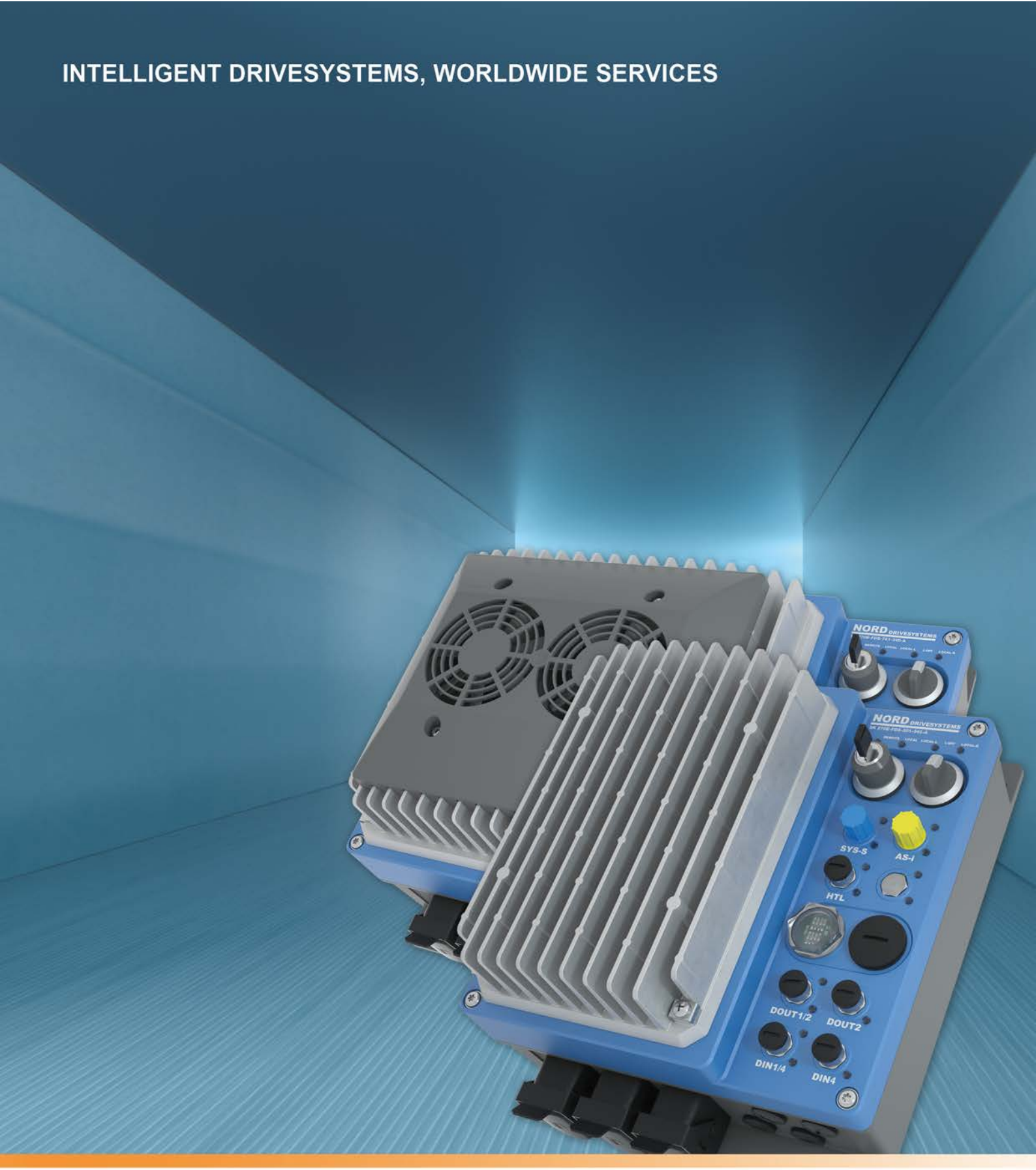
INTELLIGENT DRIVESYSTEMS, WORLDWIDE SERVICES



BU 0250 – en

NORDAC *LINK* (SK 250E-FDS ... SK 280E-FDS)

Users Manual for Frequency Inverters as Field Distributors

NORD® DRIVESYSTEMS

Documentation

Title:	**BU 0250**	
Order no.:	**6072502**	
Series:	SK 2xxE-FDS	
Device series:	SK 250E-FDS, SK 260E-FDS, SK 270E-FDS, SK 280E-FDS	
Device types:	*SK 2x0E-FDS-370-340-A … SK 2x0E-FDS-751-340-A*	0.37 – 7.5 kW, 3~ 380-500 V

Version list

Title, Date	Order number	Device software version	Remarks
BU 0250, July 2016	**6072502** / 2916	V 1.0 R0	First edition for pilot series inverters (field test)
BU 0250, July 2017	**6072502** / 2817	V 1.1 R2	• Names of option slots for control elements changed to H1, H2 and H3 • Technical data modified / supplemented • Power connection plug and M12 plug connector Correction of various pin connections • Parameters P420 / P434 / P480 / P481, functions 37, 42 supplemented • Parameters P745 / P746 supplemented • AS-i – Correction of various technical data • Braking resistors, technical data modified • CE Declaration of Conformity supplemented • Various other corrections
BU 0250, April 2018	**6072502** / 1618	V 1.1 R3	Including • General corrections • Adaptation of safety information • Revision of warnings and hazard notes • Inclusion of UL data • AS-Interface – “AXS” single slave supplemented • Supplementation and adaptation of electrical data • Connection accessories added • Adaptation of parameters: P107, 206, 208, 330, 331, 332, 333, 434, 481, 546, 558 • Update of EU Declaration of Conformity

Title, Date	Order number	Device software version	Remarks
BU 0250, September 2019	**6072502** / 3919	V 1.3 R0	Including • General corrections • Extension of the series with size 0 (0.37 kW and above) • “Plug-in EEPROM” option available • Adaptation of parameters: P245, 301, 420, 480, 434, 481, 504, 539, 558, 746 • New parameters: P336, 565, 780 • Update of EU Declaration of Conformity • Accessories (cables) added
BU 0250, September 2020	**6072502** / 3920	V 1.3 R0	Including • General corrections • “-ASS” features supplemented as option AS-Interface variant • Adaptation of UL plug connectors • Overview on the connection of an electromechanical brake extended
BU 0250, July 2021	**6072502** / 3021	V 1.3 R0	• Update “Standards and approvals” • Update of EU Declaration of Conformity • Addition of the energy efficiency levels according to the EU Ecodesign Regulation 1781

Table 1: Version list BU0250

Copyright notice

Publisher

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1 General

The SK 250E-FDS series is based on the tried and tested NORD platform. The frequency inverters are characterised by their compact design and optimum control characteristics, and have uniform parametrisation.

The frequency inverters have sensorless 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 power range is from 0.37 kW to 7.5 kW.

This series of frequency inverters can be adapted to individual requirements by means of modular assemblies.

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

Information

Accessories

The accessories that are mentioned in the manual are also subject to changes. Current details of these are included in separate data sheets, which are listed under 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 ...).

A typical feature of this frequency inverter series is their installation close to the motor, e.g. on the wall or on a machine frame.

All electrical connections (power connections and control connections) are made with plug connectors. This considerably simplifies the installation of the frequency inverter and opening the FI is not necessary.

In order to obtain access to all parameters, the internal RS232 interface (access via RJ12 connection) can be used. Access to the parameters is made e.g. via an optional SimpleBox or ParameterBox.

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

The device is configured according to the customer's individual requirements. The device equipment is therefore realised ex works. Later retrofittings of options or device conversions are not planned.

Information **The device must not be opened**

The device must not be opened at any time during its service life and does not need to be. All mounting, installation and commissioning works as well as normal operation are only done on the closed device.

- Assembly is done via freely accessible mounting holes.
- Electrical connection is exclusively established via plug connectors.
- Operational settings are made via parameter adjustments. Access for the connection of a parameterisation tool, for example, is via a blind plug. This blind plug may only be removed for work in connection with commissioning and must be properly replaced afterwards.
- Diagnostic LEDs for displaying switching and operating states are externally visible.

1.1 Overview

This manual describes all of the possible functions and equipment. The configuration and functionality are limited according to the type of device.

Basic characteristics

- High starting torque and precise motor speed control setting by means of sensorless current vector control
- Wall mounting close to the motor.
- Permissible ambient temperature -25 °C to 40 °C (please refer to the technical data)
- Integrated EMC mains filter for Class A limit values / Category C2
- Automatic measurement of the stator resistance and determination of the precise motor data
- Programmable direct current braking
- Built-in brake chopper for 4-quadrant operation, optional braking resistors (internal/external)
- Separate temperature sensor input (TF+/TF-) [a)]
- Evaluation of an incremental encoder via digital inputs [a)]
- NORD system bus for connecting additional modular assemblies [a)]
- Four separate online switchable parameter sets
- Diagnostic LEDs (incl. signal status DIs/ DOs)
- RS232/RS485 interface via RJ12 port, alternatively via USB
- 24 V DC control voltage
  - Must be provided via a plug connector, or
  - Can be provided by the FI (only with option –HVS).

    It is also possible to connect an external 24 V DC voltage supply via an optional plug connector in order to supply a high power peripheral (e.g. actuator).
- Integrated "POSICON" positioning control (📖 BU 0210)
- CANopen absolute value encoder evaluation via the NORD system bus [a)]
- Operation of *three-phase current **as**ynchronous **m**otors* (ASM) and ***P**ermanent **M**agnet **S**ynchronous **M**otors* (PMSM)
- Integrated PLC (📖 BU 0550)

a) Connection is only possible with optional plug connectors.

The differences between the individual versions (SK 250E / SK 260E / SK 270E / SK 280E) are summarised in the following table and will be described later in this manual.

Additional features

Feature	250E	260E	270E	280E
Number of digital inputs (DIN) [1) 2)]	5+2	5+2	5+2	5+2
Number of digital outputs (DO)	2	2	2	2
Number of analogue inputs (AIN) [1)]	2	2	2	2
Safe pulse block (STO / SS1) (📖BU0235)		x		x
AS Interface [3)]			x	x

1) Alternatively, the analogue inputs can also be used as digital inputs (not PLC-compatible).

2) If necessary, individual inputs can be defined at the factory by use of certain optional modules.

3) Double slave, supports the CTT2 protocol (5I / 6O) from the point of view of the device, 2nd slave: Parameter data and process data communication (📖 BU 0255)

Table 2: Additional features

Optional features

The FI can be individually adapted to the drive task. For this, a comprehensive selection of interfaces, plug connections and control elements are available, which can be used during the manufacture of the FI according to the customer's requirements.

Depending on the configuration, the meaning of the individual LEDs, function or assignment of individual plug connectors or the function of control elements (e.g. switches) may differ. The possible combinations will be illustrated and explained in the course of this manual. The individual configuration of the FI can be identified using the type plate and can be compared with the details in the manual.

1.2 Delivery

Examine the frequency inverter for transport damage or loose components **immediately** on delivery / unpacking.

In case of damage, contact the carrier immediately and arrange for a careful survey.

Important! This also applies 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 accessories and options which are explicitly intended for use with this device and stated in this manual.

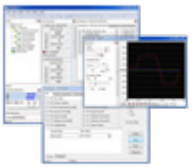
Standard version:

- IP65 version (with attached fan: IP55)
- Operating instructions as PDF file on CD ROM including NORD CON, (PC parametrisation software)

Configurable options and accessories:

	Designation	Example	Description
Control and parametrisation options	**Parameterisation units for temporary connection to the device, handheld**		For commissioning, parametrisation and control of the device **Type SK PAR-3H, SK CSX-3H** (📖 Section 3.2)
	NORDAC *ACCESS BT*		NORDAC *ACCESS BT* in combination with the NORDCON *APP* is used for the mobile parameterisation of the device. 📖 BU 0960
Interfaces	**IO Extensions**		Interfaces for extending the analogue and digital inputs and outputs. **Type SK CU4-IOE…** (📖 Section 3.3.1)
	Bus interfaces		Interfaces for integration into a field bus system (CANopen, DeviceNet, EtherCAT, Ethernet/IP, Powerlink, Profibus DP, Profinet IO, Profisafe) **Type SK CU4- …** (📖 Section 3.3.1)

Brake resistors	**Internal braking resistors**		Brake resistor for dissipating generated energy from the drive system by conversion into heat. Energy is generated by the braking processes, or by downward movement of loads, (🕮 Section 2.3.2.3)
	External braking resistors		Refer to: Internal braking resistors, however for wall mounting **SK BRW5- …** (🕮 Section 2.3.2.3)

Software (Free download)	**NORDCON** **Software** **MS Windows ®-based**		For commissioning, parametrisation and control of the device. See www.nord.com NORDCON
	NORDCON *APP*		NORDAC *ACCESS BT* in combination with the NORDCON *APP* is used for the mobile parameterisation of the device. 🕮 BU 0960
	ePlan macros		Macros for producing electrical circuit diagrams *In preparation*
	Device master data		Device master data/device description files for NORD field bus options NORD field bus files
	S7 standard modules for PROFIBUS DP and PROFINET IO		Standard modules for NORD frequency inverter See www.nord.com S7_Files_NORD
	Standard modules for the TIA portal for PROFIBUS DP and PROFINET IO		Standard modules for NORD frequency inverter *Available on request*

1.4 Safety, installation and application information

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, depending on their protection class, devices may have live bare components as well as 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. An optional mains connection outlet is also live.

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.

Power plug connectors must not be pulled out while they are connected to the power supply. 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 as well as the surfaces of power plug connectors may heat up to temperatures in excess of 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 personnel (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 according to 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. This information must always be observed even with inverters with a CE label. 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, inadequate earthing may result in electric shock, possibly with fatal consequences.

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.

Connection of the supply voltage may directly or indirectly set the inverter into operation. Contact with electrically live components will result in electric shock, possibly with fatal consequences.

All poles of cable 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)

The device is not approved for operation or maintenance work in potentially explosive environments (ATEX).

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 Device is live > 5min after removing mains voltage	**Danger** **Electric shock** The device contains powerful capacitors. Because of this, there may be a hazardous voltage for more than 5 minutes after disconnection from the mains. 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** 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. • Danger of injury due to local burns on contact. • Heat damage to adjacent objects 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** The device contains electrostatically sensitive components, which can be easily damaged by incorrect handling. Avoid all contact (indirect contact by tools or similar, or direct contact) with PCBs and their components.

1) Texts are written in English.

Table 3: 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	Label
CE *(European Union)*	Low Voltage	2014/35/EU	EN <v>T - Norm_CE_1</v> EN 60529 EN <v>T - Norm_CE_2</v> EN 63000 EN 61800-9-1 EN 61800-9-2	<v>T - Zertifikat_CE</v>	CE
	EMC	2014/30/EU			
	RoHS	2011/65/EU			
	Delegated directive (EU)	2015/863			
	Ecodesign	2009/125/EC			
	Regulation (EU) Ecodesign	2019/1781			
UL *(USA)*			UL <v>T - Norm_CE_1</v>	<v>T - Zertifikat_ULund CSA</v>	<v>B - Logo_c(UL)us </v>
CSA *(Canada)*			C22.2 No.274-13	<v>T - Zertifikat_ULund CSA</v>	
RCM *(Australia)*	F2018L00028		EN <v>T - Norm_CE_2</v>	<v>T - Zertifikat_RCM</v>	
EAC *(Eurasia)*	TR CU 004/2011, TR CU 020/2011		IEC <v>T - Norm_CE_1</v> IEC <v>T - Norm_CE_2</v>	<v>T - Zertifikat_EAC</v>	EAC

Table 4: Standards and approvals

1.6.1 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 7.3)

Information

Group fuse protection

The devices can be protected as a group via one common fuse (see below for details). Pay attention to compliance with the total currents and the use of correct cables and cable cross-sections. If the device is mounted close to the motor, this also applies to the motor cables.

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.

CSA: For Canada: ”Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code, Part I”.”

“Use 75°C Copper Conductors Only. Higher temperature ratings are acceptable."

„For installations according to Canadian National Standard C22.2 No. 274-13: For use in Pollution Degree 2 and Overvoltage Category III environments only.” or equivalent.”

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

“For NFPA79 applications only”

“The source shall be derived from a non-corner grounded type TN or IT AC source not exceeding 289 V phase to earth (or equivalent)”

Size	valid	description
1 - 2	For 480V - for 3 phase models only:	“Suitable For Use On A Circuit Capable Of Delivering Not More Than _____ rms Symmetrical Amperes, 500 (3-phase) Volts Max., When Protected by High-Interrupting Capacity, Current Limiting Class RK5 Fuses or faster, rated _____Amperes, and ____Volts”, as listed in [1)]. The short circuit rating (max. 65 000 A) is based on the connectors (Details listed below) and will be printed during production. Details listed in [1)]. “Suitable For Use On A Circuit Capable Of Delivering Not More Than _____ rms Symmetrical Amperes, ____ Volt maximum” (480V for 3-phase models), “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated _____ Amperes, and _____Volts”, as listed in [1)]. The short circuit rating (max. 65 000 A) is based on the Connectors (Details listed below) and will be printed during production. Details listed in [1)]. “Suitable For Use On A Circuit Capable Of Delivering Not More Than _____ rms Symmetrical Amperes, 500 Volt maximum”, “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated _____ Amperes, and 500 Volts”, as listed in [1)]. The short circuit rating (max. 20 000 A) is based on the Connectors (Details listed below) and will be printed during production. Details listed in [1)].
	Motor group installation (Group fusing):	“Suitable for motor group installation on a circuit capable of delivering not more than _____ rms symmetrical amperes, 500 (3-phase) V max, when Protected by High-Interrupting Capacity, Current Limiting Class RK5 Fuses or faster, rated max. 30 Amperes”. The short circuit rating (max. 65 000 A) is based on the Connectors (Details listed below) and will be printed during production. Details listed in [1)]. “Suitable for motor group installation on a circuit capable of delivering not more than _____ rms symmetrical amperes, 500 (3-phase) V max, when Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 30 Amperes and 500 Volts min.” The short circuit rating (max. 20 000 A) is based on the Connectors (Details listed below) and will be printed during production. Details listed in [1)]. “Suitable for motor group installation on a circuit capable of delivering not more than _____ rms symmetrical amperes, 480 (3-phase) V max, when Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 30 Amperes and respectively 480 Volts min.” The short circuit rating (max. 65 000A) is based on the Connectors (Details listed below) and will be printed during production. Details listed in [1)].

1) 📖 7.3

Information

Connector optional

Cat. No.	manufactured by	rated voltage	rated current	Fuse size		SCCR, RMS
09 12 003 3051 (HAN Q3/0-M) 09 12 003 3151 (HAN Q3/0-F)	HARTING ELECTRIC GMBH & CO KG	600 V	17 A (AWG 16) 21 A (AWG 14) 25 A (AWG 12) 30 A (AWG 10)			65 kA
09 12 006 3041 (HAN Q4/2 M) 09 12 006 3141 (HAN Q4/2 F)	HARTING ELECTRIC GMBH & CO KG	600 V	Power: 11 A (AWG 16) 14 A (AWG 14) 17 A (AWG 12) 25 A (AWG 10) 30 A (AWG 10, see Note 1) Signal: 2A (AWG 26)			65 kA
09 12 005 3001 (HAN Q5/0-M) 09 12 005 3101 (HAN Q5/0-F)	HARTING ELECTRIC GMBH & CO KG	600 V	11 A (AWG 16) 16 A (AWG 14)			65 kA
09 12 008 3001 (HAN Q8/0 M) 09 12 008 3101 (HAN Q8/0 F)	HARTING ELECTRIC GMBH & CO KG	600 V	11 A (AWG 16) 18 A (AWG 12)			65 kA
09 12 002 3051 (HAN Q2/0-M) 09 12 002 3151 (HAN Q2/0-F)	HARTING ELECTRIC GMBH & CO KG	600 V	19 A (AWG 16) 23 A (AWG 14) 25 A (AWG 12) 30 A (AWG 10)			65 kA
Han Q 4/0-m-crimp (09 12 004 3051) Han Q 4/0-f-crimp (09 12 004 3151)	HARTING ELECTRIC GMBH & CO KG	600 V	14 A (AWG 16) 18,5 A (AWG 14) 20 A (AWG 12) 30 A (AWG 10)			65 kA
QPD W 3PE2.5…M25	PHOENIX CONTACT GMBH & CO. KG	600 V	10 A (AWG 16) 15 A (AWG 14)		J, T, CC	5 kA
QPD 4P M25 WHQM	PHOENIX CONTACT GMBH & CO. KG	600 V	8 A (AWG 16) 12 A (AWG 14)		J, T, CC	5 kA
QPD W 4PE2.5…M25	PHOENIX CONTACT GMBH & CO. KG	600 V	10 A (AWG 14)		J	5 kA
P29036	AMPHENOL SINE SYSTEMS CORP	600 V	25 A (AWG 10)	30 A	J, T, CC, CB: 30A	65 kA
P29039	AMPHENOL SINE SYSTEMS CORP	600 V	30 A (AWG 10)	30 A	J, T, CC	65 kA

Note 1: The HAN Q4/2 can be used up to 30A with 3 wires connection (3 power / 1 grounding) only. This was tested during the evaluation. The 25 A rating is for 4 wires connection (4 power / 1 grounding / 2 signals).

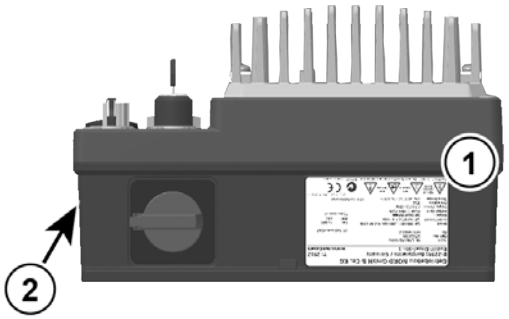
Note 2: The rated current depends on the conductor size of the field wiring.

1.7 Type code / nomenclature

The type code of the device depicts the basic features. A unique identification of the device including all customer-specific features is only possible via the device's order or serial number.

1.7.1 Type plate

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



(1)

Type:	SK 250E-FDS-301-340-A
	HWR-HVS-...
Part No.:	5050601-100
ID:	27Q303614961

Version:	AAA	1.0R0

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

(2) Two further plates which contain the supplementary electrical data for UL/CSA are affixed to the right hand side of the device.

First plate

This warning information is generally attached.

DANGER -The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted.
To reduce the risk of fire or electrical shock, current-carrying parts and other components, of the controller should be examined and replaced if damaged. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced..

Second plate

The second plate depends on the power plug connectors which are used.

Amphenol

SCCR: 65 kA, 500 V, BCP Fuse, Class CC, J, T
SCCR: 65 kA, 480 V, BCP CB
SCCR: 20 kA, 500 V, BCP CB

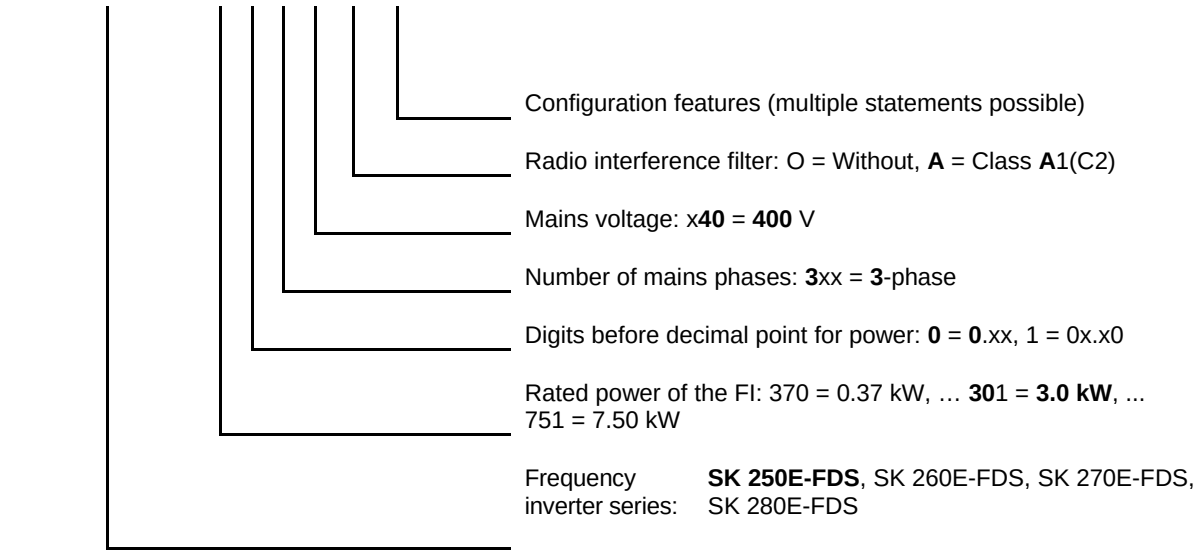
BCP Rating and further Short Circuit Rating
see manual

Suitable for group fusing
SCCR Group Installation:
same except BCP Fuse or CB rated max. 30 A

HARTING	**SCCR:** 65 kA, 500 V, BCP Fuse Class RK5 or faster **SCCR:** 65 kA, 480 V, BCP CB **SCCR:** 20 kA, 500 V, BCP CB BCP Rating and further Short Circuit Rating see manual Suitable for group fusing **SCCR Group Installation:** same except BCP Fuse or CB rated max. 30 A
Phönix	**SCCR:** 5 kA, 500 V, BCP Fuse, Class CC, J, T BCP Rating and further Short Circuit Rating see manual Suitable for group fusing **SCCR Group Installation:** same except BCP Fuse or CB rated max. 30 A

1.7.2 Field distribution type codes

SK 250E-FDS-301-340-A (-xxx)



Configuration code

	Meaning
-AS-i	Actuator-sensor interface with “AS-i” connector option
-ASS	Actuator-sensor interface with “ASS” connector option
-AUX	Actuator-sensor interface with “AUX” connector option
-AXS	Actuator-sensor interface with “AXS” connector option
-BRI	Integrated braking resistor
-BWRN	Integrated brake rectifier for controlling a 205 V DC brake
-EEP	Plug-in EEPROM for additional data backup
-FANO [1)]	Heat sink with attached fan (only for devices < 2.2 kW)
-HWR	Integrated brake rectifier for controlling a 180 V DC brake
-HVS	Integrated 24 V power supply
-TISTO	Internal STO input The digital output of an integrated fail-safe module (e.g. SK CU4-PNS) is connected to this input in order to trigger the function “Safe Torque Switch-off” (STO).
-TIDIO	With the aid of the -TIDIO option, the digital IOs of the frequency inverter are connected to the corresponding IOs of an SK CU4- installed in the FI.
-TIMSW	If the frequency inverter is equipped with a maintenance switch, the auxiliary contact of the maintenance switch (if present) can be integrated into the frequency inverter and evaluated (maintenance switch “Switch setting ON / OFF).
-USB	RS232/RS485 interface: USB port in place of the RJ12 port. **Note:** Parameter boxes cannot be connected to the USB port. In this case parameterisation and diagnosis is only possible via a PC with NORDCON software.

1) As standard, frequency inverters with powers > 1.5 kW are equipped with an attached fan. The equipment code (-FANO) is then not explicitly stated in the type code.

1.8 Power rating / Motor size

Size	Mains / output assignment
	3~ 380 – 500 V
Size 0	0.37 ... 0.75 kW
Size 1	1.1 ... 3.0 kW
Size 2	4.0 ... 7.5 kW

1.9 Version with protection class IP55 / IP65

Frequency inverters from the field distribution series SK 250E-FDS fulfil the following IP protection class:

- IP55: all inverters with mounted fans
- IP65: all inverters without mounted fans

There are no restrictions or differences to the scope of functionality in the stated protection classes.

Information **Cable routing**

For all versions, care must be taken that the cables and the cable glands comply at least with the protection class of the FI and attention is paid to compliance with the installation regulations.

2 Assembly and installation

No options can be retrofitted. All options must be recorded by NORD when ordering and before the production process. The customer must not open the device at any time and does not need to. The device is mounted by using mounting lugs that are freely accessible from the outside. The electrical connection of mains, motor and signal cables is only possible via respective plug connectors. The optionally available control elements (e.g. switches) are mounted in a freely accessible position.

Opening a defined blind plug is only required for the temporary connection of a diagnostic tool. The diagnostic tools comprise:

- Parameterisation unit SK CSX-3H/ SK PAR-3H
- NORDAC *ACCESS BT* with the NORDCON *APP*
- PC with the NORDCON software

2.1 Installation

The devices are designed for an installation close to the motor and do not need a control cabinet due to their protection class.

Distance from device: The devices require sufficient ventilation for protection against overheating and must therefore not be covered.

Mounting can be immediately next to each other.

The required distances for the connection cable routing must be maintained.

Installation position:
- Vertical, i.e. bottom position of cable connection (power connection)
- Horizontal, i.e. top position of control elements and diagnostic LEDs

See also the following illustration.

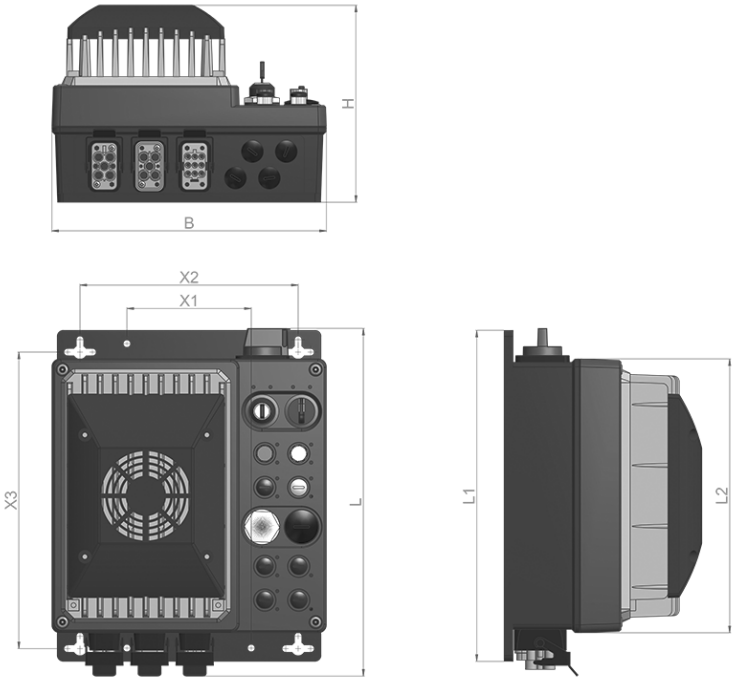
Dimensions:

The frequency inverters are supplied in various sizes depending on their output. Depending on the power and special equipment, the heat sink may be equipped with a fan. In general, size 0 is not available with a fan.

