limit moto./Customer**<br>*"Drive switch-off limit"* | The drive switch-off limit (P534 [-01]) has triggered.<br>• Reduce load on motor<br>• Set higher value in (P534 [-01]). |
| | **12.2** | **Limit gen.**<br>*"Generator switch-off limit"* | The generator switch-off limit (P534 [-02]) has triggered.<br>• Reduce load on motor<br>• Set higher value in (P534 [-02]). |
| | **12.3** | **Torque limit** | Limit from potentiometer or setpoint source has switched off. P400 = 12 |
| | **12.4** | **Current limit** | Limit from potentiometer or setpoint source has switched off. P400 = 14 |
| | **12.5** | **Load monitor** | Switch-off due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528).<br>• Adjust load.<br>• Change limit values ((P525) ... (P527)).<br>• Increase delay time (P528).<br>• Change monitoring mode (P529). |
| | **12.8** | **AI minimum**<br>*„Analogue In minimum“* | Switch-off due to undershooting of the 0% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2" |
| | **12.9** | **AI maximum**<br>*„Analogue In maximum“* | Switch-off due to overshooting of the 100% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2" |

| | | | |
|---|---|---|---|
| E013 | **13.0** | **Encoder error** | No signal from encoder<br>• Check 5V sensor if present.<br>• Check supply voltage of encoder. |
| | **13.1** | **Speed slip error**<br>*"Speed slip error"* | The slip speed error limit was reached.<br>• Increase setting in P327. |
| | **13.2** | **Shut-down monitoring** | The slip error monitoring has triggered; the motor could not follow the setpoint.<br>• Check motor data P201-P209! (Important for the current controller)<br>• Check motor circuit.<br>• In servo mode, check the encoder setting P300 and check the following<br>• Increase setting value for torque limit in P112.<br>• Increase setting value for current limit in P536.<br>• Check deceleration time P103 and extend if necessary |
| | **13.5** | **Reserved** | Error message for POSICON → see supplementary instructions |
| | **13.6** | **Reserved** | Error message for POSICON → see supplementary instructions |
| E014 | **---** | **Reserved** | Error message for POSICON → see supplementary instructions |
| E015 | **---** | **Reserved** | |
| E016 | **16.0** | **Motor phase error** | A motor phase is not connected.<br>• Check P539<br>• Check motor connection |
| | **16.1** | **Magnetisation current monitoring**<br>*"Magnetisation current monitoring"* | Required exciting current not achieved at moment of switch-on.<br>• Check P539<br>• Check motor connection |
| E018 | **18.0** | **Reserved** | Error message for "Safe Pulse Block" → see supplementary instructions |
| E019 | **19.0** | **Parameter identification**<br>*"Parameter identification"* | Automatic identification of the connected motor was unsuccessful<br>• Check motor connection<br>• Check preset motor data (P201 … P209)<br>• PMSM – CFC Closed Loop Operation: Rotor position of motor incorrect in relation to incremental encoder Perform determination of rotor position (initial enable after a "Mains on" only with motor stationary (P330) |
| | **19.1** | **Star / Delta circuit incorrect**<br>*"Motor star / delta circuit incorrect"* | |

| | | | |
|---|---|---|---|
| E020<br>E021 | **20.0** | **Reserved** | System error in program execution, triggered by EMC interference.<br>• Observe wiring guidelines<br>• Use additional external mains filter.<br>• FI must be very well earthed. |
| | **20.1** | **Watchdog** | |
| | **20.2** | **Stack overflow** | |
| | **20.3** | **Stack underflow** | |
| | **20.4** | **Undefined opcode** | |
| | **20.5** | **Protected Instruct.**<br>*"Protected Instruction"* | |
| | **20.6** | **Illegal word access** | |
| | **20.7** | **Illegal Inst. Access**<br>*"Illegal instruction access"* | |
| | **20.8** | **Program memory error**<br>"*Program memory error*"<br>(EEPROM error) | |
| | **20.9** | **Dual-ported RAM** | |
| | **21.0** | **NMI error**<br>(Not used by hardware) | |
| | **21.1** | **PLL error** | |
| | **21.2** | **ADU error** "Overrun" | |
| | **21.3** | **PMI error** "Access Error" | |
| | **21.4** | **Userstack overflow** | |
| E022 | **---** | **Reserved** | Error message for PLC → see supplementary instructions BU 0550 |
| E023 | **---** | **Reserved** | Error message for PLC → see supplementary instructions BU 0550 |
| E024 | **---** | **Reserved** | Error message for PLC → see supplementary instructions BU 0550 |

### Warning messages

| Display in the SimpleBox / ControlBox | | Warning<br>Text in the ParameterBox | Cause<br>• Remedy |
|---|---|---|---|
| **Group** | **Details in P700 [-02]** | | |
| C001 | **1.0** | **Overtemp. Inverter**<br>*"Inverter overtemperature"*<br>(inverter heat sink) | Inverter temperature monitoring<br>Warning: permissible temperature limit reached.<br>• Reduce ambient temperature<br>• Check the FI fan / control cabinet ventilation<br>• Check the FI for dirt |
| C002 | **2.0** | **Overtemp. Motor PTC**<br>*"Overtemperature motor thermistor "* | Warning from motor temperature sensor (triggering threshold reached)<br>• Reduce motor load<br>• Increase motor speed<br>• Use external motor fan |
| | **2.1** | **Overtemp. Motor I²t**<br>*"Motor overtemperature I²t"*<br><br>Only if $I^2t$ motor (P535) is programmed. | Warning: I2t- motor monitoring (1.3 times the rated current reached for the time period specified in (P535))<br>• Reduce motor load<br>• Increase motor speed |
| | **2.2** | **Overtemp. Brake r.ext**<br>*"Overtemperature of external brake resistor "*<br><br>Overtemperature via digital input (P420 […])={13} | Warning: Temperature monitor (e.g. brake resistor) has activated<br>• Digital input is Low |
| C003 | **3.0** | **Overcurrent, $I^2t$ limit** | Warning: Inverter: $I^2t$ limit has triggered, e.g. > 1.3 x $I_n$ for 60s (please also note P504)<br>• Continuous overload at FI output |
| | **3.1** | **Overcurrent, chopper $I^2t$** | Warning: $I^2t$ limit for the brake chopper has triggered, 1.3x value attained for 60s (also note P554, if present, as well as P555, P556, P557)<br>• Avoid overload of brake resistance |
| | **3.5** | **Torque current limit** | Warning: Torque current limit reached<br>• Check (P112) |
| | **3.6** | **Current limit** | Warning: Current limit reached<br>• Check (P536) |

| | | | |
|---|---|---|---|
| C004 | **4.1** | **Overcurrent measurement**<br>*"Overcurrent measurement"* | Warning: pulse switch off is active<br>The limit for activation of pulse switch off (P537) has been reached (only possible if P112 and P536 are switched off)<br>• FI is overloaded<br>• Drive sluggish, insufficiently sized<br>• Ramps (P102/P103) too steep -> Increase ramp time<br>• Check motor data (P201 … P209)<br>• Switch off slip compensation (P212) |
| C008 | **8.0** | **Parameter loss** | Warning: One of the cyclically saved messages such as *operating hours* or *enabling time* could not be saved successfully.<br>The warning disappears as soon as saving can be successfully performed. |
| C012 | **12.1** | **Limit moto./Customer**<br>*"Drive switch-off limit"* | Warning: 80 % of the drive switch-off limit (P534 [-01]) has been exceeded.<br>• Reduce load on motor<br>• Set higher value in (P534 [-01]). |
| | **12.2** | **Limit gen.**<br>*"Generator switch-off limit"* | Warning: 80 % of the generator switch-off limit (P534 [-02]) has been reached.<br>• Reduce load on motor<br>• Set higher value in (P534 [-02]). |
| | **12.3** | **Torque limit** | Warning: 80 % of the limit from the potentiometer or the setpoint source has been reached. P400 = 12 |
| | **12.4** | **Current limit** | Warning: 80 % of the limit from the potentiometer or the setpoint source has been reached. P400 = 14 |
| | **12.5** | **Load monitor** | Warning due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528).<br>• Adjust load.<br>• Change limit values ((P525) ... (P527)).<br>• Increase delay time (P528). |

## Switch-on block messages

| Display in the SimpleBox / ControlBox | | Reason: Text in the ParameterBox | Cause • Remedy |
|---|---|---|---|
| **Group** | **Details in P700 [-03]** | | |
| I000 | **0.1** | **Disable voltage from IO** | If the function "disable voltage"is parameterised, input (P420 / P480) is at Low<br>• Set "input High"<br>• Check signal cable (broken cable) |
| | **0.2** | **IO fast stop** | If the function "fast stop"is parameterised, input (P420 / P480) is at Low<br>• Set "input High"<br>• Check signal cable (broken cable) |
| | **0.3** | **Block voltage from bus** | • For bus operation (P509): control word Bit 1 is "Low" |
| | **0.4** | **Bus fast stop** | • For bus operation (P509): control word Bit 2 is "Low" |
| | **0.5** | **Enable on start** | Enable signal (control word, Dig I/O or Bus I/O) was already applied during the initialisation phase (after mains "ON", or control voltage "ON"). Or electrical phase is missing.<br>• Only issue enable signal after completion of initialisation (i.e. when the FI is ready)<br>• Activation of "Automatic Start" (P428) |
| | **0.6 – 0.7** | **Reserved** | Information message for PLC → see supplementary instructions |
| | **0.8** | **Right direction blocked** | Switch-on block with inverter shut-off activated by:<br>**P540** or by "Enable right block" **(P420** = 31, 73) or "Enable left block" (**P420** = 32, 74),<br>The frequency inverter switches to "Ready for switching on" status |
| | **0.9** | **Left direction blocked** | |
| I006 [1] | **6.0** | **Charging error** | Charging relay not energised, because:<br>• Mains / link voltage too low<br>• Mains failure<br>• Evacuation run activated ((P420) / (P480)) |
| I011 | **11.0** | **Analog Stop** | If an analog input of the frequency inverter or a connected IO extension is configured to detect cable breaks (2-10V signal or 4-20mA signal), the frequency inverter switches to the status "ready for switch-on" if the analog signal undershoots the value **1 V** or **2 mA**<br>This also occurs if the relevant analog input is parameterised to function "0" ("no function").<br>• Check connections |
| I014 [1] | **14.4** | **Reserved** | Error message for POSICON → see supplementary instructions |
| I018 [1] | **18.0** | **Reserved** | Information message for "Safe Stop" function → see supplementary instructions |

1) Indication of operating mode (message) on the *ParameterBox* or virtual operating unit of the *NORD CON-Software*: **"Not ready"**

## 6.4 FAQ operational problems

| Fault | Possible cause | Remedy |
|---|---|---|
| Device will not start (all LEDs off) | • No mains voltage or wrong mains voltage<br>• SK 2x5E: No 24 V DC control voltage | • Check connections and supply cables<br>• Check switches / fuses |
| Device does not react to enabling | • Control elements not connected<br>• Incorrect control word source setting<br>• Right and left enable signals present simultaneously<br>• Enable signal present before device ready for operation (device expecting a 0 → 1 edge) | • Reset enable<br>• Change over **P428** if necessary: "0" = device expecting a 0→1 edge for enable / "1" = device reacts to "Level" →<br>***Danger:*** *Drive can start up independently!*<br>• Check control connections<br>• Check **P509** |
| Motor will not start in spite of enable being present | • Motor cables not connected<br>• Brake not ventilating<br>• No setpoint specified<br>• Incorrect setpoint source setting | • Check connections and supply cables<br>• Check control elements<br>• Check **P510** |
| Device switches off without error message when load increases (increased mechanical load / speed) | • Mains phase missing | • Check connections and supply cables<br>• Check switches / fuses |
| Motor rotating in wrong direction | • Motor cable U-V-W interchanged | • Motor cable Switch 2 phases<br>• Alternatively:<br>– Switch parameter **P420** right / left enable functions<br>– Switch control word bits 11/12 (with bus actuation) |
| Motor not reaching required speed | • Maximum frequency parameter setting too low | • Check **P105** |

| | | |
|---|---|---|
| Motor speed does not correspond to setpoint | • Analogue input function set to "Frequency additions" and another setpoint is present | • Check **P400**<br>• Check setting of integrated potentiometer (**P1**) (SK 2x5E only)<br>• **P420**, check active fixed frequencies<br>• Check bus setpoints<br>• Check P104 / P105 "min. / max. frequency"<br>• Check **P113** "jog frequency" |
| Motor generating a considerable amount of noise (at the current limit) and "OFF" signal is implemented at slow speed with little or no control, possibly with error message 3.0 | • Tracks A and B swapped round by encoder (for speed feedback)<br>• Incorrect encoder resolution setting<br>• Encoder power supply missing<br>• Encoder faulty | • Check encoder connections<br>• Check **P300, P301**<br>• Monitor via **P735**<br>• Check encoder |
| Intermittent communication error between FI and option modules | • System bus terminating resistor not set<br>• Poor connection contacting<br>• Interference on system bus line<br>• Maximum system bus length exceeded | • First and last subscriber only: Set DIP switches for terminating resistance<br>• Check connections<br>• Connect GND of all FI connected to system bus<br>• Pay attention to routing regulations (separate routing of signal and control cables and mains and motor cables)<br>• Check cable lengths (system bus) |

**Table 13: FAQ operational problems**

# 7 Technical data

## 7.1 General data for frequency inverter

| Function | Specification |
|---|---|
| Output frequency | 0.0 … 400.0 Hz |
| Pulse frequency | 3.0 … 16.0 kHz, factory setting = 6 kHz<br>Power reduction > 8 kHz with 115 / 230 V device, > 6 kHz with 400 V device |
| Typical overload capacity | 150 % for 60 s, 200 % for 3.5 s |
| Efficiency | > 95 % according to size |
| Insulation resistance | > 5 MΩ |
| Operating / ambient temperature | -25°C … +40°C, for details (including UL values) for individual devices and operating modes, see (chapter 7.2)<br>ATEX: -20…+40°C (chapter 2.6) |
| Storage and transport temperature | -25°C … +60/70°C |
| Long-term storage | (chapter 9.1) |
| Protection class | IP55, optional IP66 (chapter 1.10) |
| Max. installation altitude above sea level | *Up to 1000 m* No power reduction<br>*1000...2000 m:* 1 %/ 100 m power reduction, overvoltage category 3<br>*2000...4000 m:* 1 % / 100 m power reduction, overvoltage category 2, external overvoltage protection required at mains input |
| Ambient conditions | *Transport (IEC 60721-3-2):* Mechanical: 2M2<br>*Operation (IEC 60721-3-3):* Mechanical: 3M7<br>Climatic: 3K3 (IP55) 3K4 (IP66) |
| Environmental protection | *Energy-saving function* (chapter 8.7), see P219<br>*EMC* (chapter 8.3)<br>*RoHS* (chapter 1.6) |
| Protective measures against | Overtemperature of the frequency inverter Short-circuit, earth fault<br>Over and under-voltage Overload, idle running |
| Motor temperature monitoring | $I^2t$ motor, PTC / bimetallic switch |
| Regulation and control | Sensorless current vector control (ISD), linear V/f characteristic curve, VFC open-loop , CFC open-loop, CFC closed-loop |
| Wait time between two mains switch on cycles | 60 s for all devices in normal operating cycle |
| Interfaces | *Standard* RS485 (USS) (for parameterisation boxes only)<br>RS232 (Single Slave)<br>System bus<br>*Optional* AS-I on board (chapter 4.5)<br>Various bus modules (chapter 1.2) |
| Electrical isolation | Control terminals |
| Connecting terminals, electrical connection | *Power unit* (chapter 2.4.2)<br>*Control unit* (chapter 2.4.3) |

## 7.2 Electrical data

The following table lists the electrical data for 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 with internally ventilated motors
- Use of external fans

**Information** **Information about current and power**

The powers stated for the operating modes are only a rough categorisation

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

The following tables include the data relevant for UL, among other things(please see chapter 1.7 "UL and CSA approval").