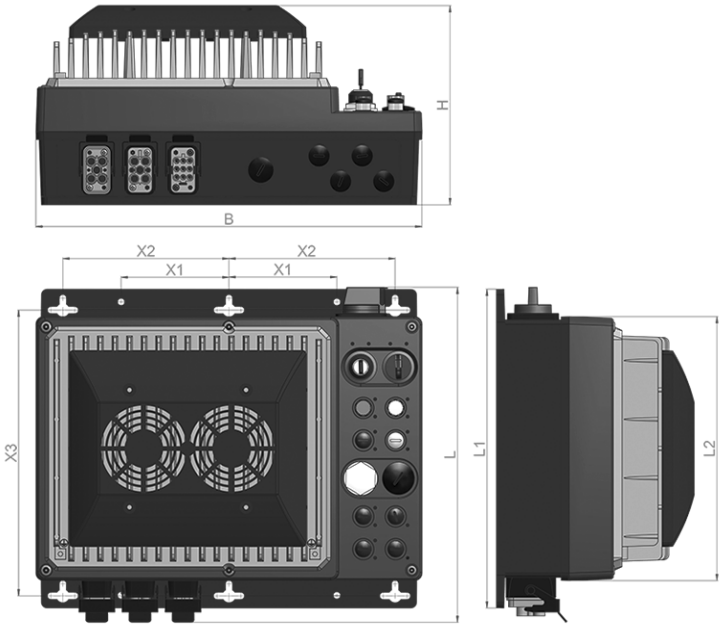
Power [kW]		Frequency inverter type SK 2xxE-FDS-…		Size	Housing dimensions					Wall mounting				Weight [3] (approx.)
by	to	by	to		B	H	L [2]	L1	L2	X1	X2	X3	∅	
0.37	0.75	370-340-…	750-340-…	0	243	130	312	294	243	110	193	263	5.5	3.8
1.1	1.5	111-340-…	151-340-…	1	243	155 [1]	312	294	243	110	193	263	5.5	4.6
2.2	3.0	221-340-…	301-340-…	1		175								4.8
4.0	7.5	401-340-…	751-340-…	2	358	184	312	294	243	100	154	263	5.5	6.8
					All dimensions in [mm]									[kg]

1) Without fan
2) Without maintenance switch 307 mm
3) Depending on configuration

Sizes 0 and 1



Size 2



2.2 Option slots and equipment versions

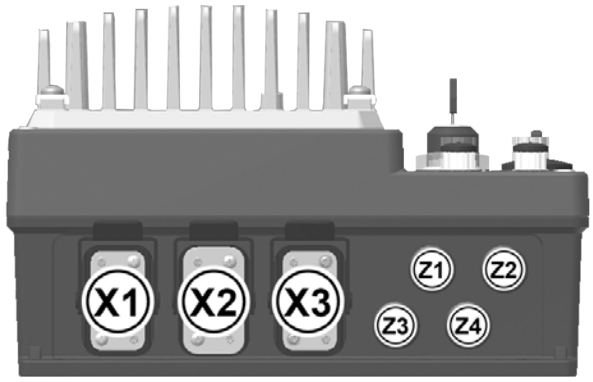
The device is configured according to the customer specification. No options can be retrofitted. All options must be recorded by NORD when ordering and before the production process.

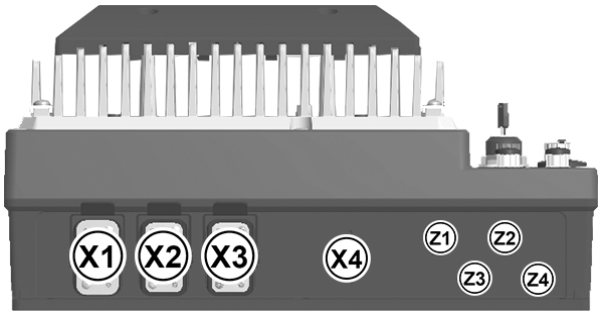
Defined positions on the device apply for the selected options and features. Dependencies between the selected options and on relevant signalling devices (LEDs) or parameter settings are explained in this instruction.

2.2.1 Option slots

The device is divided into 3 levels. Each of these levels is intended for the installation of certain options or option groups.

2.2.1.1 Connection level





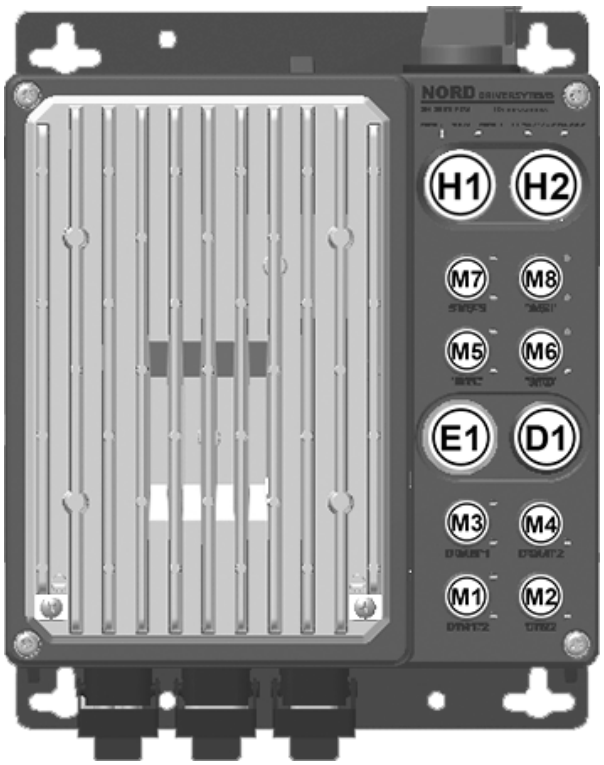
Position: bottom

The configuration and assignment of the power connections (mains and motor connections) depends on the customer's specification for the product.

This also applies for the additional option slots for the signal connections.

X1 = Power connection 1
… …
X4 = Power connection 4
Z1 =
… Additional signal connections
Z4 =

2.2.1.2 Control level



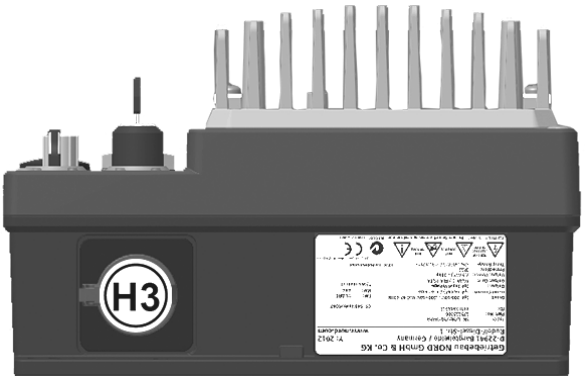
Position: front

The configuration and functions of the individual option slots are variable. They are directly influenced by the customer's specification, but are also indirectly dependent on the further features.

The meaning of the LEDs which are assigned for each option slot is also dependent.

D1 = Diagnostic opening
E1 = Status indicators (LEDs)
H1 = Control element 1
H2 = Control element 2
M1 =
… Signal connections
M8 =

2.2.1.3 Maintenance switch level



Position: top

The configuration and function of other option slots may be influenced by the maintenance switch.

H3 = Maintenance switch

2.2.2 Configuration variants

The field distribution frequency inverter is designed so that it can be configured according to the individual requirements of the drive application. Because of this, extensive interfaces are provided on the FI, which are exclusively implemented in the form of plug connectors. As with the equipment of the device, the arrangement of these interfaces also depends on the configuration of the FI and therefore differs greatly. Precisely one type of option can be selected for each option slot.

SK CU4- optional modules are used for the functional extension of the FI, for example with additional IOs or connection to a field bus system. Communication between this module and the inverter is implemented via the system bus. Via the option slots Z1 to Z4 the functions which are required by the customer are connected to the relevant M12 plug connectors.

The following tables illustrate which features can typically be combined and what influence these have on the relevant option slots.

For the use of initiators or actuators, the associated parameters and the relevant factory settings can be read out.

2.2.2.1 Configurable options

The following integrated features can be configured. Selection of the options must be made when the frequency inverter is ordered. Subsequent changes to the configuration are not possible.

	Meaning
-AS-i	Actuator-sensor interface with “AS-i” connector option
-ASS	Actuator-sensor interface with “ASS” connector option
-AUX	Actuator-sensor interface with “AUX” connector option
-AXS	Actuator-sensor interface with “AXS” connector option
-BRI	Integrated braking resistor
-BWRN	Integrated brake rectifier for controlling a 205 V DC brake
-EEP	Plug-in EEPROM for additional data backup
-FANO [1)]	Heat sink with attached fan (only for devices < 2.2 kW)
-HWR	Integrated brake rectifier for controlling a 180 V DC brake
-HVS	Integrated 24 V power supply
-TISTO	Internal STO input The digital output of an integrated fail-safe module (e.g. SK CU4-PNS) is connected to this input in order to trigger the function “Safe Torque Switch-off” (STO).
-TIDIO	With the aid of the -TIDIO option, the digital IOs of the frequency inverter are connected to the corresponding IOs of an SK CU4- installed in the FI.
-TIMSW	If the frequency inverter is equipped with a maintenance switch, the auxiliary contact of the maintenance switch (if present) can be integrated into the frequency inverter and evaluated (maintenance switch “Switch setting ON / OFF).
-USB	RS232/RS485 interface: USB port in place of the RJ12 port. **Note:** Parameter boxes cannot be connected to the USB port. In this case parameterisation and diagnosis is only possible via a PC with NORDCON software.

1) As standard, frequency inverters with powers > 1.5 kW are equipped with an attached fan. The equipment code (-FANO) is then not explicitly stated in the type code.

2.2.2.2 Configuration of option slots of the control level

The option slots **M1** to **M8** are designed for M12 plug connectors. The device-relevant assignment of the connections or functions of the individual option slots is directly printed on the option slot.

Option slot	Option type		Function	Relevant parameter	Comment
M1	a	No option			
	b	Initiator 1 / 4	DIN1	P420[-01]	Not available if **M5 c** has zero track. Set the function of the zero track in **P420[-01]**.
			DIN4	P420[-04]	
M2	a	No option			
	b	Initiator 4	DIN4	P420[-04]	
M3	a	No option			
	b	Actuator 1 / 2	DOUT1	P434[-01]	
			DOUT2	P434[-02]	
M4	a	No option			
	b	Actuator 2	DOUT2	P434[-02]	
M5	a	No option			
	b	Initiator 2 / 3	DIN2	P420[-02]	
			DIN3	P420[-03]	
	c	HTL encoder [1)]	HTL-A	P420[-02]	
			HTL-B	P420[-03]	
	d	System bus Master	SYSM		
M6	a	No option			
	b	Initiator 3	DIN3	P420[-03]	only SK 250E-FDS / SK 270E-FDS
	c	Safe stop	STO		only SK 260E-FDS / SK 280E-FDS
M7	a	No option			
	b	Initiator 6 / 7	AIN1 / DIN6	P400[-01] / P420[-06], P113	H1 / H2 only usable to a limited extent
			AIN2 / DIN7	P400[-02] / P420[-07], P113	
	c	System bus Slave or absolute encoder	SYSS		
M8	a	No option			
	b	Initiator 7	AIN2 / DIN7	P400[-02] / P420[-07], P113	only SK 250E-FDS / SK 260E-FDS, H1 / H2 only usable to a limited extent
	c	24 V DC supply [2)]	24VI		
	d	AS-Interface (“AUX“)	AUX		only SK 270E-FDS / SK 280E-FDS
	e	AS-Interface (“AS-i”)	ASI		
	f	AS-Interface (“AXS“)	AXS		
	g	AS-Interface (“ASS“)	ASS		

1) Encoder cable available on request If the encoder has a zero track, evaluation of the zero track is only via **DIN1**.

2) The 24 V DC control voltage can also be supplied via **M8 c** (AUX), **M8 f** (AXS) or the option slots **X1** or **Z1** … **Z4** of the connection level.

The device's control elements are located at the option slots **H1** and **H2**.

Different control elements can be selected. Depending on the selected combination, they can influence the functions of individual digital inputs. These functions are device-specific in the factory settings of the respective parameter.

Variant	Option slot H1 [1]		Option slot H2 [2]		Parameter function [3]		
	Type	Function	Type	Function	P420[-07]	P420[-06]	P420[-05]
0	-	/	-	/	{0}	{0}	{0}
1	I	L - A - R	-	/	{34}	{33}	{0}
2	I	L - A - R	IV	/ - Q	{34}	{33}	{12}
3	I	L - A - R	II	Sp1 - Sp2	{34}	{33}	{35}
4	II	A - L	-	/	{0}	{15}	{0}
5	II	A - L	II	Off - On	{0}	{37}	{33}
6	II	A - L	I	L - Off - R	{34}	{37}	{33}
7	II	A - L	II	Sp1 - Sp2	{0}	{33}	{12}
8	III	Q - A - L	-	/	{12}	{15}	{0}
9	III	Q - A - L	II	Off - On	{12}	{37}	{1}
10	III	Q - A - L	II	Sp1 - Sp2	{12}	{33}	{35}

Functions					
A	Automatic mode active	**L**	Manual mode active	**L**	Manual mode, Enable left
R	Manual mode, Enable right	**Off**	Manual mode, Not enabled	**On**	Manual mode, Enabled
Sp1	Speed 1 (value from P113 [-01])	**Sp2**	Speed 2 (value from P113 [-02])	**Q**	Fault acknowledgement

Operating option type	
I	Switch (left – centre – right), locking, switch or key switch version
II	Switch (centre – right), locking, switch or key switch version
III	Switch (left – centre – right), locking at centre and right, switch or key switch version
IV	Pushbutton

1) Influence on parameter functions of digital inputs DIN 6 / 7

2) Influence on parameter functions of digital inputs DIN 5 / 7

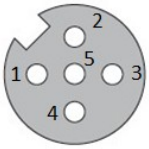
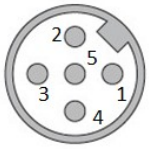
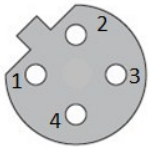
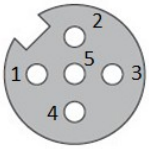
3) Variants for which the parameter functions are configured to the value {0} do not have a functional effect on the corresponding digital input. In these cases, corresponding analogue functions can be assigned via the respective alternative analogue input (also see previous table).

Plug connections for M12 plug connectors

Depending on the function, 5-pin M12 surface mounted plug connectors with coloured sockets or plug inserts are installed. The colours reflect the functional assignment of the plug connector and therefore enable easy identification on the FI. The same applies for the colour coding of the cover caps.

The following plug connectors may be used on the device, depending on the customer's specification.

Option slots M1 to M8

Function	Plug connector						Option slot	
	Contact diagram	Contact assignment						
		1	2	3	4	5	No.	Colour
DIN1 / DIN4	 Socket, A-coded	24 V	DIN4	GND	DIN1	PE	M1	BK
DIN2 / DIN3		24 V	DIN3	GND	DIN2	PE	M5	BK
DIN3		24 V		GND	DIN3	PE	M6	BK
DIN4		24 V		GND	DIN4	PE	M2	BK
DIN6 / DIN7		24 V	DIN7	GND	DIN6	PE	M7	BK
DIN7		24 V		GND	DIN7	PE	M8	BK
DOUT1 / DOUT2		24 V	DOUT2	GND	DOUT1	PE	M3	BK
DOUT2		24 V		GND	DOUT2	PE	M4	BK
AIN1 / AIN2		24 V	AIN2	GND	AIN1	+10 V Ref	M7	WH
AIN2		24 V		GND	AIN2	+10 V Ref	M8	WH
SYSM [1]			24 V	GND	CAN_H or SYS+	CAN_L or SYS-	M5	BU
STO [1]	 Plug connectors, A-coded			GND SH	24 V SH		M6	Yellow
SYSS [1]				GND	CAN_H or SYS+	CAN_L or SYS-	M7	BU
24VI		24 V		GND			M8	BK
ASI		ASI+		ASI-			M8	YE
ASS		ASI+		ASI-			M8	YE
AUX		ASI+	GND	ASI-	24 V		M8	YE
AXS		ASI+	GND	ASI-	24 V		M8	YE
HTL [1]	 Socket, B-coded	24 V	Track B	GND	Track A		M5	BK
HTL with zero track [1]	 Socket, A-coded	24 V	Track B	GND	Track A	Track -0	M5	BK

1) The plug connector's housing is internally wired to PE.

Information

Connection material, e.g. T-connectors for connection of double initiators, for looping an external 24 V DC supply or an STO signal, can be obtained commercially or can be obtained from NORD on request (see).

2.2.2.3 Configuration of option slots on the connection level

The connection level of the field distribution frequency inverter is divided into 2 areas.

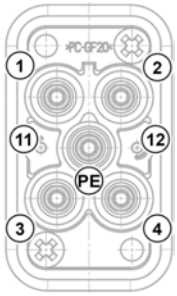
DANGER **Electric shock at X2**

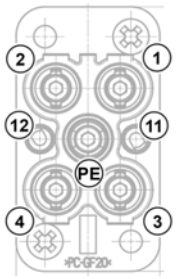
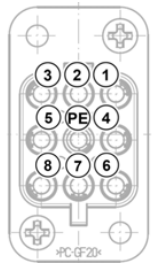
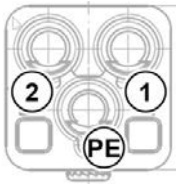
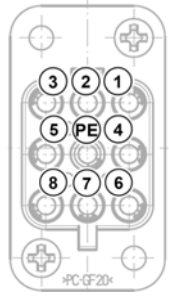
An optional **mains connection outlet** (**LA**) on option slot **X2** can also not be switched off with a repair and maintenance switch (option slot **H3**). This may therefore still be at mains voltage.

- Do not touch any contacts.
- Disconnect the device from the mains (mains supply, option slot **X1**).

Area 1, option slots X1 to X4

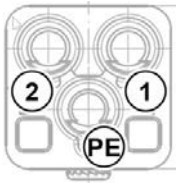
Typical machinery connectors are used. These are primarily used to connect the mains and motor cables. Special connector variants additionally ensure the connection of a PTC resistor or a 24 V DC supply or a brake resistor. The plug connectors are equipped with a detachable protective cap. **The mating connector is not included in the scope of delivery.**

Option slot	Plug connector type		Function		Contact assignment
X1	a	HARTING Q4/2+ (plug connector)	Mains connection (supply) 4 mm² / 25 A (24 V DC: 1.5 mm²) 6 mm² / 30 A (without 24 V DC!)	LE	 **1** L1 **2** L2 **3** L3 **4** N **PE** PE **11** 24 V DC **12** GND
	b	PHOENIX QPD-25 (plug connector)	Mains connection (supply) 2.5 mm² / 16 A	LE	 **1** L1 **2** L2 **3** L3 ⏚ PE

Option slot	Plug connector type		Function		Contact assignment
X2	a	-	No function		**Option slot not used**
	b	HARTING Q4/2+ (socket)	Mains connection (outlet) 4 mm² / 25 A (24 V DC: 1.5 mm²) 6 mm² / 30 A (without 24 V DC!)	LA	 **1** L1 **2** L2 **3** L3 **4** N **PE** PE **11** 24 V DC **12** GND
	c	PHOENIX QPD-25 (socket)	Mains connection (outlet) 2.5 mm² / 16 A	LA	 **1** L1 **2** L2 **3** L3 ⏚ PE
	d	HARTING Q8/0+ (socket)	Motor connection 2 (outlet) 4 mm² / 16 A	MA2	 **1** U **3** W **4** BR- **5** TF+ **6** BR+ **7** V **8** TF- **PE** PE
	e	HARTING Q2/0+ (socket)	Brake resistor 4 mm² / 25 A	BA	 **1** B+ **2** B- **PE** PE
X3	a	HARTING Q8/0+ (socket)	Motor connection 1 (output) 4 mm² / 16 A	MA	 **1** U **3** W **4** BR- **5** TF+ **6** BR+ **7** V **8** TF- **PE** PE

<table>
<tr><td>X4

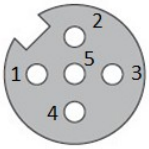
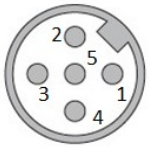
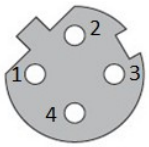
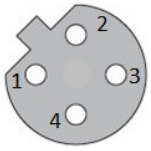
(size 2 only)</td><td>a</td><td>HARTING Q2/0+
(socket)</td><td>Brake resistor

4 mm^2 / 25 A</td><td>BA</td><td colspan="7"> 
</td></tr>
<tr><td colspan="5"></td><td>1</td><td>B+</td><td>2</td><td>B-</td><td>PE</td><td>PE</td><td></td></tr>
</table>

Area 2, option slots Z1 to Z4

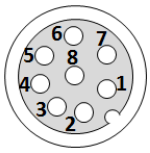
The option slots M1 to M8 are designed for M12 plug connectors. No fixed functions are allocated to the option slots. Primarily, these option slots are used to connect initiators, an integrated option of type SK CU4-… . However, if required they can also accept plug connectors for connecting other signal and control cables. **The mating plug connector is not included in the scope of supply.**

As the built-in plug connector cannot be adjusted during assembly, the use of **angled** cable plug connectors **is not recommended**.

Function	**Plug connector** [1]						**Option slot** [2]	
	Contact diagram	**Contact assignments**						
		1	**2**	**3**	**4**	**5**	**No.**	**Colour**
DIN1 / DIN2	 Socket, A-coded	24 V	DIN2	GND	DIN1	PE	Z3	black
DIN1		24 V		GND	DIN1	PE	Z3	black
DIN2		24 V		GND	DIN2	PE	Z4	black
AIN1 / AIN2		24 V	AIN2	GND	AIN1	+10 V Ref	Z1	white
AIN2		24 V	AIN2	GND		+10 V Ref	Z2	white
AOUT		24 V	AIN2	GND		+10 V Ref	Z1 - Z4	white
24VO		24 V		GND			Z1 - Z4	black
CAO (Bus-IN)		Schield	24 V	GND	CAN_H	CAN_L	Z1	gr
DEV (Bus-IN)		Schield	24 V	GND	CAN_H	CAN_L	Z1	gr
CAO-OUT (Bus-OUT)	 Plug connectors, A-coded		24 V	GND	CAN_H	CAN_L	Z2	gr
24VI		24 V		GND			Z1 - Z4	black
ETH (Bus-IN)	 Socket, D-coded	TX+	RX+	TX-	RX-		Z1	green
ETH (Bus-OUT)		TX+	RX+	TX-	RX-		Z2	green
PBR (Bus-IN)	 Plug connectors, B-coded		PBR A		PBR B		Z1 / Z2	violet
PBR (Bus-OUT)	 Socket, B-coded	5 V	PBR A	GND	PBR B		Z2 / Z1	violet

1) The housing of the plug connectors are internally wired to PE.

2) If 2 SK CU4-IOE modules are installed, or if an IO module is installed together with an SK CU4-… field bus module, the initiators and actuators are output via any of the option slots Z1 to Z4. (For detailed information refer to the order confirmation.)

Function	Plug connector [1]								Optional slot	
	Contact diagram	Contact assignment								
		1	2	3	4	5	6	7	8	No.	Colour
SIN-/COS (SIN-/COS encoder)	 Socket, A-coded	0 V	24 V	A	A\	B	B\	-	-	Z3	yellow
SI/SO (safe IOs)		0 V	24 V	SI1	SI2	SO1	SO2	T1	T2	Z4	yellow

1) The housing of the plug connectors are internally wired to PE.

2.2.2.4 Configuration of the option slot for the maintenance switch level

DANGER **Electric shock at X2**

An optional **mains connection outlet** (**LA**) on option slot **X2** can also not be switched off with a repair and maintenance switch (option slot **H3**). This may therefore still be at mains voltage.

- Do not touch any contacts.
- Disconnect the device from the mains (mains supply, option slot **X1**).

Option slot **H3** is intended for equipment with an optional repair and maintenance switch. Various versions (e.g. lockable/non-lockable) may be installed.

The repair and maintenance switch disconnects the supply to the device and therefore also the supply to the directly connected motor. For device versions which are intended for passing through the mains voltage, the daisy chain channel is not interrupted. The following devices are still supplied.

2.3 Electrical Connection

WARNING

Electric shock

Dangerous voltages may be present at the plug contacts for the power connections (e.g. mains cable, motor cable) even when the device is not in operation.

- Before starting work, check that all relevant components (voltage source, connection cables) 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.

Electrical connections are made exclusively with plug connectors.

2.3.1 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). The shielding or armouring of the cable must be earthed to the PE contact of the plug connector at the motor and the frequency inverter end.

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.

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.

2.3.2 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 (see 8.3 "Electromagnetic compatibility (EMC)").

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

Please note the following on connecting the device:

1. Ensure that the mains supply provides the correct voltage and is suitable for the current required (see 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 (supply – "**LE**"): on option slot **X1**
4. Motor cable connection ("**MA**"): on option slot **X3**
5. Optional
   a. Mains cable connection (outlet – "**LA**"): on option slot **X2**, or
   b. Motor cable connection (2. motor – "**MA2**"): on option slot **X2**

At least one four-core motor cable must be used and **U-V-W** and **PE** connected to the plug connector.

Information

Connection cables

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

2.3.2.1 Mains connection

No special fuses are required on the mains input side of the device. It is advisable to use mains fuses (see technical data) and a main switch or contactor.

Isolation from or connection to the mains must always be carried out synchronously and for all poles.

In the standard version, the device is configured for operation in TN or TT networks. The mains filter provides its normal effect and the resulting leakage current. A star point-earthed mains must be used.

Adaptation to IT networks – (from size **0**)

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 and therefore cause a risk of injury.

- 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 braking resistor to dissipate excess energy (e.g. internal braking resistor = Device with equipment code **-BRI**).
  Note: A braking resistor cannot be retrofitted. This must be taken into account when ordering the inverter.
- Ensure that the frequency inverter controller is ready for operation as necessary:
  – If a device with an integrated mains unit (device with equipment code **-HVS**) is used, the internal control unit, and therefore all monitoring functions switch on automatically.
  – If a device without an integrated mains unit (device without equipment code **-HVS**) 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 in an IT network, the FI must be configured with modification of the integrated mains filter. Modification of the mains filter is performed at the factory and must be taken into account in the order. Configuration for IT networks reduces the EMC.

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

Adaptation to HRG networks – (from size 0)

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).

2.3.2.2 Motor cable

The motor cable may have a **total length of 100 m** if it is a standard cable type (observe EMC). If a shielded motor cable is used or if the cable is installed in a metallic and well grounded duct, the total length should not exceed **20 m** (connect cable shield to PE at both ends).

Pre-assembled motor cables are available on request.

NOTICE!

Output switching

Switching a motor cable under load causes an impermissible increase of the 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 is no longer pulsing. 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 motors or several motors are connected in parallel to an FI, 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.

2.3.2.3 Brake resistor (B+, B-, PE)

During dynamic braking (frequency reduction) of a three-phase motor, electrical energy is returned to the inverter as necessary. An internal or external braking resistor can be used to avoid shut-down of the device due to overvoltage. With this, the integrated brake chopper (electronic switch) pulses the link circuit voltage (switching threshold approx. 720 V DC) into the brake resistor. The brake resistor converts excess energy into heat.

Internal braking resistor

Depending on the power of the inverter, brake resistors with the following key data are installed.

Installation of a brake resistor is optional. This is carried out at the factory and must therefore be taken into account in the order. Subsequent installation is not possible.

SK 2xxE-FDS-…	Resistance	Max. continuous output / limit [2] (P_n)	Power consumption [1] (P_{max})
…370-340- to …301-340-	400 Ω	100 W / 25 %	1.0 kWs
…401-340- to …751-340-	200 Ω	200 W / 25 %	2.0 kWs

1) Maximum once within 10 s [2]

2) In order to prevent non-permissible heating of the device, the continuous power is limited to 1/4 of the rated power of the brake resistor.
This also has a limiting effect on the energy consumption.

External braking resistor

If greater braking powers are to be expected, these can only be dissipated with an **external** brake resistor. A corresponding plug connection is then provided on option slot **X2** or **X4** (only Size 2).

The plug connector is installed at the factory and must therefore be taken into account in the order. Subsequent installation is not possible.

For the dimensioning of an external brake resistor, the electrical specifications (📖 Section 7 "Technical data") must be complied with in order to prevent damage to the inverter or the brake resistor due to overload.

A short, screened connection should be selected.

SK BRW5-…	Resistance	Max. continuous power (P_n)	Energy consumption [1] (P_{max})	Part No.	Document
…1-300-225	300 Ω	225 W	4.0 kWs	278281070	TI 278281070
…2-150-450	150 Ω	450 W	8.0 kWs	278281071	TI 278281071

1) maximum once within 120 s [2]

Connection of the braking resistor to the frequency inverter is made with one of the following optionally available connection cables.

Designation	Cable length	UL approval	Document
SK CE-HQ2-K-BRW5-OE-2_0M	Approx. 2.0 m	No	TI 275274881
SK CE-HQ2-K-BRW5-OE-2UL	Approx. 2.0 m	Yes	TI 275274280
SK CE-HQ2-K-BRW5-OE-3UL	Approx. 3.0 m	Yes	TI 275274281

Information **External braking resistor**

A combination of external and internal brake resistors is not possible.

Connection of an external brake resistor to option slot **X2** prevents the possibility of daisy chain wiring (looping of the mains voltage).

2.3.2.4 Electromechanical brake

For the control of an electromechanical brake, the device generates an output voltage provided at the motor plug's contacts (BR+ and BR-). The DC voltage level depends on the selected option. The following options can be selected:

"Integrated brake rectifier" option	Mains voltage (AC)	Brake coil voltage (DC)
-	-	No brake connection possible
HWR	400 V ~	180 V =
HWR	480 V ~	205 V =
BWRN [1)]	400 V ~	205 V =
BWRN [1)]	480 V ~	250 V =

1) Mains connection-side: N connection required!

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

Information

Parameter P107/P114

When connecting an electromechanical brake to the respective terminals of the device, you need to adjust the parameters **P107** and **P114** ("Brake reaction time" and "Brake delay off"). Set value ≠ 0 in parameter **P107** to avoid damages in the brake control.

2.3.3 Electrical connection of the control unit

Connection of the control cables is made exclusively via M12 plug connectors. The plug connectors are permanently installed at the factory. These enable the use of straight connectors, and at option slots **M1** to **M8** angled (encapsulated) cable plug connectors. The use of cable plug connectors assembled by the customer must be checked in individual cases.

24 V DC control voltage

The FI requires a 24 V DC control voltage for operation. Depending on the device, this control voltage can be provided in various ways:

- Integrated switched mains unit (equipment code **–HVS**),
- External connection via M12 plug connector (option slot **M8**),
- External connection via M12 plug connector (option slots **Z1 - Z4**),
- External connection via power plug connector (option slot **X1**).

Frequency inverters with the option **–HVS** typically do not require an external 24 V DC connection. If however such a device also has an optional 24 V DC connection facility, this can be used without danger. In this case the external 24 V DC supply supports the integrated switched mains unit. In particular this covers the requirements of powerful actuators which are controlled by the FI.

Devices which are not equipped with the **–HVS** option must be supplied via an external 24 V DC voltage source.

Information **Control voltage overload**

An overload of the control unit by impermissibly high currents may destroy it. Impermissibly high currents occur if the actual drawn total current exceeds the permissible total current.

If necessary, 24 V can be drawn from multiple terminals. This also includes e.g. digital outputs or a control module connected via RJ12.

The drawn total currents must not exceed the following limit values:

Device type	Size		
	0	1 [1)]	2 [1)]
Device with integrated power supply unit (“-HVS” device option) for SK 270E and SK 280E with “-AUX” option, even if the supply is exclusively via the yellow cable.	350 mA	280 mA / 350 mA	280 mA / 420 mA
Note: If additional control voltage is present, e.g. “-AUX” or “-AXS” option, adjacent currents may be drawn. It must, however, be ensured that the integrated power supply unit is not overloaded when there is no more external voltage.	540 mA	470 mA / 540 mA	370 mA / 510 mA
Device without power supply unit (without “-HVS” device option), external connection of control voltage for SK 270E and SK 280E with “-AUX” option, even if the supply is via the black and yellow cables Note: For AS-i, applicable for “-AUX” or “-AXS” device option	540 mA	470 mA / 540 mA	370 mA / 510 mA
Device without power supply unit (with “-AS-i” or “-ASS” device option and without “-HVS” device option), SK 270E and SK 280E with “-ASI” option, the supply is exclusively via the yellow cable.	210 mA	140 mA / 210 mA	40 mA / 180 mA

1) with fan / without fan on the heat sink

Information

Response time of digital inputs

The response 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

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.

Alternatively: Use a hybrid cable with shielding of the control lines.

2.3.3.1 Control connection details

Meaning, Functions	Description / Technical data		
Contact (designation)	Meaning	Parameter No.	Function of factory setting
Digital outputs	Signalling of the operating statuses of the FI		
	according to EN 61131-2 24 V DC With inductive loads: Provide protection via free-wheeling diode!	Maximum load 50 mA	
DOUT1	Digital output 1	P434 [-01]	No function
DOUT2	Digital output 2	P434 [-02]	No function

Information for bus control:
The digital outputs can be set with the user bits in the control word.
DOUT1: P480 [-11] = Control word Bit 8
DOUT2: P480 [-12] = Control word Bit 9

Analogue inputs	Actuation of device by external controller, potentiometer or similar.		
	Resolution 12Bit U= 0 …10 V, R_i=30 kΩ I= 0/4 … 20 mA Maximum permissible voltage at analogue input: 30 V DC	Matching of the analogue signals is performed via P402 and P403. *+ 10 V Reference voltage:* 5 mA not short-circuit resistant **Note!** A burden resistor (250 Ω) must be set for setpoint current values. This is carried out at the factory. Subsequent changes are not possible.	
10V REF	+ 10 V Reference voltage	-	-
AIN1+	Analog input 1	P400 [-01]	No function
AIN2+	Analog input 2	P400 [-02]	No function
GND	Reference potential GND	-	-

Digital inputs	Actuation of device via an external controller, switch or similar, connection of HTL transmitter (DIN2 and DIN3 only) The factory settings of digital inputs DIN5 to DIN7 depend on the configuration of option slots H1 and H2.		
	DIN1-5 according to EN 61131-2, type 1 Low: 0-5 V (~ 9.5 kΩ) High: 15-30 V (~ 2.5 - 3.5 kΩ) *Scan time:* 1 ms *Reaction time:* 4 - 5 ms	*Input capacitance* 10 nF (DIN1, DIN4, DIN5, DIN6, DIN7) 1.2 nF (DIN2, DIN3) *Limit frequency* (only DIN2 and DIN3) Min.: 250 Hz, Max.: 205 kHz	
DIN1	Digital input 1	P420 [-01]	No function
DIN2	Digital input 2	P420 [-02]	No function
DIN3	Digital input 3	P420 [-03]	No function
DIN4	Digital input 4	P420 [-04]	No function
DIN5	Digital input 5	P420 [-05]	(📖 Section 2.2.2.3)
DIN6 / AIN1	Digital input 6	P420 [-06]	
DIN7 / AIN2	Digital input 7	P420 [-07]	

Digital inputs	Actuation of device using an external controller, switch or similar.		
	DIN1-5 according to EN 61131-2, type 1 low: 0-5 V (~ 9.5 kΩ) high: 15-30 V (~ 2.5 - 3.5 kΩ) *Scan time:* 1 ms *Response time:* 4 … 5 ms	*Input capacitance* 10 nF (DIN1, DIN4) 1.2 nF (DIN2, DIN3) *Limiting frequency* (only DIN2 and DIN3) min.: 250 Hz, max.: 205 kHz	
DIN1	Digital input 1	P420 [-01]	No function
DIN2	Digital input 2	P420 [-02]	No function
DIN3	Digital input 3	P420 [-03]	No function
DIN4	Digital input 4	P420 [-04]	No function

Notes for DIN6 and DIN7:
Digital inputs DIN6 and DIN7 depend directly on analogue inputs AIN1 and AIN2. This means that the digital functions can only be used if the analogue functions are disabled (corresponding to the factory setting).

PTC resistor input	Monitoring of motor temperature using PTC		
	The motor´s PTC resistor (TF) is connected via the Q8 motor connection. Use a shielded cable.	Connect a temperature sensor to put the device into operation mode. As an alternative, you can deactivate the input function. In this case, however, the thermal monitoring of the motor is no longer possible.	
TF+	PTC resistor input +	P425	On
TF-	PTC resistor input -		

Control voltage source	Control voltage from the inverter, e.g. as power supply for accessories		
	24 V DC ± 25 %, short circuit-proof	Maximum load [1]	
VO / 24V	Voltage output	-	-
GND / 0V	Reference potential GND	-	-

1) See "Total currents" information (🕮 Section 2.3.3 "Electrical connection of the control unit")

Control voltage source	Control voltage from device e.g for supply of accessories
	24 V DC ± 25%, short-circuit protected
VO/ 24V	Voltage output
GND/ 0V	Reference potential GND

Control voltage connection	Supply voltage for the FI		
	24 V DC ± 25 % 200 mA … 800 mA, depending on load of inputs and outputs and use of options	With option (-HVS): Automatic changeover between the external supply via the connection plug and internal mains unity if the connected control voltage is insufficient.	
24V	Voltage input	-	-
GND / 0V	Reference potential GND	-	-

Control voltage connection	Supply voltage for the device
	24 V DC ± 25%, min. 380 mA
24 V	Input voltage
GND/ 0V	Reference potential GND

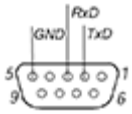
System bus	NORD-specific bus system for communicating with other devices (e.g. intelligent option modules or frequency inverters)		
	Up to four frequency inverters (SK 2xxE, SK 1x0E, SK 2xxE-FDS) can be operated on a single system bus.	→ Address = 32 / 34 / 36 / 38	
SYS H	System bus+	P509/510	Control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

Brake actuation	Connection and actuation of an electromechanical brake. The FI generates an output voltage for this, which depends on the mains voltage. The assignment of the correct brake coil voltage must be taken into account in the selection.		
	Connected loads: (🕮 Section 2.3.2.4) Current: ≤ 500 mA	Permissible switching cycle time: to 150 Nm ≤ 1/s to 250 Nm ≤ 0.5/s	
BR+	Brake control	P107/114	0 / 0
BR-	Brake control		

AS Interface	Control of FI via the simple field bus level: Actuator/sensor interface		
	Electrical data: See 🕮 4.5.2 "Features and technical data"		
ASI+	ASI+	P480 …	-
ASI-	ASI-	P483	-

Functional Safety "Safe Stop"		Fail-safe input		
		Details: BU0235, “Technical data”	The input is always active. In order to make the FI ready for operation, this input must be provided with the required voltage.	
24V SH		24 V input	-	-
GND SH		Reference potential	-	-

Communication interface		Device connected to different communication tools		
		24 VDC ± 20%	*RS 485 (*For connecting a parametrisation box) 9600 … 38400 Baud *Terminating resistance* (1 kΩ) fixed *RS 232 (*For connecting to a PC (NORD CON)) 9600 … 38400 Baud	
1	RS485 A+	Data cable RS485	P502… P513 [-02]	 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 *Part number:* 275274604 Suitable for connection to a USB port in a PC or alternatively to a SUB-D9 connection. Details: 🕮 TI 275274604		

Communication interface		Connection of the device to a PC (alternative to RJ12 interface) for communication with the NORDCON software		
		USB 2.0	*RS 232* 9600 … 38400 Baud	
1	+5V	Supply voltage	P502… P513 [-02]	
2	Data -	Data cable		
3	Data +	Data cable		
4	GND	Bus signal reference potential		

2.3.3.2 Basic control unit configuration

The frequency inverter is preconfigured at the factory, depending on the equipment of the device. This includes:

- Specific factory settings of parameters P420[-05], [-06] and [-07]
- Setting of the termination resistors on the system bus:

  If the system bus is used, it must be terminated on both sides. This can be done at the factory by setting suitable termination resistors inside the FI.
  If the termination resistors are not set at the factory, termination can alternatively be carried out during commissioning by means of normal termination resistors (CAN termination resistor, 5-pin M12 plug connector). For this, a suitable termination resistor must be plugged into the M12 plug connector (SYSM) at the beginning and end of the system bus.

2.4 Colour and contact assignments for the incremental encoder (HTL)

Function	Wire colours, for incremental encoders	Assignment for SK 2xxE-FDS
24V supply	brown / green	24V (VO)
0V supply	white / green	0V (GND)
Track A	brown	DIN2
Track A inverse (A /)	green	
Track B	grey	DIN3
Track B inverse (B /)	pink	
Track 0	red	(DIN1)
Track 0 inverse	black	
Cable shield	Connect to the "PE" contact of the plug connector.	

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

For the use of an encoder, parameters (P300) or (P600) must be activated according to requirements (speed feedback / servo mode or positioning).

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".

3 Display, operation and options

⚠ WARNING

Electric shock

Touching the circuit board below the transparent screw cap on option slot **E1** can result in an electric shock which may cause serious or fatal injury.

- The screw cap for option slot **E1** must only be opened when the frequency inverter is switched off.
- After switching off the frequency inverter wait for at least 5 minutes before opening the screw cap.

The FI is equipped with LED indicator lights LED indicator lights are directly assigned to the option slots H1 and H2 as well as to M1 to M8. These are used to indicate the signal statuses of the relevant option slot. In addition, on option slot E1 there are further, externally visible LED indicator lights for status messages.

Alphanumeric display and control modules (🕮 Section 3.2 "Control and parametrisation options ") can be used for simple commissioning by changing parameters. For more complex tasks, connection to a PC system can take place with the aid of the NORD CON parameterisation software.

Connection of such a parameterisation option is made via option slot D1. The screw cap must be removed for this. Communication is via RS 232 or RS 485 to an RJ12 connection (standard). Alternatively, a USB port can be installed as an alternative to the RJ12 connection. However, in this case it is only possible to connect a PC system for use of the NORDCON software.

3.1 Displays

LED display version	Use/Meaning
Yellow – single colour – static	Indication of the signal status (“ON” / “OFF”) or the associated function of the IOs.
Red/Green – single or dual colour – static or dynamic	Indication of operating statuses on the inverter or communication level.

H1 and H2

- If **switching options** are used, the LEDs indicate the corresponding switch setting (left/right). If the switch is in centre position, the LEDs are off (**Yellow** colour)
- Option slot H2: If an illuminated pushbutton is installed here (optional), the LED signals for “Device status/Error” (see option slot E1) are also displayed via this button.

M1 to M8

- If **initiators or actuators** are used, the LEDs indicate the corresponding signal statuses (high/low).
  (**Yellow** colour)
  The options slots M1, M3, M5 and M7 are basically intended for double occupancy.
  – Lower LED: Signal status first input or output (e.g. DIN1)
  – Upper LED: Signal status second input or output (e.g. DIN2)
  The options slots M2, M4, M6 and M8 are intended for single occupancy.
  – Lower LED: Signal status input or output (e.g. DIN2)
- If used for **bus communication via AS-Interface**, the LEDs of option slot M8 indicate the operational statuses of the corresponding slave.
  – Lower LED: A slave
  – Upper LED: B slave
  (**Red/Green** colour, dual)

E1

Option slot E1 is closed with a transparent screw cap. The LED status indicator lights which are installed in this option slot act as diagnostic LEDs and are therefore always visible.

1. Device status/error: The LED indicates the operating status of the device. (colour **red / green**, dual)
2. CU4 status/error: The LED indicates the operating status of an installed SK CU4-…. customer interface.
   (colour **red / green**, dual)
3. System bus status: The LED indicates the communication status of the system bus.
   (colour **green**)
4. System bus error The LED indicates an error on the system bus.
   (colour **red**)

Diagnostic LEDs

LED			Signal status		Meaning
No.	**Colour**	**Description**			
1	Dual Red/green	Device status	Off		Device is not ready for operation, • no mains or control voltage
			Green On		Device is enabled (inverter is working)
			Flashing green	0.5 Hz	Device is ready to switch-on, but not enabled
				4 Hz	Device is in switch-on inhibit
			Red/green Changing	4 Hz	Warning
				1…25 Hz	Overload level of the switched on device
			Flashing red		Error, Flashing frequency = error code (group) (e. g.: 3 x flashing = E003)

LED			Signal status		Meaning
No.	**Colour**	**Description**			
2	Dual Red/green	CU4 status	Off		Module (SK CU4-…) not ready for operation, • no control voltage • no SK CU4-… module installed Note: If a type SK CU4-IOE module is installed, the LED also remains off.
			Green On		Cyclic process data traffic in operation Details: P173, bit 1
			Flashing green	2 Hz	The module is initialised, there is no cyclic process data traffic. Details: P173, bit 0
			Flashing red	Flash (1 x 0.25 s every 2.5 s)	• SK CU4-EIP, -ECT, -POL: "Timeout external bus" • SK CU4-CAO: "Timeout node guarding (watchdog NMT master)" • SK CU4-PBR: "Timeout node guarding (watchdog PROFIBUS DP master)" • SK CU4-DEV: "Timeout (DeviceNet monitoring or time set in parameter P151") • SK CU4-PNT: "PROFINET Timeout" Details: for SK CU4-PNT: P173 bit 4-6, otherwise P173, bit 2
				Double flash (2 x 0.25 s every 2.5 s)	• SK CU4-EIP, -ECT, -POL, -CAO, -PBR: "Timeout according to P151” • SK CU4-CAO: "Incorrect DIP switch setting“ • SK CU4-PNT: – "Process data (CTW) timeout" – "Hardware error CAN" – "Hardware error IO" Details: for SK CU4-PNT: P173 bit 4-6, otherwise P173, bit 3
				2 Hz	• SK CU4-EIP, -ECT, -POL: "ASIC not accessible“ • SK CU4-CAO, -DEV: „Warning“ • SK CU4-PBR: „Bus interface system error“ Details: P173, bit 4
			Red On		• SK CU4-EIP, -ECT, -POL: "General configuration error“ • SK CU4-CAO, -DEV: „Bus OFF“ Details: P173, bit 5

LED			Signal status		Meaning
No.	Colour	Description			
3	Green	System bus State	Off		No process data communication
			Flashing	4 Hz	„BUS warning“
			On		Process data communication active • Receipt of at least 1 telegram / s • SDO data transfer is not displayed
4	Red	System bus Error	Off		No error
			Flashing	4 Hz	Monitoring error P120 or P513 • E10.0 / E10.9
			Flashing	1 Hz	Error in an external system bus module • Bus module → timeout on the external BUS (E10.2) • System bus module has a module error (E10.3)
			On		System bus in state “Bus OFF”

3.2 Control and parametrisation options

There are different control options available, installed on the option slots **H1** and **H2**. The required control options and their functions must be selected upon ordering or during the configuration process (🕮 2.2.2.2 "Configuration of option slots of the control level"). Retrofitting is not possible.

Parameterisation units furthermore allow for an access to and the adjustment of the device's parametrisation.

Designation		Material No.	Comment
Control and parameterisation units (handheld)			
SK CSX-3H	SimpleBox	275281013	🕮 BU 0040
SK PAR-3H	ParameterBox	275281014	🕮 BU 00040
SK TIE5-BT-STICK	NORDAC *ACCESS BT* Bluetooth stick	275900120	🕮 BU 0960

3.2.1 Control and parameterisation units, use

With an optional SimpleBox or ParameterBox all parameters can be conveniently accessed, read out or adjusted. The changed parameter data are stored in the non-volatile EEPROM memory.

Up to five complete device data sets can be stored and accessed in the ParameterBox.

SimpleBox or ParameterBox can be connected to the device via an RJ12-RJ12 cable.

Figure 1: SimpleBox, handheld, SK CSX-3H

Figure 2: ParameterBox, handheld, SK PAR-3H

Module	Description	Data
SK CSX-3H (SimpleBox handheld)	Used for commissioning, parameterisation, configuration and control of the device [1)].	• 4-digit 7-segment LED display, membrane button • IP20 • RJ12-RJ12 cable (connection to the device [1)])
SK PAR-3H (ParameterBox handheld)	Used for commissioning, parameterisation, configuration and control of the device and its options (SK xU4-…). Complete data sets can be stored.	• 4-line LCD display, backlight, membrane button • Stores up to five complete parameter data sets • IP20 • RJ12-RJ12 cable (connection to the device) • USB cable (connection to PC)
1) Does not apply for option modules, e.g. bus interfaces		

Connection

1. Remove the diagnostics glass of the RJ12 socket.

2. Establish RJ12-RJ12 cable connection between control unit and Frequency Inverter.

   As long as a diagnostics glass or a blind plug is open, make sure that no dirt or moisture enters the device.

3. After commissioning for regular operation, **reinsert all diagnostics glasses or blind plugs** and pay attention to **sealing**.

Information

Diagnostic caps' tightening torques

The tightening torque for the transparent diagnostic caps (inspection glasses) is 2.5 Nm.

3.2.2 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.

In order to integrate an SK 2xxE-FDS frequency inverter into a system bus, the option slots M7, and if necessary M5 must be equipped with the appropriate SYSS (M7) or SYSM (M5) plug connectors.

3.3 Optional modules

3.3.1 SK CU4-… optional modules

As so-called internal control terminals, SK CU4- optional modules enable the scope of functions of the FIs to be extended without changing the size. The FI provides two slots for installation of the corresponding modules. These modules are selected in the order as part of the configuration process for the FI. Retrofitting is not possible.

The following combinations are possible.

Variant	Optional modules	Installation slot
1	Bus interface	1
	IO extension	2
2	IO extension (1)	1
	IO extension (2)	2
3	Fail-safe bus interface (SK CU4-PNS) [1)]	1+2

1) This option module requires both installation slots and therefore cannot be combined with other optional modules.

Figure 3: SK CU4 … optional modules as internal control terminals (example)

Designation *)		Material 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)
SK CU4-PNS	PROFIsafe	275271014	TI 275271014
IO -Extensions			
SK CU4-IOE(-C)		275271006 / (275271506)	TI 275271006 / TI 275271506
SK CU4-IOE2(-C)		275271007 / (275271507)	TI 275271007 / TI 275271507

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

3.3.2 Optional plug-in EEPROM

The plug-in EEPROM (equipment code **-EEP**) is operated in parallel with the frequency inverter EEPROM and is primarily used for data backup. In the event of a defect in the frequency inverter the data (parameter data, PLC program) of the defective frequency inverter can be copied to an identical replacement device to minimise downtime.

Information

Operation of the frequency inverter without the plug-in EEPROM is possible without restriction.

Data transfer is not monitored and there is no comparison of data between the internal and the plug-in EEPROM.

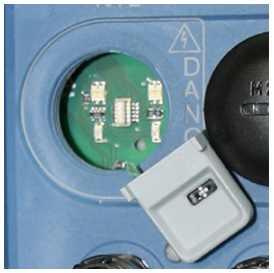
Disassembly / assembly

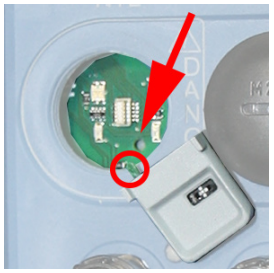
DANGER

Electric shock

The PCB below the transparent screw cap (EEPROM cover) is at the potential of the DC link circuit (approx. ½ UZW = 500 V DC). Touching the PCB or its components will result in an electric shock.

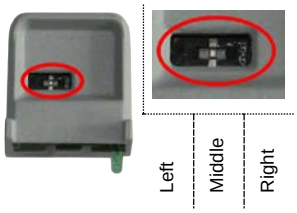
- Only remove the transparent screw cap when the frequency inverter is switched off and it has been established that no voltage is present.
- Only put the frequency inverter into operation again after the transparent screw cap has been correctly fitted.

1.	**Disconnecting the frequency inverter from the low voltage and checking the absence of voltage in the device**
Removing the EEPROM	
2.	Remove the transparent screw cap. 
3.	Pull off the EEPROM Continue with step 5 if the frequency inverter is to be operated without a plug-in EEPROM. 

EEPROM installation	
4.	Position the EEPROM so that its coding pin can be inserted into the circular recess in the PCB (see arrow). Insert the EEPROM vertically (perceptible locking). 
5.	Replace the transparent screw cap (with sealing ring) (tightening torque: 2.5 Nm). 

Function

The EEPROM is equipped with a 3-stage DIP switch. This can be used to set the function of the EEPROM. The DIP switch can be adjusted with the aid of a small flat-tip screwdriver.



An LED which indicates the present operating state of the plug-in EEPROM can be seen on the top of the housing of the plug-in EEPROM.

DIP switch Left position (coding pin pointing downwards)

	Function sequence	**LED**
	After starting the frequency inverter the data are copied once from the frequency inverter to the EEPROM.	Alternately flashing **red / green**
	After this, the plug-in EEPROM switches to operation in parallel with the internal EEPROM of the frequency inverter – all data are written to both storage media simultaneously.	Lights up **orange**
	To use the copying function, the plug-in EEPROM must be temporarily operated with a different DIP switch position. **Note the section "Disassembly/assembly" (see above)!**	

DIP switch Middle position (coding pin pointing downwards) ***Factory setting***

	Function sequence	**LED**
	The plug-in EEPROM operates in parallel with the internal EEPROM of the frequency inverter – all data are written to both storage media simultaneously.	Lights up **green**

DIP switch Right position (coding pin pointing downwards)

	Function sequence	**LED**
	After starting the frequency inverter the data are copied once from the plug-in EEPROM to frequency inverter.	Alternately flashing **red / green**
	After this, the plug-in EEPROM remains write-protected.	Lights up **red**
	To use the copying function again, the plug-in EEPROM must be temporarily operated with a different DIP switch position. **Note the section "Disassembly/assembly" (see above)!**	

4 Commissioning

⚠ WARNING

Unexpected movement

Connection of the supply voltage may directly or indirectly set the drive unit into motion. This can cause unexpected movement of the drive and the attached machine, which may result in serious or fatal injuries and/or material damage. Possible causes of unexpected movements are 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 Starting up the device

To establish basic operation capability, after the mechanical installation of the device on a suitable wall, the electrical connections must be made (🕮 Section 2.3.2 "Electrical connection of power unit").

For devices without an integrated 24 V DC mains unit (option "integrated mains unit": "HVS") it is also essential for the FI to be provided with a 24 V DC control voltage.

ⓘ Information

Factory settings

Before recommissioning it must be ensured that the device is in its factory settings (**P523**).

Functional adaptation to the application is carried out by setting the parameters of the FI. Control and parameterisation units (SK CSX-3H or SK PAR-3H) or the NORD CON PC software are available for this. The parameter settings are saved in the internal EEPROM of the frequency inverter.

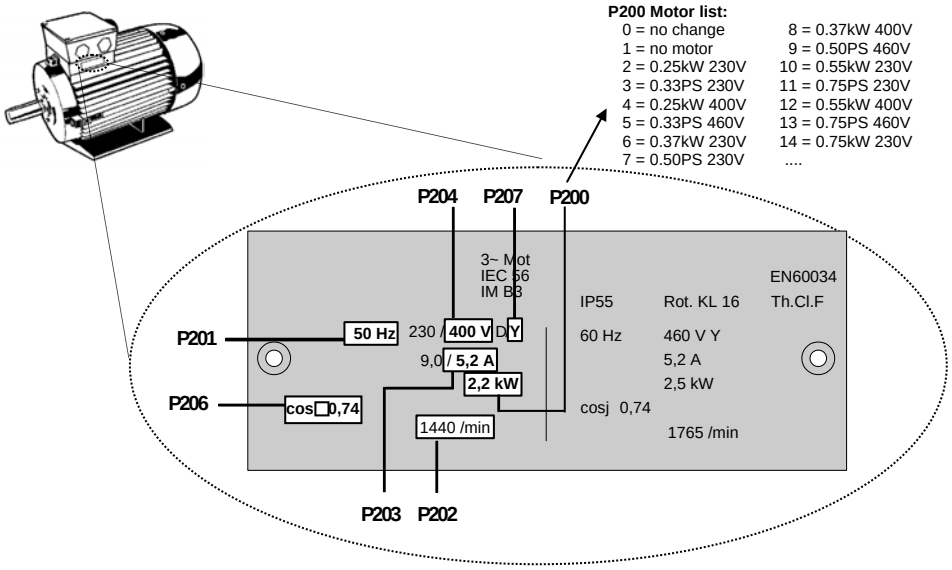
The parameters are pre-set with typical values (factory settings). To establish basic operating capability, typically only the correct motor data (P200 etc.) and if necessary the selection of the operating mode (P300 etc.) need to be parameterised.

Individual adaptations to the drive application, communication settings for other devices or a control unit, as well as optimisation of the operating characteristics must also be subsequently carried out by parameterisation. (🕮 Section 5 "Parameter")

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

4.3 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“.

4.3.1 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).

4.3.2 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"

4.3.3 Motor control commissioning steps

The main 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 mode can be found in the "Drive optimisation" guide (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. Encoders: 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

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

4.4 Temperature sensors

Connection of motors with temperature sensors (KTY-84 or PT100/PT1000) requires technical clarification with our **Technical Support**.

4.5 AS Interface (AS-i)

This section is only relevant for device of type SK 270E-FDS / SK 280E-FDS.

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 has been defined in the AS-Interface *Complete Specification* and standardised according to EN 50295, IEC62026.

The transfer principle is a single-master system with cyclic polling. Since the *Complete Specification V2.1* , a maximum of **31 standard slaves** using the device profile **S-7.0.**, or **62 slaves in the extended addressing mode** using the device profile **S-7.A.** could have been operated with any network structure at an unshielded two-wire line up to 100 m long.

Doubling the number of possible slave participants is realised by the double assignment of the addresses 1-31 and the “A slave” or “B slave” labelling. Slaves in the extended addressing mode are labelled by the ID code A and can be clearly identified by the master.

Devices with slave profiles **S-7.0** and **S-7.A.** can be operated together within an AS-i network with version 2.1 and higher (**master profile M4**), considering the address assignment (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 done via the master that also provides further management functions, or via a separate addressing unit.

Device-specific information

The transfer of the 4-bit application data (per direction) is performed with effective error protection for standard slaves with a maximum cycle time of 5 ms. Due to the higher number or participants, for slaves in the extended addressing mode, the cycle time is doubled (*max. 10 ms*) for data sent *from the slave to the master*. Extended addressing for sending data *to the slave* cause an additional doubling of the cycle time to *max. 21 ms*.

The AS-Interface cable (yellow) transfers data and power.

It can supply for both the total need of control voltage (including control voltage for the device and any connected sensors) and only the AS-Interface.

The supply of the device and any connected sensors can also be effected via an internal power supply unit (“**-HVS**” option), via the “black two-wire line” (only possible with plug connector option: “**-AUX**” or “**-AXS**” on option slot **M8**), or via a combination of both.

For the “**-AUX**” or “**-AXS**” option, the power supply unit (“**-HVS**” option) takes over a load-reducing power supply function. For the “**-ASI**” and “**-ASS**” options, it depends on the AS-i supply voltage level. Therefore, a load reduction cannot be assumed in each case.

“**-AUX**” or “**-AXS**” option (option slot **M8**): It is recommended, but not mandatory to effect the supply via **P**rotective **E**xtra **L**ow **V**oltage (**PELV**).

Supplement to plug connector option ”-ASI“ or “-AUX”

The FI is designed as a **double slave** and supports the **CTT2** protocol. For this, two AS interface slaves (1st slave and 2nd slave) are integrated into the device. Both slaves are type A/B slaves. A separate address in the extended address range (1A … 31A or 1B … 31B) must be assigned to each of the two slaves. Duplicate addresses must not be assigned.

The following types of communication can be implemented due to the double slave version:

- Cyclic data exchange:
  - 1. Slave:
    - 4I / 4O
  - 2. Slave:
    - 1I / 2O (from the point of view of the device)
- Acyclic data exchange:
  - 1. Slave:
    - Not available
  - 2. Slave:
    - Extended data transfer via CTT2 protocol
      - Parameter data (PKW)
      - Process data (PZD, e.g.: Control word, setpoints, note parameters **P509**, **P510)**

Detailed information for the use of the communication types can be found in manual BU0255

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 (LED)
- Configuration by parameterisation
- 24 V DC supply (integrated AS-i module and Frequency Inverter)

  The following possibilities should be applied.

  a. Device with integrated power supply unit (device option "**-HVS**") and connector option "**-ASI**" or "**-ASS**"

     – Connection via yellow cable for the supply of the AS-i module
     – Supply of the device and connected initiators or actuators via an integrated power supply unit
       Note: If no mains voltage is present on the device, connected initiators are not visible for the AS-i master.

  b. Device with integrated power supply unit (device option "**-HVS**") and connector option "**-AUX**" or "**-AXS**"

     – Connection via yellow cable for the supply of the AS-i module
     – Connection via black cable for the supply of the device and the connected initiators
       Note: If the black cable's voltage falls below the voltage of the integrated power supply unit, the power supply unit takes over the device supply. If the black cable's voltage falls below approx. 16 V DC, the integrated power supply unit also takes over the supply of the connected initiators or actuators.

  c. Device without power supply unit (without device option "**-HVS**") and with connector option "**-AUX**" or "**-AXS**"

     – Connection via yellow cable for the supply of the AS-i module
     – Connection via black cable for the supply of the device and the connected initiators or actuators

  d. Device without power supply unit (without device option "**-HVS**") and with connector option "**-ASI**" or "**-ASS**"

     – Connection via yellow cable for the supply of the AS-i module and the device
       Note: This version causes a high current consumption for the AS-i cable and only offers low reserves for direct connection of initiators and actuators to the device.

- Connection to the device

  – Via M12 system plug connector at option slot **M8**

Technical AS-Interface data

Designation	Option slot M8: Device with connector option …					
	… "-ASI"		… "-ASS"	… "-AUX"		… "-AXS"
AS-i supply (yellow cable)	24 – 31.6 V DC, ≤ 500 mA [1]			24 – 31.6 V DC, ≤ 25 mA [2]		
AUX supply (black cable)	*Connection not possible*			24 V DC ± 25%, ≤ 800 mA		
Extended required master	M4		M0, M1, M2, M3, M4	M4		M0, M1, M2, M3, M4
	1st slave	*2nd slave*	-	*1st slave*	*2nd slave*	-
Slave profile	S-7.A	S-7.A	S-7.0	S-7.A	S-7.A	S-7.0
I/O code	7	7	7	7	7	7
ID code	A	A	0	A	A	0
Ext. ID code 1 / 2	7	7 / 5	F	7	7 / 5	F
Address	1A – 31A and 1B – 31B		1 – 31	1A – 31A and 1B – 31B		1 – 31
As delivered	0 A		0	0 A		0
Cycle time						
Slave → Master	≤ 10 ms	≤ 10 ms	≤ 5 ms	≤ 10 ms	≤ 10 ms	≤ 5 ms
Master → Slave	≤ 21 ms	≤ 10 ms	≤ 5 ms	≤ 21 ms	≤ 10 ms	≤ 5 ms
Number of application data (BUS I/O)						
From the point of view of the AS-i master	4I/4O	2I/1O [3]	4I/4O	4I/4O	2I/1O [3]	4I/4O
From the point of view of SK 2xxE-FDS	4I/4O	1I/2O [3]	4I/4O	4I/4O	1I/2O [3]	4I/4O

1) For power supply exclusively via the yellow AS-i cable

2) For the power supply to the inverter and any connected sensors or actuators via the integrated mains unit of the FI (Option "**-HVS**") and/or via the black cable.