### 7.2.1 Electrical data 1~115 V

| Device type | SK 2x5E… | -250-112- | -370-112- | -550-112- | -750-112- | |
|---|---|---|---|---|---|---|
| | Size | 1 | 1 | 2 | 2 | |
| Nominal motor power (4-pole standard motor) | 230 V | 0.25 kW | 0.37 kW | 0.55 kW | 0.75 kW | |
| | 240 V | 1/3 hp | ½ hp | ¾ hp | 1 hp | |
| Mains voltage | **115 V** | **1 AC** 100 … 120 V, ± 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 8.9 A | 11.0 A | 13.1 A | 20.1 A | |
| | FLA [2] | 8.9 A | 10.8 A | 13.1 A | 20.1 A | |
| Output voltage | **230 V** | **3 AC** 0 … 2 times mains voltage | | | | |
| Output current [3] | rms [1] | 1.7 A | 2.2 A | 3.0 A | 4.0 A | |
| | FLA motor mounting [2] | 1.7 A | 1.7 A | 3.0 A | 3.0 A | |
| | FLA wall mounting [2] | 1.7 A | 2.1 A | 3.0 A | 4.0 A | |
| Min. brake resistance | Accessories | 75 Ω | 75 Ω | 75 Ω | 75 Ω | |
| **Motor-mounted (ventilated)** | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25 kW / 1.6 A | 0.25 kW / 1.6 A | 0.37 kW / 2.6 A | 0.37 kW / 2.6 A | |
| | S1-40°C | 0.25 kW / 1.7 A | 0.25 kW / 1.8 A | 0.55 kW / 3.0 A | 0.55 kW / 3.0 A | |
| | S1-30°C | 0.25 kW / 1.7 A | 0.37 kW / 2.0 A | 0.55 kW / 3.0 A | 0.55 kW / 3.4 A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 47°C | 23°C | 40°C | 11°C | |
| S3 70 % ED 10 min | | 50°C | 35°C | 50°C | 25°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 30°C | 45°C | 20°C | |
| **Wall mounting (ventilated / unventilated)** | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25 kW / 1.6 A | 0.25 kW / 1.6 A | 0.55 kW / 3.0 A | 0.55 kW / 3.0 A | |
| | S1-40°C | 0.25 kW / 1.7 A | 0.37 kW / 2.0 A | 0.55 kW / 3.0 A | 0.55 kW / 3.3 A | |
| | S1-30°C | 0.25 kW / 1.7 A | 0.37 kW / 2.1 A | 0.55 kW / 3.0 A | 0.55 kW / 3.6 A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 48°C | 36°C | 50°C | 16°C | |
| S3 70 % ED 10 min | | 50°C | 40°C | 50°C | 30°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 40°C | 50°C | 25°C | |
| | | **General fuses (AC) (recommended)** | | | | |
| slow-blowing | | 16 A | 16 A | 16 A | 25 A | |
| | Isc [4] [A] | **UL fuses (AC) – permitted** | | | | |
| | Class (10 000 / 65 000 / 100 000) | | | | | |
| Fuse [5] | RK5 (x) / x | 30 A | 30 A | 30 A | 30 A | |
| | CC, J, R, T, G, L (x) / x | 30 A | 30 A | 30 A | 30 A | |
| | Bussmann **FRS-** (x) / x | **R-30** | **R-30** | **R-30** | **R-30** | |
| CB [6] | (≥ 115 V) x | 25 A | 25 A | 25 A | 25 A | |

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (100 V – 120 V) according to UL/CSA
3) FLA (S1-40°C), FLA motor mounting: relates to a motor with fans
4) Maximum permissible mains short circuit current
5) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
6) "inverse time trip type" in acc. with UL 489

## 7.2.2 Electrical data 1~230 V

| Frequency inverter type | SK 2xxE… | -250-123- | -370-123- | -550-123- | -750-123- | -111-123- |
|---|---|---|---|---|---|---|
| | Size | 1 | 1 | 1 | 2 a) | 2 a) |
| Nominal motor power (4-pole standard motor) | 230 V | 0.25 kW | 0.37 kW | 0.55 kW | 0.75 kW | 1.10 kW |
| | 240 V | 1/3 hp | ½ hp | ¾ hp | 1 hp | 1½ hp |
| Mains voltage | **230 V** | **1 AC** 200 … 240 V, ± 10 %, 47 … 63 Hz | | | | |
| Input current | rms 1) | 3.9 A | 5.8 A | 7.3 A | 10.2 A | 14.7 A |
| | FLA 2) | 3.9 A | 5.8 A | 7.3 A | 10.1 A | 14.6 A |
| Output voltage | **230 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current 3), 4) | rms 1) | 1.7 A | 2.2 A | 3.0 A | 4.0 A | 5.5 A |
| | FLA motor mounting 2) | 1.7 A | 2.2 A | 2.6 A | 3.9 A | 5.4 A |
| | FLA wall mounting 2) | 1.7 A | 2.2 A | 2.9 A | 3.9 A | 4.4 A b) |
| Min. brake resistance | Accessories | 75 Ω | 75 Ω | 75 Ω | 75 Ω | 75 Ω |
| **Motor mounted (ventilated)** 4) | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25kW / 1.6A | 0.25kW / 1.8A | 0.37kW / 2.5A | 0.55kW / 3.4A | 0.75kW / 4.3A |
| | S1-40°C | 0.25kW / 1.7A | 0.37kW / 2.0A | 0.55kW / 2.8A | 0.55kW / 3.7A | 0.75kW / 4.8A |
| | S1-30°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 2.9A | 0.75kW / 4.0A | 1.10kW / 5.4A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 49°C | 33°C | 36°C | 35°C | 29°C |
| S3 70 % ED 10 min | | 50°C | 45°C | 45°C | 45°C | 40°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 40°C | 40°C | 40°C | 35°C |
| **Wall mounting (ventilated / unventilated)** 4) | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25kW / 1.5A | 0.37kW / 2.2A | 0.37kW / 2.7A | 0.75kW / 4.0A | 0.75kW / 4.3A |
| | S1-40°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 2.9A | 0.75kW / 4.0A | 0.75kW / 4.8A |
| | S1-30°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 2.9A | 0.75kW / 4.0A | 1.10kW / 5.3A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 44°C | 50°C | 42°C | 50°C | 27°C |
| S3 70 % ED 10 min | | 50°C | 50°C | 45°C | 50°C | 40°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 45°C | 50°C | 45°C | 50°C | 35°C |
| | | **General fuses (AC) (recommended)** | | | | |
| slow-blowing | | 10 A | 10 A | 16 A | 16 A | 16 A |
| | Isc 5) [A] | **UL fuses (AC) – permitted** | | | | |
| | Class / 10 000 / 65 000 / 100 000 | | | | | |
| Fuse 6) RK5 | (x) / x | 10 A | 10 A | 10 A | 30 A | 30 A |
| Fuse 6) CC, J, R, T, G, L | (x) / x | 10 A | 10 A | 10 A | 30 A | 30 A |
| Fuse 6) Bussmann **FRS-** | (x) / x | **R-10** | **R-10** | **R-10** | **R-30** | **R-30** |
| CB 7) (≥ 230 V) | x | 10 A | 10 A | 10 A | 25 A | 25 A |

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (200 V – 240 V) according to UL/CSA
3) FLA (S1-40°C), FLA motor mounting: relates to a motor with fans
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Maximum permissible mains short circuit current
6) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
7) "inverse time trip type" in acc. with UL 489
a) Size 2: only SK 2x5E
a) 5.4 A when using a suitable fan

### 7.2.3 Electrical data 3~230 V

| Frequency inverter type | SK 2xxE… | -250-323- | -370-323- | -550-323- | -750-323- | -111-323- |
|---|---|---|---|---|---|---|
| | Size | 1 | 1 | 1 | 1 | 1 |
| Nominal motor power (4-pole standard motor) | 230 V | 0.25 kW | 0.37 kW | 0.55 kW | 0.75 kW | 1.10 kW |
| | 240 V | 1/3 hp | ½ hp | ¾ hp | 1 hp | 1½ hp |
| Mains voltage | **230 V** | **3 AC** 200 … 240 V, ± 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 1.4 A | 1.9 A | 2.6 A | 3.5 A | 5.1 A |
| | FLA [2] | 1.4 A | 1.9 A | 2.6 A | 3.5 A | 5.1 A |
| Output voltage | **230 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3], [4] | rms [1] | 1.7 A | 2.2 A | 3.0 A | 4.0 A | 5.5 A |
| | FLA motor mounting [2] | 1.7 A | 2.2 A | 2.9 A | 3.9 A | 5.4 A |
| | FLA wall mounting [2] | 1.7 A | 2.2 A | 2.9 A | 3.9 A (S1-40°C) | 4.0 A[a] (S1-40°C) |
| Min. brake resistance | Accessories | 100 Ω | 100 Ω | 100 Ω | 100 Ω | 100 Ω |
| **Motor-mounted (ventilated), or wall mounting with SK TIE4-WMK-L-1 (ventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 3.0A | 0.75kW / 4.0A | 1.1kW / 5.5A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 50°C | 50°C | 50°C | 50°C | 50°C |
| S3 70 % ED 10 min | | 50°C | 50°C | 50°C | 50°C | 50°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 50°C | 50°C | 50°C |
| **Wall mounting (unventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 2.8A | 0.55kW / 2.8A | 0.55kW / 3.4A |
| | S1-40°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 3.0A | 0.55kW / 3.5A | 0.75kW / 4.2A |
| | S1-30°C | 0.25kW / 1.7A | 0.37kW / 2.2A | 0.55kW / 3.0A | 0.75kW / 4.0A | 0.75kW / 4.8A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 50°C | 50°C | 48°C | 32°C | 20°C |
| S3 70 % ED 10 min | | 50°C | 50°C | 50°C | 40°C | 30°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 50°C | 35°C | 25°C |
| | | **General fuses (AC) (recommended)** | | | | |
| | slow-blowing | 10 A | 10 A | 10 A | 10 A | 16 A |

| | | Isc [5] [A] | | | UL fuses (AC) – permitted | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Class | 10 000 | 65 000 | 100 000 | | | | | |
| Fuse [6] | RK5 | (x) | | x | 5 A | 5 A | 10 A | 10 A | 10 A |
| | CC, J, R, T, G, L | (x) | | x | 5 A | 5 A | 10 A | 10 A | 10 A |
| | Bussmann **FRS-** | (x) | | x | **R-5** | **R-5** | **R-10** | **R-10** | **R-10** |
| CB [7] | (≥ 230 V) | | x | | 5 A | 5 A | 10 A | 10 A | 10 A |

1) Note derating curve (📖 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (200 V – 240 V) according to UL/CSA
3) FLA (S1-45°C), FLA motor mounting: relates to a motor with fans
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Maximum permissible mains short circuit current
6) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
7) "inverse time trip type" in acc. with UL 489
a) 5.4 A when using a suitable fan

| Device type | SK 2xxE… | -151-323- | -221-323- | -301-323- | -401-323- | |
|---|---|---|---|---|---|---|
| | Size | 2 | 2 | 3 | 3 | |
| Nominal motor power (4-pole standard motor) | 230 V | 1.5 kW | 2.2 kW | 3.0 kW | 4.0 kW | |
| | 240 V | 2 hp | 3 hp | 4 hp | 5 hp | |
| Mains voltage | **230 V** | **3 AC** 200 … 240 V, ± 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 6.6 A | 9.1 A | 11.8 A | 15.1 A | |
| | FLA [2] | 6.6 A | 9.1 A | 11.7 A | 14.9 A | |
| Output voltage | **230 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3], [4] | rms [1] | 7.0 A | 9.5 A | 12.5 A | 16.0 A | |
| | FLA motor mounting [2] | 6.9 A | 8.8 A | 12.3 A | 15.7 A | |
| | FLA wall mounting [2] | 5.5 A [a] (S1-40°C) | 5.5 A [b] (S1-40°C) | 8.0 A [c] (S1-40°C) | 8.0 A [d] (S1-40°C) | |
| Min. brake resistance | Accessories | 62 Ω | 62 Ω | 33 Ω | 33 Ω | |
| **Motor mounting (ventilated), or wall mounting with SK TIE4-WMK-L-1 (or -2) (ventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 1.5kW / 7.0A | 1.5kW / 9.2A | 3.0kW / 12.5A | 3.0kW / 14.5A | |
| | S1-40°C | 1.5kW / 7.0A | 2.2kW / 9.5A | 3.0kW / 12.5A | 4.0kW / 16.0A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 50°C | 49°C | 50°C | 46°C | |
| S3 70 % ED 10 min | | 50°C | 50°C | 50°C | 47°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 50°C | 47°C | |
| **Wall mounting (unventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-50°C | 0.55kW / 3.8A | 0.75kW / 4.7A | 1.1kW / 6.8A | 1.1kW / 6.8A | |
| | S1-40°C | 0.75kW / 4.8A | 1.10kW / 5.8A | 1.5kW / 8.7A | 1.5kW / 8.7A | |
| | S1-30°C | 1.10kW / 5.7A | 1.10kW / 6.7A | 2.2kW / 10.4A | 2.2kW / 10.4A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 15°C | 6°C | 18°C | -4°C | |
| S3 70 % ED 10 min | | 25°C | 20°C | 30°C | 0°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 20°C | 10°C | 25°C | 0°C | |
| | | **General fuses (AC) (recommended)** | | | | |
| slow-blowing | | 16 A | 20 A | 20 A | 25 A | |

| | | Isc [5] [A] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Class | 10 000 | 65 000 | 100 000 | **UL fuses (AC) – permitted** | | | |
| Fuse [6] | RK5 | (x) | | x | 10 A | 30 A | 30 A | 30 A |
| | CC, J, R, T, G, L | (x) | | x | 10 A | 30 A | 30 A | 30 A |
| | Bussmann **FRS-** | (x) | | x | **R-10** | **R-30** | **R-30** | **R-30** |
| CB [7] | (≥ 230 V) | | x | | 10 A | 25 A | 25 A | 25 A |