3) + extended data transfer according to the CTT2 protocol (parameter data, process data)

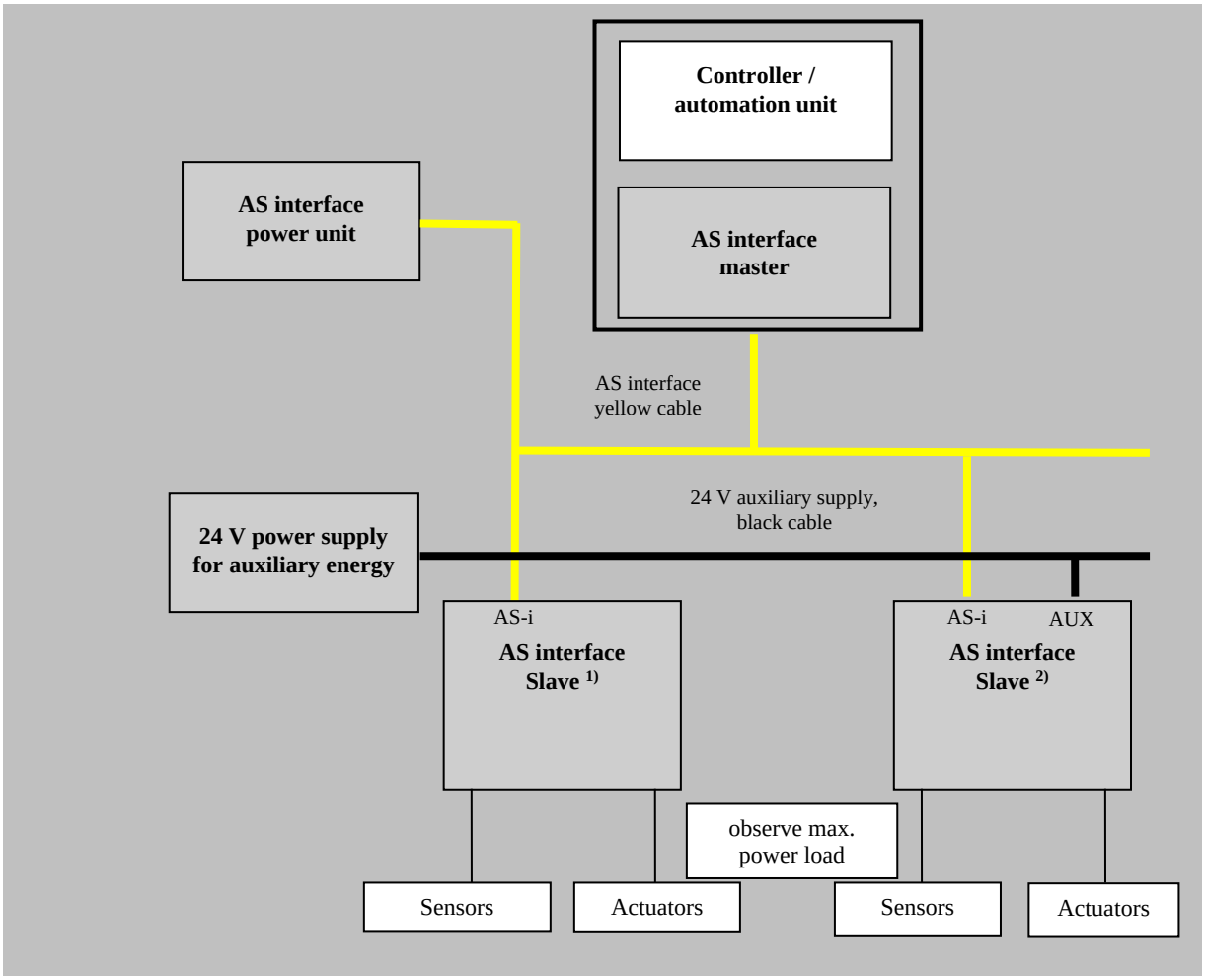
4.5.3 Bus structure and topology

The AS-Interface network structure is optional (line, star, ring and tree structure) and is managed by an AS-Interface master as an interface between PLC and slaves. An existing network can be extended with further slaves up to a limit of 31 standard slaves or 62 slaves in the extended addressing mode. The addressing of slaves is done by the master or a respective addressing unit.

An AS-i master communicates independently and exchanges data with the connected AS-i slaves. No standard power supply units must be used in the AS-Interface network. For each AS-Interface line, only one special AS-Interface power supply unit may be used for voltage supply. This AS-Interface voltage supply is connected directly to the yellow standard cable (AS-i(+) and AS-i(-) cable) and should be positioned as close as possible to the AS-i master to keep the voltage drop low.

To avoid interferences, the **PE connection of the AS-Interface power supply unit** (if available) **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 27xE-FDS / SK 28xE-FDS with plug connector “-ASI” a) or „-ASS“ a)
2)	SK 27xE-FDS / SK 28xE-FDS with plug connector “-AUX” a) or „-AXS“ a)

a) with or without an integrated mains unit (option "-HVS")

4.5.4 Commissioning

4.5.4.1 Connection

1. The connection of the AS-Interface cable (yellow) is established via the “**-ASI**”, “**-AUX**”, “**-AXS**” or “**-ASS**” plug connector on option slot **M8**.
2. The connection of a two-wire line to supply with auxiliary power (“black cable”) is established via the “**-AUX**” or “**-AXS**” plug connector on option slot **M8** (only if available). The supply should preferably be effected via PELV.

(📖 Section 2.3.3 "Electrical connection of the control unit")

4.5.4.2 Displays

The status of the AS interface is signalled by multi-colour LEDs on option slot **M8**. A separate LED is assigned to each of the two slaves of the FI.

2nd Slave [1)]

1st Slave

1) Only if plug connector option ”-ASI“ or “-AUX”

ASi LED	Meaning
OFF	• No AS interface voltage to the module • Connection cables not connected or incorrectly connected
green ON	• Normal operation (AS interface active)
red ON	• No exchange of data – Slave address = 0 (slave still in factory setting) – Slave not in LPS (list of planned slaves) – Slave with incorrect IO/ID – Master in STOP mode – Reset active
Red flashing (2 Hz) [1)]	• The slave is held at "Reset" during addressing
alternately flashing red / green (2 Hz) [1)]	• Peripheral error, AS-i communication controller in update mode

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

4.5.4.3 Configuration

The most important functions are assigned via the parameters (P480) and (P481).

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 inverter. Actuators can be connected via the available digital outputs of the inverter. The following connections are each provided for four application data bits:

BUS-IN	Function (P480[-01…-05])
Bit 0	Enable right [1]
Bit 1	Enable left [1]
Bit 2	Jog frequency selection
Bit 3	Acknowledge fault [2]
Bit 4 [3]	Release brake manually

Status		Status
Bit 1	Bit 0	
0	0	Motor is switched off
0	1	Field of rotation right present at motor
1	0	Field of rotation right present at motor
1	1	Motor is switched off

1) Enabling is with jog frequency 1 or 2 (depending on the selection of bit 2)
2) Acknowledge with flank 0 → 1.
For control via the bus, acknowledgement is not automatically performed by a flank on one of the enable inputs
3) Only if plug connector option ”-ASI“ or “-AUX”

BUS-OUT	Function (P481 [-01 … -04])
Bit 0	Inverter ready
Bit 1	Warning
Bit 2	Digital-In 1 status
Bit 3	Digital-In 4 status
Bit 4 [1]	Switch **H1**: Remote control active
Bit 5 [1]	STO inactive

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

1) Only if plug connector option ”-ASI“ or “-AUX”

Parallel actuation via the BUS and the digital inputs is possible. The relevant inputs are dealt with more or less as normal digital inputs.

4.5.4.4 Addressing

Addressing with plug connector option ”-ASI“ or “-AUX”

In order to use the device in an AS-I network, both of the slaves (1st slave and 2nd slave) which are installed in this device must be assigned a unique address. At the factory, both slaves are set to address "0". Due to the address "0" the device can be recognised as a "new device" by an AS-I master (prerequisite for automatic address assignment by the master).

As long as the 1st slave is in the factory setting (address "0") only this slave is visible on the bus. The status LED for the 1st slave (bottom) lights up continuously red. The 2nd slave is not visible. The status LED for the 2nd slave (top) flashes red.

Addressing of the 1st slave can be performed.

If the 1st slave has been assigned an address (≠ "0"), the 2nd slave, which still has address "0" automatically becomes visible for the bus. The status LED for the 1st slave (bottom) lights up green The status LED for the 2nd slave (top) lights up continuously red.

Addressing of the 2nd slave can be performed.

If an address (≠ "0") has been assigned to the 2nd slave, its status LED (top) also lights up green.

Addressing with plug connector option ”-AXS“ or “-ASS”

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 recognized as a "new device" by an AS-i master (prerequisite for automatic address assignment by the master).

Procedure

- Ensure power supply of the AS interface via the yellow AS interface cable.
- Disconnect the AS interface master during addressing
- Set an address ≠ "0“ for the 1st slave
- Set an address ≠ "0“ for the 2nd slave (Only if plug connector option ”-ASI“ or “-AUX”.)
- 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

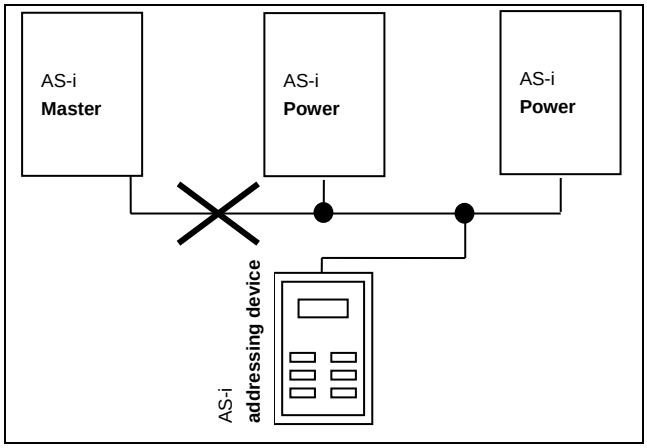
Special conditions for the supply exclusively via the yellow cable

- Ensure voltage supply of the **SK 270E-FDS / SK 280E-FDS** device also via yellow AS-Interface cable (pay attention to current consumption of control level of the device's **SK 270E-FDS / SK 280E-FDS** control level (500 mA))
- When using an addressing unit
  - Do not use the internal voltage source of the addressing unit
  - Battery-operated addressing units do not supply the required current and are therefore not suitable
  - Use addressing units with a separate 24 V DC connection for external voltage supply (example: Pepperl+Fuchs, VBP-HH1-V3.0-V1)

The following lists options how to practically implement the addressing of the AS-i slave using an addressing unit.

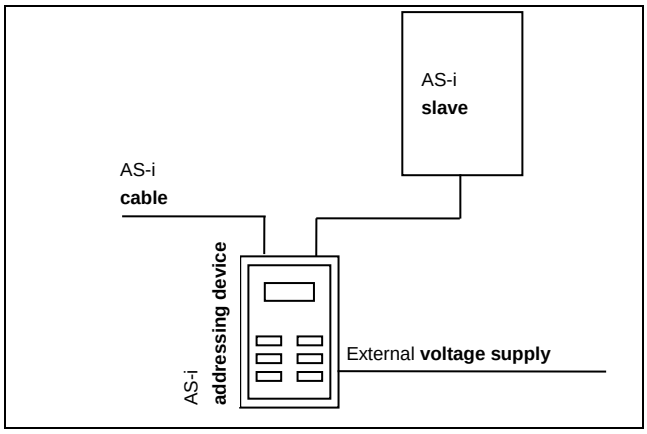
Version 1

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.



Resetting addresses to the factory setting (address "0")

(Only if plug connector option ”-ASI“ or “-AUX”.)

In order to be able to reset the factory setting, the 1st slave must first be addressed to "0". After approx. 10 sec. the 1st slave is no longer visible to the master (bottom LED flashes red). After this, the 2nd slave can also be addressed to "0".

After this, the 1st slave becomes active again and is visible to the master. The 2nd slave is no longer visible on the bus.

The original state has been restored.

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 can cause unexpected movement of the drive and the attached machine, which may result in serious or fatal injuries and/or material damage. Possible causes of unexpected movements are 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 changes in the parameterisation

Parameter changes become effective immediately. Under certain conditions, dangerous situations may occur, even when the drive is in standstill. Functions such as **P428** “Automatic starting” or **P420** “Digit inputs” or the “Brake off” 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 works, precautions must be taken to prevent unwanted drive movements (e.g. lifting equipment 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 inadequate dimensioning 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 caused by extremely steep acceleration ramps (P102, P103, P426).

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

To prevent any risk, the following must be observed:

- For lifting equipment applications or applications with frequent large load changes, parameter P219 must remain in the factory setting (100 %).
- Do not inadequately dimension the drive unit, provide adequate overload reserves.
- If necessary, provide fall protection (e.g. for lifting equipment) 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. NORDCON software or control and parametrisation unit, see also (🕮 Section 3.2 "Control and parametrisation options ") 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.

Depending on the configuration of the inverter, the control voltage can be supplied via an optional plug connector. Alternatively, the inverter can be equipped with a mains unit (option: "-HVS"), which generates the necessary 24 V DC control voltage when connected to the mains voltage (see 🕮 Section 2.3.2 "Electrical connection of power unit").

Each inverter is pre-configured for a NORD motor with the same output power at the factory. 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**.

The factory settings of parameter **P420** depend on the configuration of the inverter (🕮 Section 2.2.2.3 "Configuration of option slots on the connection level").

The relevant parameters for the inverter are described below. Explanation of parameters which relate to the field bus options or special functionality can be found in the respective supplementary manuals.

ⓘ Information **SK PAR-3H ParameterBox**

The SK PAR-3H ParameterBox must have at least software version **4.6 R1**.

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 setting P523

The factory settings 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 have been previously changed and could have an unexpected influence on the operating behaviour of the drive.

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.

It is advisable to back up the present settings of the frequency inverter beforehand.

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 response 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 release time
P120 Option monitoring		

Motor data

P200 Motor list	**P201** Nominal motor frequency	**P202** Nominal motor speed
P203 Nominal motor current	**P204** Nominal motor voltage	**P205** Nominal motor power
P206 Motor 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 lead time
P215 Boost lead time	**P216** Boost lead time	**P217** Oscillation damping
P218 Modulation depth	**P219** Auto. flux adaptation	**P220** Par. identification
P240 PMSM EMF voltage	**P241** PMSM inductance	**P243** Reluct. angle IPMSM
P244 PMSM peak current	**P245** Power system stabilisation PMSM VFC	**P246** Moment of inertia
P247 Switchover frequency 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	**P336** Rotor pos. identification mode
P350 PLC functionality	**P351** PLC setpoint selection	**P353** Bus status via PLC
P355 PLC integer setpoint	**P356** PLC long setpoint	**P360** PLC display value
P370 PLC status		

Control terminals

P400	Function Setpoint inputs	**P401**	Analog input mode	**P402**	Adjustment: 0%
P403	Adjustment: 100%	**P404**	Analog input filter	**P410**	Min. freq. Auxiliary setpoint
P411	Max. Freq. Auxiliary setpoint	**P412**	Process ctrl. setpoint	**P413**	PI control P comp.
P414	PI control I comp.	**P415**	Limit process ctrl.	**P416**	Ramp time PI setpoint
P417	Analog output offset	**P418**	Funct. Analog output	**P419**	Standard Analog output
P420	Digital inputs	**P425**	PTC resistor input		
		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**	On/Off switching delay
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	**P565**	AS-i mode

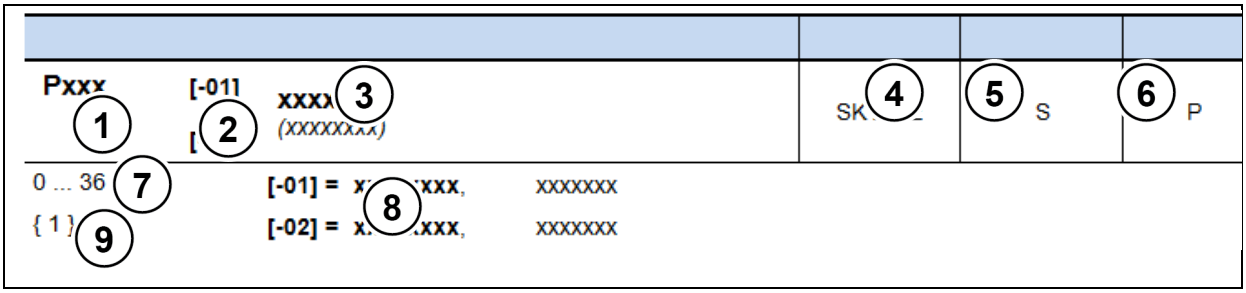
Positioning

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	**P745**	AS-i version	**P746**	AS-i status
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
P780	Device ID	**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

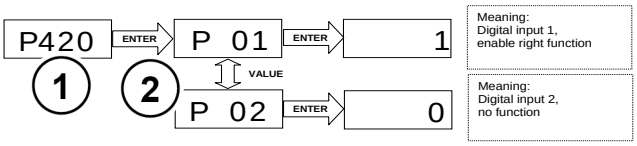
Array parameter display

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*. Important information about the operating status of the drive can be read out as required.			
P001	**Display selection** *(Display selection)*			
0 ... 65 { 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. The operating parameter set is selected using appropriately parametrised digital inputs or by means of BUS actuation. If enabled via the keyboard (SimpleBox, ControlBox, PotentiometerBox or ParameterBox), the operating parameter set will match the settings in P100.			
P101	**Copy parameter set** *(Copy parameter set)*		**S**	
0 ... 4 { 0 }	After confirmation with the OK / ENTER key, a copy of the parameter set selected in P100 >Parameter set< is written to the parameter set dependent on the value selected here **0 = Do not copy** **1 = Copy actual to P1**: Copies the active parameter set to parameter set 1 **2 = Copy actual to P2**: Copies the active parameter set to parameter set 2 **3 = Copy actual to P3**: Copies the active parameter set to parameter set 3 **4 = Copy actual to P4**: Copies the active parameter set to parameter set 4			
P102	**Acceleration time** *(Acceleration time)*			**P**
0 ... 320.00 sec { 2.00 }	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. The acceleration time can be extended by certain circumstances, e.g. FI overload, setpoint lag, smoothing, or if the current limit is reached. **NOTE:** Care must be taken that the parameter values are realistic. A setting of P102 = 0 is not permissible for drive units! **Notes on ramp gradient:** Amongst other things, the ramp gradient is governed by the inertia of the rotor. A ramp with a gradient which is too steep may result in the "inversion" of the motor. In general, extremely steep ramps (e.g.: 0 - 50 Hz in < 0.1 s) should be avoided, as may cause damage to the frequency inverter.			
P103	**Braking time** *(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 *(Minimum frequency)*			P

0.0 ... 400.0 Hz
{ 0.0 }

The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set.

In combination with other setpoints (e.g. analog setpoint of fixed frequencies) these are added to the set minimum frequency.

This frequency is undershot when

a. the drive is accelerated from standstill.
b. The FI is blocked. The frequency then reduces to the absolute minimum (P505) before it is blocked.
c. The FI reverses. The reverse in the rotation field takes place at the absolute minimum frequency (P505).

This frequency can be continuously undershot if, during acceleration or braking, the function "Maintain frequency" (Function Digital input = 9) is executed.

P105	Maximum frequency *(Maximum frequency)*			P

0.1 ... 400.0 Hz

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.

P106	Ramp smoothing *(Ramp smoothing)*			P

0 ... 100 %
{ 0 }

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

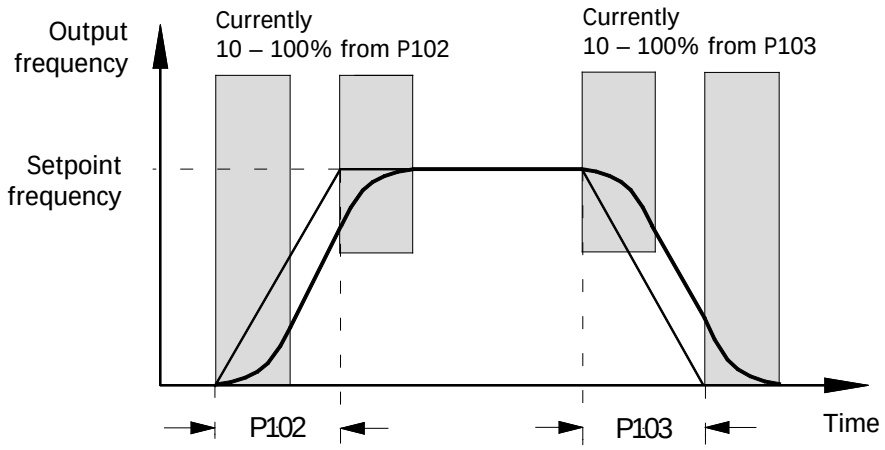
Ramp smoothing is carried out for every setpoint change.

The value to be set is based on the set acceleration and deceleration time, however values <10% have no effect.

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

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

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



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 *(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 2.3.2.4 "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.

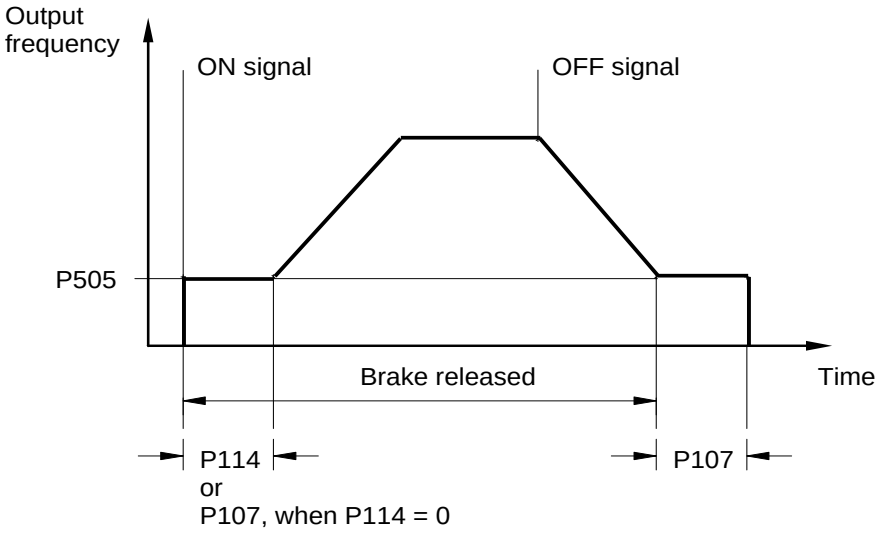
Recommendation for applications:
Lifting equipment with brake, without speed feedback Lifting equipment with brake

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 *(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 *(DC brake current)*		S	P
0 ... 250 % { 100 }	Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5). The correct setting value depends on the mechanical load and the required deceleration time. A higher setting brings large loads to a standstill more quickly. The 100% setting relates to a current value as stored in the >Nominal current< parameter P203. **NOTE:** The amount of DC current (0 Hz) which the FI can supply is limited. For this value, please refer to the table in Section 8.4.3, column: 0 Hz. In the basic setting this limiting value is about 110 %. **DC braking Not for PMSM motors!**			

P110	Time DC-brake on *(DC braking time on)*		S	P
0.00 ... 60.00 sec { 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). Depending on the relationship of the actual output frequency to the max. frequency (P105), the >DC brake time< is shortened. The time starts running with the removal of the enable and can be interrupted by fresh enabling. **DC braking Not for PMSM motors!**			

P111	P factor torque limit *(P factor torque limit)*		S	P
25 ... 400 % { 100 }	Directly affects the behaviour of the drive at torque limit. The basic setting of 100% is sufficient for most drive tasks. If values are too high the drive tends to vibrate as it reaches the torque limit. If values are too low, the programmed torque limit can be exceeded.			

P112	Torque current limit *(torque current limit)*		S	P
25 ... 400 % / 401 { 401 }	With this parameter, a limit value for the torque-generating current can be set. This can prevent mechanical overloading of the drive. It cannot provide any protection against mechanical blockages (movement to stops). A slipping clutch which acts as a safety device must be provided. The torque current limit can also be set over an infinite range of settings using an analogue input. The maximum setpoint (see 100% calibration, P403[-01] . .[-06]) the corresponds to the setting in P112. 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%)! **401 = OFF** means the switch-off of the torque current limit! This is also the basic setting for the FI.			

P113	[-01] ... [-02]	Jog frequency *(Jog frequency)*		S	P

-400.0 ... 400.0 Hz
all = { 0.0 }

When using the **SimpleBox or ParameterBox** to control the FI, jog frequency 1 is the initial value after enabling.

Alternatively, when control is via the control terminals, the jog frequency can be activated via one of the digital inputs.

The setting of jog frequency 1 can be made 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 Array [-01 of parameter P113 and is then available for the next start.

Setting of jog frequency 2 can only be carried out directly via this parameter.

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.

[-01] Jog frequency 1

[-02] Jog frequency 2

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 edited with this parameter. A 4-pole IE1 three-phase standard motor with the FI rated power is set at the factory in parameters **P201 … P209**.
By selecting one of the possible digits and pressing the ENTER key, all of the motor parameters (**P201 … P209**) are set to the selected standard power. The motor data is based on a 4-pole three-phase standard motor. The motor data for NORD IE4 motors can be found in the final section of the list.

Note:
As **P200** is = 0 again after input acknowledgement, the set motor can be controlled via the parameter **P205**.

Information

If IE2/IE3 motors are used, after selecting an IE1 motor (**P200**), the motor data in **P201 … P209** must be adapted to the data on the motor type plate.

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. In this case, the following motor data are set: 50.0 Hz / 1500 rpm / 15.0 A / 400 V / 0.00 kW / cos φ=0.90 / Star / R_S 0.01 Ω / I_{LEER} 6.5 A

2 =	0.25kW 230V	**18 =**	1.1 kW 230V	**34 =**	4.0 kW 400V	**95 =**	0.75kW 230V 80T1/4
3 =	0.33PS 230V	**19 =**	1.5 PS 230V	**35 =**	5.0 PS 460V	**96 =**	1.10kW 230V 90T1/4
4 =	0.25kW 400V	**20 =**	1.1 kW 400V	**36 =**	5.5 kW 230V	**97 =**	1.10kW 230V 80T1/4
5 =	0.33PS 460V	**21 =**	1.5 PS 460V	**37 =**	7.5 PS 230V	**98 =**	1.10kW 400V 80T1/4
6 =	0.37kW 230V	**22 =**	1.5 kW 230V	**38 =**	5.5 kW 400V	**99 =**	1.50kW 230V 90T3/4
7 =	0.50PS 230V	**23 =**	2.0 PS 230V	**39 =**	7.5 PS 460V	**100 =**	1.50kW 230V 90T1/4
8 =	0.37kW 400V	**24 =**	1.5 kW 400V	**40 =**	7.5 kW 230V	**101 =**	1.50kW 400V 90T1/4
9 =	0.50PS 460V	**25 =**	2.0 PS 460V	**41 =**	10.0 PS 230V	**102 =**	1.50kW 400V 80T1/4
10 =	0.55kW 230V	**26 =**	2.2 kW 230V	**42 =**	7.5 kW 400V	**103 =**	2.20kW 230V 100T2/4
11 =	0.75PS 230V	**27 =**	3.0 PS 230V	**43 =**	10.0 PS 460V	**104 =**	2.20kW 230V 90T3/4
12 =	0.55kW 400V	**28 =**	2.2 kW 400V	**44 =**	11.0 kW 400V	**105 =**	2.20kW 400V 90T3/4
13 =	0.75PS 460V	**29 =**	3.0 PS 460V	**45 =**	15.0 PS 460V	**106 =**	2.20kW 400V 90T1/4
14 =	0.75kW 230V	**30 =**	3.0 kW 230V	**46 =** … **94 =**	Reserved, do not use	**107 =**	3.00kW 230V 100T5/4
15 =	1.0 PS 230V	**31 =**	3.0 kW 400V			**108 =**	3.00kW 230V 100T2/4
16 =	0.75kW 400V	**32 =**	4.0 kW 230V			**109 =**	3.00kW 400V 100T2/4
17 =	1.0 PS 460V	**33 =**	5.0 PS 230V			**110 =**	3.00kW 400V 90T3/4
						111 =	4.00kW 230V 100T5/4
						112 =	4.00kW 400V 100T5/4
						113 =	4.00kW 400V 100T2/4
						114 =	5.50kW 400V 100T5/4

P201	Nominal frequency *(Nominal frequency)*		S	P
10.0 … 399.9 Hz { see information }	The motor 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 depends on the nominal power of the FI and the setting in **P200**.			

P202	Nominal speed *(Nominal speed)*		S	P
150 … 24000 rpm { see information }	The nominal motor speed is important for correct calculation and control of the motor slip and the speed display (**P001 = 1**). Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P203	Nominal current *(Nominal current)*		S	P
0.1 … 1000.0 A { see information }	The nominal motor current is a decisive parameter for current vector control. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P204	Nominal voltage *(Nominal voltage)*		S	P
100 … 800 V { 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. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P205	Nominal power *(Nominal power)*			P
0.00 … 250.00 kW { see information }	The motor nominal power controls the motor set via **P200**. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P206	Cos phi *(Cos φ)*		S	P
0.50 … 0.95 { see information }	The motor cos φ is a decisive parameter for current vector control. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

Information **PMSM**

This parameter is not relevant if a PMSM is used.

P207	Star Delta con. *(Star Delta con.)*		S	P
0 … 1 { see information }	**0 = Star** **1 = Delta** The motor circuit is decisive for stator resistance measurement (**P220**) and therefore for current vector control. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P208	Stator resistance *(Stator resistance)*		S	P
0.00 … 300.00 Ω { see information }	Motor stator resistance ⇒ Resistance of a phase winding with a three-phase motor. Has a direct influence on the current control of the FI. A value which is too high may result in overcurrent; a value which is too low may result in low motor torque. Parameter **P220** can be used for simple measurement. Parameter **P208** can be used for manual setting or as information on the automatic measurement result. **Note**: For optimum functioning of the current vector control, the stator resistance must be measured automatically by the FI. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P209	No-load current *(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 **P206** “cos φ” and parameter **P203** “Nominal current”. **Note**: If the value is to be entered directly, then it must be set as the last value of the motor data. This is the only way to ensure that the value will not be overwritten. Information **Default setting** The default setting depends on the nominal power of the FI and the setting in **P200**.			

P210	Static boost *(Static boost)*		S	P
0 ... 400 % { 100 }	The static boost affects the current that generates the magnetic field. This is equivalent to the no load current of the respective motor and is therefore load-independent. The no load current is calculated using the motor data. The factory setting of 100% is sufficient for normal applications.			

P211	Dynamic boost *(Dynamic boost)*		S	P
0 ... 150 % { 100 }	The dynamic boost affects the torque generating current and is therefore a load-dependent parameter. The factory 100% setting is also sufficient for typical applications. Too high a value can lead to overcurrent in the FI. Under load therefore, the output voltage will be raised too sharply. Too low a value will lead to insufficient torque.			

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 *(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 *(Amplification of ISD control)*		S	P
25 ... 400 % { 100 }	This parameter influences the control dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower. Dependent on application type, this parameter can be altered, e.g. to avoid unstable operation.			

P214	Torque precontrol *(Torque precontrol)*		S	P
-200 ... 200 % { 0 }	This function allows a value for the expected torque requirement to be set in the controller. This function can be used in lifting applications for a better load transfer during start-up. **NOTE:** Motor torques (with rotation field right) are entered with a positive sign, generator torques are entered with a negative sign. The reverse applies for the counter clockwise rotation.			

P215	Boost precontrol *(Boost precontrol)*		S	P
0 ... 200 % { 0 }	Only advisable with linear characteristic curve (P211 = 0% and P212 = 0%). For drives that require a high starting torque, this parameter provides an option for switching in an additional current during the start phase. The application time is limited and can be selected at parameter >Time boost precontrol< P216. All current and torque current limits that may have been set (P112 and P536, P537) are deactivated during the boost lead time. **NOTE:** With active ISD control (P211 and / or P212 ≠ 0%), parameterisation of P215 ≠ 0 results in incorrect control.			

P216	Time boost precontrol *(Time boost precontrol)*		S	P
0.0 ... 10.0 sec { 0.0 }	This parameter is used for 3 functionalities **Time limit** for the **boost lead**: Application time for increased starting current. Only with linear characteristic curve (P211 = 0% and P212 = 0%). **Time limit** for **suppression of** pulse **switch-off** (P537): enables start-up under heavy load. **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 *(Oscillation damping)*		S	P
0 ... 400 % { 10 }	With the oscillation damping, idling current harmonics can be damped. Parameter 217 is a measure of the damping power. For oscillation damping the oscillation component is filtered out of the torque current by means of a high pass filter. This is amplified by P217, inverted and switched to the output frequency. The limit for the value switched is also proportional to P217. The time constant for the high pass filter depends on P213. For higher values of P213 the time constant is lower. With a set value of 10 % for P217, a maximum of ± 0.045 Hz are switched in. At 400 % in P217, this corresponds to ± 1.8 Hz The function is not active in “Servo mode, P300”.			

P218	Modulation depth *(Modulation depth)*		S	
50 ... 110 % { 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. Normally, 100% should be set.			

P219	Automatic flux optimisation *(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.