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (200 V – 240 V) according to UL/CSA
3) FLA (S1-45°C), FLA motor mounting: relates to a motor with fans
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Maximum permissible mains short circuit current
6) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
7) "inverse time trip type" in acc. with UL 489
a) 6.9 A when using a suitable fan
a) 8.8 A when using a suitable fan
a) 12.3 A when using a suitable fan
a) 15.7 A when using a suitable fan

| Device type | SK 2xxE... | -551-323- | -751-323- | -112-323- | | |
|---|---|---|---|---|---|---|
| | Size | 4 | 4 | 4 | | |
| Nominal motor power (4-pole standard motor) | 230 V | 5.5 kW | 7.5 kW | 11.0 kW | | |
| | 240 V | 7 ½ hp | 10 hp | 15 hp | | |
| Mains voltage | **230 V** | **3 AC** 200 … 240 V, ± 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 23.5 A | 29.5 A | 40.5 A | | |
| | FLA [2] | 22.5 A | 28.5 A | 39.5 A | | |
| Output voltage | **230 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3], [4] | rms [1] | 23.0 A | 29.0 A | 40.0 A | | |
| | FLA motor mounting [2] | 22.0 A | 28.0 A | 39.0 A | | |
| | FLA wall mounting [2] | 22.0 A | 28.0 A | 39.0 A | | |
| Min. brake resistance | Accessories | 30 Ω | 20 Ω | 15 Ω | | |
| **Motor mounting (fan cooling 5), integrated in device** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-40°C | 5.5kW / 23.0A | 7.5kW / 29.0A | 11.0kW / 40.0A | | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 40°C | 40°C | 40°C | | |
| S3 70 % ED 10 min | | 50°C | 50°C | 44°C | | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 47°C | 50°C | 44°C | | |
| **Wall mounting (fan cooling 5), integrated in device** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-40°C | 5.5kW / 23.0A | 7.5kW / 29.0A | 11.0kW / 40.0A | | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 45°C | 45°C | 45°C | | |
| S3 70 % ED 10 min | | 50°C | 50°C | 47°C | | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 47°C | | |
| | | **General fuses (AC) (recommended)** | | | | |
| | slow-blowing | 35 A | 50 A | 50 A | | |

| | | Isc [6] [A] | | | UL fuses (AC) – permitted | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Class | 10 000 | 65 000 | 100 000 | | | | | |
| Fuse | CC, J, R, T, G, L (300 V) | | | x | 60 A | 60 A | 60 A | | |
| CB [7] | (300 V ) | x | | | 60 A | 60 A | 60 A | | |

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (200 V – 240 V) according to UL/CSA
3) FLA (S1-40°C)
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Fan cooling, temperature-controlled: ON= 55°C, OFF= 50°C,
After-run time when 50°C limit undershot and enable removed: 2 minutes
6) Maximum permissible mains short circuit current
7) "Inverse time trip type“ according to UL 489

## 7.2.4 Electrical data 3~400 V

| Frequency inverter type | SK 2xxE… | -550-340- | -750-340- | -111-340- | -151-340- | -221-340- |
|---|---|---|---|---|---|---|
| | Size | 1 | 1 | 1 | 1 | 1 |
| Nominal motor power (4-pole standard motor) | 400 V | 0.55 kW | 0.75 kW | 1.1 kW | 1.5 kW | 2.2 kW |
| | 480 V | ¾ hp | 1 hp | 1½ hp | 2 hp | 3 hp |
| Mains voltage | **400 V** | **3 AC** 380 … 500 V, - 20 % / + 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 1.6 A | 2.2 A | 2.9 A | 3.7 A | 5.2 A |
| | FLA [2] | 1.4 A | 2.0 A | 2.7 A | 3.4 A | 4.7 A |
| Output voltage | **400 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3), 4)] | rms [1] | 1.7 A | 2.3 A | 3.1 A | 4.0 A | 5.5 A |
| | FLA motor mounting [2] | 1.5 A | 2.1 A | 2.8 A | 3.6 A | 4.9 A |
| | FLA wall mounting [2] | 1.5 A | 2.1 A | 2.8 A | 3.6 A (S1-40°C) | 4.0 A[a] (S1-40°C) |
| Min. brake resistance | Accessories | 200 Ω | 200 Ω | 200 Ω | 200 Ω | 200 Ω |
| **Motor-mounted (ventilated), or wall mounting with SK TIE4-WMK-L-1 (ventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| S1-50°C | | 0.55kW / 1.7A | 0.75kW / 2.3A | 1.1kW / 3.1A | 1.5kW / 4.0A | 2.2kW / 5.5A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 50°C | 50°C | 50°C | 50°C | 50°C |
| S3 70 % ED 10 min | | 50°C | 50°C | 50°C | 50°C | 50°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 50°C | 50°C | 50°C |
| **Wall mounting (unventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| S1-50°C | | 0.55kW / 1.7A | 0.75kW / 2.3A | 0.75kW / 2.8A | 0.75kW / 2.8A | 0.75kW / 2.8A |
| S1-40°C | | 0.55kW / 1.7A | 0.75kW / 2.3A | 1.1kW / 3.1A | 1.1kW / 3.3A | 1.1kW / 3.3A |
| S1-30°C | | 0.55kW / 1.7A | 0.75kW / 2.3A | 1.1kW / 3.1A | 1.5kW / 3.9A | 1.5kW / 3.9A |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 50°C | 50°C | 45°C | 29°C | 1°C |
| S3 70 % ED 10 min | | 50°C | 50°C | 50°C | 40°C | 15°C |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 50°C | 35°C | 5°C |
| | | **General fuses (AC) (recommended)** | | | | |
| slow-blowing | | 10 A | 10 A | 10 A | 10 A | 10 A |
| | Isc [5] [A] | **UL fuses (AC) – permitted** | | | | |
| | Class / 10 000 / 65 000 / 100 000 | | | | | |
| Fuse [6] | RK5 (x) / x | 5 A | 5 A | 10 A | 10 A | 10 A |
| | CC, J, R, T, G, L (x) / x | 5 A | 5 A | 10 A | 10 A | 10 A |
| | Bussmann **FRS-** (x) / x | **R-5** | **R-5** | **R-10** | **R-10** | **R-10** |
| CB [7] | (≥ 230 / 400 V) x | 5 A | 5 A | 10 A | 10 A | 10 A |

1) Note derating curve (📖 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (380 V – 500 V) according to UL/CSA
3) FLA (S1-45°C), FLA motor mounting: relates to a motor with fans
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Maximum permissible mains short circuit current
6) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
7) "inverse time trip type" in acc. with UL 489
a) 4.9 A when using a suitable fan

| Device type | SK 2xxE… | -301-340- | -401-340- | -551-340- | -751-340- | |
|---|---|---|---|---|---|---|
| | Size | 2 | 2 | 3 | 3 | |
| Nominal motor power (4-pole standard motor) | 400 V | 3.0 kW | 4.0 kW | 5.5 kW | 7.5 kW | |
| | 480 V | 4 hp | 5 hp | 7 ½ hp | 10 hp | |
| Mains voltage | **400 V** | **3 AC** 380 … 500 V, - 20 % / + 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 7.0 A | 8.9 A | 11.7 A | 15.0 A | |
| | FLA [2] | 6.3 A | 8.0 A | 10.3 A | 13.1 A | |
| Output voltage | **400 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3], [4] | rms [1] | 7.5 A | 9.5 A | 12.5 A | 16.0 A | |
| | FLA motor mounting [2] | 6.7 A | 8.5 A | 11.0 A | 14.0 A | |
| | FLA wall mounting 2) | 5.5 [a]A (S1-40°C) | 5.5 A [b] (S1-40°C) | 8.0 A [c] (S1-40°C) | 8.0 A [d] (S1-40°C) | |
| Min. brake resistance | Accessories | 110 Ω | 110 Ω | 68 Ω | 68 Ω | |
| **Motor mounting (ventilated), or wall mounting with SK TIE4-WMK-L-1 (or -2) (ventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current: | | | | | | |
| | S1-50°C | 2.2kW / 5.5A | 3.0kW / 8.0A | 4.0kW / 11.8A | 5.5kW / 13.8A | |
| | S1-40°C | 3.0kW / 7.5A | 4.0kW / 9.5A | 5.5kW / 12.5A | 7.5kW / 16.0A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 43°C | 41°C | 48°C | 43°C | |
| S3 70 % ED 10 min | | 45°C | 45°C | 50°C | 45°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 45°C | 41°C | 50°C | 45°C | |
| **Wall mounting (unventilated)** [4] | | | | | | |
| Max. continuous power / max. continuous current: | | | | | | |
| | S1-50°C | 1.1kW / 3.1A | 1.5kW / 4.0A | 1.5kW / 5.3A | 2.2kW / 6.3A | |
| | S1-40°C | 1.5kW / 4.0A | 1.5kW / 4.9A | 2.2kW / 6.9A | 3.0kW / 7.9A | |
| | S1-30°C | 1.5kW / 4.8A | 2.2kW / 5.7A | 3.0kW / 8.4A | 4.0kW / 9.4A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | -3°C | -20°C | 1°C | -18°C | |
| S3 70 % ED 10 min | | 0°C | -5°C | 15°C | -5°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 0°C | -15°C | 5°C | -10°C | |
| | | **General fuses (AC) (recommended)** | | | | |
| | slow-blowing | 16 A | 16 A | 20 A | 25 A | |

| | | Isc [5] [A] | | | UL fuses (AC) – permitted | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Class | 10 000 | 65 000 | 100 000 | | | | | |
| Fuse [6] | RK5 | (x) | | x | 10 A | 30 A | 30 A | 30 A | |
| | CC, J, R, T, G, L | (x) | | x | 10 A | 30 A | 30 A | 30 A | |
| | Bussmann **FRS-** | (x) | | x | **R-10** | **R-30** | **R-30** | **R-30** | |
| CB [7] | (≥ 230 / 400 V) | | x | | 10 A | 25 A | 25 A | 25 A | |

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (380 V – 500 V) according to UL/CSA
3) FLA (S1-45°C), FLA motor mounting: relates to a motor with fans
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Maximum permissible mains short circuit current
6) The use of an SK TU4-MSW(-…) module, limits the permissible short-circuit in the mains to 10 kA
7) "inverse time trip type" in acc. with UL 489
a) 6.7 A when using a suitable fan
a) 8.5 A when using a suitable fan
a) 11.0 A when using a suitable fan
a) 14.0 A when using a suitable fan

| Device type | SK 2xxE… | -112-340- | -152-340- | -182-340- | -222-340- | |
|---|---|---|---|---|---|---|
| | Size | 4 | 4 | 4 | 4 | |
| Nominal motor power (4-pole standard motor) | 400 V | 11.0 kW | 15.0 kW | 18.5 kW | 22.0 kW | |
| | 480 V | 15 hp | 20 hp | 25 hp | 30 hp | |
| Mains voltage | **400 V** | **3 AC** 380 … 500 V, - 20 % / + 10 %, 47 … 63 Hz | | | | |
| Input current | rms [1] | 23.6 A | 32.0 A | 40.5 A | 46.5 A | |
| | FLA [2] | 20.5 A | 28.0 A | 35.5 A | 42.5 A | |
| Output voltage | **400 V** | **3 AC** 0 … Mains voltage | | | | |
| Output current [3], [4] | rms [1] | 23.0 A | 32.0 A | 40.0 A | 46.0 A | |
| | FLA motor mounting [2] | 20.0 A | 28.0 A | 35.0 A | 42.0 A | |
| | FLA wall mounting 2) | 20.0 A | 28.0 A | 35.0 A | 42.0 A | |
| Min. brake resistance | Accessories | 47 Ω | 33 Ω | 27 Ω | 24 Ω | |
| **Motor mounting (fan cooling 5), integrated in device)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-40°C | 11.0kW / 23.0A | 15.0kW / 32.0A | 18.5kW / 40.0A | 22.0kW / 46.0A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 40°C | 40°C | 40°C | 40°C | |
| S3 70 % ED 10 min | | 50°C | 49°C | 41°C | 41°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 49°C | 41°C | 41°C | |
| **Wall mounting (fan cooling 5), integrated in device)** [4] | | | | | | |
| Max. continuous power / max. continuous current | | | | | | |
| | S1-40°C | 11.0kW / 23.0A | 15.0kW / 32.0A | 18.5kW / 40.0A | 22.0kW / 46.0A | |
| Max. permissible ambient temp. with nominal output current | | | | | | |
| S1 | | 45°C | 45°C | 41°C | 40°C | |
| S3 70 % ED 10 min | | 50°C | 50°C | 43°C | 42°C | |
| S6 70 % ED 10 min (100 % / 20 % Mn) | | 50°C | 50°C | 43°C | 41°C | |
| | | **General fuses (AC) (recommended)** | | | | |
| | slow-blowing | 35 A | 50 A | 50 A | 63 A | |

| | | Isc [6] [A] | | | UL fuses (AC) – permitted | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Class | 10 000 | 65 000 | 100 000 | | | | | |
| Fuse | CC, J, R, T, G, L (600 V) | | | x | 60 A | 60 A | 60 A | 60 A | |
| CB [7] | (600 V ) | x | | | 60 A | 60 A | 60 A | 60 A | |

1) Note derating curve (📖 Section 8.4.4 "Reduced output current due to mains voltage").
2) FLA – **Full Load Current**, maximum current for the entire mains voltage range as stated above (380 V – 500 V) according to UL/CSA
3) FLA (S1-40°C)
4) SK 21xE and SK 23xE devices: For use of safe functions (functional safety: STO and SS1) the restrictions regarding the permissible temperature range according to BU 0230 must be noted.
5) Fan cooling, temperature-controlled: ON= 55°C, OFF= 50°C,
After-run time when 50°C limit undershot and enable removed: 2 minutes
6) Maximum permissible mains short circuit current
7) "Inverse time trip type“ according to UL 489

# 8 Additional information

## 8.1 Setpoint processing

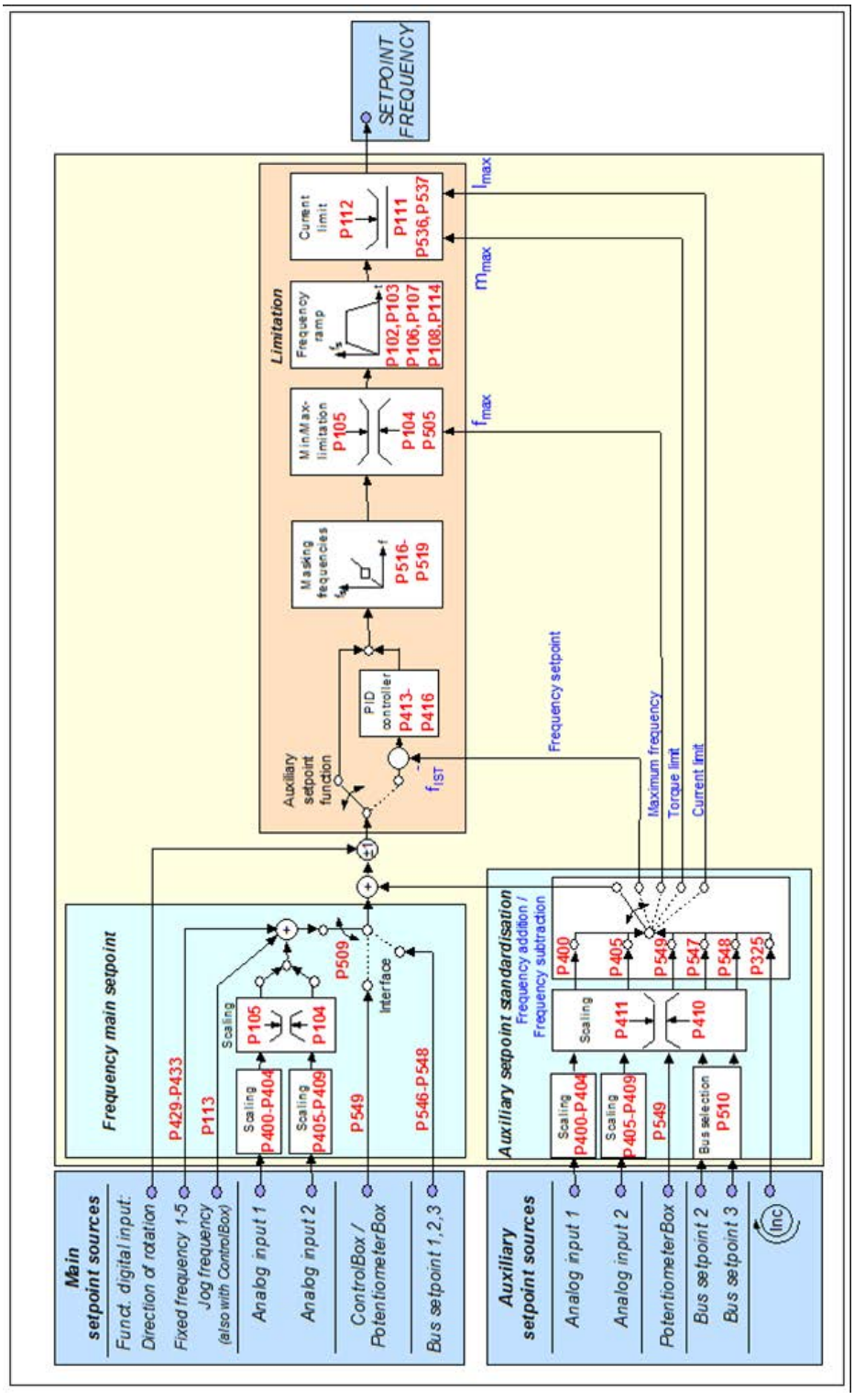



Figure 31 Setpoint processing

## 8.2 Process controller

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

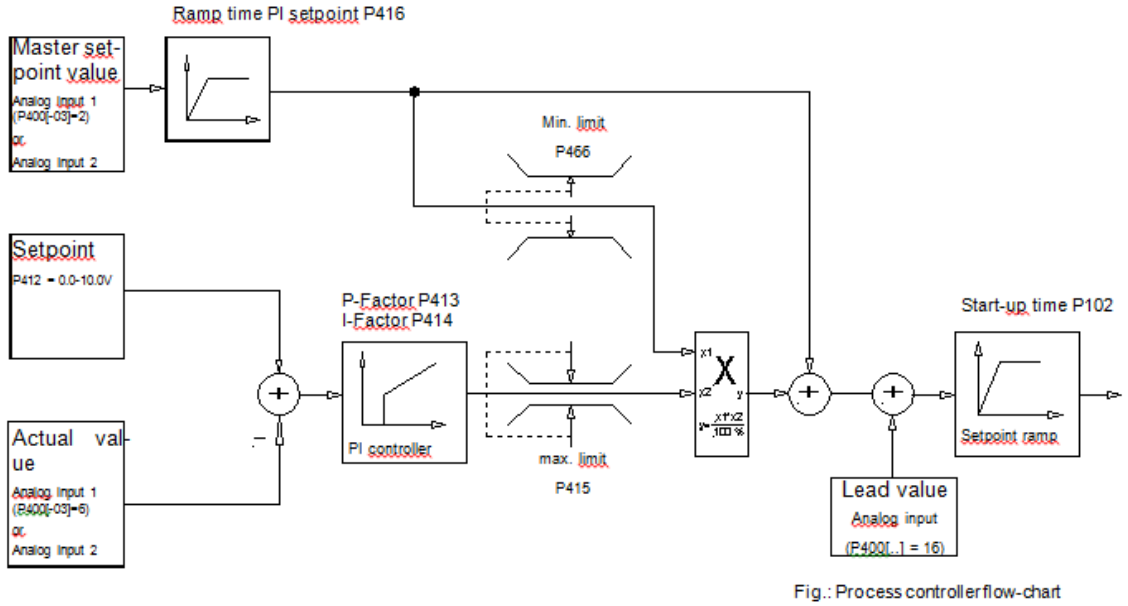
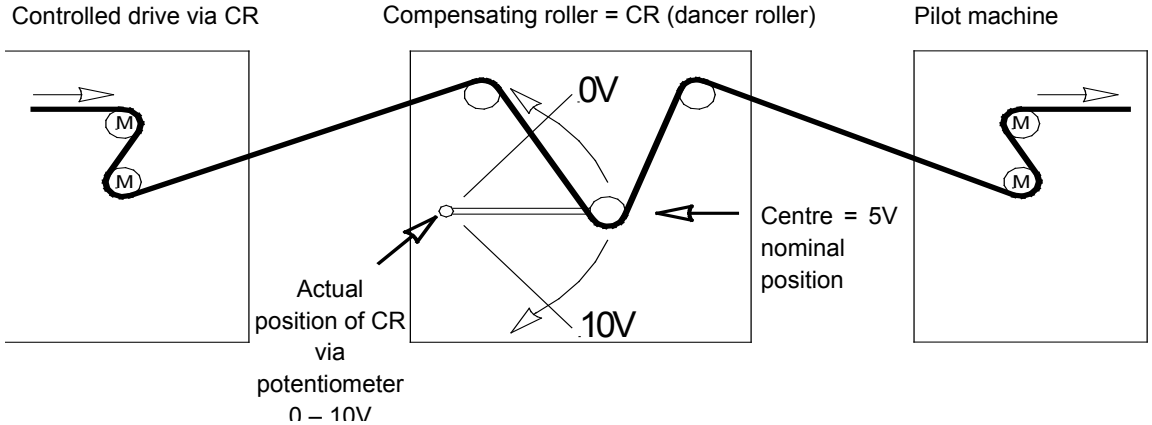
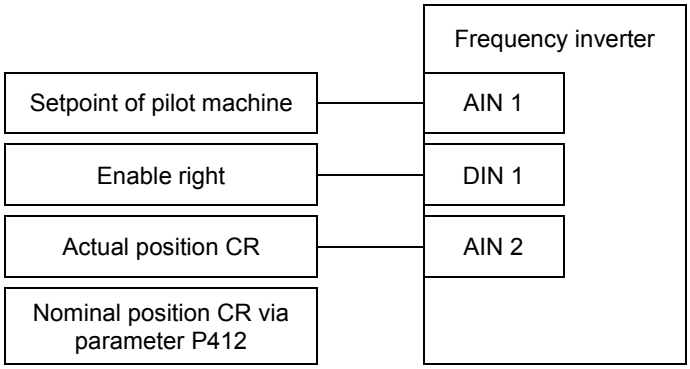
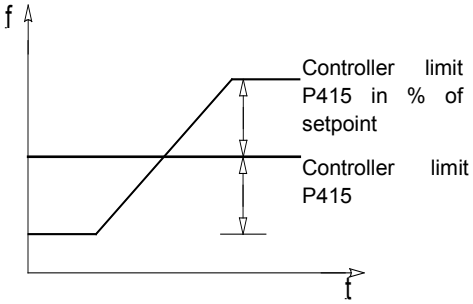



**Figure 32: Process controller flow diagram**

### 8.2.1 Process controller application example



### 8.2.2 Process controller parameter settings

(Example: SK 2x0E setpoint frequency: 50 Hz, control limits: +/- 25%)

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

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

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

P411 (setpoint frequency) [Hz] : Set frequency with 10 V at analogue 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. Analogue input 2) : **"6"** PI process controller actual value

## 8.3 Electromagnetic compatibility (EMC)

If the device is installed according to the recommendations in this manual, it meets all EMC directive requirements, as per the EMC product standard EN 61800-3.

### 8.3.1 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 indicate compliance with this directive:

1. *EC Declaration of Conformity*

   This is a declaration from the manufacturer, stating that the requirements in the applicable European standards for the electrical environment of the equipment have been met. Only those standards which are published in the Official Journal of the European Community 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 devices only have an intrinsic function when they are connected to other equipment (e.g. to a motor). The base units cannot therefore carry the CE mark that would confirm compliance with the EMC directive. Precise details are therefore given below about the EMC behaviour of this product, based on the proviso that it is installed according to the guidelines and instructions described in this documentation.

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

### 8.3.2 EMC evaluation

Two standards must be observed when evaluating electromagnetic compatibility.

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

   The limits are defined in dependence on the basic environment in which the product is operated in this standard. A distinction is made between 2 environments, whereby the **1st environment** describes the non-industrial **living and business area** without its own high-voltage or medium-voltage distribution transformers. The **2nd environment**, on the other hand, defines **industrial areas** which are not connected to the public low-voltage network, but have their own high-voltage or medium-voltage distribution transformers. The limits are subdivided into **classes A1, A2 and B**.

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

   The limits are defined in dependence on the usage area of the product in this standard. The limits are subdivided into **categories C1, C2, C3 and C4**, whereby class C4 basically only applies to drive systems with higher voltage (≥ 1000 V AC), or higher currents (≥ 400 A). However, class C4 can also apply to the individual device if it is incorporated in complex systems.

The same limits apply to both standards: However, the standards differ with regard to an application that is extended in the product standard. The user decides which of the two standards applies, whereby the environmental standard applies in the event of a typical fault remedy.

The main connection between the two standards is explained as follows:

| Category as per EN 61800-3 | C1 | C2 | C3 |
|---|---|---|---|
| Limit class in accordance with EN 55011 | B | A1 | A2 |
| Operation permissible in<br>1. Environment (living environment) | X | X [1)] | - |
| 2. Environment (industrial environment) | X | X [1)] | X [1)] |
| Note required in accordance with EN-61800-3 | - | 2) | 3) |
| Sales channel | Generally available | Limited availability | |
| EMC situation | No requirements | Installation and start-up by EMC expert | |

1) Device used neither as a plug-in device nor in moving equipment
2) "The drive system can cause high-frequency interference in a living environment that may make interference suppression measures necessary".
3) "The drive system is not intended for use in a public low-voltage network that feeds residential areas".

**Table 14: EMC comparison between EN 61800-3 and EN 55011**

### 8.3.3 EMC of device

**NOTICE** **EMC Interference to the environment**

This device produces high frequency interference, which may make additional suppression measures necessary in domestic environments (📖 Section 8.3.2 "EMC evaluation").

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

The device is exclusively intended for commercial use. It is therefore not subject to the requirements of the standard EN 61000-3-2 for radiation of harmonics.