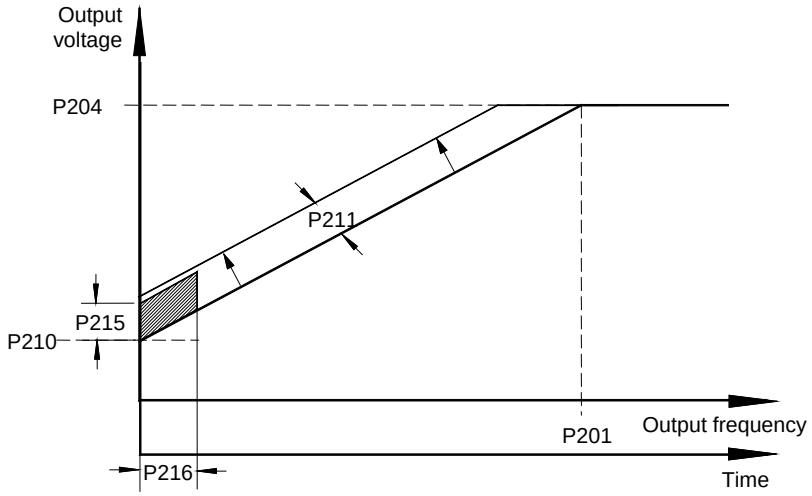
This function is intended for applications in which the required torque only changes slowly (e.g. pumps and fans). Its effect therefore replaces a quadratic curve, as it adapts the voltage to the load.

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 *(Parameter identification)*			P

0 … 2
{ 0 }

With devices with output of 7.5 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 7.5 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 *(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 P240 = 89 V * 2100 rpm / 1000 rpm **P240 = 187 V**

0 = ASM is used, *"Asynchronous machine is used"*: No compensation

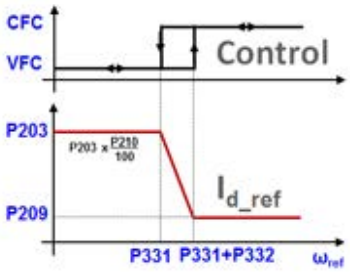
P241 [-01] [-02]	Inductivity PMSM *(Inductivity PMSM)*		S	P
0.1 ... 200.0 mH { all 20.0 }	The typical asymmetric reluctances of the PMSM are compensated with this parameter. The stator inductances can be measured by the frequency inverter (P220) **[-01] = d axis (L_d)** **[-02] = q axis (L_q)**			

P243	Reluct. angle IPMSM *(Reluctance angle IPMSM)*		S	P
0 … 30 ° { 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. The specific reluctance angle for the motor can be determined as follows: • Allow drives with constant load (> 0.5 M_N) to run in CFC mode (P300 ≥ 1) • 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 { 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 … 250 % { 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 { 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 % { 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. **0 = Off (VFC open -loop)** [1] Speed control without encoder feedback **1 = On (CFC closed-loop)** [2] Speed control with encoder feedback **2 = Obs (CFC open-loop)** Speed control without encoder feedback **NOTE:** Commissioning information (🕮 Abschnitt 4.3 "Selecting the operating mode for motor control"). 1) Corresponds to the previous setting "OFF" 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	**Encoder res.** *(Encoder resolution)*			
0 ... 19 { 6 }	Input of the pulse count per rotation of the connected encoder. If the direction of rotation of the encoder is not the same as that of the FI, (depending on installation and wiring), this can be compensated by selecting the corresponding negative pulse numbers 8...16 or 19. **0 =** 500 pulses **1 =** 512 pulses **2 =** 1000 pulses **3 =** 1024 pulses **4 =** 2000 pulses **5 =** 2048 pulses **6 =** 4096 pulses **7 =** 5000 pulses **8 =** -500 pulses **9 =** -512 pulses **10 =** -1000 pulses **11 =** -1024 pulses **12 =** -2000 pulses **13 =** -2048 pulses **14 =** -4096 pulses **15 =** -5000 pulses **16 =** -8192 pulses **17 =** 8192 pulses **18 =** 1024 SLCA [1)] **19 =** -1024 SLCA [1)] 1) The settings 18 and 19 are specially intended for use of a Contelec magnetic encoder with 1024 pulses / encoder revolutions. **NOTE:** (P301) is also significant for position control with incremental encoders. If an incremental encoder is used for positioning (P604=1), setting of the pulse number is made here. (See supplementary POSICON manual)			

P310	**Speed controller P** *(Speed controller P)*			**P**
0 ... 3200 % { 100 }	P-component of the speed encoder (proportional amplification). Amplification factor, by which the speed difference between the setpoint and actual frequency is multiplied. A value of 100% means that a speed difference of 10% produces a setpoint of 10%. Values that are too high can cause the output speed to oscillate.			

P311	**Speed controller I** *(Speed controller I)*			**P**
0 ... 800 % / ms { 20 }	I-component of the encoder (Integration component). The integration component of the controller enables the complete elimination of any control deviation. The value indicates how large the setpoint change is per ms. Values that are too small cause the controller to slow down (reset time is too long).			

P312	**Torque current controller P** *(Torque current controller P)*		**S**	**P**
0 ... 1000 % { 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. If the value "Zero" is entered in P312 and P313, then the torque current control is switched off. In this case, only the motor model pre-control is used.			

P313	Torque current controller I *(Torque current controller I)*		S	P
0 ... 800 % / ms { 50 }	I-proportion of the torque current controller. (See also P312 >Torque current controller P<)			

P314	Torque current controller limit *(Torque current controller limit)*		S	P
0 ... 400 V { 400 }	Determines the maximum voltage increase of the torque current controller. The higher the value, the greater the maximum effect that can be exercised by the torque current controller. Excessive values in P314 can specifically lead to instability during transition to the field weakening zone (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced.			

P315	Field current controller P *(Field current controller P)*		S	P
0 ... 1000 % { 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 *(Field current controller I)*		S	P
0 ... 800 % / ms { 50 }	I-proportion of the field current controller. See also P315 >Field current controller P<			

P317	Field current controller limit *(Field current controller limit)*		S	P
0 ... 400 V { 400 }	Determines the maximum voltage increase of the field current controller. The higher the value, the greater is the maximum effect that can be exercised by the field current controller. Excessive values in P317 can specifically lead to instability during transition to the field reduction range (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced.			

P318	Field weakening controller P *(Field weakening controller P)*		S	P
0 ... 800 % { 150 }	The field weakening controller reduces the field setpoint when the synchronous speed is exceeded. Generally, the field weakening controller has no function; for this reason, the field weakening controller only needs to be set if speeds are set above the nominal motor speed. Excessive values for P318 / P319 will lead to controller oscillations. The field is not weakened sufficiently if the values are too small or during dynamic acceleration and/or delay times. The downstream current controller can no longer read the current setpoint.			

P319	**Field weakening controller I** *(Field weakening controller I)*		S	P
0 ... 800 % / ms { 20 }	Only affects the field weakening range, see P318 >Field weakening controller P<			

P320	**Field weakening limit** *(Field weakening limit)*		S	P
0 ... 110 % { 100 }	The field weakening limit determines at which speed / current the controller will begin to weaken the field. At a set value of 100% the controller will begin to weaken the field at approximately the synchronous speed. If values much larger than the standard values have been set in P314 and/or P317, then the field weakening limit should be correspondingly reduced, so that the control range is actually available to the current controller.			

P321	**Speedctr. I brake off** *(Speed control I brake release time)*		S	P
0 ... 4 { 0 }	During the brake release time (P107/P114), the I component of the speed control is increased. This leads to better load take-up, especially with vertical movements. **0 =** P311 speed control I x 1 **1 =** P311 speed control I x 2 **2 =** P311 speed control I x 4 **3 =** P311 speed control I x 8 **4 =** P311 speed control I x 16			

P325	**Rotary encoder function** *(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** *(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** *(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** *(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** *(Rotor starting position detection)* (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 *(Switch over frequency CFC open-loop)* (Former designation: "**Switch over freq. PMSM**")		S	P
5.0 ... 100.0 % { 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). The parameter is only relevant for the control method "CFC open-loop" (P300, setting "2").			

P332	Hyst. Switchover CFC ol *(Switchover frequency hysteresis CFC open-loop)* (Former designation: "**Hyst. Switchover PMSM**")		S	P
0.1 ... 25.0 % { 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 *(Flux feedback CFC open-loop)* (Former designation: "**Flux feedb. fact. PMSM**")		S	P
5 ... 400 % { 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. The default value is selected so that it typically does not need to be adjusted for NORD IE4 motors.			

P334	Encoder offset PMSM *(Encoder offset PMSM)*		S	
-0,500 ... 0,500 rev { 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". 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. A sticker is typically affixed to motors supplied by NORD on which the setting is specified. Provided that the details on the motor are specified in **°**, these must be converted into **rev** (e.g. 90 ° = 0.250 rev). **Note** – The zero track is connected via **digital input 1**. – Parameter P420 [-01] must be set to function *43* "0-track HTL encoder DI1" in order to evaluate the pulses of the zero track.			

P336	**Rotor pos. identification mode** *(Rotor position identification mode)*		S	

0 ... 2
{ 6 }

The precise position of the rotor must be known in order to operate a PMSM. This can be determined by various methods.

0 = First enabling — Identification of the PMSM rotor position is performed when the drive is enabled for the first time.

1 = Supply voltage — Identification of the PMSM rotor position is performed when the supply voltage is applied for the first time.

2 = Digital input/Bus input bit — Identification of the PMSM rotor position is triggered with an external order by means of a binary bit (digital input (P420) or Bus-in bit (P480), setting "79", "rotor position identification").

NOTE:

Identification of the rotor position is only performed if the FI is in the “ready for switch-on” state and the rotor position is not known (see P434, P481 function 28).

Use of the parameter is only advisable if the test signal method is set (P330).

P350	**PLC functionality** *(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** *(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 *(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 *(PLC Integer Setpoint)*		S	
0x0000 … 0xFFFF 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 *(PLC Long Setpoint)*		S	
0x0000 0000 … 0xFFFF FFFF 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 *(PLC display value)*		S	
-2 000 000,000 … 2 000 000.000 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 *(PLC Status)*		S	
0 … 63_{dec} *ParameterBox:* 0x00 … 0x3F *SimpleBox / ControlBox:* 0x00 … 0x3F all = { 0 }	Displays the actual status of the PLC. **Bit 0 =** **P350=1:** Parameter P350 was set in the "Activate internal PLC" function **Bit 1 =** **PLC active:** The internal PLC is active. **Bit 2 =** **Stop active:** The PLC program is in "Stop" status. **Bit 3 =** **Debug active:** The error checking of the PLC program runs. **Bit 4 =** **PLC error:** The PLC has an error, but PLC user errors 23.xx are not displayed here. **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)*			**P**

0 ... 36
{ [-01] = 0 }
{ [-02] = 0 }
{ [-03] = 0 }
{ [-04] = 0 }
{ [-05] = 1 }
{ [-06] = 0 }
{ [-07] = 1 }
{ [-08] = 0 }
{ [-09] = 0 }

[-01] **Analog input 1**, Function of analog input 1 integrated into the FI
[-02] **Analog input 2**, Function of analog input 2 integrated into the FI
[-03] **External analog input 1**, AIN1 of the first I/O extension (SK xU4-IOE)
[-04] **External analog 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.
[-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.
[-08] **External A.in. 1 2nd IOE**, *"External analog input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analog input 3)
[-09] **External A.in. 2 2nd IOE**, *"External analog input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analog input 4)

... Setting values below.

For standardisation of actual values: 🕮 Section 8.8 "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**, setting for minimum frequency of frequency inverter
Lower limit: 1 Hz
Standardisation: 0 - 100% of P104

5 = **Maximum frequency**, setting for maximum frequency of frequency inverter
Lower limit: 2 Hz
Standardisation: 0 - 100% of P105

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**, normally only used in combination with a potentiometer.
Lower limit: 50 ms
Standardisation: T_Rampenzeit= 10s * U[V] / 10V (U=Potentiometer voltage)

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 = *…reserved*

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*

30 = **Motor temperature**: enables measurement of the motor temperature with a KTY-84 temperature sensor (📖 Section 4.4 "Temperature sensors")

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.

**) 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
[-06]	**Analogue input 2,** Analogue input 2

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.

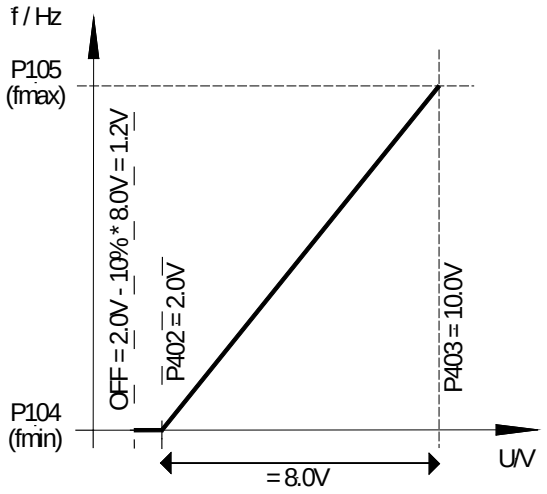
1 = 0 – 10V: If a setpoint smaller than the programmed adjustment 0% (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer.

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%** *(Analog input adjustment: 0%)*		**S**	

-50.00 ... 50.00 V
{ all 0.00 }

[-01] **External Analog input 1,** AIN1 of the first I/O extension (SK xU4-IOE)

[-02] **External Analog input 2,** AIN2 of the first I/O extension (SK xU4-IOE)

[-03] **External A.in. 1 2nd IOE,** *"External analog input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analog input 3)

[-04] **External A.in. 2 2nd IOE,** *"External analog input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analog input 4)

[-05] **Analog input 1,** Analog input 1

[-06] **Analog input 2,** Analog input 2

This parameter sets the voltage which should correspond with the minimum value of the selected function for analog input 1 or 2. In the factory setting (setpoint) this value is equivalent to the setpoint which is set via P104 >Minimum frequency<.

Note
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%** *(Analog input adjustment: 100%)*		**S**	

-50.00 ... 50.00 V
{ all 0.00 }

[-01] **External Analog input 1,** AIN1 of the first I/O extension (SK xU4-IOE)

[-02] **External Analog input 2,** AIN2 of the first I/O extension (SK xU4-IOE)

[-03] **External A.in. 1 2nd IOE,** *"External analog input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= Analog input 3)

[-04]) **External A.in. 2 2nd IOE,** *"External analog input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= Analog input 4)

[-05] **Analog input 1,** Analog input 1

[-06] **Analog input 2,** Analog input 2

This parameter sets the voltage, which should correspond with the maximum value of the selected function for the analog input 1 or 2. In the factory setting (setpoint) this value is corresponds to the setpoint which is set via P105 >Maximum frequency<.

Note
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)*		S	

10 ... 400 ms
{ all 100 }

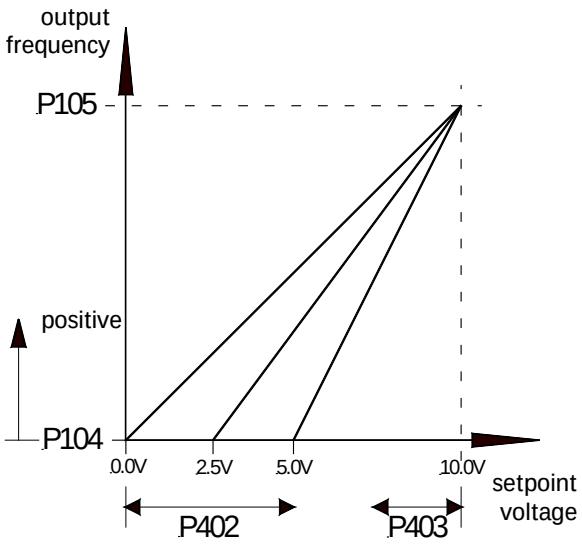
Adjustable digital low-pass filter for the analogue signal. Interference peaks are hidden, the reaction time is extended.

[-01] = Analogue input 1: analogue input 1 integrated in the device
[-02] = Analogue input 2: analogue input 2 integrated in the device

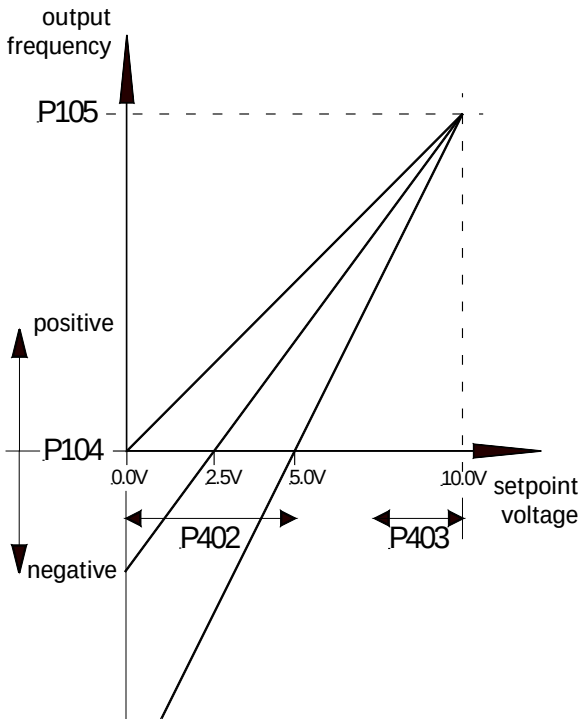
The filter time for the analogue inputs of the optional external IO extension modules is set in the parameter set for the relevant module (P161).

P400 ... P403

P401 = 0 → 0 - 10V limited



P401 = 1 → 0 - 10V not limited



P410	Min. freq. a-in 1/2 *(Minimum frequency a-in 1/2 (auxiliary setpoint value))*			P

-400.0 ... 400.0 Hz
{ 0.0 }

The minimum frequency that can act on the setpoint via the auxiliary setpoints.

Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI:

Actual frequency PID	Frequency addition	Frequency subtraction
Auxiliary setpoints via BUS	Process controller	
Min. frequency above analog setpoint (potentiometer)		

P411	**Max. freq. a-in 1/2** *(Maximum frequency a-in 1/2 (auxiliary setpoint value))*			**P**
-400.0 ... 400.0 Hz { 50.0 }	The maximum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: Actual frequency PID — Frequency addition — Frequency subtraction Auxiliary setpoints via BUS — Process controller Min. frequency above analog setpoint (potentiometer)			
P412	**Nom. val. process ctrl.** *(Nominal value process controller)*		**S**	**P**
-10.0 ... 10.0 V { 5.0 }	Fixed specification of a setpoint for the process controller that will only occasionally be altered. Only with P400 = 14 ... 16 (process controller) (chapter 8.2).			
P413	**P-component of PI-controller** *(P-component PI-controller)*		**S**	**P**
0.0 ... 400.0 % { 10.0 }	This parameter is only effective when the function PI controller actual frequency is selected. The P-component of the PI controller determines the frequency jump if there is a control deviation based on the control difference. E.g.: At a setting of P413 = 10% and a rule difference of 50%, 5% is added to the actual setpoint.			
P414	**I-component PI-controller** *(I-component of PI-controller)*		**S**	**P**
0.0 ... 3,000.0 %/s { 10.0 }	This parameter is only effective when the function PI controller actual frequency is selected. The I-component of the PI controller determines the frequency change, dependent on time. **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** *(Control limit of process controller)*		**S**	**P**
0 ... 400.0 % { 10.0 }	This parameter is only effective when the function **PI process controller** is selected. This determines the control limit (%) after the PI controller (chapter 8.2).			
P416	**Ramp time PI setpoint** *(Ramp time PI setpoint value)*		**S**	**P**
0.00 ... 99.99 sec { 2.00 }	This parameter is only effective when the function PI process controller is selected. Ramp for PI setpoint			

P417 [-01] ... [-02]	Offset analogue output *(Offset analogue output)*		S	P

-10.0 ... 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 xU4-IOE)
[-02] = Second IOE, AOUT of the second I/O extension (SK xU4-IOE)

In the analogue output function an offset can be entered to simplify the processing of the analogue signal in other equipment.

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 8.8).

- **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] ... [-07]	Digital inputs *(Digital inputs)*			

0 ... 80

{ [-01] = 0 }
{ [-02] = 0 }
{ [-03] = 0 }
{ [-04] = 0 }
{ [-05] = x }
{ [-06] = x }
{ [-07] = x }

x = Depending on the configuration (📖 Setting 2.2.2.2)

Up to 5 freely programmable digital inputs are available. The analogue inputs can also still be used as digital inputs, but their electrical characteristics are not compatible with the PLC standard.

[-01] **Digital input 1** (DIN1)**,** digital function 1

[-02] **Digital input 2** (DIN2)**,** digital function 2

[-03] **Digital input 3** (DIN3)**,** digital function 3

[-04] **Digital input 4** (DIN4)**,** digital function 4

[-05] **Digital input 5** (DIN5)**,** digital function 5

[-06] **Analog input 1** (AIN1/DIN6)**,** digital function 6

[-07] **Analog input 2** (AIN2/DIN7)**,** digital function 7

When an encoder is being used, digital inputs DIN 2 and DIN 3 must be disabled 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 managed 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.

Note: The M12 plug connectors on option slots **M1** - **M8** are used to evaluate sensors. Physically these are connected to the internal digital inputs, which in turn can be set to certain functions with parameter **P420**. Normally, the sensor signals are only read in and transmitted via the bus system via which the FI can then be controlled. The control elements at option slots **H1** and **H2** also use these inputs. In this case the relevant inputs are pre-parameterised at the factory.

Note: The default values of parameter P420 [-05], [-06] and [-07] depend on the control elements on option slots **H1** and **H2**.

List of possible digital input functions 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
	If the drive is to start up automatically when the low voltage is switched on (P428 = 1) a permanent High level for enabling must be provided. The FI is blocked if the functions "Enable right" and "Enable left" are actuated simultaneously. If the frequency controller is in fault status but the cause of the fault is no longer present, 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 simultaneously, they are added with the correct sign. In addition, the analogue setpoint (P400) and if necessary the minimum frequency (P104) are added.		

Value	Function	Description	Signal
08 [5]	Par. set changeover *"Parameter set switching 1"*	Selection of the 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 continue.	Low
10 [2]	Disable voltage	The FI output voltage is switched off; the motor runs down freely.	Low
11 [2]	Quick stop	The FI reduces the frequency according to the programmed quick stop time P426.	Low
12 [2]	Error 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 for use with a temperature sensor (bi-metal switching contact). Switch-off delay = 2 sec, warning after 1 sec.	High
14 [2, 4]	Remote control	With bus system control, Low level switches the control to control via the control terminals.	High
15	Jog frequency [1]	The frequency value from (P113 [-01]), can also be set directly with the SimpleBox or ParameterBox using the HIGHER / LOWER keys and saved in (P113 [-01]) with the OK key. If the frequency inverter is operated with jog frequency any active bus control is disabled.	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]	ParaSetSwitching 2 *"Parameter set switching 2"*	Selection of the active parameter set 1…4 first bit.	High
18 [2]	Watchdog	The input must see a High flank cyclically (P460), otherwise a shutdown will occur with error E012. The function starts with the 1st High flank.	0→1 Flank
19	Setpoint 1 On/Off	Analog input switch-on and switch-off 1/2 (High = ON) The Low signal sets the analog input to 0 % which does not result in 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	
26	Analog function Dig2 +3 *("0-10V")*	with this setting pulses which are proportional to an analogue signal can be evaluated using **DIN 2** and **DIN 3**. The function of this signal is determined in parameter P400 [-06] or [-07] Conversion of 0-10 V to pulses can be carried out via the SK CU/TU4-24V-...control terminals. Among other things, this module provides an analogue input and a pulse output (ADC). With the {28} setting, a change in the direction of rotation is made with an analogue value <5V.	Pulses ≈ 1.6-16 kHz
27	Analog function 2-10V Dig2+3		
28	Analog function 5-10V Dig2 +3		
29	Enable SK SSX-box	The enable signal is provided by the *Simple Setpoint Box* (setpoint box) SK SSX-3A. For this, the box must be operated in **IO-S** mode. → BU0040	High
30	Disable PID	Switches the PID controller / process controller function on and off (High = ON)	High
31 [2]	Disable right running	Blocks the "Enable right/left" via a digital input or bus control. Does not relate to the actual direction of rotation of the motor (e.g. following negated setpoint).	Low
32 [2]	Disable left running		Low

This function can only be used for digital inputs 2 (P420 [-02]) and 3 (P420 [-03])!

<table>
<tr><th>Value</th><th>Function</th><th>Description</th><th>Signal</th></tr>
<tr><td>33</td><td>Enable jog frequency right</td><td rowspan="3">Parameterisation of the corresponding inputs with these functions determines the jog frequency and direction which is enabled.

<table><tr><th colspan="3">Function</th><th rowspan="2">Resulting function</th></tr><tr><th>33</th><th>34</th><th>36</th></tr><tr><td>x</td><td>-</td><td>-</td><td>Enable right, jog frequency 1 (P113[-01])</td></tr><tr><td>x</td><td>-</td><td>x</td><td>Enable right, jog frequency 2 (P113[-02])</td></tr><tr><td>-</td><td>x</td><td>-</td><td>Enable left, jog frequency 1 (P113[-01])</td></tr><tr><td>-</td><td>x</td><td>x</td><td>Enable left, jog frequency 2 (P113[-02])</td></tr></table></td><td>High</td></tr>
<tr><td>34</td><td>Enable jog frequency left</td><td>High</td></tr>
<tr><td>36</td><td>Jog frequency selection</td><td>High</td></tr>
<tr><td>35</td><td>2nd jog frequency</td><td>Frequency value from (P113 [-02])
If the frequency inverter is operated with jog frequency any active bus control is disabled.</td><td>High</td></tr>
<tr><td>37 [2, 4]</td><td>Manual control</td><td>With bus system control, a High level switches to control via the control terminals.</td><td>High</td></tr>
<tr><td>38</td><td>... 41 reserved</td><td></td><td></td></tr>
<tr><td>42</td><td>0 track HTL Sync2 DI1</td><td>Activates evaluation of the zero track of an encoder.
Synchronisation with the zero pulse after each enable.</td><td>High</td></tr>
<tr><td>43</td><td>0 track HTL encoder DI1</td><td>Activates evaluation of the zero track of an encoder.
Synchronisation with the zero pulse after the first enable after “Power ON”.</td><td>High</td></tr>
<tr><td>44</td><td>3-wire direction
“3-wire control direction change”
(NC contact switch)</td><td rowspan="3">This control function provides an alternative to enable R/L (01/ 02), for which a permanently applied level is required.
In this case, only a control pulse is required to trigger the function. Control of the FI can therefore be performed entirely with keys.</td><td>0→1 flank</td></tr>
<tr><td>45</td><td>3-W Ctrl. Start Right
“3-wire control Start-Right” (NC contact switch)</td><td>0→1 flank</td></tr>
<tr><td>46</td><td>3-W-Ctrl Start-Left
“3-wire control Start-Left”
(NC contact switch)</td><td>0→1 flank</td></tr>
<tr><td>49</td><td>3-wire control Stop
“ Stop 3-wire control"
(NO contact switch)</td><td></td><td>1→0 flank</td></tr>
<tr><td>47</td><td>Motorpot. Freq. +
“Motor potentiometer frequency +“</td><td rowspan="2">In combination with enable R/L the output frequency can be continuously varied. To save a present value in P113 [-01], both inputs must be at a High potential for 0.5 s. This value is then used as the next starting value for the same direction of rotation (Enable R/L) otherwise start at f_{MIN}.</td><td>High</td></tr>
<tr><td>48</td><td>Motorpot. Freq. -
“Motor potentiometer frequency -“</td><td>High</td></tr>
<tr><td>50</td><td>Bit 0 Fixed frequency array</td><td rowspan="4">Binary coded digital inputs to generate up to 15 fixed frequencies. (P465: [-01] ... [-15])</td><td>High</td></tr>
<tr><td>51</td><td>Bit 1 Fixed frequency array</td><td>High</td></tr>
<tr><td>52</td><td>Bit 2 Fixed frequency array</td><td>High</td></tr>
<tr><td>53</td><td>Bit 3 Fixed frequency array</td><td>High</td></tr>
<tr><td>55</td><td colspan="3">… 64 Reserved for POSICON → BU0210</td></tr>
<tr><td>65 [2]</td><td>Brake man/auto rel.
“Release brake manually / automatically”</td><td>The brake is automatically released by the frequency inverter (automatic brake control) or if this digital input has been set.</td><td>High</td></tr>
<tr><td>66 [2]</td><td>Brake man. release
“Release brake manually”</td><td>The brake is only released if the digital input is set.</td><td>High</td></tr>
</table>

Value	Function	Description	Signal
67	Dig. output man/auto set "Set digital output manually / automatically"	Set digital output 1 manually or via the set function in (P434).	High
68	Digital output. man set "Set digital output manually"	Set digital output 1 manually	High
69	Speed measurement with ini. *"Speed measurement with initiator"*	Simple speed measurement (pulse measurement) with initiator	pulses
70	Evacuation run *"Activate evacuation run"*	This provides the option of operation with a very low link circuit voltage (e.g. from batteries). With this function the charging relay is actuated and the existing monitoring functions are disabled. **NOTICE!** No overload monitoring! (E.g. lifting equipment)	High
71 [3]	Motorpot.F+ and Save *"Motor potentiometer function Frequency + with automatic saving".*	With this "motor pot. Function" a setpoint (value) is set and saved via the digital inputs. With R/L by the controller, this is then started up in the correspondingly enabled direction. The frequency is retained if the direction is changed. Simultaneous activation of the +/- function causes the frequency setpoint value to be set to zero.	High
72 [3]	Motorpot.F- and Save *"Motor potentiometer function frequency- with automatic saving".*	The frequency setpoint value can also be displayed or set in the operating value display (P001 = 30, actual setpoint MP-S) or can be displayed or set in P718. A minimum frequency which is set (P104) remains effective. Other setpoint values, e.g. analog or fixed frequencies can be added or subtracted. Adjustment of the frequency setpoint is performed with the ramps from P102/103.	High
73 [2]	Right disable +fast. *"Disable left running+ Quick stop"*	As for setting 31, however coupled to the "Quick Stop" function.	Low
74 [2]	Left disable+fast. *"Disable left running+ Quick stop"*	As for setting 32, however coupled to the "Quick Stop" function.	Low
75	Dig. output man/auto set *"Set digital output 2 manually / automatically"*	As for function 67, but for digital output 2	High
76	Dig. Output 2 man. set *"Set digital output 2 manually"*	As for function 68, but for digital output 2	High
77	… 78 reserved for POSICON	→ BU0210	
79	Rotor pos. ident.	Precise knowledge of the rotor position is essential for PMSM operation. Rotor position identification is performed if the following conditions are met: • The frequency inverter is in the status "ready for switch-on", • The rotor position is not known (see P434, P481, function "28"), • Function "2" is selected in P336.	1→0 flank
80	PLC stop	Program execution of the integrated PLC is halted for as long as the signal is present.	High

1	If no digital input is parameterised for "enable right" or "enable left", and for devices SK 270E-FDS and higher, all BUS In bits (P480) which are relevant for AS-i are deactivated, a fixed frequency or the jog frequency results in enabling of the frequency inverter. The direction of rotation depends on the prefix of the setpoint.
2	Also effective for control via BUS (e.g. RS232, RS485, CANopen, AS Interface, …)
3	For devices without an integrated low voltage unit (integrated low voltage unit: Option "-HVS"), the control unit of the frequency inverter must be supplied with power for at least 5 minutes after the last motor potentiometer change in order to permanently save the data.
4	Function cannot be selected via BUS IO In Bits

Value	Function	Description	Signal
5		The operating parameter set is selected via correspondingly parametrised digital inputs or BUS control. Switch-over may be performed during operation (online). Coding is binary according to the following pattern. If enabling is via the keyboard (SimpleBox or ParameterBox), the operating parameter set corresponds to the setting 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

P425 Thermistor input

(Function thermistor input)

S

0 ... 1
{ 1 }

A connected thermistor is evaluated by the device This function must be disabled if no thermistor is connected. Otherwise the device will enter a fault state with an overtemperature message (E2.0).