The limit value classes are only achieved if

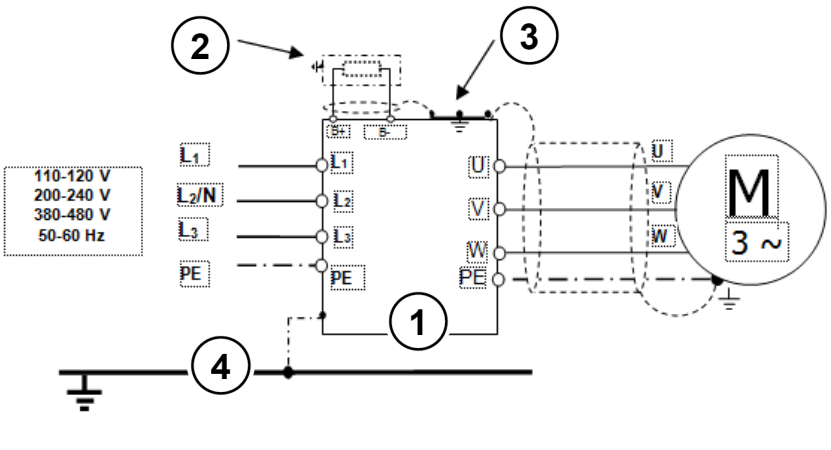
- the wiring is EMC-compliant
- the length of shielded motor cable does not exceed the permissible limits
- the standard pulse frequency (P504) is being used

The shielding of the motor cable must be attached at both sides in the motor terminal box and the inverter housing in the event of wall mounting.

| **Device type**<br>**Max. motor cable, shielded** | **Jumper position**<br>**(chapter 0)** | **Conducted emissions**<br>**150 kHz - 30 MHz** | |
|---|---|---|---|
| | | **Class C2** | **Class C1** |
| Device motor-mounted | Jumper set | + | - |
| Device wall-mounted | Jumper set | 5 m | - |

| EMC overview of standards that are used in accordance with EN 61800-3 as checking and measuring procedures: | | |
|---|---|---|
| *Interference emission* | | |
| Cable-related emission (interference voltage) | EN 55011 | C2 |
| | | - |
| Radiated emission (interference field strength) | EN 55011 | 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 / 2 kV |
| 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 % |

Table 15: Overview according to product standard EN 61800-3




| | |
|---|---|
| **1** | FI |
| **2** | Brake resistance (option) |
| **3** | EMC cable gland |
| **4** | Functional earthing |
| **PE** | Protective earth |

Figure 33: Wiring recommendation

### 8.3.4 EU Declaration of Conformity

**GETRIEBEBAU NORD**
Member of the NORD DRIVESYSTEMS Group

DRIVESYSTEMS

**Getriebebau NORD GmbH & Co. KG**
Getriebebau-Nord-Str. 1 . 22941 Bargteheide, Germany . Fon +49(0)4532 289 - 0 . Fax +49(0)4532 289 - 2253 . info@nord.com

C310700_0918

## EU Declaration of Conformity

In the meaning of the EU directives 2014/35/EU Annex IV, 2014/30/EU Annex II and 2011/65/EU Annex VI

Getriebebau NORD GmbH & Co. KG as manufacturer in sole responsibility hereby declares, that the variable speed drives of the product series



- **SK 200E-xxx-123-B-.. , SK 200E-xxx-323-.-.. , SK 200E-xxx-340-.-..**
  (xxx= 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751, 112, 152, 182, 222)
  also in these functional variants:
  **SK 205E-..., SK 210E-..., SK 215E-..., SK 220E-..., SK 225E-..., SK 230E-..., SK 235E-...**
  and the further options/accessories:
  **SK CU4-... , SK TU4-... , SK TI4-... , SK TIE4-... , SK BRI4-... , SK BRE4-... ,**
  **SK PAR-3. , SK CSX-3. , SK SSX-3A, SK POT1-. , SK EPG-3H**

comply with the following regulations:

| | | |
|---|---|---|
| **Low Voltage Directive** | **2014/35/EU** | OJ. L 96 of 29.3.2014, P. 357–374 |
| **EMC Directive** | **2014/30/EU** | OJ. L 96 of 29.3.2014, P. 79–106 |
| **RoHS Directive** | **2011/65/EU** | OJ. L 174 of 1.7.2011, P. 88–11 |

**Applied standards:**

| | | |
|---|---|---|
| EN 61800-5-1:2007+A1:2017 | EN 61800-3:2004+A1:2012+AC:2014 | EN 61800-9-1:2017 |
| EN 60529:1991+A1:2000+A2:2013+AC:2016 | EN 50581:2012 | EN 61800-9-2:2017 |

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.

First marking was carried out in 2009.

**Bargteheide, 02.03.2018**

U. Küchenmeister
Managing Director

pp F. Wiedemann
Head of Inverter Division

## 8.4 Reduced output power

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

- Output frequencies < 4.5 Hz and constant voltages (needle stationary)
- Pulse frequencies greater than the nominal pulse frequency (P504)
- Increased mains voltage > 400 V
- Increased heat sink temperature

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

### 8.4.1 Increased heat dissipation due to pulse frequency

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

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

The diagram shows the possible current load capacity for continuous operation.

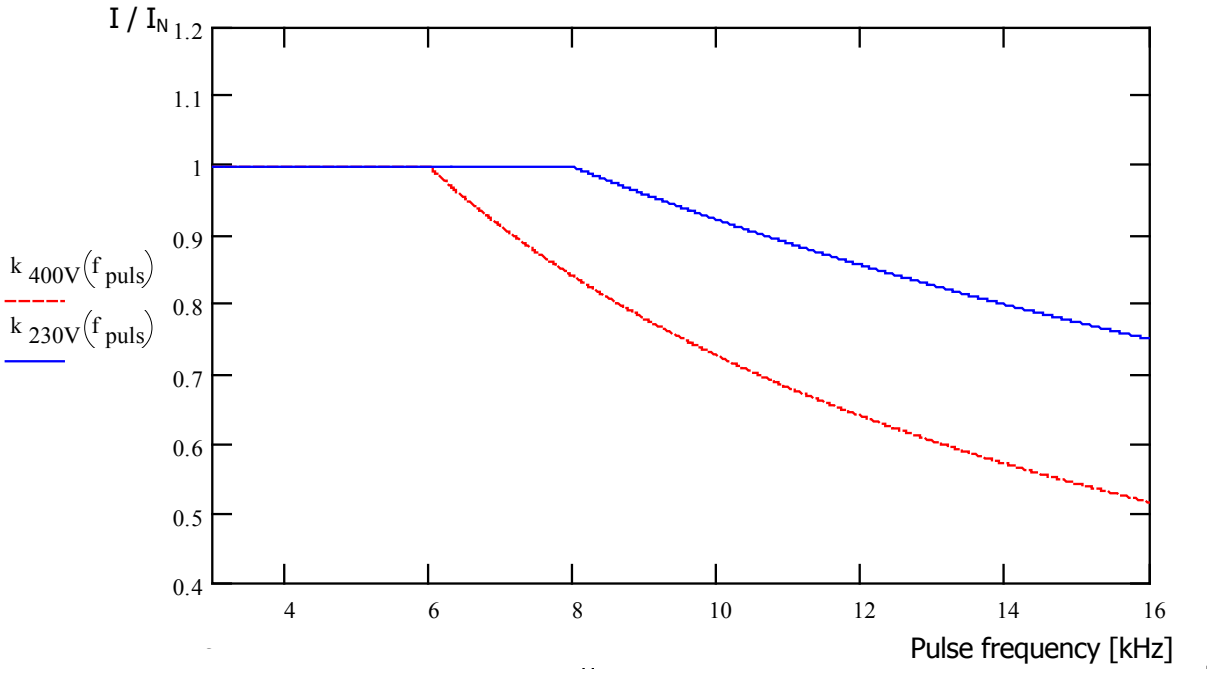



Figure 34: Heat losses due to pulse frequency

### 8.4.2 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.

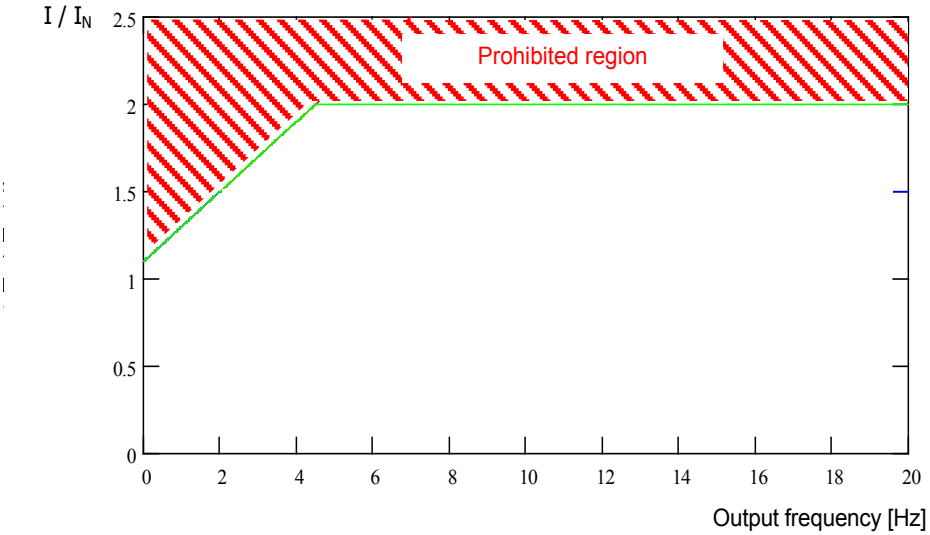
| **230V devices:** Reduced overload capacity (approx.) due to pulse frequency (P504) and time | | | | | | |
|---|---|---|---|---|---|---|
| Pulse frequency [kHz] | Time [s] | | | | | |
| | > 600 | 60 | 30 | 20 | 10 | 3.5 |
| 3...8 | 110% | 150% | 170% | 180% | 180% | 200% |
| 10 | 103% | 140% | 155%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

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

**Table 16: Overcurrent relative to time**

### 8.4.3 Reduced overcurrent due to output frequency

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




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

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

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

**Table 17: Overcurrent relative to pulse and output frequency**

### 8.4.4 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.

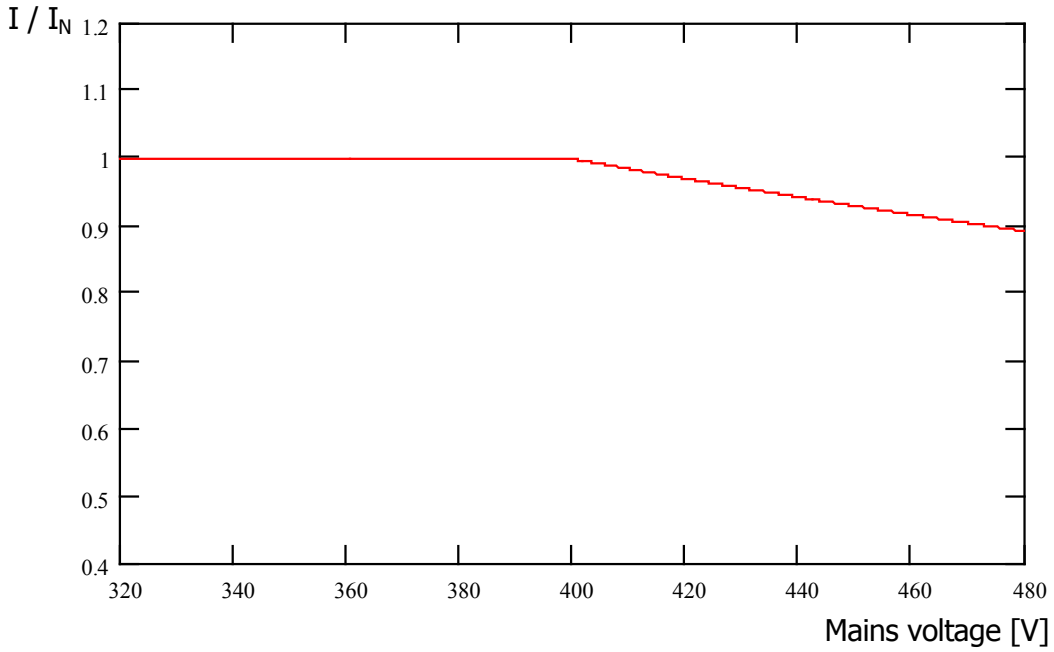



Figure 35: Output current due to mains voltage

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

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

### 8.4.6 Reduced output current due to speed

The size 1 – 3 devices are designed such that the waste heat that occurs can only be given off via the housing in sufficient quantities if the **frequency inverter with motor installation** is also cooled by an air flow. If this air flow is generated by a self-ventilated motor (impeller mounted on the motor shaft), the strength of the air flow then depends on the motor speed. This means that as the motor speed reduces, so does the air flow. Depending on the frequency inverter and the speed that is present, appropriate restrictions in the possible output power (S1 operation) must be taken into consideration.

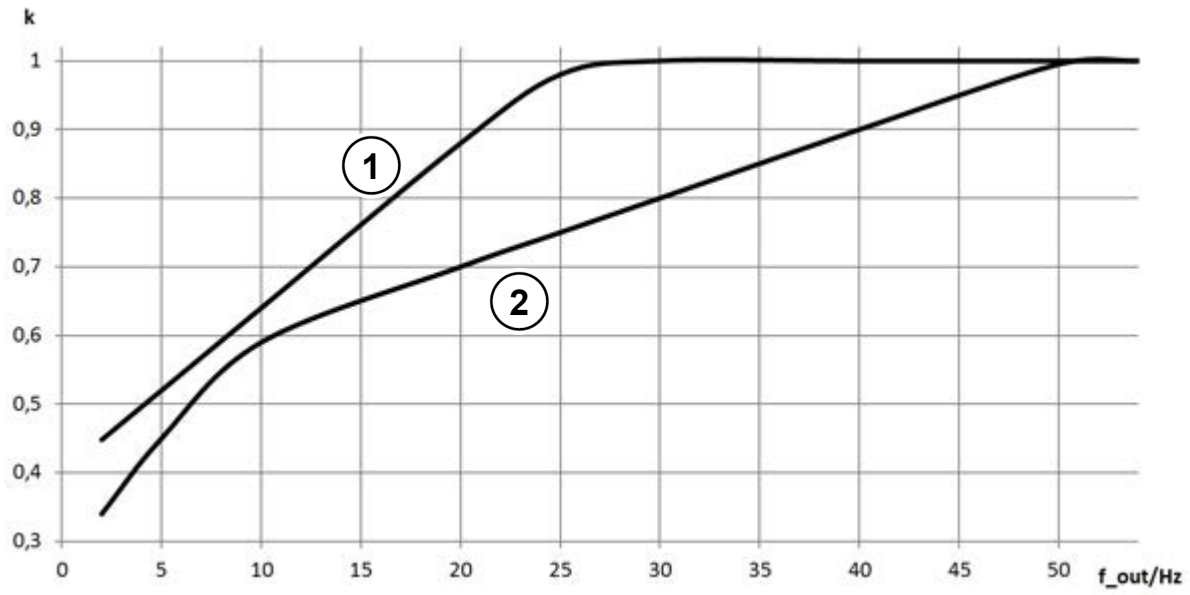
This restriction can be determined on the basis of the following graph. However, it must be taken into consideration that the result that is determined can only be a rough estimate, since various influential factors such as specific frequency inverter / motor combinations cannot also be taken into consideration. More information can be found in the catalogue G4014.

The "k" factor of the following graph must be multiplied by the nominal data of the frequency inverter concerned, and therefore results in the possible continuous current or the possible continuous output in S1 operation.

**Example:**

SK 200E-401-340A, $I_{nom}$ = 8.9 A, f_out: 20 Hz → k=0.7

$I = I_{nom}$ x k → I = 8.9 A x 0.7 = 6.2 A in S1 operation




**1 =** All device sizes 1 to 3 except the devices from ( 2 )

**2 =** SK 2xxE-111-323-A, SK 2xxE-221-323-A, SK 2xxE-401-323-A, SK 2xxE-221-340-A, SK 2xxE-401-340-A, SK 2xxE-751-340-A

**Figure 36: Derating factor "k" for motor installation (self-ventilated)**

## 8.5 Operation on the FI circuit breaker

With SK 2xxE frequency inverters (except 115 V devices), leakage currents of > 40 mA are to be expected if the mains filter is active. In other words, an FI personal protection circuit breaker must be avoided if possible.

If the frequency inverter is going to be operated with an FI personal protection circuit breaker, the leakage currents against PE could be reduced to 10 - 20 mA jumpers. However, the FI loses its specified interference suppression level because of "operation on IT network".

Only all-current sensitive FI circuit breakers (type B or B+) must be used.

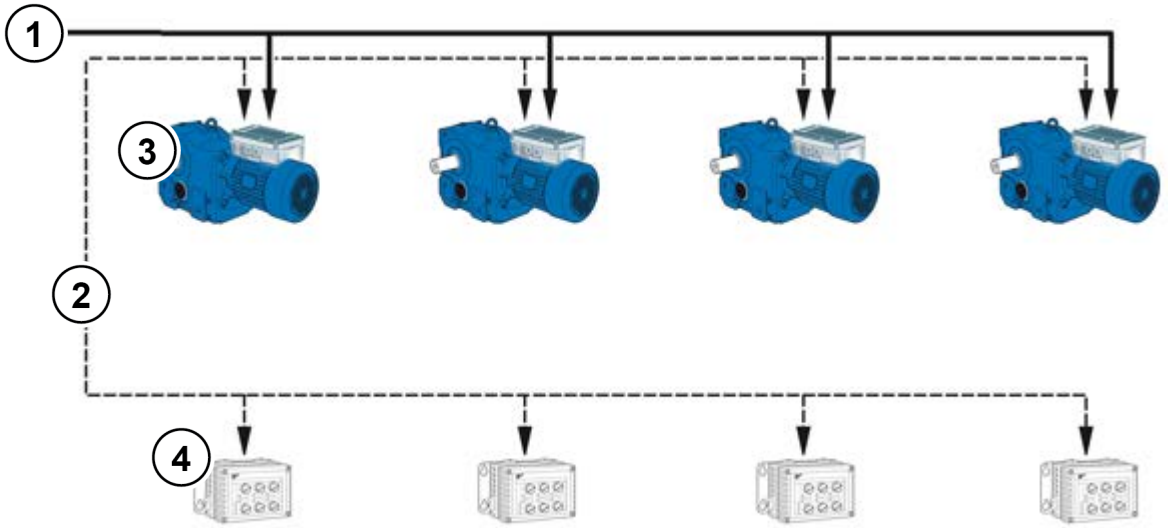
(please see chapter 2.4.2.1 "Mains supply (L1, L2(/N), L3, PE)")

(📖 See also document TI 800_000000003)

## 8.6 System bus

The device and many of the associated 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 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.




| No. | Type |
|---|---|
| **1** | Mains connection |
| **2** | System bus cable (CAN_H, CAN_L, GND) |
| **3** | Frequency inverters |
| **4** | Options<br>• Bus modules<br>• IO Extensions<br>• CANopen rotary encoder |

| Terminal | Meaning |
|---|---|
| **77** | System bus+ (CAN_H) |
| **78** | System bus- (CAN_L) |
| **40** | GND (Reference potential) |
| Terminal numbers may differ (depending on the device) | |

### Information — Communication interference

To minimise the risk of communication interference, the ***GND –potentials*** (Terminal 40) of all GNDs which are linked via the system bus GND ***must be connected together***. The shield of the bus cable must also be connected to PE at both ends.

### Information — Communication on the system bus

Communication on the system bus does not take place until an expansion module is connected to it or if the master in a master/slave system is parameterised to **P503**=3 and the slave to **P503**=2. This is particularly important if several frequency inverters connected to the system bus in parallel are to be read out using the NORD CON parameterisation software.

### Physical structure

| | |
|---|---|
| **Standard** | CAN |
| **Physical design** | 2x2, twisted pair, shielded, stranded wires, wire cross-section ≥0.25 mm² (AWG23), surge impedance approx. 120 Ω |
| **Bus length** | max. 20 m total expansion (network),<br>max. 20 m between 2 subscribers, |
| **Structure** | preferably linear |
| **Spur cables** | possible, (max. 6 m) |
| **Termination resistors** | 120 Ω, 250 mW at both ends of a system bus<br>(with FI or SK xU4-… via DIP switches) |
| **Baud rate** | 250 kBaud - preset |

The CAN_H and CAN_L signals must be connected using a twisted pair of wires. The GND potentials are connected using the second pair of wires.

### Addressing

If several frequency inverters are connected to a system bus, these devices must be assigned with unique addresses. This should preferably take place via the DIP switch S1 at the device (please see chapter 4.3.2.2 "DIP switches (S1)").

For field bus modules, no assignment of addresses is necessary. The module identifies all the frequency inverters automatically. Access to the individual inverters takes place via the field bus master (PLC) Details of how this is carried out are explained in the relevant bus instructions or data sheets for the individual modules.

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 (analogue 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. More information about the settings can be found in the Data sheets for the relevant modules.

**Information** — **Addressing**

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.

### 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 250 kBaud 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.

**Example of frequency inverter addressing**

| Frequency inverter | Addressing via DIP switch S1 | | Resulting Node ID | Node ID AG |
|---|---|---|---|---|
| | DIP2 | DIP1 | Frequency inverters | |
| FI 1 | ON | ON | 32 | 33 |
| FI 2 | OFF | ON | 34 | 35 |
| FI 3 | OFF | ON | 36 | 37 |
| FI 4 | OFF | OFF | 38 | 39 |

**Information** **CANopen absolute encoders**

In applications with CANopen absolute encoders, the encoders must be assigned to the relevant FI via the node ID. If there is one encoder and four frequency inverters in the system bus, for example, and the encoder is to work together with FI3, the encoder must be set to a node ID of 37, see table above ***Node ID AG***

## 8.7 Energy Efficiency

**WARNING** **Unexpected movement due to overload**

In case of overload of the drive there is a risk that the motor will "break down" (= sudden loss of torque). An overload may be caused e.g. by underdimensioning of the drive unit or by the occurrence of sudden peak loads. Sudden peak loads may be of a mechanical origin (e.g. blockage) or may be due to extremely steep acceleration ramps (Parameter **P102**, **P103**, **P426**).

Depending on the type of application, "breakdown" of the motor may cause unexpected movement (e.g. dropping of loads by lifting gear).

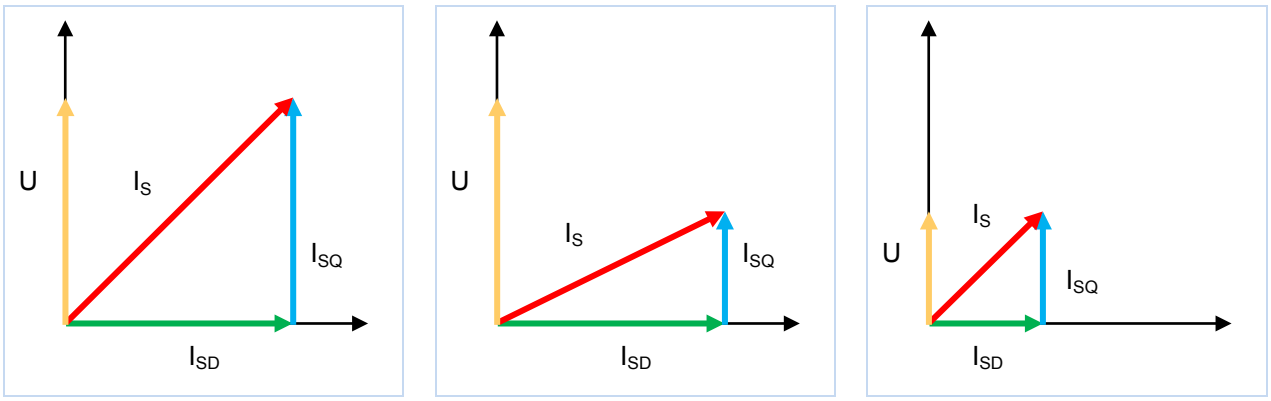
To prevent any risk, the following must be observed:

- For lifting gear applications or applications with frequent, large load changes, the parameter (**P219**) must remain in the factory (**100 %**).
- Do not underdimension the drive unit, provide adequate overload reserves.
- If necessary, provide fall protection (e.g. for lifting gear) or equivalent protective measures.

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 momentary drive power. The resulting considerable reduction in power consumption, as well as the optimisation of the cos φ factor of the motor rating in the partial load range contributes to creating optimum conditions both with regard to energy consumption and mains characteristics.

A parameterisation which is different from the factory setting (Factory setting = 100%) is only permissible for applications which do not require rapid torque changes. (For details, see Parameter (P219))




$I_S$ = Motor current vector (line current)
$I_{SD}$ = Magnetisation current vector (magnetisation current)
$I_{SQ}$ = Load current vector (load current)

**Figure 37: Energy efficiency due to automatic flux optimisation**

## 8.8 Motor data - characteristic curves

The possible characteristic curves with which the motors can be operated are explained in the following. The rating plate data of the motor is relevant for operation with the 50 Hz or 87 Hz characteristic curve (🕮 Section 4.1 "Factory settings"). The use of specially calculated motor data is required for operation with a 100 Hz characteristic curve (🕮 Section 8.8.3 "100 Hz characteristic curve (only 400 V devices)").

### 8.8.1 50 Hz characteristic curve

**(→ Variation 1:10)**

The motor used for 50 Hz operation can be operated up to its rated point at 50 Hz with nominal torque. 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, since the voltage cannot be increased beyond the value of the mains voltage when the frequency is increased above 50 Hz.

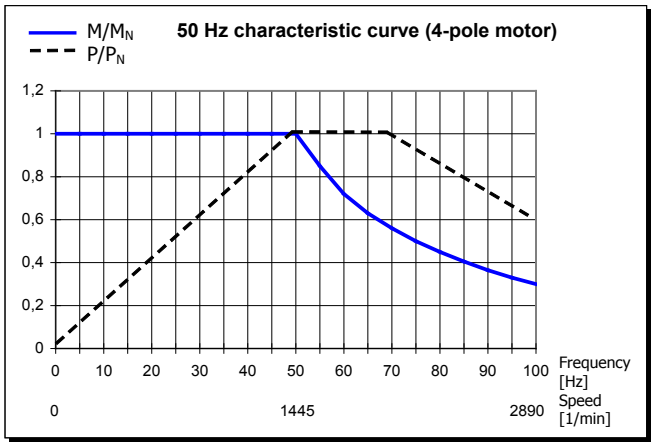



Figure 38: 50 Hz characteristic curve

### 115 V / 230 V – frequency inverter

With 115 V devices, the input voltage is doubled is doubled inside the device so that the required maximum output voltage of 230 V is achieved by the device.

The following data refers to a 230/400V motor winding. They apply for IE1 and 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).

| **Motor (IE1) SK …** | **Frequency inverter SK 2xxE-…** | **$M_N$ ** [Nm]** | **Parameterisation data of frequency inverter** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [rpm] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 71S/4 | 250-x23-A* | 1.73 | 50 | 1365 | 1.3 | 230 | 0.25 | 0.79 | Δ | 39.9 |
| 71L/4 | 370-x23-A* | 2.56 | 50 | 1380 | 1.89 | 230 | 0.37 | 0.71 | Δ | 22.85 |
| 80S/4 | 550-x23-A* | 3.82 | 50 | 1385 | 2.62 | 230 | 0.55 | 0.75 | Δ | 15.79 |
| 80L/4 | 750-x23-A* | 5.21 | 50 | 1395 | 3.52 | 230 | 0.75 | 0.75 | Δ | 10.49 |
| 90S/4 | 111-x23-A | 7.53 | 50 | 1410 | 4.78 | 230 | 1.1 | 0.76 | Δ | 6.41 |
| 90L/4 | 151-323-A | 10.3 | 50 | 1390 | 6.11 | 230 | 1.5 | 0.78 | Δ | 3.99 |
| 100L/4 | 221-323-A | 14.6 | 50 | 1415 | 8.65 | 230 | 2.2 | 0.78 | Δ | 2.78 |
| 100LA/4 | 301-323-A | 20.2 | 50 | 1415 | 11.76 | 230 | 3.0 | 0.78 | Δ | 1.71 |
| 112M/4 | 401-323-A | 26.4 | 50 | 1430 | 14.2 | 230 | 4.0 | 0.83 | Δ | 1.11 |
| 132S/4 | 551-323-A | 36.5 | 50 | 1450 | 20.0 | 230 | 5.5 | 0.8 | Δ | 0.72 |
| 132M/4 | 751-323-A | 49.6 | 50 | 1450 | 26.8 | 230 | 7.5 | 0.79 | Δ | 0.46 |
| 132MA/4 | 112-323-A | 60.6 | 50 | 1455 | 32.6 | 230 | 9.2 | 0.829 | Δ | 0.39 |

* the same data apply for the use of the 115 V version of the SK 2xxE

** at rated point

| **Motor (IE2) SK …** | **Frequency inverter SK 2xxE-…** | **$M_N$ ** [Nm]** | **Parameterisation data of frequency inverter** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80SH/4 | 550-x23-A* | 3.73 | 50 | 1415 | 2.39 | 230 | 0.55 | 0.7 | Δ | 9.34 |
| 80LH/4 | 750-x23-A* | 5.06 | 50 | 1410 | 3.12 | 230 | 0.75 | 0.75 | Δ | 6.30 |
| 90SH/4 | 111-x23-A | 7.32 | 50 | 1430 | 4.26 | 230 | 1.1 | 0.8 | Δ | 4.96 |
| 90LH/4 | 151-323-A | 10.1 | 50 | 1420 | 5.85 | 230 | 1.5 | 0.79 | Δ | 3.27 |
| 100LH/4 | 221-323-A | 14.5 | 50 | 1445 | 8.25 | 230 | 2.2 | 0.79 | Δ | 1.73 |
| 100AH/4 | 301-323-A | 20.3 | 50 | 1420 | 11.1 | 230 | 3.0 | 0.77 | Δ | 1.48 |
| 112MH/4 | 401-323-A | 26.6 | 50 | 1440 | 14.1 | 230 | 4.0 | 0.83 | Δ | 1.00 |
| 132SH/4 | 551-323-A | 36.6 | 50 | 1455 | 18.8 | 230 | 5.5 | 0.83 | Δ | 0.60 |
| 132MH/4 | 751-323-A | 49.1 | 50 | 1455 | 26.2 | 230 | 7.5 | 0.8 | Δ | 0.42 |
| 160MH/4 | 112-323-A | 71.7 | 50 | 1465 | 35.5 | 230 | 11.0 | 0.85 | Δ | 0.26 |

* the same data apply for the use of the 115 V version of the SK 2xxE

** at rated point

### b) 400V frequency inverter

The following data is based on an output of 2.2 kW using a 230/400 V motor winding. 400/690 V windings are used for 3 kW and higher.