0 = **Off:** Thermistor input not monitored

1 = **On:** Thermistor input monitoring active

Note: If monitoring is deactivated, the device no longer provides direct overtemperature protection for the motor.

P426 Quick stop time

(Quick stop time)

S **P**

0 ... 320.00 sec
{ 0.10 }

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

Emergency stop time is the time for the linear frequency decrease from the set maximum frequency (P105) to 0Hz. If an actual setpoint <100% is being used, the emergency stop time is reduced correspondingly.

P427 Quick stop on error

(Quick stop on error)

S

0 ... 2
{ 0 }

Activation of automatic emergency stop following error

0 = **Disabled:** Automatic emergency stop following error is deactivated

1 = Reserved

2 = **Activated:** Automatic emergency stop following fault

A quick stop can be triggered by error **E2.x, E7.0, E10.x, E12.8, E12.9** and **E19.0**.

P428	Automatic start (*Automatic start)*		S	P

0 ... 1
{ 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.

In the setting **On → 1** the FI reacts to a High level. This function is only possible if the FI is controlled using the digital inputs. (see P509=0/1)

In certain cases, the FI must start up directly when the mains are switched on. 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.

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

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!

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 FI
[-02] = Digital output 2, digital output 2 of the FI

Settings 3 to 5 and 11 operate with a 10% hysteresis, i.e. the output delivers (Funct. 11 does not deliver) when the limit value 24V is reached and switches this off again when a 10% lower value is undershot (Funct. 11 on again).

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

Setting / function		Output ... For limit value or function (See also P435)
0 =	No function	Low
1 =	External brake, for control of an external 24V brake relay (max. 20 mA). The output switches at a programmed absolute minimum frequency (P505). A setpoint delay of 0.2-0.3s (see also P107/P114) should be set for typical brakes. Devices with an optional integrated brake rectifier (e.g. Option „-HWR“, 🕮 Section 1.7 "Type code / nomenclature ") can control a typical motor brake directly (🕮 Section 2.3.2.4 "Electromechanical brake")	Low
2 =	**Inverter operating**: the output signals voltage at the output (U-V-W).	High
3 =	**Current limit**: based on the nominal motor current setting in P203. This value can be adjusted with scaling (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 with scaling (P435).	High
5 =	**Frequency limit**: based on nominal motor frequency setting in P201. This value can be adjusted with scaling (P435).	High
6 =	**Setpoint reached**: indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = Actual frequency! From a difference of 1Hz *→ Setpoint not reached – Low signal.*	High
7 =	**Fault**: general fault message, fault is active or not yet acknowledged. *→ Fault - Low (Ready for operation - High)*	Low
8 =	**Warning**: general warning - a limit value was reached that could result in a later shutdown of the FI.	Low
9 =	**Overcurrent warning**: At least 130 % of the nominal FI current was supplied for 30 seconds.	Low

10 =	**Motor overtemp. warning***: "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 currrent limit active:** *"Torque current limit/current limit active warning"***:** The limit value in P112 or P536 has been reached. A negative value in P435 inverts the response. Hysteresis = 10 %.	Low
12 =	**Value from P541:** *"Value from P541 – external control"*, the output can be controlled with parameter P541 (Bit 0) regardless of the actual operating status of the FI.	High
13 =	**Gen. Torque current limit:** *"Generator torque current limit active".* Limit value in P112 was reached in the generator range. Hysteresis = 10 %	High
16 =	**Comparison val. Ain1:** Setpoint AIN1 of the FI is compared with the value in (P435[-01 or. -02]).	High
17 =	**Comparison val. Ain2:** Setpoint AIN2 of the FI is compared with the value in (P435[-01 or. -02]).	High
18 =	**Inverter ready**: The FI is ready for operation. After being enabled it delivers an output signal.	High
19 =	**Low voltage ok, low voltage present.**	High
20 =	… 27 reserved — See BU 0210 for POSICON functions	
28 =	**PMSM rotor position OK** The PMSM rotor position is known.	High
29 =	Reserved	
30 =	**Digital-In 1 status**	High
31 =	**Digital-In 2 status**	High
32 =	**Digital-In 3 status**	High
33 =	**Digital-In 4 status**	High
34 =	**Digital-In 5 status**	High
35 =	**Maintenance switch status**	High
36 =	**Remote control active** Switching state of the switch in option slot **H1**: High = Remote control active, Low = Manual control active	High
37 =	**Fault or manual operation**	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

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

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 *(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. *(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] ... [-07]	Delay on/off switch *(Digital function switch on/off delay)*		S	

-30,000 ... 30,000 sec
{ 0,000 }

Adjustable switch-on/off delay for digital inputs and 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
[-05] = Digital input 5
[-06] = Digital input 6 / AIN1
[-07] = Digital input 7 / AIN2

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

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

0 ... 80
{ [-01] = 33 }
{ [-02] = 34 }
{ [-03] = 36 }
{ [-04] = 12 }
{ [-05] = 65 }
{ [-06...-10] = 00 }
{ [-11] = 68 }
{ [-12] = 76 }

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 or in combination with I/O extensions (SK xU4-IOE). *With AS-i devices, the priority is AS-i. In this case the relevant BUS IO BITs cannot be used by the IO extensions.*

[-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 / AS-i Dig In5 (Bus IO In Bit 4 + AS-i 5 or 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 Bus I/O Out Bits)

0 ... 40
{ [-01] = 18 }
{ [-02] = 08 }
{ [-03] = 30 }
{ [-04] = 33 }
{ [-05] = 36 }
{ [-06] = 39 }
{ [-07] = 00 }
{ [-08] = 00 }
{ [-09] = 30 }
{ [-10] = 33 }

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 an integrated AS interface, these I/O bits can be used by the interface itself or in combination with I/O extensions (SK xU4-IOE).

[-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 / AS-i Dig Out5 (Bus IO Out Bit 4 + AS-i 5 + DO 1 of the **first** SK xU4-IOE (DigOut 02))
[-06] = Bus / AS-i Dig Out6 (Bus IO Out Bit 5 + AS-i 6 + 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 Use of the marker

With the aid of the marker it is possible to define simple logical sequences of functions.
For this, the “trigger” of a function is defined in the arrays [-09] “Flag 1” and [-10] “Flag 2” (e.g. an overtemperature warning from the motor PTC)
In arrays [-11] and [-12] of parameter P480, the function which the frequency inverter is to perform if the “trigger” is active is assigned in arrays [-11] and [-12] of parameter P480. I.e. parameter P480 determines the response of the frequency inverter.

Example:

In an application, the frequency inverter is to reduce the actual speed immediately (e.g. with an active fixed frequency) if the motor is in the overtemperature range (“Overtemp. motor PTC”). This is to be implemented by “Deactivation of analog input 1” via the setpoint used in this example.
This is to ensure that the load on the motor drops and the temperature can stabilise again, and that the drive systematically reduces its speed to a defined amount before a fault shutdown occurs.

Step	Description	Function
1	Specify trigger Set Flag 1 to function “Motor overtemperature warning“	P481 [-07] → Function“ 12“
2	Specify the response Set Flag 1 to the function “Setpoint 1 on/off	P480 [-09] → Function“ 19“

Depending on the function selected in (P481) the function must be inverted by adjusting the scaling (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]**	**Master function value** *(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 8.9 "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 analog input 1
1 =	Actual frequency	**18 =**	Value analog input 2
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 =**	Actual frequency with slip, *"Actual frequency with slip"*
8 =	Setpoint frequency	**24 =**	Master value Actual freq. w. slip *"Master value, actual freq. 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 8.8).

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

3.0 ... 16.4 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

NOTE: In case of overload of the frequency inverter, the pulse frequency is reduced automatically, depending on the instantaneous degree of overload, in order to prevent an overcurrent shut-down (see also **P537**).

However, the use of a sine wave filter requires a constant pulse frequency at all times, as otherwise "Module error" (**E4.0**) shut-downs will be triggered.

The necessary constant pulse frequencies are selected with the following settings:

*Setting **16.2***: 6 kHz

*Setting **16.3***: 8 kHz

NB: With these settings, short circuits at the output which occur before enabling may possibly not be detected correctly.

NOTE: *Setting **16.4***: Automatic load adjustment

The pulse frequency is automatically adjusted between a minimum value (highest load reserve) and a maximum value (lowest load reserve) depending on the load.

During an acceleration phase and if high power is required (≥ rated power) the minimum value is set. With constant speed and a power requirement ≤ 80 % to the rated power, the high pulse frequency is set..

P505	**Abs. minimum frequency** *(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** *(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** *(Control word source)*		S	

0 ... 5
{ 0 }

Selection of the interface via which the FI is controlled.

0 = **Control terminals or keybd. control,** ***"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 control 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)

5 = **AS-i ***, Control via AS-Interface with CTT2 protocol (double slave)

*) 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.

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

0 ... 5
{ [-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
- **5 =** **AS-i**, see P509

P511	USS baud rate *(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 *(USS address)*			

0 ... 30
{ 0 }

Setting of the FI bus address for USS communication.

P513	Telegram downtime *(Telegram downtime)*		S	

-0.1 / 0.0 /
0.1 ... 100.0 sec
{ 0.0 }

If the frequency inverter is directly controlled via the CAN protocol or via RS485, this communication path can be monitored via parameter (P513). Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the FI reports an fault and switches off with the error message E010 >Bus Time Out<.

The inverter monitors the system bus communication via parameter (P120). Therefore parameter (P513) must usually be left in the factory setting {0.0}. Parameter (P513) must only be set to {-0,1} if faults detected by the optional module (e.g. communication errors on the field bus level) are not to result in the drive unit being switched off.

- **0.0 =** **off**: Monitoring is **switched off**.
- **-0.1 =** **No error**: Even if the bus module detects an error, this does not cause the frequency inverter to be switched off.
- **0.1 … =** **On**: Monitoring is activated.

P514	CAN baud rate *(CAN baud rate)*		S	

0 ... 7
{ 5 }

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

Note:
Optional modules (SK xU4-…) only operate with a transfer rate of 250kBaud. Therefore the frequency inverter must remain at the factory setting (250kBaud).

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

*) 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.

If the system bus address has already been set by the hardware (please check the order / project documents), settings which are made in this parameter (**P515**) do not have any effect.

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

0.0 ... 400.0 Hz
{ 0.0 }

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

This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set.

0 = Skip frequency inactive

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

0.0 ... 50.0 Hz
{ 2.0 }

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

Skip frequency range 1: P516 - P517 ... P516 + P517

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

0.0 ... 400.0 Hz
{ 0.0 }

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

This range is transmitted with the set brake and acceleration ramp; it cannot be continuously supplied to the output. Frequencies below the absolute minimum frequency should not be set.

0 = Skip frequency inactive

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

0.0 ... 50.0 Hz
{ 2.0 }

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

Skip frequency range 2: P518 - P519 ... P518 + P519

P520	Flying start *(Flying start)*		S	P

0 ... 4
{ 0 }

This function is required to connect the FI to already rotating motors, e.g. in fan drives. Motor frequencies >100Hz are only picked up in speed controlled mode (Servo mode P300 = ON).

0 = Switched off, no flying start.

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

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

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

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

NOTE: For physical reasons, the flying start circuit only operates above 1/10 of the nominal motor frequency (P201), however, not below 10Hz.

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

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. *(Flying start resolution)*		S	P

0.02... 2.50 Hz
{ 0.05 }

Using this parameter, the flying start circuit search increment size can be adjusted. Values that are too large affect accuracy and causes the FI to cut out with an overcurrent message. If the values are too small, the search time is greatly extended.

P522	Fly. start offset *(Flying start offset)*		S	P

-10.0 ... 10.0 Hz
{ 0.0 }

A frequency value that can be added to the frequency value found, e.g. to remain in the motor range and so avoid the generator range and therefore the chopper range.

P523	Factory setting *(Factory setting)*			

0 … 3
{ 0 }

With the selection of the relevant value and confirmation via the ENTER key, the selected parameter range is set to factory setting. Once this setting is made, the parameter value automatically changes back to 0.

- **0 = No change:** Does not change the parameterisation.
- **1 = Load factory setting:** The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost.
- **2 = Factory setting without bus:** All parameters of the frequency inverter, with the exception of the bus parameters, are reset to the factory setting.
- **3 = Factory setting without motor data:** All parameters of the frequency inverter, with the exception of the motor data parameters (**P201** to **P209**), are reset to the factory setting.

Note: The default values of parameter P420 [-05], [-06] and [-07] depend on the control elements on option slots **H1** and **H2**.

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

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

Selection of up to 3 auxiliary values:

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

Maximum load torque value.

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

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

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

0 ... 400 %
{ all 0 }

Selection of up to 3 auxiliary values:

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

Minimum load torque.

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

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

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

0.0 ... 400.0 Hz
{ all 25.0 }

Selection of up to 3 auxiliary values:

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

Auxiliary frequency values

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

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

0.10 ... 320.00 s
{ 2.00 }

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

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

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

0 ... 3
{ 0 }

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

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

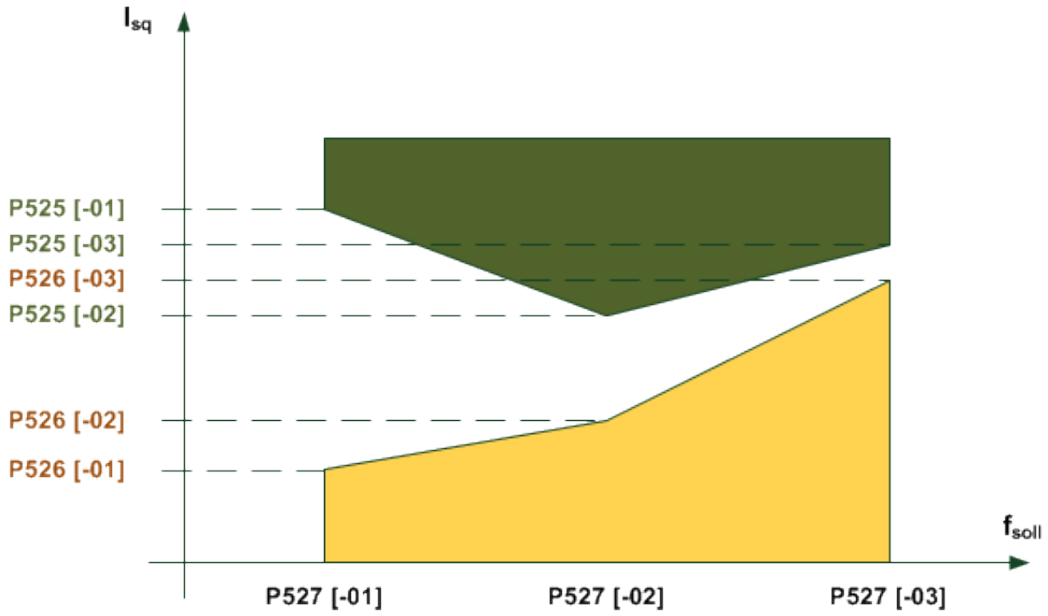
1 = **Warning**, After the elapse of half of the time defined in (P528) and infringement of the monitoring range produces a warning ("C12.5").

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

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

P525 … P529 Load monitoring

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



The time after which a fault is triggered can be set with parameter (P528). If the permissible range is exceeded *(Example diagram: 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** *(Factor I^2t-Motor)*		**S**	
50 ... 150 % { 100 }	The motor current for the I^2t motor monitoring P535 can be weighted with the parameter P533. Larger factors permit larger currents.			

P534	**[-01]** **[-02]**	**Torque disconn. limit** *(Torque disconnection limit)*		**S**	**P**
0 ... 400 % / 401 { all 401 }	Via this parameter both the **drive** [-01] and the **generator** [-02] switch-off value can be adjusted. If 80% of the set value is reached, a warning status is set. At 100% switch-off is performed with an error message. Error 12.1 is given on exceeding the drive switch-off limit and 12.2on exceeding the generator switch-off limit. **[01] =** drive switch-off limit **[02] =** generator switch-off limit **401 = OFF** means that this function has been disabled.				

P535 — I^2t Motor

(I^2t Motor)

0 … 24
{ 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.

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**.

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.

With multi-motor operation the monitoring must be disabled.

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

(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

(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 (chapter 8.4).

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** *(Output monitoring)*		S	P

0 ... 7
{ 0 }

With this protective function the output current at the U-V-W terminals is monitored and checked for plausibility. In case of error, error message E016 is output.

Settings 0 – 3 are identical to settings 4 – 7, however with the settings 4 – 7 a mechanical brake is not monitored (only relevant for equipment code "-BWRN").

0 = **Mech. brake:** Only the mechanical brake is monitored.

1 = **Mech. brake + motor phases:** In addition to monitoring of the mechanical brake, the output current is measured and checked for symmetry. If an asymmetry is present, the FI switches off and outputs error message E016.

2 = **Mech. brake + excitation.:** In addition to monitoring of the mechanical brake, the excitation current (field current) is checked when the FI is switched on. 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 = **MBr.+Motorph. + Magnet.:** In addition to monitoring of the mechanical brake, the motor phases and excitation are monitored - as 1 and 2 combined.

4 = **Switched off:** Monitoring is not performed.

5 = **Motor phases only:** The output current is measured and checked for symmetry. If an asymmetry is present, the FI switches off and outputs error message E016.

6 = **Magnetisation only:** When 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.

7 = **Motor phase + Magnet.:** Motor phase and excitation monitoring, as 5 and 6 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 *(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 **0**	0000 **0**	0000 **0**	Binary **hex**
Max. value	1111 **F**	1111 **F**	1111 **F**	Binary **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 *(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: (chapter 8.8).

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

(Definition of frequencies (chapter 8.9))

- **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 analog input 1
- **18 =** Value of analog input 2,
- **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 *"Actual frequency with slip"*
- **24 =** Master value Actual freq. w. slip *"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 = DIN 1 (FI)	Bit 1 = DIN 2 (FI)	Bit 2 = DIN 3 (FI)	Bit 3 = DIN 4 (FI)
Bit 4 = DIN 5 (FI)	Bit 5 = DIN 6 (FI)	Bit 6 = DIN 7 (FI)	Bit 7 = PTC input [FI]
Bit 8 = DI1, 1. SK…IOE	Bit 9 = DI2, 1. SK…IOE	Bit 10 = DI3, 1. SK…IOE	Bit 11 = DI4, 1. SK…IOE
Bit 12 = DOUT 1 (FI)	Bit 13 = mech. Brake (FI)	Bit 14 = DOUT 2 (FI)	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: (chapter 8.8).

[-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 *(EEPROM copy order)*			

0 ... 3
{ 0 }

Only valid with option: "**-EEP**" ("plug-in EEPROM"):

Devices with option: "**-EEP**" ***(In preparation)*** are also 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 inverter 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 inverter.

- **0 =** **No change**
- **1 =** **External** → **Internal**, the data set is copied from the memory module (external EEPROM) to the internal EEPROM
- **2 =** **Internal** → **External**, 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: The device always used the data record which is saved in the internal EEPROM.

P552 [-01] [-02]	CAN Master cycle *(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 ... 36
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 =**	Multiplication
1 =	Setpoint frequency	**18 =**	Curve travel calculator
2 =	Frequency addition	**19 =**	Servo mode torque
3 =	Frequency subtraction	**20 =**	BusIO In Bits 0-7
4 =	Minimum frequency	**21 =**	Setpoint position Low word
5 =	Maximum frequency	**22 =**	Setpoint pos. HighWord
6 =	Process controller actual value	**23 =**	Setpoint pos. Inc.LowWord
7 =	Process controller setpoint	**24 =**	Target pos.Inc.HighWord
8 =	Actual frequency PI	**25 =**	Gear ratio factor
9 =	Actual PI freq. limited	**26 =**	... 30: Reserved
10 =	Actual PI freq. monitored	**31 =**	Digital output IOE
11 =	Torque current limit (limiting)	**32 =**	Analog output IOE
12 =	Torque current switch-off limit	**33 =**	Torque process controller setpoint
13 =	Current limit (limiting)	**34 =**	d-correction F process
14 =	Current switch-off limit	**35 =**	d-correction Torque
15 =	Ramp time	**36 =**	d-correction F+Torque
16 =	Torque precontrol		

P555		Chopper P limitation *(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=

NOTE: If an **internal** brake resistor is used, the specific data for the brake resistor are set automatically. It is therefore not possible to change the parameter setting.

P556	Braking resistor *(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**). **NOTE:** If an **internal** brake resistor is used, the specific data for the brake resistor are set automatically. It is therefore not possible to change the parameter setting.			

P557	Brake resistor type *(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 **NOTE:** If an **internal** brake resistor is used, the specific data for the brake resistor are set automatically. It is therefore not possible to change the parameter setting.			

P558	Flux delay *(Flux delay)*		S	P
0 / 1 / 2 ... 5000 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 ... 5000 =** Time set in [ms] **NOTE:** Setting values that are too low can reduce the dynamics and starting torque.			

P559	DC Run-on time *(DC Run-on time)*		S	P
0.00 ... 30.00 s { 0.50 }	Following a stop signal and the braking ramp, a direct current is briefly applied to the motor to fully bring the drive to a stop. Depending on the inertia, the time for which the current is applied can be set in this parameter. The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic).			

P560	Parameter, Saving mode *(Saving mode parameter)*		S	

0 ... 2
{ 1 }

0 = **Only in RAM**, changes to the parameter settings are no longer saved on the EEPROM. All previously saved settings are retained, even if the FI is disconnected from the mains.

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

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

NOTE: If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles (100,000 x) in the EEPROM is not exceeded.

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.

P565	AS-i mode *(AS-i mode*)		S	

0 ... 33
{ 0 }

For devices which communicate via an AS interface (only possible for SK 270E-FDS and SK 280E-FDS) this is performed by the setting of the communication protocol.

After the mode has been set, the display reverts to the value 0.

The factory setting of the AS-i mode is made according to the version of the device and can be checked in P746.

0 = No change

1 = **4IO+CTT2=7.A.7+7.A.5:** *Double slave* (A/B-Slave + CTT2-Slave) in the extended address range, with extended data transfer for cyclical exchange of process data

2 = **4IO+4IO=7.A.7+7.A.7:** *Double slave* (2 x A/B-Slave) – in the extended address range

3 = *Reserved*

16 = **4IOStd=7.F:** *Single slave* – in the standard address range

17 = *Reserved*

32 = **4IOExt=7.A.7:** *Single slave* (A/B slave)- in the extended address range

33 = *Reserved*

NOTE: Switching can only be performed between AS-i modes which match the hardware configuration of the device. E.g. switching between a single slave and a double slave configuration is not possible. Such an attempt is suppressed by the frequency inverter and generates an error message.

NB: **Avoid changing the AS-i mode more than 10 times.** Frequent changes damage the device Changes are then no longer possible.

This parameter is only function above AS-i – Version 1.3 (see parameter P745).

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** *(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 (chapter 6.3). **[-01] = Present fault,** shows the currently active (unacknowledged) fault (chapter 6.3). **[-02] = Present warning,** indicates a current warning message (chapter 6.3). **[-03] = Reason for disabled starting,** indicates the reason for an active start disable (chapter 6.3). **NOTE** *SimpleBox / ControlBox:* the error numbers of the warning messages and faults can be displayed using SimpleBox and ControlBox. *ParameterBox:* with the ParameterBox the messages are displayed in plain text.. In addition, the reason for a possible disabling of starting can also be displayed. *Bus:* The display of bus-level error messages is displayed in decimal integer format. The displayed value must be divided by 10 in order to correspond with the correct format. Example: Display: 20 → Error number: 2.0			
P701	**[-01] ... [-05]**	**Last fault 1 ... 5** *(Last fault 1...5)*			
0.0 ... 25.4		This parameter stores the last 5 faults (chapter 6.3). The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.			
P702	**[-01] ... [-05]**	**Last frequency error** *(Last frequency error 1...5)*		**S**	
-400.0 ... 400.0 Hz		This parameter stores the output frequency that was being delivered at the time the fault occurred. The values of the last 5 errors are stored. The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK- / ENTER key to read the stored error code.			
P703	**[-01] ... [-05]**	**Current last error** *(Last current error 1...5)*		**S**	
0.0 ... 999.9 A		This parameter stores the output current that was being delivered at the time the fault occurred. The values of the last 5 errors are stored. The SimpleBox / ControlBox must be used to select the corresponding memory location 1...5- (Array parameter), and confirmed using the OK / ENTER key to read the stored error code.			

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

0 ... 600 V AC

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

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

P705	**[-01] ... [-05]**	**Last link circuit error** *(Last link circuit error 1...5)*		**S**	

0 ... 1000 V DC

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

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

P706	**[-01] ... [-05]**	**P set last error** *(Parameter set, last error 1… 5)*		**S**	

0 ... 3

This parameter stores the parameter set code that was active when the error occurred. Data for the previous 5 faults are stored.

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

P707	**[-01] ... [-03]**	**Software-Version** *(Software version/ revision)*			

0.0 ... 9999.9

This parameter shows the software and revision numbers in the FI. This can be significant when different FIs are assigned the same settings.

Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version.

... [-01] = Version number (Vx.x)
... [-02] = Revision number (Rx)
... [-03] = Special version of hardware/software (0.0)

P708 — Digital input status.
(Digital input status)

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 1 = Digital input 1
Bit 1 = Digital input 2
Bit 2 = Digital input 3
Bit 4 = Digital input 5
Bit 4 = Digital input 5
Bit 5 = Digital input 6 (AIN1)
Bit 6 = Digital input 7 (AIN2)
Bit 7 = Thermistor input

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 0	0000 0	0000 0	0000 0	Binary **hex**
Maximum value	1111 F	1111 F	1111 F	1111 F	Binary **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
(Analog input voltage)

-100 ... 100 %

Displays the measured analogue input value.

[-01] = **Analog input 1**, function of analog input 1 integrated into the FI
[-02] = **Analog input 2**, function of analog input 2 integrated into the FI
[-03] = **Ext. Analog input 1,** AIN 1 of the first SK xU4-IOE I/O extension
[-04] = **Ext. Analog input 2,** AIN2 of the first SK xU4-IOE I/O extension
[-05] = **Setpoint module**, SK SSX-3A, see BU0040
[-06] = **Analog function Dig**. 2, analog function of FI digital input 2
[-07] = **Analog function Dig**. 3, analog function of FI digital input 3
[-08]= **Ext. A. in. 1 2nd IOE,** *"External analog input 1 2nd IOE"*, AIN1 of the second I/O - extension (SK xU4-IOE) (= Analog input 3)
[-09] = **Ext. A.in. 2 2nd IOE,** *"External analog input 2 2nd IOE"*, AIN2 of the second I/O - extension (SK xU4-IOE) (= Analog 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 (chapter 8.1).

[-01] = Actual setpoint frequency from the setpoint source
[-02] = Actual setpoint frequency after processing in the FI status machine
[-03] = Actual setpoint frequency after frequency ramp

P719	**Actual current** *(Actual current)*			
0.0 ... 999.9 A	Displays the actual output current.			
P720	**Act. torque current** *(Actual torque current)*			
-999.9 ... 999.9 A	Displays the actual calculated torque-developing output current (active current). Basis for calculation are the motor data P201...P209. → negative values = generator, → positive values = drive			
P721	**Actual field current** *(Actual field current)*			
-999.9 ... 999.9 A	Displays the actual calculated field current (reactive current). Basis for calculation are the motor data P201...P209.			
P722	**Current voltage** *(Actual voltage)*			
0 ... 500 V	Displays the actual AC voltage supplied by the FI output.			
P723	**Voltage -d** *(Actual voltage component Ud)*		**S**	
-500 ... 500 V	Displays the actual field voltage component.			
P724	**Voltage -q** *(Actual voltage component Uq)*		**S**	
-500 ... 500 V	Displays the actual torque voltage component.			
P725	**Current Cos phi** *(Actual cosj)*			
0.00 ... 1.00	Displays the actual calculated cos φ of the drive.			
P726	**Apparent power** *(Apparent power)*			
0.00 ... 300.00 kVA	Displays the actual calculated apparent power. The basis for calculation are the motor data P201...P209.			
P727	**Mechanical power** *(Mechanical power)*			
-99.99 ... 99.99 kW	Displays the actual calculated effective power of the motor. Basis for calculation are the motor data P201...P209.			

P728	**Input voltage** *(mains voltage)*			
0 ... 1000 V	Displays the actual mains voltage at the FI input. 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** *(Torque)*			
-400 ... 400 %	Displays the actual calculated torque. Basis for calculation are the motor data P201...P209.			

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

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

P732	**Phase U current** *(U phase current)*		**S**	
0.0 ... 999.9 A	Displays the actual U phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			

P733	**Phase V current** *(V phase current)*		**S**	
0.0 ... 999.9 A	Displays the actual V phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			

P734	**Phase W current** *(W phase current)*		**S**	
0.0 ... 999.9 A	Displays the actual W phase current. **NOTE:** This value can deviate somewhat from the value in P719, due to the measurement procedure used, even with symmetrical output currents.			

P735	Encoder speed *(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 *(DC link voltage)*			
0 ... 1000 V DC	Displays the actual link voltage.			

Information **Display of untypical value**

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. *(Actual brake resistor usage rate)*			
0 ... 1000 %	This parameter provides information about the actual degree of modulation of the brake chopper or the current utilisation of the braking resistor in generator mode. If parameters P556 and P557 are correctly set, the utilisation related to P557, the resistor power, is displayed. If only P556 is correctly set (P557=0), the degree of modulation of the brake chopper is displayed. Here, 100 means that the brake resistor is fully switched. On the other hand, 0 means that the brake chopper is not active at present. If P556 = 0 and P557 = 0, this parameter also provides information about the degree of modulation of the brake chopper in the FI.			

P738 [-01] [-02]	Motor usage rate *(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. **[-01] = in relation to I_N** (P203) of the motor **[-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** **[-02] = Internal temperature of the FI** **[-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. For display, a BUS system must be selected in P509. Standardisation: (📖 section 8.8 "Standardisation of setpoint / target values")	**[-01] =** Control word		Control word, source from P509.	
		[-02] = Setpoint 1 (P510/1, P546) **[-03] =** Setpoint 2 (P510/1, …) **[-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 **[-07]** = Parameter data In 2 **[-08]** = Parameter data In 3 **[-09]** = Parameter data In 4 **[-10]** = Parameter data In 5		Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)	
		[-11] = Setpoint 1 (P510/2) **[-12] =** Setpoint 2 (P510/2) **[-13] =** Setpoint 3 (P510/2)		Setpoint data from the master function value (Broadcast) - (P502/P503), if P509 = 4	
		[-14] = Control word PLC **[-15] =** Setpoint 1 PLC **…** **[-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. Standardisation: (📖 section 8.8 "Standardisation of setpoint / target values")	**[-01] =** Status word		Status word, source from P509.	
		[-02] = Actual value 1 (P543) **[-03]** = Actual value 2 (…) **[-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 **[-07] =** Parameter data Out 2 **[-08] =** Parameter data Out 3 **[-09] =** Parameter data Out 4 **[-10] =** Parameter data Out 5		Data during parameter transfer.	
		[-11] = Actual value 1 master funct. **[-12] =** Actual value 2 master funct. **[-13] =** Actual value 3 master funct.		Actual value of master function P502 / P503.	
		[-14] = Status word PLC **[-15] =** Actual value 1 PLC … **[-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 250E-FDS-…-A)
		01_{hex}	STO	(SK 260E-FDS-…-A))
00_{hex}	No extension	02_{hex}	AS-i	(SK 270E-FDS-…-A))
01_{hex}	Encoder	03_{hex}	STO und AS-i	(SK 280E-FDS-…-A))
02_{hex}	Posicon	04_{hex}	Standard I/O	(SK 250E-FDS-…-HVS-…-A)
03_{hex}	---	05_{hex}	STO	(SK 260E-FDS-…-HVS-…-A)
		06_{hex}	AS-i	(SK 270E-FDS-…-HVS-…-A)
		07_{hex}	STO and AS-i	(SK 280E-FDS-…-HVS-…-A)

P745	**AS-i version** *(AS-i version)*	**SK 270E-FDS** **SK 280E-FDS**		
0 ... 9999.0	Version status (software version) of the AS-i interface. Have this data available if you have a technical query.			