They apply for IE1 and 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).

| Motor (IE1) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80S/4 | 550-340-A | 3.82 | 50 | 1385 | 1.51 | 400 | 0.55 | 0.75 | Y | 15.79 |
| 80L/4 | 750-340-A | 5.21 | 50 | 1395 | 2.03 | 400 | 0.75 | 0.75 | Y | 10.49 |
| 90S/4 | 111-340-A | 7.53 | 50 | 1410 | 2.76 | 400 | 1.1 | 0.76 | Y | 6.41 |
| 90L/4 | 151-340-A | 10.3 | 50 | 1390 | 3.53 | 400 | 1.5 | 0.78 | Y | 3.99 |
| 100L/4 | 221-340-A | 14.6 | 50 | 1415 | 5.0 | 400 | 2.2 | 0.78 | Y | 2.78 |
| 100LA/4 | 301-340-A | 20.2 | 50 | 1415 | 6.8 | 400 | 3.0 | 0.78 | Δ | 5.12 |
| 112M/4 | 401-340-A | 26.4 | 50 | 1430 | 8.24 | 400 | 4.0 | 0.83 | Δ | 3.47 |
| 132S/4 | 551-340-A | 36.5 | 50 | 1450 | 11.6 | 400 | 5.5 | 0.8 | Δ | 2.14 |
| 132M/4 | 751-340-A | 49.6 | 50 | 1450 | 15.5 | 400 | 7.5 | 0.79 | Δ | 1.42 |
| 160M/4 | 112-340-A | 72.2 | 50 | 1455 | 20.9 | 400 | 11.0 | 0.85 | Δ | 1.08 |
| 160L/4 | 152-340-A | 98.1 | 50 | 1460 | 28.2 | 400 | 15.0 | 0.85 | Δ | 0.66 |
| 180MX/4 | 182-340-A | 122 | 50 | 1460 | 35.4 | 400 | 18.5 | 0.83 | Δ | 0.46 |
| 180LX/4 | 222-340-A | 145 | 50 | 1460 | 42.6 | 400 | 22.0 | 0.82 | Δ | 0.35 |

* at rated point

| Motor (IE2) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80SH/4 | 550-340-A | 3.82 | 50 | 1415 | 1.38 | 400 | 0.55 | 0.7 | Y | 9.34 |
| 80LH/4 | 750-340-A | 5.21 | 50 | 1410 | 1.8 | 400 | 0.75 | 0.75 | Y | 6.30 |
| 90SH/4 | 111-340-A | 7.53 | 50 | 1430 | 2.46 | 400 | 1.1 | 0.8 | Y | 4.96 |
| 90LH/4 | 151-340-A | 10.3 | 50 | 1420 | 3.38 | 400 | 1.5 | 0.79 | Y | 3.27 |
| 100LH/4 | 221-340-A | 14.6 | 50 | 1445 | 4.76 | 400 | 2.2 | 0.79 | Y | 1.73 |
| 100AH/4 | 301-340-A | 20.2 | 50 | 1420 | 6.4 | 400 | 3.0 | 0.77 | Δ | 4.39 |
| 112MH/4 | 401-340-A | 26.4 | 50 | 1440 | 8.12 | 400 | 4.0 | 0.83 | Δ | 2.96 |
| 132SH/4 | 551-340-A | 36.5 | 50 | 1455 | 10.82 | 400 | 5.5 | 0.83 | Δ | 1.84 |
| 132MH/4 | 751-340-A | 49.6 | 50 | 1455 | 15.08 | 400 | 7.5 | 0.8 | Δ | 1.29 |
| 160MH/4 | 112-340-A | 72.2 | 50 | 1465 | 20.5 | 400 | 11.0 | 0.85 | Δ | 0.78 |
| 160LH/4 | 152-340-A | 98.1 | 50 | 1465 | 27.5 | 400 | 15.0 | 0.87 | Δ | 0.53 |
| 180MH/4 | 182-340-A | 122 | 50 | 1475 | 34.9 | 400 | 18.5 | 0.84 | Δ | 0.36 |
| 180LH/4 | 222-340-A | 145 | 50 | 1475 | 40.8 | 400 | 22.0 | 0.86 | Δ | 0.31 |

* at rated point

### 8.8.2 87 Hz characteristic curve (only 400V devices)

**(→ Variation 01:17)**

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 ≥ √3 motor power)

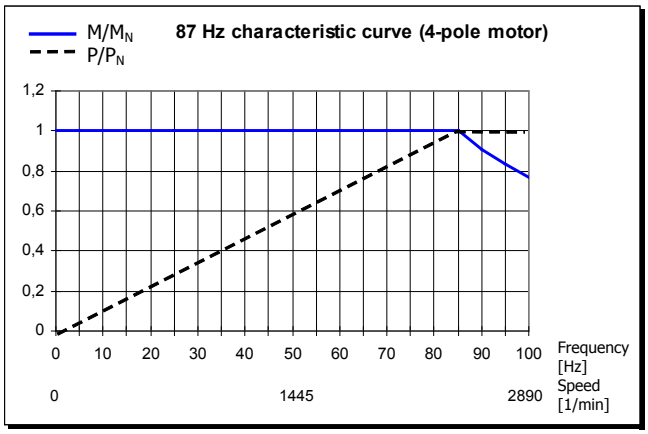



Figure 39: 87 Hz characteristic curve

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 a factor of √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.

**NOTE: The following motor data applies to standard motors with 230V/400 V windings.**

| Motor (IE1) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 71S/4 | 550-340-A | 1.73 | 50 | 1365 | 1.3 | 230 | 0.25 | 0.79 | Δ | 39.9 |
| 71L/4 | 750-340-A | 2.56 | 50 | 1380 | 1.89 | 230 | 0.37 | 0.71 | Δ | 22.85 |
| 80S/4 | 111-340-A | 3.82 | 50 | 1385 | 2.62 | 230 | 0.55 | 0.75 | Δ | 15.79 |
| 80L/4 | 151-340-A | 5.21 | 50 | 1395 | 3.52 | 230 | 0.75 | 0.75 | Δ | 10.49 |
| 90S/4 | 221-340-A | 7.53 | 50 | 1410 | 4.78 | 230 | 1.1 | 0.76 | Δ | 6.41 |
| 90L/4 | 301-340-A | 10.3 | 50 | 1390 | 6.11 | 230 | 1.5 | 0.78 | Δ | 3.99 |
| 100L/4 | 401-340-A | 14.6 | 50 | 1415 | 8.65 | 230 | 2.2 | 0.78 | Δ | 2.78 |
| 100LA/4 | 551-340-A | 20.2 | 50 | 1415 | 11.76 | 230 | 3.0 | 0.78 | Δ | 1.71 |
| 112M/4 | 751-340-A | 26.4 | 50 | 1430 | 14.2 | 230 | 4.0 | 0.83 | Δ | 1.11 |
| 132S/4 | 112-340-A | 36.5 | 50 | 1450 | 20.0 | 230 | 5.5 | 0.8 | Δ | 0.72 |
| 132M/4 | 152-340-A | 49.6 | 50 | 1450 | 26.8 | 230 | 7.5 | 0.79 | Δ | 0.46 |
| 132MA/4 | 182-340-A | 60.6 | 50 | 1455 | 32.6 | 230 | 9.2 | 0.829 | Δ | 0.39 |
| 160MA/4 | 222-340-A | 72.2 | 50 | 1455 | 37 | 230 | 11 | 0.85 | Δ | 0.36 |

* at rated point

| Motor (IE2) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80SH/4 | 111-340-A | 3.73 | 50 | 1415 | 2.39 | 230 | 0.55 | 0.7 | Δ | 9.34 |
| 80LH/4 | 151-340-A | 5.06 | 50 | 1410 | 3.12 | 230 | 0.75 | 0.75 | Δ | 6.30 |
| 90SH/4 | 221-340-A | 7.32 | 50 | 1430 | 4.26 | 230 | 1.1 | 0.8 | Δ | 4.96 |
| 90LH/4 | 301-340-A | 10.1 | 50 | 1420 | 5.85 | 230 | 1.5 | 0.79 | Δ | 3.27 |
| 100LH/4 | 401-340-A | 14.5 | 50 | 1445 | 8.25 | 230 | 2.2 | 0.79 | Δ | 1.73 |
| 100AH/4 | 551-340-A | 20.3 | 50 | 1420 | 11.1 | 230 | 3.0 | 0.77 | Δ | 1.48 |
| 112MH/4 | 751-340-A | 26.6 | 50 | 1440 | 14.1 | 230 | 4.0 | 0.83 | Δ | 1.00 |
| 132SH/4 | 112-340-A | 36.6 | 50 | 1455 | 18.8 | 230 | 5.5 | 0.83 | Δ | 0.60 |
| 132MH/4 | 152-340-A | 49.1 | 50 | 1455 | 26.2 | 230 | 7.5 | 0.8 | Δ | 0.42 |
| 160MH/4 | 182-340-A | 71.7 | 50 | 1465 | 35.5 | 230 | 11.0 | 0.85 | Δ | 0.26 |
| 160LH/4 | 222-340-A | 97.8 | 50 | 1465 | 46.0 | 230 | 15.0 | 0.87 | Δ | 0.17 |

* at rated point

### 8.8.3 100 Hz characteristic curve (only 400 V devices)

**(→ Variation 01:20)**

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 is required in this case (see below) that differs 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.

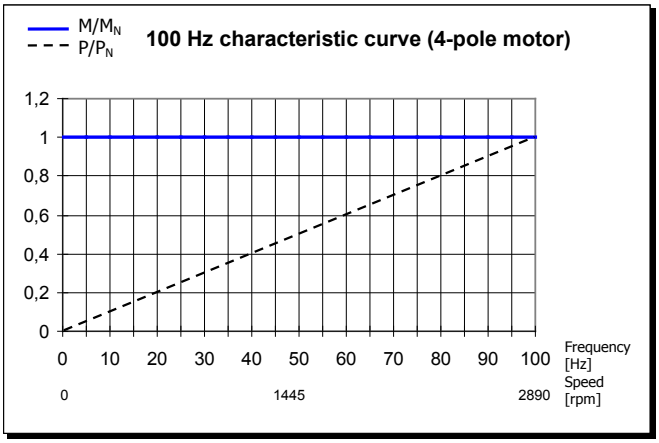



Figure 40: 100 Hz characteristic curve

**NOTE: The following motor data applies for standard motors with a 230 / 400 V winding. It must be noted that this information may change slightly because the motors are subject to certain tolerances. It is recommended that the resistance of the connected motor is measured by the frequency inverter (P208 / P220).**

| Motor (IE1) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 71L/4 | 550-340-A | 1.81 | 100 | 2900 | 1.59 | 400 | 0.55 | 0.72 | Δ | 22.85 |
| 80S/4 | 750-340-A | 2.46 | 100 | 2910 | 2.0 | 400 | 0.75 | 0.72 | Δ | 15.79 |
| 80L/4 | 111-340-A | 3.61 | 100 | 2910 | 2.8 | 400 | 1.1 | 0.74 | Δ | 10.49 |
| 90S/4 | 151-340-A | 4.90 | 100 | 2925 | 3.75 | 400 | 1.5 | 0.76 | Δ | 6.41 |
| 90L/4 | 221-340-A | 7.19 | 100 | 2920 | 4.96 | 400 | 2.2 | 0.82 | Δ | 3.99 |
| 100L/4 | 301-340-A | 9.78 | 100 | 2930 | 6.95 | 400 | 3.0 | 0.78 | Δ | 2.78 |
| 100LA/4 | 401-340-A | 12.95 | 100 | 2950 | 7.46 | 400 | 4.0 | 0.76 | Δ | 1.71 |
| 112M/4 | 551-340-A | 17.83 | 100 | 2945 | 11.3 | 400 | 5.5 | 0.82 | Δ | 1.11 |
| 132S/4 | 751-340-A | 24.24 | 100 | 2955 | 16.0 | 400 | 7.5 | 0.82 | Δ | 0.72 |
| 132MA/4 | 112-340-A | 35.49 | 100 | 2960 | 23.0 | 400 | 11.0 | 0.80 | Δ | 0.39 |