P746	AS-i Status *(AS-i Status)*	SK 270E-FDS SK 280E-FDS		

0000 ... FFFF (hex)
or
0 ... 65535 (dec)

Indicates the present state (ready, error, communication) of the AS-i interface

Bit 0-3:	Status of 2nd slave
Bit 4-6:	Reserved
Bit 7:	Cyclic communication of 2nd slave present
Bit 8-11:	Status of 1st slave
Bit 12-14:	Reserved
Bit 15:	Cyclic communication of 1st slave present During an AS-i firmware update Bit 14 and 15 = 1

Status of 1st slave	Bit 11	Bit 10	Bit 9	Bit 8
AS-i voltage from	0	0	0	0
1. Slave chip not present	0	0	1	1
Reset	0	1	0	0
ADR = 0	0	1	1	0
NODEX (No Data Exchange)	0	1	1	1
DEX (Data Exchange)	1	0	0	0

Status of 2nd slave	Bit 3	Bit 2	Bit 1	Bit 0
AS-i voltage from	0	0	0	0
2. Slave chip not present	0	0	1	1
Reset	0	1	0	0
ADR = 0	0	1	1	0
NODEX (No Data Exchange)	0	1	1	1
DEX (Data Exchange)	1	0	0	0

Note: In the form described here, this parameter is only functional up to AS-i – Version < 1.3 (see parameter P745). For use of an AS-i – Version of 1.3 or higher, the following description applies for this parameter.

P746 [-01] ... [-05]	AS-i Status *(AS-i Status)*	SK 270E-FDS SK 280E-FDS		

0000 ... FFFF (hex)
or
0 ... 65535 (dec)

[-01] Present state (ready, error, communication) of the AS-i interface

Bit 0-3:	Status of 2nd slave
Bit 4-6:	Reserved
Bit 7:	Cyclic communication of 2nd slave present
Bit 8-11:	Status of 1st slave
Bit 12-14:	Reserved
Bit 15:	Cyclic communication of 1st slave present During an AS-i firmware update Bit 14 and 15 = 1.

Status of 1st slave	Bit 11	Bit 10	Bit 9	Bit 8
AS-i voltage from	0	0	0	0
1. Slave chip not present	0	0	1	1
Reset	0	1	0	0
ADR = 0	0	1	1	0
NODEX (No Data Exchange)	0	1	1	1
DEX (Data Exchange)	1	0	0	0

Status of 2nd slave	Bit 3	Bit 2	Bit 1	Bit 0
AS-i voltage from	0	0	0	0
2. Slave chip not present	0	0	1	1
Reset	0	1	0	0
ADR = 0	0	1	1	0
NODEX (No Data Exchange)	0	1	1	1
DEX (Data Exchange)	1	0	0	0

[-02] Active AS-i mode (see P565).

Bit 0-3:	Active AS-i mode
Bit 4-15:	Reserved

AS-i Mode	Bit 3	Bit 2	Bit 1	Bit 0
4IO+CTT2=7.A.7+7.A.5, double slave, cyclic	0	0	0	1
4IO+4IO=7.A.7+7.A.7, A/B slave, standard	0	0	1	0
4IOStd=7.F, standard slave, standard	0	1	0	0
4IOExt=7.A.7, double slave acyclic	1	0	0	0

[-03] Data from master to Slave 1

[-04] Data from master to Slave 2

[-05] Parameter bits Slave 1 and Slave 2

Display of the parameter bits set from the AS-i master. The meaning of the individual bits depends on the selected profile.

Bit 0-3:	Parameter bits 0 to 3 from 2. slave
Bit 4-7:	Reserved
Bit 8-11:	Parameter bits 0 to 3 from 1. slave
Bit 12-15:	Reserved

Note:	In the form described here, this parameter is only functional for AS-i – Version 1.3 and higher (see parameter P745). For use of an older AS-i – Version of 1.3, the following description applies for this parameter.

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

(Status of DIP switches)

0000 ... 01FF (hex)
or
0 ... 511 (dec)

This parameter indicates the various internal configurations.

Bit 0:	System bus address (Bit 0)
Bit 1:	System bus address (Bit 1)
Bit 2:	System bus active
Bit 3 – 6:	Reserved
Bit 7:	Internal brake resistor
Bit 8:	EEPROM (Memory Module) Bit 8 = 0: plugged in / Bit 8 = 1: not plugged in

Address	Bit 1	Bit 0
32	0	0
34	0	1
36	1	0
38	1	1

P750 Stat. overcurrent

(Overcurrent statistics)

S

0 ... 9999

Number of overcurrent messages during the operating period P714.

P751 Stat. Overvoltage

(Overvoltage statistics))

S

0 ... 9999

Number of overvoltage messages during the operating period P714.

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

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

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

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

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

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

P760	Actual mains current *(Actual mains current)*		S	
0.0 ... 999.9 A	Displays the actual input current.			

P780 [-01] ... [-14]	Device ID *(Device ID)*			
0 … 9 and A…Z (char) { 0 }	Display of the serial number (14-digit) of the device. – Display via NORDCON: as a coherent serial number of the device. – Display via Bus: ASCII code (decimal). Each array must be read out separately.			

P799 [-01] ... [-05]	Op.-time last error *(Operating time, last fault 1...5)*			
0.1 ... ___ h	This parameter shows the operating hours counter status (P714) at the moment of the previous fault. Array 01…05 corresponds to the lastest fault 1…5.			

6 Operating status messages

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 indicators

The device status is indicated by an externally visible “FI status” LED (📖 Section 3.1 "Displays").

SimpleBox Display

The SimpleBox displays an error with its number and the prefix "E". In addition, the present fault can be displayed in array element [**-01**] of parameter (**P700)**. The last error messages are stored in parameter (**P701**). Further information about the frequency inverter status at the moment of the fault can be obtained from 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 3.2 "Control and parametrisation options ") (Parameter group **P7xx**).

To a limited extent, the messages are also indicated via the diagnostic and status LEDs.

Explanations of the LED indicators can be found in 📖 Section 3.1 "Displays".

6.3 Messages

Error messages

Display in the SimpleBox / ControlBox		Fault Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-01] / P701**		
E001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring measurements are outside of the permissible temperature range, i.e. the error is triggered if the permissible lower limit is undershot or the permissible upper temperature limit is exceeded. • Depending on the cause: Reduce or increase the ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
	1.1	**Overtemp. FI internal** *"Internal FI overtemperature"* (interior of FI)	
E002	**2.0**	**Overtemp. Motor PTC** *"Overtemperature motor thermistor "*	Motor temperature sensor (PTC) has triggered • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Overtemp. Motor I^2t** *"Motor overtemperature I^2t"* Only if I^2t motor (P535) is programmed.	I^2t motor has triggered (calculated overtemperature of motor) • Reduce motor load • Increase motor speed
	2.2	**Overtemp. Brake r.ext** *"Overtemperature of external brake resistor "* Overtemperature via digital input (P420 […])={13}	Temperature monitor (e.g. brake resistor) has activated • Digital input is Low • Check connection, temperature sensor
E003	**3.0**	**I^2t overcurrent limit**	a.c. inverter: I^2t limit has triggered, e.g. > 1.5 x I_n for 60s (also note P504) • Continuous overload at inverter output • Possible encoder fault (resolution, defect, connection)
	3.1	**Chopper overtemperature I^2t**	Brake chopper: I^2t limit has activated, 1.5 times values reached for 60s (please also pay attention to P554, if present, and P555, P556, P557) • Avoid overcurrent in brake resistance
	3.2	**IGBT overcurrent** 125% monitoring	De-rating (power reduction) • 125% overcurrent for 50ms • Brake chopper current too high • for fan drives: enable flying start circuit (P520)
	3.3	**IGBT overcurrent fast** 150% monitoring	De-rating (power reduction) • 150% overcurrent • Brake chopper current too high

E004	**4.0**	**Overcurrent module**	Error signal from module (short duration) • Short-circuit or earthing fault at FI output • Motor cable is too long • Use external output choke • Brake resistor faulty or resistance too low → **Do not switch off P537!** **The occurrence of a fault can significantly shorten the service life of the device, or even destroy it.**
	4.1	**Overcurrent measurement** *"Overcurrent measurement"*	P537 (pulse current switch-off) was reached 3x within 50 ms (only possible if P112 and P536 are disabled) • FI is overloaded • Drive sluggish, insufficiently sized, • Ramps (P102/P103) too steep → Increase ramp time • Check motor data (P201 … P209)
	4.5	**Overcurrent / short circuit in the brake rectifier** *Overcurrent / short circuit in the brake rectifier*	• Electromechanical brake defective • Electromechanical brake connected with impermissible electrical data → Check the connection data
E005	**5.0**	**Overvoltage Ud**	Link circuit voltage too high • Increase deceleration time (P103) • Possibly set shutdown mode (P108) with delay (not for lifting equipment) • Extend the quick stop time (P426) • Speed fluctuation (for example due to high inertia loads) → if necessary set the <U/f characteristic curve (P211, P212) FIs with brake chopper: • Dissipate energy feedback with a braking resistor • Check the function of the braking resistor (cable break) • Resistance of connected braking resistor too high
	5.1	**Mains high voltage**	Mains voltage too high • See Technical Data (🕮 Section 7)
E006	**6.0**	**Charging fault**	Link circuit voltage too low • Mains voltage too low • See Technical Data (🕮 Section 7)
	6.1	**Mains low voltage**	Mains voltage too low • See Technical Data (🕮 Section 7)
E007	**7.0**	**Mains phase error**	Error at terminal connection side • A mains phase is not connected • Mains asymmetrical
	7.1	**UZW phase error**	Mains phase error
E008	**8.0**	**Parameter loss** (maximum EEPROM value exceeded)	Error in EEPROM data • Software version of the stored data set not compatible with the software version of the FI. **NOTE:** Faulty parameters are automatically reloaded (default data). • EMC interferences (see also E020)
	8.1	**Inverter type incorrect**	• EEPROM faulty
	8.2	**Reserved**	

	8.3	**EEPROM KSE error** (Customer unit incorrectly identified (customer's interface equipment))	The upgrade level of the frequency inverter was not correctly identified. • Switch mains voltage off and on again.
	8.4	**Internal EEPROM error** (Database version incorrect)	
	8.7	**EEPR copy not the same**	
E009	**---**	**Reserved**	
E010	**10.0**	**Bus Timeout**	Telegram time-out / Bus off 24V int. CANbus • Data transfer is faulty. Check P513. • Check physical bus connections • Check bus protocol program process. • Check Bus Master. • Check 24V supply of internal CAN/CANopen Bus. • Node guarding error (internal CANopen) • *Bus Off* error (internal CANbus)
	10.2	**Bus Timeout Option**	Telegram timeout • Telegram transfer is faulty. • Check physical bus connections • Check bus protocol program process. • Check Bus Master. • PLC is in the "STOP" or "ERROR" state.
	10.4	**Init error Option**	Initialisation error in bus module • Check Bus module current supply. • DIP switch setting of a connected I/O extension module is incorrect
	10.1	**System error option**	System error bus module • Further details can be found in the respective additional bus instructions. I/O extension: • Incorrect measurement of the input voltage or undefined provision of the output voltage due to error in reference voltage generation. • Short circuit at analogue output
	10.3		
	10.5		
	10.6		
	10.7		
	10.9	**Module missing / P120**	The module entered in parameter (P120) is not available. • Check connections
E011	**11.0**	**Customer terminal**	A/D converter error Internal control terminal (internal data bus) incorrect or interference due to radio radiation (EMC). • Check control connections for short circuit. • Minimise EMC interferences by separate routing of control and power cables. • Earth devices and shields well.
E012	**12.0**	**External watchdog**	The Watchdog function is selected at a digital input and the impulse at the corresponding digital input is not present for longer than the time set in parameter P460 >Watchdog time<. • Check connections • Check setting P460

	12.1	**Limit moto./Customer** *"Drive switch-off limit"*	The drive switch-off limit (P534 [-01]) has triggered. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Limit gen.** *"Generator switch-off limit"*	The generator switch-off limit (P534 [-02]) has triggered. • Reduce load on motor • 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). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528). • Change monitoring mode (P529).
	12.8	**AI minimum** *„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** *„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 • Check 5V sensor if present. • Check supply voltage of encoder.
	13.1	**Speed slip error** *"Speed slip error"*	The slip speed error limit was reached. • Increase setting in P327.
	13.2	**Shut-down monitoring**	The slip error monitoring has triggered; the motor could not follow the setpoint. • Check motor data P201-P209! (Important for the current controller) • Check motor circuit. • In servo mode, check the encoder setting P300 and check the following • Increase setting value for torque limit in P112. • Increase setting value for current limit in P536. • Check deceleration time P103 and extend if necessary
	13.5	**Reserved**	Error message for POSICON → see supplementary instructions
	13.6	**Reserved**	Error message for POSICON → see supplementary instructions
E014	**---**	**Reserved**	Error message for POSICON → see supplementary instructions
E015	**---**	**Reserved**	
E016	**16.0**	**Motor phase error**	A motor phase is not connected. • Check P539 • Check motor connection

	16.1	**Magnetisation current monitoring** *"Magnetisation current monitoring"*	Required exciting current not achieved at moment of switch-on. • Check P539 • Check motor connection
E018	**18.0**	**Reserved**	Error message for “Safe Pulse Block”, see supplementary instructions
E019	**19.0**	**Parameter identification** *"Parameter identification"*	Automatic identification of the connected motor was unsuccessful • Check motor connection • Check preset motor data (P201 … P209) • PMSM – CFC Closed Loop Operation: Rotor position of motor incorrect in relation to incremental encoder Perform determination of rotor position (initial enable after a "Mains on" only with motor stationary (P330)
	19.1	**Star / Delta circuit incorrect** *"Motor star / delta circuit incorrect"*	
E020 E021	**20.0**	**Reserved**	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use additional external mains filter. • FI must be very well earthed.
	20.1	**Watchdog**	
	20.2	**Stack overflow**	
	20.3	**Stack underflow**	
	20.4	**Undefined opcode**	
	20.5	**Protected Instruct.** *"Protected Instruction"*	
	20.6	**Illegal word access**	
	20.7	**Illegal Inst. Access** *"Illegal instruction access"*	
	20.8	**Program memory error** "*Program memory error*" (EEPROM error)	
	20.9	**Dual-ported RAM**	
	21.0	**NMI error** (Not used by hardware)	
	21.1	**PLL error**	
	21.2	**ADU error** "Overrun"	
	21.3	**PMI error** "Access Error"	
	21.4	**Userstack overflow**	
E022	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E023	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E024	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550

Warning messages

Display in the SimpleBox / ControlBox		Warning Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-02]**		
C001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring Warning: permissible temperature limit reached. • Reduce ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
C002	**2.0**	**Motor overtemp. PTC** *"Motor overtemp. PTC"*	Warning from the motor temperature sensor (trigger limit reached) • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Motor overtemp. I²t** *"Motor overtemperature I²t"* Only if I^2t motor (P535) is programmed.	Warning: I^2t motor monitoring (1.3x the rated current reached for the time period set in (P535)) • Reduce motor load • Increase motor speed
	2.2	**External braking resistor overtemperature** *"External braking resistor overtemperature"* Overtemperature via digital input (P420 […])={13}	Warning: Temperature sensor (e.g. braking resistor) has triggererd • Digital input is low
C003	**3.0**	**Overcurrent, I^2t limit**	Warning: Inverter: I^2t limit has triggered, e.g. > 1.3 x I_n for 60s (please also note P504) • Continuous overload at FI output
	3.1	**Overcurrent, chopper I^2t**	Warning: I^2t limit for the brake chopper has triggered, 1.3x value attained for 60s (also note P554, if present, as well as P555, P556, P557) • Avoid overload of brake resistance
	3.5	**Torque current limit**	Warning: Torque current limit reached • Check (P112)
	3.6	**Current limit**	Warning: Current limit reached • Check (P536)
C004	**4.1**	**Overcurrent measurement** *"Overcurrent measurement"*	Warning: pulse switch off is active The limit for activation of pulse switch off (P537) has been reached (only possible if P112 and P536 are switched off) • FI is overloaded • Drive sluggish, insufficiently sized • Ramps (P102/P103) too steep -> Increase ramp time • Check motor data (P201 … P209) • Switch off slip compensation (P212)

C008	**8.0**	**Parameter loss**	Warning: One of the cyclically saved messages such as *operating hours* or *enabling time* could not be saved successfully. The warning disappears as soon as saving can be successfully performed.
C012	**12.1**	**Limit moto./Customer** *"Drive switch-off limit"*	Warning: 80 % of the drive switch-off limit (P534 [-01]) has been exceeded. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Limit gen.** *"Generator switch-off limit"*	Warning: 80 % of the generator switch-off limit (P534 [-02]) has been reached. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.3	**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). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528).

Switch-on block messages

Display in the SimpleBox / ControlBox		Reason: Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-03]**		
I000	**0.1**	**Disable voltage from IO**	If the function "disable voltage"is parameterised, input (P420 / P480) is at Low • Set "input High" • Check signal cable (broken cable)
	0.2	**IO fast stop**	If the function "fast stop"is parameterised, input (P420 / P480) is at Low • Set "input High" • Check signal cable (broken cable)
	0.3	**Block voltage from bus**	• For bus operation (P509): control word Bit 1 is "Low"
	0.4	**Bus fast stop**	• For bus operation (P509): control word Bit 2 is "Low"
	0.5	**Enable on start**	Enable signal (control word, Dig I/O or Bus I/O) was already applied during the initialisation phase (after mains "ON", or control voltage "ON"). Or electrical phase is missing. • Only issue enable signal after completion of initialisation (i.e. when the FI is ready) • Activation of "Automatic Start" (P428)
	0.6 – 0.7	**Reserved**	Information message for PLC → see supplementary instructions
	0.8	**Right direction blocked**	Switch-on block with inverter shut-off activated by: **P540** or by "Enable right block" **(P420** = 31, 73) or "Enable left block" (**P420** = 32, 74), The frequency inverter switches to "Ready for switching on" status
	0.9	**Left direction blocked**	
I006 [1]	**6.0**	**Charging error**	Charging relay not energised, because: • Mains / link voltage too low • Mains failure • Evacuation run activated ((P420) / (P480))
I011	**11.0**	**Analog Stop**	If an analog input of the frequency inverter or a connected IO extension is configured to detect cable breaks (2-10V signal or 4-20mA signal), the frequency inverter switches to the status "ready for switch-on" if the analog signal undershoots the value **1 V** or **2 mA** This also occurs if the relevant analog input is parameterised to function "0" ("no function"). • Check connections
I014 [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 • Devices without integrated mains unit (Option **–HVS**): No 24 V DC control voltage	• Check connections and supply cables • Check switches / fuses
Device does not react to enabling	• Control elements not connected • Incorrect control word source setting • Right and left enable signals present simultaneously • Enable signal present before device ready for operation (device expecting a 0 → 1 edge)	• Reset enable • Change over **P428** if necessary: "0" = device expecting a 0→1 edge for enable / "1" = device reacts to "Level" → ***Danger:*** *Drive can start up independently!* • Check control connections • Check **P509**
Motor will not start in spite of enable being present	• Motor cables not connected • Brake not ventilating • No setpoint specified • Incorrect setpoint source setting	• Check connections and supply cables • Check control elements • Check **P510**
Device switches off without error message when load increases (increased mechanical load / speed)	• Mains phase missing	• Check connections and supply cables • Check switches / fuses
Motor rotates in the wrong direction	• Motor cable: U-V-W incorrectly connected	• Motor cable: Change 2 phases • Alternative: – Check motor phase sequence (**P583**) – Change Enable right/left functions (**P420**) – Change control word Bit 11/12 (for bus control)
Motor not reaching required speed	• Maximum frequency parameter setting too low	• Check **P105**
Motor speed does not correspond to the setpoint specification	• Analogue input function set to “Frequency addition”. Another setpoint is present.	• Check **P400** • **P420**, check active fixed frequencies • Check bus setpoints • **P104/ P105** Check “Min/ max. –frequency” • **P113** Check “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	• Tracks A and B swapped round by encoder (for speed feedback) • Incorrect encoder resolution setting • Encoder power supply missing • Encoder faulty	• Check encoder connections • Check **P300, P301** • Monitor via **P735** • Check encoder

3.0		
Intermittent communication error between FI and option modules	• System bus terminating resistor not set • Poor connection contacting • Interference on system bus line • Maximum system bus length exceeded	• First and last subscriber only: Set DIP switches for terminating resistance • Check connections • Connect GND of all FI connected to system bus • Pay attention to routing regulations (separate routing of signal and control cables and mains and motor cables) • Check cable lengths (system bus)

Table 5: 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 Power reduction > 6 kHz for 400 V devices
Typical overload capacity	150 % for 60 s, 200 % for 3.5 s
Efficiency of frequency inverter	> 95 % according to size
Insulation resistance	> 5 MΩ
Operating / ambient temperature	-25 °C … +40 °C, for details (including the UL values) for the individual device types and operating modes, see (chapter 7.3)
Storage and transport temperature	-25 °C … +60/70 °C
Long-term storage	(chapter 9.1)
Protection class	Without fan: IP65, with fan: IP55 (chapter 1.9)
Max. installation altitude above sea level	*Up to 1000 m* No power reduction *1000...2000 m:* 1 %/ 100 m power reduction, overvoltage category 3 *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 *Operation (IEC 60721-3-3):* mechanical: 3M6 climatic: 3K3 (IP55) 3K3 (IP65)
Environmental protection	*Energy-saving function* (chapter 8.7), see P219 *EMC* (chapter 8.3) *RoHS* (chapter 1.6)
Protective measures against	Overtemperature of the frequency inverter Over and under-voltage Short-circuit, earth fault Overload, idle running
Motor temperature monitoring	I^2t motor, PTC / bimetallic switch
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic, 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) RS232 (Single Slave) System bus *Optional* AS-i on board (chapter 4.5) Various bus modules (chapter 3.3.1)
Electrical isolation	Control terminals
Electrical connection	*Power unit* (chapter 2.3.2) *Control unit* (chapter 2.3.3)

7.2 Technical data for determining the energy efficiency level

The following tables relate to the provisions of the Ecodesign EU Regulation 2019/1781.

Manufacturer	FI type	Rel. losses (rel. motor stator frequency / rel. torque-producing current)								Standby	IE rating
		90/100	90/50	50/100	50/50	50/25	0/100	0/50	0/25		
Getriebebau NORD GmbH & Co. KG	SK 2x0E-FDS	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[W]	
	370-340	5,7	5,0	5,3	4,9	4,8	5,1	4,8	4,8	7,0	IE2
	550-340	4,1	3,4	3,7	3,3	3,2	3,4	3,2	3,2	7,0	IE2
	750-340	3,6	2,8	3,1	2,8	2,7	3,0	2,7	2,7	7,0	IE2
	111-340	3,4	2,5	3,0	2,4	2,1	2,7	2,3	2,1	8,5	IE2
	151-340	3,1	2,2	2,7	2,0	1,8	2,4	1,9	1,8	8,5	IE2
	221-340	2,8	2,0	2,4	1,8	1,6	2,2	1,7	1,5	8,5	IE2
	301-340	2,8	1,9	2,4	1,8	1,5	2,2	1,7	1,5	8,5	IE2
	401-340	2,8	1,9	2,3	1,7	1,5	2,1	1,7	1,5	9,0	IE2
	551-340	2,7	1,8	2,3	1,6	1,4	2,0	1,5	1,3	9,0	IE2
	751-340	2,7	1,5	2,2	1,4	1,1	2,0	1,3	1,1	9,0	IE2

Manufacturer	FI type	Output power	Indicative output power	Rated output current	Max. operating temperature	Rated input frequency	Rated input voltage range
Getriebebau NORD GmbH & Co. KG	SK 2x0E-FDS	[kVA]	[kW]	[A]	[°C]	[Hz]	[V]
	370-340	0,7	0,4	1,1	40	50	380 V – 500 V
	550-340	1,0	0,6	1,5	40	50	380 V – 500 V
	750-340	1,3	0,8	2,0	40	50	380 V – 500 V
	111-340	1,7	1,1	2,6	40	50	380 V – 500 V
	151-340	2,3	1,5	3,5	40	50	380 V – 500 V
	221-340	3,3	2,2	5,0	40	50	380 V – 500 V
	301-340	4,4	3,0	6,7	40	50	380 V – 500 V
	401-340	5,9	4,0	8,9	40	50	380 V – 500 V
	551-340	7,9	5,5	12,1	40	50	380 V – 500 V
	751-340	10,0	7,5	15,1	40	50	380 V – 500 V

7.3 Electrical data

The following tables contain the data which is relevant for UL.

Details of the UL/CSA approval conditions can be found in Section 1.6.1 "UL and CSA approval". Use of mains fuses which are faster than those stated is permissible.

7.3.1 Electrical data 3~400 V

Device type	**SK 2xxE-FDS-…**	**-370-340-**	**-550-340-**	**-750-340-**	**-111-340-**	**-151-340-**
	Size	**0**	**0**	**0**	**1**	**1**
Nominal motor power (4-pole standard motor)	400 V	0.37 kW	0.55 kW	0.75 kW	1.1 kW	1.5 kW
	480 V	½ hp	¾ hp	1 hp	1½ hp	2 hp
Mains voltage	**400 V**	**3 AC** 380 … 500 V, - 20 % / + 10 %, 47 … 63 Hz				
Input current	rms [1]	1.1 A	1.7 A	2.2 A	2.9 A	3.8 A
	FLA [2]	1.0 A	1.6 A	2.0 A	2.7 A	3.4 A
Output voltage	**400 V**	**3 AC** 0 … Mains voltage				
Output current	rms [1]	1.3 A	1.7 A	2.3 A	3.1 A	4.0 A
	FLA [2]	1.2 A	1.5 A	2.1 A	2.8 A	3.6 A
Min. brake resistance	Accessories	320 Ω	200 Ω	200 Ω	200 Ω	200 Ω
Max. continuous power / max. continuous current						
	S1-40°C	0.37kW / 1.3A	0.55kW / 1.7A	0.75kW / 2.3A	1.1kW / 3.1A	1.5kW / 4.0A
		General fuses (AC) (recommended)				
	slow-blowing	10 A [4]	10 A [4]	10 A [4]	10 A [4]	10 A [4]

	Isc [5] [A]			**UL fuses (AC) – permitted**				
Class	20 000	65 000						
Fuse CC, J, R, T, G, RK1, RK5		X		30 A	30 A	30 A	30 A	30 A
CB [6] 480 V		X		30 A	30 A	30 A	30 A	30 A
CB [6] 500 V	X			30 A	30 A	30 A	30 A	30 A

1) Note the derating curve (🕮 Section 8.4.4 "Reduced output current due to low 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) Only with "Fan" (standard equipment)
4) for group fuses: maximum fuse size: 30 A
5) Maximum mains short-circuit current, Note: Further restrictions are possible depending on the plug connector which is used (🕮 Section 1.6.1 "UL and CSA approval")
6) "inverse time trip type" according to UL 489

Frequency inverter type	SK 2xxE-FDS-…	-221-340-	-301-340-	-401-340-	-551-340-	-751-340-
	Size	1	1	2	2	2
Nominal motor power (4-pole standard motor)	400 V	2.2 kW	3.0 kW	4.0 kW	5.5 kW	7.5 kW
	480 V	3 hp	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]	4.9 A	7.0 A	8.9 A	11.7 A	15.0 A
	FLA [2]	4.4 A	6.3 A	8.0 A	10.6 A	13.7 A
Output voltage	**400 V**	**3 AC** 0 … Mains voltage				
Output current	rms [1]	5.5 A	7.5 A	9.5 A	12.5 A	16.0 A
	FLA [2]	4.9 A [3]	6.7 A [3]	8.5 A [3]	11.0 A [3]	14.2 A [3]
Min. brake resistance	Accessories	200 Ω	110 Ω	110 Ω	68 Ω	68 Ω
Max. continuous power / max. continuous current:						
	S1-40°C	2.2kW / 5.5A	3.0kW / 7.5A	4.0kW / 9.5A	5.5kW / 12.5A	7.5kW / 16.0A
		General fuses (AC) (recommended)				
	slow-blowing	10 A [4]	16 A [4]	16 A [4]	20 A [4]	25 A [4]

	Class	Isc [5] [A] 20 000	Isc [5] [A] 65 000		UL fuses (AC) – permitted				
Fuse	CC, J, R, T, G, RK1, RK5		X		30 A	30 A	30 A	30 A	30 A
CB [6]	480 V		X		30 A	30 A	30 A	30 A	30 A
	500 V	X			30 A	30 A	30 A	30 A	30 A

1) Note derating curve (🕮 Section 8.4.4 "Reduced output current due to low 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) Only with "Fan" (standard equipment)
4) for group fuses: maximum fuse size: 30 A
5) Maximum mains short-circuit current, Note: Further restrictions are possible depending on the plug connector which is used (🕮 Section 1.6.1 "UL and CSA approval")
6) "inverse time trip type" according to UL 489

8 Additional information

8.1 Setpoint processing

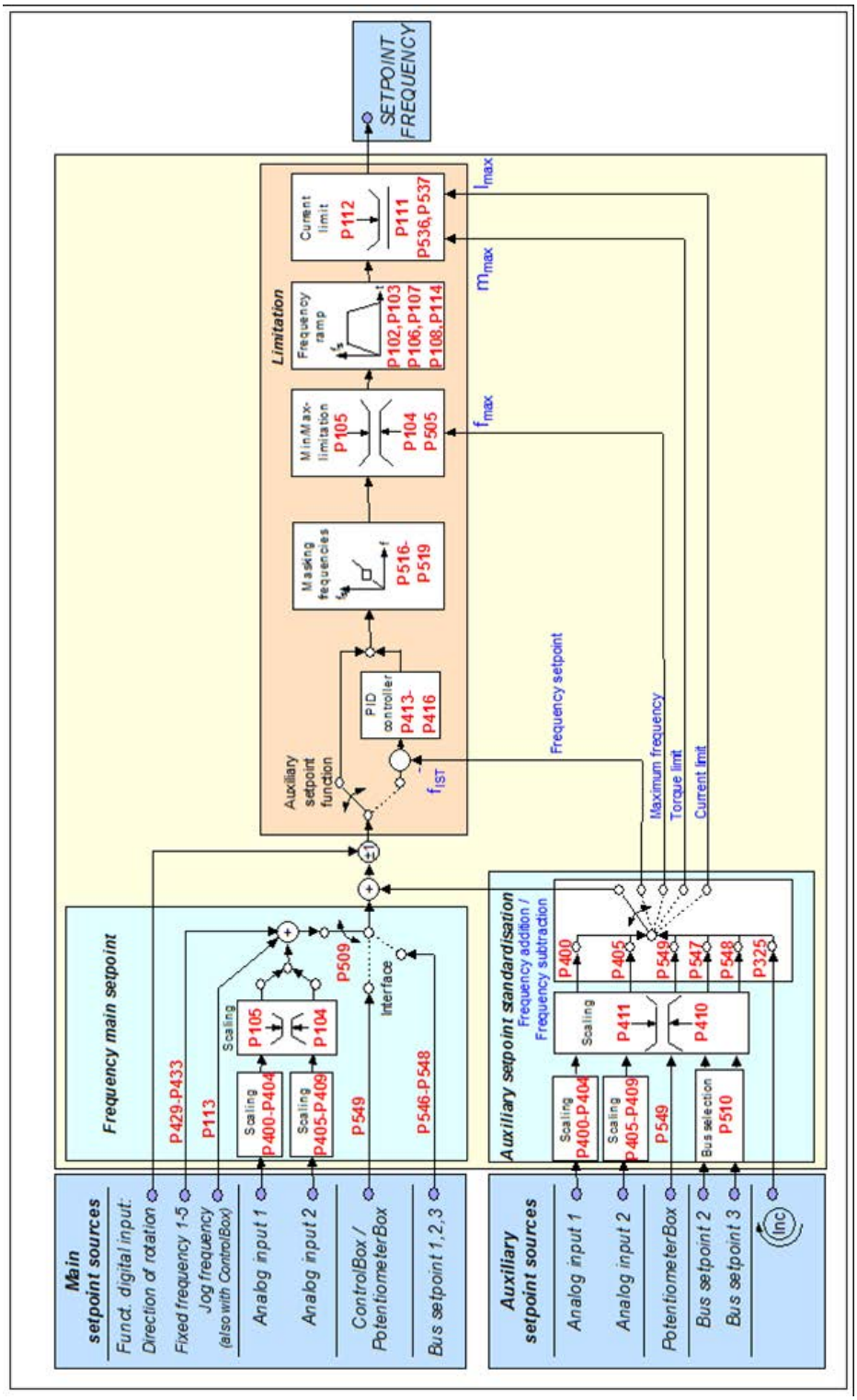


Figure 4 Setpoint processing

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.

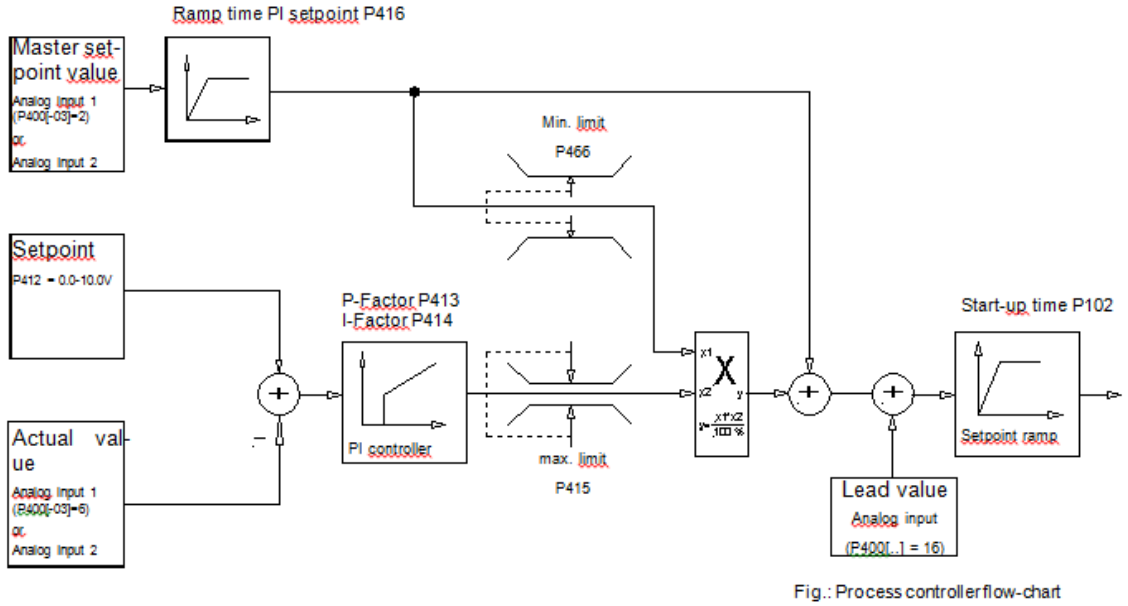
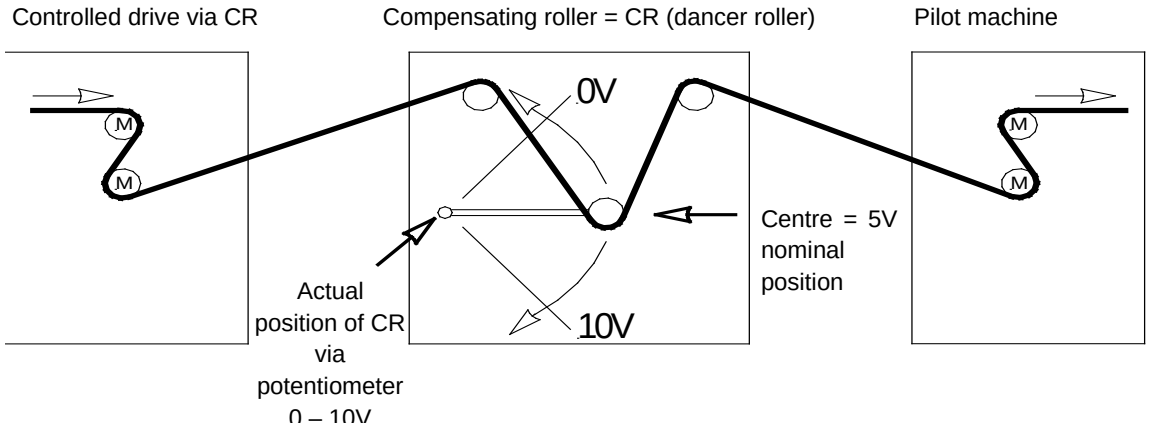
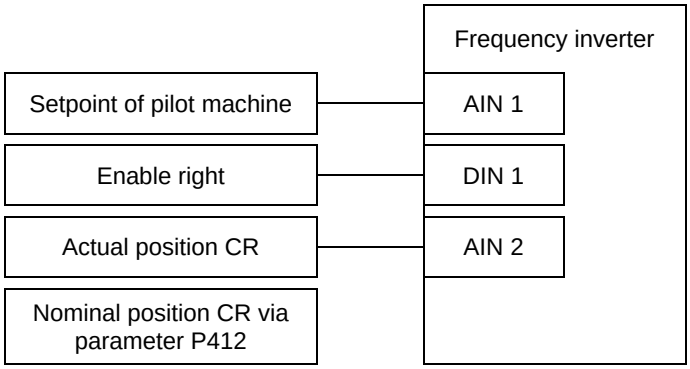
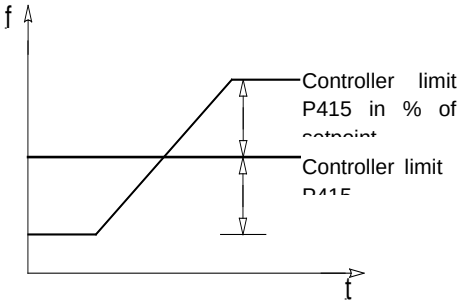


Figure 5: Process controller flow diagram

8.2.1 Process controller application example







8.2.2 Process controller parameter settings

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

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

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)

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. *EU 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. *EU 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 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 6: 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 (see 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.

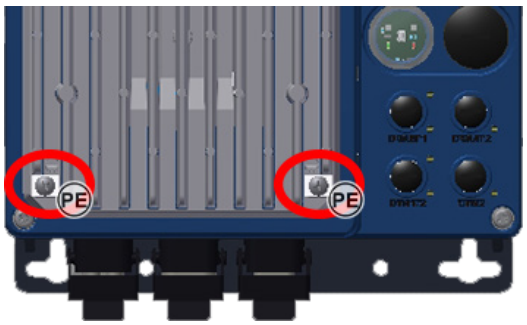
The limit value classes are only achieved if

- the wiring is EMC-compliant
- the length of shielded motor cable does not exceed the permissible limits
- The standard pulse frequency (P504) is used

The motor cable shield must be connected on both sides.

Device version **Max. motor cable length, shielded**	**Conducted emissions 150 kHz - 30 MHz**	
	Class C2	**Class C1**
Standard configuration for operation on TN/TT networks (active integrated mains filter)	10 m	-

The PE contacts of the connection cables (e.g mains and motor cable) are connected together in the device. For fault-free operation we recommend a further connection between the PE of the device and the PE of the plant construction. Two screw terminals are available for this on the heat sink.



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
		C3 (size 2)
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 7: Overview according to product standard EN 61800-3

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

C310701_1021

EU Declaration of Conformity

In the meaning of the EU directives 2014/35/EU Annex IV, 2014/30/EU Annex II, 2009/125/EG Annex IV and 2011/65/EU Annex VI

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

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- **SK 250E-FDS-xxx-323-A-.. , SK 250E-FDS-xxx-340-A.-..**
  (xxx= 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751)
  also in these functional variants:
  SK 260E-FDS-... , SK 270E-FDS-... , SK 280E-FDS...

  and the further options/accessories:
  SK CU4-... , SK TU4-... , SK TIE4-... , SK BRI4-... , SK BRE4-... ,
  SK PAR-3. , SK CSX-3. , SK SSX-3A, SK TIE5-BT-STICK

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
Ecodesign Directive	**2009/125/EG**	OJ. L 285 of 31.10.2009, p. 10–35
Regulation (EU) Ecodesign	**2019/1781**	OJ. L 272 of 25.10.2019, p. 74–94
RoHS Directive	**2011/65/EU**	OJ. L 174 of 1.7.2011, p. 88–11
Delegated Directive (EU)	**2015/863**	OJ. L 137 of 4.6.2015, p. 10–12

Applied standards:

EN 61800-5-1:2007+A1:2017	EN 61800-3:2018	EN 61800-9-1:2017
EN 60529:1991+A1:2000+A2:2013+AC:2016	EN 63000:2018	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 2016.

Bargteheide, 12.03.2021

U. Küchenmeister
Managing Director

pp F. Wiedemann
Head of Inverter Division

8.4 Reduced output power

The frequency inverters are designed for special overload situations. For example, 1.5x overcurrent can be used for 60 s. For approx. 3.5 s, 2x overcurrent is possible. A reduction of the overload capacity or its duration must be considered for the following circumstances:

- Output frequencies < 4.5 Hz and DC voltage (stationary pointer)
- Pulse frequencies greater than the nominal pulse frequency (P504)
- Increased mains voltages > 400 V
- Increased heat sink temperature

The following characteristic curves can be used to obtain the corresponding current/power limit.

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.

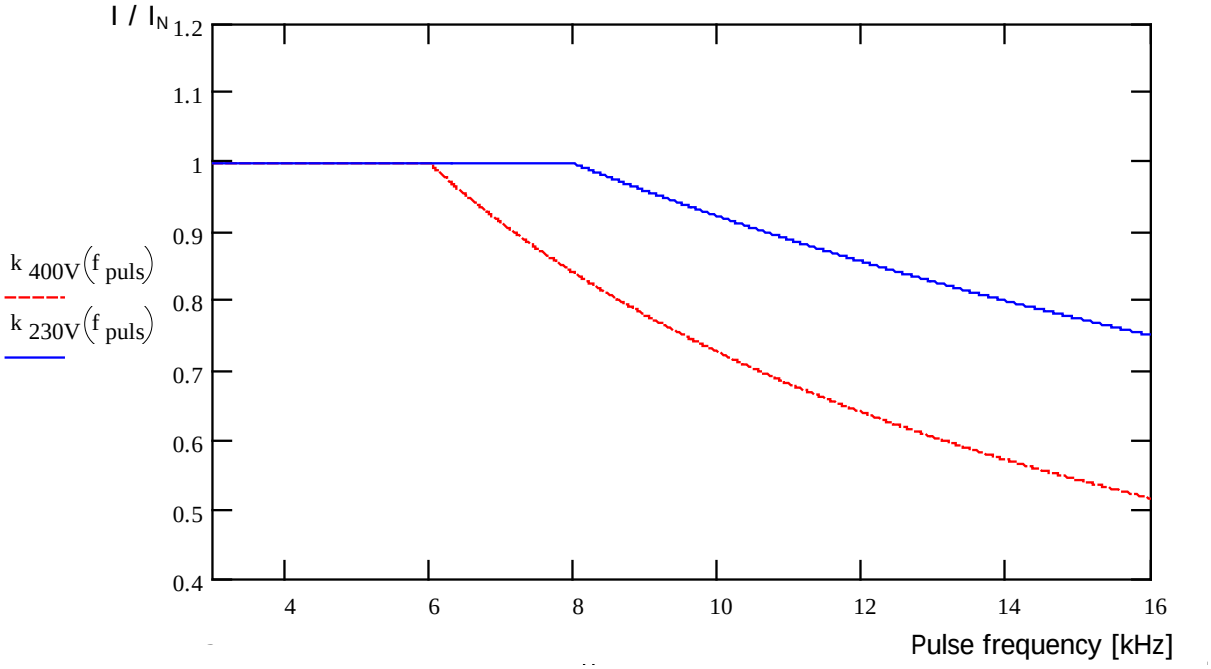


Figure 6: Heat losses due to pulse frequency

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.

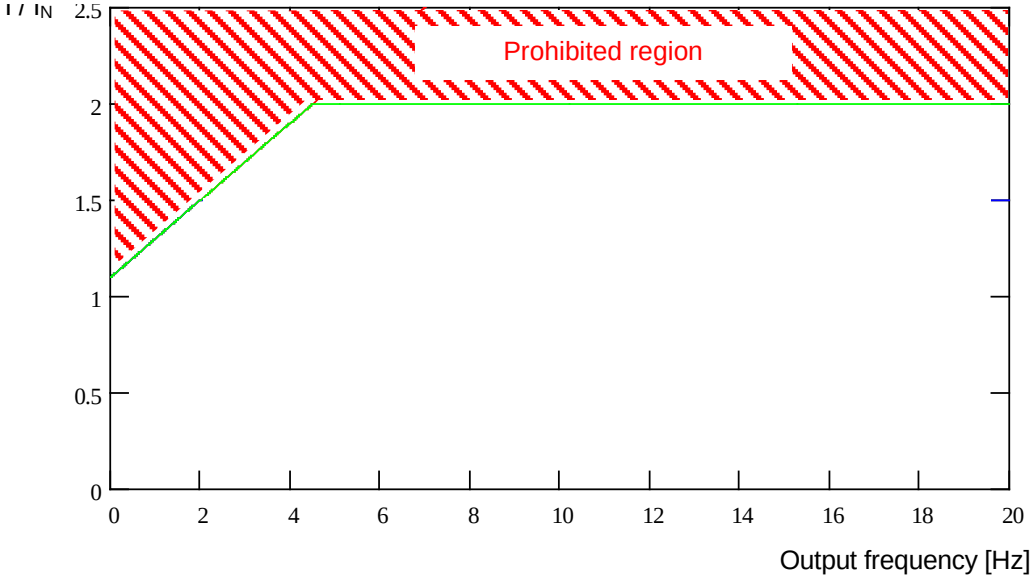
If operated repeatedly in the overload region at short intervals, the limiting values stated in the tables are reduced.

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 8: 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.

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 9: Overcurrent relative to pulse and output frequency

8.4.4 Reduced output current due to low voltage

The frequency inverters are thermally designed with regard to the rated output currents. For lower low voltages larger currents cannot be used in order to keep the output power constant. For mains voltages above 400 V the permissible output current is reduced inversely proportional to the mains voltage in order to compensate for switching losses.

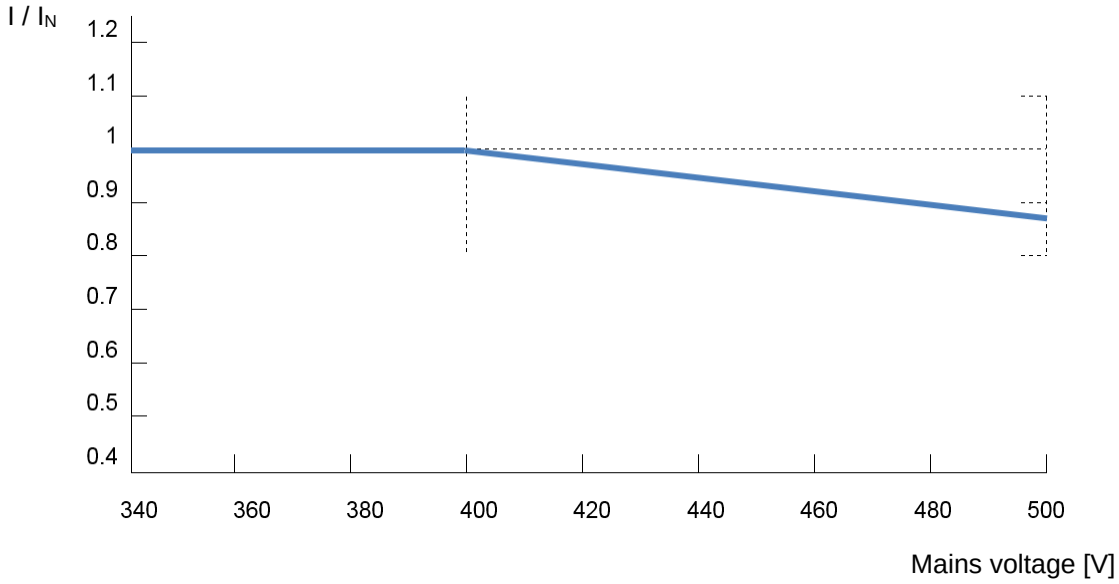


Figure 7: Reduced output current due to low voltage

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.

8.5 Operation on the FI circuit breaker

For devices with an active mains filter (standard configuration for TN- / TT networks) leakage currents of ≤ 16 mA are to be expected. These are designed for operation with leakage current circuit breakers for the protection of persons.

For devices with an inactive mains filter (special configuration for TN networks) leakage currents of ≤ 30 mA are to be expected. These are not suitable for operation with leakage current circuit breakers for the protection of persons.

Only all-current sensitive FI circuit breakers (type B or B+) must be used.

(🕮 Section 2.3.2.1 "Mains connection")

(🕮 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.

Information — **Communication interference**

To minimise the risk of communication interference, the ***GND –potentials*** 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), 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
Baud rate	250 kBaud - pre-set

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 unique addresses **(P515)**.

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 from 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	Address Node ID Frequency inverter	Node ID AG
FI 1	32	33
FI 2	34	35
FI 3	36	37
FI 4	38	39

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 inadequate dimensioning 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 caused by extremely steep acceleration ramps (P102, P103, P426).

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

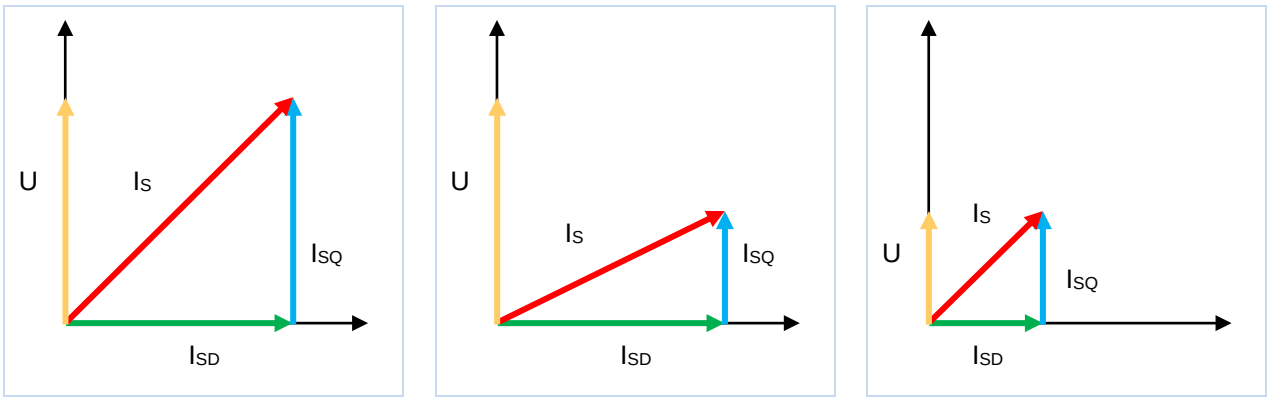
To prevent any risk, the following must be observed:

- For lifting equipment applications or applications with frequent large load changes, parameter P219 must remain in the factory setting (100 %).
- Do not inadequately dimension the drive unit, provide adequate overload reserves.
- If necessary, provide fall protection (e.g. for lifting equipment) 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 8: Energy efficiency due to automatic flux optimisation

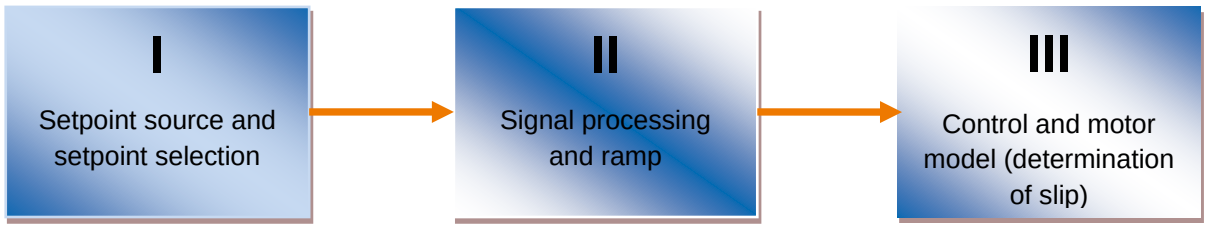
8.8 Standardisation of setpoint / target values

The following table contains details for the standardisation of typical setpoint and actual values. These details relate to parameters (P400), (P418), (P543), (P546), (P740) or (P741).

Name	**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)	

8.9 Definition of setpoint and actual value processing (frequencies)

The frequencies used in parameters (P502) and (P543) are processed in various ways according the following table.



Function	Name	Meaning	Output to ...			without Right/ Left	with Slip
			I	II	III		
8	Setpoint frequency	Setpoint frequency from setpoint source	X				
1	Actual frequency	Setpoint frequency for motor model		X			
23	Actual frequency with slip	Actual frequency at motor			X		X
19	Setpoint frequency master value	Setpoint frequency from setpoint source Master value (free from enable correction)	X			X	
20	Setpoint frequency n R master value	Setpoint frequency for motor model Master value (free from enable correction)		X		X	
24	Master value of actual frequency with slip	Actual frequency at motorMaster value (free from enable correction)			X	X	X
21	Actual frequency without slip master value	Actual frequency without master value slip Master value			X		

Table 10: Processing of setpoints and actual values in the frequency inverter

8.10 Connection accessories

The material for establishing the electrical connection is not included in the scope of delivery of the frequency inverter. However, it can be obtained from NORD or from other commercial sources.

8.10.1 Power connections - mating connectors

Parts lists for some of the mating connectors of the installed plug connectors (power connections, (📖 Section 2.2.1.1 "Connection level")) are listed below.

Installed plug connector type: ***HARTING Q2/0+ (socket)***

Recommended products for mating connectors to the installed plug connector system

Plug HAN Q2/0 (pin)

Number	Designation	Manufacturer	Information
1 x	Sleeve housing, HAN-Compact	Harting	Straight cable outlet, M25 (19 12 008 0429)
1 x	Contact insert HAN Q4/2 (pin)	Harting	(09 12 006 3041)
4 x	Crimp contact Pin 4mm²	Harting	(09 32 000 6107)
2 x	Crimp contact Pin 0.75mm²	Harting	(09 15 000 6105)
1 x	HAN-Compact Half cable gland	Harting	M25 – 14…17mm (19 12 000 5158)

Installed plug connector type: ***HARTING Q4/2+ (socket)***

Recommended products for mating connectors to the installed plug connector system

Hybrid plug connector HAN Q4/2 (pin)

Number	Designation	Manufacturer	Information
1 x	Sleeve housing, HAN-Compact	Harting	Straight cable outlet, M25 (19 12 008 0429)
1 x	Contact insert HAN Q4/2 (pin)	Harting	(09 12 006 3041)
4 x	Crimp contact Pin 4mm²	Harting	(09 32 000 6107)
2 x	Crimp contact Pin 0.75mm²	Harting	(09 15 000 6105)
1 x	HAN-Compact Half cable gland	Harting	M25 – 14…17mm (19 12 000 5158)

Installed plug connector type: ***HARTING Q4/2+ (plug connector)***

Recommended products for mating connectors to the installed plug connector system

Hybrid plug connector HAN Q4/2 (socket)

Number	Designation	Manufacturer	Information
1 x	Sleeve housing, HAN-Compact	Harting	Straight cable outlet, M25 (19 12 008 0429)
1 x	Contact insert HAN Q4/2 (socket)	Harting	(09 12 006 3141)
4 x	Crimp contact socket 4mm²	Harting	(09 32 000 6207)
2 x	Crimp contact socket 0.75mm²	Harting	(09 15 000 6205)
1 x	HAN-Compact Half cable gland	Harting	M25 – 14…17mm (19 12 000 5158)

Installed plug connector type: ***HARTING Q8/0+ (socket)***

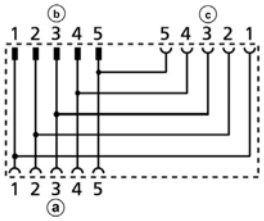
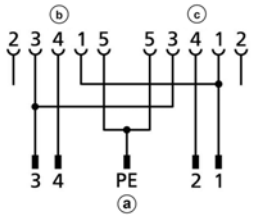
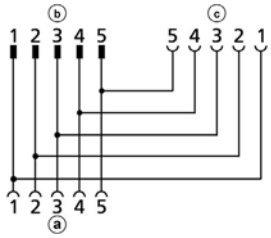
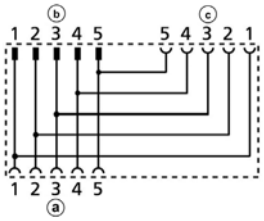
Recommended products for mating connectors to the installed plug connector system

Hybrid plug connector HAN Q8/0 (pin)

Number	Designation	Manufacturer	Information
1 x	Sleeve housing, HAN-Compact	Harting	Straight cable outlet, M25 (19 12 008 0429)
1 x	Contact insert HAN Q8/0 (pin insert)	Harting	(09 12 008 3001)
4 x	Crimp contact socket 1.5 mm²	Harting	(09 33 000 6104)
1 x	HAN-Compact Half cable gland	Harting	M25 – 14…17mm (19 12 000 5158)

8.10.2 M12 Y distributor

To create complex supply or communication lines we recommend the use of Y distributors. These are mounted directly on the relevant M12 plug connector of the filed distributor and enable direct connection to the particular line.

Designation	Material number	connection	Option slot	Contact diagram
SK TIE4-M12-SYSS-YMF	275274523	System bus	M7	
SK TIE4-M12-INI-YFF	275274525	Initiator	M1, M3, M5, M7	
SK TIE4-M12-POW-YMF	275274526	24 V DC	M8	
SK TIE4-M12-STO-YMF	275274527	STO	M6	

Connection	Meaning
(a)	Inverter side
(b), (c)	Supply cable (as input or output)

8.10.3 Motor cable

Pre-assembled cables for the motor connection are available (www.nord.com).

Designation	UL	Plug connector		Document
		FI side	Motor side	
SK CE-HQ8-K-MA-OE20-M4-xxUL	x	Pin, 8-pole	Open ends, M20 [1]	TI 275274211-212
SK CE-HQ8-K-MA-OE25-M4-xxUL	x	Pin, 8-pole	Open ends, M25 [1]	TI 275274216-217
SK CE-HQ8-K-MA-OE32-M4-xxUL	x	Pin, 8-pole	Open ends, M32 [1]	TI 275274226-227
SK CE-HQ8-K-MA-OE32-M5-xxUL	x	Pin, 8-pole	Open ends, M32 [1]	TI 275274231-232
SK CE-HQ8-K-MA-OE32-M6-xxUL	x	Pin, 8-pole	Open ends, M32 [1]	TI 275274236-237
SK CE-HQ8-K-MA-OE20-M4-xxM	-	Pin, 8-pole	Open ends, M20 [1]	TI 275274800-803
SK CE-HQ8-K-MA-OE25-M4-xxM	-	Pin, 8-pole	Open ends, M25 [1]	TI 275274805-808
SK CE-HQ8-K-MA-H10E-M1B-xxM	-	Pin, 8-pole	Socket, 8-pole	TI 275274810-813
SK CE-HQ8-K-MA-OE32-M4-xxM	-	Pin, 8-pole	Open ends, M32 [1]	TI 275274825-828
SK CE-HQ8-K-MA-OE32-M5-xxM	-	Pin, 8-pole	Open ends, M32 [1]	TI 275274830-833
SK CE-HQ8-K-MA-OE32-M6-xxM	-	Pin, 8-pole	Open ends, M32 [1]	TI 275274835-838

1) EMC cable glands

8.10.4 Mains cable

Pre-assembled cables for the mains connection are available (www.nord.com).

Designation	UL	Plug connector		Document
		FI side	Low voltage side	
SK CE-HQ4-K-LE-OE-xxUL	x	Socket, 6-pole	Open ends	TI 275274241-242
SK CE-HQ42-K-LE-OE-xxUL	x	Socket, 6-pole	Open ends [1]	TI 275274246-247
SK CE-HQ4-K-LE-OE-xxM	-	Socket, 6-pole	Open ends	TI 275274840-843
SK CE-HQ42-K-LE-OE-xxM	-	Socket, 6-pole	Open ends [1]	TI 275274845-848

1) Incl. 24 V DC cable

8.10.5 Daisy chain cable

Pre-assembled cables are available to loop the low voltage connection from one device to the next (www.nord.com).

Designation	UL	Plug connector		Document
		FI side (Out)	FI side (In)	
SK CE-HQ4-K-LA-HQ4-xxUL	x	Pin, 6-pole	Socket, 6-pole	TI 275274251-252
SK CE-HQ42-K-LA-HQ42-xxUL	x	Pin, 6-pole	Socket, 6-pole [1]	TI 275274256-257
SK CE-HQ4-K-LA-HQ4-xxM	-	Pin, 6-pole	Socket, 6-pole	TI 275274850-853
SK CE-HQ42-K-LA-HQ42-xxM	-	Pin, 6-pole	Socket, 6-pole [1]	TI 275274855-858

1) Incl. 24 V DC cable

8.10.6 Encoder cables

Pre-assembled cables for connection of incremental or absolute encoders are available (www.nord.com).

Designation	UL	Plug connector		Document
		FI side	Encoder side	
SK CE-A5M-IG0-A5F-xxM	-	M12, Pin, 5-pole	M12, Socket, 5-pole	TI 275274875-878
SK CE-A5F-AGC-A5F-xxM	-	M12, Socket, 5-pole	M12, Socket, 5-pole	TI 275274890-893
SK CE-B4M-IGC-B4F-xxM	-	M12, Pin, 4-pole	M12, Socket, 4-pole	TI 275274895-898

9 Maintenance and servicing information

9.1 Maintenance Instructions

NORD frequency converters are *maintenance free* provided that they are properly used (chapter 7).

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**

For devices which do not have an integrated mains unit (option integrated mains unit: "-HVS" a 24 V control voltage supply must be provided in order to make the regeneration process possible.

9.2 Service notes

Our Technical Support is available in case of technical queries.

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

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

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
	Outside 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	**FDS**	Field distributor(**F**ield **D**istribution **S**ystem)
AS-i (AS1)	AS Interface	**FI** (switch)	Leakage current circuit breaker
ASi (LED)	Status LED - AS interface	**FI**	Frequency inverter
ASM	Asynchronous machine, asynchronous motor	**I/O**	In / Out (Input / Output)
AOUT	Analog output	**ISD**	Field current (Current vector control)
AUX	Auxiliary (voltage)	**LED**	Light-emitting diode
BR + / BR -	Contacts for connecting a brake	**LPS**	List of projected slaves (AS-I)
BW	Braking resistor	**PMSM**	Permanent magnet synchronous machine / -motor
DI (DIN) **DigIn**	Digital input	**PLC / SPS**	Programmable Logical Controller
DS (LED)	Status LED - device status	**PE**	Protective earth
CFC	Current Flux Control (current-controlled, field-oriented control)	**PELV**	Safety low voltage
DO (DOUT) **DigOut**	Digital output	**S**	Supervisor Parameter, P003
I / O	Input /Output	**SW**	Software version, P707
EEPROM	Non-volatile memory	**TI**	Technical information / Data sheet (Data sheet for NORD accessories)
EMF	Electromotive force (induction voltage)	**VFC**	Current Flux Control (current-controlled, field-oriented control)
EMC	Electromagnetic compatibility		

Key word index

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Y

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