* at rated point

| Motor (IE2) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80SH/4 | 750-340-A | 2.44 | 100 | 2930 | 1.9 | 400 | 0.75 | 0.7 | Δ | 9.34 |
| 80LH/4 | 111-340-A | 3.60 | 100 | 2920 | 2.56 | 400 | 1.1 | 0.73 | Δ | 6.3 |
| 90SH/4 | 151-340-A | 4.89 | 100 | 2930 | 3.53 | 400 | 1.5 | 0.79 | Δ | 4.96 |
| 90LH/4 | 221-340-A | 7.18 | 100 | 2925 | 4.98 | 400 | 2.2 | 0.79 | Δ | 3.27 |
| 100LH/4 | 301-340-A | 9.69 | 100 | 2955 | 6.47 | 400 | 3.0 | 0.78 | Δ | 1.73 |
| 100AH/4 | 401-340-A | 13.0 | 100 | 2940 | 8.24 | 400 | 4.0 | 0.79 | Δ | 1.48 |
| 112MH/4 | 551-340-A | 17.8 | 100 | 2950 | 11.13 | 400 | 5.5 | 0.82 | Δ | 1.0 |
| 132SH/4 | 751-340-A | 24.2 | 100 | 2960 | 15.3 | 400 | 7.5 | 0.83 | Δ | 0.6 |
| 132MH/4 | 112-340-A | 29.6 | 100 | 2965 | 19.5 | 400 | 9.2 | 0.79 | Δ | 0.42 |
| 160MH/4 | 152-340-A | 48.3 | 100 | 2967 | 29.0 | 400 | 15.0 | 0.87 | Δ | 0.256 |
| 160LH/4 | 182-340-A | 59.4 | 100 | 2975 | 35.7 | 400 | 18.5 | 0.86 | Δ | 0.168 |
| 180MH/4 | 222-340-A | 70.5 | 100 | 2980 | 43.2 | 400 | 22 | 0.85 | Δ | 0.115 |

* at rated point

| Motor (IE3) SK … | Frequency inverter SK 2xxE-… | $M_N$ * [Nm] | Parameterisation data of frequency inverter | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_N$ [Hz] | $n_N$ [min-1] | $I_N$ [A] | $U_N$ [V] | $P_N$ [kW] | cos φ | Y/Δ | $R_{St}$ [Ω] |
| 80SP/4 | 750-340-A | 2.44 | 100 | 2935 | 1.77 | 400 | 0.75 | 0.73 | Δ | 10.4 |
| 80LP/4 | 111-340-A | 3.58 | 100 | 2930 | 2.13 | 400 | 1.1 | 0.84 | Δ | 6.5 |
| 90SP/4 | 151-340-A | 4.86 | 100 | 2945 | 3.1 | 400 | 1.5 | 0.79 | Δ | 4.16 |
| 90LP/4 | 221-340-A | 7.17 | 100 | 2930 | 4.33 | 400 | 2.2 | 0.83 | Δ | 3.15 |
| 100LP/4 | 301-340-A | 9.65 | 100 | 2970 | 5.6 | 400 | 3.0 | 0.85 | Δ | 1.95 |
| 100AP/4 | 401-340-A | 12.9 | 100 | 2970 | 7.42 | 400 | 4.0 | 0.85 | Δ | 1.58 |
| 112MP/4 | 551-340-A | 17.8 | 100 | 2950 | 10.3 | 400 | 5.5 | 0.85 | Δ | 0.91 |
| 132SP/4 | 751-340-A | 24.1 | 100 | 2970 | 14.3 | 400 | 7.5 | 0.83 | Δ | 0.503 |
| 132MP/4 | 112-340-A | 29.6 | 100 | 2970 | 18.0 | 400 | 9.2 | 0.82 | Δ | 0.381 |
| 160SP/4 | 112-340-A | 35.3 | 100 | 2975 | 21.0 | 400 | 11.0 | 0.85 | Δ | 0.295 |
| 160MP/4 | 152-340-A | 48.2 | 100 | 2970 | 27.5 | 400 | 15.0 | 0.86 | Δ | 0.262 |
| 160LP/4 | 182-340-A | 59.4 | 100 | 2975 | 34.4 | 400 | 18.5 | 0.85 | Δ | 0.169 |
| 180MP/4 | 222-340-A | 70.4 | 100 | 2985 | 40.6 | 400 | 22.0 | 0.85 | Δ | 0.101 |

* at rated point

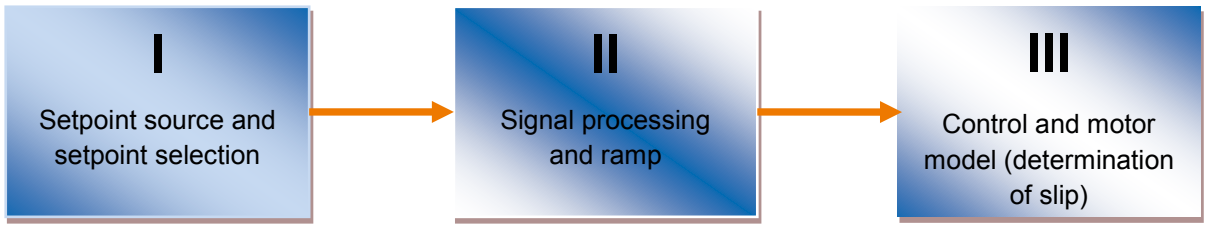
## 8.9 Standardisation of setpoint / target values

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).

| **Name** | **Analogue signal** | | **Bus signal** | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Setpoint values** {Function} | Value range | Standardisation | Value range | Max. value | 100% = | -100% = | Standardisation | Limitation absolute |
| Setpoint frequency {01} | 0-10V (10V=100%) | P104 … P105 (min - max) P104+(P105-P104) *$U_{AIN}$(V)/10V | ±100% | 16384 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $f_{targ}$[Hz]/P105 | P105 |
| Frequency addition {02} | 0-10V (10V=100%) | P410 … P411 (min - max) P410+(P411-P410) *$U_{AIN}$[V]/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $f_{targ}$[Hz]/P411 | P105 |
| Frequency subtraction {03} | 0-10V (10V=100%) | P410 … P411 (min - max) P410+(P411-P410) *$U_{AIN}$[V]/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $f_{targ}$[Hz]/P411 | P105 |
| Minimum frequency {04} | 0-10V (10V=100%) | 50Hz* $U_{AIN}$(V)/10V | 0…200% (50Hz=100%) | 32767 | $4000_{hex}$ $16384_{dec}$ | / | $4000_{hex}$ * $f_{min}$[Hz] / 50Hz | P105 |
| Maximum frequency {05} | 0-10V (10V=100%) | 100Hz* $U_{AIN}$(V)/10V | 0…200% (100Hz=100%) | 32767 | $4000_{hex}$ $16384_{dec}$ | / | $4000_{hex}$ * $f_{max}$[Hz] / 100Hz | P105 |
| Actual value Process controller {06} | 0-10V (10V=100%) | P105* $U_{AIN}$(V)/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $f_{targ}$[Hz]/P105 | P105 |
| Setpoint process controller {07} | 0-10V (10V=100%) | P105* $U_{AIN}$(V)/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $f_{targ}$[Hz]/P105 | P105 |
| Torque current limit {11}, {12} | 0-10V (10V=100%) | P112* $U_{AIN}$(V)/10V | 0…100% | 16384 | $4000_{hex}$ $16384_{dec}$ | / | $4000_{hex}$ * Torque [%] / P112 | P112 |
| Current limit {13}, {14} | 0-10V (10V=100%) | P536* $U_{AIN}$(V)/10V | 0…100% | 16384 | $4000_{hex}$ $16384_{dec}$ | / | $4000_{hex}$ * Current limit [%] / (P536 * 100) | P536 |
| Ramp time {15} | 0-10V (10V=100%) | 10s* $U_{AIN}$(V)/10V | 0…200% | 32767 | $4000_{hex}$ $16384_{dec}$ | / | $4000_{hex}$ * Bus setpoint/ 10s | 20s |
| **Actual values** {Function} | | | | | | | | |
| Actual frequency {01} | 0-10V (10V=100%) | P201* $U_{AOut}$(V)/10V | ±100% | 16384 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * f[Hz]/P105 | |
| Speed {02} | 0-10V (10V=100%) | P202* $U_{AOut}$(V)/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * n[rpm]/P202 | |
| Current {03} | 0-10V (10V=100%) | P203* $U_{AOut}$(V)/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * f[Hz]/P203 | |
| Torque current {04} | 0-10V (10V=100%) | P112* 100/ √((P203)²-(P209)²)* $U_{AOut}$(V)/10V | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * $I_q$[A]/(P112)*100/ √((P203)²-(P209)²) | |
| Master value Setpoint frequency {19} … {24} | / | / | ±100% | 16384 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * f[Hz]/P105 | |
| Speed from rotary encoder {22} | / | / | ±200% | 32767 | $4000_{hex}$ $16384_{dec}$ | $C000_{hex}$ $-16384_{dec}$ | $4000_{hex}$ * n[rpm]/ P201*(60/Number of pairs of poles) | |

## 8.10 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 |
|---|---|---|---|---|---|---|---|
| | | | I | II | III | | |
| 8 | Setpoint frequency | Setpoint frequency from setpoint source | X | | | | |
| 1 | Actual frequency | Setpoint frequency for motor model | | X | | | |
| 23 | Actual frequency with slip | Actual frequency at motor | | | X | | X |
| 19 | Setpoint frequency master value | Setpoint frequency from setpoint source<br>Master value<br>(free from enable correction) | X | | | X | |
| 20 | Setpoint frequency n R master value | Setpoint frequency for motor model<br>Master value<br>(free from enable correction) | | X | | X | |
| 24 | Master value of actual frequency with slip | Actual frequency at motorMaster value<br>(free from enable correction) | | | X | X | X |
| 21 | Actual frequency without slip master value | Actual frequency without master value slip<br>Master value | | | X | | |

Table 18: Processing of setpoints and actual values in the frequency inverter

# 9 Maintenance and servicing information

## 9.1 Maintenance Instructions

NORD frequency converters are *maintenance free* provided that they are properly used (please see chapter 7 "Technical data").

**Dusty environments**

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

**Long-term storage**

The device must be regularly connected to the supply network for at least 60 min.

If this is not carried out, there is a danger that the device may be destroyed.

If a device is to be stored for longer than one year, it must be recommissioned with the aid of an adjustable transformer before normal connection to the mains.

*Long-term storage for 1 - 3 years*

- 30 min with 25 % mains voltage
- 30 min with 50 % mains voltage
- 30 min with 75 % mains voltage
- 30 min with 100 % mains voltage

*Long-term storage for >3 years or if the storage period is not known:*

- 120 min with 25 % mains voltage
- 120 min with 50 % mains voltage
- 120 min with 75 % mains voltage
- 120 min with 100 % mains voltage

The device must not be subject to load during the regeneration process.

After the regeneration process, the regulations described above apply again (at least 60 min on the mains 1x per year).

**Information** — **Control voltage with SK 2x5E**

With devices of type SK 2x5E, a 24 V control voltage supply must be provided in order to make the regeneration process possible.

**Information** — **Accessories**

The regulations for **long-term storage** apply to the accessories, such as 24 V power supply modules (SK xU4-24V-…, SK TU4-POT-…), and the electronic brake inverter (SK CU4-MBR) likewise.

## 9.2 Service notes

Out technical support is available to reply to technical queries.

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

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

**NORD Electronic DRIVESYSTEMS GmbH**
Tjüchkampstraße 37
D-26605 Aurich, Germany

Please remove all non-original parts from the device.

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

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

**Information** — **Reason for return**

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

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

Unless otherwise agreed, the device is reset to the factory settings after inspection or repair.

**Information** — **Possible Consequential Damage**

In order to rule out the possibility that the cause of a device fault is due to an optional module, the connected optional modules should also be returned in case of a fault.

**Contacts (Phone)**

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

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

## 9.3 Abbreviations

| | |
|---|---|
| **AIN** | Analogue input |
| **AS-i (AS1)** | AS Interface |
| **ASi** (LED) | Status LED – AS interface |
| **ASM** | Asynchronous machine, asynchronous motor |
| **AOUT** | Analogue output |
| **AUX** | Auxiliary (voltage) |
| **BR** | Braking resistor |
| **DI (DIN)** **DigIn** | Digital input |
| **DS** (LED) | Status LED – device status |
| **CFC** | Current Flux Control (current-controlled, field-oriented control) |
| **DO (DOUT)** **DigOut** | Digital output |
| **I / O** | Input /Output |
| **EEPROM** | Non-volatile memory |
| **EMKF** | Electromotive force (induction voltage) |
| **EMC** | Electromagnetic compatibility |
| **FI** (switch) | Leakage current circuit breaker |
| **FI** | Frequency inverter |
| **I/O** | In / Out (Input / Output) |
| **ISD** | Field current (Current vector control) |
| **LED** | Light-emitting diode |
| **LPS** | List of planned slaves (AS-I) |
| **P1 …** | Potentiometer 1 … |
| **PMSM** | Permanent magnet synchronous machine / -motor |
| **PLC / SPS** | Programmable Logical Controller |
| **PELV** | Safety low voltage |
| **S** | Supervisor Parameter, P003 |
| **S1…** | DIP switch 1 … |
| **SW** | Software version, P707 |
| **TI** | Technical information / Data sheet (Data sheet for NORD accessories) |
| **VFC** | Current Flux Control (current-controlled, field-oriented control) |

# Key word index

**NORD DRIVESYSTEMS Group**

**Headquarters and Technology Centre**
in Bargteheide, close to Hamburg

**Innovative drive solutions**
for more than 100 branches of industry

**Mechanical products**
parallel shaft, helical gear, bevel gear and worm gear units

**Electrical products**
IE2/IE3/IE4 motors

**Electronic products**
centralised and decentralised frequency inverters,
motor starters and field distribution systems

**7 state-of-the-art production plants**
for all drive components

**Subsidiaries and sales partners**
**in 89 countries on 5 continents**
provide local stocks, assembly, production,
technical support and customer service

**More than 3,600 employees throughout the world**
create customer oriented solutions

**www.nord.com/locator**

**Headquarters:**

**Getriebebau NORD GmbH & Co. KG**
Getriebebau-Nord-Straße 1
22941 Bargteheide, Germany
T: +49 (0) 4532 / 289-0
F: +49 (0) 4532 / 289-22 53
info@nord.com, www.nord.com

**Member of the NORD DRIVESYSTEMS Group**

NORD® DRIVESYSTEMS

6072002 / 3118